The Royal Engineers Journal.

VOL. XLVI. **MARCH, 1932.**

CHATHAM:
THE INSTITUTION OF ROYAL ENGINEERS.
TELEPHONE: CHATHAM, 2669.
AGENTS AND PRINTERS: MACKAYS LTD.

LONDON:
HUGH REES, LTD., 5, REGENT STREET, S.W.1.

All Co

Work of the Royal Engineers in the European War, 1914-1919.

For sale in the office of the Secretary, Institution of Royal Engineers, Chatham.

COMPRISING THE FOLLOWING VOLUMES :—

Bridging.—With 3 maps, 59 photographs and 31 plates. Price 12s. (to members, 6s).

Military Mining.—With 25 photographs and 62 plates. Price 12s. 6d. (to members, 7s. 6d.).

Geological Work on the Western Front.—With 19 plates and 9 photographs. Limited to 500 copies. Price 15s. (to members, 10s.).

Signal Service in the European War, 1914 to 1918, The.—(By special arrangement with the Signals Association) R. E. Priestley, M.C., B.A. (late Major, R.E.). With 2 photos and 20 plates. Price 12s. 6d. (to members, 10s. 6d.).

Supply of Engineer Stores and Equipment.—Price 7s. (to members, 3s. 6d.).

Water Supply (Egypt and Palestine).—With 7 maps, 6 photos, 10 plates, and 20 sketches in the text. Price 8s. (to members, 5s.).

Water Supply (France).—With 10 maps, 37 photographs and 41 plates. Price 16s. (to members, 10s.). "A simply invaluable compendium of the work done in this vital respect on the Western Front."—*Spectator.*

Work under the Director of Works (France).—With 6 maps and 71 plates. Price 21s. (to members, 14s. 6d.).

"Miscellaneous," comprising :—(1) The Organization of the Corps, 1914-1918. (2) Engineer Intelligence. (3) Camouflage. (4) Concrete Defences and Factories. (5) Forward Communications. (6) Machinery, Workshops and Electricity. (7) Inundations. (8) Anti-Aircraft Searchlights. (9) Schools. With 105 Plates and Photographs. Price 20s. (to members, 12s. 6d., plus 9d. postage). "A mine of interest and value."—*The Daily Telegraph.*

Descriptive Accounts of Foreign Stations.—The following pamphlets have been revised and reprinted and are available, price to members, 1s. each :—

Bermuda, Ceylon, Egypt, Gibraltar, Hong Kong, Malta, Mauritius, Singapore, Sierra Leone, and *Notes on the China Command.*

Jamaica (*Typescript only*). 6d.

Notes for Officers Proceeding to India (3s. 6d. each; to members 2s. 4d.).

Studies of German Defences near Lille.—A limited number of copies of this Report by Major B. T. Wilson, D.S.O. (with 35 maps and plans and 24 photos) are available for free issue to those members who apply for them to the Secretary. The price of the Report to the general public is five shillings.

An Outline of the Egyptian and Palestine Campaigns, 1914 to 1918.—By Major-General Sir M. G. E. Bowman-Manifold, K.B.E., C.B., C.M.G., D.S.O., *p.s.c.*, late R.E. Seventh Edition, 1929. With 17 maps and sketches. Price 4s. 6d.

History of the Corps of Royal Engineers.—Vols. I and II, by Major-General Whitworth Porter, R.E. Vol. III, by Colonel Sir Charles M. Watson, K.C.M.G., C.B., M.A., late R.E. Three Vols. £1 10s. (to members, 12s. 6d.).

History of Submarine Mining in the British Army.—By Brig.-General W. Baker Brown, C.B. Price 5s. (to members, 3s. 4d.).

A History of R.E. Cricket.—By Captain R. S. Rait Kerr, D.S.O., M.C., R.E. (with 8 plates). Price 5s. 4d. post free.

History of the 12th Company, Royal Engineers.—By Lieut. M. R. Caldwell, R.E. (Illustrated.) Price 7s. 8d. (to R.E.s 3s. 2d.) post free.

"65 R.E." History of the 65th Company, Royal Engineers.—Price 5s. (post free 5s. 4d.).

History of the 20th (Field) Company, Royal Bombay Sappers and Miners.—By Major H. W. R. Hamilton, D.S.O., M.C., R.E. Price 2s., post free.

The Early Years of the Ordnance Survey.—By Colonel Sir Charles Close, K.B.E., C.B., C.M.G., SC.D., F.R.S. (illustrated). Price 6s. (to members 4s. 6d.) post free.

General Sir Charles Pasley, K.C.B., F.R.S., D.C.L., Colonel Commandant, R.E., 1780-1861.—Price 1s. 6d.

THE INSTITUTION OF ROYAL ENGINEERS.

Authors alone are responsible for the statements made and the opinions expressed in their papers.

CONTENTS.

All communications for the Institution should be addressed to:—
The Secretary, The Institution of Royal Engineers, Chatham.

COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS.

(Incorporated by Royal Charter, 27th February, 1923.)

Patron:—H.M. THE KING.

President.
Brig.-Gen. *Sir* James E. Edmonds, *Kt.*, C.B., C.M.G., *p.s.c.* 1931

Vice-Presidents.
Lt.-Col. W. A. J. O'Meara, C.M.G., *p.s.c.*.....1929
Maj.-Gen. R. L. B. Thompson, C.B., C.M.G., D.S.O. (*D.H.*) 1931

Elected.
Maj.-Gen. R. N. Harvey, C.B., C.M.G., D.S.O. 1929
Maj.-Gen. *Sir* William A. Liddell, K.C.M.G., C.B. 1929
Col. A. J. Savage, D.S.O. 1929
Col. E. K. Squires, D.S.O., M.C. 1929
Major N. M. Vibart, D.S.O., M.C., *p.s.c.* 1930
Lt.-Col. C. E. Colbeck, M.C. 1930
Col. D. S. Collins, D.S.O. 1930
Lt.-Col. B. L. Eddis, D.S.O., *p.s.c.* 1930
Col. W. Garforth, D.S.O., M.C. 1930
Lt.-Col. W. Cave-Browne, D.S.O., M.C. 1930
Brigadier G. H. Addison, C.M.G., D.S.O. 1931
Maj.-Gen. *Sir* Reginald U. H. Buckland, K.C.M.G., C.B. *Col. Cdt. R.E.* 1931
Lieut.-Col. R. P. Pakenham-Walsh, M.C. 1931
Major I. S. O. Playfair, D.S.O., M.C. 1931
Lieut.-Col. A. P. Sayer, D.S.O. 1931

Ex-Officio.
Maj.-Gen. H. L. Pritchard, C.B., C.M.G., D.S.O. (*Cdt. S.M.E. and Instr. R.E.*).
Col. E. E. B. Mackintosh, D.S.O. (*A.A.G. R.E.*).
Col. A. C. Dobson, D.S.O. (*A.D.W.*).
Col. R. N. Burn, O.B.E. (*A.D. Tn.*).
Col. G. F. B. Goldney, C.M.G., D.S.O. (*R.E. Board*).
Col. M. N. MacLeod, M.C. (*G.S.*)
Major C. C. Phipps O.B.E., M.C. (*C.I.C.*).
Major C. de L. Gaussen, M.C. (*Staff Captain S.M.E.*)

Corresponding Members.

Lieut.-Col. J. E. Duigan, D.S.O., N.Z.S.C. (late R.N. Zealand Engrs.)	28	10	24
Lieut.-Col. *Sir* Tannatt W. Edgeworth David, K.B.E., C.M.G., D.S.O., F.R.S.	12	1	26
Lieut.-Col. T. R. Williams, C.M.G., D.S.O. (Australian Staff Corps)	28	1	36
Major G. R. Turner, M.C., D.C.M. (R.C.E.)	28	10	30

Secretary: Lieut.-Col. P. H. Kealy.....1st October, 1927.

2,200—1.3.32.

Sir Bernard de Gomme Kt. Chief Engineer of Great Britain, 1661-1685

All contributions for the R.E. Journal from officers on full pay, except Memoirs and Reviews, should be forwarded to the Editor in duplicate, as laid down in K.R. 522c, and Amendment No. 41 for illustrations, together with a statement from the authority (if any) under whom the writer is immediately serving, that such authority has no objection to permission to publish being applied for.

Authors alone are responsible for the statements made and the opinions expressed in their papers.

THE ORGANIZATION AND EMPLOYMENT OF THE CORPS OF ROYAL ENGINEERS.

By MAJOR-GENERAL H. L. PRITCHARD, C.B., C.M.G., D.S.O.

THE subject of the organization and employment of the Corps of Royal Engineers is one which many R.E. officers have constantly under consideration. Articles on this subject appear from time to time in *The R.E. Journal*, and it also attracts attention outside the Corps.

In war an army cannot live, or move, or fight, without its own engineers. In war no one asks what they are for, they generally ask for more of them, but in peace, the army shares with the civil population all the excellent services that exist, and therefore they sometimes wonder why they have engineers.

THE EVOLUTION OF THE CORPS.

Like the British constitution, the Corps organization is easier to work than to define and control by regulation. Again like the British constitution it has been evolved rather than created.

Continuing the simile it will thrive by evolution, not by revolution.

Numerous committees at the War Office have considered the subject from time to time. Some very eminent men of all arms, including Royal Engineers, have served on those committees. They have sought the advice and opinions of a large number of witnesses drawn from within and without the Corps. Those witnesses have included officers of nearly all ranks.

Their opinions and recommendations are recorded in many printed pages, and some of them have had their effect. The Corps has emerged from these enquiries as it stands to-day.

By 1716, artillery had reached a state of development and importance such as to justify the formation of a separate corps to deal with it. The Military Branch of the Ordnance was accordingly separated definitely into Engineers and Artillery on a regimental basis. This was analogous to a process which has been repeated during the succeeding centuries. In the process of evolution we have created and developed various activities, and when they have reached a sufficiently sturdy growth, they have been committed to the care of a separate corps. Unfortunately in this process, we have not always been left with as much of the engineering portion of these developed activities as we might have been in the interests of the service as a whole.

One offspring which we brought into the army world was mechanical transport. There was a considerable battle after the South African War as to whether the R.E., or R.A.S.C., should man and work mechanical transport in the army. If we had not attempted to claim that we should drive the mechanical transport and man and control transport units, but had confined our claim to doing the engineering work involved, there is little doubt that our claim would have been admitted at once, and we should now be manning and controlling all the workshops that deal with mechanical transport. If we had occupied that position when mechanical fighting vehicles came into the picture, it is obvious that all vehicles, and all the mechanical engineering of the army, would have come automatically into our workshops. Had that occurred we should have been obliged, as we should be now if we were to take it over, to create a specialist mechanical branch of the Royal Engineers to deal with the work. By specialist branch I mean that no one would work in workshops who was not a member of that R.E. branch, but many members of the branch would be found outside the workshop in other R.E. units and activities.

For a period of forty years, submarine mining was developed by the Corps and brought to a very high state of efficiency; but, when the submarine was invented, and it was obvious that mines would function all over the sea, and not be restricted to harbours, it was logical to transfer it to the navy. For 22 years, aeronautics formed one of the duties of the Corps, but with the development of the aeroplane, the Royal Flying Corps was formed in 1912 to deal with these activities. It was obvious that there could not be a Corps within a Corps, but why did we not continue to do the engineering work for the new Corps, *i.e.*, its workshops and its buildings, at least so long as it was under the War Office, and even after it went to a separate ministry? Fortunately we do its works services in India, our officers are working under the Air Ministry in Iraq and Malta, and these services are our responsibility in war.

The last child of the Corps to leave the parental roof is the Royal Corps of Signals. In the invention and research work and the

shops of that Corps, there is great scope for science and engineering, and our officers have played and are still playing a great part in that work, but the Signal units do not require engineers, and it was right that they should be formed into a separate Corps.

Future Evolutionary Tendencies.

This evolutionary process may or may not continue. We may or may not create and develop other engineering activities. We may or may not take over all the mechanical engineering of the army. The natural tendency is, when anything new and strange makes its first appearance on the battlefield, to give it to the Royal Engineers to find out about it, and see what they can make of it. When they have produced something practical and useful, other people begin to take an interest in it.

Our Corps figured very prominently in the early stages of gas warfare and tank warfare. We provided the heads and many of the subordinates of those branches of warfare.

Evolution is likely to continue. Any healthy organization grows and develops. When it starts to decrease or disintegrate it is on a short road to abolition. The last war and the next war should be the principal subjects of our study to guide us in our organization and training, but the military history of earlier campaigns is universally recognized to have a great value. As engineers we would be unwise to scorn the engineering records of campaigns of 30 years ago, or even a hundred years ago. Engineering feats were accomplished which deserve our admiration and study.

War is a very different thing from what it was, but even to-day we should employ some old methods. In street fighting the Indian Mutiny methods described in *The R.E. Journal* by the letters of Sir Edward Thackeray are still good ones to follow. It is worth while to study the course of evolution that has come about to see if we can extract any main principles that will guide us in further evolution.

I suggest that we can learn some lessons, and that those lessons are that, being a Corps of Engineers, it was right that anything that was not engineering should be taken from us, but that we should continue to carry out the engineering portion of any new military activities, and serve the army as Engineers in any capacity, organizing ourselves so that we are able to do so.

We can serve the army best if we undertake to do all their engineering, and if all qualified engineers in the army are Royal Engineers, as used to be the case. Can we not return to that status?

This brings one to the thorny subject of specialization. Let us consider the conditions under which the Corps is required to work and to serve the army.

THE "SMALL WAR" THE NORMAL WAR.

The nation keeps a very small army and a very large Empire. It always has kept a small army in peace, and there is no sign whatever that it intends to alter its habits in this respect. On many occasions it has raised quite a large army for war. In the last War it raised as fine an army as the world has ever seen. But always on the return of peace Parliament hastens to disband the army, preserving only the smallest remnant for future eventualities.

The army being small the Corps of R.E. is also small, and with the army it is scattered all over the globe, keeping the peace in many countries where trouble is likely to arise at any moment.

The Regular Army has always had a number of small wars to wage with its own resources. On occasions it requires to call out its Regular Reserve to fill it up for the task. It may go farther and call for volunteers to form temporary units, as in the South African War. About once a century the existence of the Empire is challenged. On the last occasion, and on any future occasion when a life and death challenge is made, the whole nation serves wherever and in whatever capacity it may be required.

These then are the conditions in which the Corps has to serve the army. Normally it must manage the business with its peace establishment, occasionally it may call for volunteers and Supplementary Reservists to help it. On rare occasions it will have to receive, absorb, organize, and direct the engineering manpower of the nation.

It is obvious, therefore, that an R.E. officer may find himself in any part of the world and faced with a sudden emergency, or sent off at a day's notice from England to a distant place to deal with an emergency. He may be the only Engineer on the spot when an emergency occurs. He will certainly have comparatively few other R.E.s with him.

We have seen that unless the scale of the emergency is very great the nation is not going to take any special steps to raise Engineers for the occasion. It is the inveterate habit of the nation to underrate the scale of the emergency, and to provide a small force at the beginning, without dislocating its civil occupations.

As the army shrinks in peace-time more and more trimmings are lopped off the Corps. Only a few types of units, and only a few of each type, are maintained, and those are on reduced peace establishments. In these circumstances all that we can do is to write down in a book called *War Establishments* everything that we should like to have, and everything that we mean to create when more money becomes available. But these luxuries are not for normal times, or even for times of normal emergencies. A great deal has to happen before the door of the Treasury opens to disgorge partially trained or untrained Engineer units of various specialities, and specialist

Engineers who volunteer to apply their knowledge in strange surroundings and amid unusual conditions.

On that day those who have been organizing for it are required to have their organization all ready, and carefully planned to absorb these good things. They require to have a good deal of varied knowledge to utilize them to the best advantage. It is obvious, therefore, that the few regular R.E. units maintained in peace, Field Companies, Fortress Companies, Railway Companies, A.A. Searchlight Battalion, Survey Company, may find themselves to be the only Engineer unit at the spot where the emergency occurs, or they may be the only Engineer units which the nation is prepared to send out as reinforcements. The emergency may not be considered of sufficient importance to justify the expense of calling out Territorial or S.R. units, which are organized primarily for big emergencies.

The Engineer units and individual officers and W.O.s of the S.R. are an exceedingly valuable reserve; but they are a reserve, and moreover a reserve which must not be hastily or unnecessarily utilized, or it might be destroyed. Civil engineers and artisans in joining the S.R. have undertaken to serve whenever the Army Reserve or *a portion of the Army Reserve* is called out. Technically, therefore, we may call them out for comparatively small emergencies, *e.g.*, we might have called them out to serve with the Shanghai Force, because certain specified Reservists of Section A were called out on that occasion, but we did not call out the S.R. units either of the R.E. or of other arms for Shanghai. It is not good policy to use them except for grave emergencies. If skilled and thoroughly qualified civilians holding responsible positions (and those are the ones we want) are frequently uprooted from their civilian occupations for minor emergencies such as Shanghai, or for Indian frontier expeditions, or for trouble in Palestine or Egypt, then the present willingness to fill the S.R. units might decrease to vanishing point.

The wisest policy will be to nurse this valuable Supplementary Reserve, and only use it when we are absolutely obliged to do so.

Consequently the Regular R.E. must realize that they have to serve the Army as Engineers in peace, and in minor wars, in almost any part of the globe, in varying climates, and under very variable conditions of work. Economy keeps our numbers small, the numbers and types of our units must be few, the number of our personnel not with units is small, but the Empire and its liabilities are large.

Surprise and variety are therefore the certainties that await us in our work, not only in war but in peace.

The Question of Specialization.

If we divide ourselves into the number of types of specialists obtaining in civilian engineering, the number of each type available for that type of work in war or peace will be ridiculously inadequate for

the task that may face them, while the other specialists would be unemployed.

This principle applies not only to officers but to other ranks. A man who is skilled at some trade will make a better Sapper than an unskilled man. A good bricklayer or a good fitter is of far more value building a pontoon bridge, or revetting a trench, than an unskilled man, because the skilled tradesman has learnt to concentrate, to work to rule, to get a job done and to do it neatly and completely. Every engineering job requires a varying proportion of skilled and unskilled labour according to the nature of the job. The proportion may be as low as 1 to 1 (the bricklayer and his mate), or it may be as high as 1 to 10 (road construction). The unskilled labour can be improvised in the army with Pioneer Battalions, infantry working parties, civilian Labour Companies of various races, but the skilled labour requires to be organized and trained in Engineer units. Throughout our history and throughout the last War we insisted upon the Sapper being a man with some skill at some trade. After the War the skilled tradesman was practically unobtainable in the army. Either he had been killed or the cessation of training of apprentices had caused the vacancy to be left unfilled, or he was drawing such good pay in civil life, and so certain of employment, that the army had no attractions for him. Faced with this difficulty we set to work to train boys in trades at Army Schools, and in the meantime we were obliged to take the unskilled man whom we called a pioneer. It was a concession to an emergency. As the emergency passes, and it is passing, let us hope that the unskilled man without a trade will disappear from Engineer units. The difficulty is largely one of finance, which so often necessitates a compromise.

SPECIALIZATION FOR FIELD ENGINEERS.

To continue the discussion of specialization. It is sometimes stated that Field Engineering is a branch of Corps work which requires specialization, not apparently because it is considered to be difficult, but because it is stated to be easy.

A Field Engineer only differs from another Engineer in that he lives in a field, whereas the other Engineer has the opportunity and the sense to get into a billet or a hut. In these days there is more necessity than ever to give to the combatant units at the front all the assistance that modern engineering and ingenuity can give them. The very best engineering brains and practice should be at their disposal. The variety of climates and countries in which the army finds itself, presents an infinity of engineering problems in war, and in peace, to those who serve the combatant units at the front. Good engineering saves many lives. Bad engineering increases casualties from wounds and sickness.

The Field Engineer is usually, though not always, much more pressed for time than the Engineer farther back. Time is always a governing factor in military engineering to a much greater extent than in civil engineering. A man must be much more skilled to do a job quickly than slowly. Given unlimited time a comparatively ignorant Engineer might perhaps design and plan what is required, but to design and organize at lightning speed exactly what is required to meet a quite unexpected emergency, the trained Engineer with a broad-based education and practice is required.

Senior Engineer officers with war experiences in many parts of the world are not likely to agree that the Field Engineering tasks that faced them were either simple or limited in scope and variety.

No portion of army organization can live in a vacuum at the front. Every army organism has its roots at the base and extends to the front where it functions. Engineering whether it be called "Field" or by any other name is no exception to this rule. It cannot disregard this root principle. Field Engineers will wither away at the front if they are not nourished and supported by an Engineer organization extending back to the base and up to G.H.Q.

It must be recognized then that an Engineer officer, who aspires to deal with field engineering, requires a broad-based engineer education and as much variety in practice as possible not only with units, but on practical engineering works of as large a scale as he can obtain.

Specialization for Electrical and Mechanical Engineers.

When we consider electrical and mechanical engineering the case is somewhat different. The amount of this work required to be done for all branches of the army is now very great (whereas formerly it was not). The number of qualified electrical and mechanical engineers and artisans employed in the army in peace is very considerable, and would be very large indeed in even a small war. There is no fear that they would be standing idle because their particular type of work was not required. Not only are they required in workshops, but they are required to permeate all units and all the activities of the army. We want to do everything possible to obtain all the help we can from mechanical science. The terms "electrical and mechanical engineering" comprehend a whole group of what in civil life are various specialist occupations. To bring all these varieties of specialists into one comprehensive branch would not be narrow and rigid specialization such as we have contended is unprofitable for the army.

A one-sided specialization of this great branch of engineering is therefore advocated: "one-sided" means that, whereas no Engineer would be employed in workshops, or in mechanical units, who was

not a qualified member of that specialist branch, on the other hand every facility would be given for these specialists to serve in other units and branches to assist them in mechanizing their work.

Unless all mechanical engineers and artisans of the army are grouped together in one branch it will not be big enough for specialization. It would be impracticable to specialize the few specially qualified mechanical Engineers we now have in the R.E., for reasons already explained, but if we join them to all the other qualified personnel in the R.A.S.C., the R.A.O.C., and elsewhere, then we have a large enough group of Engineers to stand as a branch on their own, and to serve every part of the army. As all Engineers in the army should be Royal Engineers this group should be a branch of our Corps. It would be a branch permeating all portions of the army, in which there would be plenty of scope for interesting occupation and a career. It would not be a case of repeating the mistake sometimes made in the past of taking genuine engineering work from the Corps, which on the contrary would be given the task of evolving a suitable organization to deal with it.

SPECIALIZATION IN OTHER WORK.

Of the other possible occupations of our Corps I can see none for which a case for specialized and separated branches can be made out, as I have done for the E. and M. Engineers.

Again, it is necessary to emphasize the smallness of our Corps to deal with a variety of work in peace and in small wars. In a big war such as occurs about once a century the case is different. It is understood that in the last Great War the number who wore the R.E. cap badge was about a quarter-million. When you have that number to organize, and at your disposal, when the scale of all types of engineering is so enormous as it was in the last war, then it is practicable without waste of personnel, and necessary, to organize in specialities: to have your railway units doing nothing but railway work, your road units, your water supply units, your forestry units, etc., etc. The personnel allotted to field units are not likely to be moved out of those units, but in a big war the large number of casualties that occur will cause personnel to move from back units to the front units to fill vacancies, and the Field Companies and the Army Troops Companies will find themselves faced with an infinite variety of work embracing every kind of speciality.

EXPANSION OF THE CORPS ON THE OUTBREAK OF A "GREAT WAR."

At a time of rapid expansion, such as occurs on the outbreak of a Great War, there must be a regular skeleton all ready framed and organized to receive the flesh that is to be built upon it. The days

of improvising whole Corps *ab initio* on the outbreak of war are long since past. Bitter lessons were learnt in the campaigns of previous centuries by trying to improvise purely from civilian sources army Transport Corps, Medical Corps, Engineer Corps, or even infantry or cavalry without any regular nucleus. Small as our Regular Army was it provided the nuclei in every arm and branch of the Territorial and New Armies which were raised in the last war, and the Regular R.E. was as necessary in that function as any of his comrades in the other branches of the army.

This then is another duty laid upon the regular R.E. To be ready to receive, absorb, organize, and direct, the magnificent reserve of civil engineering talent which pours into the army in a great war. To be competent to do this the senior Regular R.E. officer from Major upwards must be equipped with a broad-based education and a variety of practical experience. Under such circumstances the combination of the all-round regular military Engineer and his more specialized civilian colleague forms an extraordinarily strong and satisfactory amalgam. What one may lack the other supplies. They are complementary and supplementary to each other. They rapidly weld into an indistinguishable mass which is exactly what the army wants.

A Divisional Commander requires a C.R.E., and a Corps or Army Commander requires a C.E., who can organize and apply all this variety of talent to the varied engineering work that is necessary for his operations. A senior R.E. officer, from Lieut.-Colonel upwards, who below that rank has been content to limit his service to one branch only of our Corps activities, will find himself out of his depth in such a situation. A Commander requires a senior Engineer officer who is a soldier and an engineer with wide experience in different countries of various kinds of engineering work.

Soldier and Engineer.

The Corps of Royal Engineers came into existence and has continued because of the need which has always been felt in every war to have soldiers who were also Engineers, and Engineers who were also soldiers. The whole teaching of military history in this respect will not be disputed. Consequently the Royal Engineer must be a soldier and engineer.

If the nation required only soldiers, they would not go to the expense of training Engineers to be soldiers, they have other ways of obtaining soldiers. If the nation required for its wars men who are only Engineers, well there are thousands of civil engineers. But it would be flying in the face of all war experience, including the most recent war, to refuse to recognize the need for men who are both soldiers and Engineers. Those three words define the Royal Engineer and the task set to the man who aspires to be one.

ANALOGIES IN ARMY ORGANIZATION.

The principle of broad-based education and variety of practice is followed by the Staff of the Army and by the Royal Artillery.

The Staff College does not educate some officers for G work, some for Q, and some for A. It gives them an all-round Army education. When they leave the Staff College they are systematically appointed to the three types of Staff work in turn to give them variety of experience. When they become commanding officers their knowledge of all arms, and the variety of their experience in the co-operation of all arms, is recognized as an essential asset of a senior officer.

In the Great War when a Staff of a size commensurate with our enormous army was required and officers with limited training had to be employed on the Staff, then specialization in G, or Q, or A work was to a great extent followed. A Staff officer who started in one line was likely to continue in it, just as I have pointed out that a quarter-million Engineers more or less remained in branches. But for the normal small war and for peace the Staff follow the same principles as our Corps.

The Royal Artillery before the war divided into Field Artillery and Garrison Artillery, but the Great War united them again. It is realized that an Artillery officer cannot confine his knowledge to one type of gun, and that a General requires his Artillery Commander to be able to handle all types of artillery.

PEACE EMPLOYMENT AND TRAINING OF THE CORPS FOR WAR.

Enough has been said of what is required of Engineers in war; let us now confine ourselves to how the R.E. train, organize, and employ themselves in peace to fill the role required of them in war.

The peace establishment of officers of the Corps, Regular and T.A., takes into account the number required to fill the war establishment of the number of units of an Expeditionary Force of a definite size and to maintain certain training centres at home. Also upon the officers required for the various engineer organizations of a Base and L. of C. of definite proportions, taking also into consideration the Supplementary Reserve in their appropriate situations.

As already stated, economy limits the number of R.E. units maintained in peace and their establishments. Consequently it is obvious that there are a considerable number of R.E. officers required for war for whom employment must be found in peace which will fit them to perform their war duties.

Bearing in mind all we have said before, the object is to find practical and varied engineering work for these officers wherever it can be found in any part of the world.

Moreover, since all officers must be soldiers as well as Engineers

and capable of serving in Engineer units in war, and in due course commanding and utilizing those units when they are senior officers, it is necessary to give every officer at least one and preferably two tours of service in a unit. If this is to be done it is impossible to allow one set of officers, who may find such employment congenial, to monopolize the posts in units. Nor would such permission be to the advantage of those officers. They require more varied and practical training to fit them for the rank of Lieut.-Colonel R.E. It is on the past training and the actions of the senior officers of the Army from Major upwards that success mainly depends.

In the past, officers of our Corps have found a very large amount of practical engineering in conquering and developing newly acquired additions to our Empire. Right up to the opening of the last war, first in India, later in Africa, and in every part of the Empire, R.E. officers were to be found on large public works, on expeditions opening up and developing new country, and also in the older settled countries in very prominent positions on engineering work. The experience thus acquired proved invaluable in war. Since the war, the same procedure has continued, but to a less extent, as the Empire has ceased to expand and the necessity to absorb into civil life again all the personnel of the Navy, Army and Air Force of the Big War has crowded out our applicants for such posts.

Nevertheless great efforts have been made since the war by those in authority to find openings where our officers can be employed on big engineering work abroad. These efforts may be said to have culminated in a circular sent out in 1930 by the Secretary of State to Crown Colonies instructing them when they had such a vacancy to give reasons, if any, why it should not be filled by an R.E. officer. The issue of this letter unfortunately coincided with the commencement of the economic blizzard which has struck the whole world, so that in place of vacancies occurring on engineering works, there has been wholesale shutting down of such enterprises, with the result that some R.E. officers who had been well placed have been returned, as funds for their enterprise had been cancelled.

The position in this respect last February was that we had 38 officers thus employed (see Appendix III), in addition to 70 who are in public works or miscellaneous employment in India. This, of course, is not satisfactory, but until world conditions improve the situation in this respect is not likely to get better. Any improvement in the world situation will be utilized to search for such employment for our officers. Everything has been done to reduce delays in replying to any offers. It must be remembered that we are competing for these appointments with the whole civil engineering profession. It is obviously difficult to find work for Engineers, military or civil, at the present day, or for some time to come, but the matter is kept constantly in view.

India at present takes and employs 377 R.E. officers, of whom in February, 1931, 116 were with Sappers and Miners, 189 on Works Services, and 72 in miscellaneous employment.

As we compete for engineering work outside, it would not be unreasonable if we were asked what the Army does to employ its Engineer officers on its own work.

The answer is that at home and in the Colonies we employ 169 on Regimental Establishments, 176 on Works Services, 56 Staff Officers, and others as shown in Appendix I, including 377 in India.

Survey work is one of the subjects studied and practised by the Corps because, firstly, it enters into every kind of engineering, and secondly it is now one of the most deadly weapons we have upon the battlefield. An accurate map means accurate artillery fire. Air photography, mapping, printing and reproduction of maps are all essential for a Commander's guidance, and for the work of the troops. Fortunately we have excellent opportunities for experience in this work in the Indian Survey Department, in the Ordnance Survey of England, and in expeditions to map the unmapped portions of the globe.

WORKS SERVICES AS A TRAINING FOR WAR.

As to employment on what is called "Works Services" at home and "Military Engineer Services" in India, there are a very large number of officers in the Army, and many in the R.E., who believe this employment to be valueless for war training, whereas the reverse is the case.

It is true that at home we quite unnecessarily lose a very great deal of the value of this training by doing nearly all the work by contract, instead of by direct labour or petty contracts. It would require a whole and separate article to deal with the pros and cons of this controversial question of contract or direct labour. Here the author can only take space to express his conviction that it would be an advantage to the State if a great deal more work was done by direct labour and, of course, an immeasurable advantage to the war training of the officer. But, even with conditions as they are, the Works training is invaluable war training for an R.E. officer. One can go farther and say that it is essential for that purpose.

War cannot be completely mobile. If it were the army would advance 900 miles in two months. The most mobile optimist will not anticipate such success, or contend that any war will last only two months. The fact is that for a great part of any war, forces are halted, and some portion of the army is halted all the time.

When 20,000 men halt just where they find themselves to be, in a very few days their demands for engineer services begin to be very similar to those of a small town in peace, in the way of housing,

roads, water supply, sanitation, etc.; in addition to specialities in defence against enemy action in all three elements, water, land and air. Their communications have to be improvised rapidly to a great capacity. An engineer who has not dealt with army demands of this nature in peace will find himself very much handicapped in war.

The officer employed on works services is continually thinking of and working with every kind of material and using it for its particular purpose. He acquires a knowledge of the capacities of workmen of various trades and the factors of time and expense. Even though he may be only the supervisor of a contractor, he must have a thorough knowledge of the voluminous and detailed information in the contract and see that it is adhered to. He learns to organize and arrange for work to be done and to get it done. Of course there is some drudgery in the work as there is in all work. The man who wants to avoid all drudgery wants to avoid all work. The variety of Engineer work involved in these services is not appreciated by those who have not experienced it. The army that came back from the war was very different from the army that went out. It could not fit into its former habitations. It had come back with mechanical transport instead of horse transport, with a Tank Corps and a Signal Corps grown out of all knowledge. Every arm was reorganizing and requiring buildings to suit its altered organization. Many amenities unknown to the pre-war army are necessities to-day. Hut barracks are wearing out. For many years before the war there had been a large programme for rehousing the army. And so it goes on continually. All this work presents an infinity of engineering problems to the Engineers engaged upon it. All this experience is absolutely essential for an Engineer in war, and an officer who gets no practice in it is unlikely to be of any use as a senior Engineer officer in war.

About 100 years ago, the Duke of Wellington, having found that the history of a civilian department carrying out the work services of the army had been one long record of bickering, scandal, and failure, handed over the work to the Royal Engineers, and we have no reason to object to an enquiry into the way it has been done. F.M. Sir J. Burgoyne explains the Duke of Wellington's views on this matter as follows:

"The abuses and failings of the barrack department could no doubt in great part be rectified. But it is necessary for war purposes to maintain a Corps with trades and training similar to those of the building professions. It is therefore better on all counts that this Corps should be charged with the building work of the Army in peace."

Those words are as true to-day as they were when the Great Duke expressed that opinion. Were he alive now we might hope that he would make a similar decision about mechanical engineering.

About 1904 a Secretary of State for War tried the experiment of creating a civilian department to do the building work. The experiment had to be abandoned. For the sake of the army and for the sake of the war training of the Engineers it is essential that they should be employed on this work.

THE NECESSITY FOR VARIED EXPERIENCE.

It is equally essential that R.E. officers should not spend all their service on this work. I refer the reader again to the paragraphs which explain why the R.E. officer must be soldier and engineer, and why he must have variety of experience.

An officer before he reaches the rank of Lieut.-Colonel must have had experience of at least two, and preferably three branches of the Corps activities, if he is to become an efficient senior Engineer officer, capable of directing and organizing the work and the personnel that will be allotted to him.

Corps activities may be described as employment in Engineer units, or on Works Services, Fortification, Railway Work, Electrical and Mechanical Work, Survey, or Army Staff.

Some officers find that it is pleasanter, and the line of least resistance, to continue the work that they have got used to and like, and do all they can to avoid a transfer to another type of work, but this is very short-sighted. It is not for the benefit of the army, and certainly not a benefit to the officer. He will find his mistake when he becomes a Lieut.-Colonel, probably before that.

An officer who does a three years' tour as a Subaltern and, later, as Captain or Major, another three or four years' tour in any of the above branches of work will, if he works, find that he has acquired a considerable knowledge of the subject, with which he is well equipped to direct and organize others later on in his service. There is, therefore, time for an officer before he is promoted Lieut.-Colonel to acquire considerable experience of three branches of Corps activities. An officer with this experience built on to a broad-based education at Cambridge and Chatham is what a Commander requires for his C.E., or C.R.E., in war or in peace.

There are exceptions to every rule, and circumstances have always arisen, and will always arise, which cause a small percentage of our officers to get unusual and long-continued experience mostly in one line, which turns them into quite eminent specialists. We have always been able, and continue to be able, to produce specialists to influence the policy and management of every branch of our activities. For the individual this sometimes leads him to an early dead end, or he may rise to considerable fame.

It is better to produce the few specialists we require by evolution than by regulation.

Summary.

If I have carried the reader with me so far, he will agree with me that the Corps has every right to claim its past record as justification for its existence, and that it has earned the reputation which it undoubtedly possesses by engineering achievements in every part of the Empire, in war and in peace, and by serving every portion of the army from the front line to the base.

We cannot live upon our past, we can only thrive by progress and evolution.

For healthy evolution we must study the lessons of the past and strive to penetrate the future.

It is obvious that it has been a right policy to take from us whatever was not engineering, and a wrong one not to leave with us any engineering work that served the army.

As a Corps of Royal Engineers our ideal should be to embrace all the Engineers of the army, and to do all the engineering required by the army.

The Corps exists because the nation always has required men who were both soldier and engineer, and that must be the qualification of every R.E. of every rank.

The nation and the army learnt the lesson many years ago that Corps of Engineers, or of any other kind, cannot be improvised *ab initio*, but must be built upon a peace establishment and a regular framework. Therefore let us organize to absorb in times of national emergency the valuable reserve of civil engineers.

The Regular R.E. must be prepared for a great variety of work in any part of the Empire in peace or war. Therefore he must be trained by variety in his employment.

To serve the army well at the front, as elsewhere, all that science and engineering can do for it must be done. To do this rapidly and at short notice, Engineers must have wide experience obtained by variety of employment. It is not an easy task that can be undertaken by men with limited education and narrow experience.

We must seek every opportunity to get experience for our Engineers outside the army, but also to give them within the army all the experience which it has to offer.

"Works" experience is essential for the war training of the Engineer officer, and the army benefits by having this work done for it by its Engineers.

R.E. officers, if they are to develop into suitable senior Engineer officers who can serve their Commanders, must get employment in at least two and preferably three branches of our activities, of which one must be in Engineer units, and another Works Services or outside engineering work. This is not too much to ask of any officer. Finally I repeat that our ideal is to embrace all the Engineers of the

army and to do all the engineering required by the army. Is not this an ideal worthy of our past and of our future ?

The poet who wrote the following lines must, I think, have had the Royal Engineer in his mind :—

" Think big and your deeds will grow :
Think small and you'll fall behind :
Think that you can and you will :
It's all in the state of mind.

If you think you're outclassed, you are :
You've got to think high to rise :
You've got to be sure of yourself before
You ever can win a prize."

APPENDIX I.

STATEMENT OF EMPLOYMENT OF THE OFFICERS OF THE CORPS ON 1ST FEBRUARY, 1931, INCLUDING A FEW NON-REGULARS AND CIVILIANS, EXCLUDING QUARTERMASTERS.

	Establishment.
Regimental, Home and Colonial	169
Works Services, Home and Colonial	176
Extra Regimental Schools, etc., see Appendix II ...	96
Employed and paid by other Govts., see Appendix III	45
Staff Officers	56
Extra Regimental Students	13
Transportation (Home)	11
Regimental Officers under Instruction	102
Abnormal Establishments (Shanghai and Singapore) ...	5
Indian Establishment	377
	1050

APPENDIX II.

EXTRA-REGIMENTAL SCHOOLS, ETC.

Appointment.	*Establishment,* 1931/32.	*Strength on* 1.2.31.
Army Technical School—Boys	4	4
58th Porton Company, R.E.	3	3
School of A.A. Defence	3	3
Permanent Staff T.A. and S.R. (Adjutants)	27	27 (*b*)
S.M.E., Chatham	21	22 (*a*)
School of E.L., Gosport	9	10 (*c*)
R.M.A.	6	6
R.M.C.	2	2
Survey Battalion, R.E.	8	8
Small Arms School	1	1
Experimental Bridging Establishment ...	2	2
R.E. Stores	4	4
R.E. Board	2	2
R.T.C., Longmoor	3	3
Air Defence Experimental Establishment	1	1
	96	98

(*b*) Includes 1 non-regular officer. Excludes 1 ordered from Scottish. Includes 1 ordered Southern Command.

(*a*) Includes 1 ordered Gibraltar.

(*c*) Includes 1 ordered Egypt, and 1 to Staff. Excludes 1 Officer earmarked to join.

APPENDIX III.

EMPLOYED AND PAID BY OTHER GOVERNMENTS.

Appointments.	*Establishment,* 1931/32.	*Strength on* 1.2.31.
Other Governments	45	—
Malay Survey Section	—	2
Ordnance Survey	—	2
Boundary Commissions	—	5
Iraq Army	—	1
Nigerian Survey and P.W.D.	—	4 (*a*)
R.A.F. Air Ministry	—	5
Sudan Government	—	7 (*b*)
Gold Coast	—	6
K.A. Rifles and W.A.F.F.	—	2
Johore Volunteers	—	1
Home Office	—	1
Baghdad—Haifa Railway	—	1
Tanganyika Railways	—	1
	45	38

(*a*) Includes 1 ordered to Eastern Command.

(*b*) Includes 1 ordered to Eastern Command.

DEMOLITIONS CARRIED OUT AT MONS AND DURING THE RETREAT, 1914.

A COMPILATION BY MAJOR-GENERAL SIR REGINALD U. H. BUCKLAND, K.C.M.G., C.B., *Colonel Commandant R.E.*

FOREWORD

BY MAJOR I. S. O. PLAYFAIR, D.S.O., M.C., R.E.

1. *The Part Played by Demolitions on the British Western Front.*

There were four principal periods of demolition activity.

First: In 1914, by the British during the retreat from Mons. These, as Gen. Buckland's narrative shows, were mostly last-minute attempts to prepare and fire charges on bridges in the presence of a pursuing enemy.

Second: In March, 1917, by the Germans during their withdrawal from the salient between Arras and the Aisne to the Hindenburg defences. This was a deliberate and methodical laying waste of the entire area to be evacuated. All rails were removed and craters blown in the railway cuttings and embankments. Roads were blocked by craters at every cross-road, embankment and cutting. All machinery was removed or broken. Gardens, trees, houses and every form of shelter were destroyed. The programme was carefully worked out and co-ordinated by the Higher Command; it took five weeks to prepare. *The desired military result, namely, respite from attack, was achieved.*

This was not the first time that demolitions on a large scale were used in the war, for in 1914 the Germans prepared roads and railways for wholesale destruction before withdrawing from the Vistula to the Silesian frontier. (See article on "Wholesale Demolition," by Col. G. C. Williams in *The R.E. Journal* of March, 1924.)

Third: In March, 1918, by the British during the second battle of the Somme. To what extent they had profited by the experience of 1914 and 1917 will be seen from Gen. Buckland's second article. (See also the article "Demolitions in the Field," by C. de L.G. in *The R.E. Journal* of October, 1918.)

Fourth: In November, 1918, by the Germans in their final retreat. This was a case of wholesale demolitions in a *forced* retreat. In the words of the official dispatch: "At the time of the Armistice, railheads were on the general line, Le Cateau-Valenciennes-Lille-Courtrai, and for many miles in front of them bridges had been broken

and track torn up or destroyed by mines." In fact, railhead had dropped 70-80 miles behind the fighting troops; and, for lack of communications, the advance of the British Army was reduced to that of three brigades on each Army front. It would probably have come to a temporary standstill in the course of the next few days.

2. *The Doctrines of* 1914 *and of the Present Day.*

The *Manual of Field Engineering*, 1911, contained a chapter on hasty demolitions with explosives. It was entirely technical and contained no reference to the principles of the use of demolitions or to reconnaissance. *Cf. M.F.W. All Arms*, 1925, sec. 117.

Military Engineering, Vol. IV, 1910, was also entirely technical. There was no section on general principles corresponding to sec. 52 of the 1923 edition.

Field Service Regulations, 1909, reprinted 1914, made no reference to demolitions except under *Fortress warfare* and in the following terms under *Rearguards*. "A rearguard to a force retreating should be lightly equipped and should usually be accompanied by a strong detachment of engineers provided with demolition equipment . . . The Commander should receive instructions as to what extent he is at liberty to break down bridges, burn villages, and destroy railways with a view to impeding the enemy's progress." This gives the impression that the engineers with the rearguard were expected to do all the necessary demolitions. *Cf. F.S.R.*, 1929, sec. 44, 2: "The rearguard commander. . . will be told the probable rate of movement of the main body and what demolitions *are being put in hand* to impede the enemy's advance."

Moreover, the whole of sec. 46 is new, except the list of expedients for delaying the enemy. A similar, but shorter list appeared in the 1909 edition. In sec. 46 the need of foresight, a clear policy, co-ordination and the allocation of responsibility is made clear.

3. *Technical Methods and Equipment.*

Guncotton has fully justified the confidence placed in it and it is still the only explosive carried as equipment, though ammonal is a much better crater-producing agent.

The quantities carried have been altered, thus:—

	1914.		1932.	
	Slabs. 15 *oz.*	*Primers.* 1 *oz.*	*Slabs.* 1 *lb.*	*Primers.* 1 *oz.*
Field Company ...	560	720	728	720
Field Troop	280	480	1120*	480*
Army Troops Coy. ...	Nil	Nil	448	720
Cavalry Regt. ...	96	240	Nil	Nil

* Per Field Squadron. The 1st, 2nd, 3rd and 5th Field Troops were formed into the 1st Field Squadron in September, 1914.

Accessories.

1914.	1932.
Detonators No. 8 (for fuze).	Same.
Detonators No. 13 (electric).	Same.
Fuze, safety, No. 9, burning at 4 ft. per minute.	*Fuze, safety, No.* 11, burning at 2 ft. per minute.
Exploder Mark V., 1 per section.	1 *Mark V.* per Fd. Coy., and 1 *Mark VI.* per section. The latter fires through only 40 ohms. An electric detonator has a resistance at fuzing point of 2·6 ohms.
Instantaneous Fuze, coloured orange, and bound with crossed thread to distinguish it in the dark. Made of quick-match in a waterproof cover; rate of burning 30 yards per second. See footnote on page 26.	*Fuze, instantaneous, detonating*, consisting of T.N.T. in a tin tube. Action practically instantaneous.

The formulæ for calculating guncotton charges are unchanged, but there have been a few alterations in the method of applying them and in certain practical matters.

For example: 1911—"One detonator is sufficient for a continuous guncotton charge." 1925—"In the case of an extended charge at least one point of detonation for each 10-ft. run should be provided."

Again, 1911—"In the presence of the enemy, charges may be placed hurriedly and so under unfavourable conditions. They should therefore be increased by 50 per cent."

1925—"Charges placed hurriedly where they cannot be examined properly after being fixed should be increased by a percentage (say 50 per cent.) to allow for bad contact, etc."

The method of applying the steel-cutting formula to a plate girder has been changed. Briefly, the old method was to calculate the separate charges required for cutting the flanges (plus thickness of angle iron plus height of one rivet-head) and to add the calculated charge for the whole web. The total so obtained was divided into two parts, in proportion to the metal in the upper and lower halves of the girder (often equal), and placed in the diagonally opposite angles formed by the junction of the web with the top and bottom flanges. The two charges were to be fired simultaneously. The present method is to double the calculated charges for the flanges if they cannot be placed in contact with the whole of the breadth of the flanges to be cut. (See *M.E.*, Vol. IV, 1923, plate 21.) The girder illustrated on plate 173, *M.F.W.*, 1925, and on plate 21 of *M.E.*, Vol. IV, 1923, would have required only 14 lb. of guncotton according to the pre-war rules.

4. *The Lack of a Demolition Plan; The Reason and Results.*

On August 16th, Sir John French paid his first visit to Gen. Joffre and recorded his impressions in these words. "He certainly never gave me the slightest reason to suppose that any idea of retirement was in his mind. He discussed possible alternatives of action depending upon the information received of the enemy's plans and dispositions; but his main intention was always to attack." The next day Sir John called on Gen. Lanrezac, and they "arrived at a mutual understanding which included no idea or thought of retreat."

In his book "1914" Sir John writes: "Up to the time of the battle of Mons, so far as the British troops were concerned, the forwarding of offensive operations had complete possession of our minds. . . . Nothing came to hand which led us to foresee the crushing superiority of strength which actually confronted us on Sunday, August 23rd. . . . Late on the 21st I received Gen. Lanrezac's orders to his troops; he was only awaiting the development of moves by the Third and Fourth French Armies to begin his own advance."

Evidently the sudden change from intended advance to enforced retreat took G.H.Q. by surprise. No demolition plans had been made beforehand, and once the retreat had begun there was little chance of making any. It has been seen how little attention the existing manuals paid to the matter. In the circumstances the large measure of success achieved speaks highly for the British technical methods and equipment, and above all for the determination of the executive personnel concerned. Small wonder, though, that the control of affairs must have seemed to them chaotic.

"We were always being sent back *towards* the enemy to reconnoitre and prepare demolitions. It seemed as if the Staff never thought of them as tactical operations. They seemed to say to themselves when they crossed something:—'By G——! here's a bridge, let's blow it up! Where's a Sapper?' All their arrangements were very confusing—orders, counter-orders, disorder. The transmission of orders was bad, too; it was of necessity slow, but the order writer seemed to think that when an order had been written the deed was done, even if the site was 10 miles away. Aggravating to all and dangerous for some."

A field company in the retreat seems to have been rather like a dog being taken for a country walk. Master sets himself a fairly definite course, to which dog has generally to conform or else he gets lost. But dog covers twice the distance! He scampers ahead; then darts off to one side; then to the other; and every now and again he gets left and has to be whistled up.

5. *Replenishment of Explosives.*

The *Field Service Pocket Book*, of 1913, contained a table of explosives carried in the field, and the only units mentioned in it were the

Field Squadron, Field Company and Cavalry Regiment. The principle is now established that explosives to replace wastage are dealt with in the same way as S.A.A., *i.e.*, through the S.A.A. Sections of the ammunition companies and maintenance companies.

But although an organization exists for carrying explosives in various echelons it does not follow that we can afford to be lavish. Generally speaking, if more time is available in which to make preparations larger charges can be *usefully* employed. For example, where cutting of the girders is all that can be done in a few hours, more time might allow of one or both abutments being blown up.

This point of view is interesting :—

" One point I think should be emphasized about hasty demolitions in the face of the enemy. Beware of calculations. I gave an order to my people not to fuss over calculations but to cover the girders with all the stuff they could tie on, and let it go. The result was we never failed through lack of power but we burnt a hell of a lot of powder ! My view was that my first job was to demolish and do it thoroughly and quickly and certainly. Replacement of explosives I am afraid I did not look upon as my funeral."

But there is no getting away from the fact that guncotton can be used once only, and the engineer is doing the best for his side who does the job with the least expenditure of stores. There will often be a strong and very natural temptation to " give her plenty," and so make doubly sure of success. It may be argued, with some force, that no Divisional Commander will haul his sappers over the coals for having used more guncotton than necessary on a successful demolition. When the supplies run short he may even join in the general chorus which is blaming " the system " and the inadequacy of the various echelons.

The question of replenishment of explosive may be a very important one. Bridges are being made stronger and bigger, and reinforced concrete is being used more and more. The hasty demolition of reinforced concrete literally eats up explosive.

The importance of *time* is likely to be greater than ever where the bridge is of reinforced concrete, because a great saving in explosive is effected if the reinforcement can first be bared so that the guncotton can be put into close contact with it.

6. *Mons.*

Sir John French's " 1914 " contains a description of the terrain ; see pages 48 to 55. This book, and the *Official History* and *Dispatches*, and Sir F. Maurice's *Forty Days in* 1914 gain enormously in force when read in conjunction with Gen. Buckland's narrative. Doubtless this is due to the interest aroused by the constant reference to individuals ; for there is hardly a paragraph in which the name of some officer, man, or unit of the corps does not occur. And the

interest thus aroused is infectious. It spreads to include other units, other arms, other individuals. It forms a host of new contacts. It makes the dry bones live.

One cannot read this little side-light on the affair at Mariette (see page 29) without feeling a strong desire to learn more of this B Company and how they fared during the rest of the Retreat, and later. The anecdote was sent to me by an officer well known to the Corps. " I myself was present at the bridge at Mariette when Captain Wright and Serjeant Smith tried to blow it up. Actually B Company, 1st Bn. The Northumberland Fusiliers was in the act of withdrawing when Wright began his forlorn hope. Although we did not know it, by that time we had practically been cut off by the Germans who had come in about Mons. Wright's gallantry made a great impression upon the men of B Company of my regiment. Two days later in the early morning, when they were leaving a very chilly bivouac at Bavai, they recognized Wright riding by and cheered him heartily ; rather a unique demonstration from Northcountrymen."

One more example, this time from the other side of the hill. Its dramatic effect is increased when we know what difficulties the 17th Field Company was struggling to contend with in the dark at St. Ghislain (see page 30). The quotation is from *Vormarsch*, translated as *The Advance from Mons*, by Capt. Bloem of the 12th Brandenburg Grenadiers. His regiment had been roughly handled at Tertre. " A bad defeat, there could be no gainsaying it ; in our first battle we had been badly beaten, and by the English ! The English we had so laughed at a few hours before ! . . . Suddenly a tremendous burst like an explosion ; not far away, either. A terrifying noise. A few moments later, another. Everyone jumped to their feet. What on earth was it ? Certainly not a gun of any kind. A rumour ran around that it was the bridges ; that the English had blown up the canal bridges ! Surely impossible ! *The English blow up bridges !* Nonsense, it must have been something else—but what ? . . . I listened speechless with amazement. Positions evacuated ? *Bridges blown up ?* Advance on the canal ? . . . So the explosions during the night were explained. . . . Now we are at the famous canal. The bits of the blown-up bridges were lying about all round, but our engineers were already at work putting a pontoon bridge across for the artillery. Close by, a narrow iron footbridge had been left that could be swung across. This we now had to cross in single file."

7. *In Conclusion.*

With the blowing up of the bridges spanning a natural obstacle, a retreating force has not necessarily played its last card. A comprehensive scheme will have included the destruction or removal of all useful stores and materials, and as thorough a spoiling as possible

of the most approachable sites. As long as ground observation of the obstacle is possible, the pursued can interfere very seriously with the task of the pursuer, as in the crossing of the Aisne by the British in 1914. Even if observation is not possible, as at night, the engineers of the retreating force will usually be able to predict the most probable sites at which work on crossings will begin, and with a little co-ordination the artillery should be able to delay work there considerably. If air observation and attack from the air can also be utilized, so much the better.

The mobility of the engineers . . . co-operation . . . offensive action . . . economy of means . . . all these principles seem to have crept into this foreword. Can it be that demolitions are, after all, an operation of war?

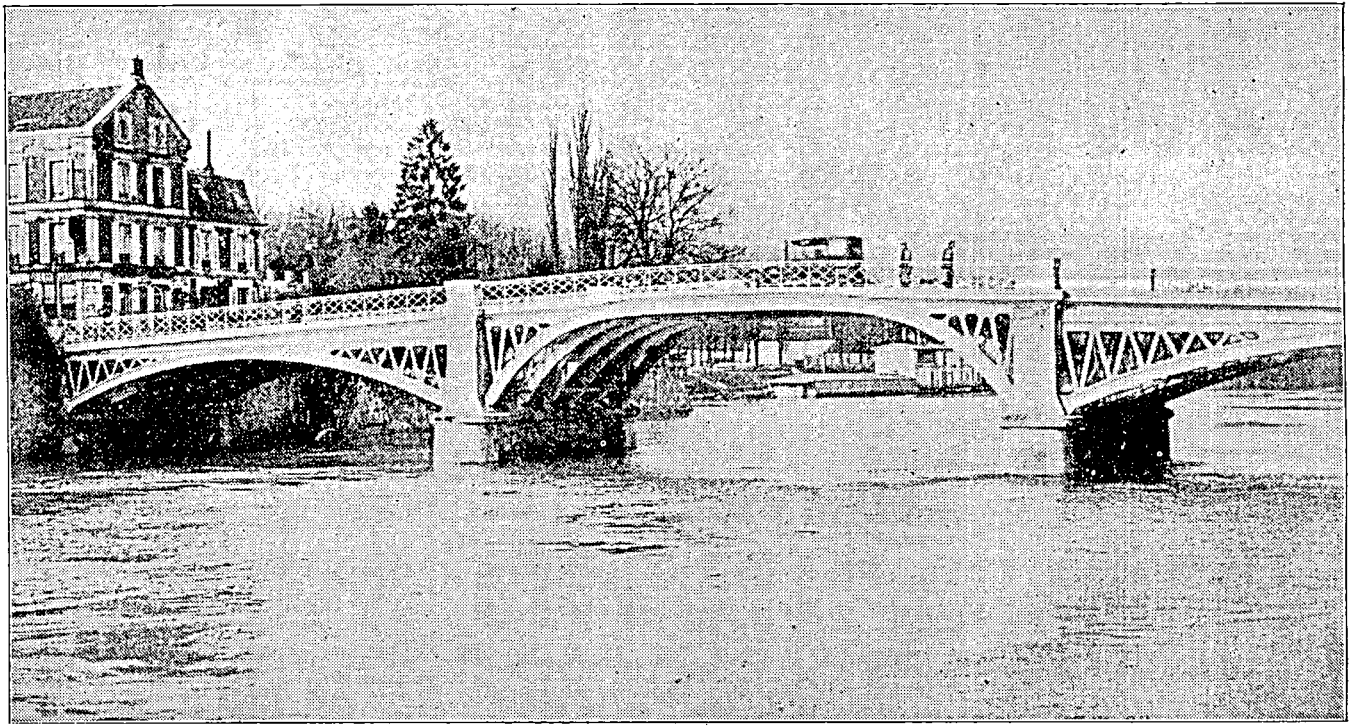
THE following account of the demolitions carried out between Mons and the Marne (23.8.14—5.9.14) has been compiled in response to Major Playfair's letter dated 23rd February, 1931, in the monthly *Supplement* to the Corps Journal. It is based on Vol. I. of the *Official History of the War*, by Brig.-Gen. Sir J. E. Edmonds, and on the operation orders, and war diaries of G.H.Q., Corps, Divisions, C.R.E., and Field Companies, and Company histories, which have already appeared in *The R.E. Journal*. As will be easily understood, a complete series of orders issued is not now forthcoming, and the diaries are sometimes sketchy, having been compiled in very trying circumstances, or written up later in times of comparative leisure. It is, therefore, impossible to get a full record of all the work of this nature which was done.

Many of the orders available are quoted at length. It is quite clear that demolitions, to be effective, must be planned in accordance with a definite scheme issuing from the supreme command, in which responsibility is delegated to the higher units in accordance with the areas in which they are operating. Orders, too, have to be issued sufficiently early for them to filter down to the R.E. units which have to march to the site of the work and carry it out. This takes time, and it is important that the site should be reached, or at least reconnoitred, by daylight, if a successful demolition is to be accomplished.

Purely technical details when available have been collected in an Appendix, to which references are made in the text.

A nominal roll of the R.E. officers of the units concerned will be found in Appendix A.

DEMOLITIONS CARRIED OUT AT MONS AND DURING THE RETREAT, 1914.



Bridge after being repaired. The original centre span was probably similar to the other two.

23rd August.

On the night of the 22nd/23rd August the disposition of the B.E.F. was as follows. On the right, the I. Corps (1st and 2nd Divisions) had arrived late in the evening on a line facing N.E. from Peissant, 10 miles S.E. of Mons, to near Spiennes, 2 miles S.E. of the same place. The II. Corps had the 3rd Division on its right, holding a position extending from Spiennes (inclusive), passing N. of Mons, and along the Condé Canal to Mariette (inclusive), whilst the 5th Division held the line of the canal from the railway bridge E. of St. Ghislain to the bridge on the Ville Pommeroeul-Thulin road (both inclusive). West of this the cavalry guarded the canal crossings as far as Condé, but they were relieved by the newly constituted 19th Infantry Brigade between 2 and 3 p.m. on the 23rd.

It had been the intention to resume the advance on the 23rd, in conjunction with the French, General Lanrezac's Fifth Army, on our right, the B.E.F. pivoting on its right and wheeling until it faced in a north-easterly direction, but during the night Sir John French received news which convinced him that he would be attacked in the morning by the enemy in superior numbers. He therefore summoned the commanders of the I. Corps and of the Cavalry Division to meet him at 5.30 a.m. on the 23rd at Sars la Bruyère,* the H.Q. of the II. Corps, 6½ miles S.W. of Mons, and at the conference gave orders for the outpost line to be strengthened, and the bridges over the Mons canal to be prepared for demolition. It is to be noted that from the Ville Pommeroeul road to Mons the bridges were practically all in the outpost line; east of that they were beyond it, and to the west they were guarded by cavalry only.

In order to appreciate the varying degrees of difficulty under which the R.E. had to carry out their work on the bridges, it is necessary to have some idea of the times at which the German attack began to develop from east to west along the front on the 23rd.

East of Mons mounted troops were in contact at 6 a.m., and near Ville Pommeroeul, between 6.30 and 7 a.m. At 9 a.m. German guns were shelling our infantry between Nimy and Oburg, and their infantry (IX. Corps) advancing to the attack, but without any material success up to 11 a.m. At 11 a.m. the German III. Corps attacked Jemappes and Mariette, and the fighting spread west, reaching St. Ghislain and les Herbières at noon (severe fighting at 6 p.m.) and la Hamaide at about 1.30 p.m. At Pommeroeul the first attack (by cavalry) was at 4.45 p.m., and at Lock 5 (German IV. Corps) at 5 p.m. From this it will be seen that the day's fighting fell almost entirely on the II. Corps. In the I. Corps area there is no record of any demolitions having been carried out.

Fortunately the G.O.C. II. Corps, before the C.-in-C.'s conference,

* Not shown on the map.

had foreseen the imminence of an attack, and had at 2.30 a.m. sent orders to the 3rd Division* to prepare the bridges over the canal for demolition, and a further order at 8.53 a.m. directed that they were to be destroyed in the event of a retirement being necessary, but not earlier.

The C.R.E., 3rd Division, received orders accordingly to prepare the bridges in the divisional area, but no bridge was to be demolished without an order from the divisional staff. His companies were scattered on other work, and it took a little time to collect them, so that on the right of the division the posts and bridges were rushed before the work was finished.

The O.C. 56th Coy. had personally reconnoitred the canal near Mons during the evening of the 22nd; he sent in a report and sketch, and asked permission to start preparing the bridges for demolition at once, but was told to do nothing before 6.30 a.m. next day. Foreseeing that an additional supply of explosives would be required, he sent a subaltern into Mons with the G.S. wagon, but none could be got.

When 3 sections of this company reached the canal on the 23rd they found that the enemy was already sniping at the bridges. The right section was rushed whilst fixing their charges; Lt. Holt was amongst those killed, and Serjt. Miles and the rest of the section were captured; but there is nothing to show on what bridge they were engaged. What happened to the other two sections is not recorded.

On the left of the division there was more time, and eight bridges were to be prepared by the 57th Company, which had spent the night at Cuesmes; but owing to two sections being away on other work, there was a shortage of leads and explosives. The instantaneous fuze forming part of the peace equipment of this company had been withdrawn a short time before mobilization, and had not been replaced. Consequently all multiple charges had to be fired electrically, and a section carried but one exploder.†

* Only orders now extant can be quoted; but it is evident that a similar order was sent to the 5th Division, as it reached the 59th Field Coy. "during the night" 22nd-23rd.

† From the account of the work of the 17th and 59th Coys. on this day, it looks as if they, too, had no instantaneous fuze.

It should be explained that, before the introduction of the *cordeau détonant* or detonating fuze, the normal arrangement for exploding several charges simultaneously (and a girder bridge almost always necessitates the fixing of several separate charges at selected points) was to provide a length of safety fuze, burning at the rate of 4 ft. a minute, which the operator lit with a match at its free end, and then walked away to a safe distance. The other end of the safety fuze was fixed in a "junction box," from which equal lengths of instantaneous fuze, burning at the rate of 30 yards a second, were connected to each of the detonators. Each detonator was inserted in a 1-oz. dry guncotton primer, which was placed in close contact with the guncotton forming a charge. The flame, having crept along the safety fuze, ignited simultaneously all the ends of the instantaneous fuze in the junction box, and the charges all went off together. If several charges were to be exploded at once without instantaneous fuze, exactly equal lengths of safety fuze, one to each charge, had to be cut, and lighted simultaneously, and even then it was not certain that they would all burn at exactly the same rate.

Very early in the morning Lt. Day, 57th Coy., with Corpl. Payne* and 12 sappers on bicycles, and half a tool cart containing tools and explosives, went to the road bridge over the railway and canal N.W. of Mons, with the intention of blowing up the part of the bridge over the canal. The portion over the railway was guarded by infantry, who reported all quiet. Lt. Day sent Corpl. Payne with one sapper along the canal to reconnoitre the next bridge towards Nimy (a railway bridge). This was also guarded by infantry, and whilst Corpl. Payne was examining it a wounded German officer and two men came in to surrender. When Corpl. Payne returned with his report, Lt. Day decided to go on with 6 sappers to demolish the Nimy bridges, leaving the rest of the party to deal with the bridge at Mons.

There seems to have been no hurry, and Corpl. Payne, fresh from the Q.I. course at the S.M.E., got his charges carefully fixed, and made sure that his six sappers (five of whom were reservists) knew how to hold the head of the match against the exposed powder of the safety fuze, and strike the box across the match.† Owing to the lack of instantaneous fuze, and having no exploder, Corpl. Payne had to try to send off all his six charges simultaneously by using equal lengths of safety fuze. There were not, however, sufficient match boxes to give one to each man, so he arranged that three men should light their lengths of safety fuze and hold them at once against the ends of the other three lengths. This seems to have worked well, and all the fuzes were hissing when Corpl. Payne and his men ran across the railway lines under the bridge, and got on to the road on the other side.

Owing to the noise of bursting shells, which were now falling fast, it was not possible to distinguish the sound of any explosion of the charges, but Corpl. Payne heard later that at least some of the charges had gone off, and that pieces of the bridge had come hurtling through the air.

Lt. Day, on arriving at the Nimy bridges, set to work on the railway bridge, as he considered it more important than the other (a swing road bridge), and he had not sufficient explosives to do both. Unfortunately before he could get his charges fixed the Germans attacked and captured the bridge, and he was wounded and taken prisoner.‡

Lt. Boulnois, of the same company, with 4 N.C.O.s and 4 sappers of No. 3 section mounted on bicycles, and accompanied by his forage cart with all the explosives available, the exploder, and a drum of leads, set off at 7.15 a.m. to reconnoitre the bridges allotted to him, from Jemappes station to Mariette. These were drop bridges

* Now Major A. Payne, Quartermaster, 4th Bn. Cheshire Regt.

† Compare the demolition of their pontoon bridge by the 59th Coy. below.

‡ At the time he was reported to have been killed.

(Sketch App. B) of from 40 to 50-ft. span, and 25 slabs of guncotton were allowed for each of them, so that charges could be placed on each girder and on some of the transverse members. Long lengths of electric leads were cut off the drum and dropped, with the guncotton, as each bridge was reached, so that a couple of men could get everything ready for the exploder to be attached when required.

It was now about 11 o'clock, and at Lock 2 the German attack had already begun. A company of the R. Scots Fusiliers, which was holding a barricade at the N. end of the bridge, was soon driven back to a similar barricade some 20 yards south of the canal, but it prevented the enemy from crossing. In the meantime Lce.-Corpl. Jarvis and Sapper Neary, working in a small boat underneath the bridge, managed to fix their charges, whilst heavy firing went on over their heads, but they had to make occasional dashes back across the 20 yards between the canal and the barricade to fetch explosives and run out their leads.

Serjt. Smith, with Sapper Dabell, fixed the charges on the bridge at Mariette, whilst Lt. Boulnois, during a lull in the firing, sank half a dozen barges in the canal, detonating a single slab of guncotton in each of them with safety fuze.

The forage cart having been sent off to a safe rendezvous, Lt. Boulnois with the drum of leads on the carrier of his bicycle, and Serjt. Smith carrying the exploder in addition to his rifle, rode off together to visit the men at work on the other bridges. At about 2 p.m. they met Capt. Wright, Adjt. R.E. 3rd Div., coming from Lock 2, where he had been wounded in the head by shrapnel whilst trying to cross the 20 yards between the barricade and Lce.-Corpl. Jarvis's boat. No orders had yet been received as to the destruction of the bridges, but now they stopped a dispatch-rider searching for the Scots Fusiliers, and learned that he was carrying orders for a general retirement. They at once realized that they were faced with the problem of instantly blowing up 5 bridges on a front of 3 miles with one exploder.

Capt. Wright started off in a car to order the destruction of Lt. Day's bridges, and told Lt. Boulnois to get on with his as best he could. Lt. Boulnois bicycled with Serjt. Smith to his right hand (easternmost) bridge close to Jemappes station, and connected the exploder to the leads which 2nd-Corpl. Wiltshire had run to a barricade south of the canal. The O.C. R. Scots Fusiliers, who was in command here, was reluctant to give permission to fire the charges, as his orders distinctly said that this was not to be done without sanction from D.H.Q., but eventually he agreed, and the bridge was successfully destroyed at about 3 p.m.

Obviously there was now no time to lose, so Lt. Boulnois decided to omit the bridge at Lock 2 (Lce.-Corpl. Jarvis) and Lce.-Corpl. Halewood's two bridges next to it, and make with his two N.C.O.s

At about this time the enemy shelled the railway bridge heavily, and the guncotton charges were blown off without being detonated. Corpl. Marsden did good work in going over the leads and attempting to refix them, but he was killed later whilst watching the attack through his telescope.

Owing to the heavy fire the party working on the bridge on the main road had had to be withdrawn, but at 7 p.m. Serjt. Payne and 5 sappers completed the preparations, 2nd-Lt. Godsell remaining there to blow it up. At 11 p.m. Serjt. Payne went with 6 men to re-prepare the railway bridge, but by that time everything was quiet, and the Germans could be heard singing.

The difficulty at the St. Ghislain bridges was that the section's one exploder being in use at the railway bridge, safety fuze had to be used, and it was necessary to blow up the two bridges (road and foot) simultaneously lest the first explosion should disturb the arrangements for the second. This feat was attempted by using equal lengths of safety fuze, but as there were 4 charges on the road, and 5 on the footbridge, it meant selecting 9 sappers to light up at a given signal. It is to be remembered that the company consisted of 60 per cent. reservists, that this was the first demolition they had attempted, and that they were under fire for the first time.

By 1.30 a.m. on the 24th, the infantry were all south of the canal, and it had been arranged that the explosions in St. Ghislain were to be the signal for blowing up the other three bridges. Just as all was ready a sudden outburst of shelling and musketry fire drove the demolition party off, but as soon as it died down they were collected again, and at 2nd-Lt. Godsell's order the fuzes were lighted. The result was completely successful at all the bridges.

Lt. Pottinger of the same company met with difficulties on the lattice girder road bridge at Lock 4, as the charges refused to go off owing to some fault in his exploder. When he could no longer get on to the bridge owing to the heavy fire, he tried to set off the detonator by firing at it with his revolver (he was one of the best revolver shots in the Army), but even this failed, though he hit the primer, and the bridge had to be left standing. He and his party were cut off and had much trouble in wriggling their way back to join their company.

The 17th Coy. also sank several barges on the canal by exploding a 1-lb. slab of guncotton in each close to the keel.

During the night 22nd/23rd the 59th Coy. received orders to prepare the bridges over the canal on the left of the 5th Div. for demolition, and started work very early on the morning of the 23rd. Lt. Pennycuick with No. 1 section (Serjt. J. Buckle)* prepared the plate girder railway bridge west of Lock 4, and a small drop bridge on a track about one mile farther west again. The charges on the railway

* Now Capt. J. Buckle, D.C.M., R.E. (ret.).

Unfortunately a few footbridges at St. Ghislain and elsewhere were left standing, and were used by the enemy next morning. It is to be noted that the canal locks were very narrow, and could be quickly bridged by the enemy.

24th August.

On the 24th, the B.E.F. retired to a line E. and W. through Bavai: no demolitions were carried out.

25th August.

On the 25th the retirement was continued, and the I. Corps crossed the Sambre, which lay diagonally across their line of march. It is noted in the diary of the 5th Cavalry Brigade that the bridges over that river had been prepared for demolition by the I. Corps, but nothing is said about their destruction.

The O.C. 11th Coy., whilst on the march E. of Aymeries,* met the Chief Engineer I. Corps, Brig.-Gen. Rice, who told him that he might be called upon to blow up several bridges at Bachant, Pont sur Sambre, and Berlaimont, but left it to him to decide whether to complete his march or set to work at once. He chose the latter course, and called on the 5th Coy. for assistance, but on reporting his action to the B.G.G.S. I. Corps he was informed that it had been decided that the English were not to blow up the bridges. The C.E. also stopped the 5th Coy. just south of Pont sur Sambre, and told the O.C. to send officers to measure up certain bridges for demolition, but before the work had been begun Major North was informed that the French would undertake this task.

26th August.

On the 26th the main body of the I. Corps reached Etreux, but no orders appear to have been issued about destroying the bridges there, or at Oisy, until the following day.

The II. Corps fought the battle of le Cateau, but in view of further retirement Lt. Flint was sent with No. 3 section 59th Coy. to prepare the bridge over the canal St. Quentin at Jussy. This he did during the night 26th/27th, and subsequently (on the 28th) handed it over to the cavalry for demolition.

The importance of destroying this bridge was due to the fact that it lay in the gap between the two Corps.

27th August.

On the 28th the I. Corps crossed the Oise at Guise, and continued their march to Mont d'Origny, but uncertainty seems to have prevailed as to whether bridges were to be destroyed or left intact.

The 23rd and 26th Coys. prepared several bridges for demolition,

* Between Bachant and Berlaimont.

but none was actually destroyed. The bridge at Petit Cambrésis, on the Sambre canal, 1 mile N. of Oisy, was prepared by the 23rd Coy., and a footbridge constructed alongside for the use of the rear party, but at 3 p.m. orders came to withdraw the charges and leave the bridge standing. Arrangements had been made to destroy the permanent bridge over the canal at Oisy, also the temporary trestle bridge alongside erected by the 23rd Coy., but at the last moment urgent orders were sent by the 1st Div., the 1st Brigade, and the C.R.E. cancelling their destruction.

The O.C. 26th Coy. sent two sections to Etreux to prepare the bridges there over the Oise, and reported that there were five to be done. He was ordered not to destroy them, but to arrange to bring them under fire. No. 4 section went to Guise, and found there a French officer who had orders to destroy all the bridges over the Oise at that place, also Capt. Parker of the Welch Regt., who had orders from his brigadier (3rd Inf. Brigade) to allow no one to interfere with the bridges. The Company diary goes on to say, "Gave the French officer a letter stating that the English force assumed entire responsibility for the bridges over the Oise. On receipt of this he undertook to stop all work on the bridges by the French."

The II. Corps, who had broken off their fight on the afternoon of the previous day, and reached le Catelet during the night, continued their march to Ham. At 5 p.m. they issued orders for the bridges near Ham over the Somme canal, and over the river Somme, to be prepared for destruction by Divisions.

The 17th Coy. arrived at Ollezy just S. of the Somme at 6.30 p.m., and 2nd-Lt. Godsell was sent with No. 2 section to prepare the bridge over the Somme, ¾ mile N. of the village, also another bridge farther west which could not be found. The road bridge at St. Simon had been prepared on the 25th by Major Howard, 57th Coy., but he had been ordered by the G.O.C. 5th Div. to hand over "his firing apparatus" to the R.E. of that Division. He left his tool cart, and started off alone to rejoin his company, which had marched on. Lt. Smyth, with No. 1 section, 17th Coy., took over charge of this bridge, and had been told not to destroy it without orders from Div. H.Q. He found another bridge in the vicinity, not connected with any road, which he decided to blow up, informing his Div. H.Q. accordingly, but as it was a strongly built bridge with five girders, he took on three with his first charge, and demolished the remaining two with a second. Divisional H.Q. at Ollezy, hearing a second explosion, thought that the bridge at St. Simon had been blown up prematurely, leaving the cavalry on the wrong side, and rushed out on horse and bicycle and on foot to remedy the supposed disaster, only to find Lt. Smyth quietly supping with a local inhabitant. Lts. Godsell and Smyth watched by their bridges throughout the night, but withdrew through the outposts at dawn, leaving their charges

labelled for the cavalry to deal with. There is no record of these bridges having been destroyed.*

28th August.

On the 28th the I. Corps, marching chiefly east of the Oise, reached St. Gobain, and remained there throughout the 29th.

In the 2nd Div. the O.C. 11th Coy. was told by the C.R.E. to reconnoitre the bridges over the Oise at Beautor (one) and at Condren (two) for demolition: the calculations were made by Lt. Martin, checked by Capt. Skipwith, and forwarded to the C.R.E.

In accordance with II. Corps' order of 5 p.m. the previous day, the bridges at Ham were reconnoitred by the C.R.E. 3rd Div., accompanied by Capt. Henderson and Lt. Boulnois, at daybreak on the 28th, and the 57th Coy. was sent there. Capt. Henderson had no trouble with the bridge allotted to him, but Lt. Boulnois met with a difficulty at his. This passed over a lock, and consisted of three main girders connected by longitudinal brick arches resting on the lower flanges, so that there was no simple way of attaching the charges. Luckily he discovered a barge lying in the canal near by, and used it as a platform for his men to stand on under the bridge. His preparations had been completed when our cavalry retired across the bridge, and announced that the pursuit had slackened. The C.R.E. wishing to save explosives, which were running short, reported the matter to the G.O.C., who left the destruction of the bridge to his discretion. Lt. Boulnois was finally ordered to withdraw his charges and leave the bridge, which was as well, as shortly afterwards a French cavalry brigade was met advancing to cross it.

The II. Corps reached the vicinity of Noyon in the evening, and the interval between the two Corps, which had existed since the 25th, was at last closed.

29th August.

The I. Corps remained stationary on the 29th, but in the 2nd Div. orders were sent to the C.R.E. to proceed with the demolition of the bridges at Beautor and Condren, infantry covering parties being provided. The C.R.E. allotted Beautor to the 11th Coy., and Lt. Martin with No. 2 section had it ready at 4.15 p.m. The order for its destruction was given by the G.O.C. 4th Guards Brigade early on the 30th. (App. C.)

Condren was allotted to the 5th Coy. and the O.C. sent 2nd-Lt. Renny-Tailyour with No. 4 section to prepare the two bridges there. (App. D.) At the same time he received a copy of an order making the 5th Cav. Brig. responsible for the destruction of the bridges at Chauny, so he sent to ask the 5th Field Troop whether any assistance

* The Field Squadron marched through Ham, and never went near Ollezy or St. Simon.

was required, but this message must have gone astray, as he received no reply.

It was actually the 4th Field Troop which was concerned with the bridges at Chauny. At about noon on the 29th this troop was near Pierremande, 3 miles S. of Chauny, when orders were received to prepare the bridges at Chauny for demolition. On arriving there it was found that some French sappers* were preparing to destroy the bridge carrying the broad-gauge railway over the canal E. of the village, so Capt. Chenevix-Trench decided to take on the metre-gauge railway bridge half a mile farther east, and the road bridge over the river and canal (70-ft. span) south of the village. It took very little time to prepare these bridges for demolition, and a corporal was left in charge of the metre-gauge railway bridge, with orders to blow it up when he heard the explosions at the bridges west of him, or earlier if the situation rendered it necessary. The French blew up their bridge at about 3 a.m. on the 30th, but only slightly damaged it. The corporal at once set off his charge, cutting one end of the bowstring girder and dropping it into the canal.

Meanwhile Capt. Chenevix-Trench and Lieut. Swinburne stood by the prepared road bridge awaiting orders, which "came at fairly frequent intervals, and were often contradictory." At one time a Brigade Major of Cavalry, going north in a car, stopped to ask when the bridge was to be destroyed, and on being told that in accordance with the latest order it was to go up in half an hour's time, he begged for some postponement as his brigade was still north of the river. Fortunately another order came to say that the bridge was not to be destroyed yet.

That night, or early next morning, the 4th Field Troop was ordered to move south, which it did, leaving Lieut. Swinburne with two or three men, all with bicycles, to destroy the bridge when ordered, or, in default of orders, when he should think right. On the 30th, when the Troop had marched 10 or 15 miles, Lieut. Swinburne rejoined, bringing with him his exploder and leads, also a written order directing him to remove his charges, throw them into the river, and rejoin his unit.

The O.C. 5th Field Company, having received no reply to his message addressed to the 5th Field Troop, was evidently uneasy in his mind as to whether the cavalry could deal with the bridges at Chauny without assistance. His diary records that at 8.30 p.m. he proceeded to Chauny, so that it must have been nearly dark when he got there, and he must have found Lieut. Swinburne on the road bridge waiting for orders. It would appear that he did not learn what had been done on the two railway bridges over the canal, as he formed the opinion that in addition to the road bridge prepared

* Presumably Railway Engineers, as they were interested in the broad-gauge railway bridge only.

by the 5th Field Troop (he still thought that it was the 5th) four others would have to be destroyed to make an effective obstacle. When he reached the bivouac of his company at Amigny,* he reported the state of affairs to his Group Commander, the G.O.C. 6th Inf. Brig., and was told to send back and prepare these bridges for demolition. Nos. 1 and 2 sections were sent off accordingly, but they received a series of orders and counter orders, and the final order came so late that they were only partially successful in destroying the two railway bridges S.E. of Chauny, where the work had to be done piecemeal as no exploder was available. It was noted by the O.C. Coy. in his diary that the road bridges over the canal and river were not destroyed, and that as far as he knew the 5th Field Troop blew up no bridge there. This was correct except as regards the metre-gauge railway bridge over the canal.

Twice during the night 29th/30th the O.C. 5th Coy. at Amigny received orders to blow up the bridges at Condren, twice they were cancelled. At 5 a.m. on the 30th another order came, and was quickly transmitted to Condren, where the larger of the two bridges was immediately blown up. The smaller had been destroyed at 3 a.m. on a previous order, as the counter order had arrived too late.

[NOTE.—The remainder of Major-General Sir Reginald Buckland's article on the 1914 demolitions will appear in the June issue of *The R.E. Journal*. He is now engaged on a similar compilation concerning the demolitions by the Fifth Army in March, 1918, and would welcome accounts of any personal experiences connected with this period. His address is:—66, Elsworthy Road, London, N.W.3.]

APPENDICES.—PART I.

A. Nominal Roll of Officers by Units.
B. Bridges on the Condé Canal.
C. Beautor.
D. Condren.

The sketches are not to scale, but dimensions are given where available.

APPENDIX A.

ROLL OF R.E. OFFICERS AND UNITS.

G.H.Q. Engineer Adviser—Brig.-Gen. G. H. Fowke.
G.H.Q. Liaison Officer for Railways—Capt. S. F. Newcombe.
I. Corps, Colonel R.E.—Brig.-Gen. S. R. Rice, C.B.
II. Corps, Colonel R.E.—Brig.-Gen. A. E. Sandbach, C.B., D.S.O.†
III. Corps, Colonel R.E.—Brig.-Gen. F. M. Glubb, C.B., D.S.O.

* Two miles S.E. of Chauny, not marked on the map.
† During the early days detached in command at a Base Port.

CAVALRY DIVISION.

1st Field Squadron—Major E. S. Sandys.

Capt. P. O. L. Jordan.
Capt. L. Chenevix-Trench.
Lieut. T. A. S. Swinburne.
Lieut. G. E. H. Sim.
Lieut. T. H. Foster.
Lieut. R. R. Egerton.
Lieut. R. G. W. H. Stone.
Lieut. K. MacL. Carnduff.

1ST DIVISION.

C.R.E.—Lt.-Col. A. L. Schreiber, D.S.O.
Adjutant—Capt. L. C. Jackson.

23rd Field Coy.
Major C. Russell-Brown.
Capt. G. H. Addison.
Lieut. R. L. Bond.
Lieut. J. H. Stafford.
Lieut. J. W. D. Mallins.
2nd-Lieut. A. J. Parkes (S.R.).

26th Field Coy.
Maj. H. L. Pritchard, D.S.O.
Capt. N. W. Webber.
Lieut. E. E. Calthrop.
Lieut. A. G. Smith.
2nd-Lieut. M. R. Wingate.
2nd-Lieut. J. D. Manley (S.R.).

2ND DIVISION.

C.R.E.—Lt.-Col. R. H. H. Boys, D.S.O.
Adjutant—Capt. A. J. Darlington.

5th Field Coy.
Major C. N. North.
Capt. J. K. Dawson-Scott.
Lieut. Æ. F. Q. Perkins.
Lieut. A. E. J. Collins.
Lieut. G. C. Gowlland.
2nd-Lieut. H. F. T. Renny-Tailyour.

11th Field Coy.
Major P. T. Denis de Vitre.
Capt. J. W. Skipwith.
Lieut. K. J. Martin.
Lieut. A. Tyler.
2nd-Lieut. G. L. Miller.
2nd-Lieut. R. D. Morris (S.R.).

3RD DIVISION.

C.R.E.—Lt.-Col. C. S. Wilson.
Adjutant—Capt. T. Wright.

56th Field Coy.
Major N. J. Hopkins.
Capt. J. J. H. Nation.
Lieut. C. G. Moores.
Lieut. J. A. Leventhorpe.
Lieut. C. G. Martin.
2nd-Lieut. H. W. Holt (S.R.).

57th Field Coy.
Major F. G. Howard, M.V.O.
Capt. H. M. Henderson.
Lieut. P. K. Boulnois.
Lieut. A. F. Day.
2nd-Lieut. C. L. Y. Parker.
2nd-Lieut. R. C. Wells (S.R.).

4TH DIVISION.

C.R.E.—Lt.-Col. H. B. Jones.
Adjutant—Capt. W. G. S. Dobbie.

7th Field Coy.
Major S. G. Faber.
Capt. V. P. Smith.
Lieut. R. G. Wright.
Lieut. K. I. Gourlay.
Lieut. G. N. Macready.
Lieut. W. D. Stavert (S.R.).

9th Field Coy.
Major J. B. Barstow.
Capt. G. F. Evans.
Capt. F. C. Westland.
Lieut. C. E. Fishbourne (S.R.).
Lieut. G. le Q. Martel.
Lieut. B. K. Young.

5TH DIVISION.

C.R.E.—Lt.-Col. J. A. S. Tulloch.
Adjutant—Capt. J. R. White.

17th Field Coy.
Major C. W. Singer.
Capt. E. F. W. Lees.
Lieut. G. B. F. Smyth.
Lieut. C. E. R. Pottinger.
Lieut. H. W. Porter (S.R.).
2nd-Lieut. K. B. Godsell.

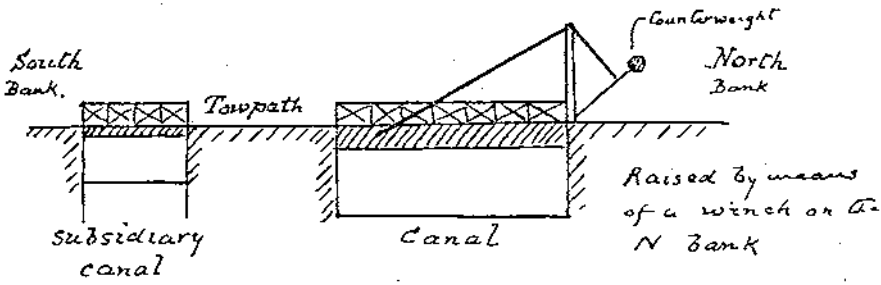
59th Field Coy.
Major G. Walker.
Capt. W. H. Johnston.
Lieut. J. A. C. Pennycuick.
Lieut. R. B. Flint.
2nd-Lieut. A. C. H. Carr.
2nd-Lt. C. Y. Stevenson (S.R.).

APPENDIX B.

MONS.

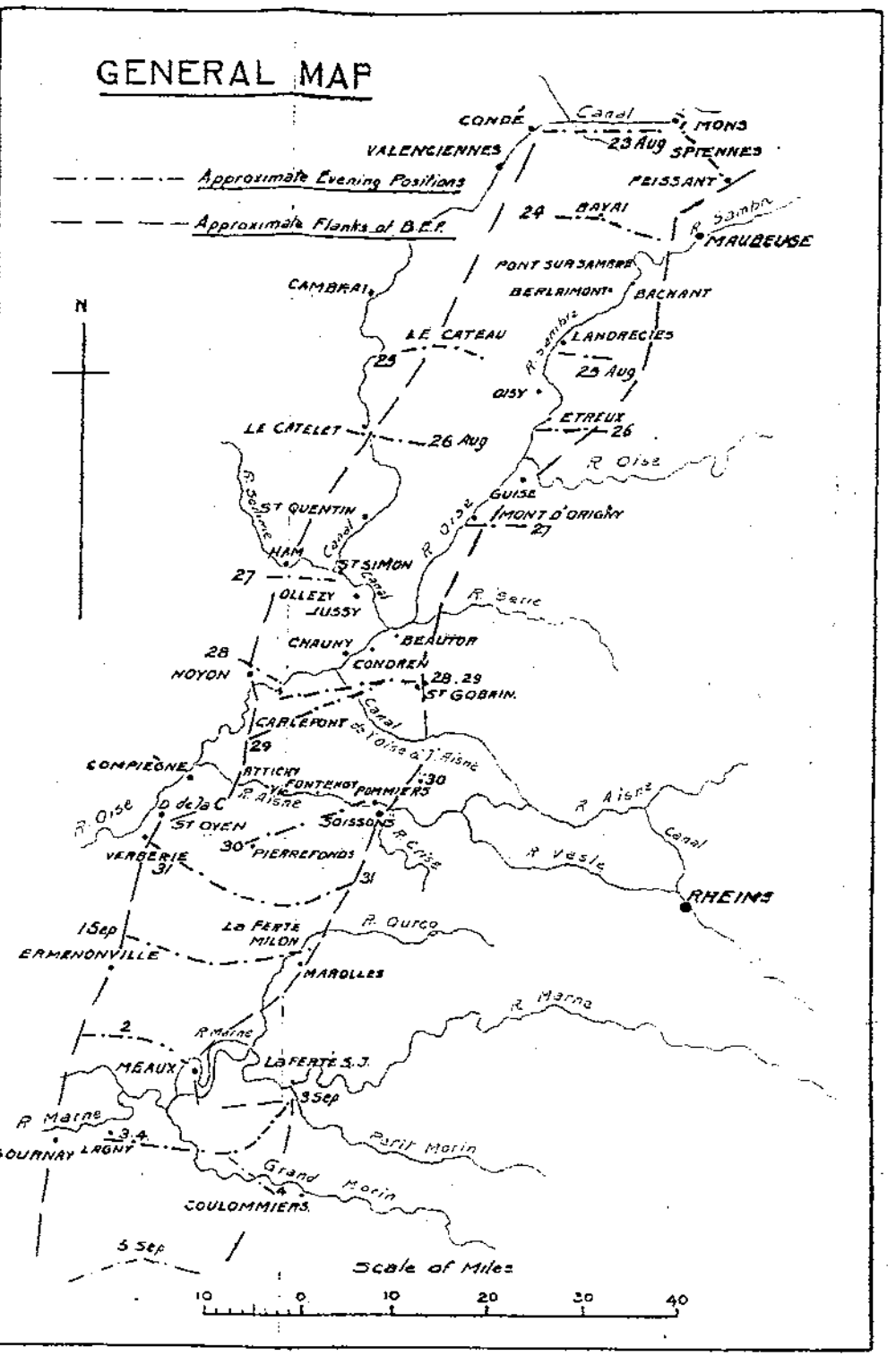
(Sketch B.)

(*a*) Typical drop bridge on the Condé Canal.



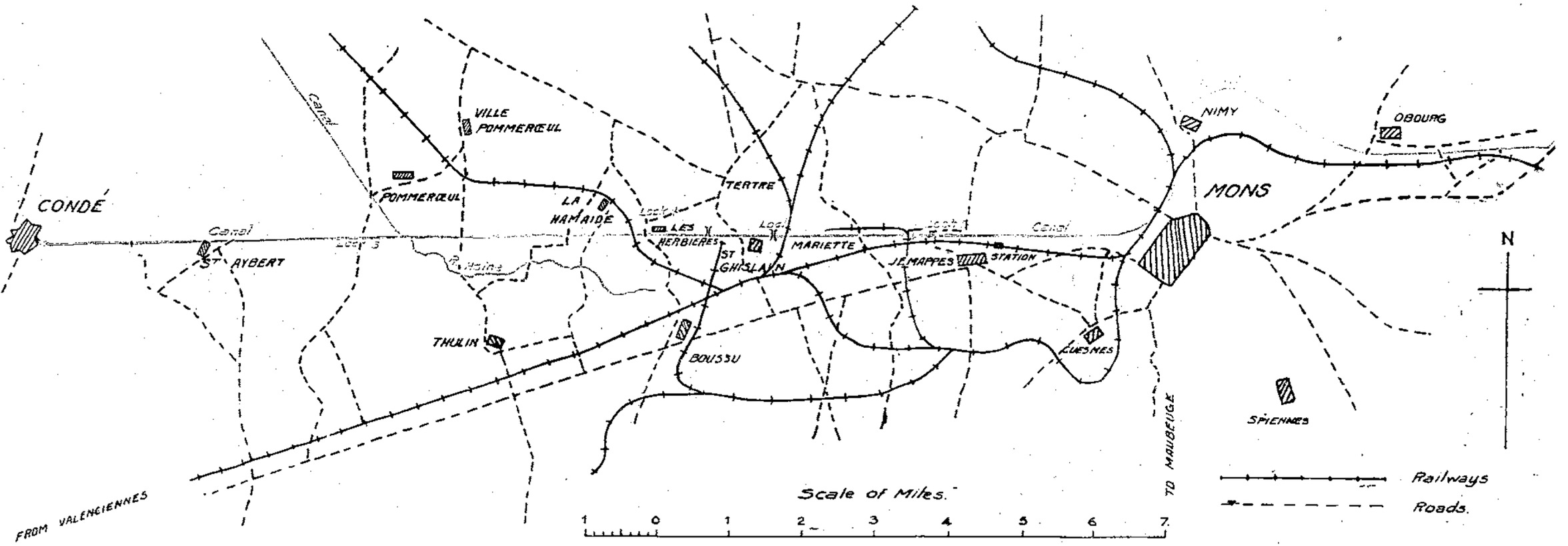
A subsidiary canal ran from Mons to Condé along the south side of the towpath of this canal. These drop bridges were hinged at their northern abutments, furnished with counter-weights, and raised by means of a winch on the northern bank. They usually consisted of two I-section girders, with cross members.

In some parts the towpath was above the level of the surrounding country.

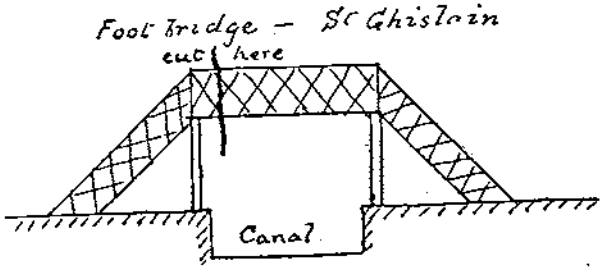

GENERAL MAP
Approximate Evening Positions
Approximate Flanks of B.E.F.
N
CONDÉ
Canal
MONS
VALENCIENNES
23 Aug
SPIENNES
FEISSANT
24
BAVAI
R Sambre
MAUBEUSE
PONT SUR SAMBRE
CAMBRAI
BERLAIMONT
BACHANT
LE CATEAU
LANDRECIES
25
R Selle
25 Aug
OISY
ETREUX
LE CATELET
26 Aug
26
R Oise
R Somme
ST QUENTIN
GUISE
R Oise
MONT D'ORIGNY
27
HAM
Canal
ST SIMON
27
OLLEZY
JUSSY
Canal
R Serre
28
CHAUNY
BEAUTOR
NOYON
CONDREN
28.29
ST GOBAIN
Canal de l'Oise à l'Aisne
CARLEPONT
29
COMPIEGNE
ATTICHY
FONTENOY
POMMIERS
30
R Aisne
R Oise
Dde la C
ST OYEN
SOISSONS
R Aisne
R Vesle
Canal
VERBERIE
30
PIERREFONDS
R Crise
31
31
RHEIMS
15 Sep
La FERTE MILON
R Ourcq
ERMENONVILLE
MAROLLES
R Marne
2
R Marne
MEAUX
LA FERTE S.J.
3 Sep
R Marne
3.4
LAGNY
OURNAY
Petit Morin
Grand Morin
COULOMMIERS
5 Sep
Scale of Miles
10 0 10 20 30 40

DEMOLITIONS AT MONS, 1914.

MONS.



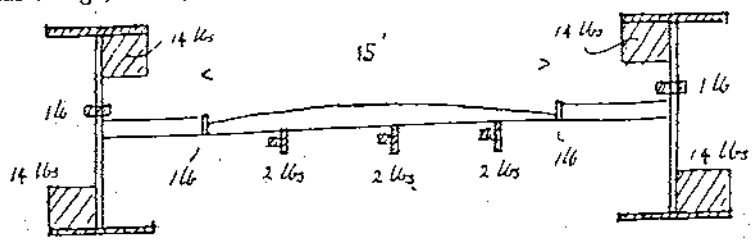
(*b*) Footbridge at St. Ghislain (Sketch B (1)).



(no dimensions given

APPENDIX C.

Bridge over the Oise (or the Canal de l'Oise à la Sambre) at Beautor. Lattice girders, span 30 ft., attacked at centre.
Total charge, 66 lb., fired in series. Demolition complete. (Sketch C).



N.B Cross member appears to have been omitted

APPENDIX D.

Bridges over the Oise at Condren.

(*a*) Private bridge east of the road bridge. Width of roadway 14 ft. Lattice girder, through span 50 ft., depth 6 ft., width of top and bottom flanges 10 in.

Charge, 32 lb., fired electrically; result satisfactory.

(*b*) Road bridge, width 25 ft., lattice girder, through span 100 ft., carrying one pair of rails, depth of girders 8 ft., width of top and bottom flanges 14 in. Charge, 48 lb., fired electrically. Result: girders cut, but rails held up, and had to be severed by another charge of 6 lb.

(To be continued.)

GRAVITY SURVEY.

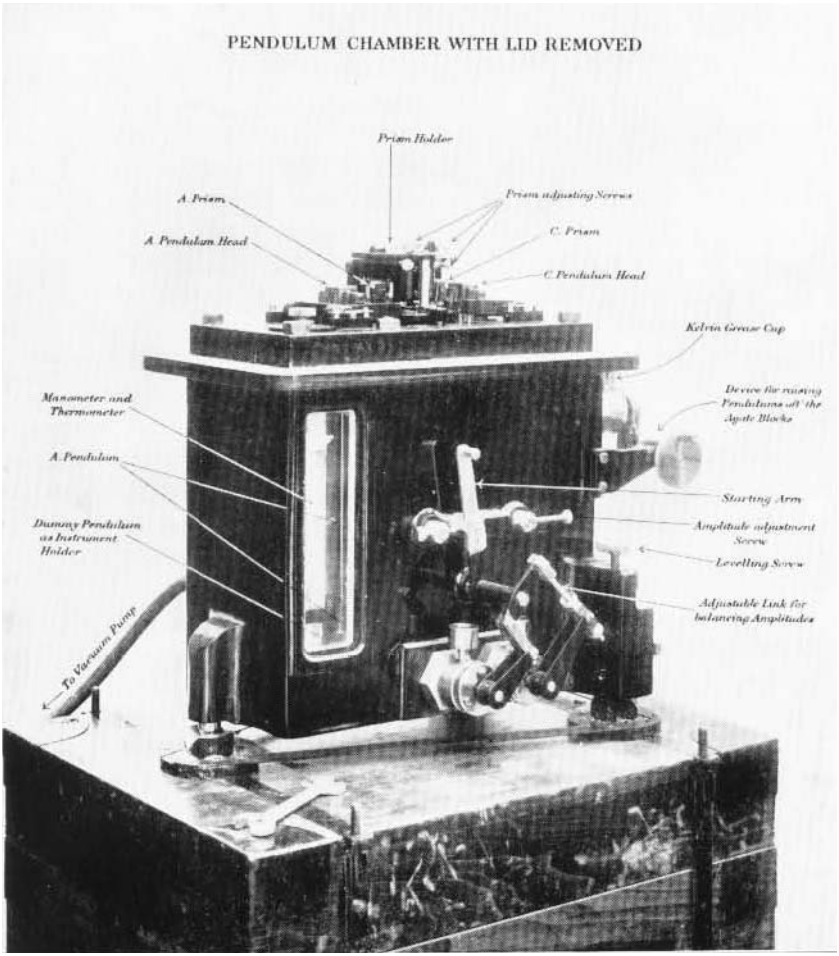
By CAPTAIN J. C. T. WILLIS, R.E.

MANY of us were brought up to believe that the Intensity of Gravity "g" (it has been described as "the speed with which one can drop a brick") is a constant amount and is equal to an acceleration of 32·2 ft. per sec. Many of us do not realize that it varies in intensity all over the face of the earth. This variation is due to three factors, viz., the latitude which obviously governs the intensity of the centrifugal force acting on objects on the earth's surface, the height which is a measure of the distance of a point away from the centre of gravity of the earth, and the density of the earth at the point concerned. Of these, the first two are readily to be determined, while a very shrewd idea of the latter can be obtained from geological surveys. We are, therefore, in a position to compute what gravity ought to be. With the apparatus shortly to be described we are also able to measure it with some accuracy. The difference between the observed and computed values constitutes an anomaly. The reasons for such anomalies are the subject of much scientific research and some controversy leading us to such subjects as Isostasy, the Compensation of the Earth's Crust, Tectonic Lines on the Earth's Surface, and kindred matters.

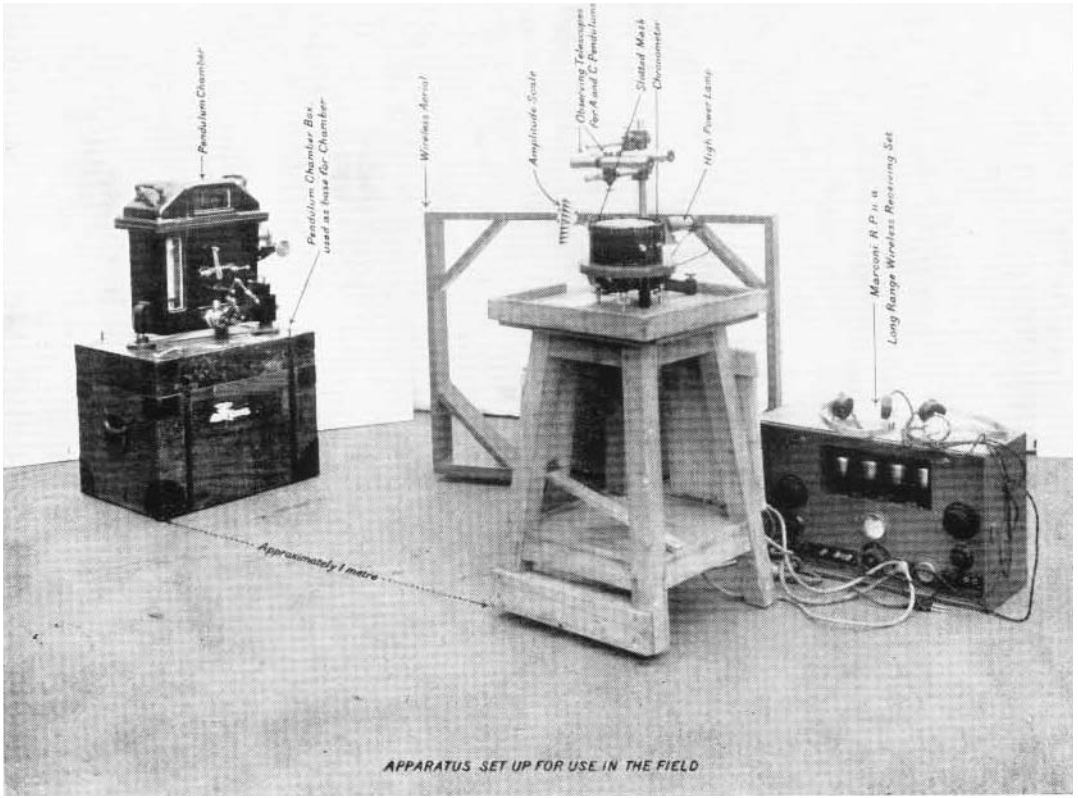
The object of this article is not, however, to discuss the theory of gravity, but rather to describe the apparatus in use and to give a short outline of work that has been done in Great Britain in recent years.

The whole system of gravity determination is based on the fact that the period of swing of a pendulum varies with the force of gravity. If, therefore, pendulums are swung at a base station at which gravity is known, and are then transported elsewhere and swung under identical conditions at a second station, the difference in the time of swing will give a relative measure of the force of gravity at the second point.

The apparatus consists of a pendulum chamber (see Photo 1) some two feet in height made of an aluminium alloy in which can be hung two pendulums. This chamber is capable of very accurate levelment, and has a lid, the whole being capable of supporting a vacuum. Outside the chamber are fitted, firstly a lever for giving the initial impulse to the pendulums. This lever transmits its motion through an adjustable link,



Gravity survey photo 1



Gravity survey photo 2

by means of which exactly equal and opposite amplitudes may be given to each pendulum. Secondly, a window in the lid, through which the observations are conducted, and thirdly, another window in order that the barometer and manometer may be read. These two instruments are fixed into a dummy pendulum so as to reproduce as nearly as possible the exact conditions inside the pendulums themselves. In addition there is a small wheel which enables the pendulums to be raised from their supports when not in use. Beneath the pendulums are two small hair-brushes which are used to bring the pendulums to rest. They are brought into action by a further movement of the starting lever. The pendulums themselves are made of Invar ; they rest in the chamber on agate supports, the weight of each pendulum being taken by a stellite knife edge incorporated in its head. In the head of the pendulum also there is a highly polished reflecting surface, whose purpose as regards reading the timing of the swings will be made clear later. Each pendulum is very carefully polished and has a period of a complete double swing of something just over one second of time. The oscillation represents about two degrees away from the vertical on each side.

In order to obtain the value of gravity at any station correct to three figures of decimals, in C.G.S. units, it is necessary that the time of oscillation of the pendulum should be read to seven figures of decimals of a second. This extreme accuracy is obtained by observing coincidences between true seconds of time and the swing of the pendulum. The period of this swing, as stated above, is slightly greater than one second, and thus permits of a " time vernier " being established between true seconds and pendulum swing.

The detail of the method at present utilized is this. A strong flash of light is produced from the observer's table at intervals of exactly one second. This beam passes into a prism apparatus situated between the pendulum heads, and is deflected by the prism on to the highly polished surface in each pendulum head. It is reflected back from this into the same prism and thence into a telescope situated on the observer's table. Now, it is clear that the position of the pendulum head will be at a constantly differing angle every second, as it has a constantly " losing rate " as compared with the seconds themselves. This means that each flash is deflected at a different angle and so appears in progressively different parts of the field of view of the telescope—in fact, it disappears at intervals from the field of view entirely. The effect from the observer's end, then, is to see a series of flashes at true second intervals proceeding across the field of view of the telescope, disappearing from sight and then coming back again in the opposite direction. The initial adjustment of the apparatus is such that when the pendulum is at rest and hanging truly vertical, the flash occurs exactly on the horizontal

cross wire of the telescope. If, therefore, observations are made to determine the exact instant of time that each flash passes once again the horizontal wire of the telescope, we can, by measuring the time distances apart of these occasions, obtain the true coincidence period between seconds of time and verticality of the pendulum. From this by a very simple formula $\left(s=\frac{c}{2c-1}\right)$ follows to the exact time of swing of the pendulum. Now it is manifestly impossible to obtain an accurate result except from the mean of a prolonged series of coincidences. The following system is, therefore, adopted. A group of coincidences at the beginning of the swing is observed, and some hours later a further group at the end of the swing. A rough value of coincidence period can be extracted from the first or the last group, and by obtaining the time which has elapsed between the two groups and dividing it by this approximate period, we obtain a whole number which represents the true number of coincidences which have elapsed between the opening and closing observations. Of course, all the time one is confronted by the problem that the pendulums whose rate is to be measured are far more accurate timekeepers than any known clock or chronometer, with the possible exception of the main timekeepers at the Observatories, which are, of course, impossible to take into the field. We are, therefore, compelled to attempt to measure the time of swing of these pendulums, with a chronometer which relatively speaking is extremely inaccurate. The only link we have between the field chronometer and the observatory timekeepers is the rhythmic signals transmitted by Rugby, Bordeaux, Nauen, etc. These signals, however, only occur at intervals of some 6 or 8 hours. Tied as one is at present to a chronometer when in the field, it is essential that each swing should be of exactly the same length as the interval between two such rhythmic signals in order that the chronometer may be rated from the signals both at the beginning and at the end of the swing. If the reading of the coincidences of the pendulum can be made exactly simultaneously with the rating of the chronometer by the rhythmic time signals, both at the beginning and at the end of the swing, it follows that the pendulums themselves are the timekeepers, and that the only function of the chronometer is to keep tally of the number of coincidences which elapse in the observer's absence. This is, in a way, about all it is fit for, as a chronometer with a variation in its daily rate of perhaps ·5 sec. is not of much value to an observer who is measuring a pendulum swing to one millionth of a second.

In some future Utopia it may be possible to have the ticks of the Shortt clock at Greenwich transmitted by wireless throughout the whole 24 hours, but until that comes, field observations with the present apparatus must be carried on by means of the chronometer, with each swing period gripped fast at either end by the rhythmic

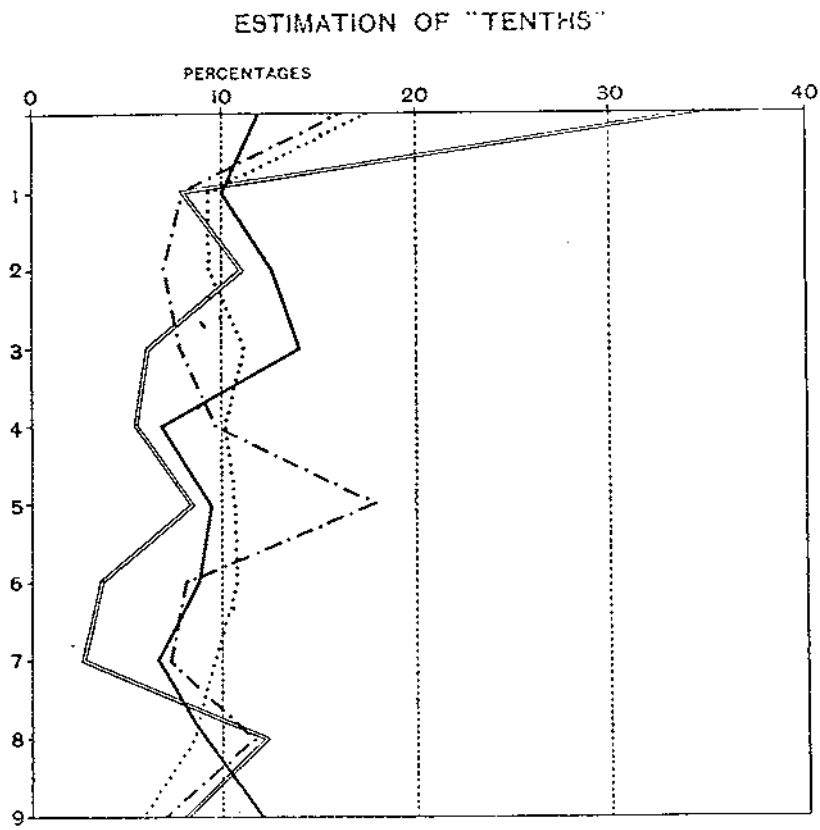
time signals. Without the necessity of being tied to these rhythmic signals the apparatus itself is quite capable of determining the force of gravity in two or three hours, but since the rhythmic signals are eight hours apart, one is limited to one swing per day. Including setting up the apparatus, four days at a station are needed before one can obtain the requisite three swings. This is a tedious and unnecessary performance, but without it as things are at present one could not hope to obtain anything approaching concordant results in a series of swings even with the finest chronometer in the world.

Originally the chronometer was used in an electric circuit to operate a flash box which gave the required beams of light each second. This instrument was somewhat temperamental in its behaviour, at any rate when connected up with the chronometer. It used to make odd noises, occasionally it struck work altogether, and never gave that confidence which one would like to feel. The flash box itself was an unnecessary link in the system of making the chronometer produce a flash every second. Consequently various alterations were carried out to the chronometer itself with a view to dispensing with the flash box. A small mirror was fitted on to a light spring which was flicked by the escapement wheel of the chronometer at each second. A strong light from some external source was thrown on to this mirror, and each flick caused the reflected beam to jump across a small slit in the outer casing of the chronometer. The result produced a very satisfactory method of observation, the method being still in use for all "field" stations. The chronometer was one of Messrs. Mercers' standard productions, and was partially taken to pieces by very unskilful hands on several occasions, being also much altered and cut about by Messrs. Mercers themselves. In spite of not only having a mirror added but also having one second mirror inadvertently dropped into the inner works, whence it was never subsequently retrieved, it still continued to function with the required accuracy, and was in use throughout the Hebrides campaign in the early summer of this year.

The actual observation, though needing a little practice, is in effect quite simple. Each flash seen by the observer in the telescope represents an exact second. When two consecutive flashes straddle the horizontal line, estimation is made by the observer as to the exact decimal of a second at which the transit took place. The time of each transit is then booked in seconds and decimals of a second. Individual tendencies of different observers are interesting to study, though of no great importance as regards the accuracy of the results. Figure 1 represents a diagram showing estimations to a tenth of a second, being the mean of many observations by four different men. These graphs show how some observers in estimating tenths have some very marked likes and dislikes. It will be noticed that many are extremely fond of ·5 and that all are more fond than they ought

to be of the exact whole number. In this particular case this is of purely academic interest, though in some classes of observing, when errors are cumulative, it might be very advantageous to have some idea of a man's "personal equation." This, however, is by the way, for in practice the number of coincidences observed is such that minor inaccuracies in the estimate of one-tenth of a second have no effect on the determination of the time of swing.

In addition to the actual observing there is the rating of the



chronometer by means of rhythmic signals. This, of course, is perfectly straightforward, the ideal being that two observers are available, one observing the coincidences simultaneously with the other reading the chronometer. Where this is not possible a group of coincidences is taken immediately before the time signal and a similar group taken immediately after, the same procedure being adopted at the closing end of the swing. So much for the detail of the apparatus.

To return, however, to the actual observations, it is clear that with the apparatus as it is at present, there is an immense amount of

rather finicky adjustment to be competed with before one can sit down and commence observing.

The first procedure of setting up in the field is to mount the pendulum chamber on its travelling box (Photo 2). A concrete pillar is, of course, the ideal, but in most places this is not practicable, and the box is at present the only alternative. It has been shown that there is a very considerable " sway " in this box, and when tested with a single pendulum, it was found that this amounted to something of the order of 200 units in the seventh place of decimals of the time of swing. The whole object, of course, of having two pendulums swinging in opposite phase is to eliminate this sway; but the fact that the box itself is by no means the perfect form of support makes it absolutely essential that the amplitudes should be exactly equal and that no " resultant " can exist.

In any future design of apparatus it is suggested that the prism attachment and the lid should be so modelled that the chamber can rest on the ground and observations can still be conducted from a table of convenient height. At present to place the chamber on the ground would be to require the observer to " assume the prone position," as the *Manual of Infantry Training* delicately has it. The greater part of the observer's skill is required, not for the observations themselves, but in setting up and adjusting the apparatus. Most of the observing gear is in an experimental stage, and some of the minor details are of a somewhat " Heath Robinson " nature. In fact, it is unlikely that any other piece of scientific apparatus is so largely dependent on the adhesive qualities of plasticene. First, the pendulum chamber is levelled and the pendulums themselves inserted. This in itself requires a steady hand, for the pendulums, costing some £70 odd, must not be touched by the human hand and must not be bumped or jarred in any way. After that the chronometer is adjusted so that the light flashes on to the mirror, the mirror is adjusted so that the flash is reflected through the slit. The prisms are then adjusted so that the flash falls on them fairly and squarely, and is returned by reflection to the observer's telescope, and finally the telescope is adjusted so that the flash falls true on the horizontal wire when the pendulums are at rest. When all this has been done the work can commence!

All this finicky adjustment is particularly trying to the temper, and most of it could be avoided if one had the time and money to produce the ideal apparatus, ideal from the observer's point of view, at any rate, though perhaps the man who is asked to design it will have other views! The best way of thinking out an ideal is to have a thorough grouse about each separate item as it is, and then see how it can be improved. The grouses are as follows:—

Firstly, it takes eight hours to complete a swing, and hence three days to complete a minimum set. Four days, including setting up

and taking the apparatus down. Add movement from place to place and week-ends, and the speed of observation is something rather like one station per week.

Secondly, with rhythmic signals as they now are, one is tied to the chronometer, a relatively inaccurate instrument. To give it as little scope as possible, it is best to observe the pendulums and take in the time signals simultaneously. This means two observers and rather a "crowd" just at the time that the observer requires his maximum concentration.

Thirdly, that for transport purposes the whole outfit has to be taken to pieces—with complete loss of adjustment—and re-set up at every station, with loss of time and loss of temper at each station.

And now for the ideal apparatus. This must dispense with a chronometer and there are two ways of doing so. The first, accepting the rhythmic signals as they are, enables a coincidence period to be set up between the wireless dots (as opposed to chronometer seconds) and the swing of the pendulums and has already been achieved by Mr. E. C. Bullard, of the Cambridge School of Geodesy, whose device for photographing beams of light reflected from the pendulum head against a beam produced by vibration of a mirror attached to a loudspeaker unit receiving the rhythmic signals, worked admirably in Southampton and Paris, and when finally completed, will be a most satisfactory piece of designing. But by this method one is still tied to the rhythmic time signals, and hence to eight-hour swings. The ideal of having the Greenwich clock transmitting seconds throughout the whole twenty-four hours seems to involve so many difficulties that one must look elsewhere for a solution.

Hence the second method, which consists in the production of a set of pendulums, in all respects, save that of period, similar to the field set, swinging at the base station, and their swing period transmitted on their own wave length as a wireless impulse to stations in the field. The production of this piece of apparatus is, I believe, already in hand at Cambridge, and when finally completed will solve the time measurement problem by enabling the field pendulums to be compared directly against the standard pendulums and thereby enable the chronometer, clock and rhythmic signal to be dispensed with altogether. This system is already in use by Professor Nörlund in Copenhagen, and is giving satisfactory results.

So much for the "time" problem in its ideal state. The observation method itself can now be considered. There is no doubt that photographic recording is the ideal, and that everything in connection with it should be so simple as to be capable of being managed by the ordinary R.E. N.C.O. If this is to be so, the endless finicking adjustments must be done away with. It should be possible to produce a pendulum chamber with a more or less permanent vacuum. The pendulums to be capable of being clamped within that vacuum for

transport: a photographic drum and dark box for receiving the beams of light on sensitized paper to be fixed permanently and rigidly to the chamber, the prisms and lights to be fixed in constant adjustment and the whole apparatus encased in one frame.

Shortly one should be able to see a light lorry moving over the country, stopping at any village garage: the driver and his assistant lowering one large frame to the floor, levelling the whole concern, connecting up the lorry headlights to connections on the box to provide the beam illumination, operating a couple of switches, and setting the pendulums swinging: returning a few hours later, reversing the procedure and disappearing in a cloud of dust with "g" determined at Little Plumpton with much less fuss than it takes a lesser man to change a wheel on a car; a delightful picture, though not an impossible one, by any means.

On the assumption that one has the power of observing five stations a week, the best method of utilizing that power should be considered. The first thing to undertake is quite obviously the gravity survey of Great Britain—lamentably behind other countries in this respect. And to undertake this the usual method of triangulation would require reversal. It would be necessary to cover the country to start with with a "secondary net" of gravity stations widespread in scope and of a second order of accuracy. The results of this will dictate where to look for anomalies; primary work, more accurate and more expensive, can follow in just those areas where it is reasonable to suspect that something of special interest may be found.

Having dealt with the methods of observation, it may be as well to give an outline of the work which has been undertaken during the past few years.

The base station for Great Britain is taken as the gravity station at the Greenwich Observatory, which is strongly tied to Potsdam, where absolute determinations have been made.

The first campaign in 1929, served to connect the pendulum house at Cambridge with Greenwich, and the National Physical Laboratory at Teddington. The second campaign in 1930 included Greenwich as the base station, Cambridge (in order to strengthen the connection between it and the base station), Oxford Observatory, Bembridge, Seven Oaks and Ashdown Forest. The last two stations were selected on the recommendation of the Geological Society, as it was anticipated that they would show some anomaly relative to each other, since the Ashdown Forest area has older rocks coming more nearly to the surface. The observations were subsequently closed at Greenwich. The third campaign in 1931, included Cambridge as the base station, Edinburgh Observatory, Leith Fort, where Captain Kater observed in 1818, and some twenty stations in the Hebrides and north of Scotland, closing again at Edinburgh

Observatory. The fourth campaign was designed to connect the Observatory at Greenwich with the National Observatory at Paris, including a main station at the Ordnance Survey, Southampton.

The connection was made, but on the return journey to close observations at Greenwich, the car carrying the instruments was damaged by collision, and the pendulums themselves thrown out of adjustment. It should be remembered that a difference in length of the pendulums of less than 1-200th of a millimetre is sufficient to render the observations absolutely valueless. As the entire system of relative measurement is based on the pendulums being swung at different stations under exactly similar conditions, and being finally checked at the closing station to ensure that no alterations in those conditions have taken place, the whole of these observations were vitiated. Though morally certain of the results, they cannot be published as scientific data.

The car which was responsible for the accident was a very old Morris Cowley two-seater, with badly adjusted brakes. The resultant loss of time and effort assessed in terms of money was not far short of £200. There is a lesson here for Y.O.s on survey tours!

The general result of these observations in Great Britain tends to show that no extreme anomalies exist, and that the force of gravity behaves very much as would normally be expected. The collection of scientific data, however, even if providing only negative information, is essential, and the steady improvement in the design of the apparatus, due to trials and errors, leads us to hope for fast and accurate determinations in the future in other parts of the Empire, where anomalies are known to exist, and where their investigation is of the greatest interest and importance.

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

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

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

PREFACE.

THE companies of the Royal Engineers all have a fine record of achievement behind them with which all serving in the Company should be acquainted in order that *esprit de corps* may be fostered and the fine traditions of the past upheld.

This history is mainly intended to be a record of the Company in the Great War but, in order to make it as far as possible complete and of use for those serving in the Company as well as of general interest to the Corps, a short account of the other campaigns in which the Company has been engaged is included.

It is inevitable, if only from considerations of space, that the perspective of time should be greatly in evidence. It is not that previous campaigns were of less interest at the time that the account of them is short. It is felt, however, that only the more important events are of special interest now to the majority. Moreover, accounts of previous campaigns have been written before and anyone wishing to obtain further details is referred to Conolly's *History of the Royal Sappers and Miners, the History of the Royal Engineers*, and the account of the Boer War in *The R.E. Journal* for December, 1903, all of which have been consulted in compiling this record.

The authority for the Great War is very largely the war diary, coupled with the writer's personal experience between 1915 and 1918, but the chief credit must be given to Lieut.-Colonel J. A. McQueen, D.S.O., M.C., R.E. (ret.), who originally wrote this part of the history and whose notes have been very largely used.

The history of the Great War is given in considerable detail because it has not before been written and because, for the first time, the Company served together as one unit, and was not split up into small detachments as was the case in the Boer War and previous campaigns.

It is much to be regretted that considerations of space preclude

mentioning sections individually to any great extent, although the section was the unit of the Company; and also that it is impossible to mention by name many of the N.C.O.s and men on whose gallantry and good work the reputation of the Company is founded.

H.A.B.,

Dover, 1931.

CHAPTER I.

EARLY HISTORY AND DIARY OF MOVES SINCE 1806.

THE origin of the companies of Royal Engineers is to be traced to the Military Company of Artificers raised at Gibraltar by Royal Warrant, dated March 6th, 1772. The name was almost immediately changed to the Soldier Artificer Company. The Corps of Royal Military Artificers was raised in England in 1787 and the Soldier Artificer companies at Gibraltar were absorbed into the Corps of R.M.A. in 1797. The Corps of Engineers, which goes back to the seventeenth century, was a Corps of Officers only and became the Corps of Royal Engineers in 1787.

The 7th Company was first so called in 1806 when the companies of artificers were first numbered, but the Company was probably raised in 1793 for the war in Flanders. The numbers were not, however, much used at this time—the companies being more usually known by the name of their stations.

In 1811 the Corps was reorganized into eight-company battalions and the Company history becomes obscure.

In 1812 the R.M.A. were altered to Royal Military Artificers and Sappers and Miners, and again in 1813 to the simpler title of Royal Sappers and Miners. The companies of Artificers and later of Sappers and Miners were officered by the Corps of (Royal) Engineers until 1856, when the officers and men were combined into one corps —the Corps of Royal Engineers.

1816 the Company was at Chatham.

In 1819 the Corps were reduced to 12 companies of 62 men each and the numbers are again traceable.

1816–1827. At Algiers, Portsmouth and Jersey, Barbados, Woolwich, Portsmouth. Barbados was a very unhealthy station in those days and there was much sickness.

1827–1831. In Canada employed on Rideau Canal.

1831. Disbanded in Canada and the 18th Company was renumbered the 7th on 1st February, 1832.

1832. Mottoes, "*Ubique*" and "*Quo fas et gloria ducunt*," granted to the Corps, together with the Royal Arms and the cannon.

1833–36. Halifax.

1836. Woolwich.

1842–48. Corfu.

1848–54. Woolwich, Chatham, Portsmouth.

1854. Embarked for Crimea (see account in Chapter II).

1856. Returned to Chatham.

1857–62. Halifax.

1862–69. Chatham, Dover, Chatham, Woolwich.

1869. St. Helena. Made the famous Jacob's Ladder up the cliff.

1876. To Cape Town.

1879. Zulu War (see Chapter II).

1880. To Chatham.

1881. To Natal to reinforce after Majuba, but too late, as peace was declared as soon as the Company arrived.

1882. To Aldershot.

1884. To South Africa. Bechuanaland Expedition (see Chapter II).

1885. To Chatham.

1885. May. Became 7th Field Company.

1899. July 15th. Embarked for South Africa (see Chapter II).

1902. September 28th. Disembarked in England. Stationed at Aldershot.

1906. Shorncliffe.

1914. August 22nd. To France. Great War (see Chapter III *et seq.*).

1919. Reduced to Cadre.

1920. Reformed at Chattenden and joined the Army of Occupation, Cologne.

1929. Returned with Army of Occupation and stationed at Colchester.

The "Black Horse."

The Company has for many years now been known as the "Black Horse" Company. The origin of this name is difficult to trace accurately, but it appears that, at least as far back as 1885, the Company was known by this name owing to the colour of its horses. Whether or not the name was copied from the 7th Dragoon Guards, who are known as the "Black Horse," it is difficult to say, but there seems no harm in preserving the old name which has stuck to the Company for so long.

CHAPTER II.

CAMPAIGNS PRIOR TO THE GREAT WAR.

THE WAR IN THE CRIMEA, 1854–56.

THE 7th Company landed in Gallipoli on April 8th, 1854, commanded by Captain C. J. Gibb, R.E., and were for some time employed on landing piers, log huts for hospitals, stables, etc., at the base port.

On December 7th the Company moved from Gallipoli to Sevastopol, its strength being 3 officers and 86 men. The Company brought 400 gabions and large numbers of sandbags which were very welcome at the siege, where revetting material had hitherto been very short, the sappers having to use stones for the purpose. In January, 1855, very severe frosts set in and this was most detrimental to the work as the troops brought to the trenches coffee, which for some unaccountable reason had been sent out unroasted, and other articles that required cooking. For this purpose they made use of brushwood from gabions and fascines and anything in the way of fuel that they could lay their hands on, even pick-helves becoming scarce. In fact the diary of the siege shows that the sappers had to labour under great difficulties, but nevertheless carried on with their customary zeal and cheerfulness.

At this time a section, or more accurately a squad, was termed a brigade and consisted of 1 N.C.O. and 8 men.

The doings of the Company in the siege are too varied and intricate to relate, but the sappers were mainly acting as overseers to infantry and Turkish labour, doing the actual skilled work of laying gabions, sandbags, etc., themselves.

The following awards were gained :—

*Victoria Cross**.—Corpl. William J. Lendrim for intrepidity—getting on top of a magazine and extinguishing sandbags which were burning and making good the breach under fire, April 11th, 1855.

For courage and praiseworthy example in superintending 150 French Chasseurs on February 14th, 1855, in building No. 9 Battery —left attack—and replacing the whole of the capsized gabions under a heavy fire. Was one of the four volunteers for destroying the farthest rifle pit on April 20th.

Medal for Distinguished Service in the Field.—Spr. William Bruce and Spr. Neil McInnes.

Lieut. Anderson and Lieut. Drake were mentioned in dispatches and strongly recommended for reward but without result.

* Corpl. Lendrim's Victoria Cross and medals are in the R.E. Museum. This was the first Cross gained by the rank and file of the Corps.

ZULU WAR, 1879.

The annexation of the Transvaal in 1878 lead to the disastrous war of 1879.

The 7th Company was in South Africa at the time, under the command of Major F. W. Nixon, R.E., who had with him Lieutenants F. H. MacDowel and J. Clarke. The Company appears to have been much split up at this time and it is difficult to trace the movements of the different detachments.

In the disastrous affair at Isandlwana, where 52 officers and 806 men lost their lives, Lieut. MacDowel was killed and also four sappers—the whole of the R.E. with this column. In this action 16 officers and 400 men out of 16 officers and 403 men of the 1st Bn. the 24th Regt. and the whole of the Company of the 2nd Bn. present were killed.

At Fort Kambula, Serjt. Wood and 10 sappers of the 7th Company were present.

At Ulundi, Serjt. Wood and 6 sappers fought in the square during the battle, Serjt. Wood being wounded. In this battle, which ended the war, some 1,900 white officers and men and 540 natives were attacked by 20,000 Zulus, of whom only about half got close enough to take part. It was, however, a fine example of British square fighting and the Company should feel proud to have taken a part in it.

BECHUANALAND EXPEDITION, 1884.

In this expedition, which was commanded by a famous sapper, Sir Charles Warren, the Company was mainly occupied in overcoming the difficulties met with on the march, of which water supply was the greatest.

The C.R.E. says, "Where water was found it was generally in pools in a river bed, which were fenced round and protected from being fouled by cattle. Generally, however, wells had to be sunk and in all cases means for raising water had to be provided." An improvised waterwheel was made by the Company from bully beef tins.

The Company, commanded by Capt. C. H. Bagot, with Lieutenants C. E. Haynes and C. E. Salvesen and 71 N.C.O.s and sappers, arrived in Cape Town in December, 1884, and pushed forward to Langford railhead. They then marched 312 miles to Mafeking, meeting with many difficulties which the sappers had to overcome. Thence, after camp-making at Mafeking they marched to Monopolole, 120 miles north.

The sappers, whilst at Mafeking, built a church for the Wesleyan mission. Of this Mackenzie writes: "I had not seen such brick-

laying in the country. I do not think many buildings for a long time to come will excel this church at Mafeking in the excellence of the workmanship of the R.E." Colonel Durnford (the C.R.E.) took special interest in this work and was pleased to be able to render such substantial help to the people whose protection and welfare had been one of the leading objects of the expedition.

The Company returned to Chatham in December, 1885.

THE SOUTH AFRICAN WAR, 1899 TO 1902.

14th July, 1899. The Company left the Curragh and embarked at Southampton on the 15th, with a strength of 6 officers, 180 N.C.O.s and men and 30 horses. Bt. Lieut.-Colonel W. F. H. S. Kincaid in command.

5th August; September to November. Arrived at Cape Town and was sent to Wynberg Camp and employed on accommodation. In September, when war appeared inevitable, the Company was split up to various stations on the Cape Colony frontier.

No. 1 Section left for Kimberley, under Lieut. McClintock.

No. 3 Section proceeded to Orange River Bridge.

No. 2 Section went to De Aar junction.

No. 1 Section was involved in the siege of Kimberley almost at once.

H.Q. and No. 3 Section undertook a variety of works amongst which were the conversion of a railway bridge over the Orange River (120 feet span) for transport and the demolition of a road bridge at Hope Town.

No. 2 Section was employed on the defences of De Aar junction, an important railhead and depot. Sappers Matty and Oldcorn received the D.C.M. for their presence of mind when the detached telegraph and observation post which they were working was surrounded and captured. The enemy made the mistake of demanding surrender before cutting the telegraph and the sappers were able to send warning to Colesberg, 18 miles away, and smash up the office before surrendering.

20th November. No. 2 Section rejoined the Company, which joined the 1st Division and took part in the advance to the Modder River.

28th November. The Company went forward with an infantry escort to attempt the repair of the Modder River bridge, but, being received with heavy gun and rifle fire, were obliged to lie out under fire for the rest of the day, losing 3 sappers wounded. On the following day the Company threw a pontoon bridge of 13 bays across the river and cut ramps down the steep banks on each side.

11th December. Accompanied an unsuccessful night attack on Magersfontein.

January, 1900. From December 12th to early in February, 1900, the Company was in Modder River camp, employed on a variety of duties.

February. Marched with the Highland Brigade to Koodoesberg drift, arriving on the 4th. They entrenched the summit of Koodoesberg hill and took part in the action on that day.

12th February. Transferred to the newly-formed 9th Division and accompanied it in the cross-country march to Bloemfontein.

18th/19th February. Battle of Paardeberg Drift. The Company was employed on strengthening the captured ground and in working a ferry.

20th/26th February. Employed making brushwood shelters, sinking wells, maintaining ferries and pushing forward with the trenches which were gradually approaching the Boer lines.

26th February. A party, under Col. Kincaid with Capt. F. R. F. Boileau and Lieutenants C. S. Wilson and H. Musgrave, took part in the capture of Cronje's Laager.

Capture of Cronje's Laager (Paardeberg).

This is one of the most famous exploits in the history of the Company and the following extract from Conan Doyle's *Great Boer War* gives a very good description :—

" The two brigades at either end of the Boer line had lost no chance of pushing on and now they had come within striking distance. On the night of February 26th (1900) it was determined that Smith-Dorrien's men should try their luck. The front trenches of the British were at that time 700 yards from the Boer lines. They were held by the Gordons and the Canadians, the latter being nearer the river. The orders were that the Canadians were to advance and the Gordons to support. . . . The Canadians advanced in the darkness of the early morning before the rise of the moon. . . . Nearest the river-bank were two companies who were followed by the 7th Field Company R.E., carrying picks and empty sandbags. The long line stole through the pitchy darkness knowing that, at any instant a blaze of fire, such as flamed before the Highlanders at Magersfontein, might crash out in front of them. A hundred, two, three, four, five hundred paces were taken. They knew that they must be close upon the trenches. If they could only creep silently enough they might spring upon the defenders unannounced. On and on they stole, step by step, praying for silence. Would the gentle shuffle of feet be heard by the men who lay within stone throw of them ? Their hopes had begun to rise when there broke upon the silence of the night a resonant metallic rattle, the thud of a falling man, an empty clatter. They had walked into a line of meat cans slung upon a wire —only nine yards from the trench. At that instant a single rifle sounded and the Canadians hurled themselves down upon the

ground. Their bodies had hardly touched it when from a line 600 yards long there came one furious glare of rifle fire. . . . In that terrible red light the men, as they lay and scraped desperately for cover, could see the heads of the Boers pop up and down, and the fringe of rifle barrels quiver and gleam. . . . To rush the trenches in the face of such a continuous blast of lead seemed impossible, and it was equally impossible to remain where they were. In a short time the moon would be up and they would be picked off to a man. The outer companies on the plain were ordered to retire. . . . The right of the line was hardly in better plight. All firing had ceased for the moment, the Boers being evidently under the impression that the whole attack had recoiled. Uncertain whether the front of the small party on the right of the second line, now consisting of some 65 sappers and Canadians lying in one continuous line, was clear for firing should the Boers leave their trenches, Capt. Boileau, of the sappers, crawled forward along the bank of the river and discovered Capt. Stairs and 10 men of the Canadians, the survivors of the firing line, ensconced in a crevice of the river-bank overlooking the laager, quite happy on being reassured as to the proximity of support. This brought the total number of the daring band up to 75 rifles. . . . Col. Kincaid, R.E., now in command of the remains of the assaulting party . . . had his men distributed for digging as well as the darkness and the ignorance of the exact position relative to the Boers would permit. . . .

"In the early dawn the workers found not only that they were secure themselves, but they were in a position to enfilade over half a mile of the Boer trenches. Before daybreak the British crouched low in their shelter so that the Boers did not realize the change which the night had wrought. . . . For half an hour (*after daybreak*) a brisk fire was maintained, at the end of which time a white flag went up from the lines. Kincaid stood upon his parapet and a single, haggard figure emerged from the Boer warren.

"'The Burghers have had enough. What are they to do?' said he.

"As he spoke his comrades scrambled out behind him and came walking and running over to the British lines.

"No doubt Cronje had already realized that the extreme limit of his resistance had come, but it was to that handful of sappers and Canadians that the credit was immediately due for that white flag which fluttered on the morning of Majuba Day over the lines of Paardeberg."

Cronje surrendered unconditionally after this.

The action of the Company was highly commended by Lord Robeats, who inspected them and congratulated them on their gallant conduct.

28th February, 1900. No. 1 Section rejoined from Kimberley after the relief, none the worse for their adventures.

1st March to 23rd April. At Bloemfontein employed on the varied duties of a large camp, with one or two minor expeditions to relieve the monotony. This long halt did not provide much rest for the Company.

25th April. The advance to Pretoria began, the Company marching with the Highland Brigade.

On this day No. 2 Section, under Lieut. Wilson, left to join the 19th Brigade, part of General Ian Hamilton's force, and did not rejoin until December, 1900.

1st July. No. 1 Section was left behind while H.Q. and No. 3 Section went to join Sir A. Hunter's command.

No. 1 Section did not rejoin until 1902.

23rd July to January, 1901. Colonel Kincaid joined the Staff and Lieut. Musgrave took command until October, when Capt. Haggitt took over on the arrival of the Company at Bloemfontein, where the H.Q. nominally remained for the rest of the war. Actually they were split up in small detachments all over the country and it is impossible to do more than mention a few more important events.

January and February, 1901. Detachments of the Company carried out the laying of mines along the railways to discourage the Boers from tampering with them, and at various river crossings. Two sappers were accidentally killed when unsetting mines at daybreak through touching the trip wires.

February to end of war, 1902. Towards the end of February the Company undertook the systematic defence of the railway from Bloemfontein to Norval's Pont and Bethulie, on the blockhouse system. By the end of 1901 they had built, or assisted to build, some 240 forts and blockhouses varying in type from three-story masonry blockhouses with steel loopholes and 2 ft. 6 in. walls, to the sealed pattern circular corrugated-iron type. 123 miles of the line were fitted with continuous tension-wire alarm guns, flares, fixed rifles, etc., for the protection of the wire entanglements between blockhouses.

This type of work went on until the end of the war. Part of H.Q. ran workshops in Bloemfontein for the manufacture of blockhouses, etc.

September, 1902. The Company returned to Aldershot after 3 years 10 weeks' service. Of the original 6 officers and 180 other ranks who embarked in 1899, only 3 officers and 45 other ranks returned to Aldershot.

The deaths due to the war were 1 officer (Lieut. Trench), 12 N.C.O.s and men, the remainder being transferred or invalided.

No. 1 Section at Kimberley.

From 18th September to October 15th, 1899, on which date the enemy first appeared before the town, the Section was fully employed in preparing the defences of the town. During the siege they occupied a portion of the defences as well as carrying out multitudinous other duties from running searchlights, manning the civil telegraph exchange, when it got too hot for the civilians, to making improvised guns. In spite of the fact that by January rations had been reduced to a mule and horseflesh basis the Section managed to keep remarkably fit.

Lieut. McClintock was the first officer of the garrison to be wounded, but fortunately only slightly.

In the Western Transvaal.

After it again left the Company in July, 1900, this Section carried out various defence works and in October, 1900, joined General Barton's force, which was working round south of Magaliesberg, and arrived at Potchefstroom on 12th November. During the first 19 days of this trek the force was engaged on 13 days ending with De Wet's defeat at Frederikstad, where Capt. T. Fraser carried out the demolition of a bridge after the M.I. rearguard crossed it, closely followed by the Boers.

On November 28th, Capt. Fraser handed over to Lieut. C. R. Johnson and the construction of the defences of Potchefstroom occupied the whole of December.

From March, 1901, to April, 1902, the Section was mainly employed on blockhouse work and covered an immense amount of ground. It rejoined the Company in April, 1902.

No. 2 Section. Advance to Pretoria.

No. 2 Section, under Lieut. E. E. B. Wilson, with General Ian Hamilton's force, took part in the actions at Israel's Poort, Houtnek, Vet River, Zand River and Doornkop, and in the fighting on June 4th, 1900, outside Pretoria, marching into Pretoria with the main army on the next day.

In the Transvaal.

On July 15th, 1900, the Section became part of a composite company with a section of the 9th (Field) Company, under Lieut. H. W. Buckle, the whole under the command of Capt. Clifford Coffin. It served with General Ian Hamilton's force to September, 1900, being chiefly employed in improving communications and building temporary bridges. It accompanied numerous expeditions to the north and north-east of Pretoria.

The Section rejoined the Company at Bloemfontein by train route by December, 1900. This was the first move by train the Section

had done for 13 months, during which it marched 1,900 miles, took part in 19 general actions, in the capture of 10 towns and in fighting on about 60 other days.

Honours gained in South African War, 1899–1902.

D.S.O.

Lieut. R. L. McClintock.
Lieut. E. E. B. Wilson.
Lieut. C. R. Johnson.

D.C.M.

C.S.M. H. Martin.
Serjt. G. Clark.
Spr. H. Matty.
Spr. T. Oldcorn.

BREVET COLONEL.

Major and Brevet Lieut.-Colonel W. F. H. S. Kincaid.

BREVET MAJOR.

Capt. T. Fraser.
Capt. F. R. F. Boileau.

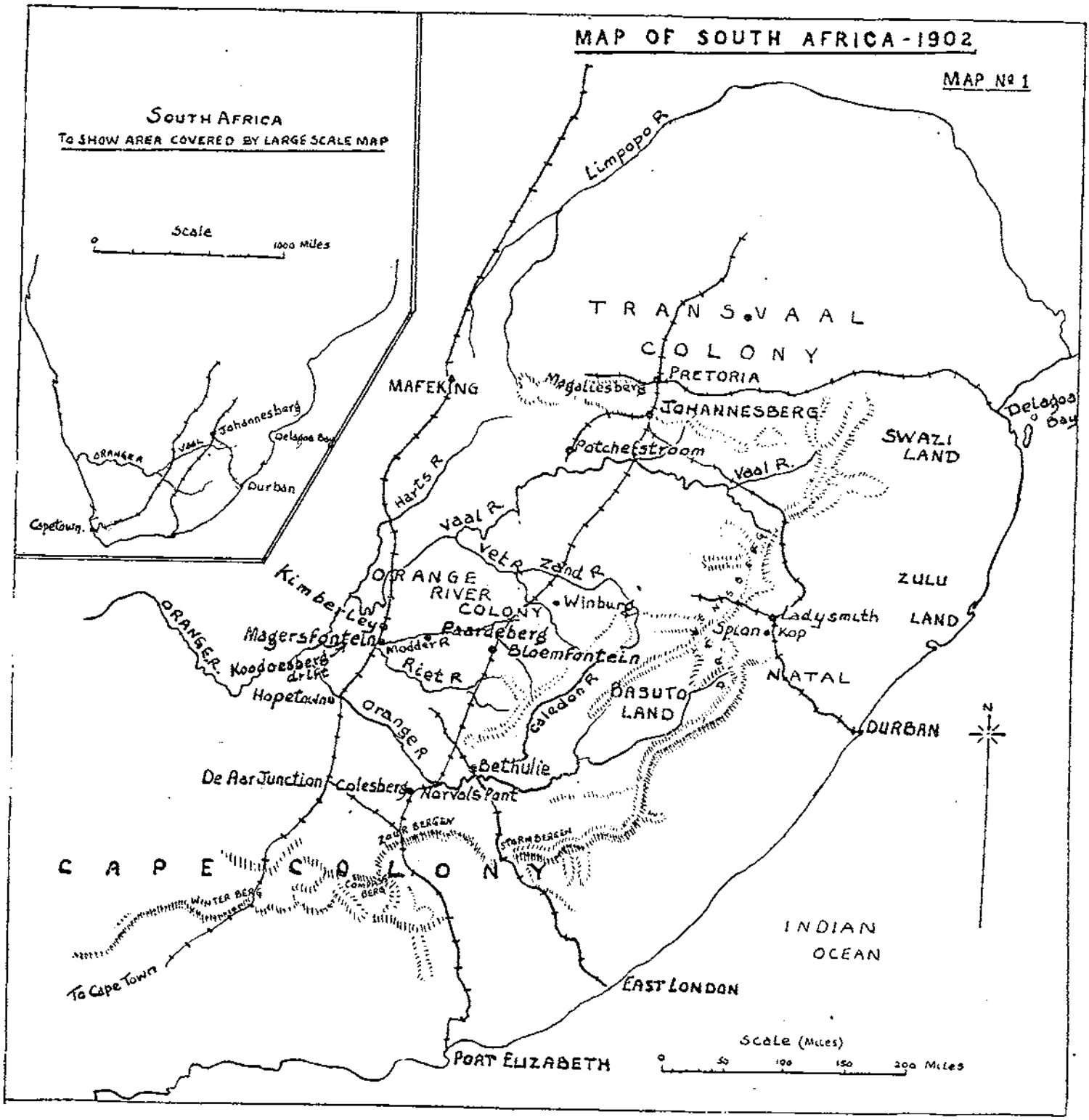
MENTIONS.

Major and Bt. Lieut.-Colonel W. F. H. S. Kincaid.
Major E. D. Haggitt.
Capt. T. Fraser.
Capt. F. R. F. Boileau.
Lieut. R. L. McClintock.
Lieut. E. E. B. Wilson.
Lieut. H. Musgrave.
Lieut. C. R. Johnson.
C.S.M. H. Martin.
Serjt. G. Clark.
Serjt. H. Brush.
Cpl. J. Reid.
Cpl. K. Hackett.
Lce.-Cpl. J. Boyd.
Lce.-Cpl. F. Sherborne.
Spr. H. Matty.
Spr. T. Oldcorn.

OFFICERS WHO SERVED IN SOUTH AFRICAN WAR, 1899–1902.

O.C.			2nd in Command.			Company Officers.		
Appointed Date.	Name.	Casualty Date.	Appointed Date.	Name.	Casualty Date.	Appointed Date.	Name.	Casualty Date.
Came out with Coy.	Bt. Lt.-Col. W. F. H. S. Kincaid	To Staff 24/8/00	Came out with Coy.	Capt. F. R. F. Boileau	To Staff 27/6/00	Came out with Coy.	Lt. R. L. McClintock	To Staff 26/6/00 Wounded at Kimberley.
Aug. to Oct., 1900	Lt. H. Musgrave	Acting	Mar., 1900	Capt. T. Fraser	To Staff College, 28/11/00	,,	Lt. E. E. B. Wilson	—
Oct., 1900	Major E. D. Haggitt	—	1902	Capt. R. H. MacDonald	—	,,	Lt. H. Musgrave	A./D.W. in June, 1901
						,,	Lt. C. R. Johnson	—
						?	Lt. C. C. Trench	Died April, 1902

(To be continued.)


MAP OF SOUTH AFRICA - 1902
MAP Nº 1
SOUTH AFRICA
TO SHOW AREA COVERED BY LARGE SCALE MAP
Scale
0
1000 Miles
ORANGE R.
VAAL
Johannesberg
Delagoa Bay
Durban
Capetown.
Limpopo R.
TRANSVAAL COLONY
PRETORIA
MAFEKING
Magaliesberg
JOHANNESBERG
Delagoa Bay
SWAZI LAND
Potchefstroom
Vaal R.
Harts R
Vaal R
Vet R
Zand R
ORANGE RIVER COLONY
Kimberley
Winburg
ZULU LAND
Ladysmith
Spion Kop
Magersfontein
Modder R
Paardeberg
Bloemfontein
ORANGE R.
Koodoesberg drift
Riet R
NATAL
Hopetown
Caledon R
BASUTO LAND
orange R
DURBAN
Bethulie
De Aar Junction
Colesberg
Norvals Pont
ZOUR BERGEN
STORMBERGEN
CAPE COLONY
WINTER BERG
COMPASS BERG
To Cape Town
INDIAN OCEAN
EAST LONDON
PORT ELIZABETH
Scale (Miles)
0
50
100
150
200 Miles
N

WATER SUPPLY IN THE FIELD.

By LIEUT.-COLONEL A. P. SAYER, D.S.O., R.E.

IN the March, 1931, issue of this *Journal* there appeared an article on this subject by Lieut.-Col. Martel which dealt with the problem in India and the plant that had been adopted as equipment of Sapper and Miner units as the solution to that problem. That article has, I am sure, been read with interest by many, and I think that the opinions of some, on the subject of what water supply equipment should be carried by R.E. Field units, have been considerably influenced by it. I feel that some comment or consideration of the problem from the British Army point of view is desirable and I imagine one of Lt.-Col. Martel's aims in writing the article was to provoke a reply.

His object was " to see whether something very similar would not be equally suitable for Home Field Companies," and I am venturing into print in an endeavour to show that though " the British Service might do worse than copy the whole scheme *in toto*," it might, and I hope will, do better.

The appearance of his article was peculiarly opportune, as the thoughts of many of us at home were occupied by this and other equipment problems preparatory to the concentration at Aldershot of a Division at war strength ; this took place in August and formed the centre of interest of the training season. I may as well add that at the time of writing I am unaware of any conclusions that may have been reached as a result of that concentration and have seen no decisions published as yet.

I am putting forward my views in reply to Lt.-Col. Martel not because I feel particularly qualified to write on the subject but because my present work has brought me into closer touch than anyone else with the results of the experiments and trials that have been carried out with the object of developing suitable water supply equipment for R.E. Field units. While, however, my work gives me this advantage I want it to be clearly understood that any opinions I may express in this article are my own, and are not intended to represent in any way the views of those who direct the policy of the army or select its equipment.

Lt.-Col. Martel's article indicates that he, and presumably India, is well satisfied with the pumping set described, and I am sure that

India, and perhaps Lt.-Col. Martel, is better able to judge India's needs and how to provide for them than I am. It will, I hope, be realized that any criticism of the set that I may make is not directed at India, but is merely incidental to the consideration of the proposal that the British Army might be similarly equipped.

Before we go into details of the needs and the methods of supplying them, it will be as well to have in mind the principle that underlies the whole policy of training and equipping the British Army. This can, I think, best be stated in the words of the War Office instructions issued in connection with the divisional concentration already referred to, namely, " . . . *bear in mind the fact that we are preparing for a highly mobile type of war, a very hard war in which there will be no place for luxuries.*" There seems no need to add to this, except perhaps to include in the term " luxuries " everything that is not absolutely necessary.

The first point that requires careful consideration is the source from which water will have to be obtained in the field. Lt.-Col. Martel mentions but two conditions and really considers only one as affecting the Engineer units ; no doubt in providing for the most difficult case he has covered the easier ones, but I am very much in doubt if this is economical or efficient when we are considering a force that is intended to be as mobile as possible.

I suggest that the variety of conditions should be expanded and, apart from piped supplies which we can omit from our consideration, we should include the following :—

(*a*) An abundant and suitably dispersed surface supply, *i.e.*, suitable for ordinary pumps with a normal suction lift ;
(*b*) a restricted surface supply or a surface supply to which access is restricted by tactical or sanitary considerations or perhaps by natural difficulties ;
(*c*) a restricted number of points where deep water is available, *i.e.*, where the water is at a depth beyond the lifting capacity of the ordinary pump ;
(*d*) a very restricted deep supply and a surface supply of perhaps less good water.

As regards (*a*) I entirely agree that in such cases units can fend for themselves if they are provided with water-carts, buckets and a minimum of troughs and L. and F. pumps. For all the other conditions the Divisional Engineer units will require sufficient plant to provide suitable water points.

The Indian set is designed to deal with condition (*c*), but it is obvious from various remarks in the article that its use in condition (*b*) is contemplated, though only as an afterthought. It will be as

well, I think, to mention here that since the article was written, this Indian set has been altered and rearranged so that the crude and cumbersome method of driving the centrifugal pump through the elevator, even though the latter is not required for raising water, has been eliminated. The set should now be capable of use in condition (*b*) without having to install the elevator head-gear.

For the moment I propose to leave the question of the small pumping units, troughs, tanks, etc., which will always be required as adjuncts to the power pumping plant that must be the basis of the water supply equipment, but I will just take this the first opportunity of endorsing Lt.-Col. Martel's objection to any idea of trying to replace the hand-power L. and F. pump by a small motor-driven pump of equal or slightly increased output; such small sets are undoubtedly unreliable, uneconomical and for field use unpractical and unnecessary.

The power plant that we require must be able to raise water from wells and make it available at the surface; in addition it must be able to bring surface water from its source to a convenient site for consumption or distribution. Apart from the varied conditions of supply already mentioned, there are further variations of depth in the deep sources and of height and distance in the surface sources; the plant must therefore have a considerable range of adaptability. Were steam or electric power always available in field units it might be possible to use some form of force pump for all purposes; we are, however, practically limited to the I.C. engine as a power unit and with this limitation a water elevator is the most suitable for raising deep supplies and for surface water the centrifugal pump is certainly the simplest and most compact form of force pump available.

Lt.-Col. Martel in his article advocates the combined set, that is with the elevator and the force pump driven from the same engine, and here in his " chain of thought " he seems to have missed several links, for he gives no arguments for or against combining the parts. Obviously India is providing for the worst case. This certainly has the wisdom of " Safety First," and in such an important matter as water supply there is a good deal of justification for it. On first sight this same justification appears applicable to the British Service, but I suggest a little consideration of other aspects will show that a combined set is not necessarily the most suitable.

That the worst case must be considered I agree, but consideration must take account of the likelihood of its occurrence. I agree that when a single Sapper unit, be it R.E. or S. and M., is serving a force which may, on occasion, have to rely on deep-water sources, that unit must carry equipment which includes elevator gear. That the

elevator gear must necessarily be combined with the pump I do not agree.

As regards the economy of using one power unit to run both elevator and pump I agree that if mechanical efficiency alone is taken into account it has the advantage, but that is not the only factor. A power unit that is suitable for the combined set is not necessarily economical when running the pump by itself, and therefore the proportion of times that the combined set will be used as a whole has a bearing on this question of economy. In addition I suggest that in the field the ease of handling and rapidity of installation are also factors that affect the economical aspect, and it is obviously easier to handle and install a separately driven pump than the combined set when the pump alone is needed.

It seems to me that the advocates of the combined set are mainly considering the individual R.E. unit and looking on it as normally independent and separate. Our army is, however, based on the primary tactical unit, the division, and what we are considering is the equipment needed for the R.E. units of the division ; the division as a whole must come into the picture.

How often will the whole division have to rely solely on deep-water supplies ? I suggest that the occasions will be so very rare that should such conditions be encountered unexpectedly (if they are foreseen special provision can be made to meet them) they could be dealt with by restricting the allowance of water or by increasing the time over which supply is given. I am of the opinion that it is not essential to provide the division with the full number of power-driven elevators that are needed to produce the full water requirements. I suggest that the occasions when more than two large water points served by power elevators are needed will be exceptional and the provision within the division of three such elevators would give a sufficient reserve ; anything more than this number is wasteful in carrying capacity and a handicap to mobility.

As an additional argument to support my estimate of the rarity of this form of water point *for the whole division* I suggest that those with experience of wells might consider the frequency with which they are likely to find them with a sufficiently good recuperation to allow 3,000–4,000 gallons an hour being taken from them for any length of time ; my limited experience does not encourage me to expect to find many of them very often.

Turning now to the force pump, obviously it will be required in nearly every case where water points beyond the capacity of one or two L. and F. pumps are formed, and I think it can be accepted that everyone agrees that each divisional R.E. unit must carry one at least.

With the inclusion of the power pump in all these units and the exclusion of the elevator from some of them, the normally combined set is unsuitable for adoption as equipment. It might, of course, be arranged that, when required, the elevator could be added to the power pump and driven by the same motor or engine, but it seems to me better to provide the elevator with its own power even at the expense of increasing the number of power units. If it has its own power unit it can be used by itself without the pump; the specification of the Indian set provides for the use of the elevator in this manner, though it still involves the pump being installed even when not used. I can imagine cases where the elevator will be used by itself and the pump will be required to operate as well some distance away; such cases are included in the condition (*d*) mentioned earlier.

Before going on to discuss the details of the water supply plant my suggestions so far provide for each unit carrying power pumps and one unit carrying elevator gear in addition; this unit naturally would be the Field Park Company, which already has the function of supplying other forms of equipment as required to other units in the division.

The first point of importance in considering the details of plant required is to decide the capacity or output that is needed. The criterion for the pumping capacity is the peak load, that is to say the maximum requirements in a short period; it is a question of rate rather than of quantity. Lt.-Col. Martel bases his figures on five gallons per animal and one gallon per man, the animals to be watered in two hours and the total to be supplied in four; his suggested figure of 4,000 g.p.h. does not quite agree with this timing, but at this rate the animals can rely on four gallons a head in two hours, and that should suffice. Other estimates put the need at half a gallon per man and four per horse in two hours; some increase the rate by allowing half an hour for installing the water point and requiring all watering to be completed in 1½ hours. These estimates agree approximately as to the total of the immediate requirements of the division being round about 30,000 gallons, with a maximum group requiring about 9,500 gallons.

In all these estimates there are two variables, one the actual time in which these quantities must be supplied and the other the proportion of men or, more probably, of animals that will depend on the main water points. As regards the former it is obviously desirable in all cases and particularly so after a hot day's march to get the water distributed as quickly as possible; it is not, however, *essential* to fix an absolute time limit. As regards the other variable, the proportion using the water point will depend on the local conditions, both natural and tactical, and no limiting condition can be assumed. I suggest that a reasonable formula to cover these

variables is to provide sufficient capacity to provide for 60% of the requirements in two hours; if the full supply has to be given, then the period is extended to three hours.

On this basis the maximum group of a division will require water at the rate of 3,200 gallons per hour, allowing 10% for wastage, which will be the output of which the main power pumping plant of each divisional engineer unit must be capable. Of course, any increase over this figure will be acceptable to meet emergencies, but, as we are aiming at essentials only, the increase in output should not be allowed if it involves an increase in weight or a reduction in handiness. This question of handiness is of importance, and I include in that term ease of transport and of carrying, simplicity and rapidity of getting into action, a degree of adaptability and the minimum of "specials." I regard this matter of "specials" as of particular importance, and from the suggestions of various people as to suitable types of pumps it seems to me that this point is frequently overlooked. In this case the chief items concerned are the piping or hose for use with the pumps and the fuel for the power unit. For the pump we must select or design one that will produce the required output when it is using the service L. and F. hose. Even for the short length of suction hose that is required and that will almost be part of the pump itself I deprecate a special size, but I would not insist on it if the improvement in output gained thereby made it possible to reduce the weight of the plant. For the delivery side there can be no question of allowing a special size.

Apart from the simplicity and power of extension or adaption given by using the same hose as is required by the hand pumps, this matter of the hose has a large bearing on the pump design. It must be remembered that the figure given in *M.E. Vol. VI* for the loss of head per 100 feet of 2-inch pipe amounts to nearly 30 feet at 60 g.p.m., and the object of the pump is to get water from the source to a convenient point for use or for distribution; this may and probably will involve some static head as well as distance. The head of 35 feet against which the Indian set is designed to work does not seem to me to be adequate for anything but the simplest description of distribution of wellhead water. I suggest that the pump ought to be able to produce the required output against a head of 80 to 100 feet.

The other point mentioned above concerning the fuel for the power unit is obvious. For the British service we have no choice, we are limited to petrol by practical considerations of supply and availability in emergency. The whole army is dependent on it for moving and living in the majority of campaigns, and where other forms of transport have to be used the organization for the supply of petrol still remains. The Petter engine with the Indian water supply set is designed for running on paraffin; there is no reason why a petrol-

driven Petter engine should not be used instead of the paraffin engine; they are, I believe, equally reliable. Its slow running compared with the small petrol engine is the advantage claimed for this engine. This is, I agree, an advantage, but is it a necessity? The argument is a bit thin when we remember that this slow-speed engine is carried in a lorry driven by a "little high-speed petrol engine," and that lorry has to carry on also for days on end. It seems to be more like an excuse than an argument—an excuse for the comparatively large weight of the Petter engine. The greater solidity of the Petter no doubt suits India and the S. and M. personnel who have to use it; for the British Service, which is not being equipped only for Indian campaigns, and in which "motor-mindedness" is getting commoner every day, the conditions are different, and the light petrol-driven pump should receive as reasonable attention and intelligent handling as a lorry engine, and consequently the greater solidity of the Petter would not compensate for the extra weight.

The plant that has been tried out for the British Service and will I hope be adopted in the near future consists of the following parts:—

(*a*) A Rees-Roturbo pumping set which is capable of an output of about 3,500 g.p.h. against a head of 100 ft. This set comprises a two-stage centrifugal pump geared direct to a Watermota engine, all carried on a small double channel base. It is fitted with suction and delivery connections for service hose; normal pump speed 2,150 r.p.m.; petrol consumption about 0·6 g.p.h.; dimensions 3′ 6″ x 2′ x 1′ 6″ approx., weight with detachable carrying handles 256 lb. approx.

This set has proved itself reliable and reasonably robust on all its trials; it has been run for long periods, and steadily produced its rated output without hesitation or signs of wear, and it has survived a large amount of handling and the vicissitudes of transport. Two men can carry it, and it can be installed and brought into action very quickly.

(*b*) An Aquatole elevator, type F.1, with fast and loose pulleys; belt driven by a Watermota engine similar to that incorporated in the pump set. The elevator and engine will be fixed to a bed frame with a spill tank, and may be carried fixed to the frame or not as most convenient, as the attachment is simple. The Watermota has detachable handles which make it easy to carry; weight with handles 220 lb. approx.

It is not, of course, fair to make a detailed comparison of this plant with the Indian set, as the latter is designed primarily for combined use, while the former is designed with a view to the more

frequent use of the pump set by itself; a few general comments are, however, desirable.

The Indian pump included in the set is a 2-inch Ruston, single-stage centrifugal fitted with a 2½-inch suction hose; the delivery outlet is 2-inch, so it may be presumed that it is intended for use with 2-inch piping or hose. As already stated, at 1,350 r.p.m. it will deliver, according to the makers, 4,000 g.p.h. against a 35-ft. head. The Rees-Roturbo will produce its rated capacity steadily against any head up to the 100 ft. for which it is designed; the substitution of a 2½-inch for the 2-inch suction hose will increase the output by from 7 to 25 per cent. according to the head against which it is working.

I have already remarked on the Petter engine of the Indian set, and while I agree that its life under the conditions mentioned is likely to exceed that of the Watermota I do not agree that, all things considered, it has the advantage. The Watermota has proved itself a reliable power unit and has stood up excellently to all the tests and rough handling to which it has been submitted. It would certainly be a good thing both for us and I think for India if some of these engines were really tested out in India; for India it would probably solve their problem of a suitable set for pack transport.

As regards the elevator there is little to say; the F.1 type recommended for home units is the same as the F.2 adopted by India, except that the latter has side plates for enclosing the chain in the head-gear. It should, however, be noted that while India claims 4,000 g.p.h. for this elevator the makers only rate it at 3,000; we also have found that it will produce more than the makers claim for it on occasion without speeding up, but it is, I think, undesirable to allow for anything beyond the rated output. The makers now produce a suitable bottom pulley, called the Borehole type; we have found this quite satisfactory.

On the basis of the above suggestions the plant mentioned would be distributed as follows:—

(*a*) To each Field Company	..	1 Rees-Roturbo pumping set.
(*b*) To the Field Park Company		1 ditto.
	plus	1 ditto spare.
		3 elevator sets.

This gives four pumping sets, plus one spare, and three elevator sets in the division, as against the four combined sets adopted by India. If we take the length of elevator chain to be carried as 250 ft. per set, as is proposed for our equipment, we find that the Indian divisional power plant is at least 18 cwt. heavier than that proposed for the British Service. A reduction of weight of this amount is important and when it is accompanied by a greater power of adaptability in the plant itself, as well as greater ease of transport and

handling, I do not think I am putting it too high if I say that this plant is decidedly better for our needs than the Indian equipment.

Before leaving the matter of power plant, I would like to comment on the suggestion that has been made by several people lately that two smaller pump sets, each of roughly half the output, would be better than the one. This certainly has the advantage of allowing some dispersion, but I am sure this advantage could only be obtained at the expense of weight. A set of 1,500 to 2,000 g.p.h. capacity would weigh at least 75% of the Rees-Roturbo set, and I very much doubt if the same degree of reliability could be obtained. Even if this extra weight were accepted I am very doubtful if a suitable commercial article could be found; no doubt one could be designed and produced, but would there be any market for it other than the Army? That point, and the consequent difficulty of obtaining a supply or of increasing production in emergency has to be taken into consideration. I think I can say that the possibilities of such sets have been fully considered in arriving at the Rees-Roturbo set recommended. I think I may also say that consideration of this point does not cease with the recommendation of a particular type. At the present moment the possibility of using other means of raising deep water is being investigated, with a view to supplementing the elevator gear or possibly of reducing the amount to be carried; at the same time such plant may provide an additional or supplementary force pump for the Field Companies.

Turning to the rest of the water supply equipment, the adjuncts to the power plant, our needs are very similar to those provided for in Lt.-Col. Martel's article. The *chursa* set in Indian conditions is certainly needed, but its inclusion in the equipment of our Field Companies does not seem necessary. This adjunct can be classed with those "stores and equipment which are necessary at infrequent intervals or on special occasions only," and added to the normal equipment only when needed. It may also happen that the investigation mentioned above may provide an alternative to the *chursa*.

L. and F. pumps have served the mobile troops singlehanded, so to speak, for a good many years and in a good many campaigns, and they are still needed for distribution purposes and as a standby. If we can include in our equipment some special connectors for the hose it will make it possible to distribute direct from the power pump on occasion and so reduce the labour of hand pumping; a four-way connector for the hose would not be a very weighty or bulky article.

The trough is an essential link between the pump and the horse's mouth, and can be used for other purposes when required; it may be rather cumbersome, but cannot be dispensed with, and should be included at the rate of one per L. and F. pump. The number of

these items given by Lt.-Col. Martel seems rather large for our units ; I suggest six per company will suffice.

The remaining item is tanks. As regards type Lt.-Col. Martel is satisfied with the semi-self supporting type that India has produced, but that is probably due to the fact that he has not had experience of the type that has been developed at home. This type is certainly superior to the Indian pattern, as it is self-erecting as well as self-supporting, and can accommodate itself with very little loss of capacity to a sloping site.

The small tank mentioned is doubtless very nice and handy, but has, I think, no place in our equipment. India has four tanks of 1,500 gallons capacity to each pumping set, that is to say, storage for two hours' supply. This seems to me luxurious for normal watering; a capacity of half an hour's pumping output should be all that is necessary. I suggest that an allowance of one 1,500-gallon tank for each power pump or elevator is reasonable.

I do not think there is any need to comment on the rest of the article ; the sub-division of a force into water units appears to be a simple aid to estimating and to staff work. The method of carriage of the equipment in India is no doubt the best solution of their present problém, but it seems to me rather a close approach to the introduction of a new form of specialized Sapper unit. That, however, is a matter for India, and the conditions in our divisional units are different ; the Field Park Company is already mechanized, and the progress of mechanization of the Field Companies is proceeding and though it is proceeding slowly there seems some possibility of its completion in the event of mobilization. For us then there is no need to introduce special motorized sub-units.

There I will leave this problem—I have tried to show what seem to me to be the minimum needs of the British Service, and how I consider those needs should be met. If I have made out my case I think it can be said that we can suit ourselves better than by adopting the Indian pattern of water supply equipment. I think also it is fair to say that India's experience with the plant, and Lt.-Col. Martel's advocacy of it, have been of considerable assistance in clarifying our views on how to solve our problem.

[*Note :—*

Correspondence on this article appears on page 206.—EDITOR.]

THE CONSTRUCTION OF MAZARAI BRIDGE. KAJURI PLAIN OPERATIONS, 1930-31.

By CAPTAIN E. F. E. ARMSTRONG, R.E.

POLITICAL AND STRATEGICAL CONSIDERATIONS.

IMPORTANT considerations were, by November 1930, indicating the necessity of a link across the River Bara, on the Kajuri Plain, further forward than the bridge already constructed at Bara during the operations of that year.

Up to this time the main area of operations had been the Kajuri Plain. Operations were now to be extended to the Aka Khel plain on the south side of the River Bara. In addition, the policy for the future was taking shape. A line of posts was to be established well forward in the Kajuri and Aka Khel plains, viz., Fort Salop, Jhansi Post, Nowshera Post. With good communications, both lateral and back toward Bara and Peshawar, these posts should have a deterring effect on Afridi incursions into the Peshawar Vale in future. For the lateral communication, a bridge would be required across the River Bara which separates the Kajuri and Aka Khel plains.

Reconnaissances were carried out, and a site at Mazarai provisionally chosen. Towards the end of November orders were received to construct at this site a bridge capable of taking loads up to 12-ton steam rollers. The work was to be carried out by No. 5 Field Company, K.G.O. Bengal Sappers and Miners, and the 1st Battalion Sikh Pioneers. These units formed a camp above the site at the end of November, and work on the bridge and its approaches commenced forthwith.

TYPE OF BRIDGE.

Inglis Bridges Mk 1, were available. This type is capable of taking 12-ton steam rollers singly over a span of ten 12-ft. bays. The maximum length that can be cantilevered out in launching is also ten bays.

SITE OF BRIDGE.

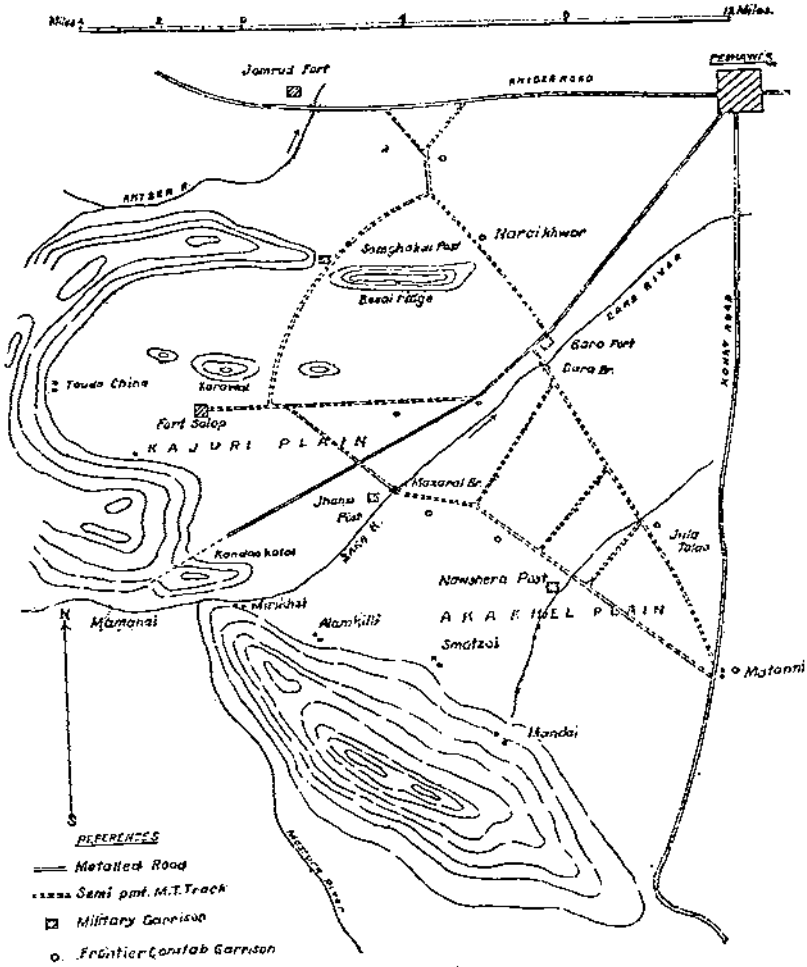
The River Bara cuts through the highest portion of the plain, the river being from 100 to 350 ft. below the general level of the plain. The banks rise generally in two steps to the plain level. There was no place sufficiently far forward where the gap even across the lower step was narrow enough for a single span.

At the site chosen, a gap of 83 ft. was measured from a ledge on the left bank to the sheer cliff of the right bank which was 46 ft. above this ledge. The banks were of hard gravel conglomerate.

GENERAL DESIGN.

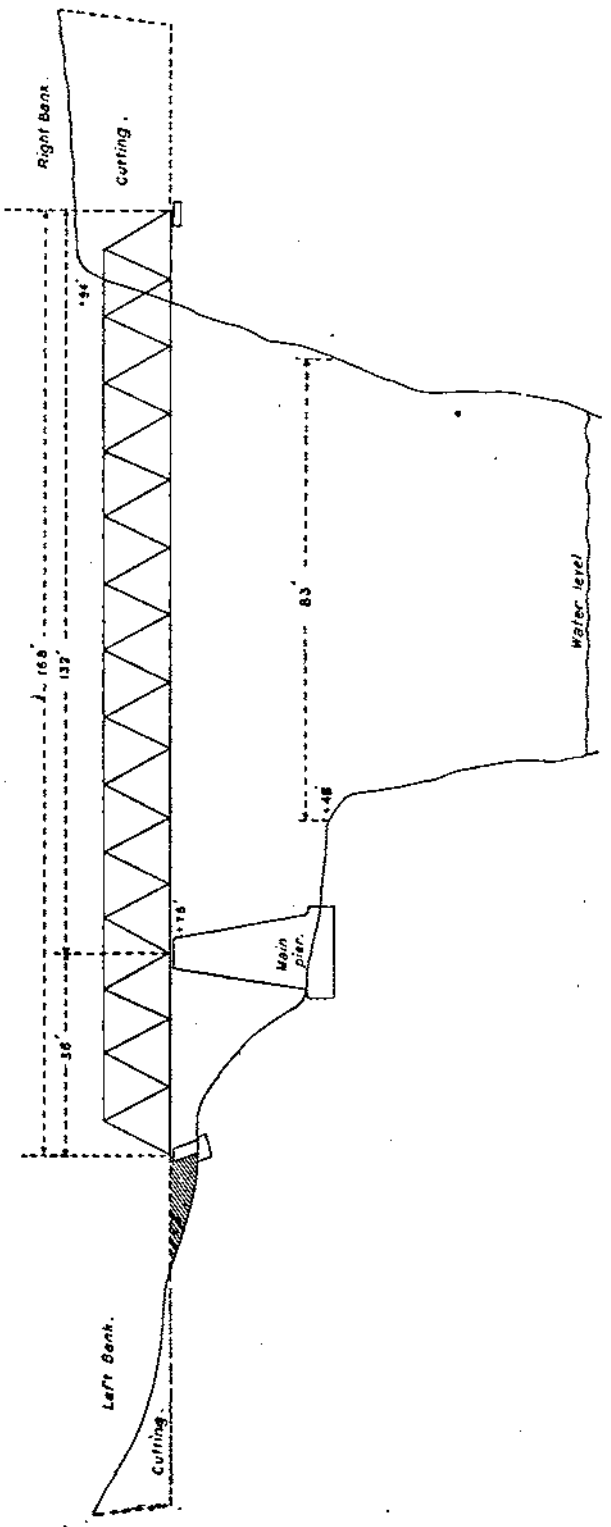
It was decided to build a high pier on this ledge and to cut a roadway in the right bank to the level of this pier. A compromise between cutting and building was necessary, and a 30-ft. pier

KAJURI PLAIN AREA.



SKETCH A.

was chosen, necessitating a cut of 16 ft. on the right bank. A subsidiary span would be necessary on the left bank from the main pier back to a bank seat. Launching would be carried out from the left bank. The shape of the ground precluded launching either by swinging or by cantilevering out in the normal way. By partial cutting and filling and by constructing a temporary roadway from the main pier to the bank seat, a straight length of 100 ft. would be


Right Bank.
Cutting.
Left Bank.
Cutting.
Main pier.
Water level
168'
132'
36'
83'
46'
15'
SECTION OF GAP.
Scale of Gap
Feet. 24 12 0 24 48 72 Feet.

available for assembling and launching the Inglis Bridge. On both sides considerable cutting would be necessary for a roadway from plain level to bridge.

DETAILED DESCRIPTION.

1. THE SPAN. The minimum measured gap was 83 ft. A bridge level 30 ft. above this level was fixed. After allowing for the necessary set back of the foot of the pier from the edge of the bank, and allowing for the increase in the span at the extra 30 ft. height, it was apparent that the main span would have to be more than 10 bays (*i.e.*, 120 ft.). Ten bays would reach the other side, but, for the permanent bridge, 11 bays would be required.

The subsidiary span was to be 36 ft. or 3 bays.

The Mk 1 type Inglis is not designed to take full loads over more than 10 bays. To compensate for the 11th bay in the main span, it was therefore decided to treat the subsidiary span as a counterweight arm, and to weight it sufficiently to reduce the maximum stress in the main span to that in a 10-bay span equally loaded.

2. CALCULATIONS. The calculations for the amount of counterweight necessary were based on the maximum stress due to the 12-ton steam roller load, and also to the effect of infantry in fours crowded at a check.

The table below summarizes the result :

Load.	*Maximum stress in the tube.*
(*a*) 12-ton steam roller on main span of 10 bays ..	41·58 tons.
(*b*) 12-ton steam roller on main span of 11 bays with ten tons counterweight in last 2 bays of subsidiary span	39·95 tons.
(*c*) Infantry in fours on main span of 11 bays with ten tons counterweight in last 2 bays of subsidiary span	40·09 tons.

It was arranged therefore to lay 5 tons counterweight in each of the last two bays. (*Vide* Photo 9.)

3. CUTTINGS. This work was carried out by 1st Bn. Sikh Pioneers. The ruling gradient is 1/12, curves on the flat and of 60 ft. radius. The roadway is 18 ft. wide, sides of the cuttings being about 6/1. On the right bank a 40-ft. straight off the bridge was laid out.

The length of the main cuttings are :—

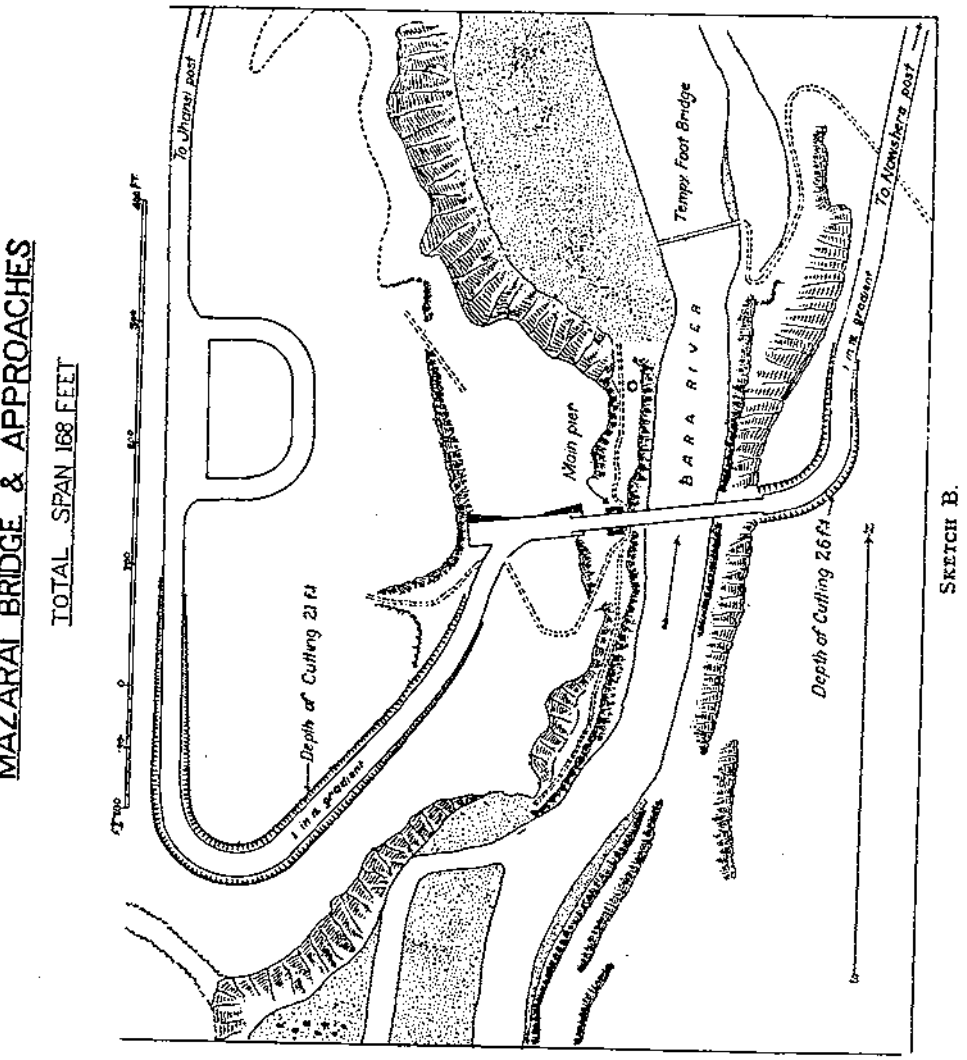
Right bank, 265 ft., av. depth 20 ft., maximum depth 26 ft.

Left bank, 738 ft., av. depth 16 ft., maximum depth 21 ft.

The total excavation was about 250,000 cubic ft. The ground is all hard conglomerate, in parts of which a pick makes little impression.

The time spent on this work was 13,500 man-days (7-hour day).

This gives an excavation figure of nearly 20 cubic ft. per man-day. In view of the nature of the soil, and the great depth of the cutting, that is a very high figure to have reached. A usual working party strength was 375.



The following explosives were used :—

Dynamite	..	..	..	..	1350 lb.
Gelignite	..	..	..	..	200 lb.
Gun Powder	..	..	..	..	500 lb.

A compressor was sent up to assist in the bore holes. It had one drill only, but averaged twenty-five 3-ft. bore holes a day.

Sketch B and Photos 7 and 8 show the cuttings.

4. THE MAIN PIER. A dimensioned drawing is appended.

(*a*) It was decided to make the top of the pier a minimum of 19 ft. x 5 ft. in order to be able to work with comfort on the top. A slope of 6/1 for the sides was decided on. The height is under the 30 ft. originally planned, as the setting back of the foot from the edge of the cliff brought it on to higher ground. A height of 28 ft. 6 in. brought it up to the determined level.

It was originally intended to construct the pier of a 3-ft. masonry skin with a core of rubble. Owing to the absence of quarryable rock in the neighbourhood, it was decided to construct it of concrete. To economise in concrete, the interior was to be of hand-placed stone strengthened by vertical and transverse ribs of concrete. (Photo 1).

(*b*) *Materials.* Aggregate was obtained from the river bed, and from the excavations near by. Sand had to be brought from a nullah about two miles away.

Timber centring was used, the 2-inch planks being held in position by 4 in. x 3 in. verticals stayed together through the pier with 14 S.W.G. from opposite sides. (Photos 1 and 2.)

(*c*) *Mixing.* Mixing was carried out as near as the slope of the ground would allow. Two platforms were used and the mix was either carried in pans, or shovelled along chutes of C.I. to the pier. About 30 men were employed on each platform. The mix appeared rapid and effective, on one occasion 1,000 c.ft. being laid in 3½ hours.

A 1 : 3 : 6 mixture was used up to the top 5 ft. thereafter 1 : 1½ : 5.

Photo 2 shows the mixing in progress.

(*d*) *Constructional Notes.*

(i) The blocks of hand-placed stone (Photo 3) were continued up to a height of 12 ft., at which point they had tapered so much that their construction slowed up the work. It was found more economical to pour mass concrete, utilizing a large number of "plums" to save the equivalent concrete.

(ii) In order to reinforce the side of the pier to allow for the thrust due to expansion and contraction of the bridge, a strip of army track netting 7 ft. wide was laid up each side from the plinth level to the top, 9 in. inside the face. (Photo 1.) A horizontal layer of concrete was poured at 8 ft. height, and a layer of army track netting placed at 12 ft. Thereafter the pier was mass concrete.

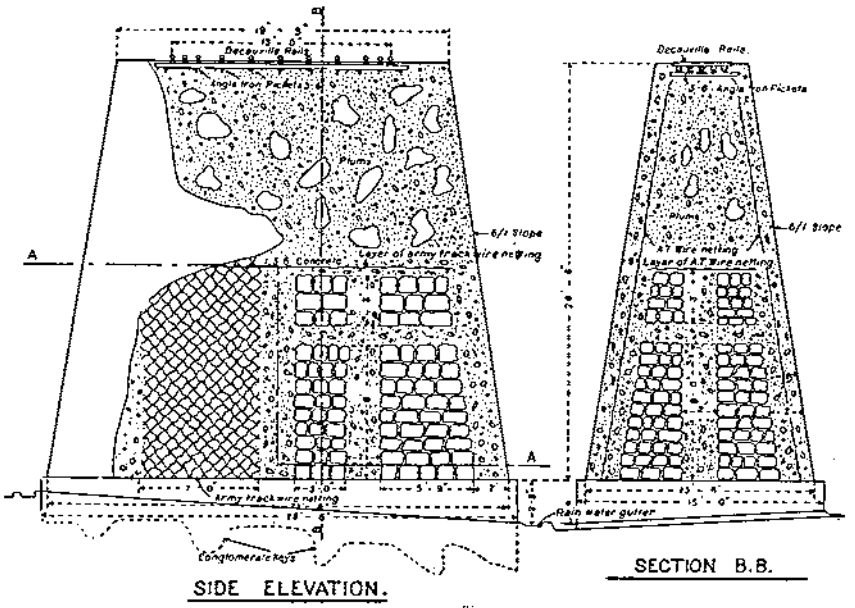
(iii) The bearing for the transom of the bridge consisted of eleven 3-ft. lengths of Decauville rail which were laid transversely on top of five 15-ft. lengths. These were supported on angle iron pickets, concrete being poured up to ½ in. from the top of the 3-ft. length.

(iv) The time taken was as follows :—

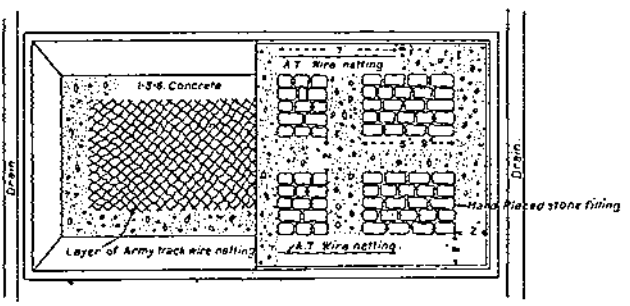
Collecting sand, aggregate and stones	7000 man-hours.
Fixing, centring and scaffolding ..	850 man-hours.
Mixing and pouring	2000 man-hours.

5. THE TWO BANK SEATS.

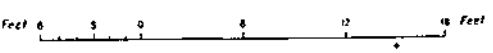
(i) *The Right Bank Seat* consisted of a concrete slab 3 ft. x 1 ft. 6 in. with eleven 3-ft. lengths of Decauville rail for the transom bearing.



MAIN PIER.



PLAN. ON SECTION. A. A.



(ii) *The Left Bank and the Bridge Approach.* The approach was partial cut and fill, a retaining wall being built on one side. A bank seat 19 ft. wide was built on to the hard conglomerate, with wings

back to the rock, and retaining wall. The rails on this bank seat were permanently concreted in before the bridge was launched. For the cantilever effect, it was expected that it would be sufficient if these rails were one inch below the level line of the main pier and far bank seat rails. This proved to be an error when the bridge was jacked down, as the camber in the bridge caused it to sit on the two bank seats and ride clear of the main pier. The bridge had then to be jacked up again on the main pier while the near bank seat was broken up and lowered. It was finally made up so that the cantilever end of the bridge was riding about $\frac{1}{2}$ in. clear unloaded.

6. TEMPORARY ROADWAY. The straight run back from the bridge on the near side had by now been excavated so that a length of 100 ft. was available from the main pier back to the end of the excavation for assembling and launching the bridge.

The span from main pier to the near bank seat was 36 ft. 22 in. x 7 in. x 30 ft. R.S.J.s from the Vibro-Pile Bridging stores were available for a temporary roadway across this span. On the final roll forward, there would be a live load of nearly 40 tons on this roadway ($17\frac{1}{2}$ skeleton bays plus 11·2 tons counterweight plus 2 tons weight of trolly). It was decided to use six of these R.S.J.s, two equidistant about each trolly wheel track, one outside. A crib pier of sleepers was built up in front of the bank seat, and the R.S.J.s spanned from main pier to crib pier.

A sleeper roadway was laid and spiked down to a composite beam bolted between the R.S.J.s. Distance pieces were bolted between the girders. The space between R.S.J.s and bank seat was completed with sleepers. (Photos 5 and 6.)

7. LAUNCHING. It was decided to launch 10 bays on to a temporary bank seat and then to add the 11th bay forthwith.

In order to be able to complete rapidly this 11th bay on the far bank the bridge was launched with the stiffener, the top horizontal, and the diagonal tubes of the 11th bay already assembled.

The launching was carried out by a series of rolls forward. On completion of the roll, the bridge was jacked down, the launching trolly moved back to its next position and more bays added in rear up to the limit of the available 100 ft. of straight.

The stages in launching were as follows :—

After 1st roll forward	..	Head of bridge over main pier.
After 2nd roll forward	..	Head of bridge 4 bays out.
After 3rd roll forward	..	Head of bridge 6 bays out.
After 4th roll forward	..	Head of bridge 8 bays out.
After 5th roll forward	..	Head of bridge 10 bays out (Final roll).

The bridge was pushed forward by man power, preventer tackles and chocks under the wheels of the launching trolly being used as

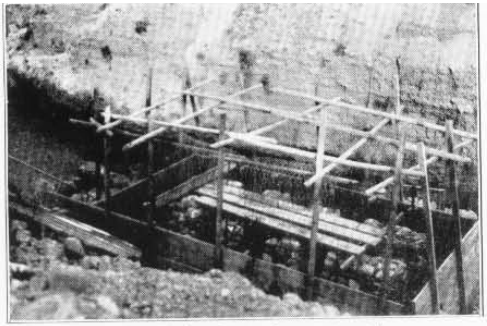


Photo 1.—Main pier under construction.

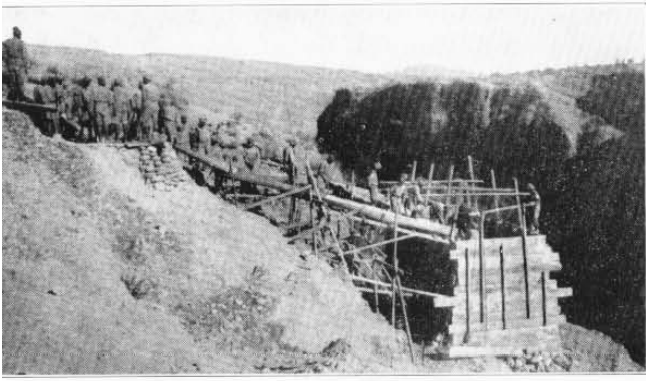


Photo 2.—Concreting of main pier in progress.

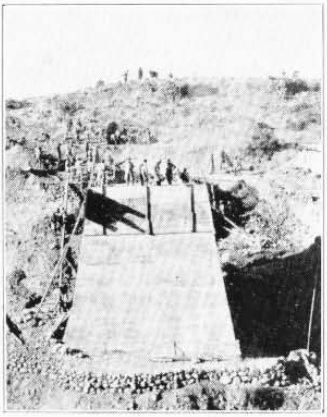


Photo 3.—Main pier nearing completion.

Construction of Mazarai bridge 1-3 1930 -31

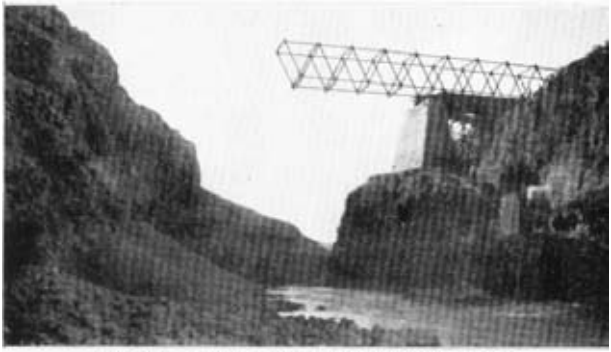


Photo 4.—Completion of second stage in launching.

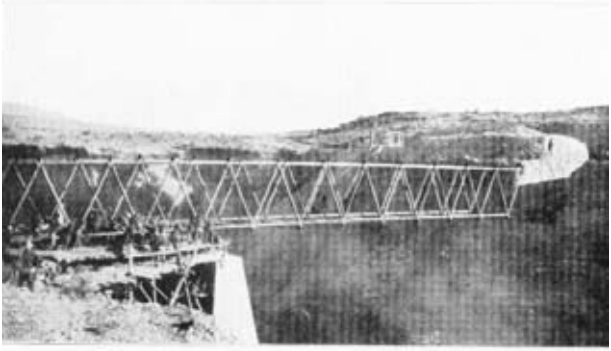


Photo 5.—Completion of fourth stage in launching.

Photo 6.—Launch completed.

Construction of Mazarai bridge 4-6

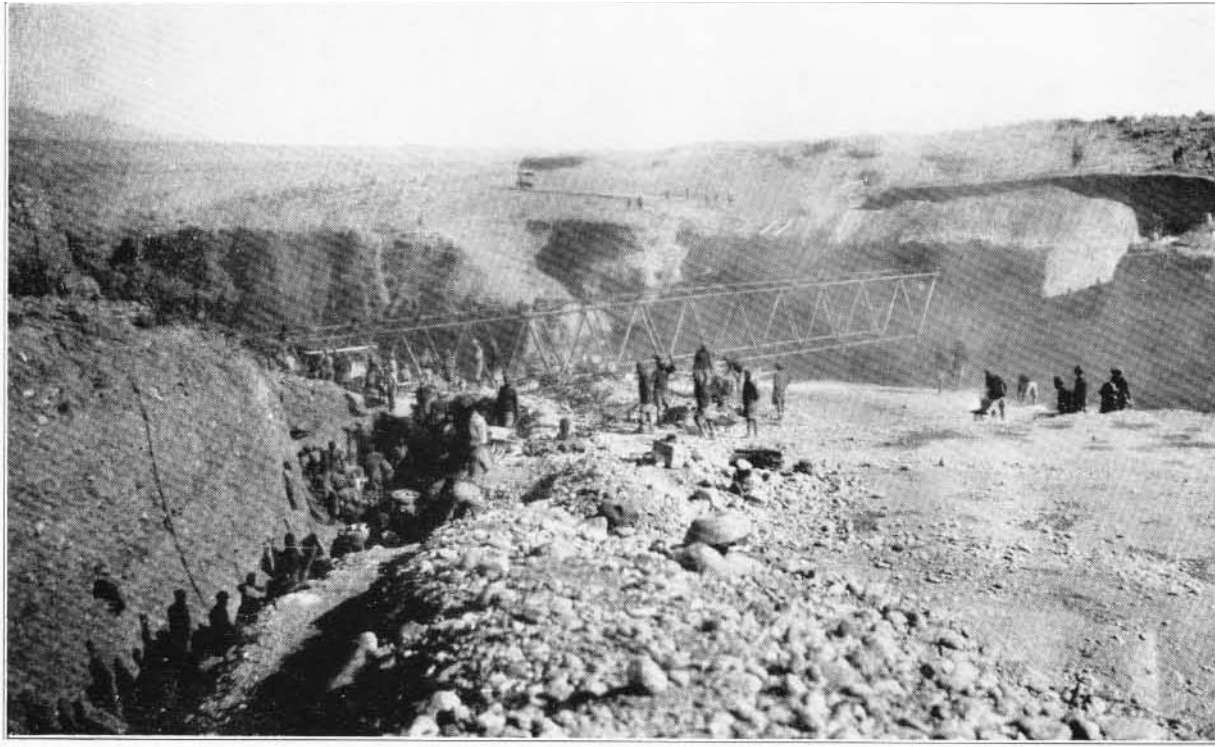


Photo 7.—Showing excavation of approaches, and launching in progress.

Construction of Mazarai bridge 7

Photo 8.—View of left bank cutting completed.

Photo 9.—View of subsidiary span, showing concrete counter-weight in end two bays.

Construction of Mazarai bridge 8-9

checks to excessive movement. In the final roll forward, tackles were used on the near side to assist the forward movement. This was very effective, the last roll, in spite of the heavy weight, proving the easiest.

8. JACKING DOWN. The bridge had to be jacked down 27 in. on to the main pier.

The method adopted was to employ the lifting screws of the launching trolly, which was placed on the crib pier. This gave a safer and more gradual movement than ordinary jacks.

The difficulty due to the camber being more than was anticipated has already been mentioned.

9. COUNTERWEIGHT. Five tons of counterweight were laid in each of the last two bays, the concrete being laid up to half the height of the road bearers. Supporting bars of old 4-inch piping strapped to the lower horizontal tubes were fixed to ensure the concrete not falling out due to bridge vibration. (Photo 9 shows this counterweight.)

10. TEST OF BRIDGE. After the decking was laid, the bridge was tested with a concentrated dead load of over 16 tons in the centre of the main span.

The deflection was $\frac{3}{4}$ in. Traffic on the bridge has subsequently included 12-ton rollers and the Scammel road train with two laden trucks.

11. SUMMARY OF TIMES.

(*a*)	Excavation of Bridge approaches (Pioneers)	13500 man-days (7-hour-day).
(*b*)	Construction of main pier	9850 man-hours.
(*c*)	The two bank seats and temporary roadway	3800 man-hours.
(*d*)	Assembling and launching	2300 man-hours.
(*e*)	Completing bridge	1300 man-hours.

A SUBALTERN IN IRELAND IN THE 80's-90's.

By SLIPPER.

I.

THERE was the usual "soft rain" when I* staggered down the gangway at North Wall early one morning in Christmas week 188– to join my first station. The after-effects of a rough crossing prevented my lingering over badly cooked eggs and bacon and chicory called coffee. So I was soon perched on a side-car rattling along the Quays to Kingsbridge station.

There are some sights and smells that remain for ever in one's memory. I have never forgotten the squalor of those Quays—the dingy, poverty-stricken houses on one side, in the centre the muddy granite setts, and on the other side the murky waters of the Liffey, reputed to give that undefinable flavour to Guinness's stout.

On arrival at the Curragh Camp I found myself C.O., Adjutant, and several Commanders: every officer was out hunting with the Kildare hounds. I kicked my heels, doing nothing, till towards the dinner hour when the sportsmen began to return; the first full of bruises in a brougham; another on a car, having left a lame horse behind; and another on foot leading his crock. To obviate the impression that the Army did no work, I must remind the reader that this was Christmas week, and state that the Curragh garrison, with its training ground actually at its door-steps, was second to none in efficiency in the light of those days. Also on no other occasion during my three and a half years at the Curragh was there so much "grief" during a day's hunting.

To hunt being *de rigueur* I was soon able to provide myself with a horse, and fortunately with a good one. But, although I had hunted in England, I found much to learn in negotiating the Irish banks. The Land League was still in more or less full blast—hounds were poisoned on the way to and from meets; piquets were posted to prevent hunting folk passing along some road or other; the fixture cards of the meets were false and private notices were sent round altering the venues. It was the normal effect of revolution—the revolutionaries were economically cutting their own throats. Incidentally it was an illustration of the natural moral cowardice of the Irish; if one asked a countryman the way, he would look up and down the road and, if no one was in sight, whisper ". . . but for

* The personal pronoun is used extensively in these Memoirs for the sake of brevity and not through egotism.

God's sake yer 'anner don't say I tauld ye." My first day's hunting witnessed a very unpleasant incident: over the first big bank I took a toss, but fortunately kept my reins and was able to remount; over the next I took another, and found a lady with a number of Leaguers gesticulating round her and one of them prodding her horse in the stomach with a pitchfork. She and I were of the "also ran" fraternity, which was the reason of our isolation. Matters looked serious; but my strange oaths in a strange language saved us and we were allowed to depart without further injury.

Conditions during the Land League times were full of humorous incidents and the crimes bore no comparison with the horrors of the Sein Fein campaign. Under the iron fist in the velvet glove of "bloody Balfour" (so unjustly thus nicknamed) the agitation gradually fizzled out.

Hunting generally was of the very best; no wire, no motor cars, no tarmac, and small "fields," especially in the Dunlavin country. There were long rides to the meets, but most of the roads had level grass verges and one was young. We generally sent our horses on and hacked out on "hairies." At one well-known gorse covert in the Dunlavin country I found that, by hiding at one corner away from the rest of the "field," I nearly always got a good start; later on, the Chief Staff Officer, a hard-riding cavalry colonel, asked me my secret; the conversation resulted in my driving him out in his dog-cart to subsequent distant meets while he read *The Times*. Of many days with the Kildares two stand out in my memory. The first, a 17-mile walk home with a lame horse. The second, a day of honour and discomfiture—pride ever hath a fall. It was a frosty morning and it was only after much cogitation that two of us started to ride out 16 miles towards Athy; we gradually slithered to the meet and arrived with a thaw. During a morning run, hounds crossed a widish stream, and the only way for us was to jump off a revetment wall into the water. During another run later in the day, I found myself for the first and only time in my life completely alone with hounds, checked near the same stream; of course, I tried to hunt them, and equally, of course, they took no notice of me; they crossed the stream, and, seeing a gap in the wire on both banks and thinking what a pity we had not found a similar gap in the morning, I plunged in; it was a deep drinking hole; the horse forthwith came to the conclusion he was drowned, turned over on his side, and floated down the current; I followed, loosening his girths; some of the "field" then came up, so I tied the last of several hunting crops to his bridle and he was towed down to a sandy spit at a bend where much whipping persuaded him that he was still alive. A kind samaritan of a yeoman farmer lent me a dry change of clothes, and we started off home. It was then freezing hard again and pitch dark, so that it was long past the dinner hour when we arrived.

After my first buy, I always bought my horses at country fairs, with the help of a lady-owner who was a remarkable judge of a young horse. The most successful was a roan mare purchased from a priest. We started driving her in a dog cart without further thought and she went like a lamb ; but some weeks after came a telegram from a cousin, " For heaven's sake don't drive that mare, she's a dangerous jibber." The next day in the shafts she started jibbing—an interesting manifestation of telepathic information through the reins of our unwonted nervousness. She kept up this habit for some weeks, and we gradually cured her by getting out and standing talking to her till she chose to move on. She was a perfect hunter and feared nothing. So fearless was she that the first time I rode her with troops on a field day, as a " galloper " to the commander of one side, I was able to gallop her right up to the face of a square firing volleys. She was the unwitting cause of an amusing incident when H.R.H. the Duke of Cambridge was reviewing the garrison ; I rode her at the head of my little army ; it was a broiling hot day ; my wife on my proper charger was sitting, holding a white umbrella, a few yards short of the saluting point ; her horse slept quietly until he recognized the rumble of our wheels and saw the mare, when he suddenly trotted out and took his usual place ; my wife just managed to prevent him marching past. H.R.H. was, fortunately, amused rather than angered. It may be a wish father to the thought, but my memory retains an impression that H.R.H. himself had an umbrella up.

One summer my wife and I drove the mare over the Wicklow mountains for a deferred honeymoon at Arklow. The map was not very accurate ; but we managed to pick out the through track from the bye ones, and on arrival put up at a spotlessly clean cottage near the shore. We spent most of the time on the beach, letting the mare disport herself in the sea. On the return journey, when halted on a steep grade admiring the view, the mare backed down a bank and upset the dog-cart, breaking a shaft. After a long search we found a cottage, borrowed some rope and a piece of plank, put the shaft in splints, and completed the long journey slowly but safely. My colonel was so jealous of our expedition that he started off to repeat it, got lost in the mountains, and had to return. Though irrelevant to horse flesh, I remember that my wife thought how enjoyable it would be to row down the R. Barrow from Athy to Waterford ; we hired a skiff at Athy and enjoyed the easy going down to Carlow ; the next day we reached a part of the river that was canalized, wide, full of rushes, and exposed to all the winds of heaven ; after battling for hours and being blown back almost as far as we rowed each stroke, we abandoned the boat and took to the train.

My colonel was a famous pig-sticker and rider to hounds. He had not long before jumped a fence into a quarry ; some of the other sportsmen galloped round to pick up the fragments ; they found

him and his horse practically unharmed, and he was cursing himself for not knowing that the quarry was there. Later on he had the misfortune to lose the sight of one eye from crashing through a bullfinch. One day, when he was out hunting, one of my men, who was awaiting discharge as a harmless lunatic, was set to do a simple job of work in the colonel's garden; when the colonel returned he found the man, having done nothing, asleep in a bed of geraniums. As a consequence, orders were issued that all men were to be inspected at work daily before 9.0 a.m. As the Camp covered a large area, this meant a long walk before starting to hunt. When the meet was distant, we saved time by going round dressed in full hunting kit, less spurs and top hat, with a military cap and overcoat.

From the above it must not be assumed that life was all play and no work. There were frequent field days on the Curragh plain and occasional manœuvres. On one field day, a general asked a gunner battery commander why his guns were not firing at a certain target; the gunner, afterwards a well-known Master of Hounds, replied, "Oh, I haven't time for soldiering." One summer the Dublin garrison fought the Curragh one: in those days we still soldiered in full dress, and it was an inspiring sight seeing A.D.C.s, gallopers, and even whole squadrons of cavalry careering across country in summer time; but after a really wet day many of us had to sleep in our patent leather jack boots, as by no pulling could they be removed even after standing on one's head to let the water out.

There were some interesting characters in my unit. I remember particularly three N.C.O.s. One was English, a great stickler for discipline; if he was in charge of a job which elicited some grumbling, his answer to the grouser was invariably: "Horders is horders and must —— well be obeyed." Another was Scotch: it frequently happened on route marches that some vehicle in his charge broke down, got passed by all the others, and then followed on; eventually we discovered that this enabled him to pick up loaves that more careless people had allowed to drop out. The third was Irish: his principal qualification was a blind obedience to orders; I believe that if you had said to him, "Corporal—go and shoot yourself" he would have done it forthwith. In later years I met another Irishman of the same quality, a troop serjeant major: his troop was on a night march across country on a very dark night; at one point it was necessary to drop into a sunk lane and then turn sharp right steep down into a thick wood; the leading driver hesitated and said, "Major, this looks like hell," and the T.S.M. promptly answered, "Go to hell then."

With so much hunting, there was little time for shooting except for odd days of poaching on neighbouring bogs. My best sport was due to an invitation from a brother officer to shoot on his father's large property on the borders of Limerick and Tipperary. During

the Land League troubles the father's bailiff, who much resembled the father, had been shot dead one evening in the courtyard of the house, and next morning the father received an anonymous letter regretting that there had been a mistake in the identity of the victim. Within a few hours the father quitted the house, bag and baggage, leaving everything as it was, breakfast gear unwashed, beds not made, cues on the billiard-table. This was as we found the house some two years later, and I believe it remained so until the old man's death many years afterwards. We had to put up at the village pub. The grounds were full of pheasants, for some unknown reason not poached, and we had to hooroosh them off the window sills before we could shoot them. A near neighbour, a wealthy man, in a large domain completely surrounded by a high wall, had imported artisans from England and Scotland and lived in a state of siege, but entirely self-supporting. At another house the occupants had removed the staircase and retired nightly up a ladder which the last to bed pulled up after him. In Kildare, matters were much more quiet, of course; but one well-known landlord, also a well-known shot, after giving out that anyone who fired at him and missed was a dead man, went about with no escort except his own conspicuous revolver.

When we were shooting down Tipperary way, most of the inhabitants of Tipperary town were still living in a cluster of huts they called New Tipperary and we called Tin Town. The adherents of the "no-rent" campaign had chosen this typically Irish way of cutting off the nose to spite the face.

In the summer we had many pleasant evenings trout-fishing in the R. Liffey near by, with occasional week-ends on the upper reaches of this river and its tributary, King's River. The most successful sport, however, was when my wife and I, tired of the immediate proximity of soldiery in the Camp, hit upon a little coast village named Glenbeigh, between Tralee and Valentia I. To our horror we were woken up very early our first morning by the sound of gunfire, and found that "the powers" had this year chosen this remote spot for artillery practice. However, we found that two rivers, each about four miles long, flowing down from lakes in the mountains, were full of the most unsophisticated trout; we spent the mornings fishing up a river and the evenings fishing down, and on one occasion I caught three fish at one cast. In those days there was no railway, and the journey from Tralee had to be made in a four-wheel side-car. On the return journey, the centre of the car was occupied by enormous clothes baskets containing the mails; after a long delay, whilst the driver and the only other passenger were discussing the rival merits of whisky with and without water, we started off; the driver sat, or rather, lolled with loose reins, the ponies cantered, and the car swayed like a boat at sea; going across a long bog I noticed that

when I bumped into a basket there was no retaliative bump from the passenger on the other side; looking over the basket I found he had disappeared; looking back I saw a wee figure far away along the ribbon of the road; we waited, and when he reached us he said he had jumped off to get his hat.

The Curragh Camp, including its offshoots at Newbridge and Kildare, was for the officers—if not for the "other ranks"—a delightful station, so much so that several of us dispensed with our long leave. The Curragh garrison was for the most part housed in so-called Crimea huts, which were, generally speaking, in better condition than those at Aldershot. The huts were built along a low ridge near one edge of the plain, an undulating expanse, roughly five miles by four miles, of sound springy turf grazed by sheep. Most of the officers' huts were on the open side and one could start galloping from one's front door. A subaltern's authorized accommodation consisted of two rooms, nine feet by nine feet, in a hut consisting of four such pairs. Few of the married officers' quarters had enclosures, so the ladies who tried to grow window boxes had constant trouble in contending with the sheep. The sheep rather lent themselves to practical jokes, and were occasionally caught, leg-bound, and placed on someone's bed.

In our own mess dogs were allowed in for the simple reason that they could not be kept out. A brother officer had a pair of black-and-tan dachshunds who were so friendly as to be a source of annoyance to another officer who was that rare person, a dog-hater. One afternoon, when the dog-hater was alone in the ante-room, the General Commanding came to call, accompanied by his own two fawn dachshunds; the dog-hater, much to the surprise of the visitor, picked up the dogs by the scruffs of their necks and threw them out of the French window. Another brother officer had a pair of these dogs, and when ordered away gave them to a brother of his in Dublin; they were inveterate hunters and had often stayed out two or three nights at a time; after a few days in Dublin they were missing; and about a week after turned up at our mess, somewhat emaciated but obviously very pleased with themselves at having found their way over some 26 miles of unknown country.

For that period there was a surprising abstemiousness in the officers' messes, in many of which it was *de rigueur* to economize in drink in order to hunt. Occasionally, however, there were falls from grace. I remember a New Year's Eve dinner in a Highland mess when, rather late in the evening, someone called out "fire"; some of the diners rushed to a nearby fire piquet, seized the hatchets and ladders, and began hacking into the roof of a hut occupied by an old and very respectable civilian official and his daughters.

Somewhere in the early 80's I think, the Irish Government had started a Science and Art Department with the laudable idea of

teaching some science to the lower orders. Apparently any man or woman who could prove any knowledge of some scientific subject was allowed to start a class, usually a night class, and was paid not by results but on the number of his or her pupils. The head of the department was an ex-officer and an Irishman. Whether or no he mistrusted his own compatriots, he offered British subalterns employment as occasional inspectors at a fee of £1 a day plus travelling expenses. Most of us jumped at this offer, as, although all such absences counted against our quota of leave, it caused us to travel over a large part of Central Ireland and to know the people, and it helped us to pay our hunting expenses. The inspections were of two sorts, one the attending of a periodical examination, the other a surprise visit at any time. The latter often necessitated a long journey on the receipt of a telegram.

Several happenings linger in my memory. On one visit to the west, to attend an examination of a class run by some priests, I found everything as it should be; but after the examination I was introduced to the priests' common-room for a night-cap, and the whisky was so potent that I was only just able to struggle back to the hotel and throw myself on the bed before I fell asleep.

On a similar visit to the capital of a north-western county the class consisted of a large number of girls in a convent. I was seated on a dais; nothing I could do availed to stop the constant chatter, even the nuns being oblivious of the most important of the rules; and the last straw was when a collection of blanc-manges and lemonade was put down for my regalement. I reported the examination as invalid, and was glad to escape another visit to the same place. In that town a very large cathedral, about ten times the size necessary for the inhabitants, and built regardless of expense, was approaching completion. I asked one of the nuns where the money came from, and she replied "mostly from raffles." It appeared that the prizes offered included at the head such expensive articles as pianos and dog-carts; when the results were published these prizes always happened to fall to some (non-existent) emigrant in Australia or Canada, and were thus available for the next raffle. The priests, by reading out in chapel the names of subscribers, ensured a full measure of contributions.

One school to which I made a surprise visit was held in a barn, and a few bare-legged and empty-headed boys were being taught the elements of electricity by the light of a farthing dip and a black-board. On another occasion I was ordered to visit a school near the capital of a central county. On arrival I found great difficulty in finding anyone who had ever heard of the village, but at last I found a jarvie who said he thought he knew the way. It was a pitch black, pouring wet night, so, in spite of the reputed distance of seven miles, I started off in a brougham instead of a side-car. After

an hour or so we were going up a very steep hill; the horse jibbed, and I got out and pushed behind; the horse then plunged forward, my hands slipped off the back of the cab, and one wrist fell on some spikes on a false back axle such as was usually provided on such conveyances to stop little boys riding behind. I bound up my wrist, and got in again. Soon the horse jibbed once more; I looked out of the window and saw a blank space; I jumped out, and the rain having stopped and a moon emerged, discovered that we were nearing the top of a spiral track in a quarry. We took the horse out, turned the cab round, harnessed up again, refound the road, and eventually arrived at the village. Everyone in the few cottages seemed to have gone to bed. But eventually I discovered that the schoolmaster had been dead two years, and his brother had been submitting false returns and drawing the fees.

Next morning I repaired to the doctor to have my wrist attended to. He was extracting a tooth from a country wench. When it came out she put her hand to her mouth and said, "But dochter ye've taken the wrong tooth; 'twas on the ither side." So then he extracted the real culprit, and on her query, "How much do I owe ye?" replied "A shillin'."

These journeys often necessitated long drives by side-car. On one occasion the following conversation took place between the jarvie and me:—

Jarvie: There's goin' to be a ribillion soon.
Self: Really, and who's going to rebel?
Jarvie: All the people av coorse.
Self: Who are they going to rebel against?
Jarvie: The Govirnment av coorse.
Self: Have they got any rifles?
Jarvie: Stacks av thim.
Self: And ammunition?
Jarvie: Lashons.
Self: Then why don't they rebel now?
Jarvie (pointing to a village on a hill): Shure, are not they afraid of thim two polis up beyant there!

Many of the hotels then, even in the larger towns, were indescribably grimy, more especially the bedrooms; and the food was extraordinarily lacking in variety, consisting mostly of mutton chops and bacon and eggs. The "service" was in keeping, but much could be forgiven on account of its friendliness. Once, when the calling of me to catch an early train was overlooked till apparently past remedy, the boots said to the boot boy, "Run, Mike, and do be stoppin' the train;" on arrival at the station I found the train well on the move, and a porter running after it waving a lantern; the train returned and all was well.

After more than three of the most enjoyable years of my life, my

unit was moved to Aldershot. In those days troops changed station complete with horses, vehicles, etc. We marched up to Dublin and spent the night at Portobello barracks, the women and children and the heavy baggage going respectively by passenger and goods train. On arriving at North Wall next morning there were no signs of the baggage and after a long search we found it forgotten and forlorn on a distant siding.

We embarked on H.M.S. *Assistance*, an ancient vessel famed for its "liveliness" in anything but a dead calm, which carried out all the coast-wise transporting of troops. Every voyage was prophesied to be her last.

The first night out we dressed in mess kit; but when we reached the open sea, the old ship began to hum, and most of us were soon obliged to go to bed without any undressing. The whole passage was as bad as it could be, and it was not until we reached Portland that the invalids could trust themselves on deck. If I remember right it took four days, whereas the usual time was two, and we were mighty glad to get into Portsmouth Dockyard. It was the normal custom for troops disembarking there to spend one night in Cosham barracks to recover their shore legs. For some unknown reason we were ordered to march straight off to Petersfield. It was a bright, clear autumn morning; and one of the views that linger in my memory is that from the Portsdown Hills over the smiling landscape to the north. After the bedraggled drabbiness of Ireland, it all seemed so clean and tidy.

On reaching Aldershot the next morning we were greeted with the news that we were for an annual inspection on the following morning. Perhaps this was the usual method of taking the conceit out of a newcomer to the holy of holies. The men sat up nearly all night cleaning their personal equipment, harness, etc., and the only fault the inspecting officer could find was that our bugler was fuddled with drink.

II.

After a tour of service in India I found myself back again in Ireland, this time at Athlone, which is as near as possible the centre of the "distreshful counthry" and more or less surrounded by vast bogs. (*Pace*, the title of these reminiscences, I was then a Captain.)

Playing a lone hand I was able to take a house some distance out on Lough Ree. For this and about 60 acres I paid £60 a year rent. The lake provided many pleasant summer evenings fishing for perch; and near where I kept my boat, a snipe and I played Aunt Sally many times until a brother-in-law came to stay and shot him at first sight.

The town consisted very largely of public houses with and without off-licences. The principal general emporium was kept by a voluminous old dame who had two sons, well known to be inveterate poachers. Often, when my wife went to buy something, she would sidle up to her with a lump in her apron, and say " Here's a foine phaysant for ye, de bhoys found it wounded on de road and had to put the poor crayture from its misery." On one occasion this happened just after the shooting season had ended and our guests at dinner included our landlord, the agent for his brother's big shoot.

An instance of blind obedience to orders was afforded by a neighbouring cottager who used to take our washing to the town. My wife always said " Mcfie, take this basket to the laundry and leave it." On one occasion she saw it in the house the same afternoon, and he said, " Well ma'am ye tauld me to take it there, but ye niver tauld me to lave it, so I brought it back."

My charge included the whole of central Ireland except Dublin itself and the Curragh. So my duties took me over much of the same ground as in previous years on Science and Art Inspections. Most of the rail journeys on branch lines were very tedious, and frequently two days were spent on a duty lasting no more than two hours. I also covered many miles by road : on one occasion I was accompanying my Chief on a side-car with an extremely fidgety mare in the shafts; eventually she broke into a canter, and turning a bend, bumped into a low stone wall and upset us over it into a field ; on our expostulating to the jarvie, he said, " It's dis way, sorrs; I only bought de mare yisterday, and the fellah I took her from tauld me ' For God's sake don't ye drive her.' " At Galway once, at the start of the salmon run, the banks were lined with fishermen on such short " stands " that they looked as if a bait-and-float fishing competition on the Upper Thames was in progress ; at the same time, boys from the town were on the weir trying to catch salmon in umbrellas. One year I had occasion to visit Achill Island, and stayed at a little hotel kept by a descendant of Sheridan, a keen ornithologist, who lived a lonely life there to observe migrant birds. He told me an amusing story, illustrating the readiness of Irish wit. Arthur Balfour was on a tour finding out what he could do to assist " congested districts." At Achill the inhabitants stated they wanted a railway.

A.B.: What for ? *Achill:* To take away our prodjuce av coorse. *A.B.:* What produce have you ? *Achill:* Arl sarts. *A.B.:* Have you any flying fish ? *Achill:* Av coorse we have—Faith, in the summer there's so many av thim we do be shuttin' our windies to stop thim flying into our rooms.

I believe they got their railway.

Dotted about the country were numerous small barracks, built, I believe, after the great rebellion of 1798 and still maintained by the War Department ; most of them were let to tenants ; they

proved very useful again during the Sein Fein troubles after the Great War. On the west coast there were also some Martello towers, relics of the Napoleonic wars. At Athlone, outside the actual town, was a small fort of the Vauban type, of which the ground had been leased by the War Office for some hundred years. Apparently some W.D. economist discovered this, and orders came for the land to be handed back to the owners. The ground must originally have been allotments for the owners were quite numerous. They were not over-pleased at having, without compensation, to take over comparatively small plots that once were level but now had sections like the chart of a fever patient.

Near one Militia barracks there was a rifle range of which the stop butt was a natural mound some 200 feet high, the danger zone behind being an extensive bog. During one training period, while musketry was in progress from the 200 yards firing point, a turf cutter on the bog was shot in the leg ; a court of enquiry was held, and the victim was awarded £25 damages. Next year another man was shot ; the court found that a number of the bog savages had been deliberately walking up and down the bog on the chance of picking up a fortune in return for a harmless puncture ; and the victim got nothing.

At another depot station a new rifle range was to be built. The technical staff being short, the War Office engaged a pensioner from a Colonial Public Works Department to survey the bog and take the levels of the target line and the firing points. He took a considerable time over this ; and before (luckily) work was commenced, it was accidentally revealed by men who had carried his instruments from the station that he had spent all his days at a wayside pub, laboriously compiling a series of imaginary level readings.

The General commanding the Dublin district was Viscount Frankfort de Montmorency. He liked to make inspections at short notice and detested finding anything specially "got up" for the occasion, such as a remarkably good dinner in the men's barrack rooms. On inspecting units prior to departure for the East his pithy but most valuable advice was—"Keep your bellies warm and your heads cool."

The Commander-in-Chief was Earl Roberts. At one of his annual inspections of the Athlone garrison, I, as the solitary non-participant, was deputed to meet him at the station. It was a pelting wet day. Dear old "Bobs Bahadur" arrived with one A.D.C. The last time I had seen him was at Rawalpindi when, as Commander-in-Chief in India, he had inspected the *enceinte* defence works then in progress. His arrival was in brilliant Punjab winter weather, he had a numerous staff, and a large escort of, I think, all arms.

The country round Athlone being mostly bog, there were no regular packs of hounds within riding reach and officers had to train to the

West Meath or the Galway Blazers. My first summer, before I realized that my duties would allow of no time for hunting, I bought a mare at a country fair. She was half-sister to Frigate, the Grand National winner, and a most beautiful creature. Her price was £45, so we knew there must be a snag; but I tried her over fences, found she had a silken mouth, and had her passed sound; so decided to risk it. When she reached our stables she was tied to a wall ring in a loose box, in case she might be troublesome in grooming; she soon pulled the ring out, and we discovered that one idiosyncrasy was a dislike of being tied up. The first time I took her on the road she stopped short after a mile or so, and at once started backing of her own accord, moving as fast as when walking forward. For several days I tried to cure her by letting her back as far as she wanted, often a quarter mile, and waiting till she chose to go forward again; but this time patience had no reward. Then one day, when my wife was riding her and she jibbed as usual, my wife gave her a wallop which started her cantering on; the mare then proceeded to gallop, without any attempt to run away, and my wife made her go on galloping for several miles till she was really tired; the mare never jibbed again.

Next winter a local gentleman farmer raised a small pack of hounds to hunt carted deer. I took the mare out for the opening meet. There was a thickish mist that day. After the stag had been enlarged and given some law, hounds were laid on. The mare jumped like a stag, but I found her usual silken mouth quite uncontrollable. The fences, stone-faced but rotten banks and boggy ditches, being more than unpleasantly tricky, I took the opportunity of landing in a lane to pull her out and start off home. The mist soon became a fog; and some little time later, to my intense annoyance, the stag crossed the road just in front of me and, before I could stop her, the mare jumped out of the road and galloped after him. Fortunately, the music of the hounds behind was muffled and there were no other horses to excite her, and I succeeded in pulling her out once more. I have never forgotten the look of intense horror in that stag's eyes when he crossed the road, and have often wondered how soon tame stags become accustomed (as they undoubtedly do) to being hunted. I sold the mare at one of the principal fairs in the south for more than I gave for her, so all was well.

It was, I think, on some of my travels that I heard the following yarns. The first concerned the Council of a well-known lake resort. One of the councillors proposed the purchase of a "gondōla" as likely to be an attraction for tourists. Another agreed, but considered it would be advisable to purchase a pair, as then the "gondōlas" might breed with some profit to the council.

The other story I have always thought a very apt sample of the true Irish wit, which generally contains a hidden vein of sarcasm.

Pat Murphy was had up before the Resident Magistrate for being drunk, was fined 2s. 6d., and paid up. When told to "get down" he remained in the dock, and after several exhortations to remove himself the following dialogue took place :—

R.M.: For goodness' sake, get down, man.
Pat: Not till I have yer recate.
R.M.: What on earth do you want a receipt for ?
Pat: Well, it's dis way yer 'anner. When I go to heaven, St. Patrick will be at the gate ; and he'll say "Pat, ye was dhrunk" ; and I'll say, "I was that once yer holiness, but I paid me foine" ; and he'll say, "then where's yer recate." And a moighty quare fool I'd be looking then, runnin' up and down hell lookin' for ye to give it me.

My two tours in the Emerald Isle left impressions of the national characteristics of the lower classes of its inhabitants that interested me greatly in the troublous years after the Great War. They had a great propensity for drink ; perhaps the fact that the frequent rain made them wet outside induced them to keep themselves wet inside as a corrective to conflicting temperatures of the body. I remember once dining with a very aristocratic but not over wealthy widow, who took great pride in having everything pertaining to her household in the very best style. The coachman-butler created considerable alarm by the manner in which he handed round the soup ; at the fish course he was even more erratic. His mistress then said to him : "Conolly, you're drunk." To everyone's surprise he answered simply, "I am, ma'am," and took his departure from the room.

It has been truly said of the Irishman, who is always against any Government, that "he does not know what he wants and won't be happy till he gets it." Another characteristic is their inconsequential behaviour ; it is a truism that in Ireland it is always the unexpected that happens, but it does not happen in the way you would expect it to if you expected the unexpected.

They have a gift for ready repartee ; but while ever prepared to make fun of others, they much dislike being made fun of. They also have a talent for impromptu apt descriptions, as when a serjeant, drilling some men who were marching with wobbly knees, said, "Now thin nombre wan phlatoon, buck oop ; ye're loike a lot of —— dooks." Or when an old dame, asked how a certain Council was functioning, replied, "Shure, not at all ; but phwat wad ye expect whin de Prisidint always has a dhrip to de ind av his nose."

Instances of their capacity for blind obedience to orders have been given above.

A bad trait is their moral cowardice as individuals. In mass they may be brave enough, and few troops have shown more courage

than Irish infantry in battle. But individually they lack the courage to act according to their own true convictions, and are always afraid of "what the other fellow will say." Hence they are easily gulled and led by any intimidating agitator.

Their worst trait of all is the latent streak of cruelty that seems to break out about once in every generation, as manifested during the numerous risings since 1599, and most recently exemplified in the horrible brutalities committed during the Sein Fein rebellion.

III.

What the native Irish used to call "the English Garrison," namely the English and Scotch families which, to provide a pacifying element, were planted in Ireland by James I., Oliver Cromwell, James II., William III., and after the 1798 rebellion, was constantly being recruited by British Officers, who, having served in Ireland and learnt to like the people, the facilities for sport, the happy-go-lucky life, and even the climate, settled there after their retirement. This custom brought a deal of money into the country and added appreciably to its prosperity.

In my Curragh days I had found an ideal site for a house, a place where a mansion belonging to a titled namesake of mine had been burnt down in 1798. I made a plan of a house, and for over thirty years looked forward to joining the "English garrison" myself. After my own retirement in 1920 this site was not immediately available; but I found a house for sale that I had always admired, and entered into negotiations for its purchase. When I went over the unrest was no worse than in the times of the Land League and had the same humorous elements. During my three weeks' stay the agitation seemed to burst suddenly into terrorism and rank anarchy, and on my departure at North Wall the gangway was guarded by British sentries with fixed bayonets. Not long after, I heard that the Sein Feiners felled some of my host's trees across the roadway; the military came along and with the help of some of the villagers removed the obstructions; then the Sein Feiners came back, found the men who had assisted the military, took off their clothes, and marched them up and down the road.

I ceased negotiations for the house until the troubles should blow over. They never did.

CONSTRUCTION OF STEEL AND CONCRETE WATER TOWER.

By LIEUT.-COLONEL F. HIBBERT, M.C., R.E.(T), M.INST.C.E., F.G.S., C.R.E. 53rd (Welsh) Division.

AN elevated storage tank was required to meet the needs of a new housing site, the ultimate demand being based upon the maximum possible development of 400 houses, with an average population of five per house, requiring 20 gallons per head per day.

A capacity of 80,000 gallons, therefore, provides 48 hours supply in case of breakdown in pumping arrangements, supply of electrical energy or other causes.

The supply is taken from an existing service reservoir at ground level, which is supplied by gravitation from an impounding reservoir 26 miles distant.

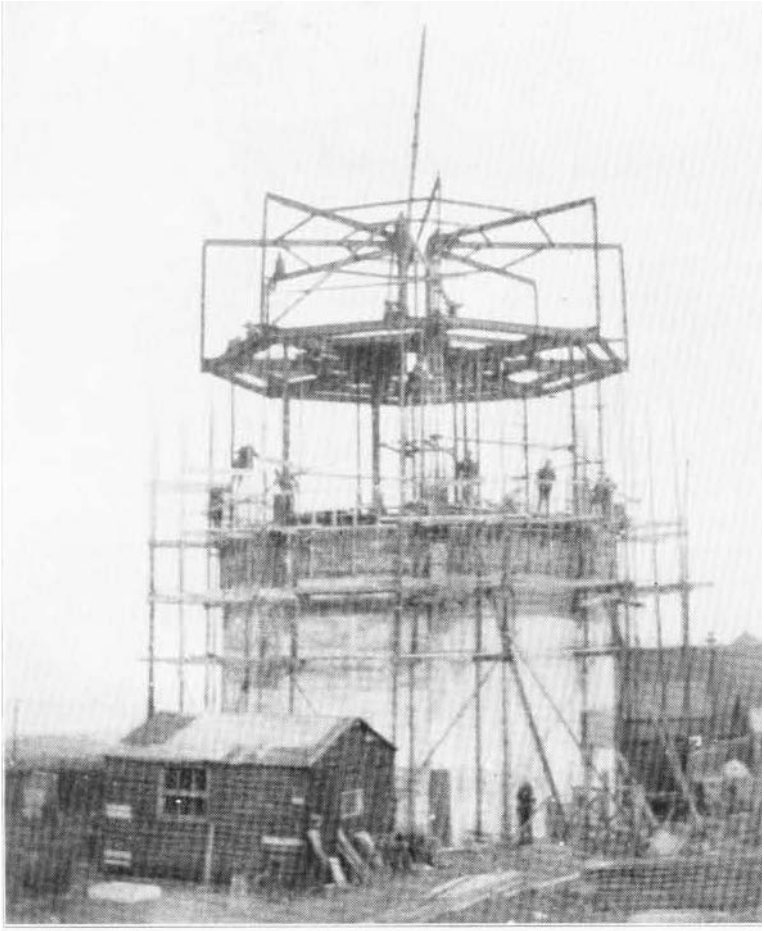
The tower has a total height from ground level of 60 feet—the tank is 12 feet deep and contains 80,000 gallons when full.

It is octagonal in plan, the tank being carried on eight main columns on the outer circumference and eight secondary columns on an inner circumference, the columns in each set being braced by circumferential beams, and the two sets of columns braced together by radial beams.

The radial beams at the base of the tank form the floor beams and the corresponding beams at the top of the tank form the roof beams, columns at the points of the octagon connect floor and roof beams, and these, together with the columns in the circumference of the access shaft through the centre of the tank to the roof, form the support to the roof.

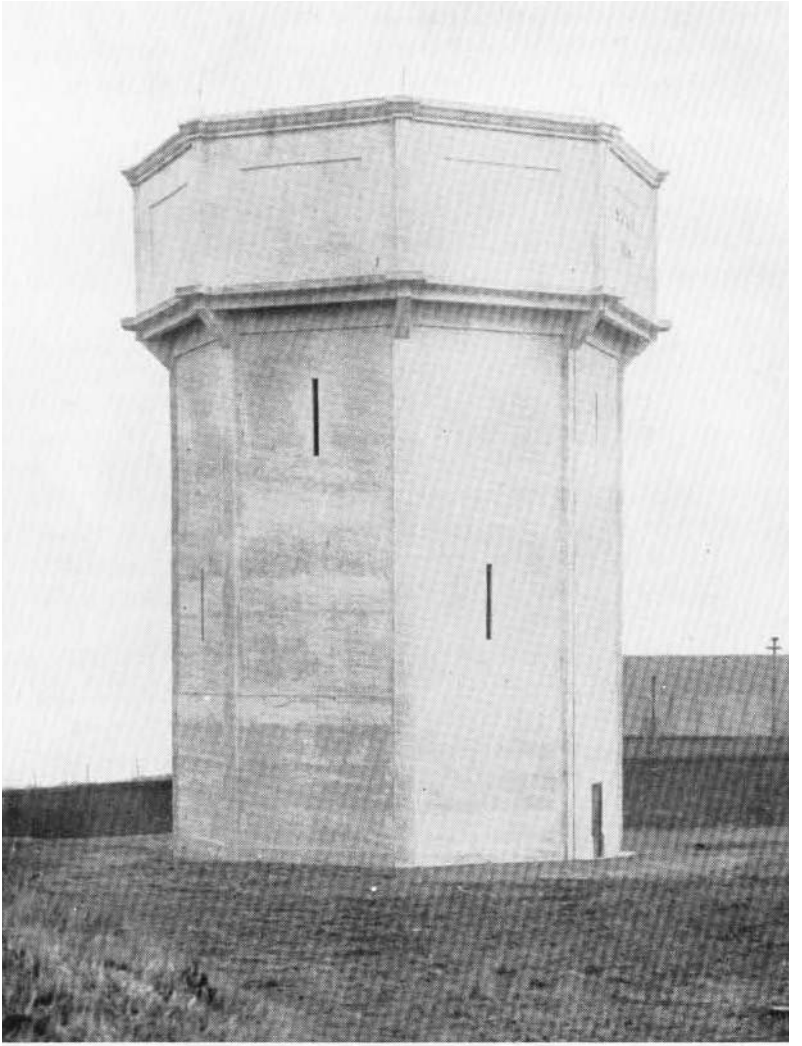
The space inside the inner set of columns from ground level to the first tier of radial braces is enclosed with a concrete wall and roof, and forms a convenient room for housing pumps, motors, switches, water level indicators, etc.

Electrically-driven centrifugal pumps raise the water to the tank, the pumps being automatically controlled by means of float-operated switch gear. Two sets of pumps are installed, the switch gear being so arranged that the pumps come into operation at different levels of water in the tank, so that for normal working one set is sufficient to meet the demand, but in case of fire when there is an extraordinary demand, both sets will come into operation. The arrangement also



Photograph 1.—Framework of Tank.

Construction of steel & concrete water tower photo 1.



Photograph 2.– The Tower completed.

Construction of steel & concrete water tower photo 2

allows of each set being given the normal duty in turn by the introduction of a change-over switch and also provides a standby set for normal work.

In this particular case the site is in a very exposed position, and something in the nature of a solid elevation was required to conform to surroundings, so as to avoid the usual " spider " elevation of a water tank on legs. Consequently the resistance to wind pressures was very much increased, and these factors had some bearing in the decision to depart from the use of ordinary reinforced concrete, as well as the fact that the work could be carried out as cheap if not cheaper.

This water tower, though a composite structure of steel and concrete, differs entirely in detail of design and method of construction from the ordinary character of reinforced concrete with which we are familiar.

In this special character of construction, the major part of the steel employed takes the form of a rigid pre-erected skeleton framework of the ultimate composite structure, which steel skeleton is designed of sufficient strength to carry, without additional support, the temporary centring, the wet concrete and the working loads incidental to construction.

As in this case the initial structure is of steel, which is ultimately reinforced by concrete, the system of construction would appear to be more suitably described as " Concrete Reinforced Steelwork," rather than reinforced concrete.

The pre-erected steel skeleton of this tower is built up partly of structural steel sections and partly of plain round mild steel rods ; these units being connected in a special manner so as to ensure the necessary co-ordination between them, and between each of them and the concrete in the ultimate composite structure.

This special combination of structural steel sections, bars and concrete has been so devised as to admit of the application thereto of the basic principles underlying the accepted data of design of reinforced concrete structures, and the method of combination which permits of this application is the subject of a patent.

This improved character of construction must not be confused with concrete-cased steelwork construction, wherein the structural steelwork itself is designed to meet the ultimate load for which the structure is required, and wherein the concrete is simply a protective casing and additional dead load to be carried.

In the case of this " Concrete Reinforced Steelwork," the metal employed, although of sufficient strength to carry the dead load and constructional loads, is of insufficient strength in itself to carry the ultimate loads ; the structure being incomplete without the addition of the concrete.

From this it will be appreciated that the full structural value of

the concrete is taken advantage of and thereby very considerable economy in steel is effected.

The pre-erected skeleton framework of this tower comprises the steelwork of the columns, horizontal braces, tank wall members, and the main and secondary beams of the tank floor and roof.

This initial steel structure is erected upon reinforced concrete foundations of the ordinary type, and, as will be appreciated, forms a complete rigid and truly aligned steel skeleton of the ultimate water tower.

As the moulds or centring for the concrete may be entirely suspended from this pre-erected structure, the process of construction is considerably simplified as compared with the tediously slow and expensive process involved in the case of the ordinary type of reinforced concrete construction. It will be appreciated that as the initial steelwork structure is designed to carry the dead loads, the moulds or centring may be removed as soon as the concrete has set sufficiently to adhere to the pre-erected steel, so liberating it at very much shorter intervals than has been possible hitherto in the case of the ordinary type of reinforced concrete construction.

The temporary shuttering to form the floor and roof slabs is carried from the sides of the beam boxes, which in turn are suspended from the pre-erected steel skeleton already described.

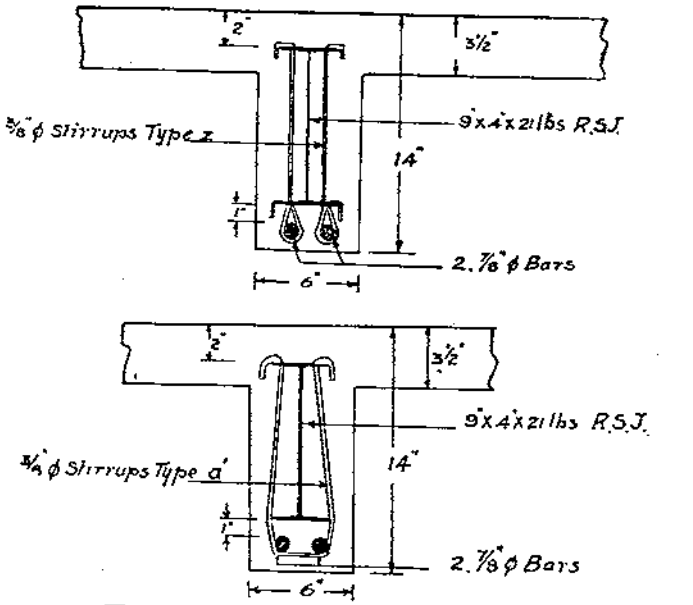
The time which the centring was allowed to remain in position is governed entirely by the short span slabs, which do not contain rigid reinforcement.

As soon as the slabs have matured sufficiently, the whole of the centring of both beams and slabs may be struck and it is found possible to do this within two to three days of the placing of the concrete concerned.

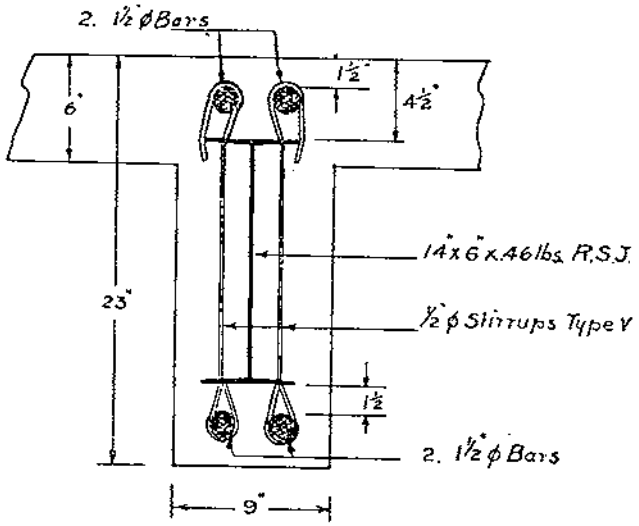
In this system of construction, as in the case of ordinary reinforced concrete construction, the slab forms the compression part of the beam. It is unnecessary, however, in this case, to cast the slabs at the same time as the ribs of the beams, because efficient mechanical combination is afforded by the pre-erected steel structure.

In the case of ordinary reinforced concrete work, this simplification of the process of construction cannot be allowed and all those familiar with the process of construction of such work will appreciate the advantage of this new method, wherein the procedure definitely specified is to cast the ribs of the beams to a level of $\frac{1}{2}''$ or so below the soffit of the slabs, prior to the concreting of the slabs. It will be appreciated that the constructional process is simplified considerably by deferring the placement of the reinforcing steel for the slabs until after the concrete is poured into the lower part of the beams.

The accompanying diagram of a typical beam built up in accordance with this new system of construction will serve to explain its action. It will be noted that the bars are placed below the tensile



TYPICAL CROSS SECTIONS THROUGH MAIN ROOF BEAM.



TYPICAL CROSS SECTION THROUGH MAIN FLOOR BEAM.

flange of the R.S.J., that is, in a position more remote from the neutral axis of the beam, and they are held rigidly in position by means of stirrups which pass around the bars and through the metal of the flanges of the joist.

Towards the end of the beam the bars are bent up at 45° and are hooked at their ends in the manner of ordinary reinforced concrete construction, short stirrups connecting their upper ends to the compressive flange of the R.S.J.

To enable these bars to pass up in a vertical plane into the compressive area of the concrete, the lower flange of the joist is notched.

At the first stage of the constructional process, the R.S.J. carries the dead weight of the centring and the concrete of the rib of the beam only, so that at the time the concrete in the lower part of the beam sets, there is an initial stress of something like 4,000 lb. per sq. inch in the R.S.J., while the bars still remain without stress.

As soon as this first-placed concrete has set, there is complete mechanical combination between the bars and the R.S.J., afforded by means of the stirrups, which pass through the metal of the joist, acting in conjunction with the concrete.

At the next stage of construction, that is, when the concrete slab is placed, the additional dead load is taken by the new beam section which has become a composite structure in its lower part, but which still remains a naked steel structure in its upper part, and free to deflect until the slab concrete has set.

This second stage of construction adds a stress of something like 2,500 lb. per sq. inch in the tensile flange of the joist, and induces a first stress of about 4,000 lb. sq. inch in the bars, which are more remote from the neutral axis.

When the full working load is applied, the tensile stress in the R.S.J. flange is increased by approximately 9,500 lb. sq. inch and in the bars by 12,000 lb. per sq. inch.

The intensities of stress quoted are assumed for the purpose of explanation of the three-stage action and on the assumption of an allowable tensile stress of 16,000 lb. sq. inch in the extreme fibre. And it will be noted that the sum of the stresses in the flange and in the bars both reach this allowable intensity, although the one is closer to the neutral axis than the other.

This unusual and obviously economical condition of stress would appear unobtainable in any other character of structural work.

In the design of water-retaining reinforced concrete structures, it is essential in order to ensure watertightness, to limit the tensile stress in the steel reinforcement to an intensity within which the concrete will follow the deformation in the steel without developing minute cracks, this limit of stress being somewhere in the region of 12,000 lb. per sq. inch, as compared with 16,000 lb. per sq. inch which is accepted as the safe limit in general structure work.

In the special character of construction described in these notes, however, there is an initial stress in the steel at the time the concrete sets around it, so that the limit of tensile stress allowable in a completed water-retaining structure becomes 12,000 lb. per sq. inch plus the intensity of stress imposed by the dead load carried at the time the concrete sets, so long as the sum of these two values does not exceed the safe allowable tensile stress in steel.

Similarly, as the compressive part of the R.S.J. is initially stressed prior to the setting of the concrete, the compressive stress ultimately taken therein is not limited to 15 times the stress in the concrete, as it essentially is in the case of the ordinary type of reinforced concrete structure work.

The design of beams may be such that the initial stress in the compressive part of the R.S.J. when added to 15 times the stress in the concrete reached the full allowable compressive stress in naked steel, which is nearly double the intensity obtainable in ordinary reinforced concrete.

The columns and braces supporting the tank are reinforced in accordance with this principle of imposition of an initial stress in the R.S.J. core, so resulting in a much less overall concrete section than is obtainable in ordinary reinforced concrete work.

The standard specification for cement was used and the proportions of gauges of the standard reinforced concrete mixture measured by volume was as follows :—

3 parts of $\frac{3}{4}$" down to $\frac{3}{8}$" aggregate as specified.
1 part of $\frac{1}{4}$" down to $\frac{1}{8}$" aggregate as specified.
2 parts of sand as specified.
1 part of British Standard Portland Cement.

The usual precautions were taken with regard to testing, mixing and placing of concrete.

In addition to the usual crushing tests to ascertain the compressive value of the concrete at seven and twenty-eight days, percolation tests were applied to $2\frac{1}{2}$" thick test slabs representing the concrete mixture.

Water pressure was applied on one face of the test slab, commencing with ten feet head, and increasing by ten feet head daily until 40 feet head of pressure was reached, which remained applied for four days.

In order to comply with specification, no sign of moisture must appear upon the opposite face of the slab at any stage throughout the test, and on completion of the stated period, the said face of the slab must remain quite dry.

No difficulty was experienced in complying with this specification after the concrete mixture had been carefully adjusted.

All steel used was of British manufacture and complied in all

respects with the current British standard specification for mild structural steel.

The normal period required for the construction of this tower is four months, provided reasonably good weather conditions prevail.

Actual costs are shown below, and in this connection it should be noted that the site is 1½ miles from the nearest railway station and approximately 500 feet above the level of the station, with gradients of 1 in 6, so that haulage costs were unusually high.

Tower complete with access ladders, manholes, lightning conductor and pump house, excluding Engineer's fees and wages of Clerk of Works	£3,540
Pumps, motors, switchgear, float arrangements and pipe work, excluding cost of connections to main cable and main water pipe	£501

Comparing the actual cost of this water tower with the estimated cost of construction by ordinary reinforced concrete, there was a saving of over 10%, but there would be a greater percentage saving on a tower of normal design, *i.e.*, a tank supported on legs without the outer solid walls, as the method of construction of the walls is common to both systems.

The time factor is also very important, as the system adopted shows a saving of at least one-third the contract time, the value of which will vary according to the need for the particular work.

Photograph 1 shows the water tower in process of erection, and Photograph 2 the completed structure.

[*Note.*—Two large drawings showing details of steelwork, etc., have had to be omitted. ED., *R.E. Journal.*]

The Bridge in Use

A timber pile bridge in upper Burma

A TIMBER PILE BRIDGE IN UPPER BURMA.

By LIEUT. J. R. S. W. ELKINGTON, R.E.

THE following is an account of a road bridge in Upper Burma and of its construction by a detachment of the 12th Field Company, Q.V.O. Madras Sappers and Miners, working as contractors for the Public Works Department. The work presented several unusual features and it is thought that it was sufficiently outside the ordinary run of S. and M. Field Company work in peace-time to merit description.

Readers from India will be familiar with the system by which the Indian Government permit technical troops to undertake contracts for the P.W.D. or railways. At present the rules applicable to Sappers and Miners are briefly :—

(i) Only 50 per cent. of engineer pay of troops employed on contract work is paid by Government. The remaining 50 per cent., naturally has to be paid to the men from the contract.

(ii) No extra expenses will be borne by Government. This condition imposes many liabilities on the Officer Commanding. Journeys connected with the contract are " unauthorized " and railway warrants cannot be used ; loss of and wear and tear of tools has to be made good.

In May, 1930, the Executive Engineer, P.W.D., Mandalay Division, an ex-Madras Sapper, offered the company the opportunity of tendering for the construction of a timber pile bridge over the Htongyi Chaung on the Kyankse–Kume road, some 40 miles south of Mandalay. The Htongyi Chaung was at that time bridged by an old timber bridge of uncertain age and strength, which, during the rains, was frequently submerged. It was proposed to build a new bridge at a higher level and of greater span. The new bridge was to be built on dry land and the river afterwards diverted underneath it ; the site plan shows how this was to be done. In the photograph the excavation for the waterway can be seen. The whole scheme was part of the Rangoon–Mandalay trunk road now nearing completion.

The Proposed Bridge.

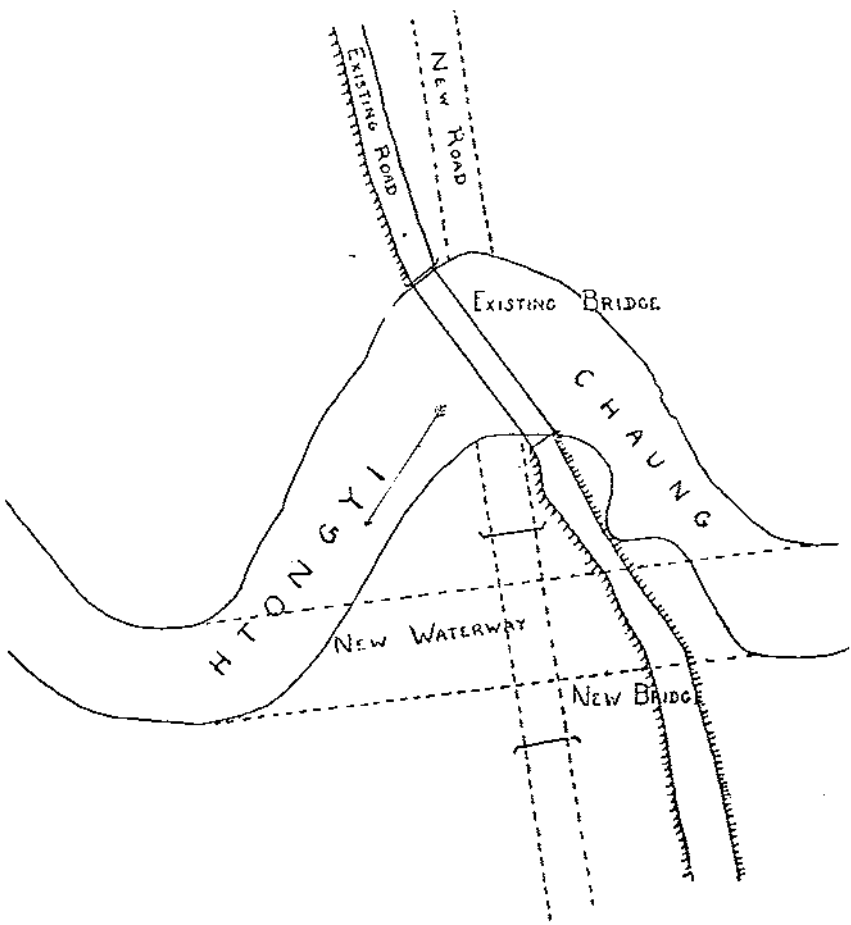
The bridge was designed by the P.W.D. to carry a ten-ton road roller. It consisted of four R.S.J. spans, each of 43 feet, carried on timber pile piers. The timber was intended to be pyinkado throughout, but to use up old stock, some teak was actually used. Pyinkado

is a very hard and brittle local timber—in water it possesses the annoying property of sinking like a stone.

Piers.

The type of pier is shown in Fig. 1. The load is taken by four 12 in. × 12 in. pyinkado piles driven to a set of one inch in the last four blows of a one-ton monkey from a ten-foot drop.

SITE PLAN



The method of construction of the piers differed from military practice. Instead of cutting off all piles at one level and fitting a cap across them each pile was to be cut off square at whatever level below the head the timber was sound. Extension pieces were fitted to the piles with a butt joint and four-inch wooden fishplates and carried up to transom level. The piers were braced with two double

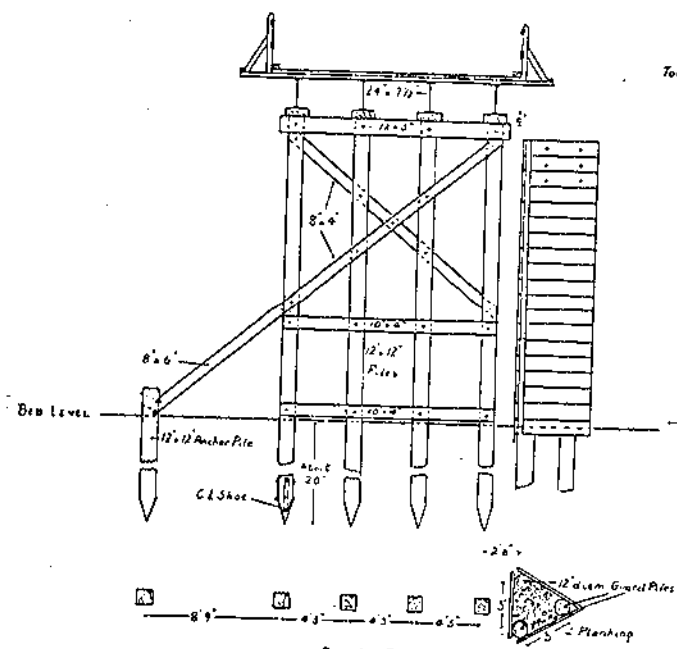


Fig. 1 Piers
Scale 5 Feet to 1 Inch

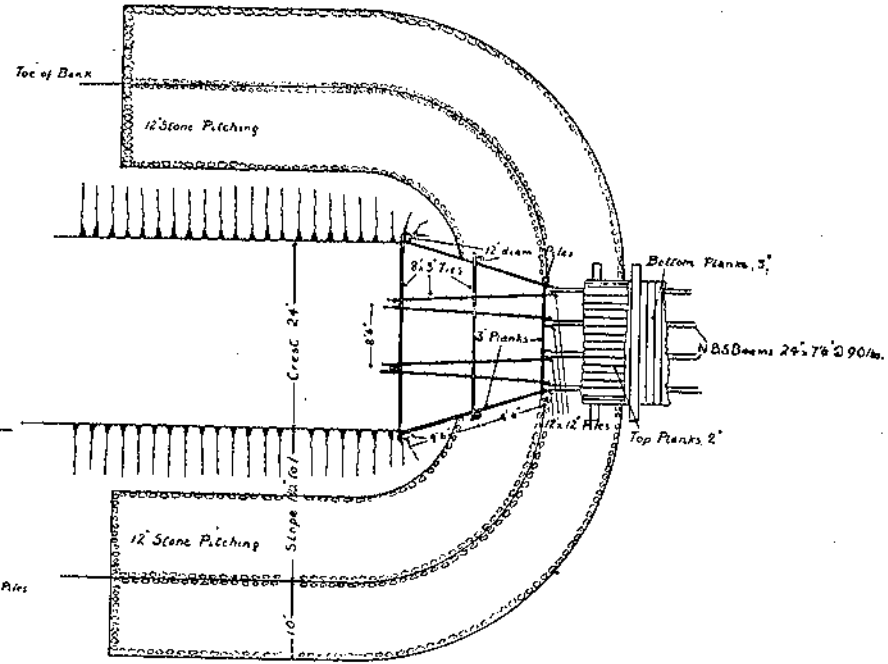


Fig 2. Plan of Abutment
Scale 10 Feet to 1 Inch

horizontal braces and with diagonals. The whole pier was strutted to an anchor pile on the downstream side.

Guard Piles.

Each pier was provided with a guard on the upstream side, to prevent floating trees striking the pier. These were formed by three 12-in. diameter round piles driven in the form of a triangle. Two-inch planking was bolted to the outside of the piles and the enclosed space filled with rubble, see Fig. 1.

Abutments.

Fig. 2 shows one of the abutments, both of which were similar. The load bearing piles were tied back to anchor piles, 20 ft. behind the face of the abutment, by timber ties. Return walls of three-inch

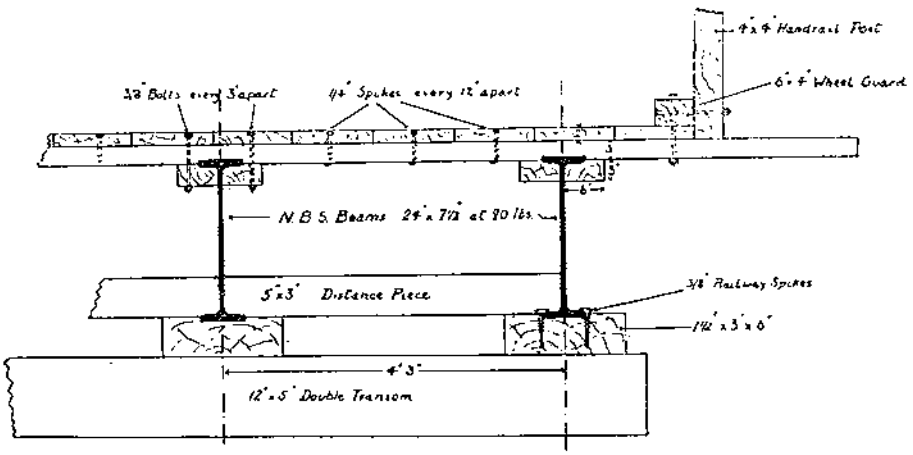


Fig. 3. Fixing of Decking.

planking bolted to 12-in. round piles were provided. The return walls were tied together under the roadway by timber ties.

Girders and Decking.

The road bearers were 24 in. x $7\frac{1}{2}$ in. R.S.J.s, four in number spaced 4 ft. 3 in. centre to centre. This size of girder was adopted because the timber bridge will be replaced eventually by a masonry one for which the same road bearers will be used.

Transverse decking would need to be very heavy to carry a 10-ton roller with the wide spacing of road bearers adopted. The P.W.D. design overcame this difficulty by laying the decking in two layers, one transverse and one longitudinal, firmly bolted and spiked together. Fig. 3 shows a detail of the decking. The lower, transverse, planks were of three-inch thickness while the upper, longitudinal, planks were two inches thick. Both layers being

firmly fixed together, they should deflect as a whole and the load should always be distributed over several of the lower, transverse, planks. This type of decking has much to recommend it on grounds of economy in timber but it takes a very long time to lay and must inevitably lose a great part of its strength as soon as the spikes holding the two layers together work loose through vibration or rusting.

Acceptance of Contract and Preliminary Work.

From the P.W.D. Engineer's point of view it would have been better had we been prepared to supply all materials and do the complete job. This was rather more than the company could tackle; we wished to erect the bridge only, materials being supplied to us at site by the P.W.D. After going through a process which was rather like a score or so of F.s rolled into one we submitted Rs. 6,316 to the P.W.D. as our figure for erection only. It was estimated that with an average working party of 40 men, the work would take some 2½ months to complete if three pile drivers could be made available.

The P.W.D. found our figure to be about Rs. 100 cheaper than they could expect from any of their contractors and graciously gave the work to us, although it meant considerably more trouble for them.

In Mandalay Division there were, at this time, other pile bridges in hand as well as the Htongyi Chaung bridge and the P.W.D. were very short of pile drivers. They could only offer us one old, and somewhat infirm, wooden pile driver but suggested that if we could make up pile drivers from steel rails they could supply the necessary winches and monkeys. The Subadar had had some experience of pile driving by this method on the Frontier and was quite optimistic about its chances of success in Burma. A small pile driver was rigged up in the lines in Mandalay and several 12 in. × 12 in. piles were driven as an experiment. This proved satisfactory and we accordingly told the P.W.D. that we would be able to make our own pile drivers from steel rails. All the N.C.O.s of the Company were given an opportunity of driving piles with the small pile driver set up in the lines.

Experiments were also carried out with various forms of driving heads for square and round piles, the object being to devise some kind of band which would clip on to the top of the pile in place of the more normal ring. In all, a total of 23 12-in. square piles and 25 12-in. round piles had to be driven and it was thought that if a suitable driving head could be devised, which could be changed quickly from one pile to the next, a great saving of time would be effected.

After several heads made from sheet iron strengthened with mild steel straps had been tried without success, the simplest possible

arrangement proved, in the end, the most satisfactory. It consisted of a 6 in. x ½ in. mild steel strap clipped round the top of the pile as shown on Fig. 4, and secured by a one-inch bolt. It will be noticed that the clip was extended to project through the rail uprights of the pile driver. A bolt passed through a slotted hole

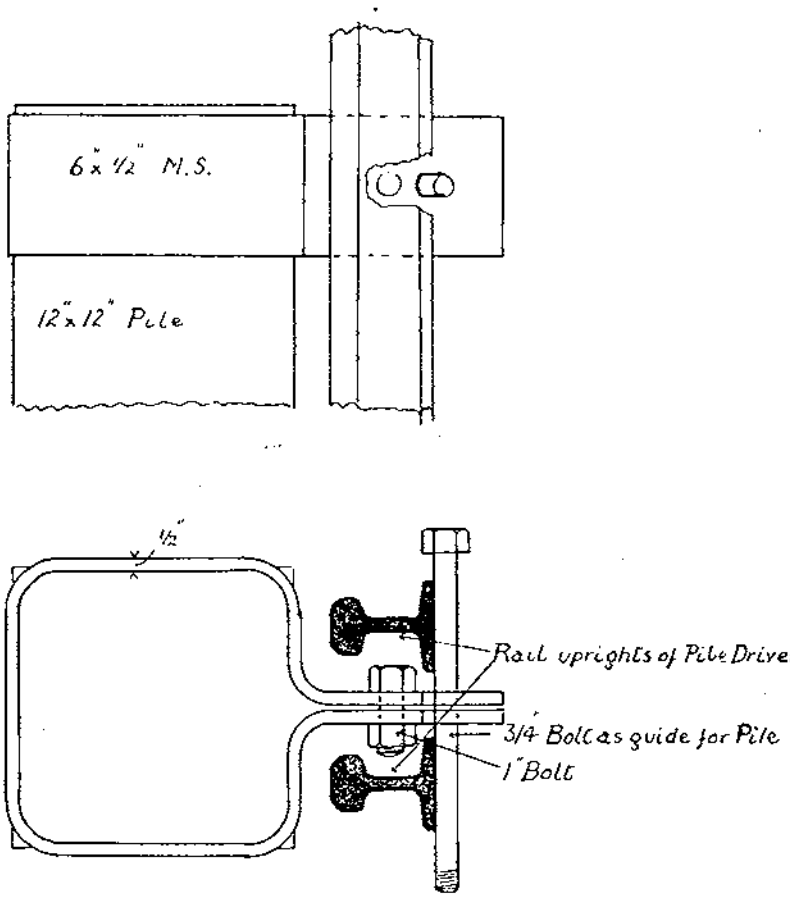


FIG. 4. DRIVING HEAD

in the clip bore against the back of the rails and formed a guide for the pile.

Camping Arrangements.

The only camp site anywhere near the work was by no means an ideal one. Local inhabitants said that it was above flood level but it was, nevertheless, very wet and, further, was immediately downstream of the native village of Yehwan. The writer knows no Burmese and has seen the name of the village spelt in many different

ways but never quite as he spells it. However, it sounds like "Yeh-wan," as Yehwan it went down in early correspondence and Yehwan it remained as far as we were concerned. One has to be firm in one's dealings with the Burmese language.

The men were to live in 160-lb. tents, in all of which bamboo charpoys were to be built for the men to sleep on as the ground was very wet. When actually built these charpoys were not beautiful to look at and made the inside of the tents very cramped, but a few days' rain soon proved their utility.

Drinking water for the camp was to be drawn from the Htongyi Chaung just downstream of the village. It would have been difficult to find a more heavily-polluted source of supply anywhere in Burma, but it was the only one available and arrangements were therefore made to use it. After drinking heavily chlorinated water for several weeks, the writer discovered that a pinch of Eno's Fruit Salt in a *chatthi* of chlorinated water produces, first, a glorious effervescence, and then, a tasteless water. Perhaps some chemically-minded reader can explain the reaction?

Progress of Work.

By July 1st all gear which was to go out with the detachment had been overhauled, the necessary extra tools had been made up or bought and Army Headquarters had sanctioned our carrying out the work. A start was not, however, made until August 14th, owing to difficulties experienced by the P.W.D. in obtaining the timber.

The detachment left Mandalay 64 strong, 2 British officers, one of whom was an officer of the I.A.R.O. attached for 30 days' training, 1 Indian officer, the Subadar, and 61 Indian other ranks. We proceeded by rail to Myittha, a railway station on the main line, six miles from the work, which we reached at 8.15 a.m. From Myittha all tools and stores went to Yehwan in bullock carts, twenty-two of these vehicles being necessary. The road from the station, an unmetalled one, was fortunately dry, and although some of the carts did get into trouble in bad places, by evening all had been unloaded in camp and the camp set up. The following day was spent in work on the camp, building latrines, stables, etc., work on the bridge not being commenced until August 16th. Before the bridge could be set out two large trees had to be felled and cleared away. A line of telegraph wire prevented our felling trees in the most convenient direction and they had to be dropped right across the centre line of the bridge. The telegraph wire did not cease to make its presence felt here and for the next month it was continually in the way. The back guys of all pile drivers had to be passed over it, and more than once it was, accidentally, somewhat roughly handled. However, it stood up manfully to all such shocks and though it sagged ominously, it never actually broke.

Pile Shoeing.

All piles, both round and square, were shod with cast-iron shoes bolted through the pile. When work was started the bolts for bolting on the pile shoes had not arrived; to avoid delay, coach screws were used in their place for the first few piles. In the writer's opinion coach screws are not only easier to fix but give a better result than when bolts are used with this particular type of shoe. To auger straight through a foot of hard timber is not easy and the chances are that with bolts the pile shoe will not be a very good fit on the nose of the pile. In such a case there is always the danger that the first blow of the monkey will displace the pile shoe slightly and the pile will be difficult to drive true. When coach screws are used it is an easy matter to ensure a good fit between the shoe and the pile nose.

At first, pile shoeing was a slow business but when the men became practised three men were able to shoe two piles and prepare their heads for the driving cap in the working day of 8½ hours. Even this may seem slow, but it must be remembered that pyinkado is exceptionally hard. I believe I am right in saying that the P.W.D. find difficulty in getting their Chinese carpenters to work with this wood at all.

Pile Driving.

Once pile driving was started it proceeded very much more rapidly than had been expected. We had had bad luck at the start as the very first pile to be driven proved to be faulty and broke in two after it had penetrated about six feet.

The pile drivers, of which three were employed, were made up of two 36-foot lengths of 61-lb. steel rails. The rails were bolted together at the top and bottom, a sufficient distance apart to allow the monkey to slide freely up and down between them, and provided with a wooden base plate. Four guys of 1½-in. S.W.R. were used for each pile driver. The monkeys used weighed ¾ ton, 1 ton and 1½ tons, and were raised by hand winches, no steam winches being available. The winch work was very heavy, four men were necessary to man each winch while a relief of four stood by. In all a crew of 12 men was found necessary for a pile driver.

The driving heads made up in Mandalay before leaving proved very satisfactory. They were easy to adjust and protected the piles well. The only trouble experienced was with the 1-in. bolts securing the driving head. On two occasions these bolts broke while a pile was being driven, but as several spares had been brought from Mandalay it was a simple matter to replace them. These heads were only used for the 12-in. square piles. Originally it had been intended to adopt a similar arrangement for the round piles. When these were delivered

they were found to be in reality anything from 14 in. to 2 ft. diameter at the top and the idea of making a driving head for them was abandoned. The first few piles were dressed at the top and fitted with a 12-in. diameter wrought-iron ring, but it was found that a few blows of the monkey drove this ring down, and into, the pile and in the majority of cases started a bad split. Stout binding wire round the top of the pile was next tried and proved fairly satisfactory. Eventually the piles were driven without any form of protection at the top and very little splitting resulted.

At the piers the ground level was some eight to ten feet above the assumed bed level of the new waterway. In order to start the piles as near bed level as possible a trench was dug at each pier, by P.W.D. coolies, and the pile drivers were set up in the trench. When filled with rainwater these trenches made the shifting of pile drivers rather difficult.

Pile driving was started at 3 p.m. on August 18th, and the last pile refused on October 4th. The following figures may be of interest :

	12 in. × 12 in. Square Piles.	*12 in. Diam. Round Piles.*
Total Depth Driven ..	396 ft.	336½ ft.
Number of Driving hours	242 hours	177 hours.
Average rate of drive ..	1·64 ft. per hour.	1·90 ft. per hour.

The soil was very variable, in parts running sand was met and in others a hard material similar to *kunker*. The driving hours in the above table include all stoppages due to breakdowns but do not include the time taken to move the pile driver from one pile to another. This last took in all 3,760 man-hours, or 78 man-hours per pile, considerably longer than had been anticipated.

Fitting Extensions to Piles.

The fitting of the extensions and bracing to the piles was straightforward, if somewhat heavy, carpenters' work. Some difficulty in the fitting of bracing was experienced due to the piles being in many cases oversize. The actual sizes of the piles were found to vary from 12 in. to 13½ in. square and the oversize piles had frequently to be cut in order to get the heavy bracing to lie flat against all the piles of a pier. The bolts supplied were often only just long enough for the job and the bolt heads had frequently to be countersunk in order to get the nuts on. For rapid work of this nature the bolts should be at least two inches longer than the timbers through which they pass and should have long threads. No cutting of timber or countersinking of bolt heads would then be necessary and a great saving of time would be effected.

Raising of Girders and Decking.

The raising of the girders was commenced on September 13th and the last girder was in position on 27th. The girders of adjacent spans butted together and were joined by fishplates and bolts. No cutting of the girders was allowed since this might impair their utility when they are required for a permanent masonry bridge. It was somewhat of a relief to find that, when raised, all girders fitted into position with the joints between spans central over the piers.

The laying of the decking was a very lengthy operation. No earth cover being provided, the heads of all bolts and spikes had to be countersunk flush with the top planking, a most laborious task. Otherwise the decking calls for no particular comment.

The writer, unfortunately, was unable to see the bridge completed, but by the time he left Burma for England all the girders were in place and part of the decking had been fixed. The bridge was finally completed early in November.

Conclusion.

The work provided excellent training in heavy bridging and all trades for the men. At first many mistakes were made but fortunately none was costly in materials or time.

The steel rail pile drivers have much to recommend their use on dry land. Possibly over water they might prove too unstable in large sizes, but for this particular work they proved very satisfactory. They can be rapidly erected and dismantled and can be easily moved from place to place. Piles can be very accurately plumbed when driven by this method, and if a pile is not driving straight it is a simple matter to lean the pile driver over slightly and give the pile a glancing blow to straighten it up.

In all carpenters' work the adze proved an invaluable tool. The men at first preferred to work with chisels and progress was somewhat slow. Later when they became accustomed to working with an adze work proceeded much more rapidly.

It was very hard work for the men and at times the rain made conditions rather unpleasant, but it provided a change from the normal routine of trade training and there is a certain satisfaction in feeling that we have left our mark on Burma.

OVERLAND TO INDIA IN 1907.

By COLONEL F. C. MOLESWORTH.

Now that political and other conditions are so different, an account of a journey from England to India, *via* Russia and Persia, 25 years ago, may be interesting.

The idea of returning from leave to India *via* Meshed in N.E. Persia was put into my head by the presence of some relatives at the British Consulate-General there. Accordingly, I applied to the India Office for permission to travel that way, as well as for the special sanction necessary to travel in Russian Transcaspia. In due course these arrived, my passport was *viséd* by the Russian Embassy and Persian Legation in London, and a ticket for the journey as far as Vienna purchased.

Accordingly, I left London at 9 a.m. on October 1st, 1907, and reached Vienna at 6 p.m. the following evening. We (an officer of the Indian Political Department, returning from leave to Seistan in East Persia, and myself) then bought tickets for Baku, and entrained at the north station, leaving at 10 p.m. the same night. We went through Cracow and Lemberg and by evening the next day had reached the Austro-Russian frontier. Here a break of gauge necessitated a change, and we had to halt for a day to recover some lost baggage. We found a very inferior hotel in which to spend the night.

We got off the following night, and spent three days and four nights passing through the south of Russia. We stopped regularly for meals at the larger stations. The fare was good; the railway refreshment rooms were generally treated as clubs, and many of the upper class inhabitants patronized them for meals. Many such diners could speak French, and, when we were in difficulties, were anxious to help.

For the first and second days, the countryside consisted of rolling fields, from which the wheat had just been harvested. On the third day, by which time we were in sight of the Caucasus, the country was barren, with sparse willow jungles. Even these had disappeared by the time we reached the Caspian at Petrovsk, on the third evening; at 6 a.m. on the fourth morning we reached Baku.

Earlier that year Baku had been the scene of terrible massacres of Armenians by the Russians; in many cases the houses were built with cellars below, in which fires had been lit and the unfortunate inhabitants smoked out. At the time of our visit, however, all was calm.

We met there an American officer returning to the U.S.A. from the Philippines. He had travelled *via* the Manchurian battlefields and the Trans-Siberian railway, and was proposing to continue through Egypt and South Africa. He told us that he knew no Russian except the word for beer, in fact no word of any language but his own.

A comfortable steamer took us across the Caspian to Krasnovodsk. We left Baku at 10 p.m. and by 8 a.m. the next morning were already in sight of the west coast. We were summoned to breakfast and I was a bit disappointed to find only lax and similar *hors d'œuvres*, and was resigning myself to make the best meal I could off them, when a curtain was drawn aside and a huge breakfast of almost every conceivable meat course revealed.

We reached Krasnovodsk at 1 p.m., disembarked and explored the town, which resembles Aden in its appalling barrenness. The same evening we boarded the Trans-Caspian railway. The carriages were very inferior to those in Russia proper; there were no sanitary conveniences in the train, and no refreshment rooms at stations. We were glad that our journey in it was short, for at 11 a.m. the next morning we reached Askhabad.

Here an unexpected delay occurred. My special permission to travel in Transcaspia, referred to above, was written in French; the local police authorities professed themselves unable to accept it, and it was therefore necessary to wire to St. Petersburg for confirmation. A Belgian officer of the Persian Customs, *en route* from Enzeli* on the Caspian to Seistan, was in the same boat as myself, but my political companion was allowed to proceed. Five days elapsed before the necessary permission arrived. These days passed pleasantly enough. The Belgian and I stayed in a small hotel run by a French lady, and were made honorary members of the French community. The Russian authorities placed no restrictions on my movements; I wandered about at will. Askhabad was at that time the headquarters of an Army Corps, and there were plenty of barracks. The Russian soldiers did not impress me; they slouched about the streets in very unsmart and dirty uniforms. The few officers I met were well turned out, and, whenever they spoke French, conversational and anxious to help.

Money was a difficulty. I carried only English sovereigns, which I was unable to change. It speaks a lot for the impression made by the British there that my hostess allowed me to depart with nothing but a verbal promise to pay her bill from Meshed.

On October 15th, permission was received for us both to start, and the next day, the Belgian, his Persian servant, and I got into a phaeton driven by a Russian youth and drawn by four horses. When I wanted to talk to the driver, I spoke to the Belgian in bad French, which he translated into Persian to his servant, who rendered

* Since renamed Pahlevi.

it into Turki, which the Russian understood. We proceeded southwards towards a barren range of mountains, and spent the next three days climbing laboriously up and down immense parallel ridges. By the end of the first day, we had reached Persian territory, and had a passport and customs examination. The road, as far as Meshed, had been well designed by Russian engineers for cart traffic, and had been well constructed, but, on both sides of the border, was falling into disrepair, bridges were collapsing, and irrigation channels were wandering at will over the roadway.

There were unfurnished *sarais* along the road, affording shelter for the night, but at Kuchan, our third halt, a small town, I was put up by the Governor in his guest-house. It was Ramazan, the Mohammedan month of abstinence, and a muezzin on the roof of my room called the faithful to prayer, with, it seemed to me, little intermission all night.

Two more days along a broad and fertile valley brought us to Meshed; a journey of five days, during which we had traversed 150 miles. Here, in the British Consulate-General, I spent two or three weeks. I was taken by the Consul-General, Major, now Brig.-Gen. Sir Percy, Sykes, to call on the Governor-General of Khorasan. I was struck by the tortuous entrance to his reception room—a Persian custom, I was told, to baffle an angry mob, and give the occupant time to flee. A frock-coat was *de rigueur* on such occasions, as Persians at that time considered a short coat indecent. Calls on the Russian community were also incumbent. A detachment of Indian Cavalry served as Consular escort, and it was interesting to compare them with the Cossacks who formed the Russian guards, and also with the Persian *sarbaz*. This is the term for a Persian foot-soldier, the word meaning literally one who plays with his head, *i.e.*, not having anything else to play with. The Persian army rarely got any pay, and so most of them were in employment as shopkeepers or night-watchmen.

Meshed, familiar during the Great War to many officers on the East Persia Cordon, was a city of about 100,000 inhabitants. The shrine of Imam Raza, eighth in descent from Mohammed, dominates the whole city. It is the third most sacred spot in Islam, and along the roads radiating from Meshed one finds large stones, which, one is credibly informed, are propelled nightly by angels towards the shrines. Undoubtedly they do progress Meshedwards, but it should be added that it is a meritorious act to give the angels a helping hand. On the surrounding hills are piles of stones heaped up by travellers at the points where they first catch sight of the dome of the shrine.

I was interested to find that Meshed was, at the time, a corps station; the R.E. were represented by Serjt. Stephens, i/c Indo-European telegraphs.

At Meshed, I got hold of a Punjabi servant who wished to return to

India, and of an Afghan groom who was going back to Kandahar ; I bought two ponies, and hired mules for baggage ; on November 6th, my Belgian friend and I started southwards. Two Indian Cavalry sowars accompanied me as escort, relieved at Turbat-i-Haidari by another, who came as far as Seistan. He was an amusing fellow, and used to tell the Persians that his carbine would kill at 80 miles, adding that the British Government had a gun so powerful that if it were placed in Teheran, it would cover the whole of Persia.

We reached Seistan, a distance of 514 miles from Meshed, in 25 days, of which two were halts at Turbat-i-Haidari and Birjand. The marches were perforce long, as water was often procurable only at great distances apart. The longest march was 36 miles. In many places the water was brackish.

The country, once Turbat-i-Haidari was left behind, was, generally speaking, very bare. A few willows, poplars and tamarisks were the only trees to be found. There were occasional streams, often only a few miles in length from their source under a mountain range until they were absorbed in cultivation or lost in the desert ; yet they teemed with fish, whose origin remains a mystery. Where the track crossed hills, it was indescribably bad, for, as someone has said, in Persia the mules are the only engineers. Where it crossed desert, it divided up into innumerable parallel or intersecting paths.

In the N.E. of Persia, roofs of buildings were flat, rammed earth resting on matting and poplar poles. As one journeyed south, timber became scarcer and buildings were domed with brick. It surprised me to learn that these domes, which were often 16 feet by 12 feet in area, were built entirely without centring. The method, a most ingenious one, has been described as follows : " the bricks are kept in place by thinking hard until they meet at the centre."

The weather was all I could have wished for, for cold nights succeeded bright sunny days, with a very occasional drizzle by way of variety.

At nights we put up in *sarais*, generally indescribably filthy, whose rooms seemed to have been used indiscriminately by man and beast. Keating's powder was very necessary ; indeed, the bite of certain Persian bugs is said to be fatal to strangers. I carried a tent for use when the local accommodation was too disgusting. Halts at the consulates at Turbat-i-Haidari, Birjand and Nasratabad,* the capital of Seistan, made a very welcome change.

Persian bread, made in large slabs about an inch thick, and almost a yard square, not unpalatable, together with sheep or goats, fowls and eggs, were obtainable almost everywhere. Potatoes, occasionally green vegetables, and at one point melons, supplemented my small stock of European stores. With regard to melons, a party of Britishers

* Now to be called Shahr-i-Zabul.

a short time before me had found the water so salt that they squeezed them and made tea with the juice. There was always grain and fodder for the animals.

The inhabitants were very friendly, though I found that lower standard Persian, passed some years before in India, was not a great aid. On one occasion only, a few shepherds tried to prevent us from watering our horses at a well, but a firm front very soon made them change their manner. On the march, my Afghan *sais*, who led the cavalcade on my spare pony, came in for a number of salutes; the rest of us seemed to be regarded as undistinguished retinue. I found it an excellent plan to carry a small stock of pocket-knives and similar articles to give to anyone who helped us. At most halting places the sick and lame came round for treatment, in the touching belief that every white man was a doctor. It was hard to explain that I was unable to cure limbs that were broken years ago, but dished out quinine and similar medicines in small quantities for diseases, and hoped for the best. Indians of all classes were always very pleased to see a *sahib*.

It was a very pleasant change to reach the oasis of Seistan, and cross the reedy Hamun, after miles of desert.

The previous year there had been an outbreak of plague in Seistan. An I.M.S. officer had been sent from India to investigate the outbreak, and came to the interesting conclusion that the disease was introduced by ducks. Colour was lent to the theory by the fact that the disease started among the Saiyads, a race of hunters and fishers inhabiting the shores and islands of the Hamun, and that duck were known to visit Seistan on migrations between the deltas of the Indus and Volga, in both of which regions plague was, at the time, raging. The rat was, in this instance, proved not guilty, as no rat was likely to undertake the forty days' camel journey from the nearest infected spot, nor could the plague microbe survive so long.

During the plague, which was somehow associated in the local mind with the Indian Government, the British community became temporarily unpopular, and an attack by the rabble on the Consulate was feared. It is pleasing to record that a number of Afghans, with rifles and ammunition, turned up and offered to help in the defence of the Consulate, if necessary.

At Nasratabad, the capital, I paid a duty call on the Russian consul, who insisted on preparing a magnificent champagne lunch for me. I was interested, therefore, in reading in the papers of his subsequent career. He became a Bolshevik agent and ultimately lost his life in Afghanistan, in a theological argument with some Afghans, which developed into an armed fight.

In Seistan, I changed my mules for camels, and after a halt of six days said good-bye to my Belgian friend, and started for India. On the second day's march, the fertile area was left behind, and the

desert began again. The overflow from the Seistan Hamun, known as the Shela, at that time a series of intensely salt pools, had to be crossed. In years of heavy flood, this overflow doubles back to within a few miles of the Helmand at Rudbar, in Afghanistan, where the cutting of a canal to the south would cut off all the fresh water from Seistan, and make an oasis instead in the south-west of Afghanistan.

At one point between Seistan and the British frontier, a well had recently been dug by Ashraf Khan of the Political Department, our Vice-Consul at Kuh-i-Malik Siah. In doing so, a cannon-ball of about seven inches diameter had been dug up; there were no identification marks on it; it might possibly have been dropped by Nadir Shah's army in the early eighteenth century.

After rounding the Kuh-i-Malik Siah, where the three countries meet, I reached Robat, in British territory. A detachment of the 127th P.W.O. Baluch L.I. (now the 3rd Bn. (Q.M.O.)/10th Baluch Regt.) was stationed there. One of the reasons for a garrison in that inhospitable region was that gun-runners from the Persian Gulf had recently made a short cut across the wedge of British territory lying between British Baluchistan and Afghanistan. The two British officers had made a little garden in the bed of the dry river there, the only bit of green amid appalling desolation. The Afghans had replied to Robat by building a fort as close to it as they could in their own territory, but had been forced to abandon it, as the water was undrinkable.

From Robat to Nushki, then the railway terminus, ran the Seistan trade route, established by the energy of Col. Webb-Ware of the Political Dept., who sank wells and laid out camping grounds through one of the most desert countries on earth. The trade route has, of course, been superseded by the N.W.R. connection to Duzdap,* which carries you in two days over what then took three weeks, but this does not belittle the magnificent achievement of driving a camel track for 400 miles through a waste howling wilderness. The route, after repairs needed to fit it for motor traffic, served as part of the L. of C. of the East Persia Cordon, during the Great War, until superseded by the railway.

Conditions at the time were, however, bad. Water was scarce and often brackish, in one place nearly as salt as the sea. There was one stage of 39 miles without water at all.

For the whole of one march, a lake with reedy shores and islands showed up on one side of the track, at a distance, it seemed, of not more than a quarter of a mile; it was, however, only a mirage. There were occasionally moving sandhills. These formed processions crossing the track from north to south, always in the same direction. The sandhills were of uniform shape, like an exaggerated crescent,

* Now called Zahidan.

with its horns down wind. The grains of sand, driven by the prevailing wind, mounted the gentle windward slope, and then fell steeply down the leeward slope, and remained there buried until the entire dune had passed, when the cycle began anew. The largest sandhills were about 40 yards from tip to tip and perhaps twenty feet high. They gave a good deal of trouble to the telegraphs.

Another feature of the landscape was an abundance of dead camels, varying from a fresh corpse to a heap of bones.

The country was stark and bare; rocks and sand with scarcely a trace of life. In places exposed rocks were fluted in a north and south direction by the agency of sand and stones blown over them by the prevailing wind.

The *Civil and Military Gazette*, of Lahore, commenting on the description in the *Gazetteer* of the Trade Route remarked, "The picture . . . makes one's senses ache with the sheer desolation of it." The population density of that part of Baluchistan at that time was two-thirds of a person per square mile; at the same ratio, there would be only 34,000 persons in the whole of England.

There were, however, compensations in the way of comfortable furnished bungalows at the end of nearly every stage, where passing travellers had left a quantity of literature.

As Nushki was approached, the country grew more pleasant. There were *pish* palms (palmyras) in the dry water-courses and tamarisks on the flats. At one point the country seemed to have been inundated by a river of mud, leaving rocks and small hills like reefs in the sea.

I reached Nushki, then the terminus of the railway, on January 2nd, 1908. My march from Meshed, 973 miles in length, had taken me 58 days, including 11 days of halts, an average of 20·70 miles per marching day. The cost, exclusive of the price of ponies, came to about £120.

I followed in the tracks of an officer of the I.A. who had recently done the entire journey from Meshed to Nushki in 24½ days. He arrived at Meshed with some three weeks only of his leave left, underestimating the difficulty of travelling. A journey to India *via* Constantinople, the alternative, would have taken a month at least, so he started on the heroic effort to get through. Our consuls helped him by arranging for horses, and he kept up an average of 50 miles a day, a feat which must be very nearly a record.

THE SOLDIER SURVEYOR AND HIS TRAINING.

By BRIGADIER H. ST. J. L. WINTERBOTHAM, C.M.G., D.S.O., *A.D.C.*

I SUPPOSE there is no single one of our numerous Corps activities in which the choice of the proper method or tool is not a matter of the first importance. It is so anyhow in survey. One might meet a man attempting a tertiary triangulation in the Sudd area, trying ground photo topography on Nairobi plain, running a long traverse in the Orange Free State, contouring from air photographs in the Ashanti forest or measuring a base with a Gunter's chain. If one did, however, one would regard him with wonder, not unmixed with that awe we keep for nature's innocents. Situations very similar to these did arise, naturally enough, when the Empire overseas contributed so many surveyors to the Field Survey Battalions.

There was the man who would always compute to the millionth part, but had a strange predilection for the wrong " figure of the earth " ; the man who would remain for hours gazing through the business end of a theodolite at a blank fog when all he wanted was 500 yards of traverse, and the man who would traverse for mile upon mile when surrounded by excellent " trigs." and a perfectly visible sun. The Sapper surveyor, officer and man, was naturally more versatile. There had been boundary commissions galore, and topo. surveys in such widely different landscapes as those of Pemba Island, Uganda and Canada. The bias was perhaps towards the methods of good visibility, for few of us had been surveying in the Forest Belt. Yet there were some who had waited for weeks on end for a " ray " in the Highlands, and some who had striven to deal with mining claims on the Bauchi Plateau.

From the word " go " we were, in fact, on top of our job, and this is no mere trumpeting but a fact attested by ally and enemy alike. We mixed methods as occasion dictated. Often enough of a foggy morning, for example, we surveyed our guns on a " controlled compilation " of Napoleon's cadastrals just as we " revise "an Ordnance Survey plan. This is, by the way, the method one would naturally use in England except upon open plains or downs innocent of fence or enclosure. A " bearing " to one edge of the sun, or to a star, at a given time would then complete the problem.

The British Army has visited most climates. We have known the mists and woodlands of northern Europe and the sunnier barer plateaux and mountains of mediterranean lands. In the last war

we saw such widely different European problems as the forest of Mormal on a dripping autumn day and the Montello with anything up to 50 trigged campaniles visible in the Venetian plain. We have surveyed in the dry, clear air of the near east and of the north-west frontier. We have suited method to case. But in pre-war days we did no tactical survey training. We were not organized in tactical units. We were not expected to produce the goods at a moment's notice in Suffolk, and to demonstrate survey methods to a damp and cynical audience in the Thames valley. Whatever we did do on service was all to the good, and smacked of "astrology." One of my earliest experiences in France was to bail out of the guardroom my second best trig. observer, who had the temerity to be using this "complicated goneometrical instrument" under the suspicious eye of an ammunition column commander!

Now, alas, there is no mystery about us or our doings, and there is a growing unbelief in our promises. To what is it due? The answer is that we are endeavouring to demonstrate methods and processes correct for most probable theatres of war, but wholly wrong under ordinary British conditions.

It is not natural that the normal soldier should understand how impossible it is for us to do better here. Surveying is a technical subject little understood by the laity and maps are so common that their manufacture would appear to be a question of small difficulty. Nevertheless visibility is essential for our work and where is it generally worse? Unless in fact we fight in the Aleutian Islands or the Falklands, it is doubtful if we should ever meet with such bad visibility elsewhere. The methods we ought to use here are almost bound to be wrong when zero hour arrives, and as a consequence we are trying to defeat nature, and to prove what we can do in the wrong way. We continue to rely on the air photographs we know we should get in sunnier climes on service, and every time the weather, the seventh day of rest, or the importunities of some other branch do us down. We allow the highly gratified commander of the blue invading corps a day whilst we prepare (openly enough to judge from the surveyors on the skyline) to open a wholly precise bombardment and, thereafter, to blow him out of the water, but in the course of that day the floodgates of heaven are opened and the solution delayed.

Is it not time to say frankly that if we must perpetually train in England, if we must demonstrate to restore confidence, then we had better suit our methods to England and forget the likelier theatres? A theodolite is not a weapon which goes off in all weathers if you press a button. Neither man nor camera can survey if you cannot see. If we actually did fight in England we should naturally issue six-inch plans for gun survey and orientation. We should not attempt original air photo surveys. We should not want photo or litho sections. By striving after instrumental surveys we are

merely sliding back into a conventionalized traversing, we are using too many men, and we are failing even so. Are we to give up the methods we must use in unsurveyed lands? I cannot see why we should. We cannot practise them here, however. Egypt, Palestine, Cyprus, are admirable training grounds for the purpose. There we should make real advances in knowledge, method and instrument. If a small experimental unit of sapper, gunner and airman were to function together where the sun smiles month after month we should gain that mutual esteem and efficient co-operation which is lacking —in these survey matters—to-day. And we should not find ourselves dragging a chain in the mute but shocked presence of dozens of excellent trig. points.

Such a training ground might provide an excellent individual training for officers. There is a ditch—broad and deep—waiting for the blind under blind leadership. In matters of precise measurement there is no safety in numbers. A playful kitten with a skein of wool could not create the havoc possible to the untrained officer in two minds—each of them wrong—in charge of a survey unit. A training centre should of course reflect, most often, the problems of our possible theatres of war. I have a mental picture of them which may not coincide with the official view, but we should all concur not to look for them in Hampshire. It is ridiculous that any officer should join a tactical survey unit until he is able to judge and act aright. He can best obtain those attributes with the sweat of his brow, and the purple of his indelible pencil, in the remoter places. So independent are we in England that we cannot even beacon the highest point of the squire's domain or trim the farmer's tallest tree to significant shape. Even if we did we should not see them in to-morrow's drizzle.

Best of all would be to seek and seize those opportunities of colonial survey " peak loads " which are sure to be many after the depression lifts. If we can; if we finally escape from volumes of obstructive files; the army will be the gainer. We must remember, however, that, as lately as the Crimea, officers who asked for a map were told that they could no doubt buy them privately, but that no official issue could be made.

If the officer knows his job the rank and file can be organized swiftly enough. This is no subject for well-bred supervision by the best—but least knowledgeable—people, and it is really time that we looked for an increase of skill and a cut in numbers. Time, too, that we said boldly " We cannot function under English conditions as we can in better visibility. We must suit method to task and visibility. We will, no longer, use African methods in England nor postulate English methods for Asia."

General Sir Reginald Clare Hart VC KCB KCVO Colonel Commandant

MEMOIRS.

GENERAL SIR REGINALD CLARE HART, V.C., K.C.B., K.C.V.O., COLONEL COMMANDANT, R.E.

(Reprinted by permission from *The Times*.)

THE death occurred on October 19th, 1931, of General Sir Reginald Hart, V.C. There was a time when proof of great personal gallantry was normally regarded as a primary qualification for high command in the Army. Had such a condition ever been rigidly enforced, then Sir Reginald Hart would indeed have justified his rise to military eminence on that score alone. But he possessed other claims to advancement which, even in more recent days, secured his retention on the active list of the Army until the age of 70 and down to the last year of the Great War.

Reginald Clare, son of Lieutenant-General H. G. Hart, of Netherbury, Dorset, was born at Scarif, Co. Clare, on June 11th, 1848. He was educated first at Marlborough and then at Cheltenham, whence he passed into the Royal Military Academy. From Woolwich he was gazetted into the Royal Engineers on January 13th, 1869. Already in that year he distinguished himself by saving the life of a drowning Frenchman at Boulogne. In diving off the pier to save the man he struck some sunken obstacle and suffered injuries which left permanent scars on his head and face. For this exploit he received the silver medal of the Royal Humane Society, in addition to a commemorative medal from the town of Boulogne.

As a young officer he went to India, where from 1874 to 1878 he served as an assistant garrison instructor in the Bengal Command, an early experience of education which influenced his whole future career. In 1879 he was employed in the Second Afghan War. Allotted to the Khyber Column he first served with the 2nd Division during the second Bazar Valley Expedition against Zakka Khel Afridis. Later he received a minor staff appointment in the Q.M.G.'s branch. It was on January 31st, 1879, during that campaign that he gained the Victoria Cross. He was accompanying a detachment of the 24th Infantry, then engaged in covering the rear of a convoy which had just debouched from the hills on to the plain. Close behind the convoy followed some post-runners, escorted by a party of 13th Bengal Cavalry. These were fired on by a party of Afridis, who, though lying in wait for the convoy, had not dared to attack it. At the sound of the shots the infantry escort of the convoy looked back and saw one of the troopers lying helplessly wounded with some 20 Afridis rushing down the hill towards him. Hart ran to the assistance of this man, followed by some officers and men of the escort. Such was his speed that he managed to reach the trooper

ahead of the others and before the Afridis could dispatch him. Though seeing him alone, the enemy withdrew and opened fire on him. But Hart had quickly dragged the wounded man behind a rock, where both remained till the infantry arrived to their rescue. The trooper died while being carried into camp.

Hart, however, nourished some other ambitions, and in 1880 he succeeded in qualifying for the Staff College, with the result that he was granted the *p.s.c.* certificate without passing through Camberley. Then in 1881 for some five months he was specially employed in West Africa, returning home to receive a brevet majority in January, 1882. In that year he was selected to serve as aide-de-camp to Major-General Graham, who was to command the 2nd Brigade forming part of the Expeditionary Force which Sir Garnet Wolseley was then taking to Egypt. Soon after his arrival at Alexandria, Hart took part in the important diversion of August 5th. Then when the expedition proceeded to Ismailia he took part in the whole of the fighting that preceded the occupation of Cairo, including the actions of Kassassin and of Tel-el-Kebir when he was acting as assistant Q.M.G. to Graham's force. On returning home in November he received the brevet rank of lieutenant-colonel for his services.

Not long after he returned to India, where in 1884 he once more saved a life and so received a silver clasp to his former medal of the Royal Humane Society. On this occasion he brought to land a gunner, who was on the verge of drowning in the Ganges Canal at Roorkee. He then turned again to military instruction, and in October, 1885, obtained the appointment of Garrison Instructor in the Bengal Command. Next year he was promoted brevet colonel at the unusually early age of 38. He remained in this appointment until July, 1889, when he became Director of Military Education in India, receiving his substantive rank at the same time. It was while in this post that, in 1894, he brought out his book, *Reflections on the Art of War*, a volume, now somewhat antiquated, which was well thought of at the time. It went through three editions in the next few years.

In March, 1896, Hart at length abandoned his educational work in favour of a more active appointment. This was the command of the Belgaum District, which carried with it the rank of brigadier-general. While he was thus employed there occurred the great rising of the frontier tribes which necessitated punitive operations in Tirah. In October, 1897, Hart was consequently given the command of the 1st Brigade in Sir William Lockhart's force. In that capacity he went through the whole campaign until April, 1898, taking part in the operations in the Khanti Valley, the forcing of the Sampagha and Arhanga Passes, the march into the Waran and Masura Valleys, the passage of the Safri Pass, and the closing operations in the Khyber and Bazar regions.

The South African War broke out at that time, but Hart was not released from India. He remained in his command, but in 1901-2 was again mobilized for active service on the North-West Frontier; to a man of his temperament this was but a poor consolation for the campaign that he missed.

However, at the close of 1902 he was promoted major-general and given the command of the Thames District, which later became the Thames and Medway Defences. This position also carried with it the command of the School of Military Engineering at Chatham. Hart's future was no longer so promising. He had grown older, and long service in India had given him a one-sided experience of war. None of the more recent campaigns in Egypt nor South Africa had known him. Yet his military record fully merited recognition, and in November, 1907, he received the command of the troops in Cape Colony. A year later, on promotion to lieutenant-general, he vacated the post, but returned to the Cape in 1911 as Commander-in-Chief of the troops in South Africa. Finally, in June, 1914, he was promoted full general.

When war broke out in 1914, Hart, in view of his unusual career and of his seniority, could not expect to find employment with the Expeditionary Force in France. He was consequently glad to accept the position of Lieutenant-Governor and Commander-in-Chief of the Forces in Guernsey and Alderney. There he remained until he retired in June, 1918, on attaining the age of 70.

Thus ended a remarkable career. A total stranger to fear and inured to fatigue, Sir Reginald Hart was regardless of personal safety in action. What he practised himself he expected in others. So he gained the reputation of being a "hard man," oblivious of the weaknesses of the men under him. Yet he was always popular, quick to encourage, and generous with his praise. His early advancement is proof that, even in an age when professional success was more easy to achieve than now, academic attainments did not always go unrewarded. He remained an ardent student of all things military and of history in particular, maintaining that no commander was worthy of his position unless he had bestowed time and study to the teachings of the past.

He was created K.C.B. in 1898 and K.C.V.O. in 1904. In 1881 he married Charlotte Augusta, daughter of Mr. Mark Synnot, *D.L.*, of Ballymoyer, co. Armagh. He leaves three sons and one daughter.

R.H.B. also wrote in *The Times*:—

"Sir Reginald Hart's name was not so familiar to the public as that of some other soldiers of his generation, since he was unfortunate in not holding an active command either during the South African campaign, or during the Great War, but as his record, to which you have drawn attention, shows, he bore all his share of 'the burden and

heat of the day.' The fact that without any sort of outside influence or any of the advantages that wealth can give he rose to the highest rank but one in the military hierarchy speaks for itself.

"He was a singularly beautiful and at the same time striking character. Old-fashioned only in the sense of his courtly and gentle manners and in his disdain for the vulgar self-advertisement so often lauded as 'personality' in these days, he embodied all those qualities which have made and kept the British Army of good repute in every part of the world. While a deep student of his profession—some will remember his book *Reflections on the Art of War*—he was no pedant. On the other hand he was a bold and original thinker and carried his independence of mind into spheres outside those purely military, contributing at various times articles to such periodicals as the *Hibbert Journal* and *Nineteenth Century*. He had, indeed, a first-class brain, lucid, penetrating, logical, which became no whit less acute with advancing years, and which made it a rare delight to hold converse with him. While he held certain strong principles, he was at all times tolerant of the honest opinion of others.

* * * * * *

"The evening of his life was all that one could ask or desire for a revered friend. His family were long out in the world, but he was surrounded by the loving care of the courageous and gracious lady who had been his companion and helpmeet for so many years in so many climes. Nothing petty or querulous marred the serenity of his outlook. Although physically frail and with the appearance of being somewhat older than his actual years, he marched the last stage of his earthly pilgrimage in the same lofty spirit which had, while he was a young officer, marked him out for his bravery among brave men.

A.L.S. writes :—

"I served in close touch with Sir Reginald Hart, when he was Commandant S.M.E. and G.O.C., Thames District and subsequently when he was in the latter capacity only. I always felt that the more I knew him, the 'whiter' man he proved to be, and I have had the deep impression which has never left me that he would not have done a mean thing to save his life, and he could not conceive of anyone doing otherwise. He was also an enthusiast, and as such, his ideas may have been considered extreme by some at the time.

"When at Chatham his chief idea was to improve the amenities of life of the rank and file in barracks, and the improvements he then advocated have, I believe, been carried out since."

Sir Reginald was appointed a Colonel Commandant, R.E., on the 5th May, 1922.

MAJOR-GENERAL SIR ELLIOTT WOOD, K.C.B., COLONEL COMMANDANT, R.E.

ELLIOTT WOOD, Engineer-in-Chief at Headquarters in the South African War and one of the best Field Company commanders the Corps ever possessed, was the third son of Dr. Miles Wood, of Ledbury and was born on May 5th, 1844. The doctor was a distinguished country practitioner of the old school who did all his professional visiting on horseback and kept a number of first-rate hunters for his work which were also used for his favourite sport when his duties permitted. His family consisted of four sons and three daughters, all of whom became fearless riders at an early age, while Elliott himself developed a remarkable talent for training horses.

Amid these pleasant surroundings Wood imbibed all the traditions of true sportsmanship and learnt the merits of physical and moral courage, and of fitness to endure hardship and fatigue, while the more intimate subject of religion was instilled into his nature by his beloved mother. His home life was particularly happy.

He entered the " Shop " from King's College second on the list, and passed out sufficiently high to get his choice of Sappers or Gunners. He joined Chatham in January 1864 with his great friend Elsdale, subsequently the eminent balloonist. Being very light and small of stature he found no place in the regimental football or cricket teams but he was an expert gymnast and a very powerful swimmer and his light weight was of a great advantage for riding. Together with Elsdale he entered into every form of aquatic sport. It was now that he first learned to use a canoe, a form of sport in which he later became an expert.

Both Wood and Elsdale volunteered for India at the end of their Chatham course and both were accepted. Elsdale's father, however, died suddenly and the son was required to remain to settle up the estate, so the two friends went up to the Horse Guards to ask that their orders for India might be cancelled. With real kindness of heart, the D.A.G. cancelled the orders for both, and later sent them together to the Cape. On arrival Wood was ordered to Grahamstown and later to Cape Town, and his friend to Natal. They never served together again.

At Cape Town, Wood's duties did not entail the frequent long treks on horseback or by wagon which had been his delight at Grahamstown, and he now had time to design and build his first canoe, in which and in others similarly constructed he navigated at least two unexplored rivers in South Africa, and many other rivers in the United Kingdom and on the Continent. Elliott Wood kept notes of all

his travels, illustrated by water colours. He was a very rapid worker and could, with a few strokes, produce an accurate impression of a scene which he would work up in detail later on.

He returned home in 1873, was at Chatham in the 32nd Company for a while, and then sent to Guildford to build the Brigade Barracks there by daily labour. A feature of the construction was the use of concrete staircases, balusters and landings cast in a solid mass, a novelty in those days, which he designed and carried out with complete success. Having done so well at Guildford he was put in charge of the reconstruction of Knightsbridge Barracks, an important work at which he was kept for four years. While in London he was promoted Captain after fourteen years as a subaltern. He was then A.D.C. to Sir Lintorn Simmons, during which time he went with his Chief and Major (later Major-General Sir John) Ardagh to the Berlin Congress after the Russo-Turkish War of 1877-8. Subsequently he proceeded on his second tour of foreign service to Malta, where he took over command of the 17th Fortress Company, R.E.

In 1882, while the air at home was thick with rumours of war in Egypt, so little was the Governor kept informed of War Office plans, that he permitted his A.D.C. and a number of other officers, of whom Wood was one, to go home on leave. On reporting to the A.A.G., R.E., he was told that he was required to be with his unit. After only an hour or so at home, he hastened back to Malta, where he arrived just two hours before the transport sailed for Egypt. His company had already left for Alexandria, with extra equipment, Maltese carts and mules, so that it could be used as a field company.

On arrival there he discovered it was intended that his company should become a Field Park, and that the requisite stores had been sent to him from Malta. He saw at once that if he had to take all of them over his unit would never be able to move. He therefore made a selection of what he thought he might require, collected what extra carts he could, and, as the Ordnance officer refused to receive the balance, he left it on the wharf. After a few weeks of hectic work on defences, water supply and communications, the 17th Company was relieved by the 21st Company R.E. and moved by sea to Ismailia.

On arrival there Wood could not get any attention paid to his demands to have his mules, carts and stores landed, so finally one morning early he rode down to the water's edge, and having divested himself of all clothing and wrapping his shirt round his helmet like a turban, he swam out to the transport, put on his shirt as he went up the ladder, and in that unconventional kit explained the urgency of the case to the captain of the ship with so much vigour that his stores were off-loaded and his mules dropped overboard without any further delay.

His foresight in making his unit mobile was rewarded. Experience

Major-General Sir Elliott Wood 1905-6, KCB, Colonel Commandant RE.

Major-General Sir Elliott Wood 1889-1894. KCB
Colonel Commandant RE.

quickly showed that the G.S. wagons of the field companies sent out from England were far too heavy for the country, and much to his satisfaction his unit with its light carts was sent forward to the Cavalry Brigade. In the subsequent operations two pontoons, designed and built by him at Alexandria, were of untold value in maintaining communications across the waterways. When Cairo was occupied after the fighting was over, the 17th Company had the proud position of being with the first troops to enter the city.

From 1882-84 the company was employed on the ordinary work of peace. During this time Wood made a trip to Jerusalem, where he was shown round by Charles Gordon himself. On his return to Egypt he was sent to make a reconnaissance for the advance of a force to Assouan and Assiout, and later to Suakin on special duty with the troops which were opposing Osman Digna's threat after his success against Baker Pasha's force at El Teb.

The operations there were mostly armed reconnaissances, and Wood was employed as intelligence officer and galloper. He was successful in discovering water and mapped a considerable part of the area. Thus by the time that a new campaign in the Eastern Soudan was decided upon, he had a very good knowledge of it, which was made use of freely by successive commanders.

The 17th Company R.E. arrived in Suakin on 1st July, 1884, and Wood at once started on the construction of defences, hospitals and piers in anticipation of the concentration of the troops.

He had drawn up a definite plan for an advance on Berber from Suakin, and while at Cairo, tried to interest Lord Wolseley's staff about it but without effect. Remembering the Red River Expedition the C.-in-C. was determined on a water route, by the Nile.

A feature of the defences of Suakin was the double-storied block-house, of Wood's own design. In connection with these works he had rifle batteries constructed, from which a single man could fire a number of rifles by one motion. His experience with mechanical tread mines is worth recalling. A number of these were laid in abandoned defence works to catch raiders ; unfortunately, Askwith, one of his subalterns, accidentally set one off and was destroyed, together with all the plans showing the location of each mine. Wood knowing that the mines were set to go off at 7 lb. pressure, then went to search for them himself, and succeeded in locating the whole number.

When the concentration of troops for the new campaign was completed and the order came for the advance on Tamai, Wood was detailed to lead it. The plan which he had put forward was certainly to move on Tamai, but only after a clearing of 100 yards' width had been made for the whole route, and a zeriba had already been made for the camel transport at the places selected for the camps. These essential details were not adopted. As a result the projected march

of eight miles of a column, under Major-General Sir John McNiel, through uncut scrub had to be curtailed by three miles. But the force having arrived at a suitable place, a zeriba was laid out by Wood and immediately put in hand under Major (later Lieut.-General Sir Edward) Leach, V.C. of the 24th Company R.E. Work was progressing well when the transport arrived. Without waiting for orders the camel men dumped their stores not inside the space marked but *outside*. Another zeriba had to be laid out and before it was complete the Soudanese war cry was heard and the Dervishes rushed forward. The situation was retrieved from what at one time looked like a disaster by the staunchness of the troops concerned.

On June 4th, 1885, the 17th Company with Wood and his two now famous subalterns, Heath (later Major-General F. C. Heath-Caldwell) and Graham Thompson (later Brigadier-General) embarked for England and arrived at Chatham on July 7th, 1885. They had a royal reception; the C.O. had been awarded two brevets, the C.B. and *q.s.*, and the two subalterns had promises of brevets as soon as they were promoted captain, while the whole company had covered itself with glory.

After a short stay at Chatham and another at the Curragh, Wood was appointed A.A.G., R.E., and he gave up the command of a company of which he had been O.C. for nine years in succession, with every rank from Captain to Colonel.

From the War Office he went as C.R.E., to Malta. Whilst there he used his canoe for a detailed examination of the coast line of the Island and discovered many possible landing places hitherto undreamt of. From Malta he went as Chief Engineer to Aldershot. On the outbreak of the South African War he was appointed Chief Engineer to Sir Redvers Buller, commanding the expeditionary forces, and went out with the staff to Cape Town. When the circumstances arose which decided Buller to go to Natal, Wood was sent to De Aar to command the Frontier Posts with the local rank of Major-General, which he retained throughout the war. There he had to deal with the risings of rebels at Prieska, and promptly proclaimed martial law in the town. In this he was not supported by the Cape Government, with the result that the trouble spread, and the rebels remained more or less active almost to the end of the war.

As the troops moved up country, Wood went forward to Orange River, and from this station he conducted a small operation to secure Zoutpans Drift over the Orange River, which was entirely successful.

With the arrival of Lord Roberts, the plans for an advance from Magersfontein eastward to Bloemfontein were pushed forward and there was a great deal to do with regard to improving communications, notably at Orange River station where the only practical crossing was the railway bridge, which was a box girder type about 60 feet above the water. Water at the camps of concentration prior to the march

was a great anxiety ; for though the bore holes had been put down, Wood could not get the pumps, which were at Cape Town. Equal as ever to the occasion he wired :—" We want water here not men I claim priority for my pumps."—They came !

On the march to Bloemfontein he rejoined Lord Roberts's staff as Engineer-in-Chief. His brother, Colonel C. K. Wood, was at the same time Chief Engineer to Buller's Force in Natal, a unique coincidence in the history of the Corps.

On arrival at Bloemfontein it was again almost impossible to get any stores or building material up from the base, before a fatal epidemic of enteric had got a firm hold on the troops.

From Bloemfontein on to Pretoria the Boers had destroyed the railway very effectively. All the main bridges were blown up, and Wood took the opportunity of making sketches of them—from which some of the bas-reliefs of the South-African Plate in the R.E. Mess were made.

Pretoria surrendered on the 5th June. On August 28th, Wood accompanied Headquarters to Belfast, was present at the battle of Berg-en-dal, and thence followed the advancing troops to Komati Poort. Here Elliott Wood took his farthest east bathe. He made it a practice to swim in every river, lake, or sea that he crossed if it were humanly possible ; the presence of sharks or alligators was no deterrent.

Under Lord Kitchener the war took a fresh phase. Mobile columns operated in every part of the war area and the Boers were soon reduced to parties of mounted riflemen without artillery, which operated chiefly against the railways, our main communications. It was then that Wood, speaking from his experience at Suakin, advised the C.-in-C. of the importance of blockhouse defence, against an enemy who had no guns. Later, on the invention of the bullet-proof Rice blockhouse, the railways were rapidly protected by a chain of defensive posts, and from this beginning the idea of cross-country blockhouse lines was developed which did so much to bring the war to a close.

In connection with the blockhouse line construction, he ordered each party to be provided with " block-wagons," *i.e.*, ox wagons fitted with bullet-proof, loop-holed walls, after the style of the Rice blockhouse ; these secured the head of the line under construction in case of attack at night. His endeavours to obtain mobile searchlights for use on the blockhouse lines during the " drives " were frustrated by delays in manufacture at home.

Having served for three years without a day off duty, except for a short period of quarantine, Wood went home shortly after the conclusion of peace, and on arrival was re-appointed Chief Engineer, Aldershot, with the rank of Major-General. He had been made a K.C.B. in Lord Roberts's gazette, but his substantive promotion

having been so long delayed, his seniority in the Army had been very gravely prejudiced. By a new regulation published about this time, it was ruled that a Chief Engineer of a Command was not a staff officer, but only " attached " to the staff, and no place was assigned to him on parade, when all members of the staff were present. Wood fought with characteristic energy against this ruling on the grounds that it was derogatory both to the Corps to which he belonged and the appointment. But it was no good, so disregarding all personal considerations, and as the strongest protest he could make as an officer of the R.E., he asked to be permitted to resign. Thus passed into retirement one of our foremost fighting Royal Engineers.

In 1906 he married Beatrice, widow of H. R. Dugmore and daughter of Lt.-Col. R. Bourne, and settled down very happily to a useful country life in Herefordshire. He was specially interested in all diocesan and parochial services, supported Lord Roberts's National Service League, the Boy Scouts, whose Chief Commissioner he was until over 80 years of age, and many other activities.

At the outbreak of the War in 1914, though 70 years of age, he volunteered for any sort of employment, preferably with his old Corps on defence works, but to his keen disappointment his services were not accepted owing to his age. He therefore found occupation in energetic service for the wounded, speaking at patriotic meetings, etc.

In 1921 he was appointed a Colonel Commandant of the Corps of Royal Engineers.

He continued his useful life, even taking part in local social functions and reading the lessons in church up to the last, when he passed peacefully away, quite unexpectedly, at his home at Holmer Park, Hereford, on 7th September, 1931.

R.N.H.

Colonel Robert Smeiton Maclagan. CB, CSI, CIE.

COLONEL ROBERT SMEITON MACLAGAN, C.B., C.S.I., C.I.E.

On October 29th, 1931, died at Haileybury, Colonel Robert Smeiton Maclagan, the third of his family in succession to serve the crown beyond seas. His grandfather, Doctor David Maclagan, after having been attached for some time to the 91st Foot, was for the last three years of the Peninsular war surgeon-in-chief to the 9th Portuguese Brigade in the 4th division of Wellington's Army. Mentioned many times in Beresford's " General Orders " for his zeal and skill, he received the Peninsular medal with five clasps. He reverted to the British service in 1814, but retired after Waterloo, and took up private practice in Edinburgh, where he was in succession president of the Royal College of Physicians and of the Royal College of Surgeons of Scotland. He died in 1865. Of his large family three came to high distinction, Sir Douglas Maclagan, M.D., who (like his father) was president of both of the Scottish Royal Colleges of Physicians and of Surgeons, General Robert Maclagan, R.E., and William Maclagan, Archbishop of York from 1891 to 1908.

Robert Maclagan, Doctor David's third son, born in 1820, entered the East India Company's service at an early age, passed through its Military College at Addiscombe with exceptional distinction, and received all possible medals, with the Sword of Honour given to the best cadet of the year. Gazetted to the Company's Engineers, he went out to India in 1841, and served under Sir Charles Napier in Scinde, and under Lord Gough in the second Sikh War. In May, 1857, when the Mutiny broke out at Meerut, Robert Maclagan senior was Principal of the Thomason Engineering College at Roorkee and all through the siege of Delhi he was sending down engineers' stores to the camp on the Ridge. His eldest child was born while the fighting around Delhi was in full swing.

He was principal of the Roorkee College for 12 years. After holding the important post of Secretary to the Governor in the Punjab Public Works department for seventeen years he retired as a full General in 1879. He died in London, aged seventy-four on April 22nd, 1894.

Robert Maclagan the second, with whom this memoir deals, was the General's third child and second son, by his wife Patricia Gilmour, daughter of Patrick Gilmour of Londonderry. His whole career was in most respects a very close reproduction of that of his father, as will be presently seen. He was born at Roorkee on October 1st, 1860, spent his first six years with his parents there, and was sent home, along with a brother and sister next to him in age, in 1866. He was placed under the care of his maternal great-aunt, Margaret Dalrymple, one of those admirable old ladies who in Victorian

days used habitually to take charge of the "Indian children" of the next generation. Miss Dalrymple resided in Cheltenham—then, as now, the gathering-place of many old Indian Service families. It was in January, 1867, that Robert went to his first preparatory school, where he joined on the same day as the writer of these notes. This was the beginning of a friendship that was to last for sixty years, despite the long breaches of separation caused by two very different careers.

Robert went to Haileybury and I to Winchester, but we foregathered in many holiday times, till the break came on his sailing for India. He was at Haileybury from 1874 to 1878, in "Lawrence" House, rose rapidly in the school, was a prefect for his last year, and figured in the Cricket XI. This was always his favourite game, though in later years he came to have no mean skill at lawn tennis—but that game was still practically unknown in the eighteen-seventies.

Determined from a very early age to follow his father's career in the Engineers, Robert competed for the entrance examination for Woolwich in 1878, passed in high, and all through his two years at the Academy was certain of achieving the career at which he aimed. He was Senior Under-Officer for his last year, and received the sword of honour given to the best cadet, when commission and medals came round in 1879. It was an enormous pleasure to him to set this sword alongside of the exactly similar one which his father had won at Addiscombe in 1840. His commission to the Royal Engineers—he was third on the list—was dated February 2nd, 1880. After spending two years at Chatham, he sailed for India on December 8th, 1882, and on his arrival was posted as Assistant Engineer in the Lucknow division.

But he was soon moved up into the Punjab, and his first three years of Indian service were spent continuously on canal work in that province. His first employment was in the construction of the Swat River Canal; he was then transferred to the Chenab Canal for two years, and after a few months spent on a third canal job in the Bari Doab, he was transferred to Dera Ghazi Khan in October, 1885, and turned on to another branch of the engineer's profession—road building. For four years he was in this trans-Indus section of the frontier, assisting in the construction of new strategical roads running up into the Baluchistan hills from the Indus valley for the opening up of Quetta, the advanced point towards Kandahar, which had been occupied after the Afghan War of 1878-80.

It was while at work in the Dera Ghazi Khan district that Robert Maclagan elected for continuous Indian service in January, 1887, with the result that all the rest of his career was spent in the region where it had begun, save the single year 1900-1901 when he was lent from the Indian army for service in South Africa during the Boer War. This was not, however, his first war service; in the autumn

of 1888, he was for two months acting as field engineer with the River Column of the Black Mountain expedition under General McQueen. On October 4th he notes in his diary that there was a fierce Ghazi attack, " which was quite exciting, as they got in among us, and did some damage." For this campaign he got the North-West Frontier medal with the bar " Hazara 1888."

Robert Maclagan's long sojourn on the trans-Indus frontier ended in 1889, when, on receiving his captaincy, he was transferred to Delhi. In January, 1891, he was sent on the Miranzai expedition, and when this was over transferred to the second Black Mountain expedition as field engineer. This won him a second bar to his North-West Frontier medal.

This campaign being ended, Robert Maclagan got his first long leave home and sailed from Bombay in July, 1891. He attended the Indian course at Chatham for a year, and this with furlough and subsidiary leave gave him fully two years in England, from August 1891 to October 1893. This was the last period during which he had the happiness of finding his whole family alive and united. He spent much time with them both in London and in Scotland, and was present at the marriage of both of his sisters—the elder married William Goodenough Hayter of the Charity Commission in August, 1891, the younger the author of this memoir in March, 1892. In the two summers of this long leave we enjoyed many a healthy tramp together in the Highlands.

On returning to India in December, 1893, Robert Maclagan found himself once more placed as an executive engineer in Delhi. His service here was broken in 1894 (December) by orders to join a Miranzai expedition, during which he planned and built the fort at Wano. When this was finished he was transferred to Dera Ismail Khan, where he served for three years, mainly employed in road building and surveying. At the end of 1897 he was " lent to the military department " again for field service, and took part in the operation in Waziristan and the Tochi Valley—for which he received the second of his decorations, the later Victorian " Indian General Service " medal, with the bar Waziristan. At the end of this expedition he was for the first time in his long and healthy life invalided for several months, but was back at his normal work at Dera Ismail Khan for the whole of the following year 1898. In March, 1899, he had qualified for the second time for long leave to England, which he reached by the circuitous route of Singapore, Hong Kong, Yokohama, Vancouver and New York. He was wont to say that the most exciting episode in his not unadventurous life was the extraction of a peculiarly obstinate molar tooth by a blacksmith in a mining camp in British Columbia, for the sum of one dollar.

Robert Maclagan was still on leave in England when the South African war broke out. In December, 1899, he got permission to be

transferred for a year to "General Service," and reaching Cape Town in January, 1900, was allotted to railway work. For the greater part of his campaign he was in charge of the lines round Bloemfontein, an unending task, as they were perpetually being blown up by the Boers. He was given the South African medal with three bars—Cape Colony, Orange Free State, and Transvaal—and was mentioned in dispatches.

By the end of 1901 Robert Maclagan was back in India, told off at first to Public Works Department activities at Lahore, but soon after transferred to Simla, where he was personal assistant to the Chief Engineer during Lord Curzon's Great Durbar of 1903.

In January, 1905, Maclagan was promoted to the rank of Lieutenant-Colonel, and got six weeks' privilege leave, which he utilized for a tour round Burma, whose conditions he was desirous of mastering. Returning to Simla for the summer, he became engaged to Beatrice Duperier, elder daughter of General H. W. Duperier, an old comrade in the Corps. After his marriage on December 23rd, 1905, he took his bride home to England, making a long stay in Egypt on the way; they returned to India in December, 1906. Maclagan was now "Executive Engineer 1st Grade" and served for four years at Delhi, Ambala, and Simla.

In 1910 he was selected to serve on the committee which was to prepare the scheme for the King's Coronation Durbar at Delhi in the following year, as the "Public Works" representative. This threw on him an immense amount of responsible business, for which he was specially well equipped owing to his local service in Delhi many years back. The preparations for the Durbar were on a colossal scale; not only had royal pavilions and arenas to be planned, but camps extending over many square miles, an elaborate system of water-supply, and emergency roads penetrating everywhere in the region which had been requisitioned for the show. The arrangements were most complicated and perplexing, but all went off well, without a hitch, when the crucial days came and the King and Queen appeared. In his very short diary Maclagan, always full of a sense of humour, records one absurd anecdote, sufficiently indicative of the difficulties of dealing with Indian mentality.

"I must record an incident of the Durbar, of which I do not think that anyone but myself is aware. It had been arranged that people of distinction were to be allowed to go about freely in front of the dais until about five minutes before their Majesties were due, and then were to be driven off, while a small army of sweepers were to brush the red cloth clean. All went well, but when I came back from having a final look round, to take up my official seat, I found two sweepers' shoes right in the middle of the space on which their Majesties were to alight. I called to the police-havildar and told him to have them removed. This seemed to put him in trouble, as

he said that the sweepers were all gone, and none of his men would touch sweepers' shoes at any cost. I had visions of having to walk in front of the assembly with two sweepers' shoes in one hand and my sword in the other. But after some discussion a bright thought struck the havildar. He fixed his bayonet, spiked the shoes with it, and took them off in triumph, much to my relief. A minute later the King arrived. I got a letter from the Viceroy on the evening of the Durbar, saying that their Majesties had been very much pleased with the whole arrangements, and thanked me for the work I had done on the Durbar Committee ; moreover that they had been pleased to award me on his recommendation the companionship of the Star of India." To this the C.B. was added almost simultaneously.

It was undoubtedly owing in large measure to his successful management of the details of the Durbar that Maclagan was in the February of the following year (1912) appointed Secretary to the Government of the Punjab for Public Works—the same post that had been held by his father, the General, some thirty years back. Among the important schemes completed in his time as Chief Engineer were the construction of a great bridge over the Ravi at Lahore, a hydro-electric system for supplying Simla with electricity from the Sutlej river, the laying out of several water-supply systems for the use of municipalities, of which the most notable was probably that for Sialkot, and the preparation of a dam in the Nimmal Gorge, in the North-West Punjab, for local irrigation.

He was holding the secretaryship when the Great War broke out in August, 1914, but applied at once to be released from this duty, in order that he might serve on one of the active fronts. This request was refused, on the official ruling that no Engineer officer above the rank of Lieutenant-Colonel could be spared from India. When his three years' tenure of the secretaryship expired, and with it his normal time of service in the corps, he was informed that the scarcity of senior R.E. officers was so great in India, that he must stay on beyond his time of retirement, as commanding engineer at Quetta, for the 4th division. Here he was employed for nearly four years, till the war was at last over, and he was free to return to England. During the war years there was much precautionary work to be done at Quetta, the most important section of which was the planning and laying out of a strategic railway over Northern Baluchistan to the Persian frontier, which developed a new trade route of great importance across what had been hitherto desert regions. On his final retirement in February, 1919, he was given the C.I.E. to add to his already well-earned C.S.I. and C.B.

It may be mentioned that just as he was leaving he had the satisfaction of learning that his younger brother, Sir Edward Maclagan, had been appointed Lieutenant-Governor of the Punjab—where his family had made such a well-remembered name. So ended a long

and honourable term of service, in which Robert Maclagan had made many friends and admirers, and no enemies, for he was the most kindly and the least self-seeking of men. One who served under him for long periods writes the following testimonial.

"It was a pleasure to work under R.S.M. He was sympathetic and always ready with help and advice when it was asked for. He was most hard-working and conscientious, never sparing himself. Though a sound practical engineer he was never above asking for an opinion from one who had specialized on some particular branch of engineering, and acting upon the suggestion. He was devoted to his work, but had many outside interests—archæology was one of them. Although in civil employment for so many years, he saw more active service than most officers of his corps—as witness his three medals with their seven clasps."

Everyone with whom he came in contact had great confidence in his judgment. This appreciation of him started very early. One of his first friends writes that "at Woolwich, when the cadets were in difficulties about some question of discipline or good form, the debate generally ended by someone saying, 'Let us go and ask Bob,' and it was just the same to the end, everyone relied upon him for sound judgment, absolute fairness and very real sympathy—and no one was disappointed." This verdict can be repeated by the writer of this memoir—his earliest friend of all.

In the summer of 1919 he was back in England, with his whole family. He had now four children, Malcolm, born May 29th, 1907, Myrtle, born April 2nd, 1911, Robert, born May 13th, 1913, and Rosemary, born July 4th, 1917. Considering the difficulty which was experienced by every officer returning from the war in finding congenial employment at home, it is no small testimony to Maclagan's outstanding eligibility that he secured, within a few months of his arrival in England, a post exactly suited to his tastes and capacity. The Bursarship of his old public school, Haileybury, fell vacant in 1920, and he was chosen for the appointment over the heads of many distinguished competitors, as pre-eminently the man for the place. He was not only an expert in the construction and maintenance of buildings of all kinds, but accustomed to the handling of large sums of money, and the management of a numerous staff of subordinates of all sorts. The headmaster of Haileybury writes of him:

"Coming at the time when the difficulties due to the war were over, and the numbers of the school were rising, he was faced with all the problems of making good the things which had been left undone during the war, and of carrying out the developments which were necessary to bring the college up to date. The question of finance came first: every penny of expenditure had to be watched: it required first-rate ability and great judgment to decide what could and what could not be done: also the power to say 'no' in

such a way as to make refusals acceptable. A number of houses were built for married masters: electricity was everywhere substituted for gas; a new surgery and recreation-room were added at the sick house: the chapel dome was covered with copper, and the school workshops remodelled. His greatest work, however, was the laying out of the War Memorial Hall, and the new common-rooms and clock-house. In all these schemes his experience as an engineer was invaluable: as in everything else that he did, he gave himself without stint to the work, and overcame every sort of difficulty, structural and financial."

All this was accomplished with the minimum of friction and the maximum of appreciation from every individual with whom Maclagan had to deal. For he was no mere organizer and autocrat, but the most sympathetic and genial of administrators, popular not only with the authorities with whom he worked, but with the boys of his school, and the large staff of employees whose energies he had to direct and stimulate.

Robert Maclagan spent ten happy years in the Bursar's House outside the College, and had the good fortune to see his eldest son well launched in the Corps of Royal Engineers—like his father and grandfather—and his second son accepted as a cadet at Sandhurst. His health began somewhat to fail in 1929, and necessitated a long visit to the military hospital at Chelsea. But he resumed his work, and was busy, almost to the last, in his very congenial post at Haileybury, when a recrudescence of the lingering, but not painful, disease of which he had warning in the preceding year, came upon him. He was wasting away, conscious and serene to the last, all through the summer and autumn of 1931, and died peacefully on October 29th. The best testimonial to his noble character and distinguished career was the immense assembly of friends and relatives, old comrades from his Corps, and Haileyburyians of all generations, who came to take their last farewell of him in the crowded chapel. Not least in affection among them was the author of this memoir.

C. W. C. Oman.

COLONEL THE HON. MILO GEORGE TALBOT, C.B.

MILO GEORGE TALBOT, who died on the 3rd September, 1931, at Bifrons, Canterbury, was the fourth and last surviving son of the fourth Lord Talbot de Malahide. His father, James, 4th Lord Talbot of Malahide, was born in 1805, and married in 1842 Maria Margaretta, youngest daughter of Patrick Murray of Simprim, Co. Forfar. He died in 1883.

Milo Talbot was born at Malahide Castle on the 14th September, 1854, and here the early days of his life were spent. After travelling on the Continent in 1864-5, Milo was sent to a preparatory school called "Overslade," near Rugby—his elder brother being then at the big school. After Easter, 1868, he went to Wellington (then under Dr. Benson, afterwards Archbishop of Canterbury). He remained at Wellington until 1871 and got into the School XI his last term, when he also won the racquets single. That autumn he had his first try for Woolwich and passed in second, but did not join until the spring of 1872. In his first term at Woolwich he played for the eleven. Owing to a shortage of officers, the usual instructional period of two and a half years was reduced to one year and nine months. He passed out second and his commission into the Royal Engineers was antedated to the 29th April, 1873, though he did not join at Chatham until January 1st, 1874.

A History of R.E. Cricket gives Talbot's sports record, where it is stated that he was, in the early years of his service, a very fine bat and a good bowler. He also played racquets for the Corps *v.* R.A.

INDIA AND AFGHANISTAN (1876-1888). HOME (1888-1893).

On completing his time at Chatham, Talbot, now a full-blown Lieutenant R.E., decided to go to India, and on November 7th, 1876, he landed at Bombay and joined the 2nd Company of the Bengal Sappers and Miners at Delhi, where they were engaged in laying out the camp at which Queen Victoria was proclaimed Queen Empress on January 1st, 1877. He lost no time in learning the language, and came under the command of Captain (now General Sir) Bindon Blood at Roorkee, where he learnt to play polo and did a certain amount of big game shooting.

Shortly afterwards, he was dispatched on an expedition against the Jowaki Afridis. On this expedition he accompanied Captain Holdich, and their particular work consisted in improving roads for mule transport and blowing up the towers in the villages. The political officer of the force was Sir Louis Cavagnari, who was afterwards murdered in Kabul. On the return of the expedition, early

Colonel The Hon, Milo George Talbot, CB

in 1878, for which he received a medal and clasp, Talbot was posted to a company of Sappers and Miners at Peshawar.

In 1878, an expedition was organized against Afghanistan, the Northern column, which included the Peshawar Valley Force, being commanded by Sir Samuel Browne. Talbot, with his company of Sappers and Miners, was sent to the Fort of Jamrud, at the mouth of the Khyber Pass, in anticipation of the advance northward. The capture of Ali Musjid followed almost at once, and the bulk of the Sappers and Miners who had joined from Roorkee were employed on improving the roads.

The following winter was spent at Jalalabad employed in making a road thence to Dakka, and in the spring of 1879 they moved on to Gandamak, where peace was concluded. The force then returned to India down the cholera-stricken Kabul river valley, leaving two companies of Sappers and some native infantry at Landi Kotal. Here, in his spare time, Talbot applied himself to the study of Punjabi and Pushtu, which were to stand him in good stead in the near future. A month later, orders came to him to join the force in the Kurram Valley, and here he was again employed for a couple of months in road making—his labourers being mainly Hazara tribesmen.

Meanwhile, Cavagnari and his mission had gone on to Kabul and when the outbreak occurred there which led to their massacre, preparations were at once made for the immediate dispatch of a force under Sir Frederick (afterwards Lord) Roberts. Talbot and his Sappers accompanied this force and took part in the Battle of Charasia, and in the entry into Kabul, where they were quartered in the Sherpur cantonments.

A few days later, some troops were dispatched down the main road with orders to establish communication with the force which had re-occupied the road *via* the Khyber and Jalalabad, which was the main line of communication: Talbot accompanied the force to report on the road and make a sketch of it. Whilst on this duty, he met Captain (afterwards Colonel Sir Thomas) Holdich, who was on his way to Kabul to take charge of the survey, and for whose arrival at Lataband he made all preparations. This chance civility had a remarkable effect on Talbot's subsequent career, for, on his return later to Kabul, Holdich invited him to join the survey, which was the wish of his heart, and, as his brother-officer Ferrier (now Major-General J. A. Ferrier) remarked, "his real career then began," though not at once, for soon afterwards the Afghans rose, the force in Sherpur was practically besieged, and Talbot was ordered to join General Gough's troops, then advancing from Lataband. Sherpur was relieved without a shot being fired, and Talbot was employed on R.E. duties under Captain (afterwards Lord) Nicholson till ordered to join the Survey Department under Holdich. It

was not possible to do much from Kabul owing to the intense cold of the winter, but in the spring of 1880 he took part in one distant expedition to the top of Takht-i-Turkman—the highest point of the Paghman range.

Sir Donald Stewart, the Commander-in-Chief, had meanwhile arrived in Kabul with a force from Kandahar, and when the news came of the Maiwand disaster he decided at once to dispatch Roberts to Kandahar with a picked mobile force, whilst Sir Donald withdrew the remainder of the troops to India by the Jalalabad line.

Talbot was ordered to join General Roberts' staff, and thus took part in the memorable and marvellously rapid Kabul to Kandahar march which ended in the relief of Kandahar after a spirited action. Talbot remained here in charge of the survey, and one of his least pleasant duties was the burial of the dead at Maiwand.

Unfortunately, much of Major Leach's reconnaissance work in the Argandab and Khakrez Valleys and the valuable information concerning the passes into and across the Hazara country had been lost during the retreat from Maiwand, but Talbot, with the assistance of Lieut. Lang, R.E., was able to replace this by their own surveys.

He was subsequently sent to Bombay with his sketch map of the battlefield, which he produced at the court martial held there in connection with the disaster.

From Bombay, he proceeded to Sukkur for survey work, but the rising of the Mahsud Waziris, early in 1881, resulted in his recall to Dera Ismail Khan, to join the expedition sent to punish the raiders. Once more he joined Holdich and together they proceeded to Bannu, whence part of the expedition started, but little opposition was encountered. Incidentally, Talbot mentions the blowing up of some caves which the Mahsuds used as dwelling-places, but as the official report stated that " the only effect of the explosion was to destroy a prodigious quantity of fleas," the frontier medal was not awarded for this expedition ! Talbot had, however, already received a mention in dispatches, the Afghan medal and four clasps, and the bronze star granted for the Roberts march.

The survey work carried out in the Waziristan country by Holdich, Talbot and Martin and their native assistant, Imam Baksh, covered an area of about 1,200 miles, and filled up blanks for portions of the country which had not been visited during Sir Neville Chamberlain's expedition in 1860, and which had never before been seen by Europeans. The plane-tabling by Talbot of the watershed between Khaisar and the Dawar Dur formed a useful continuation of Woodthorpe's work in Khost with the Roberts's expedition. Several mountains, including the peaks of Pirghal and Shuidar (11,000 feet in height) were ascended, and points fixed as far as 200 miles distant.

Some useful and interesting notes on the tribes and roads were compiled by Talbot and printed in full on page 36 of the appendix to the Surveyor-General's Report for 1880-81.

Talbot was next sent to Lower Burma to measure a base line with Colby's bars and connect it with the triangulation which was then being completed. On finishing this work, he joined Holdich's party surveying in the Kohat district of the N.W. Frontier, where a detail survey of about 1,227 square miles of country lying in the Eastern edge of the district along the Indus was made, several additional heights determined and a large plan of the City and Cantonment of Kohat executed. Holdich reported very highly of the aid rendered by Talbot and remarked that " it was due to the thoroughness of his instructions that such an excellent reconnaissance of Birmal was made."

In the summer of 1883, Talbot was again at Mussoorie acting for Holdich, who was on leave, but in the following winter it was decided to send an expedition under Sir Robert Sandeman to visit the southern portion of British Baluchistan, and Sir Sidney Burrard (formerly Surveyor-General of India) has provided some interesting notes on this next sphere of Talbot's activities from which the following extracts have been made.

" A survey party under Talbot was attached to the mission, and Wahab was selected to be his assistant.

" The vast extent of territory which had lately come under British rule between India and Persia was largely a *terra incognita:* on the best maps then available thousands of square miles were shown as sandy desert, which were afterwards found to be covered with ranges of mountains rising to altitudes of 10,000 feet.

" On October 5th, Talbot assembled his party at Jacobabad, where Wahab and two native surveyors joined him. The party met Sir Robert Sandeman at Quetta, and arrived at Kelat on October 30th. Wahab and the two surveyors and half of the khalassies were now suffering from fever, and Wahab recorded in his diary that everything was looking bad for the success of their expedition except that 'Talbot kept well and did everything.' After a week's halt, the epidemic had abated and the party were able to move forward. On December 23rd, the survey party met the political officers at Kharan, and on Christmas Day Sir Robert entertained all the members of the mission at a dinner in his tent. After Kharan, Talbot and Wahab working together, carried the survey over the hills of Western Baluchistan. In January, they met Sandeman again at Panjgur, and received directions from him to explore westwards to the Persian boundary, but to avoid entering Persia.

" On April 23rd, the mission returned to Quetta, and Sir Robert Sandeman, in bidding farewell to the members, expressed himself very pleased with the political and geographical results obtained."

Sir Sidney expresses his opinion of Talbot in the following words:

> "Talbot was noted amongst his contemporaries for his abilities and his soundness of view. All the survey work he ever did was done so well. What he had to do, he did with all his might. He was well placed for his age in the Survey of India and would have been Surveyor-General had he remained in the department. But he had no such ambition and reverted to military employment. When afterwards he was at the Staff College, it was thought that he would be certain to rise very high."

Talbot's seven months' work in these alternately scorching and freezing highlands resulted in an enormous out-turn of topography and the determination by triangulation of many points in Persia connecting St. John's surveys with Indian bases. His intimate knowledge of Persian was invaluable, though such was his modesty about his proficiency in that language that even his friend Holdich was unaware that he possessed it.*

It was not, therefore, by any means a surprise to those acquainted with his wonderful aptitude for this class of work, when news came that he had been selected with Holdich and Gore (and three competent native surveyors) to accompany the expedition appointed to demarcate the Afghan frontier on the north-west, a task which was destined to occupy more than two years and was fraught with vitally important results, both political and geographical. The latter are dealt with fully in the excellent papers contributed from time to time to the Royal Geographical Society by Holdich and Yate (Sir Charles) in his book, *Travels with the Afghan Boundary Commission*. For present purposes, it will be sufficient merely to outline this stupendous work in which Talbot so efficiently participated.

The Delimitation Commission left Quetta on September 19th, 1884, under the command of Colonel (the late Sir) J. W. Ridgeway. The triangulation laid out by Talbot and Wahab in 1883 to the south and south-west of Kelat formed the basis for the extension of the Afghan triangulation from Nushki to the Helmand, and a fairly satisfactory junction was effected at Galichah just east of that river.†

In 1885, Captain Maitland with Talbot (now a Captain) travelled from Herat through Obeh and Daulat Yar to Bamian, thence through the difficult passes of the Hindu Kush to Balkh and back *via* Maimena to rejoin the Commission at Chahar Shambu.

* A long and very interesting extract from Talbot's official report on his Baluchistan work is printed as Appendix xxxvi in the General Survey Report of India (1883-4).

† In a lecture given at the Royal Artillery Institution on 10th December, 1896, the lecturer, Colonel J. K. Trotter, R.A., said: "For an account of the modification of the rules in force in high-class geodetic surveys which may be adapted in boundary work, I know of no better advice than that contained in a small pamphlet on *Rapid Triangulation*, by Major the Hon. M. G. Talbot, R.E., compiled at the Intelligence Division."

The work of the Survey Section of the Commission included almost all Western and Northern Afghanistan and in addition Talbot and Gore surveyed Khorassan east and south-east of Mashad. Talbot also formed one of a committee detailed to report on the defences of Herat and the measures necessary to place them in a satisfactory condition. Black's *Memoir of Indian Surveys*, 1875-1890, contains the official account of the work of the Delimitation Commission.

On completing this work, Talbot took leave and arrived in England in November, 1886, after ten years' absence. After barely a year spent at home Talbot, now a Brevet Major, applied to return to India, and on arrival there he sent in his resignation from the Department to the Surveyor-General, but as this could not take effect for six months, he received orders to proceed to Burma, where he arrived in November, 1887, and was appointed to superintend the field operations in Lower Burma.

He had already suffered previously from eye trouble, and the climatic conditions of Burma proving more trying in this respect, he was passed medically unfit, and finally reverted to home service on April 30th, 1888. He arrived in England in May, was given short leave, and then took up the command of a depot company at Chatham, where he found many old friends.

Talbot now made up his mind to go up for the Staff College, and in the examination which was held in July, 1889, he passed in first on the list. During the summer vacation in 1890, General Chapman, then head of the Intelligence Department at the War Office, who had known Talbot in Afghanistan, invited him to visit the old fortresses at Widdin, Rustchuk and Varna, and report if the stipulation as to dismantling these fortresses had been carried out—he was also instructed to collect any new information to add to the handbooks on Serbia and Bulgaria. He passed out of the Staff College in December, 1891, and, after spending Christmas in Ireland, he joined the Bridging Battalion at Aldershot.

The esteem in which he was held at the Staff College is well described by his old friend Aston (now Major-General Sir George Aston) in his interesting book, *Memories of a Marine*, but as he had withheld Talbot's name he (after his old friend's death), in a letter to *The Times*, re-published the paragraph, and stated to whom it referred.

After eight months at Aldershot, Talbot obtained "a job after his own heart" by being appointed to the Mapping Section of the Intelligence Department at the War Office. He was promoted Major in the Corps on October 1st, 1892. In the summer of 1893, he met Major Wingate, then Director of Military Intelligence in Egypt, and thus began a friendship which terminated only with his death. It was arranged by Lord Kitchener, then Sirdar of the Egyptian

army, that Talbot should accompany Wingate to Egypt and carry out some mapping there, while still retaining his War Office appointment.

EGYPT AND SUDAN (1893-1905).

On his arrival in Egypt in the autumn of 1893, Talbot proceeded forthwith to Wadi Halfa; he lost no time in fixing its position by telegraphic comparison with Cairo, and started a small triangulation. In the same year he accompanied a patrol into the western desert and fixed the position of certain wells which had formed bases from which the Dervishes sent raiding parties into Egypt. The year following he commenced a triangulation from Suakin based on the positions shown on the Admiralty Chart.

On completion of this work, which was necessarily much circumscribed as Dervish forces were still in the neighbourhood and survey operations could not safely be carried far afield, he returned to his post at the War Office in London.

In the spring of 1896 Kitchener began his first move into the Sudan—a campaign which lasted three years and only terminated with the final overthrow and death of the Khalifa in November, 1899.

Talbot now saw his chance of getting more survey work done, and an application to Kitchener resulted in his being sent out at once on "special service," though still retaining his appointment as a D.A.A.G. in the Intelligence Department of the London War Office.

After the successful action at Firket on June 7th, 1896, and subsequent advance towards Dongola, Talbot found it possible to carry out further triangulation work, and eventually completed a time-table survey from Wadi Halfa to Kerma. During the next two years of constant campaigning Talbot, whenever he could spare the time from his other duties, continued to fix positions along the Nile Valley. Merowe was telegraphically fixed in 1897, and a small triangulation commenced to fix points between Merowe and Abu Hamed.

At that time the general idea was that the contemplated Sudan Railway was to start from Korosko and go south, *via* Murrat, along the camel route to Abu Hamed, as it was believed the only water in that arid desert was to be found at Murrat. Thither Talbot, accompanied by another Engineer officer, Stevenson, proceeded.

A triangulation was started from Murrat, but on their way back to Wadi Halfa, they were struck by the possibility of finding a much better line for the railway straight from Wadi Halfa to Abu Hamed. Kitchener approved of the idea, and later on an unfailing supply of water was found at two places along this route, which the railway eventually followed.

Meanwhile, Wingate had gone with the Rodd Mission to Abyssinia, and Kitchener applied for Talbot's services in order that he might take over temporarily the duties of Director of Military Intelligence

during Wingate's absence, which lasted from April to September, 1897. This kept him in Cairo during the hot weather, and meantime his War Office appointment having expired, he received orders to return to England preparatory to going again to India. After a month at home, Kitchener again arranged for his return to Egypt, and he rejoined the Expeditionary Force as an officer temporarily attached to the Egyptian army, to date from 1st January, 1898.

On arrival he was posted to Merowe as Staff Officer to General Sir Leslie Rundle, then in command of Dongola Province. By this time he had received the Egyptian medal and clasp "Sudan, 1897."

The battle of the Atbara which took place in April, 1898, had the effect of opening the road from Korti to Metemma *via* Gakdul, along which Talbot accompanied a force in August, fixing, as he went, a number of positions. This, it will be remembered, was the route used by Wolseley in 1884 when attempting the relief of Khartoum and the rescue of Gordon.

Continuing their march southwards along the left bank of the Nile, they reached Kerreri on September 1st, to find Kitchener's Anglo-Egyptian army disposed in a half-moon formation covering the village, and, in the afternoon, from an isolated hill some way in front of the position, the whole Dervish army was seen advancing from Omdurman. Firing began at dawn the next day (September 2nd), and the great battle which ensued ended in a complete victory for the Anglo-Egyptian forces.

For his services in the 1898 campaign Talbot received a brevet Lieut.-Colonelcy, the British Sudan medal and a clasp for the battle of Khartoum.

When possible, he continued his survey work, and amongst other details it is interesting to note that the Marchand expedition which resulted in the famous "Fashoda incident," had traversed the Congo-Nile watershed and marched through the Bahr-el-Ghazal, thus materially adding to Talbot's topographical information of the Southern Sudan. Meanwhile, Kitchener lost no time in organizing the newly-acquired territory, which incidentally covers an area more than three-quarters the size of India. Many changes were also made in the army; Rundle, the Adjutant-General, had left; Wingate was appointed in his place, and Kitchener offered Talbot the post of Director of Military Intelligence, vacated by Wingate, which he accepted, and as this necessitated joining the Egyptian army, he then entered that service with the rank of Miralai (Colonel) from January 1st, 1899. During the whole of this year he was kept very busy with Intelligence work and general organization, but succeeded in getting short leave home in the autumn.

On December 22nd, 1899, Wingate succeeded Kitchener, who had been sent to South Africa in order to take up the position of Lord Roberts's Chief of the Staff, and he at once invited Talbot to

take up the newly-created post of Director of Surveys, which was accepted, the appointment dating from January 1st, 1900.

On his arrival in South Africa, Kitchener asked a large number of his senior and experienced Sudan officers to join him, including Talbot, and there is no doubt that the latter, then on his way to settle the boundary between the Sudan and the Italian Colony of Eritrea, was much disappointed to receive a message from the Governor of Kassala to the effect that his services had been applied for by Kitchener, but that Wingate had refused. The latter, faced with the not inconsiderable task of evolving order out of the chaotic stage through which the Sudan was then passing, can perhaps be excused for "drawing the line" after the greater number of his experienced officers had left for the South African theatre of operations. To lessen the blow, however, as far as possible, he recommended Talbot (who received his regimental promotion to Lieut.-Colonel in March, 1900), for further promotion to Brevet Colonel, an honour which he richly deserved; it was granted some months later.

Although the Sudan-Eritrean boundary was not finally settled at that time, Talbot, accompanied by the Italian delegate, Captain Colle, did valuable work, and incidentally he visited Asmara, the capital of the Italian colony, which he described as "having a delightful summer climate."

Reporting on the situation, the Governor-General said:

> "The much vexed question of these frontiers may be said to have been settled on a definite basis, and the work of demarcation has been already commenced by Colonel Talbot and Major Gwynn, the former working in conjunction with the Italian delegates on the Sabderat-Setit line, whilst the latter will be responsible for the demarcation of the Sudan-Ethiopian boundary."

In the circumscribed space necessarily allotted to this abridged memoir, it is not possible to describe in detail the immense amount of work executed by the Survey Department under Talbot's most able direction, but particulars will be found in Major Pearson's paper to the Royal Geographical Society, which was prepared in collaboration with Talbot and published in May, 1910.

To Wingate's infinite regret, as well as to that of his old friend, Slatin, who had been for some years Inspector-General of the Sudan, Talbot resigned his appointment in April, 1905, and returned to England.

Retirement at Home (1905-1914).

Talbot's comment in his diary on this important step in his career is thus laconically described:

> "My period of service as a Lieut.-Colonel expired on April 29th, 1905, and I decided not to seek re-employment, but to retire and devote my energies to pushing the cause of Compulsory National Training."

Talbot did not allow much time to elapse before taking up enthusiastically the objects of the National Service League, for the pursuance of which he had given up a career in which he had so greatly distinguished himself and had done invaluable service for the Empire; but the spirit of true patriotism glowed in that quiet and unassuming nature, and in spite of a reluctance to public speaking, he took steps to cultivate the art, and very soon successfully occupied platforms both in England, Scotland and Ireland. At this period Mr. (now Sir George) Shee, was Secretary of the League, which had been founded on February 22nd, 1902, and, writing of his old friend, Shee says:

> "Milo was a very cheery, delightful member of committee, very able, very modest, with a quaint and rather attractive habit of allowing a long period of rather puzzled-looking gravity to culminate in a tremendous guffaw which ceased as suddenly as it began."

Meanwhile, Lord Roberts had taken up, independently, the question of rifle-shooting, his object being to produce a nation of riflemen. The Chairman and other members of the National Service League urged Talbot to press his old Chief to join the League, and this he ultimately succeeded in doing, with the result that, in due course, Lord Roberts whole-heartedly supported it, and an immense impetus was given to the cause.

It was at this period that Talbot became a keen golfer, remaining so almost to the end of his life and, until a few years before his death, he also played a good game at squash racquets.

A memorable date in Talbot's life about this time was May 24th, 1909, when the President of the Royal Geographical Society (Major Leonard Darwin) at the Anniversary Meeting of the Society presented to him the Patron's Medal in recognition of his great services:

> ". . . in the mapping of very extensive areas under exceptionally trying conditions and always with a very high ideal as regards accuracy of work."

Talbot, in his extremely modest reply, characteristically remarked:

> "Many of you, I know, have experienced the sensation of reaching a peak commanding a wide view over country which, up till then, has appeared only as a white blank in the map, and I am sure that all of you who have felt the joy of that moment must agree with me that it is ample compensation in itself for any amount of preliminary toil and discomfort."

Hitherto, Talbot's men friends looked on him as a confirmed bachelor, but in 1911 he married Eva, daughter of the late Colonel Joicey, *M.P.*, of Newton Hall, Northumberland, and on December 1st, 1912, at 21, Belgrave Square, their first child, Milo John Reginald, was born. The early summer of 1914 saw them at Marienbad,

and whilst there the Serajevo assassination occurred. Little thinking what this was to lead to, they rented Hartham Park (Lord Islington's house) near Chippenham, and had only occupied it a few weeks when the Great War broke out.

THE GREAT WAR. THE WAR OFFICE. BACK TO THE SUDAN. THE SENUSSI MISSION. HOME (1914-1918).

Talbot at once applied for service, and was appointed to the Military Intelligence Department at the War Office. Fifteen months of very strenuous work there resulted in a partial breakdown, and he was ordered to rest and temporarily to give up work. The 1916 New Year's Honours Gazette gave him a well-earned C.B., and soon afterwards he was asked if he would go out and join Wingate in the Sudan. This he accepted, and once more taking up his Egyptian rank of Lewa, Pasha, he was employed on Intelligence work in Khartoum. Here his previous experience of the country and its problems proved invaluable.

This is not the place to describe the various enemy activities in the Egyptian and Sudan theatres of operations, but incidentally they led to the selection of Talbot for an important and delicate mission to the Italian Colony of Cyrenaica, in North Africa. This began with an official visit to Italy. Leaving Alexandria on May 25th, 1916, he reached Rome after a circuitous route in an Italian vessel to avoid enemy submarines, which, at that period, were specially active in the Mediterranean.

The object of "the Talbot Mission" was to endeavour to take advantage of the situation in Cyrenaica to come to an agreement between the Senussi adherents of Sayed Idris and the British and Italian Governments. After preliminary negotiations with the Italians and the British Ambassador, Sir Rennell Rodd, in Rome, where Talbot also found his old staff college comrade, Colonel Delmé Radcliffe, installed as Chief of the British Military Mission to the Italian army and through whom he obtained the services of Mr. Haslam as Italian interpreter, he started for Cyrenaica and the combined British and Italian Missions finally took up their quarters at Zuetina, an Italian fort on the sea coast about sixty miles west of Benghazi, whilst Sayed Idris remained in his camp about 20 miles distant. One of Talbot's first moves was to obtain Sayed Idris's sanction for the release of the British crew of the *Coquet*, who had been for some time prisoners of the Senussi and who were eventually handed over at Zuetina.

Prolonged and difficult negotiations now took place which resulted in an Anglo-Italian Agreement (dated July 31st, 1916). Much work remained to be done in connection with the stipulations of the agreement, and the mission did not return to Cairo till October, where

Talbot remained till arrangements had been made for further negotiations with Sayed Idris. These involved a second journey to Cyrenaica and on this occasion, in addition to the efficient Hassanein Bey, Talbot had the assistance of Mr. Francis Rodd, of the British Diplomatic Service, and a very proficient Italian scholar. Meanwhile, Kitchener, who had stipulated that on the conclusion of the war he should return to his post in Egypt, had been drowned, and the choice of his permanent successor fell on Wingate, who came down from Khartoum to take up the appointment of High Commissioner at the end of 1916.

Talbot received a further "Mention in Dispatches" in the *London Gazette* of October 25th, 1916, and the "mission" started again on its journey to Cyrenaica towards the end of January, 1917. This time the journey was made by motor-car to Sollum, where an Italian torpedo-boat met them and brought them to Tobruk. The members of the Italian Mission had already arrived, and Sayed Idris was encamped 20 miles off. Further prolonged negotiations took place, resulting in tripartite agreements between the British, French and Italian Governments, and in two separate agreements: (1) between the British and Sayed Idris, and (2) between the Italians and Sayed Idris.

Talbot returned to Cairo in May, 1917, and shortly afterwards he left for Marseilles, carrying dispatches from the High Commissioner to Paris, and narrowly escaping destruction by an enemy submarine.

After commenting on the result of the negotiations, the High Commissioner concluded his final dispatch to the Foreign Office (dated Cairo, April 28th, 1917), in these words:

> "I desire to bring very especially to your notice the really admirable service rendered by Colonel the Hon. Milo G. Talbot, C.B. To his patience, tact, and clear foresight, are due, I consider, not only the signature of our Treaty with Sayed Mohammed Idris, but also in a very considerable degree, the satisfactory arrangements made between the latter and the Italian authorities. It is evident that Colonel Talbot's personality and wise counsels have sensibly influenced the attitude of Sayed Idris to the proposals of our Allies and have contributed very materially to the successful issue of these negotiations."

It has been deemed advisable to comment somewhat fully on Talbot's mission to the Senussi, as apparently but little has been recorded of this important work. The manner in which these difficult and delicate negotiations were conducted showed him to be possessed of statesmanlike qualities of no mean order, which merited the highest consideration.

Talbot was finally struck off the strength of the Egyptian army and Expeditionary Force on August 31st, 1917, receiving the British and Victory war medals only. He took up his residence with his wife

and family first at Hartham until they eventully moved to Bifrons, near Canterbury, in 1920, where he and Mrs. Talbot took a keen interest in local affairs, both social and political, and he was seldom absent from the Canterbury Cricket Week functions.

In May, 1930, his only surviving brother, Reginald, died, and he thus became heir presumptive to his nephew, James, 6th Lord Talbot de Malahide.

DEATH AND FUNERAL.

Towards the close of 1928, symptoms of heart trouble developed, which gradually increased, until the end came on September 3rd, 1931, and Milo Talbot was laid to rest in the cemetery at Malahide on September 8th. The funeral was private and as simple as possible; his widow, son and daughter and a few relations only being present.

It is no easy matter to summarize Milo Talbot's somewhat complex character: brilliantly clever, capable and efficient in every respect; a direct descendant of an ancient family known in the annals of British history for men of outstanding mark in the military, administrative and political arenas; himself a gallant and distinguished soldier and administrator and, above all, a surveyor, map maker and cartographist of exceptional merit, meticulously accurate in mind and action and with scientific attainments of no mean order; yet, withal, pre-eminently modest and apparently devoid of all personal ambition: imbued especially with the vital necessity of giving first place to the interests of the profession he so faithfully served, and relegating to the background any thought of personal advantage, concerned only in devoting all his energies to the best interests of his Sovereign, his country and Corps.

Such were the ideals of this exceptionally gifted yet selfless officer.

To those of his Corps to whom reference was made in seeking material for this short memoir of a dear friend and good comrade of many years' standing, one could not but be struck with the unanimity of view as to Milo Talbot's character and career:

> "He could have done anything and have risen to the highest positions had he wished."

R.W.

Note.—This memoir is the abridgment of a much fuller one which the Hon. Mrs. Milo Talbot has had printed, and which she will be pleased to present to any member of the Institution of Royal Engineers who applies to the Secretary for a copy.—Editor, *R.E. Journal.*

BOOKS.

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

THE FIFTH ARMY.

By General Sir Hubert Gough, G.C.M.G., K.C.B., K.C.V.O., etc.

(Hodder & Stoughton, Ltd., London. 1931. Price 25s.)

This is not merely the story of the Fifth Army in March, 1918; the volume covers the whole of the fighting in which General Sir Hubert Gough had a share from the arrival of the B.E.F. in France. In his own words it is a plain tale of the War as he saw it himself, and it was written to cater for the needs of three quite distinct classes of readers—for the historian, who requires details and facts: for the soldier and ex-soldier who wants reasons and opinions as well: and for the civilian who is not necessarily interested in purely military details and to whom the drama of the story is, perhaps, its main interest.

The author has written a good book. To all classes of readers an authoritative account, as this is, of the great "victory in retreat" of March, 1918, cannot fail to be of absorbing interest. The author has had access to the archives of the Official Historian to verify facts and obtain information which was not available when the events he describes took place. Consequently that portion of the book which deals with periods not yet touched by the official history of the War is the first reliable account of events of which the public has so far only a general knowledge.

With the official history available it is not proposed to discuss General Gough's narrative, and comment will be limited to matters to which he draws attention in the conduct of operations.

The author holds the French staff to be entirely responsible for the first great mistake of the War—the strategical deployment of the French and British Armies. "The "B.E.F.," he writes, "could have been better placed, not so dangerously exposed, "and would have covered the French flank equally well, if it had been concentrated "in echelon a little distance to the left rear of the French Fifth Army. I am not "sure that either Lord Kitchener or Mr. Asquith ever forgave Sir Henry Wilson for "the dangerous position our Army was placed in, and for which they held him "partially responsible." General Gough states that certain of our military leaders were against concentration of the B.E.F. in any area in advance of Amiens, and that Sir Henry Wilson had discussed the area around Le Cateau and Avesnes as an alternative; but the final decision was left to the French, and it was they who decided that the place for the British Army should be on the left of the line of French Armies, which it would thus prolong.

The next point on which General Gough lays stress is the vagueness and insufficiency of information given in the orders issued to the British Cavalry, and to himself as Commander of the 3rd Cavalry Brigade. The "fog of war" is often mentioned by military writers, but its effects have to be felt to be realized in all their intensity. There was plenty of it about everywhere during the first week of the War and during the retreat from Mons. "How far the French Staff," writes General Gough, "was "responsible for misleading British G.H.Q. it is impossible for me to say . . . Their "original calculations had not contemplated that the Germans would leave only "4 Corps (three active and one reserve) on the Russian front, nor that they would at "once employ a large number of reserve corps in front line . . . but between the

"attack on Liége on August 5th, and the Battles of Charleroi and Mons on August "23rd and 24th, there was plenty of information as to the strength of the German "outflanking wing, which included 3 out of the 7 German Armies on the Western "Front, available to show the true state of affairs, and the French had ample time "to rectify some of their original mistakes in dispositions."

The almost wilful blindness of the French G.Q.G. resulted in the actual situation on the left flank being the very reverse of that envisaged, and instead of the British advancing on Soignies and then turning eastwards to envelop the Germans advancing from Brussels—as ordered—it was they who were to be called on to fight at once on the defensive and feel the threat of envelopment of their own flank.

In this case the "fog of war" may or may not have been imposed by the enemy, but when it was created by ourselves it drives General Gough to say some hard things about G.H.Q. and the Cavalry Division. He writes: "Responsible Commanders "should have been informed, at all events on entering the theatre of war, in the clearest "possible manner of the general plan of campaign and of the positions of all forces "operating near them . . . Secrecy was, I think, carried to excess, and it was "contrary to all our Staff training previous to the war. Of the two dangers—the "risk of one's own orders falling into the hands of the enemy, or the lack of intelli- "gent and coherent initiative in commanders due to the absence of information— "the latter is far the most serious." The only comment that can be made on this dictum is, Was there adequate liaison between staffs and units at this early stage of the War? Later on the necessity of temporarily attaching officers to neighbouring staffs and units during operations was recognized almost universally.

General Gough, after discussing the faulty disposition of the allied cavalry screen (to cover the advance from Maubeuge on Soignies) and attributing the reason for it to the faulty instructions given on August 16th by General Joffre to Sir John French, points out that the result was that the II. Corps (Smith-Dorrien) found itself advancing entirely uncovered, and four brigades of the British Cavalry Division had to be side-stepped from right to left of the British Army right across the impedimenta of the infantry in order to protect the left flank; and he goes on to make the following comment on this 'encounter battle.' "Sir John French, at this early stage, employed "all his force 'taking up a line' (the term used by Sir John in his dispatch). A "better disposition would have been to cover his front with two advance guards, "each composed of one cavalry brigade, one infantry brigade, and one artillery "brigade. Another cavalry brigade could have covered the right flank and estab- "lished contact with the French, while the two remaining brigades (there were five "in all under General Allenby) could have moved out to cover the left flank. One of "the results of deploying on a line was that the British Army was immobilized in "its positions, lost its capacity for manœuvre, and had to wait on events dictated by "the enemy." This partly explains why the II. Corps had to fight single-handed, with only two divisions against six German divisions, at Mons on August 23rd-24th, while the I. Corps was hardly engaged at all.

So much has been written about the retreat that it is only necessary to refer to an incident at its beginning. On August 24th the whole of the 1st Line Transport of the Cavalry Division was massed north of the stream which flows through Audregnies (S.W. of Le Cateau). To clear the only bridge and the village in case of a retreat the transport was suddenly ordered by Cavalry Divisional Staff to retire southwards. "The move was very essential," writes General Gough, "but unfortunately we did "not see any of the wagons of our brigade for many days." It was bad enough to be deprived of their transport, but the maps not in actual use were also on the wagons, and the retreat commenced with no maps of the country behind them! General Gough managed to cut a section out of a small-scale wall map in the Mairie at Catillon and was careful to ensure that it covered the whole area of a possible retreat to Bordeaux, the city to which the French Government did retire a few days later! Whether the separation was intentional in its Spartan severity is not stated, but it

would seem to have been hardly necessary in a well-disciplined regular army to have deprived the cavalry—although it formed the rearguard—of its 1st line Transport for so long, unless, as happened in the case of the 4th Division after Le Cateau, the wagons had to be emptied and the contents, including greatcoats, dumped or burnt, to provide transport for the sick and wounded. The maps incident was not unknown even in South Africa where mounted columns were apt to run off the maps issued for the trek; but even De Wet stuck to his Cape Cart (which also carried ammunition) when he was pursued for 300 miles during the "Hunt" in Cape Colony and the Orange Free State in 1901. General Gough was able to buy a toothbrush on the fifth day! "Fifth" reminds us of the story he tells about the duration of the War. He had been asked by Colonel Page Croft, commanding the 1st Hertfordshire (Territorial) Battalion to address his men in November, 1916. General Gough did so and in an inspiring speech reminded them that there had been a Seven Years' War, a Thirty Years' War, and even a Hundred Years' War. "Having delivered my oration," he writes, "I felt I had done well, but I received a chilly reminder that no sentiments, "however well founded, can suppress the innate sense of humour in the British "soldier, for one of the men was overheard to remark to his neighbour as the battalion "marched away: 'Cheer up, Bill, I have always been told the first five years are the worst!'"

It was not only at Maubeuge that the author found himself hampered by the insufficiency of his orders. General Gough relates another incident during the advance to the Aisne. He now commanded a cavalry division himself and he writes: "Even "on September 6th none of us had an inkling that the scene was now set for a great "and, in fact, perhaps the most decisive battle of the War. But why were we not "warned? Joffre's instructions for a counter-offensive were issued to his Army "commanders on the evening of September 4th, and Sir John French had agreed to "conform in the general advance ordered for September 6th. Yet no attempt was "made by G.H.Q. to explain to the Corps and Divisional Commanders the extra-"ordinary opportunity now presented for a decisive blow at the enemy . . . valuable "time was necessarily lost while we were ascertaining the situation." This is true, and the slowness of the B.E.F. in advancing has been commented on by various critics. It is suggested that the author might have brought out the point that every superior commander should devote some time, however short, during his busy day, to study the march of events in the theatre of war as a whole. It can be overdone, as it perhaps was when Sir Henry Wilson was in command of the 4th Corps, but too often it was neglected altogether with the result that events that might have been anticipated and prepared for came as a surprise. But a commander cannot study a general situation if he is not given or cannot go and obtain information from those who ought to be in possession of it. On September 13th, at 5 a.m. General Gough, wrote as follows to G.H.Q.: "I should be obliged if I could receive definite orders "daily (1) as to what places I am to reconnoitre and what information is required: "(2) the axis of march of my brigades (he had not yet been gazetted as a Cavalry "Divisional Commander) and the line they are expected to reach daily: (3) what "distance ahead of the infantry I am expected to be. At present I receive practically "no orders. In consequence, it is impossible to act with decision and without "constant hesitation. Every night the infantry come up and crowd us out of "billets to the great detriment of our men and horses. This is particularly fatal if "this weather is to continue." It had evidently been a bad night, but General Gough was probably amply justified in writing to a staff officer at G.H.Q. as he did. The writing of orders is elemental: what General Gough said was elemental; but it is a fact that before the War the framing of orders to cavalry, whether it was an officer's patrol, a reconnaissance squadron, or even large units, was often very perfunctory; and too often it was left to the recipient of the order to interpret to the best of his ability what was in the mind of the giver of the order—if the giver had got so far as to crystallize in his mind what he really did want done. There was nothing new or

difficult in drafting an order to cavalry ; it was all down in print, but apparently few officers who had not themselves served in the cavalry and excepting a few who had seen service in mounted infantry had any conception of what information is necessary for a cavalry leader to enable him to fulfil the task given him properly. Training in writing such orders may not have been omitted at the Staff College, but it was not stressed elsewhere. However, it was to be many months before the cavalry had to be employed again in its proper role, and in the meantime General Gough was, on September 15th, promoted Major-General at the age of 44 to command the 2nd Cavalry Division and sent with it to take part in the " Race to the Sea."

" It is difficult," he writes, " to over-estimate the strategical importance of this " move initiated by the G.O.C.-in-C. and G.H.Q. Indeed it is doubtful whether the " full bearings and advantages of it were realized at the time. Had we had French " troops (whose base would have been Central France) on the extreme left flank " during the First Battle of Ypres or in 1918, it is very possible that the Channel " Ports would have been lost to us. This does not mean that the fighting qualities " of the French troops are being called in question, but it is merely a matter of lines of " communication and the vital necessity of covering them. Another object was the " hope of outflanking the German Army. About this time, however, the German " Command also reached the conclusion that a turning movement by the north gave " more promise of regaining the initiative, and of essential victory, than a continuance " of the Battle on the Aisne: . . . neither side had started in time, however, nor had " either sufficient superiority of force to turn and roll up the opposing flank." But the Channel Ports were saved, though they had been at the mercy of the Germans from the end of August; whether they realized the opportunity or not, the Germans preferred the chance of the bigger prize, the defeat of the main enemy army in the field and the sack of Paris, realizing that if success crowned their effort the Channel Ports could be occupied at their leisure.

The march of the Cavalry Corps to the north commenced on October 1st. It was intended that the cavalry should be in a position to cover the move and detrainment of the infantry and guns as they moved north, and eventually cover the detrainment of the II. Corps at Lille. But long before the cavalry could get there the Germans, who were also marching north-west, had forestalled them. In the event, they were able to cover the detrainment of the III. Corps at Hazebrouck, and then push on northwards to extend the line and eventually join hands with General Rawlinson's 7th Division and 3rd Cavalry Battalion, which had been employed in the vain hope of saving Antwerp.

On October 14th, General Gough met General Byng and the 3rd Cavalry Division at Wytschaete and took over the front as far as St. Eloi and the Hollebeke Canal.

Before leaving this phase of the War it is interesting to learn that General Gough considers that it was a mistake on the part of the Commander of the Cavalry Corps not to allow the Second Cavalry Division to push on eastwards immediately after the capture of Mont des Cats on October 12th. " It appeared to me," he writes, " that " we were on the flank if not partly in rear, of the Germans who were heavily engaged " (on our right) with our 1st Cavalry Division and the 4th Division. The Germans " opposite to us were only cavalry supported by Jäger. It seemed a priceless chance " for my cavalry to sweep round, roll up their flank, threaten their rear, and thus help " the 4th Division to advance . . . Even if the Germans retreated at once, to remain " passive on top of the Mont des Cats was to waste a valuable day. The following " day, the Germans having fallen back, we ventured to advance again, and during the afternoon occupied Kemmel." Though, as events proved, General Gough could only have gained a local success, one wonders what General Allenby had in mind, and whether he knew of the proximity of General Byng's cavalry division ? Again, the ' fog of war,' perhaps !

The share of the Fifth Army and its Commander in the great battle of March, 1918, has been the subject of so much ignorant criticism that General Gough is fully

justified in taking up the pen on its behalf and in trying to dispel some of the misrepresentations as to his own part in the operations.

There can be no doubt that the length of front allotted to the Fifth Army was such that it could only be thinly held by the troops at its Commander's disposal. Whether the French were justified in demanding that the British should take over more of the front is open to question. But why did Field-Marshal Haig accede to the demand, and having done so, why did he allow the southern sector and the junction point of the Allies to be held so lightly? We need only discuss the second part of the question, for the answer to the first is obvious to those who, like General Gough, knew Sir Douglas Haig and how he never allowed himself to take a selfish or narrow view of the situation on the Western Front. He was forced to do so by Mr. Lloyd George. In 1916, previous to and during the Battle of the Somme, Sir Douglas Haig did not receive the full number of troops that had been promised him for that battle. In 1917, after Arras and Paschendaele, large numbers of troops were deliberately retained in England by Mr. Lloyd George, although the losses during the year had been enormous, and although the possibility—nay certainty—of a great German effort in the spring of 1918 was obvious in view of the breakdown of the Russian front.

At the beginning of 1918 the British C.-in-C. had a double problem to solve, for he had to cover the Channel Ports, and he had to prevent the Germans breaking through and separating the Allied Armies. His reserves were insufficient to guarantee his ability to fulfil both tasks with success. He had to make up his mind which portion of his front was most likely to be attacked and which of the alternatives open to the enemy would be most dangerous to the Allies if the Germans were successful.

It is advisable when studying this campaign to refresh one's memory by reference to a small-scale map of the theatre of war in order to realize the narrowness of the strip between the British front and the sea. There was little enough room for manœuvre. The British stood literally with their backs to the wall!

It was impossible for anyone to foretell exactly where the Germans would make their main effort. The French were convinced that it would fall on their front, and they clung to this belief to the very last, longer in fact than they were justified in view of the information pouring in from all sources as to the strength and disposition of the German reserves and the date of the attack. The British C.-in-C. could not move any of his very small reserves until he knew exactly where the German mass had struck, and the breadth of the attack.

The German plan, as we now know, was to overwhelm the British, and they relied—General Gough quotes a German authority in proof of it—on the French being slow in moving to the assistance of their ally while there was the slightest chance of an attack on themselves. The Germans decided to throw one mass against the British Third Army and the right of the First, and simultaneously launch a subsidiary but scarcely less heavy mass against the weak British Fifth Army; with the object of throwing back the Fifth Army, fending it off, as it were, with their left, and then turning north so as to roll up the British front, which was already being heavily attacked from the east. [In the end the Fifth Army refused to be fended off, and so the German plan failed.]

The British C.-in-C. had correctly divined the German intention to concentrate their efforts against his front, and he decided that covering his communications to the Channel Ports was his first duty. He probably hoped, for he was far-sighted to a degree which perhaps is now more generally recognized than it was then, that if the Germans broke through at the point of junction with the French he would be able to fall on them from the north while the French attacked them from the south: and he knew that, to enable him to do so, all depended on his ability to hold the German attack on the front of the Third and First Armies. We shall have to wait for the official historian, or even Lord Haig's diaries, to know what his plan was; but in the meanwhile it is not safe to say more than that we do not know whether he realized that the Fifth Army would be as heavily attacked as the Third. It is safe to say that

he, if not his staff, was prepared for it, and that he did not intend to take any chances on the Third Army front.

General Gough, when he heard that the whole of his front was involved, was no doubt convinced that the brunt of the attack was directed at the Fifth Army. It is doubtful whether he realized at the time that the Third Army was equally if not more heavily involved.

G.H.Q. was naturally in closer touch, by reason of its location, with the Third Army than with the Fifth. It remained so during the battle. General Gough makes a point of this and maintains that G.H.Q. should have kept in closer personal touch with him instead of relying on the telephone and second-hand—and often inaccurate and exaggerated—reports from other sources as to the march of events on his front, and as to the position, losses, and morale of his troops. He is justified in this, but he lays too much stress on the fact that his left was in the air almost from the commencement of the battle owing to the right of the Third Army retiring more rapidly than his own left. He may lose some of the sympathy which his readers are ready to extend to him—now that they know the facts from his point of view—because of the reiteration of this complaint. He confesses that he did not know for months afterwards what did happen on the Third Army front—no fault of his probably; but he is justified in pointing out that the arrangements made by G.H.Q. for the safety of the junction point of the Third and Fifth Armies, and by G.Q.G. in conjunction with G.H.Q. for that with the French, were inadequate in view of the small number of troops at his disposal in relation to the extent of his front.

General Gough's frank admission that he now realizes that it might have been better if he had so directed the retreat that his troops would have been fighting in line with, and not in front of, those on the flanks, is important. By clinging so tenaciously to the positions they had been ordered to hold, his gallant troops not only suffered heavy losses in their positions but further losses when the survivors, if any, were eventually withdrawn. But to have done this, he rightly reminds us, would have entailed disobeying, first the orders of the C.-in-C. to hold on to certain essential points or lines of defence, and later the order of Marshal Foch to stand and fight where he was to the last man. He holds that if he had obeyed these orders to the letter his Army would have failed in its task, and that in endeavouring to carry them out, his losses were unnecessarily increased; for, in both cases the result was the same—they were either overrun by vastly superior numbers, or he was debarred from withdrawing them on his own initiative and in his own time.

That General Gough was most ungenerously treated when he was made the scapegoat for the losses in the Fifth Army during these last days of March, 1918, there is no shadow of doubt. G.H.Q. had no conception of the magnificent defence put up by the Fifth Army—which refused to be thrust aside as the Germans had intended—or of the personal part played by its Commander in organizing that defence and directing the retreat. That he never lost hold of the situation for one moment is proof of the quality of his leadership; the fact that he did so was only possible because of his untiring physical energy and the way in which he constantly visited and always kept in touch with, and thus encouraged, his subordinate commanders. In these he was indeed fortunate. In Generals Maxse and Watts, who commanded his centre and left, he had two of the best of Corps Commanders. Both infantrymen: the one with a wonderful reputation for training soldiers: the other an equally fine fighter, with a remarkable eye for country and the courage of his opinions. He gives both their due, rather by implication than by direct statement.

It has become a habit to blame the author for the great losses suffered by his troops, but it is perhaps overlooked that he and his Army were chosen to carry out very arduous tasks—tasks which inevitably entailed heavy losses. To reorganize the shattered left wing of the Fourth Army after the first day of the Battle of the Somme and achieve the results that he did in that battle and on the Ancre was no light task. Bullecourt and Paschendaele, the one undertaken to help the Third Army at

Arras, and the other to give the French time to pull themselves together after the Nivelle fiasco and its consequences, both meant hard fighting and inevitable heavy losses. Finally, the post of honour, and certainly of danger, on the right of the British Army in March, 1918, showed that the Commander-in-Chief knew the value of the Fifth Army and its Commander as a fighting unit, and used it with confidence. Events prove that it was not misplaced. The reader will agree that the Fifth Army was not often or for long at rest, but it would be difficult to imagine General Gough otherwise than supremely happy at being selected with his Army for arduous tasks. There are, however, very few soldiers who can judge in all circumstances what the British soldier is, or is not, capable of doing, or can see when he has really reached the end of his tether. The few who have the gift are—not unnaturally—usually infantrymen. There is on page 117 of the book a reference, to say the least, unnecessary, to a real hard-fighting soldier who possessed the gift but had the misfortune to differ with the author on the subject during the Battle of Loos. The incident throws a sidelight on the charge of unnecessary losses. It might well be omitted from any further edition of the book if only for the reason that to the general reader the reference is unintelligible, and to those who know the man it is worse. If it is necessary to mention it as a lesson in discipline it had better be rewritten.

Though out of sequence we now hark back to the last phase of the Battle of the Somme, the fighting on the Ancre in November, 1916. The author is able to write more freely than the official historian is likely to be allowed to do when he completes his account of the Somme. It is interesting, therefore, to read what is said about the resultant effects of the losses on the Somme on politicians at home. He makes it clear that Mr. Lloyd George was rattled by the effect on public opinion and had made up his mind to try and shelve Sir Douglas Haig, and intended to do so at a conference to be held in Paris in November, 1916. It was the knowledge of this intrigue that, in spite of the bad weather all through October, determined the C.-in-C. to allow General Gough to try and bring off a successful coup, for which preparations had been in progress, before the conference took place. On November 8th the rain ceased and the date of the attack—on Beaumont Hamel—was fixed for November 13th, with the proviso that if impossible on that day it was to be cancelled altogether. It was left to the Army Commander to make the final decision, and on November 10th General Gough decided to launch the attack on November 13th provided there was no more rain. There are not many inaccuracies in General Gough's narrative, but it is only fair to the officers and men concerned to point out an error in his account of this battle. He is technically correct in saying that the 63rd (Naval) Division captured Beaucourt on November 14th, but the men that did so belonged to the 111th Infantry Brigade, commanded by Brig.-General R. Barnes. General Gough mentions visiting him in his fighting headquarters on November 14th. The 111th Infantry Brigade formed part of the 37th Division, and had been attached temporarily to the 63rd Division for this attack. On November 13th, the opening day of the battle, it was in close reserve and was thrown into the fight to push through the leading infantry and continue the attack on the 14th. Passing through the remnants of the battalion commanded by Lt.-Col. Freyberg, who was wounded, it captured Beaucourt and consolidated the position. On the following night the 37th Division took over from the 63rd; its artillery was already in the line. Its 63rd Infantry Brigade captured the Bois d'Hollande and penetrated to the northern outskirts of Grandcourt in the subsequent fighting. The fact that the 37th Division, which was with the Fifth Army for less than a month, ever formed part of it is also omitted from the Index.

The practice of splitting up a division and throwing its brigades piecemeal into a fight, especially in different sectors, as was done with the 111th and 112th Brigades on the Somme as well as on this occasion, is not one to be encouraged. It is bad for morale, and does not get the best value out of *esprit de corps*. It was not repeated when curiously enough the 37th and 63rd Divisions met again in the Third Army under similar circumstances in the

opening phase of the final advance on August 21st-23rd, 1918. It was now the 37th Division that was in line and made the initial attack—this time with a limited objective. The 63rd was in close reserve, with its artillery in the line. At 10 a.m., when the 37th had captured its objectives, the 63rd was pushed through, followed by its artillery, and penetrated on August 22nd close up to the railway line. During the night of the 22nd-23rd the 37th passed through the 63rd, and, supported by both divisional artilleries, captured the line of the railway and Achiet-le-Grand. The 63rd was then withdrawn. *Verb. sap.!* But there was an important difference—the weather, a subject to which General Gough has often to refer. It was rain and the consequent mud that made the advance so difficult in the chalky soil at Loos in September, 1915; it was rain and mud in that wet July and autumn on the Somme, and again on the Ancre in 1916. It was snow, and rain, and mud east of Arras in April, 1917; and it was rain, which commenced at 2 p.m. on July 31st, the opening day of Paschendaele (not "in the evening" as stated by General Gough), and continued through the wettest August on record, and right on to November, that alone saved the Germans in that long-drawn-out struggle. As the author says, "General Mud" was a factor to be reckoned with in nearly every operation in this campaign.

In conclusion, the author has produced a good book and has achieved the object with which he set out, to please the historian, the soldier, the general public, and last but not least the survivors and friends of the Fifth Army.

There is a good Index, and the maps are amply sufficient to explain the letterpress.

H.B-W.

GORDON AND THE SUDAN.

By DR. BERNARD M. ALLEN.

(Macmillan & Co. 1931. Price 21s.)

This book is a genuine, well-documented attempt (perhaps the first) to string out the six years' struggle by Gordon against the slave trade and the one-year tragedy of Khartoum.

Period.	*Subject.*	*Number of pages.*
1874-76	Gordon governor of Equatorial Province	68
1877-79	Gordon governor of whole Sudan	60
1880-1883	Interlude—Gordon in India—China—Mauritius—South Africa Palestine	32
1884, Jan. 18 to 1885, Jan. 26	The Tragedy of Khartoum	233
A digression	Showing that there is no foundation for the gossip about Gordon "drinking"	20
	Appendices—Bibliography—Index	51
	Maps and Plates, 28. Total pages	464

The Slave Trade.—Until the nineteenth century no government bothered much about slavery or the slave trade. In 1808 America forbade the import of slaves. In 1834 Britain emancipated slaves under her flag. In 1863 America abolished slavery under her flag.

But the Sudan slave trade did not really begin till the middle of the nineteenth century. In 1820 the great Mehemet Ali (an Albanian Mahometan with probably no Turkish or Semitic blood in his veins) prosecuted conquests in the Sudan hoping to find gold and slaves. Said (Khedive, 1852–1863) thought of abandoning the Sudan as useless. In 1862–65 Sir Samuel Baker, seeking the sources of the Nile, found slave trade in full swing. Indeed his explorations were hindered by the slave dealers very seriously. From 1869–73 Baker was Governor of the Equatorial Province specially to suppress slave trade, and Gordon followed Baker, 1874–1879. Baker, as

a pioneer, and Gordon, with restless energy, did good work, but their efforts were partly neutralized by (1) climate, sickness, difficulties of communications; (2) laziness, ignorance, treachery of most native officials; (3) corruption and incompetence of the Pashas; (4) and, finally, by the nature of the Khedive Ismail, who reduced Egypt to bankruptcy and abdicated on June 30th, 1879.

Gordon resigned and left Egypt on January 10th, 1880, and did not return till January 24th, 1884. During those four years the Sudan had gone from bad to worse.

Baring (when in September, 1883, he landed in Egypt after three years in India) found that "the pot he had left simmering in 1880 had boiled up and over."

Egypt, 1880-1883.—When Egypt went bankrupt, the Nile went on flowing through the desert to the Mediterranean just as it had done for centuries. The *fellahs* still cultivated their lands. Merchants of all sorts—Levantines, Copts, Syrians, etc., and some Europeans—made what profits and losses they could. Officials still squeezed the *fellahs* and merchants. But there was no longer any "government" in any proper sense of the word—and there never had been any "nation" since the Pharaohs. Nubar (an Armenian Christian and the most experienced Egyptian minister) used to comment on the cry "Egypt for the Egyptians" by saying "There are no Egyptians."

The situation 1880–1883 was therefore:

(1) The foreign bondholders who had lent money to Ismail were wicked enough to want dividends on their loans. So expert financiers, French and English, puzzled away how to get something from somebody.

(2) In 1882, in the absence of any real Egyptian government, Arabi headed an Egyptian rebellion. Tewfik (Ismail's successor) had to fly from Cairo till Britain suppressed the rebellion and replaced him in position. Nobody knew what to do next, so Lord Dufferin was sent to Egypt to draw up a Constitution, which he did in beautiful language.

(3) In 1883 the real trouble began. Lower Egypt was quiet. The *fellahs*, created soldiers in 1882 for purposes of the rebellion, had returned to their homes. But the Sudan had been bubbling since 1880 under the "organization" known as "the Mahdi," really controlled by "The Khalifa." The Sudanese, under such leadership, easily killed, converted, or immobilized the Egyptian garrisons who were supposed to be maintaining the authority of the Khedive in the swamps and deserts of the Sudan.

And the crisis came in November, when news reached Cairo that the Hicks expedition had been annihilated. Then something or other had to be done.

1883. *Gordon in Palestine.*—Gordon returned from South Africa November 7th, 1882, spent seven weeks in England, mainly with his sister at Southampton, and on December 28th, 1882, started for Palestine. On the 16th January he arrived at Jerusalem, and in the middle of December left Palestine for Brussels, where he arrived January 1st, 1884. In his letters to his sister during this period he comments:

May 7th. "Our government will not say they will stay (in Egypt). Yet stay they must."
May 20th. "I wonder sometimes what is written in the roll of futurity about me."
Sept. 15th. "If the Palestine Canal is made we shall then abandon Egypt."
Sept. 20th. "Graham writes from Egypt that he is likely to go from there at the end of the year. That looks as though we should evacuate Egypt."
Oct. 25th. "I have lived my life too quickly."
Nov. 5th. "Hope you won't mind my going to the Congo." "You know what little rows I get into in England."
Nov. 25th. "As for the Sudan I am much interested, but I should feel repugnance to going back there."

Gordon's letters to his sister consist mainly of religious thoughts and speculations. They were written, of course, for her eye only, and were naturally indigestible for the public. But a great admirer of Gordon, a Roman Catholic, looked on the letters as records of a sort of spiritual preparation, or "Retreat," previous to the tragedy of Khartoum.

The Congo Proposal, Jan. 1st–18th.—While in Palestine, Gordon received a telegram from King Leopold, asking him to go to the Congo. Gordon telegraphed to the War Office for permission. Wolseley advised Hartington (October 16th): "Looking "at the fanatic character of the man and a chance of collision with the French "adventurers, I think it very doubtful whether permission should be given." On the 25th October Gordon received telegraphic reply, "Secretary of State decides to "Sangdon your employ on Congo." Gordon accepted the King's offer and asked when he should start. The King replied: "Come to Brussels. See no one. Talk "to no one." On *November 17th* Gordon received a written copy of the message of *October* 25th—two words had been altered in transmission—"declines" to "decides" —"sanction" to "sangdon." On receipt of the correct telegram Gordon wrote to his sister: "If nothing is changed, for the present I shall stay here some time." On further consideration he saw there would be no harm going to see the King, and he arrived at Brussels 1st January, 1884. The King promised to arrange a Trust Deed by which Gordon (and his relatives) would be compensated pecuniarily for loss of pension. On the 7th January Gordon left Brussels for Southampton, and the same evening sent in resignation of his Commission in the British Service. The resignation was held over till January 15th, when Wolseley discussed the matter with Gordon—Gordon agreed to go to Suakim, report and return—on return he would be free to go to the Congo. Pending the decision of Government, Gordon left London at 10 a.m. on the 16th for Brussels to break the news to the King. On the 17th, at 2 p.m., he received a telegram from Wolseley to return to London, where he arrived at 6 a.m. on the 18th.

The Tragedy of Khartoum.—The steps by which Gordon was sent to Khartoum, and his failure to get the assistance of Zebehr, are described in the chronologies below, but since the publication of Dr. Allen's book two opinions have been published.

In *The Life of Lord Salisbury*, Vol. III, page 98, Lady Gwendolen writes: "When (on Jan. 18th, 1884) Lord Salisbury read the news (that Gordon was to be immediately sent out) he laid down the paper upon his knees with a gesture of depair. 'They must have gone quite mad,' he exclaimed. . . . He considered Gordon, by his qualities as well as by his defects, to be the last possible man to be entrusted with any form of diplomatic mission."

In *The Life of Lord Rosebery*, Vol. I, page 211, Lord Crewe writes:—"In an ill-starred moment it was decided to send Gordon of Chinese fame to carry through the evacuation. . . . Lord Wolseley's unstinted admiration and personal affection for 'Charley Gordon' did more than anything else to impel Ministers to this hapless decision."

Everyone interested in Gordon should read Dr. Allen's book. The adventures in the Sudan, 1874–1879, are like an epic. The tragedy of Khartoum is too involved and controversial for definite conclusions. But the deep religious belief which inspired Gordon's courage and perseverance did not lessen—it rather heightened—the insight, the foresight, and the common sense of Gordon himself.

There have been many eulogies of Gordon, but Dr. Allen (page 301) happens to reproduce in the parliamentary debate on Zebehr, one of the best. One of the shortest comes in a speech by Gladstone after the fall of Khartoum: "There will never be another Gordon."

CHRONOLOGIES.

Chinese Gordon for the Sudan.—At the end of 1882 Lord Dufferin, then in Egypt, suggested Gordon for the Sudan, but no action followed

1883.

Nov. 9th. Gladstone announced: "We are about to withdraw—the order has been given—that withdrawal will include the evacuation of Cairo."

Nov. 22nd. Baring to Foreign Office. Owing to Hicks' disaster the withdrawal must be postponed.

Nov. 25th. Foreign Office to Baring. Egypt must rely on her own resources.

1883.

Nov. 27th. Granville to Gladstone. "Do you see any objection to using Gordon in some way? He has an "immense name in Egypt and is popular at home. He is a strong but sensible opponent "of slavery. He has a small bee in his bonnet. If you do not object I will consult Baring."

Dec. 1st. Foreign Office to Baring. Would Gordon be useful?

Dec. 2nd. Baring to Foreign Office. Not at present.

Dec. 9th. Baring to Foreign Office. Egypt proposes employ Zebehr. We cannot object.

Dec. 10th. Baring to Foreign Office. Egyptian disaster near Suakim. We must now change our policy and tell Egypt what to do.

Dec. 13th. Foreign Office to Baring. Egypt must abandon all territory south of Wady Halfa. Employment of Zebehr inexpedient.

Dec. 22nd. Baring to Foreign Office. Change of policy involves sending British officer to withdraw Egyptian garrisons in Sudan.

Dec. 30th. Alarmist telegrams from Khartoum.

1884.

Jan. 1st. Sir Samuel Baker in *The Times* proposes Gordon for the Sudan.

Jan. 2nd. Gordon writes Baker: "I will not go to the Sudan, for I feel it is too late."

Jan. 8th. Nubar succeeds Cherif as Prime Minister in Egypt. Gordon at Southampton interviewed by Stead. Stead's article published in *Pall Mall Gazette*, Jan. 9th, with heading "Chinese Gordon for the Sudan," and reproduced in *Times*, Jan. 10th.

Jan. 10th. Wolseley recommends Gordon. Foreign Office to Baring asks whether Gordon or Wilson would be useful.

Jan. 11th. Baring to Foreign Office. Cannot use Gordon at present.

Jan. 12th. Wolseley wires Gordon come and see him.

Jan. 14th. Granville suggests to Gladstone putting a little pressure on Baring to accept Gordon. Gladstone agrees. Granville wires *No.* 28 to Baring and sends copy to Gladstone.

Jan. 15th. Gordon sees Wolseley and gives him a memorandum of proposed instructions. Granville wires *No.* 28*a* to Baring that Gordon is ready to go to Egypt. Abdel Kader (in Cairo) refuses to go to Khartoum if he has to announce the abandonment of the Sudan.

Jan. 16th. Baring in difficulty owing to Abdel Kader's refusal. Replies to the two telegrams 28 and 28*a*:

(1) 10.30 a.m. replies to No. 28 that Nubar wants a qualified officer to go to Khartoum.

(2) 11.15 a.m. replies to No. 28*a* (which he did not receive till after 10.30 a.m.) "Gordon the "best man if he will pledge himself to carry out the policy of withdrawal from Sudan as soon "as possible."

Gladstone wrote Granville approving the two telegrams sent by Granville, 28 and 28*a*, but warning "if Gordon reports what should be done, he should not be the judge *who* should do it, nor ought "he to commit us on that point by advice officially given."

Jan. 18th. Wolseley took Gordon to the meeting of Ministers, "who said they were determined to evacuate "and would I go and superintend it. I said 'Yes.'" Gordon to Barnes, 19/1/84.

The instructions to Gordon written by Granville were based partly on Gordon's Memorandum of Jan. 15th, but an addition was made altering the position. "Colonel Gordon will be under "the orders of H.M. Minister at Cairo and will report through him to H.M. Government and "perform such other duties as may be entrusted to him by the Egyptian Government through "Sir E. Baring." These words changed Gordon's work from advisory to executive, the very danger against which Gladstone had warned Granville on the 16th. But Hartington, in reporting to Gladstone, enclosed a copy of Gordon's Memorandum of the 15th, but did not explain the addition to the instructions.

Jan. 19th. Gordon travelling through France wrote Granville further suggestions, one of which was that he should be appointed Governor-General.

Jan. 22nd. Granville telegraphed on to Baring Gordon's suggestions, and told him he might settle terms and act on them at once.

Jan. 23rd. Baring replied suggestions excellent but thought Gordon should go to Cairo to confer.

Jan. 28th. Granville wired to Gordon (at Port Said) hoping he would concur.

Zebehr.—From 1856 to 1876 Zebehr was the great slave-trader in the Sudan. He was born in 1831 and went to school in Khartoum. In 1874 he attacked Darfur, killed the Sultan, and with the assistance of Ismail Ayoub (then Governor of Khartoum), conquered the province. Later on (1875?) the two conquerors disagreed and went to Cairo to settle matters. The Khedive retained them both in Cairo in "honourable detention."

In 1877 began in Darfur a three-cornered fight between (1) Suleiman, the son of Zebehr, very energetic; (2) The Egyptian troops in garrisons, quiescent; (3) Haroun, a local chief with a native following. Into this *mêlée* Gordon, as Governor-General, plunged and, by his personality and his energy from May to October, established order.

In March, 1878, Gordon was in Cairo. Zebehr, wanting to go back to his trade, asked for Gordon's help. Gordon refused, and on return to Khartoum found evidence that Zebehr was helping his son Suleiman. By July it was clear that Suleiman was organizing a big rebellion against the authority of the Khedive. Gordon was immersed in duties at Khartoum, but fortunately Romolo Gessi, though no longer in the Egyptian service, consented to lead the expedition against Suleiman. Gessi in his youth had served under Garibaldi, and from 1874–76 under Gordon as one of his ablest captains. In Gordon's words Gessi was "short, compact in figure, most "determined man. Ought to have been born in 1560—same disposition as Francis "Drake."

Gessi's expedition left Khartoum July 15th, 1878 and lasted a whole year, but Suleiman's power was broken and Suleiman himself was shot.

In 1884, Jan. 24th–26th, Gordon was in Cairo on his way to Khartoum. He accidentally met Zebehr, who had still a bitter grudge against him. This chance meeting produced in Gordon a "mystic feeling" that Zebehr was *the* man to help him to pacify the Sudan and evacuate the Egyptian garrisons. He told Baring of his mystic feeling and asked him to arrange a meeting with Zebehr in Baring's house. Baring (though not an expert in "mystic feelings") agreed and on the afternoon of the 26th, Zebehr and Gordon had a violent argument. Baring, Nubar and Watson were against the idea, so Baring decided against it but promised Gordon that, if on reaching Khartoum, he still wanted Zebehr, he would support him. Gordon continued pressing for Zebehr, Feb. 8th from Abu Hamed, Feb. 18th from Khartoum. On March 2nd Stewart agreed with Gordon, and on March 5th appeared in *The Times* a message from Power in Khartoum saying Zebehr necessary. And on March 10th, Gordon sent his last messages to Baring, before the cessation of telegraphic communication, that if Zebehr is not sent it would be no use holding on to Khartoum.

Baring at first advocated Zebehr succeeding Gordon, but on March 4th he was prepared to send him at once.

On March 11th there was a Cabinet meeting. Gladstone, who was in favour of sending Zebehr, was confined to his bed. The rest of the Cabinet present were against Zebehr, either on the merits of the question, or because they felt sure Parliament would refuse. Granville went to see Gladstone in his sick room, and reported on return: "Gladstone thinks it very likely that *we* cannot make the House swallow Zebehr, but he thinks *he* could." So Zebehr was refused, and Granville telegraphed accordingly to Baring.

Lord Northbrook, in 1886, wrote to Baring: "I am still of the same opinion" against Zebehr.

Baring (*Modern Egypt*, I, 529) wrote in 1907 (23 years after the event): "Reviewing the matter, I am still of opinion that Zebehr should have been employed."

Queen Victoria telegraphed to Gladstone agreeing to Zebehr (*Morley*, III, 159).

(Extract from speech by the Rt. Hon. W. E. Forster in the House of Commons, March 11th, 1884.)

"Pray do not suppose that I disparage the qualities of this wonderful man (General Gordon). I know no man like him. I go further than that. I believe him to be a hero. As a personal administrator he has the intuitions of genius. He is utterly regardless of all personal considerations; he despises money. He cares nothing for fame; he cares nothing for pleasure, for life or for death. He seems to have no temptations. Perhaps he may have one temptation. If you will read his striking journals and letters, you will feel—I do not know why—that perhaps he is weary of life. Well, he says so; and I confess it sometimes occurs to me that it would be the greatest possible delight to him to be a martyr. Undoubtedly he is a deeply religious man. In this world God's guidance and government are to him the strongest and greatest realities of life, and so we find this, that while personally one of the humblest of men, thinking nothing of his own qualities, he has the power of unlimited self-confidence in himself because he believes himself to be God's instrument. He gets out of difficulties in a way no other man could. No wonder that, with all those qualities, those savages look upon him, not as a man, but as a demi-god. I have more confidence in what General Gordon does himself than in what he recommends others to do. . . . Do not let the Government suppose that they will get rid of responsibility simply by putting Zebehr in Gordon's place."

D.M.

ZEPPELINS OVER ENGLAND.

By Freiherr Treusch von Buttlar Brandenfels.

(Harrap. Price 8s. 6d.)

To those who were responsible for the security of Great Britain from air attack during the War, von Buttlar Brandenfels was, probably, the best known and most feared of the German Zeppelin commanders; and his book will be read with particular interest by all who are, or have been, in any way connected with air defence.

From this account of that period of his life when he was intimately associated with the German Naval Airship Department we derive the impression of von Buttlar (as he is more generally known to us) as an individual in whom was found to be all that has come to be regarded as best in the tradition of the air. His sporting outlook on life pervades his entire story, and, with the exception of a possibly unfortunate reference to the "King Stephen" case, his narrative is told without trace of animosity towards his erstwhile enemies.

The ruse employed by him to obtain his original entry into the air service, as an escape from the monotonous naval routine to which he was condemned in the strange port of Wilhelmshaven, and the roguish joy he invariably experienced in attempting dangerous exploits will appeal to most readers as surely as alighting with his Zeppelin on the waters of the Alster with a bottle of champagne at stake did to the manager and staff of the Atlantic Hotel in Hamburg.

Indeed, it was nothing but a mad escapade, carried out without the knowledge or orders of his Commanding Officer, which resulted in the first air-raid over England, and definitely established the feasibility of this form of attack.

We see von Buttlar throughout his adventurous career apparently devoid of personal fear, yet constantly attended by the most amazing good luck protecting him and his crew even when acting in defiance of the dictates of common prudence. On one occasion, for example, he and his ship came safely through an exceptionally violent thunderstorm with the wireless aerial trailing out, and on another voyage when a "Light-mine," or magnesium flare, on the workings of which he was satisfying his curiosity, exploded on board, they were again spared disaster.

Von Buttlar Brandenfels shows us that Germany had only one Zeppelin in commission at the outbreak of the War, and had, therefore, made no preparations for long-distance raids by air. "When I say that the Airship Detachment was completely "taken by surprise I am putting the case mildly. Of the large revolving airship "sheds near Cuxhaven not even the foundations had been laid."

The author confirms the fact that air-raids on Great Britain were only tolerated by the German Higher Command on the understanding that museums and royal palaces were to be spared, "as if," says he, "from the height to which I had to climb in an "air-raid I could possibly distinguish whether what lay beneath me was a museum "or a palace belonging to the King of England!" This would appear to dispose conclusively of the threat of "pin-point" bombing while there is ample further evidence to show that accurate aerial navigation by night over a strange and darkened country is next to an impossibility; and a certain humour to be found in the dependence on neutral journalism to assist in compiling the reports of raids carried out.

The Germans appear fully to have realized that their direction-finding wireless was used by us to locate and plot their approach.

Von Buttlar pays a tribute to the efficiency of our lighting control. He happened on one occasion to reach England before the order to darken had been circulated and "suddenly everything below went black . . . How magnificently their 'Lights-"out' orders functioned!"

Due merit is also accorded to our airmen who raided Tendern and blew up two Zeppelins in their sheds, and the author appears to voice the astonishment of the German nation that England did not repeat this experiment more often.

The reader will trace the development of the efficiency of the British Anti-aircraft

Defences reflected in the increasing desire of the German aviators to conduct their raids at a respectable height, and he will learn, at first hand, of the physical discomforts of the crew which so far limited efficient working at those altitudes.

Von Buttlar does not, however, bring out the reason for the ultimate suspension of the Zeppelin raids on England, though the great wastage and difficulties in replacement would appear to have contributed largely as can be seen from the fact that, of 78 airships which the Imperial Navy had on the active list during the War, 26 were lost at the hands of the enemy and 26 through bad weather conditions or by accident. Seventeen were struck off as obsolete, and, at the cessation of hostilities, only nine ships remained in commission. The high proportion lost to the elements would seem to constitute a powerful argument against the reliability of the lighter-than-air machine.

The author considers, however, that airships are not without a future for war purposes but that, with present-day long ranges of heavier-than-air machines, the North Sea would, in future, be too small for the safe use of Zeppelins against England. He reserves to these aircraft the duties of long-distance reconnaissance and convoy duty but maintains that airships, by nature, must remain under naval administration.

Though the book is distinctly narrative in style it will be found to contain a wealth of technical information relative to airships, including a theory as to the cause of the R101 disaster based on the experiences of the author under similar climatic conditions. "In critical situations one should always take the ship as high as possible. For one "can always come down. Nobody has yet remained stuck up above!"

A word of praise is due to the translator for having so faithfully preserved the characteristic German composition and style while rendering a fluent English version which is practically devoid of those bracketed quotations which so frequently interrupt the continuity of the translated page.

L.E.C.M.P.

ANTI-COMMANDO.

By VICTOR SAMPSON and GENERAL SIR IAN HAMILTON.

(Faber & Faber. Price 15s.)

This book, the title of which was suggested by Colonel Denys Reitz's recently published work, *Commando*, has been written by General Sir Ian Hamilton to place on record the great services rendered in the cause of Empire by another famous South African soldier, Colonel Sir Aubrey Woolls-Sampson. Colonel Reitz vividly describes the kind of guerrilla fighting in which the Boers excelled in the later phases of the South African War of 1899-1902, and is modesty itself in writing of the exciting episodes in which he took part. Woolls-Sampson is the last man to write about the part he had taken on the other side in that civil war, for such it was. It is fortunate for us that a practised pen was ready to prevent us forgetting what the British Army owed to the bravery, initiative and entire disregard of self of this distinguished character. Had the author limited himself to writing about Woolls-Sampson there would have been ample space in this volume of 220 pages for a full account of the many thrilling episodes in the life of a very exceptional man and soldier; but the ostensible object of the book, suggested by *Commando*, has been somewhat lost sight of by including in it episodes in which Woolls-Sampson had little or no share.

Static warfare gave little opportunity to Intelligence Officers with forces in the field in France and Belgium. They came into their own in Palestine, Arabia and Africa, and would have done so in the march on Berlin.

South Africa with its large native population gave full scope to a man who possessed a profound knowledge of the character and languages of the native races combined with equally profound knowledge of the Boers and their ways. If, in addition, that man was a born soldier (British, but born in South Africa) with a soldier's training and experience of fighting in that theatre of war, all the elements that go to make

an efficient field intelligence officer were ready at hand. Woolls-Sampson and Colonel McKenzie possessed all these attributes. Captain Frank Smitheman could claim the first in even a greater degree perhaps than the others, for he added a commanding *personality* (Ramalele—"Long Legs" was his native name) which goes far with natives; but he was not a trained soldier and consequently his judgment of what soldiers could, or could not do was apt to be at fault, and he was no squadron leader. He stepped into his proper niche when Colonel (now Field-Marshal) Plumer chose him as his intelligence officer when with 600 men he was "containing" De la Rey and several thousand Boers for several months before Mafeking was relieved. Woolls-Sampson found his right place when he was sent to General Bruce Hamilton in the Eastern Transvaal. His was the imagination or the initiative: his the means—his own native scouts—to get information of the enemy's location and movements. The Column-Commander had the instrument and the will to put the information to good use; but he had also the knowledge, the experience and the power of judging whether the information was good enough; whether his men were fit to go, and whether there was time to carry out the attack without running the risk of being engaged by superior forces before he could rally. The first occasion on which Bruce Hamilton put himself in Woolls-Sampson's hands must have been a trying ordeal. But nothing succeeds like success, and he soon realized that Woolls-Sampson was no ordinary man and that his information could be relied on; and he learnt to trust him. Lord Kitchener too realized that he had at last got a fighting column which could find Boers, fight them and capture prisoners in large numbers. Every request to replace casualties in horses and men was promptly met. Sir Ian Hamilton does not mention why this happy combination was broken up, but it would seem that if they had been transferred with the best of their now experienced mounted troops to another part of the theatre of war their successful methods in the Eastern Transvaal would have reaped an equal and perhaps greater reward elsewhere.

Sir Ian Hamilton does not probe for the intelligence officers' secret. What made Woolls-Sampson the great intelligence officer he was? He was only half-educated as a boy. It was only when he had become a man that he learnt to read books. But nature-study, not as taught in our elementary schools perhaps, was his school. He learnt to know the native from early childhood in Cape Colony. As a youth he worked and had to fend for himself in the diamond fields of Kimberley, and learnt more about natives from other parts of Africa. He learnt how to recognize a native he had met years before in quite a different part of South Africa, and owed his life to the fact. Not many British soldiers ever had that gift. He acted as a native commissioner on the Swaziland border and in the Waterberg District in Northern Transvaal. He was imprisoned after the Jameson Raid, though he had done his best to prevent the Uitlanders encouraging that hopeless attempt at a *coup-de-main*. He raised the Imperial Light Horse Regiment in 1899 and commanded it at the Battle of Elandslaagte, and was desperately wounded at Ladysmith.

Not only did he know the natives but he had learnt their languages and dialects, of which there are many. He could converse with any native he met, and understand what he was driving at, because a native cannot say that black is black or white is white: he is a master of simile. He needed no interpreter to help him. He had no difficulty in picking out natives he could trust, and was able by a process of elimination to collect a faithful band, who trusted him because they knew that he would never give them a task beyond their powers or which he would not undertake himself. With such men at his call he was able to plant an observer in a native kraal to report the movements of the Boer Commandos to the scouts he sent to communicate with them. Often, no doubt, he was able to dispense with the observer, for he knew the headmen and could trust them to tell him or his messengers all they knew. The natives realized long before the Boers, and even the British, who was going to be on top in the end. They had experienced British Power, and its result, and that knowledge, and to a certain extent rewards in the shape of coin or cattle did the rest.

All they asked for was to be protected in their kraals from the looter, and that their women should not be interfered with. Frank Smitheman never armed his natives, for a native, if caught armed, was killed and his rifle lost. Woolls-Sampson probably followed the same rule, but there were many columns who indulged in a mob of armed and mounted natives whom they called scouts. If the authors of this book had been able to give us details of Woolls-Sampson's methods, it would have had a real value; we can get the results of his work from the War history. What we want to know is how he used his natives and the personal share he had in the many successful raids which did so much to enhance the reputations of the various column commanders with whom he served. We are not even told the name by which he was known to the natives.

H.B-W.

NEWTON: THE MAN.

By LIEUT.-COL. R. DE VILLAMIL.

(Foreword by Professor Albert Einstein.)

(Gordon D. Knox. Price 3s. 6d.)

Professor Einstein remarks in his foreword that Colonel de Villamil's discoveries "make it possible for us to frame a realistic picture of the man as he lived and worked, "a picture that has a real atmosphere very much more substantial than the old "legend of the apple in the orchard." These discoveries are, principally, two: first, the inventory of Newton's possessions at the time of his death; and, secondly, a catalogue of Newton's library, which consisted of 1,896 books, and the books themselves, to the number of 860.

Colonel de Villamil's account of his finds and comments extend to 48 pages, and of these, eighteen are devoted to a thorough analysis of the dealings which Newton had in the South Sea Stock. The author succeeds in exploding, "once and for all, "the absurd story that Newton, in his old age, gambled from greed of gain." It is pointed out that Newton's salary as Master of the Mint, including "profits of the Coinage," amounted to the very substantial sum of some £2,000 a year. He invested money in the South Sea Company as an ordinary, and perfectly legitimate business transaction. It may be added that, as not infrequently happens, he lost money in the process. After his death all the goods and chattels and credits of Sir Isaac Newton, late of Saint Martin-in-the-Fields in the County of Middlesex, were appraised at the sum of £31,821 16s. 10d. But one should read Colonel de Villamil's little book to see how he found the "True and perfect Inventory" in the form of a roll of vellum five inches broad and seventeen feet long; and how he found a catalogue of the books, and nearly half of the books themselves, at Barnsley Park in Gloucestershire.

No doubt, the part of the book which will, in future, most be referred to, is the catalogue of the library, of the 362 books in folio, the 477 in quarto, the 1057 in octavo and smaller sizes, and the hundredweight of pamphlets. From this list we can get some idea of the intellectual food of the greatest of our men of science, and from this we can learn something of his tastes in literature. We shall find many classical works, histories, sermons, theological works, and of course, works on mathematics and science generally. An interesting entry is "Locke of Human Understanding." Colonel de Villamil remarks that there are many French books, many being books of travel; but there are no English classics, no Chaucer, no Shakespeare, no Milton.

The author of the singularly interesting little book has laid all students of science, and of the history of science, under an obligation. It will not be given to all of us, at the age of four-score years, to render such excellent service.

C.F.C.

ALBERT, KING OF THE BELGIANS, IN THE GREAT WAR.

His Military Activities and Experiences set down with his Approval.

By LIEUTENANT-GENERAL GALET, H.M.'s Military Adviser, Chief of the Staff of the Belgian Army.

(Translated by Major-General Sir Ernest Swinton, K.B.E., C.B., D.S.O., Chichele Professor of Military History, Fellow of All Souls College, Oxford, late R.E.)

(Putnam, 24, Bedford Street, London. 1931. Price 25s.)

This volume, writes Sir Ernest Swinton in his Foreword, presents the Belgian case from a period anterior to the outbreak of hostilities to the end of the year 1914, and tells us the old story of apathy, neglect of warnings, and of the inevitable unpreparedness to meet the storm about to break. General Galet does not indulge in a lengthy and detailed narrative of the actual fighting; he is concerned rather to portray the equally important and more far-reaching events which took place behind the front line, of which he is especially qualified to speak. What he has to tell us of the different problems facing the King comes as a revelation, and makes us realize to what extent the state of preparation—such as it was—of the Belgians and their gallant struggle against overwhelming odds were due to the King's foresight, strength of character, and resolution. The account of his difficulties when once hostilities had commenced, his doubts, and the decisions he had to take—frequently in opposition to his own counsellors and at variance with the advice of the Allies—is a tribute to his fearlessness and judgment. It must not be forgotten, he concludes, that during the whole course of the War, King Albert was the only head of a state to exercise active command in the field. An early attempt was made to induce him to hand over the military direction of affairs to one of his Generals, and the French Higher Command later suggested that he should nominate a commander with whom they could deal direct. King Albert ignored both suggestions and took immediate steps to show both his own counsellors and the French Government that he intended to command his Army in person. It is fortunate, both for the Belgians and for the Allies, that he insisted on his prerogative.

General Galet is well qualified to write the official history, for such it is, of a very important phase of the Great War, and is to be congratulated on the moderation and tact with which he has carried out his task. Born in 1870, the son of a working man, educated in the school of his native Walloon village of Erpion, he developed a taste for mathematics and at the age of 17 enlisted in the Artillery. In 1894 he received a commission and five years later went through the two years' course at the École de Guerre. There he made the acquaintance of the future King, a fellow student, and formed an association which was profoundly to influence not only his own career, but that of the Prince he has served so well. In 1912 he was selected by the Prince, now King, to be his Military Adviser, and he held this post in the rank of Captain throughout the War with the official position of *Officier d'Ordonnance* to His Majesty. After the cessation of hostilities he, now a Lieutenant-Colonel, took part in the peace negotiations in Paris as military expert with Belgian Delegation. Subsequently he became Commandant of the École Militaire, and in 1926 was appointed Chief of the Staff, a post which he still (1931) holds.

It is common knowledge that at the moment war broke out the Belgian Army was in the throes of reorganization. It was caught changing horses in the stream, when reforms initiated in the face of much opposition, delayed by the apathy and blindness of the Government and the people, and almost thwarted by the ignorance and obstinacy of those at the head of military affairs, were only in their infancy and almost barren of results. Divided counsels as to the mobilization and concentration of the Army in the event of war with Germany, a shortage of officers, a deficiency of munitions and equipment, and a misguided tendency on the part of the General Staff and senior Officers to accept blindly the French military doctrine of "the offensive at all costs" regardless of the efficiency of the weapon available, nearly

ended in complete disaster. The Field Army, inefficient, badly officered, and untrained as it undoubtedly was, never had a chance of showing what it could do. It was the same with the fortifications guarding the frontier. These had been designed by Brialmont to meet the very case that occurred when Germany showed her hand and deliberately infringed the neutrality of Belgium, which she, in common with other Powers, had guaranteed by Treaty. In pre-war days we were accustomed to regard the works of Brialmont as far ahead of contemporary fortification on the Continent, and though doubts had been freely expressed as to their sufficiency in view of the rapid development of modern heavy artillery, the question of expense had delayed the steps—already envisaged by the Belgians—to bring them up to date. The first great surprise of the War, the super-howitzer, found the Belgian forts at Liège and Namur wanting. The Belgians fought well before Liège, and put up a much stouter resistance than they have been credited with. The German losses were far heavier than was realized outside of Belgium, but the *enceinte* was too large for the troops available to defend it. By the accident of a bridge not being blown up, Germans under Colonel Ludendorf were in Liège days before the forts had been destroyed and captured. The second great surprise, a surprise in which all the Allied intelligence services were involved, the unexpectedly large number of Reserve Divisions produced by the Germans, enabled the enemy to contain the little Belgian Field Army—reduced to 50,000 rifles—until the arrival of reinforcements and heavy artillery which swept the Belgians almost out of their country and simultaneously brought about the fall of the Fortress of Antwerp, the national keep of Belgium. It has been the habit to belittle the Belgian effort, but even the British Official Historian, whose account of this phase of the War is almost the only one in the English language, will admit that the resistance which the Belgians put up at Liège under the gallant Leman and before Antwerp under the direct orders of the King had its effect on the Battle of the Marne and the subsequent "race to the coast." This volume will convince the reader that in the Battle of the Yser, the exhausted remnants of the Belgian Army played no insignificant part in saving the Channel Ports.

It is fortunate for the British Army that the study of Logic—with a big L—is not an obligatory subject in the education of its officers. Time and again in France, in operations and behind the front, we were brought up short by the results of the study of Logic at the École Polytechnique. The reviewer once asked a most able liaison officer why so-and-so had done this or that? The liaison officer, a diplomat by training, a Territorial for the War, who had gallantly led his men to slaughter in white gloves and red breeches in September, 1914, and been severely wounded, replied, "Oh, he is a *Polytechnicien*, they live on logic." The French Staff had drunk deep of the potion, and could not understand why their Allies failed to do the logical thing in its proper sequence. Improvisation, based on the circumstances which actually existed, was as unknown to them as it was to the Germans and their pupils the Japanese. The Belgians suffered from this trait of the French character equally with the British. They also suffered, as we did, from French *directives*. The simple Englishman received a voluminous *directive* in the middle of the night typed on thin paper, prepared his orders and waited for the word "go." Instead he received an operation order—probably more accurately based on the situation as it was rather than it, logically, should have been, which necessitated an entirely new set of orders to be prepared and acted on in a minimum—or less—of time. Having issued them he received an intimation that our Allies would not be ready for 24 hours!

Again, the French system of *liaison* is a very commendable system—on paper. But efficient liaison work implies that the liaison officer has studied the character of the nation with whom he has to work as well as posted himself exactly as regards all the circumstances in which the force to which he was attached was situated. French Missions were attached to all allied Commanders, and, logically, liaison should have been perfect. But, in practice, it was often far from being so. Even the late Colonel

Huguet, a friend of England before the War, was far from being the perfect liaison officer long before the end of it.

The Belgians suffered as well as ourselves. The *directives* they received through the French Mission always envisaged the offensive—when no offensive was humanly possible. Nothing, therefore, happened because it could not happen either owing to the state of the Belgian Army, or the action of the enemy. It was the same with General Foch's orders to Sir John French before Ypres. The troops tried to advance, but what little success was obtained was bought at enormous cost. Tasks were set on insufficient information: had liaison been more complete and more *sympathique*, the situation at the front could have been presented more accurately at French Headquarters before orders were issued. Judging from the book *Haig's Command*, which, by the way, was never read by Earl Haig, although it contained a preface by him, for he never read anything relating to events in which he had taken part, it took four years and a month to cure even General Foch of this pernicious habit of the French Staff Officer, due to the defect, for such it was, in their training. Excess of logic has become a national characteristic, for *Polytechniciens* go into civil professions as well as into the Army. It was in circumstances such as have been described that the King of the Belgians showed his judgment and tact. It was no easy task to fight the apathy of the Government, the obstinacy of the Belgian military hierarchy who rather prided themselves in being up-to-date when they blindly followed the lead of the French—on paper—of the offensive at all costs, and then to have to combat the efforts of the French Higher Command to subordinate Belgian policy and operations to their own plan of operation without any regard for Belgian national sentiment or the condition of the Belgian Army. That the King was able to do so successfully reflects great credit on his knowledge of his people, on the deep study which he had given for years to the military problems he had to face, on his judgment and on his tact. On more than one occasion he conceived it to be his duty to give way, but in regard to the two most critical decisions he had to take in 1914 his will was adamant. The first was when the French brought pressure on him to deflect the Belgian Army when it was forced to withdraw from the Meuse, away from its natural, and national base, Antwerp, and make it conform to the French plan of operation. The second was when General Foch tried to force the exhausted Belgian Army to advance from the positions on which it stood on the line of the Yser, with a view to enveloping the supposed right flank of the Germans facing the British and French. Fortunately, the King resisted: the newly-formed German Fourth Army did the rest as it advanced rapidly westwards. The King knew the condition of his troops, and that they must rest and reorganize if ever the Army was to be of any value again.

The Belgians are very proud of their share in the Battle of the Yser. They would be the last not to give credit to what was achieved by their French Allies and especially the French Marine Corps. But this volume proves that they fought most gallantly to save the last strip of their Fatherland from the enemy.

It is difficult for any historian to write freely of events in which many of the participants are still alive: doubly hard when the principal actor in these events was the King; and it might be thought that an account written in such circumstances was bound to be biased. If that be the opinion of the reader when he peruses the title of this book, it may be stated without fear of contradiction that he will modify his opinion after reading it. General Galet writes in simple, straightforward style, and anyone who knows the Belgians and their Sovereign will recognize that we have here a fair statement of fact, not influenced by fear or affection for the King and Commander-in-Chief. General Galet certainly writes with tact and moderation. Moderation is necessary in regard to those, both soldiers and civilians, who in their ignorance made the task of the Army so much harder than it need have been. Tact was incumbent in describing the difficulties with which the King was confronted in his dealings with General Joffre and his representatives and later with General Foch.

In the course of his narrative the writer gives us a full account of the opening of

the sluice-gates of the Yser. The decision to open them and destroy for several years a large and fertile tract of country was a momentous one: the actual opening of the sluices was a risky and exciting incident: the effect was dramatic—for it meant that the Battle of the Yser was won, and the Channel Ports were saved.

Several annexes are to be found at the end of the book and are worth studying, especially annexe iii—"Scheme of Operations in case of invasion of Belgium from the "east, worked out by General (then Captain) Galet for the King during the winter "of 1912-13," and annexe ix, "A report made at the end of 1914 by the General "Staff upon the transfer of the Base from Antwerp to Ostend, with amendments "by the King to the Orders."

It is to be regretted that there is no index. There are five maps in the letterpress, which are sufficient, but only for the general reader. The translator is to be warmly congratulated.

H.B-W.

THE NEW CONCEPTION OF MATTER.

By C. G. DARWIN, M.A., F.R.S., Tait Professor of Natural Philosophy, University of Edinburgh.

(G. Bell & Sons, Ltd. Price 10s. 6d.)

This is one of the numerous works which have appeared during the last few years covering more or less the same field. Although mathematics does not enter into this volume it can hardly be called popular or easy reading; perhaps semi-popular would be the proper term to apply to it. It is the result of a course of lectures delivered at the Lowell Institute of Boston.

It is certainly very difficult for the layman to get a clear idea of the mathematician's world which we conclude this is intended to convey. The author remarks in the introduction, "It is one of the most unsatisfactory features of the enormous recent "developments of science that they are so remote from the ordinary things of life." Another great authority says "no one except a mathematician can ever hope fully to "understand those branches of science which try to unravel the fundamental nature "of the universe—the theory of relativity, the theory of the quanta and wave-mecha-"nics." It will be seen, therefore, what difficulties confront the writer who attempts to expound them by the aid of words alone. Yet by clever exposition, with the help of apt similes, it should be possible to give at least some idea of the nature of things.

One often hears the question asked, "If these things are so remote from life what "difference can they make, why bother about them at all?" In reply, it is easy to show that what was originally purely a scientific experiment, performed with no thought of ultimate utility, has often proved to be of great value to mankind; Faraday's well-known discoveries, made during the course of purely scientific investigations, resulted in the development of the great electrical industry; or, to come to more recent times, the invention of the thermeonic valve, considered at first a scientific curiosity, led up to making broadcasting possible. In fact it is quite impossible to see where investigation may not lead, whether in the purely philosophic conception of things, or in the realms of industry—there is always a chance of any intelligently conducted research leading to unforeseen results.

This book is an attempt to describe the ideas at present current regarding the fundamental constitution of the physical world. The author exalts the physicist above the philosopher. "It was the physicist Einstein who gave life to the principle "that our theories should not be concerned with things that are unobservable," and "there are too many alternatives offered to the undirected speculations of the philo-"sophers, and we may expect that it will be the physicists, with the possibilities of "testing alternatives by appeal to experiment, who will continue to lead the march of "our knowledge of the physical world." In the first chapter the development of ideas about the atom—the building material of matter—is traced from the time of

Dalton to the present day of electrons and protons, and how the different elements are built up from them. What is considered to be the difference between a photon, or light quantum, and an electron is explained. The photon appears to be the supplier of energy which reaches the earth from the outside. The photon may knock electrons out of the atom, and this happens when light affects our eyes by knocking electrons out of the atoms of our retina, " the atoms so affected feeling themselves " chemically imperfect send a protest in that sense along the optic nerve to the " brain."

The mystery of the ether remains unsolved despite the fact that " much of the " speculation of the 19th century was directed to finding this out." It should be one of the fundamental things of the universe and is not to be expected that it can be expressed in terms of things it is itself going to explain later. We should not ask what the ether is, but rather what it does. It is simply the medium carrying the photon which brings the energy necessary to keep the whole system going.

The next subject is that of waves of various forms and the dual nature of the electron behaving apparently as a wave and a particle, thus partially reviving the abandoned corpuscular theory. The question may be said to have only reached the mathematical stage so far, and is not in a state to be given a physical meaning which can be translated into ordinary language. This may come later.

The diffraction of matter leads to the principle of least action which makes the total expenditure for the performance of any action a minimum. There is no particular reason for this except that nature calls for the greatest possible economy in expenditure for action. Often this does not seem to be geometrically the shortest way but it involves the least expenditure of energy, or the product of energy and time tends to be a minimum.

Another principle, called the uncertainty principle, which holds " that no experi- " ment can be invented which should at the same time require the electron to behave " like a particle and like a wave." The author discusses this complicated question and shows " how the conflict between wave and particle is always avoided." The principle of indeterminism has led to the supposition that there is no determinism in events involving single atoms, and that apparent determinism is due to the large scale on which events are dealt with. In other words determinism is of a statistical nature and not a physical law. It is something like the mortality tables used by life insurance companies which tell little about the individual life but a great deal about the average life. However, the question is not easy and we must leave it to the reader to unravel.

To show how puzzling some of the problems are, speaking of the interaction between photons and electrons, the author says the theory " is extremely difficult, indeed it " has been only in the hands of the leading workers in this field that anything has " been made of it, and it is, I think, rather widely felt that it is not founded on right " lines."

The last chapter deals with yet another principle, the exclusion principle, which includes two chief ideas " one is that electrons can never be distinguished one from " another in any way, and the other is, roughly speaking, that electrons avoid one " another." To quote from another authority this principle seems " to imply " action-at-distance in space and time as though every bit of the universe knew what " the other distant bits were doing, and acted accordingly."

From this attempt to outline the contents, the reader will gather that the work deals with the many intricate problems concerning the new physics now occupying the attention of some of the greatest thinkers and experimenters in the world. Their work has already led to many revolutionary ideas, though they do not appear to have touched the practical side of classical engineering mechanics.

It is necessary to read Professor Darwin's work if we would keep abreast of the times.

H.L.C.

ARMADAS OF THE SKY: THE PROBLEM OF ARMAMENTS.

By PAUL MURPHY.

Foreword by Sir Max Pemberton, Preface by Major-General N. G. Anderson, C.B., C.M.G., D.S.O.

(The Houghton Publishing Co., London. 1931. Price 5s.)

In his Foreword to this interesting little book, Sir Max Pemberton considers that Major Murphy has made out a powerful case not only against our present armaments but also against our current ideas as to the best means of reducing and abolishing them.

In the Preface, on the other hand, Major-General Anderson, a former professor at the Staff College, after vouching for Major Murphy's technical qualifications for venturing to write a book of this description, although not a professional soldier, writes: "We would gladly believe that the world had done with war . . . but in "view of our very small forces and our alarmingly big commitments, we must con- "stantly ask ourselves these questions—Is our defensive position really sound? Is "the money we are spending annually being spent to the best advantage? . . . "In our insular position we must consider to what extent our present Naval and "Military forces could ward off attacks and keep the home seas open for food sup- "plies, if our Air Force—a comparatively small one—was decisively defeated."

One begins to wonder whether we are about to read a book in favour of disarmament, or of armament! A speaker broadcasting recently from Savoy Hill with a view to the approaching conference on disarmament quoted from a book which he had read, mentioning Major Murphy's name as the source of his information, which showed that the speaker at all events regarded *Armadas of the Sky* as propaganda, and useful propaganda, in favour of disarmament! Major Murphy certainly does in some of his chapters describe in very realistic fashion the horrors of air bombardment and poison gas bombs, but if we read to the end it would appear that his primary object in writing the book was "armament," and plenty of it, provided it was organized on a sound and economic basis. In his final chapter he pleads for the League of Nations and Disarmament, but stipulates that the League should first confine its studies to ascertaining the causes of war; and then, and not until then, we could, perhaps, discuss disarmament.

After discussing developments in submarines, poison gases and mechanization, he proceeds to show that the three elements of the defensive forces of the Empire, land, sea, and air, are each grinding their own axe, and there is consequent waste of brain power and material, and that, notwithstanding the huge sums expended on the Navy, Army and Air Force, we are not getting anything like full value for our money.

Basing his argument on the recent enormous developments in the speed and power of aeroplanes and the inevitable and universal growth of civil aviation, he writes: "Take a birdseye view of the situation as a whole and dictate your problems from "the unassailable position of air dominancy. Can aircraft effectively attack "mechanized armies? Can air fleets successfully encounter or circumvent sea fleets? "If the answer is in the affirmative in both instances (Major Murphy brings forward "a great deal of evidence that it is), then the case for fundamental changes in our "present military equipment is urgent and overwhelming. The possibilities of air "dominance in warfare and the implications which follow, have been very imperfectly "appreciated by military authorities because they have always approached the "question from the angle of the service affected. The result of this has been to create "a departmental vision." For instance, he continues, the tendency of the Admiralty has been to adopt a defensive attitude towards the aeroplane. To meet developments in the aeroplane the Admiralty proceeds to develop anti-aircraft guns, increase armour-plate protection, and modify certain strategical and tactical conceptions . . . "Such a point of view is a *defensive* one, and the danger is this; when looking at a "subject from a particular angle, the only things that stand out are those which are "visible from that angle, and there is great danger of overlooking all kinds of *offensive*

" possibilities. The counter argument is that the Air Force will look after such possi-
" bilities. But can they? Only the Admiralty can fundamentally and instinctively
" know what are the really weak points in sea fleets which might be exploited by
" appropriate aircraft development. Liaison? But what is the good of liaison
" between people who have been regarding the matter from an exclusively depart-
" mental aspect? What can the Admiralty tell the Air Ministry about air anti-naval
" development when their whole attention has been concentrated on naval anti-
" aircraft development? " The sailor will naturally say in answer to such arguments :
" Well, then, place all air control as it affects the sea in the hands of the Admiralty."
But Major Murphy shows us it is not quite so simple as that, and goes on to give us another example as instanced by the attitude of the War Office and the Air Ministry on the question of Tanks *v.* Aircraft.

The Air Ministry's reply, he says, to suggestions from both Admiralty and War Office to hand over its functions, would be simple and unanswerable, for there is also an air angle, in Major Murphy's opinion, the most important.

Major Murphy's remedy for the evil is fusion under a Ministry of Defence. His proposals briefly are :

1. *The National Defences must be based on air power;* and must be so arranged as to give this new form of force the maximum chance of success.

2. *Fusion of air and sea forces into one arm is certain.* Aircraft may operate from land bases, or they may be seaborne, and so considered as acting from sea bases; but unified direction of the two will be found essential both in the interests of economy and efficiency. The naval arm must continue to exist in order to provide distant bases, land and sea, for offensive action in various parts of the world. The coast line of Great Britain as a frontier or a dividing line between land and sea action has ceased to exist.

3. *Air fleets must supersede mechanized armies*, which Major Murphy considers are already obsolete. Why not fly over obstacles instead of trying to barge through them with land tanks which are vulnerable to aircraft? But he admits the possible retention of mechanized machine-gunners for protective, and possibly also for offensive purposes on land when the air fleet has overcome enemy resistance.

On the subject of a Ministry of Defence, Major Murphy says that what we do not need is a magnificent building to house the three departments under one roof, of the size of the Admiralty superimposed on the War Office and crowned by the Air Ministry building on top of all! What is needed is centralization of ideas combined with a means of enforcing the adoption of a new angle of vision and a new outlook by recalcitrant departments, a new focal point, in fact, for a new way of regarding an old problem. Its primary function would be to define defence problems with precision, which, he says, is precisely what is not and cannot be done at present by the Committee of Imperial Defence. These defence problems when so defined should be considered by that committee, and then studied and developed by an Imperial Defence General Staff. The whole question of the services of supply must be reorganized to prevent waste, and he suggests the creation of an Imperial Institute of Research to work on research on possible developments of war for all three services, functioning directly under the Imperial General Staff.

The little book—only 120 small pages—is worth reading. It is well written and well argued, and gives plenty of food for thought—and argument.

H.B-W.

SURVEY OF INDIA, GENERAL REPORT, 1929 TO 1930.

Published by order of BRIGADIER R. H. THOMAS, D.S.O., Surveyor-General of India.

The total area of the combined programmes of the survey of India is 1,864,275 square miles; of this 819,350 square miles remain to be surveyed, so it will be seen that rather more than half the modern programme, which was settled in 1905, has been completed. The earlier maps are, therefore, now about 25 years old and the time

for their revision has already arrived. It does not seem likely that any scheme for revision will be put forward at present, nor in the near future, for the introduction of democratic government in India is certain to be so expensive that there will be little to spare for survey, at least if India follows the example of other democracies.

The mistake is always made of supposing that maps can be done without, or at least that surveys can be postponed, so map production is one of the first to come under the axe. This is one of the greatest and most expensive mistakes in the end, but it is only recognized by the very few far-seeing administrators. There are not many of them about in these days.

A notable feature of the report is the commencement of a special survey for the Bhakra Dam Irrigation Project. This is one of the largest schemes of its kind in the world. The dam will be 500 feet high and will command and supply water for twelve million acres. It involves the demarcation down to 25-acre rectangular plots and the contouring of the area to one-foot intervals. The survey for this project will take twelve years. This gives some idea of the magnitude of Indian irrigation schemes.

Of special interest from a military point of view in the domain of air survey, which has now become a regular feature of the survey of India, the one-inch maps of a portion of Tirah have been revised from photographs taken by the Royal Air Force; also some original survey has been carried out in the same area. Control for this work in the inaccessible country on the North-West frontier is being provided by the Wild Photo-theodolite.

Air survey for producing settlement maps is in progress in the districts of Sitapur, Bahraich and Fyzabad in the United Provinces. The Survey of India is undertaking the traversing necessary for the provision of control for mapping from air photographs.

The customary tables showing out-turn and cost rates of each party are given.

Very valuable information is given in these annual reports. It is only possible to refer to a few points in a review of this kind.

H.L.C.

A CELTIC HURLY-BURLY.

By L. LUARD.

(Blackwood. Price 7s. 6d.)

A Celtic hurly-burly is the story of how *Maitenes II.* came into being and of her adventures in her first two Fastnet Races—those of the years 1929 and 1930. Before any definite steps could be taken towards the building of *Maitenes II.*, the stumbling block of finance had to be overcome, and the author gives a very amusing account of how prospective buyers of her predecessor—*Maitenes I.*—would come and view her, poking here, prodding there, smelling somewhere else, and forcing large and unwieldy bodies into the most inaccessible parts of the vessel, and then invariably leaving with some lame excuse.

The description of the planning of the new yacht is very realistic, and one can easily picture the proud and enthusiastic owner improving on his old love, giving extra accommodation, better hull form and sail plan, and more numerous and better fittings. But the purse is the criterion and one reads of the sad and frequent decisions to save a little on this fitting and to economise on that by substituting something cheaper. All the troubles and anxieties of building—late arrival of plans due to the designer's illness, failure of sub-contractors to keep to delivery dates and such like—are clearly described and seen as a warning to those who may be contemplating building cheaply and in a hurry and more especially to those who elect to patronize a small and apparently ill-equipped yard. This race against time is the undercurrent of the story.

At last, however, the great day arrives and the new creation takes the water a few weeks before her first trial of strength in the Fastnet Race of 1929. A further period of frenzied activity fitting out, so well known to many ocean racers, ensues, during which the situation daily seems to get worse, but at the end of which one is on the starting line at gun-fire very nearly, if not quite, prepared for the great event.

The two Fastnet Races are described somewhat briefly and one would like more space devoted to these battles with the elements.

The book is certainly readable, but from the yachtsman's point of view and particularly from that of the ocean racing man it would be improved by the addition of plates showing the lines and the sail plan of the yacht, and also by a less flowery but more practical description of her behaviour under racing canvas.

J.H.D.B.

DIFFERENTIAL EQUATIONS OF ENGINEERING SCIENCE.

By P. Field Foster and J. F. Baker.

(Oxford University Press. Price 12s. 6d.)

In the preface the authors state that this book is not intended to appeal to either the purely practical engineer or to the mathematician, but to the large body of engineers between these extremes " many of whom have to use mathematics as a tool, and still " more who require a knowledge of the higher mathematics in order to understand " and appreciate the theoretical advances in their science."

It is this last point which is so important to the R.E. Officer, who must very largely depend on reading engineering books in order to keep abreast of the times, and the best of these books are nowadays mathematical in outlook.

The book only deals with the directly useful types of equation, and in fact covers the mathematics required for the Mechanical Science Tripos in a very concise and workmanlike manner.

A good example of the authors' practical standpoint occurs in the explanation of Taylor's theorem—" The above argument is based on the assumption that the original function admits of being expanded in a convergent series. The assumption is usually justified in the case of a simple function representable by a continuous graph. This criterion, though not satisfactory from a strictly mathematical point of view, is sufficient for most practical purposes."

After dealing with equations of the first order and first degree, the authors devote a great deal of space to the consideration of the very important linear equation with constant coefficients. Here we are at once introduced to the Heaviside D Operator and this very properly is most thoroughly dealt with.

The full vibration equation is next considered and possibly this is one of the most valuable pieces of work in the book—a variety of methods of solution is offered, including a full description of the very convenient vector method.

This chapter is followed by examples on various other types of differential equation, including the integration of equations in series.

Excellent chapters follow on harmonic analysis, partial differential equations and the numerical solution of otherwise insoluble equations.

This book can be confidently recommended to R.E. officers as covering all the advanced mathematics they are ever likely to require—it is written in a clear, easy style, and all the methods are illustrated by admirable examples.

R.S.R.K.

CRAFTSMANSHIP IN THE TEACHING OF ELEMENTARY MATHEMATICS.

By F. W. Westaway.

(Blackie & Son, Ltd. Price 15s.)

This is a book which can be confidently recommended to anyone with an interest in mathematics, and indeed to any instructor in engineering subjects, for although the book only touches on such matters, it is full of useful wrinkles for the teacher in general.

The author has realized through long experience that a sound interest in mathematics must be built up on teaching the elements of each of its many branches in an interesting and educative way.

In fifty short chapters he contrives to cover the ground from the ABC of arithmetic to de Moivre and wave motion, and the last chapters are devoted to applications such as map projections, statistics, and the philosophy of mathematics.

It is interesting to note that the author considers "mathematics is one of the easiest, "perhaps *the* easiest, of all subjects to teach," yet "it is a rare thing for a mathematical "teacher to be able to feel at all satisfied with his professional skill before the age of "30. He is lucky if other people adjudge him efficient before the age of 35."

I think most officers who have held 4-year appointments as instructors will agree that they are only beginning to understand the art of teaching at the end of their appointments.

A very valuable feature of the book is the bibliography provided at the end of each chapter—this alone makes the book intensely valuable for either those interested in mathematics, or in teaching generally.

For example, how many Army Instructors know of *The Approach to Teaching* (Ward and Roscoe), *The New Teaching* (Adams), *Handbook of Suggestions to Teachers* (H.M.S.O.)?

Another class of officer to whom this book will be a boon is the married man whose children expect assistance in their "homework." How many of us are capable of distinguishing between the three methods of subtracting 5 from 13? Which method will lead to the greatest accuracy?

It is refreshing to find the author insisting on accuracy of work, and that exercises must have a close relation to practical life—e.g., why give children an entirely false idea of the value of labour by asking them "if 36 men working 8 hours a day for "16 days can dig a trench 72 yd. long, 18 ft. wide, 12 ft. deep, in how many days "can 32 men working 12 hours a day dig a trench 64 yd. long, 27 ft. wide, and 18ft. "deep?"

The book is well written, and is one that can be opened at any chapter.

R.S.R.K.

THE ELEMENTS OF MACHINE DESIGN. PART 2.

By UNWIN AND MELLANBY.

(Longman's, 450 pp., 332 figs. Price 12s. 6d.)

This is an up-to-date revision of the second part of a well-known book which has been popular for upwards of 30 years.

Although dealing more particularly with the details of reciprocating steam engines, much of the book is applicable to the design of all types of reciprocating machinery.

The special features of the revision are the addition of a chapter on "torsional oscillations" which is an excellent introduction to this important aspect of the design of high-speed reciprocating engines. The treatment of flywheels and radial valve gears has been much improved and simplified, and minor alterations and additions made here and there throughout the book.

The printing is good, the diagrams clear, and the price very moderate, but it is a pity that greater prominence is not given to details of I.C. engines.

W.M.

BOOKS FOR GENERAL READING.

Recommended by Brig.-General Sir James Edmonds, C.B., C.M.G.

THE STORY OF THE ROAD, FROM THE BEGINNING DOWN TO A.D. 1931. (Alexander Maclehose & Co.) By J. W. Gregory, F.R.S., LL.D., D.SC., Emeritus Professor of Geology in the University of Glasgow.

A very readable book. The parts describing roads in the Middle Ages and the introduction of wheeled vehicles are particularly interesting.

SHAKESPEARE AND THAT CRUSH (Oxford, Basil Blackwood). By Richard Dark, pictures by Thomas Derrick.

A comic survey of English literature, with corresponding pictures of celebrities in, but after the manner of "1066 and all that."

OUR FATHERS (William Heinemann). By A. Bott.

Reproductions of two hundred and fifty woodcuts, mostly from the *Graphic*, depicting the manners and customs of the later Victorian period, 1870-1901, with annotations.

MAGAZINES.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(1931. TOME II.—NOS. 4 TO 6 INCLUSIVE.)

Les opérations de l'Armée Belge pendant la campagne 1914-1918. Three parts of a series of articles with the foregoing main title appear successively in the numbers of the *Bulletin* under notice. The operations of 1918 on the Western Front are dealt with in No. 4: the situation as it existed towards the end of 1917 and in the early months of 1918 is briefly reviewed. Russia had entered into negotiations for peace with the Central Powers in December, 1917, and on March 3rd, 1918, the Soviet Government signed the Treaty of Brest-Litovsk: six days later, Rumania also made peace with the Central Powers. Germany was, in consequence, able to transfer the troops liberated on the Eastern to the Western Front, and thus obtained the advantage of a considerable superiority in numbers in the latter theatre. Whereas in November, 1917, Germany had 150 divisions on the Western and 84 on the Eastern Front, by the middle of March, 1918, these figures had become respectively 190 and 45, and by the beginning of June, 200 and 35. In March, 1918, the Entente Powers had only 175 divisions on the Western Front wherewith to oppose the enemy. The German High Command desired to take advantage of a situation which temporarily favoured the Kaiser's forces and planned to obtain a decision by a supreme effort on the Western Front before the American Army could be made available to take its place in the line. In spite of the considerable success obtained by the enemy in the early stages of the offensives launched in the period March 21st—July 15th, 1918, the Entente troops managed to hold their own; by mid-July the situation was completely saved. In No. 4, the dispositions of the Entente troops at the opening stage of the German attacks are described; the various steps taken between November, 1917, and April, 1918, with a view to securing unity of command on the Western Front are discussed; the memorandum prepared in May, 1918, for the purpose of providing for unity of action with the Anglo-French troops on the part of the Belgian Army, which, for constitutional reasons, could not be placed under the direct command of Foch, is set out in full; a resumé is given of the principles upon which the defensive tactics of 1918 were based; the contents of the Belgian *Instructions Tactiques* issued in February, 1918, to meet the new organization introduced in the Belgian Army in the preceding month are briefly reviewed; extracts are also given from the instructions issued in February, 1918, by the French G.Q.G., and by the Belgian General Staff in March, April, and June, 1918.

The events on the Belgian Front during the period, February 7th—March 28th, 1918, are dealt with in No. 5. The period was one during which a re-distribution took place with a view to increasing the reserves to be held in readiness by Foch for the purpose of meeting the offensive which it was expected the Central Powers would, in view of the complete collapse of Russia, launch on the Western Front. The correspondence which passed between the French G.Q.G. des Armées du Nord et du Nord-Est and the Belgian General Staff in relation to the extension of the Belgian Front is published in No. 5. It was agreed that the Nieuport Sector should be taken over by the Belgian Army from the French XXXV Corps on February 7th, 1918; the measures adopted in connection with this relief and the organization of the defences in this zone are briefly described. The enemy displayed considerable activity on the Belgian Front during February and March, 1918. The Belgians carried out a number of raids during this period; particulars are given in the original article.

The events of the period March 28th—April 17th, 1918, are dealt with in No. 6. A

short account is given of the offensives launched by the Germans in March and April, 1918.

In an interview which took place on January 20th, 1919, between Foch, then C.G.S. of the French Army, and King Albert, the question was discussed as to the possibility of a further extension of the Belgian Front and of the eventual creation of a single command in Flanders under King Albert. A memorandum containing the views of the Belgian General Staff on these two matters was sent to Foch on January 28th, 1918, and is published *in extenso*. The reasons for rejecting the French proposals are set out.

Subsequently, in February, 1918, when Foch was appointed President of the *Comité Exécutif Militaire* and directed to take measures for the constitution of a "general interallied reserve," he again approached the Belgian C.G.S. on the subject of the extension of the Belgian Front; it was eventually agreed that the Belgian right should be extended so as to rest on the railway at Langemarck. The measures taken in connection with the transfer of the Boesinghe zone from the British 32nd Division to the Belgian Army are set out: a description is given of the defences in this zone and of the manner in which they were occupied by the Belgians. The Operation Orders issued by the Belgian G.Q.G. on March 24th, 1918, are published in No. 6.

Pages d'histoire de l'Armée Belge au cours de la guerre, 1914-1918. Articles, with special sub-titles, are published under the foregoing main title in each of the numbers of the *Bulletin* under notice. The article in No. 4 bears the sub-title *L'action du 1er Chasseurs à pied à Merckem, le 17 avril* 1918; it contains an extract from the War Diary of the 11th Company of the Regiment named, which, in April, 1918, formed part of the Belgian 9th Division, then holding the Drie-Grachten Sector. A description of the Belgian defences and the disposition of the troops in this Sector are given. Particulars are also given of the attack which was launched against this part of the Belgian line by a part of Riedl's Division, and of the Belgian counter-attack, in which the 1er Chasseurs à pied played a prominent part. The lessons to be learnt from the operations of the Belgian 9th Division at Merckem on April 17th, 1918, are set out in No. 4.

The article in No. 5 bears the sub-title *Le 9e de Ligne à la Bataille de Merckem*; it is contributed by Capt. Sclavons. The regiment named formed part on April 17th, 1918, of the Belgian 3rd Division and was holding the Hoekske Sub-sector (Merckem Sector), and was on the immediate right of the 1er Chasseurs à pied. The special features of the Merckem Sector, its defences and the dispositions of the troops in it are set out by Capt. Sclavons. The situation on the Western Front in April, 1918, is described and also the defensive measures which were adopted on the Belgian Front, when the British Army was obliged to fall back before the German Fourth and Sixth Armies. Particulars are given of the German plan of attack against the Entente line and of the part played by the Belgian 9th Foot at the Battle of Merckem. Although driven from its defences by the first onslaught of the enemy, this regiment eventually re-occupied the positions which had been lost and took 600 prisoners; its own casualties amounted to 7 officers and 359 O.R.

The article in No. 6 bears the sub-title *La Défense de la Redoute de Dorpveld* (29 *septembre*—2 *octobre*, 1914). A description of this redoubt, which was situated on the S.W. border of Wavre-St. Catherine, and its armament are given in the original article; a plan and sections are also provided. The garrison of the redoubt on September 29th, 1918, consisted of two officers and 112 O.R. Particulars are given in the original article of the German attack against the redoubt and the defences in the interval between it and Fort Wavre-St. Catherine. The German heavy artillery began to bombard the redoubt on September 29th and continued to do so almost continuously up to October 2nd. The results achieved by the bombardment are recorded in No. 6; by 4 p.m. on October 1st, the cupola had been put out of action and was, in consequence, evacuated. Later on the same evening, a part of the German 48th Reserve Infantry Regiment occupied the damaged cupola and also established itself in the

shell-craters nearby. The garrison, however, continued to resist, and it was only after the Germans had made a breach in the roof of one of the casemates by a mine that the Belgian Commander decided to withdraw his troops from the redoubt. The evacuation began at dawn of October 2nd; many of the garrison were drowned in attempting to cross the wet ditch; others were shot down; a few wounded were captured; a Sub-Lieutenant and 17 men alone succeeded in reaching Antwerp. At 5 a.m. on October 2nd, the enemy sprang a second mine and enlarged the breach in the roof of the casemate already referred to; the enemy now made an entry into the upper casemates of the redoubt and by 6 a.m. gained complete possession of the interior of the work.

An extract from the official history of the German 48th Reserve Infantry Regiment, wherein an account is given of the attack on the Redoubt, is published in the original article. The lessons to be learnt from the defence of the work are dealt with in an article by Col. Tournoux published in the *Revue du Génie Militaire* for December, 1929, under the title *La défense de la redoute de Dorpveld à Anvers en* 1914; extracts therefrom appear in No. 6. In conclusion, General Deshacht, the author of the original article, calls attention to the lessons of the defence which particularly bear on matters affecting the design of works of this type.

Les Acropoles ou la Fortification permanente dans l'Antiquité. Two parts of an article on this subject contributed by Major F. Delvaux appear in Nos. 4 and 6; a number of plans and illustrations are provided. In an introductory chapter to Part I, Major Delvaux traces the early history of the ancient type of fortress of which the Acropolis of Athens is a familiar example. A description is given in No. 4 of the Acropolis of Tiryns, and also an account of its defence when besieged in 547 B.C., by the forces of Argos, a rival town in the district of Peloponnesus.

In No. 6 Major Delvaux deals with the privileged position occupied by Athens, and describes the gradual development of the defences of Attica, which resulted in this division of Greece becoming eventually a strongly fortified region.

Du danger aérien du choix et de l'emploi des moyens pour y parer dans le cas particulier d'un territoire peu étendu et à population dense. This article is contributed to No. 5 by Major-General Vandeputte, who discusses the problems connected with defence against aerial attacks more particularly in relation to Belgium. The measures adopted in 1918 for the defence of Paris and of London against aerial attacks are briefly reviewed; the general principles affecting the defence arrangements against aerial attacks and the various measures which should be adopted are discussed; and the questions affecting the system of command and the defence organization are examined.

L'Instruction Provisoire française sur le Service en Campagne. This subject is discussed in Nos. 5 and 6 by an anonymous author. The instructions contained in the French Field Service Manual relating to the general organization of the larger formations; the functions assigned to the various arms; the organization of the infantry division and of the infantry regiment; the general principles relating to the measures to be taken to protect troops against surprise, gas-attacks and aerial attacks; and matters affecting the intelligence service are dealt with in No. 5.

The instructions relating to advanced guards; rearguards; flank guards; outposts; the conduct of troops when in contact with an enemy; the transport of troops into action by motor lorries and the measures to be taken for their protection whilst on the move; and the measures to be adopted for forcing the passage of a river are discussed in No. 6.

Le Pacte Général de Renonciation à la Guerre dit "Pacte Kellogg" ou "Pacte de Paris." This article is contributed anonymously to No. 5; the history of the Pact of Paris and the various views which have been expressed on the subject are dealt with therein. It is pointed out that the Pact is alone an expression of good-will; under its provisions war as a means of settling international differences has not been entirely excluded. Grave international disputes are as likely to occur in the future as they have done in the past, and the author of the original article calls attention

to the serious menace to international security which will continue to exist should no solution be provided for dealing with those cases in which *critical differences* arise between nations. He considers that considerable progress would be made if all nations could be persuaded to adhere to the provisions of the "Acte Générale d'Arbitrage" approved at the League of Nations Session of September 28th, 1928.

Aide-Mémoire du Chef de Groupe, des Chefs d'Équipe et Équipiers, en ce qui concerne le Groupe au Combat Offensif. This article is contributed to No. 6 by Capt. Collin, who points out that the various duties of subordinate leaders and the specialists in the ranks are now definitely laid down in a number of manuals and pamphlets. It is, however, only after a laborious study of the regulations that the junior ranks can put themselves in a position to obtain a clear idea of their numerous and complicated duties. In order to assist them in acquiring the necessary information without excessive effort, Capt. Collin has arranged the duties of the junior ranks in various situations in tabular form in parallel columns.

W.A.J.O'M.

WEHR UND WAFFEN.

(*October*, 1931.)—Since the date of the last number of *Heerestechnik* reviewed a new title marks the amalgamation of that publication with the *Artilleristische Rundschau*. Strictly the scope of *Heerestechnik* has not been extended by this change, since it already took as its province all military technics, but an increase in the number of articles on artillery affairs is only natural. Room for such has been found by an increase of size to double the number of pages. The price remains almost the same, 8 marks 50 a quarter against 8 marks, a fact sadly illuminating.

The Problem of Artillery Fire-control, by Major Schneider. Although in the Great War highly successful concentrations of fire were certainly achieved, they necessitated an over-centralization unsatisfactory in that it was possible only as long as the enemy did nothing to upset our preconcerted plans, or until the success of our infantry imposed a change of position upon our guns. Hence the author puts in a plea, in place of a battery datum, for the orientation of each gun, in order both to eliminate much calculation and to facilitate control.

The Importance of good Camouflage in Battle. The battlefield of the future must be visualized before this importance can be gauged. Long lines of skirmishers, connected artillery positions, formed bodies of reserves, etc., will no longer be in the order of things. The battle will resolve itself into separate combats, formations will dissolve into combat groups. Heavy artillery especially will thus lose its targets and its effectiveness. Also the aeroplane will not be able to exercise much effect upon the confusion of separate points. Gas will lose much of its efficacy in the large empty spaces. Once a target is recognized, however small, it will soon be put out of action. Also a number of objects, each small in itself and scarcely discoverable, will in a limited space lead to destruction, since such a space lends itself to being taken under mass-effect, machine-gun fire, artillery fire, aeroplane bombs or gas. Hence the urgent necessity of splitting up into as many as possible small and not easily recognizable targets spread over a large area. These small objects must be mobile so as to avoid fire, when once they have been recognized, so as to carry out the attack, or to evade it. Hence the answer—camouflage must be everywhere and immediately available for use, *i.e.*, every single target, whether it be a rifleman, a group, an infantry-gun, etc., must carry its own camouflage about with it. If this would be difficult now with the infantry armed with the ordinary rifle a great improvement will occur on the introduction of the automatic rifle. Compared with the fire effect of a rifle group of three to four men the fire-power of an automatic rifle group would be so great that the latter would be able to afford the labour of carrying their own indispensable camouflage.

Trials of this camouflage equipment, produced by a Munich artist, have been so

successful as to produce invisibility in various lights at 50 metres' distance, and in the absence of all natural cover.

The new Regulations for Artillery Co-operation Aeroplanes in the French Army. The present French Air Force regulations, the *Règlement provisoire de manœuvre de l'aéronautique*, date from 1925. Without waiting for a new complete issue it has been decided to issue a revision of that portion alone which deals with the work of aeroplanes doing reconnaissance and observation for the artillery. This article draws attention, not to the new regulations, but to some notes on them by one of the Revision Committee, Major Canonne (*quel beau nom d'artilleur !*), which appeared in the June *Revue des forces aériennes.*

The chief difference between these regulations and the old ones is that the latter were based too much upon the 1916 and 1917 experiences, when artillery 'planes did excellent service in position warfare, while the new regulations pay more attention to the experiences of 1918, when the conditions became more like those of mobile warfare, gun-positions were changed, communications were lost, programmes could not be worked to, and the services of the artillery observation 'planes were noticeably of less value.

Thoughts about the Armament, Equipment and Organization of modern Infantry, by Lieut.-General Baron Botzheim. The author claims that, as an artillery officer, he can get a clearer view of what future development of infantry should be striven for, than the infantry-officer who is more or less under the influence of his traditional views of his own weapon. He fears that the infantry officer must hanker for the happy days of uniform equipment and uniform organization, the ideal circumstances in which he took the field in '14, *viz.*, one man, one rifle, while the few machine-guns that then existed were in special formations. In consequence, the infantry will be inclined to resist their own specialization which has long since begun, and must continue. The machine-gun having taken the place of the rifle as the infantryman's chief weapon for the fire-fight, the infantry must split up into machine-gunners whose task is, with the artillery, to obtain fire-superiority and to prepare the way for the remainder of the infantry, who with rifle, hand-grenade and bayonet will gain the final success—provided the enemy has not already left the field.—(*To be continued.*)

Foreign Opinions about the Value of Permanent Fortification. In these days, when there is much to read and little time in which to read it, a good case can be made in favour of reviews, and even of extracts. In order to compile the latter one man has the task of searching, collecting and collating, and then—if he has done his work well—a number of other men can profit by his labours. Such collections, however, make often jerky reading, the wisdom tends too much to the aphorismic, contexts are missing and the same words used by different writers have not always the same meaning. Even then the reader may not fail of his profit, for he still has the references to pursue. In the present collection of opinions the voices range from Jean Fleurier, who writes in the *Revue Militaire Suisse* under the title " The Failure of Permanent Fortification in the Great War—a Fable ! " through General Fayolle's " Some lessons which can be drawn from the last war " to Major Deguent's " The role of Permanent Fortification in National Defence," which appeared in the *Bulletin Belge des Sciences Militaires.* After quoting from these three writers, who are all heavily *pro* permanent fortification the compiler feels sufficiently emboldened to soar up to Napoleon, whom he lays under contribution for two extracts from Vol. XII of his correspondence :

" A fortress like a gun does not defend itself ; one must know how to use it to the best advantage," and " It is often asked whether fortresses are still necessary. In many countries they are asserted to be unnecessary. In my opinion one cannot draw up a good plan of campaign without them."

Returning to earth, some excellent quotations are made from an article by Lieut. H. B. Harrison in *The R.E. Journal*, December, 1926, which is referred to later as " these English teachings." They pave the way to a description of the fortifications of France's Eastern frontier in which " from their left flank, covered by the similarly

modernized Belgian fortress system, to the Mediterranean the hundreds of millions of German reparations have been converted into steel and concrete." This description is taken from an Austrian article called "The Safety Psychosis beyond the Rhine" or "The Bastion of Lorraine and its Danger."

The remainder of the quotations are rather less to the point, and have somewhat the air of having been left over. *Army Ordnance*, Washington, quotes the United States Assistant Secretary for War on the importance of the P.B.I. in spite of mechanization and armour, and Lieut. Hardee in the *Infantry Journal* is equally complimentary to the "man with a gun in his hand." Finally Field-Marshal Count Schlieffen is quoted on the eternal struggle of ordnance *v.* armour, from his "Present-day Warfare."

Foreign Opinions about Artillery. This starts with Colonel Fuller in the *R.A. Journal.* Having sketched the tank-battle of the future he rules out the bayonet, the sword and the lance as obviously playing no part therein, while the rifle and the light machine-gun can play only a subordinate part. Thus there remains as chief weapon of the future, the artillery; the most important soldier will be the gunner; and the best army will be one based upon mechanized artillery. The increase of range and increased weight of metal in the development of artillery in the past will now be replaced by increased rapidity of fire and increased accuracy, combined with a relatively small calibre. In fact, Colonel Fuller's prominent artilleryman of the future turns out to be an anti-tank gunner, a logical enough conclusion from his premiss that the battle of the future will be fought between tanks.

From General Herr's book *L'artillerie ce qu'elle a été, ce qu'elle est, ce qu'elle doit être*, is culled: "There is no object in increasing the range of a gun and its rate of fire, unless its accuracy remains satisfactory—a fact easily lost sight of." Brigadier Maltese in *Rivista Militare Italiana* writes of artillery mechanization. He allows for its completion in Europe between 40 and 50 years.

Quotations from *Instructions sur l'emploi tactique des grandes unités* show what the French Regulations consider the responsibilities as regards artillery of corps commanders and division commanders respectively.

(*November*, 1931.) *The American Universal Field-gun*, by Colonel Blümner. Light Artillery possessed a universal field-gun only up to the end of the last century when Germany was the first to break the G.S. principle by introducing the light field-howitzer. There followed anti-aircraft guns, infantry-guns and anti-tank guns. The author considers how ordinary field artillery can be made suitable for anti-aircraft defence, and suggests that the American idea of making an anti-aircraft gun suitable for use as a field-gun is the best way to unification.

A trial gun, 7·5-cm. calibre, was made at Watertown Arsenal, U.S.A. in 1930. It has two firing positions. The first, which can be gained in one minute from the travelling-position, has 90° of traverse and elevation to 80°. Its second firing position has 360° of traverse and takes four minutes of attainment. Seven photographs and pictures show the gun on a crane, on a lorry, firing position with splayed trail, travelling position on pivot, firing from a lorry, and mounted on a bed.

Artillery Observation. A plea for the recognition of observation alongside fire-power and mobility as going to make up artillery fighting efficiency—a fact apt to be overlooked in peace training and at inspections, where, being non-spectacular, observation often gets crowded out of the picture. The whole is written in a crisp and attractive style.

Thoughts about the Armament, Equipment and Organization of modern Infantry. The author, having tabulated the infantry firearms, considers each in turn as regards characteristics and functions, preparatory to making his selection of what the infantry should have, and in what numbers.—(*To be concluded.*)

The Physiological Conditions of the Gas-mask. Though the protection of the gas-mask makes it possible for us to live and move in a poisoned atmosphere, even the most modern of gas-masks can be the cause of certain disturbances of bodily functions,

and thus of a lowering of the wearer's powers of performance. The two most important disturbers are the limitation of the field of vision, which has an irritating effect on sensitive people, making them " hot and bothered " ; and difficulty in breathing, which may result in craving for air, symptoms of suffocation, exhaustion of the breathing muscles, disturbance of the circulation and overloading of the system with carbonic acid. Minor troubles, like headache, are generally due to the gas-mask not being perfectly fitted. The chief aids to the gas-mask wearer are a good mask, *i.e.*, with opening close to nose and mouth, and stiff enough to keep the dead-space small, *i.e.*, the reservoir of breathed air which is the first to be breathed again ; good fitting to avoid discomfort ; thorough familiarity through use and practice ; and a recognition of the enforced limitation of power and endurance.

Balloon Aprons, a contribution to the subject of the protection of the civil population against hostile aircraft, by Dr. Kölzer. The author is a great believer in this form of protection. First started in Germany at the end of 1914 at Oberndorf and at Rottweil, it was abandoned the next summer owing to lack of hostile aeroplane activity, to be restarted in 1917 for the protection of industrial establishments in Lorraine, in the Saar, in Luxemburg and the Rhine industrial region. Most important testimony as to the moral effect of an anti-aircraft apron is given by the Director of the Burbacher Colliery, near Saarbrücken, who says, " There were many night-attacks on the mine, and mostly successful ones. After a particular night-attack, which caused a fair amount of damage and the loss of many lives, the unrest among the colliers was such that they wanted to stop all night-work in the mine. A balloon-barrier was then put up to protect the works, which had a great effect upon the workmen's feelings. It also stopped the night-attacks. The mine was called upon to pay a contribution of 100,000 marks towards the cost of the barrier. For the benefit received we would have paid twice that sum."

Foreign Opinions on Signals. Consists of extracts from foreign military journals emphasizing the importance of wireless, not only for purely military purposes, but also (alas !) for propaganda. Colonel Dwight Davis, discussing this latter use in the *Coast Artillery Journal*, says that the necessity of undermining the morale of the enemy nation by wireless propaganda, and the difficulty of preventing the enemy's efforts of a similar nature, both point to complete power being in the hands of one man, *i.e.*, to a dictatorship in war.

Of other means of communication found in the signaller's repertoire two are mentioned. From Norway, the *Norsk Militärt Tidskrift*, comes a pat on the back for the dogs, and also a practical suggestion. In these hard times a recommendation that civilian owners should be asked to train their dogs in message carrying, and then be allowed to bring them on manœuvres to show what they can do, has an air of promising cheapness about it, which encourages hope of realization.

Of the pigeons, whose value in stationary warfare may be taken as proven, a Swedish writer in *Tidskrift i Fortifikation* recommends them as particularly suitable for the battlefield. They form a comparatively invulnerable and very reliable auxiliary means of communication, which in some cases is the only one possible. This was proved once more lately, not on the battlefield, but when all technical means of communication failed in the recent great earthquake in Japan.

British use of Gas Shell in 1899. A Lieut.-General on the retired list signing himself " M " writes : " The British fired gas shell as early as the battle of Colenso. In the battery which I was commanding, there suddenly fell shells of about 12-cm. calibre, from the gases of which all the gun-crews suffered. The gases got on our chests, made the eyes water, and hung about our clothes for days. My hands were quite canary-yellow for four or five days, and no washing helped. After the battle we found out that the shell had been fired by a naval battery on shore. The explosive was Lyddite, a powder, in which was a thin yellow rod, the poison gas, a picrate. The shells were originally intended for firing at enemy ships, the gas being provided to put the gun crews out of action by penetrating into gun turrets and casemates. In

the open air its effect was not so powerful; but it lay about on the ground for days till evaporated by the sun."

(*December*, 1931.) *The Problem of Artillery Fire Control.* Major Schneider adds a few pages to his article with this title in the October number in order to answer points which have arisen as regards his proposals for a universal principle of command for the whole of the artillery permitting orders to be given in their simplest form and without calculations to the firing battery.

Heretical Views on Naval Guns. The views are those of Captain B. Ashworth, R.N., is his book *Navies of To-day and To-morrow*, or at least some of his views, since with many of the opinions and judgments the critic seems to agree. The following appear to be the "heretical" views: (1) the value of naval guns is determined not by weight or calibre, but by the choice of correct range, *i.e.*, of a range at which a reasonable proportion of hits can be obtained. (2) It is a mistake to build *Nelsons* and *Rodneys* for 16-in. guns with fabulous ranges when their chance of hitting owing to the steep angle of descent is practically *nil*. (3) Shooting by means of aeroplane observation at a moving target below the horizon is foolery. (4) Exaggerated hopes built upon aeroplane-spotting at gigantic battle distances have wrongly influenced the construction of ship and gun. (5) Fire command posts are too complicated and expensive. To concentrate them in one spot is a mistake. There is an exaggerated degree of accuracy in calculating machines out of all proportion with the inaccuracy of the observations upon which it is based. The gun-layer has sunk to a machine who does no aiming but only sees that pointers agree.

The book, in spite of its unreal exaggerations, is recommended to those who are able to read it with technical knowledge and judgment, for them to see the trend of the views of weapon development and use since the War, and also to check again the teachings of the War.

The Artillery Beaten Zone. The moral of this article is that the battery commander has at all times from the state of wear of his guns, from the quality of the ammunition which he is receiving, and from the degree of training the gun crews have had, to form an accurate picture for himself as to the extent of his battery's beaten zone. He will thus not only be able to spare his own infantry, but, when the replacement of guns is causing difficulties, he will be the less likely to have his worn barrels idle and out of action as unserviceable.

Thoughts about the Armament, Equipment and Organization of Modern Infantry (concluded). Having considered and discussed ten different kinds of firearms which the infantry must have at their disposal, and nine more varieties of fighting-equipment (engineer and signal stores, hand and rifle grenades, gas and smoke equipment, camouflage stores, etc.), the author is ready to make his proposals as regards establishments.

The Infantry Brigade to consist of 1 H.Q. company and 3 battalions, 1 artillery detachment of 3 batteries, 3 light ammunition columns, 1 supply column, and 2nd-line transport.

Infantry Brigade H.Q. company to consist of 1 signal section (telephones, wireless and lamp-signalling, cyclists, motor and push), 1 H.Q. section of clerks, batmen, cooks, etc., and two heavy machine-guns with detachments for anti-aircraft and anti-tank defence.

Each battalion to consist of H.Q. section, 4 rifle companies, 1 machine-gun company, 1 infantry gun company, 1 light ammunition column, and S. and T. wagons, and cookers.

The provision of a fourth rifle company in the battalion is specially considered more important than an increase from three to four battalions in the brigade, or an increase from three to four brigades in the division.

It will be noticed how also in these proposals the brigade is increasing in strength and in importance, and especially in fighting-power. Baron Botzheim himself calls it "to a certain extent already a small division." At the same time, although he

thinks a permanent allotment of engineers to the brigade " in itself very desirable " he decides on leaving them—together with the machine-gun motor-cycle companies—with the division for allotment as necessity arises.

The Elimination of Wind for Heavy Machine-Gun Fire. The article originates in the fact that neither of the appropriate German Training Regulations, H.Dv.73, Heavy Machine-Guns, nor H.Dv. 142, Army Meteorology, deals adequately with the question of wind affecting heavy machine-gun fire ; and yet it is precisely on account of wind that shooting by the map and indirect fire of heavy machine-guns, in spite of all care, sometimes are a complete failure. The wind generally allowed for is that prevailing at the guns ; whereas the wind at the target may be quite different, while the winds encountered by the bullets on their way there are more likely to be different than not. A heavy machine-gun barrage at, say, 3,500 metres, will meet on its way : (1) terrain wind, which consists of eddies from (2) ground wind, which rises to about 25 metres from the ground ; and (3) upper wind. Since sailing flight with engineless aeroplanes came in, these sources of its motive power have been much studied. In 80 per cent. of all cases the upper wind differs from the ground wind both in direction and velocity, while the terrain wind which is caused by obstacles (houses, woods, nullahs, etc.) can blow vertically up or down, and often in a direction opposite to that of the ground wind from which it springs. It is the terrain wind, generally in itself incalculable, which, to the exclusion of the other two winds, is taken into account in laying the guns.

An example is given where a barrage was 100 metres out each way, range and direction. Unfortunately, in spite of the elimination mentioned in the title, the article can give no more help to correcting the aberrations of flight due to wind than to refer to the method recommended by the British and French M.G. Training Manuals, *viz.*, to increase the number of machine-guns.

Notes from Foreign Military Periodicals. Gives particulars of the Jugo-Slavian Artillery, taken from *Le Forze Armate*, Rome, and of the Rumanian Artillery, compiled from Russian, Polish and Jugo-Slavian military papers. The former, by reason of its origin, is heterogeneous as regards material, being partly composed of guns captured from the Austrians (Skodas) partly inherited from the old Serbian army, and partly acquired through the alliance with France (old Schneiders.) The whole of the artillery has mechanical transport except the divisional artillery, which is still horsed, but is also capable of being carried as pack for mountain warfare. The Rumanian Artillery has 311 light batteries, also all horse-drawn, 42 heavy and 15 A.A. batteries.

Foreign Opinions about Motorization. Colonel Fuller is the first to be laid under contribution this month and furnishes quotations from three different sources, the *Journal of the R.A., The R.E. Journal*, March, 1928, and the *Infantry Journal*, Washington. As with Verey lights, it is wasteful to let off so many dazzling quotations at once. Colonel Fuller's statement of the object of mechanization, *viz.*, to increase the energy of an army's blow by enabling it to carry at greater speed greater masses of ammunition and more powerful weapons, leads up to Napoleon's application of mv^2 to armies and the value of rapid marches, and to an extension of the meaning of the word " mobility." Colonel Commandant Mudie is quoted from the *Royal Tank Corps Journal* as having said that an army's mobility is not only the rate at which its components move, it must be taken to include the time the army takes to act upon information received, or in other words, to get under way.

All these demands for mobility and speed turn war into a matter of transport, as Colonel Davis points out in the *Coast Artillery Journal*, since the army's mobility ceases unless its lines of communication forward adequate supplies, while the industrial programme of the home-country breaks down unless the supply of raw material is maintained. After Brigadier-General Maltese has shown in the *Rivista Militare Italiana* what the true mechanization of an army entails, the selection is appropriately closed by M. Clemenceau's famous telegram to President Wilson in which he said that

in the forthcoming German offensive, petrol would be as indispensable to the Allies as blood.

International Sailing Flight Congress in London. Eight nations sent representatives and much important business was done. Germany having been the pioneer and pace-maker in engineless flight, it is expected now that other nations should do their share and also work on independent lines. In England the provision of a central sailing flight experimental station is planned, also of a sailing flight school. The only Government establishment of this nature existing at present is in Italy. The importance of extending trials to the tropics was recognized by the Congress, and England will institute such in India by means of ordinary airmen who are also interested in engineless flight, and will then send out a party to co-operate.

As regards starting, a committee recognized the value of the towing start by car on the flat for training, but the downhill start is obligatory for pilot's certificate.

World's Air Records. The awarding body for these is the *Fédération Aéronautique Internationale*, which has up to the present recognized 157 world's air records. Of this number France holds 74, the U.S.A. 36, Germany 27, Italy 7, Great Britain 4, and the rest of the world, 9.

Marches in Gas-Masks. It is reported that in Russia, portions of a rifle division made a march of 36 km. in mountainous country, partly in great heat and partly in the dark, wearing gas-masks for 8 hours and 35 minutes. Some individuals who kept their gas-masks on during halts wore them for 10 hours. The extra exertion due to the mask being worn can be gauged from the fact that some soldiers lost in weight from one and a half to four kilos, while pulse-beats rose as much as 25 to the minute above normal.

Trials in the U.S.A. with artillery horses wearing gas-masks show that the horses stand the test well from two to four hours, provided they are not moved out of the walk.

F.A.I.

REVUE MILITAIRE FRANÇAISE.

(*October*, 1931.)—In his second instalment of *La recherche de la décision*, Général Fangeron deals with the Marne and the first battle of Ypres. He describes clearly, and without an excess of detail, how the action of the leaders on both sides produced the battle of the Marne. The French, in counter-attacking, wanted to stop and then drive in the German right, while the German 1st Army was endeavouring to move in a south-easterly direction across the front. We all know how the allies were only partly successful, largely owing to the intervention of "His Majesty Chance." The writer then goes on to the first battle of Ypres and shows how both sides tried to get round the northern flank, each without success. He ends by pointing out that it is not true that action by the flank is produced by lack of imagination on either side, but by each force having insufficient strength to break through on their front and so having to attempt to get round the flank.

Chef de bataillon Gingues begins *Le gouvernement de la défense nationale* in this number. This is the government formed in Paris after Napoleon's surrender at Sedan in 1870, with the revolution of September 4th. The writer deals with the position of the government, its difficulties owing to its not moving out of Paris and its efforts to form an efficient army. Looking back at the French endeavour to continue the war, one can now see that their chance was very small and they would have done better to make peace immediately. The revolutionary government, however, hoped that, by calling up the national guards, they would be able to carry on with the war. As is pointed out in the preface, a solid and well taught army provides the maximum guarantee of peace and security, and this is what the French had not got in 1870.

The third instalment, by Lieut.-Colonel Larcher, of *Le 1er corps de la Belgique à la Marne* describes the earlier part of the Battle of Guise. There is no doubt that Franchet d'Espérey was a real commander and was able to get the utmost out of his

troops. His appearance to the 45th Infantry Regiment, mounted and followed by his staff and pennant, although shells were falling thickly, gave rise to immense enthusiasm. The whole attack was really led by officers, not only junior but senior. When the guns moved forward they were preceded by senior officers reconnoitring; when the infantry showed signs of flagging the bands played the Marseillaise. The corps commander watched from close up and was ready to intervene when necessary. The instalment closes with brigades commanded by Pétain and Sauret beginning their offensive towards the north.

Lieut.-Colonel Aublet begins *La 10e armée russe et le désastre d'Augustovo* in this number. This army was on the northern part of the Russian front opposite East Prussia and was attacked by the Germans early in 1915. This instalment deals with General Sivers', the army commander's, measures for reconnaissance before the attack and the early stages of it. The most interesting part of the article lies in the messages and telephone conversations given as an appendix. General Rousky, commander of the group of armies, gave different orders from his chief of staff and it is clear what a gulf lay between the issue of an order and the way it was carried out.

La campagne de 1918 et la bataille du 15 juillet, by Général Goudot, begins in this number. He starts with rather a wide description of what happened in Russia, how Lenin and Trotsky were sent to Russia, how Russia made peace, how the Americans were finally brought into the War, how the Germans attacked in 1918 before the Americans arrived in France and the strength of the troops on each side. The writer finishes with the German attack of 15th July. It is not very clear in this instalment exactly what all this preliminary description is aimed at, but very likely the next instalment will explain.

(*November*, 1931.)—The third instalment of Général Fangeron's *La recherche de la décision* is occupied with Falkenhayn and his failure to produce the success which the Germans were in need of during the early stages of the War. The writer admits that Falkenhayn took over from Moltke when the German army was in retreat, and that he converted this retreat into a vigorous offensive. On the other hand he would not really face the Western front throughout 1915 and his great successes in the east, although spectacular, did not really advance the Germans on the decisive part of the front. When eventually he did attack at Verdun the methods used were not up to the standard required. As General Fangeron says, a genius in command exerts a continuous influence over events, and Falkenhayn failed to have this influence.

In the second instalment of Chef de bataillon Gingues' *Le gouvernement de la défense nationale* the method of recruitment of the new army is described. Great detail is given in this number, in fact, a good deal more than is of interest to Englishmen; but what does stand out is the method of electing officers. They were to be selected by their own men, thus bearing considerable resemblance to the more recent Bolshevik army. There is little wonder that the Germans had not very great difficulty in defeating the national army after the regular army had almost entirely surrendered.

The second instalment of Colonel Aublet's *La 10e armée russe et la désastre d'Augustovo* appears in this number. The German advance continued on the north and the orders of General Rousky, the commander of the group of armies, continued to lag behind the true situation. It is truly pathetic to read such descriptions of the so-called Russian steam-roller being rolled back and back when opposed to the Germans. Practically all the Russian Commanders and staffs were generally out of touch with what was happening with the troops themselves, and when they moved back they failed to let anyone else know. It is really small wonder that the Russians were seldom successful when opposed to soldiers of the type of the Germans.

The fourth instalment of *Le 1er corps de la Belgique à la Marne* deals with the remainder of August 29th and the preparations for a further attack on the night 29th-30th. There is no doubt that the French 1st Corps put up a very fine attack and that they were undoubtedly successful. On the other hand the units were so mixed up that by nightfall hardly any commanders knew where their troops were,

the men were almost all suffering from hunger and thirst, and few realized that they had been successful. Franchet d'Espérey, the corps commander, however, realized that the Germans had received a set-back and that it was essential to exploit his success. He therefore ordered the 1st division to attack again at 1 a.m. The instalment closes with one brigade preparing to do so while the other was simply unable to be ready.

Général Goudot completes *La campagne de 1918 et la bataille du 15 juillet* in this number. The instalment is devoted to a long description of the prospects of the attack followed by the attack itself. It is quite clear that the French realized exactly how the Germans were going to attack and made the corresponding preparations. As a result the German blow was in the air and they were held up completely by the main French positions. Great credit is due to General Gourand and his fourth army for this success. The writer states, however, that the reason for the success was not that the secret of the defence had been found but that the Germans had attacked throughout 1918 on the same principle and the French had had the intelligence to defend their sector accordingly. It was from July 15th that the War began to turn in favour of the allies.

(*December*, 1931.)—Général Fangeron's fourth instalment of *La recherche de la décision* deals with the French efforts to pierce the front from 1914 to 1917. He begins by pointing out that as the French could not organize before the War for an advance through Belgium, although it was expected that the Germans would violate the neutrality of that country, it was necessary to pierce the German front from the direction of the Ardennes. What was not realized was that, however dashing the French in attack, machine-guns in defence were too powerful. Hence the first French attack was a complete failure. This was followed by Joffre " nibbling " at the Germans. Looking back on it, there was never any real chance of breaking through owing to the vast area from which the Germans could draw their reserves and the same applied when the Germans attacked at Verdun. The writer described the development of artillery and the lack of surprise and points out that every attack did more harm to the attackers than to the defenders. The instalment closes with the remark that fortunately Foch was able to draw the proper lessons from the continual failures of 1914-17 and we shall no doubt hear of his success in the next instalment.

Chef de bataillon Gingues has a short instalment on *Le gouvernement de la défense nationale* in this number. The government following the revolution in 1870 decided that there was not enough contact between officers and men and instituted a system of camps throughout the country to bring them closer together. Gambetta made an excellent speech on this question, but the difficulty was the time required to train both officers and men. The camps were not a great success for various reasons described in the instalment. The whole article is of historical interest purely but of little military value now.

The third instalment of Colonel Aublet's *La 10e armée russe et le désastre d'Augustovo* continues the description of the Russian commander's failure to grapple with the situation. General Sivers and his chief of staff seemed to have completely different ideas and when one wired to a corps the other wired something quite different to the Army group. The 20th corps were told to attack; actually they were gradually being surrounded by the Germans. The instalment closes, apart from further orders and telegrams by the Russians, with the 20th corps nearly surrounded near Augustovo, the corps on either side having retreated and left this corps " in the blue."

The fifth instalment of *Le 1er corps de la Belgique à la Marne*, by Lieut.-Colonel Larcher, describes the cessation of the Battle of Guise and the resumption of the retreat under orders from the Fifth Army. At the end of the previous instalment General Sauret was preparing to attack again with the 2nd brigade. This attack did not get very far and unfortunately the rest of the 1st division retreated a short way thinking that the Germans were counter-attacking. Later in the morning, however, the 1st corps was able to advance again under orders from Franchet d'Espérey.

During the day the Army Commander gave instructions for a further retirement and Franchet d'Espérey had to break off the action by day. This he carried out most successfully and the whole corps retired without much difficulty. Although their losses were considerable, the morale of the corps went up to a great extent as a result of the Battle of Guise.

Lieut.-Colonel Aubert has an interesting article entitled *Trop de papiers ?* in this number. All staff aspirants feel that there is too much paper, but when they arrive on the staff they have difficulty in cutting it down. It is impossible here to describe the writer's arguments, but the article is worth studying by anyone who is likely to go into an office where much paper is dealt with. One reason for the increase, which does not affect us, is the suppression of the " archivistes," who knew their way about thoroughly and who were not relieved as rapidly as the ordinary soldiers. Apart from this, care is necessary the whole time to prevent the increase of paper, and the writer describes clearly how he thinks this prevention can be carried out. H.A.J.P.

MILITAERWISSENSCHAFTLICHE MITTEILUNGEN.

(*November-December*, 1931.) *The Capture of Monte Priaforà*, by General von Fabini, describes how, during the Austro-Hungarian offensive of May, 1916, in sixteen days of hard mountain fighting the Italians were driven back from their frontier, west of the Asiago plateau, for a distance of 12 kilometres in a southerly direction. The series of well-arranged systematic operations which achieved this, made possible, and culminated in, the capture by the Tyrolese Imperial Rifles of Monte Priaforà, 5,000 feet high. This effort was, however, not in the original scheme, but a *coup de main*, which surprised friend and foe alike. It was further remarkable for placing the Austrians securely upon the last *massif* before the plains of Italy commence, a position threatening the other side with disaster. From this last *massif*, however, they found it quite impossible to dislodge the Italians, and there in the first week in June, simultaneously with the advance of the neighbouring Third Army in the Seven Communes, the push petered out. The narrative gains much in value through including an account of the proceedings from the Italian side, taken from Amadeo Tosti's *La guerra Italo-Austriaca.*

The Exploitation of the Interior Line in the War on Three Fronts, May to July, 1915, by General Ratzenhofer. Following on the author's study of railway activity behind the Carpathians in the first four months of 1915 (*vide R.E. Journal*, June, 1931, p.387), General Ratzenhofer deals now with an intensive period of mass transport of troops. The three months treated in this article start at the time of the Austro-German break-through in Galicia, and include the train-movements necessary to bring into position 500 miles away a new army to face a new opponent, Italy, and to fight the first two battles of the Isonzo.

After preliminary remarks on railway organization and staff work, and upon the movement by train of the larger military units, the author tells his story, which he renders intelligible to us only in the light of a diagram of the railways concerned, and especially of a train movement time-chart for all the larger formations moved. The chart shows that the latter were moved generally in corps of two divisions, but in some cases it is obliged to descend as far as recording the movement of independent brigades. General Ratzenhofer deals with these movements separately and then summarizes them into large power movements on main lines broad-gauge, according to plan, self-contained and hence embodying the element of surprise. Of these he distinguishes three kinds :

(1) In a narrow area, *e.g.*, the first and second waves of reinforcement to the 11th German Army after the break-through at Gorlice. The first wave consisted of three divisions with army troops and was carried from the German frontier to Galicia in 351 trains in nine days. The second wave consisted of four divisions and one brigade and took nine days in 305 trains.

(2) In a larger area, *e.g.*, the "lightning" assembly of the German Balkan forces, three divisions from Germany to Serbia at a daily intensity of 44 trains, *viz.*, 174 trains of 100 axles in four days.

(3) Parallel movements on a broad front finally converging, *e.g.*, the assembly of Austro-Hungarian forces from the two other theatres, the Carpathians and the Balkans, against the Italian invasion, 868 trains in 23 days.

A further classification is the laborious transfer of troops on railways of small capacity and partly in a bad state of repair. In this category fall re-distributions necessitated by changes in the length of front, one of 152 trains in 10 days to the right wing in Galicia, and one of 178 trains to the left wing which took the same time. Enemy activity as well as poor lines reduced train intensity. Similarly, after the recapture of Lemberg, the 1st Army was moved complete by rail to avoid a march of 170 km. (shortest distance) and took 26 days in 339 trains.

The sum of all these railway journeys is 3,284 troop trains in three months, or nearly double the number required in August, 1914, during the first three weeks of mobilization against Russia.

In characterizing the important assistance derived from railways by the higher command, the author shows also clearly the limits imposed by the technical principles of mass-transport upon railway exploitation.

The Defence of the Isonzo up to the Fall of Gorizia. This is an extract from a manuscript History of the War, written by Colonel Veith and originally intended for publication in the United States. That intention having fallen through, the author, before leaving for Asia Minor on the voyage of exploration which cost him his life, made over the documents to the Director of the War Archives, for any use the latter might see fit, but preferably for publication.

The present instalment deals shortly with the third and fourth battles of the Isonzo, gives at some length an account of the fighting conditions generally, and a full description of the sixth battle in which Gorizia fell. The fifth battle is dismissed as a demonstration, lasting nine days, which falls as easily from the frame of the eleven Isonzo battles "as the Pastoral from Beethoven's symphonies."

The author compares the fighting on the Isonzo with that on other fronts and on other sectors of the Italian front, and ranks it for frightfulness with Champagne, the Somme and the Ypres Salient. Troops which were pulled out from there and sent to any other front looked upon their move as going into rest. The Isonzo became the high school for war, and troops which had fought there for months and been through at least one battle were regarded as having "passed through the gauge."

In distinction from the rest of the position, which was in limestone, the defences of the Gorizia bridgehead were in an easily worked red-brown sandstone. This lent itself so well to tunnelling purposes that wonders of position warfare arose. Finally the whole hill of Podgora was like an ant heap, having externally hardly any signs of organic life, while internally it was bored through and utilized in every direction. Electricity was used throughout for lighting, for cooking, for stone-borers, and for charging the wire obstacles with high tension. In the third battle, after thorough bombardment by heavy artillery and partly by the aid of regular saps, the Italians with great gallantry managed to gain the summit of this "electric fortress," but were immediately counter-attacked and driven off by the 22nd Dalmatians.

Colonel Veith's articles make delightful reading, and it is easy to understand why the compilers of the Official History constantly turned to his manuscript for quotations with which to brighten their own account, but they do not rise to being History, as a small example shows. The Austrians officially place the Italian losses in the first four battles of the Isonzo at 91,000. This article claims 150,000 in the third battle alone.

Artillery Considerations relating to the Break-through of Flitsch-Tolmein, 24th October, 1917, by Lieut. Field-Marshal Riedl, late of the Hungarian Army. This is one of a long series of articles which appeared in *Katonai Közlöny*, the object of which was

gradually to crystallize out of a number of examples from the Great War the fundamental ideas underlying the use of artillery. The battle referred to is possibly better known by its Italian name of Caporetto. This victory is claimed by the author as "belonging strategically, tactically and from an artillery standpoint to the grandest manifestations of power of our old monarchy." The method of treatment is to give a table of guns and frontages, and compare results with the figures of other break-through battles. In this case of a successful break-through the Germans and Austrians had 3,322 guns of sorts, 653 T.M.s and 142 Archies on a front of 73 km. Taking guns alone this works out to 22 metres of front per gun. Actually on the front of the two corps where the attack occurred the length of front was less than five metres per gun. The ammunition fired by the 14th Army, of which these two corps formed part, was 2½ million rounds, or 72 rounds per metre of front. Comparisons are then made with the corresponding figures for other break-through battles, *viz.*, for Gorlice and Magyaros against the Russians, for the May, 1916, offensive in the Seven Communes against the Italians, for the capture of Lovcen in Montenegro, and for the advance of the Italian 10th, 8th and 12th Armies in October, 1918. Field-Marshal Riedl's deduction is that on the ground of these experiences collected in the long struggle of the Great War, apart from gross tactical mistakes, it is possible to make certain of the desired success by hurling against the point of attack sufficient masses of artillery ammunition.

As the author wrote in Hungarian it may be permitted to reproduce in literal English what the German translator has made of one sentence. The following would have delighted Mark Twain: Enormous difficulties met the bringing-up into position of the heavy guns "over the in the deep Newsnow lying, only upon the very steep, narrow, new Serpintineroad to be gained by climbing 1,611 metres high lying Majstrowkasaddle."

Unsolved Problems of Tactics, by Lieut.-Colonel Rendulic. The problems dealt with, either tactical in themselves or having a bearing on tactics are: to what extent hostile aircraft will affect marches, hence marching formations: how rapid tanks can co-operate with infantry: the correct proportion of infantry to other arms: the best size for the group: artillery and infantry co-operation, especially the communication between F.O.O. and B.C.: co-operation in the attack between rifle groups and light machine-gun groups: the sphere of the heavy machine-gun: the trench-mortar, can the rifle companies be certain of its co-operation when the heavy machine-gun has failed? The siting and moving of infantry guns: whether the infantry has sufficient weapons of attack: the rifle-grenade: creeping barrages: the last hundred yards.

The author discusses these and other problems, showing in many cases what the official views appear to be in foreign countries, Germany, France, Great Britain, Italy and the U.S.A. He weighs pros and cons, but is very careful to avoid anything in the nature of a decision. This attitude is in accordance with his remarks upon the fluid nature of tactics, which in its modern details tends to become more problematic. That since the War a *second* edition of Field Service Regulations has been found necessary by the French, by the Italians and "even by the English," Colonel Rendulic attributes to first editions having indulged in too much legislation about detail. The Germans avoided this mistake, and are still carrying on with their 1921 Regulations. From all of which one gathers that tactical problems are like the poor, always with us; that in armaments, establishments, training, etc., the questions arising from these problems have to be answered; that the answers that are given, being often different, cannot all be right; that when they *are* right, they do not necessarily remain so; and hence, that tactics must most surely be the object of unceasing study.

Artillery Equipment for the accompaniment and direct support of Infantry. The author, Major Däniker of the Swiss General Staff, is a machine-gun expert of international reputation. He depicts for us by means of data and photographs certain infantry-guns so as to give an idea of the choice available. His preliminary remarks appear to derive from the French Artillery Regulations and from an article in the

Revue d'infanterie, by General Challéat. The need felt by the infantry of immediate artillery support has led to a portion of the divisional artillery being earmarked for this purpose. These guns are not placed under infantry orders, but they communicate direct with the infantry, and comply with its demands as their first duty. In France they are known as *artillerie d'appui direct*, while the remainder of the D.A. is known as *artillerie d'action d'ensemble*. If artillery were placed by the D.A. under the orders of the infantry a new relationship would arise. The French call such artillery *artillerie d'accompagnement immédiat;* and the case of its being found by the D.A. is unlikely, since field artillery is not suitable. This accompanying artillery, or infantry-artillery, is better furnished by infantry-guns, *e.g.*, the Stokes mortar or the 37-mm. gun.

The guns described are :

(1) The Schneider 75-mm. gun E.L. (*extra léger*) ; muzzle velocity, 300 metres a second ; maximum range, 6 km. ; weight of shell, 10 lb. ; for horse draught or men draught, pack animals or men-loads, seven loads, none greater than 35 kilos. As 300 metres a second is insufficient muzzle velocity for anti-tank use, Schneiders have made a second barrel, 47-mm. calibre, for mounting on the same carriage, which fires a $3\frac{1}{17}$-lb. projectile at 600 m/sec. muzzle velocity.

This gun is intended to fill the gap between infantry accompanying weapons and field artillery, especially in respect to the task of combating tanks.

A third possibility for this gun is a 105-mm. barrel, weighing 35 kilos and firing a 27-lb. shell to a maximum range of 1,200 metres.

(2) The Schneider 70-mm. Infantry Gun, S.A.C. ; muzzle velocity, 240 m/sec. ; maximum range 4 km. ; weight of shell, 9½ lb. The total weight is 287 kilos or 63 kilos less than that of the 75-mm. E.L., but it has not the same advantages for mountain use, as it does not break up into small enough loads.

(3) The Skoda 70-mm. B.A., has a 6¾-lb. shell and a maximum range of only 2½ km. ; weight, 100 kilos less than the 75-mm. Schneider.

The Ground Organization of a Military Air Power and its Importance for the Conduct of Aerial Warfare, by Capt. Ritter, late of the German General Staff. The author, who draws upon Group-Captain Courtney, the R.A.F. Quarterly's report on the Air Manœuvres, and Wing-Commander Garrod's *Air Strategy*, starts with general considerations. Those who look upon air force as the only war-instrument of the future overlook the air force's chief military weakness, *viz.*, that it is earthbound. It would be a mistake to look upon the necessary ground organization of an air force as no more than corresponding to the land force's lines of communication. It can be shown that its ground organization is not only its line of communication, but also an integral portion of the air fighting unit. That an air unit forms with its ground organization an organic whole derives from the fact that its military effectiveness, its strategic and tactical striking power depend upon the existence and suitability of aerodromes, air-parks, etc. The decisive military quality of an air force is its strategic mobility. This mobility is not merely a question of speed and range. It includes the power of taking effective military action when the aircraft has reached its objective. This is where the importance of ground organization comes in, for the aeroplane, by far the most mobile of weapons in the air, notoriously, out of the air, moves even slower than the infantry.

The distance of its aerodrome from the front is a factor in its efficiency, smaller certainly in the case of heavy bombers, but greater in the case of army co-operation squadrons, which are obliged to sacrifice some of their effectiveness in exchange for partial immunity against bombing.

Air force in war would be possessed of true strategic mobility only if air units could change from aerodrome to aerodrome daily and as a matter of course.

As things are Colonel Guillemeney says that the chief and most anxious care of French Air Force Headquarters in the latter half of 1918 was finding the necessary aerodromes and putting them in order; that many French air units on the day of the Armistice had still their old peace-time aerodromes, 100 miles from the front; and that if the advance of the Allies had continued the greater part of the French air formations would have gone out of action.

Captain Ritter then turns to his main theme, and says that the importance of civilian air-traffic lines for the development of ground-organization of military value is much over-rated. The civil aerodromes, upon which these lines are based, being in the neighbourhood of large cities or important industrial centres, and their position being well known to everybody, would hardly ever be of use to military units, except temporarily. The use of such aerodromes is opposed to all ideas of secrecy, or camouflage.

One exception the author sees to this, and that is in the case of a world-empire, like the British, where the provision and maintenance of a civil line of air traffic, *e.g.*, from London to South Africa, or from London to India, is undoubtedly of military importance. This importance cannot, however, be extended to the network of civilian air-traffic within the countries of Europe.

Artificial Cold for Army Purposes. The article starts with general remarks on refrigeration; the effects of the expansion of gases and of the vaporization of liquids; expansion machines, vaporization machines, compression machines; the gases used, SO_2, CO_2, NH_3, Methyl and Ethyl chlorides. Existing peace arrangements in Austria are then described, *viz.*, a Brown Boveri A-S automatic refrigerator, as installed at the garrison slaughter-houses in Vienna and in Linz. These are compression machines working with sulphur dioxide and water-cooled. They are entirely enclosed and hermetically sealed, only requiring the bearings to be oiled about once a month. A similar arrangement is working at the Government Farm, Brock-Neudorf, for chilling milk, except that instead of working continuously, this machine switches itself on at night when a cheap rate is charged for current and stores cold for the hours when a higher rate is charged. Both types are arranged also for making ice. Compared with these the war-time arrangements were primitive to a degree, and apart from stationary establishments, did not go beyond railway trucks, air-cooled by the motion of the train, for milk vans and railway trucks containing ice-boxes, for the carriage of meat.

Thus it is small wonder that great attention began to be paid to the subject of cold production, and this has led in the last few years to improvements hitherto undreamt of. As regards their employment on railways the army need not specially concern itself with these improvements, since they will certainly be adopted by all the railways, to the extent that means allow, and will thus be automatically at the army's disposal when war breaks out. But as regards the transport of meat by lorry, cold must be provided for preservation. Air cooling as formerly provided in trains is insufficient protection for ordinary (unfrozen) meat in summer; while the supply of ice to be carried is difficult. The methods which have entirely superseded them are:

(1) To make each meat-carrying lorry produce its own cold by means of a compression machine run off the lorry engine. The chief objection to this method is the difficulty of providing the necessary cooling water.

(2) The provision of cold cartridges. By cold cartridge is understood a completely closed metallic container, filled with some appropriate salt solution, *e.g.*, K.Cl. The latter, appropriately treated and at a particular temperature, freezes together to a homogeneous mixture of ice-crystals and salt-crystals, known as cryohydrate. Certain firms engaged in the milk trade, which use cold cartridges of this description the exact composition of which, however, has been kept secret, are able to produce a temperature of 12° below zero, centigrade, for between 50 and 60 hours. A few of these distributed about a meat-wagon would suffice to keep it at the desirable temperature of 2° to 4° C. The drawbacks of this method are that the cartridges have, so to

speak, to be recharged after 48 hours' use, and that this recharging is rather a slow process.

(3) The use of solid carbonic acid, or "dry ice." This method was first used in railway wagons in the United States for the preservation of a delicate product of the confectionery trade—ice cream. CO_2 has the great merit of being a waste product in several processes, and available in great quantities. It can be obtained in the market in liquid form in steel cylinders under a pressure of about 60 atmospheres. When released through the smallest of jets it is obtained as a solid in the form of the finest snow. This snow, pressed into blocks, is known as "dry ice." At a temperature of $-80°$ C. this form of carbonic acid has the consistency of chalk, can be easily cut or crumbled and turns back into gaseous carbonic acid without leaving water or other residue. Its slow rate of evaporation makes it a valuable substitute for ice, and as it is always surrounded by an insulating layer of gaseous CO_2, it is suitable for packing in paper, cardboard or thin wooden cases, and can thus be sent long distances. The weight of liquid CO_2 required to produce a given weight of "dry ice" is about 2 to 1. The price of "dry ice" at present is about twopence a pound so it is considerably more expensive than real ice, but its performance is between five and ten times as great. One great advantage that it has over ordinary ice is that the CO_2 given off fills the space surrounding the object to be preserved and by driving away the oxygen further protects it from decay.

More trials are necessary before deciding between the two methods, cold cartridge or "dry ice," but as things stand it appears as if the future belonged to the latter.

Pocket-book of Airfleets, 1931 edition, by Dr. von Langsdorff, volume, Military Aviation, with 338 illustrations, in linen cover, 8 marks (present English equivalent 11s. 6d.), published by J. F. Lehmann's, Verlag, Munich.

This well-known handbook has increased so greatly in size this year as to be issued for the first time in three volumes, dealing with aircraft under the headings, military, trade and traffic, and sport. As before, three languages are used, German, English and French.

It is noticeable when looking at the latest styles of construction that the majority of these are single-seater fighters, a type of which it is increasingly said that it is tactically dead. As representatives of this type, photographs are shown of the De Havilland "Interceptor," a monoplane, and of the Hawker "Interceptor." An interesting modern two-seater fighter is shown in the Bréguet 27, which with the S.E.C.M.—Amiot 140—B3, also shown by photo, most clearly displayed at the Paris Air Exhibition the direction of French technical development.

Of the bombers there are also four good photographs: Caproni Ca 90 PB (the largest military 'plane), Handley-Page h.p. 38, the Fiat 120 (reconnaissance), and the Czecho-Slovakian Aero A 42.

Finally the writer, Colonel Löhr, laments that since German designers and patentees can only reap the fruit of their labours through foreign licences to manufacture, one is obliged to seek in the *Pocket-book of Airfleets* German ideas under the headings of other countries, *e.g.*, the Dorniers under Italy, Japan and Switzerland: Rohrbacks under England and Japan; Junkers and Hemkel under Sweden. He promises us that this state of affairs, impossible to maintain, is for the last time depicted by the 1931 edition.

Royal United Service Institution Centenary. The Editor himself writes a long and complimentary article about the R.U.S.I., based to some extent upon the contents of the May number of the *R.U.S.I. Journal*. He states that the institution has its counterpart in no other country, and that it is certainly in every way worthy of imitation. After saying nice things about both the British Army and our Royal Air Force, he winds up with sincere congratulation on the R.U.S.I. Centenary.

F.A.I.

REVUE MILITAIRE SUISSE.

(1931. Nos. 7 to 12 inclusive.)

L'éducation du soldat. This article appears in No. 7; it deals with a memorandum (dated May 30th, 1931) issued by the Chief of the Swiss Federal Military Department. In this memorandum, the text of which is reproduced *in extenso* in the article, attention is called to certain irregularities on the part of officers which have been brought to the knowledge of the Swiss War Office. It has been thought desirable, in consequence, to issue instructions in relation to the means to be adopted for maintaining discipline and for securing that spirit of mutual confidence and respect between superior officers and their subordinates which is so essential to the well-being of an army.

L'historique des manœuvres de la 1re Division. This article is an anonymous contribution to No. 7; it is a review of a report by Colonel Commandant Sarasin on the Swiss Army Manœuvres of 1930.

Le début de la guerre de 1914 en Autriche-Hongrie. In a note to this article, which appears in No. 7, the editor of the *Revue* states that, during the last months of his life, the late Colonel Feyler was engaged on a study of the events in Austria-Hungary, Serbia, Galicia and Russia connected with the outbreak of hostilities in 1914. The original article is the concluding part of Colonel Feyler's first study; in it he points out that the decision of the Austrian General Staff to change over from Plan B to Plan R for the purpose of undertaking a war on two fronts instead of on a single front, as originally contemplated, gave rise to many difficulties. The mobilization arrangements of the Austrian Army on the outbreak of the War are described in the original article. The Archduke Charles, who was appointed C.-in-C. (with General Conrad, as his C.G.S.), at once entrusted the command of the troops to be employed against Serbia to Feldzeugmeister Oskar Potiorek; on the other hand, there was some delay in arranging for the direction of the combined operations of the Austrian and German forces against Russia. This delay, it is explained, was occasioned by a divergence of views which had taken place between the political and military authorities in Berlin towards the end of July, 1914; the former no longer felt sure that Great Britain would, in any event, remain neutral, and, in consequence, made an endeavour to put a check on Austria's bellicose attitude. However, the Great General Staff at Berlin was bent on bringing about a rupture between Austria and Russia: extracts from telegrams which passed between Berlin and Vienna are published in the original article and provide convincing evidence in relation to the intentions of the Kaiser's military advisers.

By the end of July, the two Central Powers both found themselves definitely committed to a war on two fronts. The Austro-Hungarian General Staff, in consequence, was faced with a situation full of uncertainties. What would Bulgaria do? What Italy? What Rumania? These questions are briefly discussed in the original article.

La radio et l'aviation au service de l'artillerie lourde. This article is contributed to No. 7 by Major Tschumy, who describes therein the assistance received from wireless messages and the air force (in directing its fire) by an artillery brigade which took part in the Swiss Army Manœuvres of 1930.

Anticipations ou réalités. This article is contributed to No. 8 by General Roquerol, who draws attention to the fact that problems relating to the organization of modern armies have to be considered in the light of two new factors: mechanization and gas-warfare. These factors call for modifications in the principles upon which strategical and tactical operations have in the past been planned. In order that an army may not find itself in a position inferior to that of its adversary on the sudden outbreak of hostilities by reason of the latter being equipped with products based on the most up-to-date inventions, and being also thoroughly trained in their uses, it is necessary for those in responsible positions to maintain constant touch with the advances taking place in the domains of mechanical and of chemical inventions. It is alone by

continually studying the influence of inventions in these fields on warfare that it becomes possible to utilize them to the best advantage in planning strategical and tactical combinations. The subject is treated by General Rouquerol under the following heads: land transport, aerial transport, poison gases, attack and defence.

L'organisation des groupes attelés de mitrailleurs. A paper on this subject was read by Lieut.-Colonel Isler at the 1930 Conference of the "Société suisse des Officiers"; it is reprinted in No. 9 of the *Revue*.

Une nouvelle étude sur l'Assurance militaire fédérale. This article is contributed to No. 8 by Capt. P. Pétermann, who deals therein with some of the anomalies in the provisions of the Swiss Statutes relating to the insurance of soldiers and persons employed in military establishments.

Manœuvres suisses. This article is contributed to No. 9 by M. R. Masson who deals therein with the criticisms of Colonel Fonjallaz and Colonel Sunier on the manœuvres of the Swiss 1st Division held in September, 1930.

Nos Grandes Manœuvres: "Ce qu'elles sont; ce qu'elles pourraient être." This subject is dealt with in Nos. 9, 10 and 11 by Colonel A. Cerf, who points out that insufficient attention is paid at manœuvres to the realities of war. In these circumstances, soldiers are taught false lessons: the consequences must, he says, prove disastrous to an army if during its peace-time training the realities of the battlefield are ignored. It is to a feature of this kind in the training of the French Army that he attributes the disasters with which it met in the early stages of the Great War. The measures which might be adopted to remedy the matters regarding which complaint is made are discussed by Colonel Cerf. The subject of armament is treated in No. 9; matters relating to organization, schemes set at manœuvres and their execution are discussed in No. 10; matters connected with the handling of troops, the conference at the conclusion of manœuvres, and umpiring are discussed in No. 11.

La Suisse et son armée dans la guerre mondiale. A contribution, with the foregoing title, is made by General P. E. Bordeaux, of the French Army, to a work entitled *Collection de mémoires, études et documents pour servir à l'histoire de la guerre mondiale* compiled by M. Henry Bordeaux, of the Académie Française. The original article is a review of the General's contribution to the work in question.

La guerre des moteurs. This subject is discussed by M. S. de Stackelberg in Nos. 10, 11 and 12; he deals therein with the age-long effort which has been in progress to increase the fighting power of armies and has led in recent years to the introduction and development of tanks and the mechanization of military equipments. In No. 10 the history of mobile military "engines" is traced from 218 B.C. to 1918 A.D. In the former year elephants were used, M. de Stackelberg points out, by Hannibal in the Battle of the Trebia to play a part similar to that assigned to the present-day tanks: these animals were partly protected by a kind of armour and each of them carried on their backs four bowmen shielded in wooden turrets. Italian engineers, it would seem, were the first to design machines which might properly be spoken of as armoured-cars. They began experimenting in the early part of the XVIth century, but it was not until towards the end of that century that any real progress was made; in 1588 and 1589 armoured vehicles to carry crews of four to six men were constructed by Augusto Romelli and by Duke Alphonso of Ferrare respectively. The advent of the modern tank at the Battle of the Somme in 1916 is briefly dealt with in the original article. An important lesson to be learnt from the experience of the Great War is, M. de Stackelberg suggests, the need which exists nowadays for organizing the industries of a country in normal times of peace in such a manner that the requirements of national defence may be quickly met in a time of stress. It is no longer sufficient, as was formerly the case, to provide a few distinct establishments for the manufacture of armaments and military equipments; many of the machines and appliances required by an army to-day are merely elaborated models of things in every-day use in civilian life.

In No. 11 M. de Stackelberg deals with the technical developments in relation

to armoured " engines " during the period 218 B.C. and 1918 A.D. ; the special features of up-to-date tanks are discussed in some detail.

In No. 12, M. de Stackelberg discusses questions affecting the tactical employment of mechanized formations ; the advantages accruing to a force which is mechanized ; the effect of mechanization on War Establishments ; the influence of the increased speed of tanks on the tactical handling of troops ; the functions and organization of mechanized forces of the future ; and the position to-day of the " motorization " problem.

Le rendement actuel de notre artillerie de campagne. This article appears in No. 10 ; it is a paper read by Captain P. Huber at a meeting of the " Société suisse des Officiers " at the end of 1930 ; he deals therein with the improvements which have been effected in the armament of the Swiss Field Artillery in recent years and indicates the further improvements which might advantageously be introduced.

Chronique de l'Air. Articles by 1er Lieut. E. Naef appear in Nos. 8 and 10 ; in the former he deals with some of the developments which have recently taken place in connection with military aviation. In No. 10 some particulars are given of the large-scale manœuvres carried out recently by the Italian and French Air Forces. An air attack on Turin, during which realistic measures were taken for the safety and protection of the civil population, is described. The French manœuvres were carried out in Lorraine ; the object in this case was to test the air defence organization generally, including the measures to be taken for the protection of the civil population.

Comment se fera la guerre de mouvement. This article is contributed to No. 11 by Lieut.-Colonel E. Mayer, of the French Army ; he analyses therein the views of General Pershing and also of Foch in relation to a " war of movement." Colonel Mayer considers the teaching of the " old school " on this subject erroneous, and it is to the attempts made in the early days of the Great War to put into practice the tactical methods of this school that he attributes the French defeats at Charleroi, Morhange and the Grand Couronne. Col. Mayer strongly condemns the conduct of those who seek to adopt the typical tactical methods advocated in text-books, regardless of the actual situation at a given moment and without considering the cost which may be entailed. He sums up his view in the following words : " le danger se trouve dans les plans préconçus, dans les idées *a priori*." He says definitely that no one can foretell what a war of the future will be like : it is in the attitude of those who imagine that the secrets of the future are not hidden from them that the greatest danger lies.

The views of Colonel Mayer are in some respects contested in an editorial note. It is pointed out that there will always exist some difference between peace-time military preparations and the realities of war. In the circumstances, so far as the training of troops is concerned " les plans préconçus et les idées *a priori* sont inévitables " : indeed, they play a useful part in what may be called the *discipline intellectuelle* of an army.

Caractères des armées modernes. This article appears in No. 12 ; it is the first part of an address by General Debeney, formerly C.G.S. of the French Army, to officers of the Swiss Army. General Debeney reviews in this part of his address the great changes which, in recent years, have taken place in the character of the armament and equipment of armies. He calls attention to the fact that on a modern battlefield, it is the role played by the " material " possessed by troops which is the dominating factor. In modern armies then sight should never be lost of the problems which relate to the immediate conversion of peace-time industrial undertakings to purposes connected with the production of war material. The consideration of problems of this kind constitute a matter of the first importance and can be summed up in the words : " préparer une guerre de materiel ! " As a matter next in importance, plans must at the same time be prepared with a view to utilizing to the greatest possible extent the whole of the other resources of a State in order to render them available for the purposes of national defence : the second problem of importance then is to organize " le potentiel de guerre " of a State.

Réorganisation de l'artillerie. The Council of the "Société suisse des Officiers" recently issued an invitation calling for Papers on subjects dealing with problems relating to the organization and armament of the Swiss Army. The original article, which appears in No. 12, has been prepared by Colonel Labhart in response to the invitation aforesaid; he makes far-reaching proposals for the re-organization and re-armament of the Swiss Artillery.

W.A.J.O'M

THE MILITARY ENGINEER.

(*November-December*, 1931.)—Major-General R. N. Harvey contributes an account of British military mining from 1915 to 1917, illustrated by plates from *The Work of the R.E. in the European War; Military Mining*, published by the Institution of R.E., to which publication attention is directed for a fuller account of this thrilling phase of static warfare.

In *Weather Effect on Military Campaigns* are mentioned the heavy rains of June 16th and 17th, 1815; the adverse weather conditions in Gallipoli; the climatology of the North Sea; and the air raids on London.

In *Ferrying with Pontoon Equipment* is described a series of experiments with outboard motors and three-pier rafts. The results were generally successful, but it is admitted that the outboard motor is a temperamental piece of machinery. The remedy is "to pick a good operator, permanently assign him to a single motor, and make him responsible that his motor is always ready to run." Another sound piece of advice is "if the worst comes to the worst, drop anchor." There was difficulty over the grounding of one raft on a falling tide before it could make the landing stage. Luckily the cargo was in this case horses, so they were pushed into the water to look after themselves. The author's comment is: "Artillery tractors cannot be made to swim." The principal conclusions seem to be:—(i) An outboard motor requires to be reversible; this is particularly useful for checking headway. (ii) Turns must be made with caution, or the attachment of the motor is strained to breaking point. (iii) Choppy water is a constant source of trouble to the ignition. Finally, and of particular interest to us, is the comment: "There is no reason why pontoon rafts cannot be towed from a motor-boat adapted to rough water, under conditions far more severe than any under which outboard motors can operate."

The Division Quartermaster Regiment corresponds to our Divisional R.A.S.C., and takes the place of the Division Quartermaster Train. The Division Quartermaster (O.C., R.A.S.C.) doubles roles of special staff officer to the Division Commander and Commander of the quartermaster troops of the division. For these duties he has two staff sections, the special and the regimental. The quartermaster troops consist of the Service Company, the Wagon Battalion and the Motor Battalion. The Service Company has two officers and 100 men. The Wagon Battalion consists of H.Q. and two wagon companies, each of 62 wagons for cargo. The battalion commander is also Remount Officer to the division. The Motor Battalion consists of H.Q. and four companies. One is a motor maintenance company which is charged with the supply of gasoline and oil for the whole division, and with the replacement of parts and accessories for all vehicles not served by the Ordnance Dept. It has a medium tractor for "trouble shooting" purposes. Two of the companies are M.T. companies and operate fifty-four 1½-ton trucks each. The fourth company is called the "motor-cycle company," and provides motor transportation and motor-cyclist messengers for Div. H.Q., besides operating a general pool of motor-cycles and cars for service within the division. Examples of the regiment at work are given by means of assumed situations.

Among the articles of engineering interest are *The New Welland Ship Canal*, excellently illustrated; *The Goodyear Zeppelin Airship Dock*, in which wind pressure is investigated; and *Modern Concrete Pavements*, which summarizes the experiences of the past ten years. The author considers that concrete will continue to increase in general use as the most practical type of pavement for roads of heavy service and economical maintenance.

I.S.O.P.

REVUE DU GÉNIE MILITAIRE.

(*August-September*, 1931.) In "Souvenirs du Passé," Colonel Doizelet gives an account of the conquest of French West Africa and of its development under French administration.

Segu was the capital of a territory belonging to a formidable enemy of the French, El Hadj Omar, who, about 1860, ravaged the whole country as far as Timbuctoo.

About 1863, General Faidherbe, who had established order in the colony of Senegal, tried to open up a route into the interior. No appreciable results were, however, obtained up to 1866, when the question of advancing into the interior had to be dropped.

The next event of importance occurred in 1890. Major Archinard, who was in command of the troops in Upper Senegal and Niger, with Captain Bonnier as his Chief of the Staff, decided to attack Ahmadou (the son of El Hadj Omar) in his capital, Segu. After a march of 400 miles across a country practically devoid of supplies, Segu was taken by assault on April 6th.

In 1892 the tribes east of Segu rose in revolt, but the rebellion was crushed by Bonnier.

At the end of 1893 two columns started from Segu for Timbuctoo. The first column, under Lieut.-Colonel Bonnier, took the easier route, *viz.*, following the course of the Niger, and entered Timbuctoo on January 10th. The second column, under Major Joffre, of the Engineers (then Director of the Kayes-Niger Railway), marched by land, keeping on the left bank of the Niger, with Timbuctoo as its objective. His column met with a considerable amount of opposition, and he reached Timbuctoo on February 12th. In the meantime Bonnier, while on the march, on January 15th, some 30 miles west of Timbuctoo, was ambushed by the Tuaregs, and was killed, along with ten other European officers.

The writer goes on to comment on the changes that have taken place in the country since the days of Archinard, Bonnier, and Joffre. During the past ten years a system of irrigation has been inaugurated. A barrage has been built across the Niger, raising the water surface to a suitable level to command the surrounding country. Dykes have been erected along the left bank to protect the country on that side of the river from flooding. The main river has been connected with some of its former branches, and the latter have been converted into main canals, with distributaries branching off them. A large area of land that was formerly arid has been brought under cultivation, and the country can now look forward to an era of prosperity.

Colonel Bailly gives an account of the "Crossing of the Marne by the Germans," on July 15th, 1918, based on three separate German narratives.

After the battle on the Chemin des Dames the Germans succeeded in forming a salient in their line south of the Aisne, about twenty km. wide, bordering on the Marne from Château Thierry to Troissy. The 1st and 7th German armies occupying this salient were unfavourably situated, their only line of supply being a single line of railway that was under long-range fire from the French artillery positions.

The German Higher Command were faced with the alternatives of abandoning the salient, or of attacking. They decided to attack.

The article gives an account of the heavy and light boat bridges and footbridges constructed by the German pioneers across the Marne in the attack. In places ferries were established.

The 33rd, 8th and 6th Reserve Corps of the 7th Army succeeded in crossing the river and occupying a position on the left bank, in spite of the fact that the French Artillery, supported by the Air Force, was concentrating its fire on the river crossings.

Lieut.-Colonel Lobligeois continues his series of articles on "Réflexions sur la Fortification Permanente," and considers the question of trace with regard to the ground contours, the slopes, drainage, and ventilation of tunnels. For underground work he strongly recommends the use of compressors, and prefers having a number of small electrical compressors to one big one.

(*October*, 1931.) 1. Lieut. Bellat gives an account of the telephonic equipment

installed in the camp at Mailly between January and March, 1931, by the Sapper Telegraphists under his command and others. The work consisted mainly of laying underground cables, and was rendered specially difficult by the rain that fell almost incessantly throughout January and February. The periodic testing of each circuit is very necessary, as well as the greatest care in keeping the junction boxes free from damp. The author insists on the great importance of following the official instructions for the maintenance of underground cables.

2. Colonel Bailis' article on the passage of the Marne by the Germans on July 15th, 1918, is concluded in this number. A brief account is given of the fighting on the 15th, 16th and 17th. On the 17th the French counter-attacks, and the fire of the French batteries on the Marne bridges caused terrible losses in men, horses, and material, and rendered the repair of the bridges impossible. The Germans had no alternative but to withdraw the three corps of the 7th Army to the north of the Marne. The retreat took place on the night of July 20th-21st. Thanks to the devotion and energy of their Pioneers, the Germans succeeded in re-establishing the bridges and conveying their troops to the north bank, almost to the last man.

The Germans attribute their failure to the following reasons :

(1) The surprise was a failure, and the French had sufficient warning to organize the defence and establish a strong second line.
(2) The preparations for the attack were too hasty, and the enemy's artillery positions were not accurately known.
(3) The troops had had little rest and little preparation, and they included young soldiers who could not be fully relied upon.
(4) An epidemic of influenza had weakened some of the units just before the battle.
(5) The artillery preparation on the second position had been insufficient owing to shortage of munitions.

Colonel Bailis agrees with the first of these reasons and lays down as a maxim for the future that, in an offensive operation involving the crossing of a river, absolute secrecy is essential, and that if the enemy has forty-eight hours' notice of an impending attack, the chances of its success are very problematical.

He does not agree with the other reasons given by the Germans for their failure. Orders for the preparation for the attack by the 7th and 1st Armies were issued on June 14th, and the attack was originally fixed for July 10th. He considers that the German troops were no more exhausted than the French were. There was a considerable amount of sickness amongst the French as well as amongst the Germans.

After giving a detail of the Artillery taking part in the attack, he points out that three-quarters of an hour's preparatory bombardment of the modest second position was insufficient to clear the way for the infantry advance. The want of success was due to the failure of the supply of ammunition to keep pace with the expenditure after the first position had been captured.

In conclusion, the author states that, for crossing a small river like the Marne, the Germans had provided two bridges per division, supplemented by footbridges and ferries, and that eventually these bridges were found totally inadequate.

3. Lieut.-Colonel Lobligeois continues his " Réflexions sur la Fortification Permanente." In the ninth chapter he considers the application of his principles to mountainous country. The main points to be considered in this case are : (a) rock is often met with at ground level or near it ; (b) above certain altitudes, mountains are often covered with clouds, and visibility is reduced to a range of a few yards ; (c) certain points are quite inaccessible, even to infantry, and no defence is necessary ; (d) slopes are sometimes so steep that fire cannot be brought to bear along them ; (e) transport is difficult owing to the scarcity of communications.

4. Lieut. Beauvais, in " Topographie Souterraine," describes two alternative methods of aligning a tunnel from a central adit by means of a tacheometer and plumb-bobs.

5. The last article is a résumé of a memoir that appeared in 1929 amongst the publications of the Ministry of Health in London, and deals with the purification of water in bathing tanks. The method recommended is a combination of continuous filtration and chlorination.

(*November*, 1931.) 1. "Le Génie aux Dardanelles." Captain Dubois has written an interesting article on the work carried out by the French Engineers on the Gallipoli Peninsula in 1915.

After a brief reference to the naval operations in the Dardanelles on March 18th, he describes the landing of the French troops on April 25th. Sir Ian Hamilton entrusted to General Amade the execution of a diversion on the Asiatic coast. This was carried out successfully, and prevented the Turks from bombarding, with their heavy guns, the British, who were landing on the European side of the Straits. In compliance with the instructions received, the French re-embarked on the night of the 26th-27th, and were thrown into the "furnace of Gallipoli."

After the first desperate fighting, the operations eventually developed into trench warfare. One of the greatest difficulties encountered was an adequate supply of drinking water. For a time the force subsisted on water distilled from sea water on the *River Clyde*. Later on, three separate sources of supply from springs were developed by the Engineers. They were connected together, and the water was conveyed by a pipe line to the beach at Seddul-Bahr. The pipes were purchased in Athens.

The most important work carried out by the Engineers was the construction of a harbour, enclosed by two breakwaters roughly at right angles to one another. One breakwater consisted of the *River Clyde*, which had been sunk parallel with the Asiatic coast, and was connected with the shore by a jetty. The other breakwater consisted of two ships: the *Saghalien*, an old Messageries Maritimes steamer, and the *Masséna*, an obsolete ironclad. These two ships were sunk, end-on to one another, at the end and in continuation of a stone pier, thus forming a long, continuous breakwater. The action of the current caused the *Saghalien* to heel over on one side; the *Masséna* went down vertically on her keel. The construction of the stone pier was carried out by Somali coolies, the material being conveyed from the quarries at Cape Helles by means of a Decauville railway. The harbour thus had a narrow opening, and there was a depth of eight metres alongside the *Masséna*.

The breakwater stood the violence of the autumn storms better than the piers constructed by the British at "W" Beach, and was of the greatest value in the final evacuation.

The writer describes at some length the evacuation of Suvla and Anzac between December 10th and 20th. The evacuation of Cape Helles, which took place between December 31st and January 8th, was more difficult, as the Turks had been forewarned. The same arrangements and subterfuges were, however, successfully adopted. The French embarked first, and the 16,000 British, with their guns and animals, followed later. Thanks to the eight-metre depth of water, the transports from Mudros were able to moor alongside the *Masséna*, and this fact was of the greatest value in hastening the embarkation.

The writer ends with the remark: "The splendid organization, British discipline, weather that remained favourable almost to the last, all combined to bring about the success of a gigantic operation, unique in military history."

2. Lieut.-Colonel Lobligeois continues his "Réflexions sur la Fortification Permanente."

In the tenth chapter he deals with the case of works on level dry ground, and in the eleventh with works on level waterlogged ground. Drawings are given of a suggested type of fort. The work is triangular in plan, and is surrounded by a flanked ditch. In section it consists of three underground galleries: the upper one serving the gun and machine-gun turrets, observation posts, etc., located above it:

the middle gallery contains kitchens, expense magazines, machinery, etc.: while the lowest gallery contains water tanks and high explosive ammunition.

In the case of waterlogged ground it will be desirable to raise the level of the whole work. The ditch will, as a rule, be full of water. The difficulty will be to keep the underground communications dry, by lining the tunnels with concrete or steel tubing. The cost of such lining will be very heavy, hence the necessity for reducing underground communications to a minimum.

3. Major Prétat has written a note on a furnace for heating iron wheel-tyres, costing 1,500 francs, most of which represents the price of fire-bricks. A working party of 8 men was able to heat and shrink on 58 tyres in six hours of effective work. Three-hundred kilogrammes of fuel were used, consisting of sawdust and shavings collected from the workshops.

4. "Les Communications radio-télégraphiques dans l'Armée." This is a translation of an article in the *Rivista d'Artiglieria e Genio*.

In radio-telegraphy the wave-lengths least suitable for transmitting messages over long distances from powerful broadcasting stations are those best suited for work in the field. Wave-lengths varying from 100 to 400 metres are those least favoured by broadcasting stations, and for work in the field it is suggested that the limits of wave-lengths should be between 60 m. and 1,500 m. The maximum distance that such waves would be required to travel would be 1,000 kilometres, and as a rule, it would be very much less.

After describing the system of distribution of radio messages adopted in the Italian Army, the author points out some innovations that have been adopted.

Accumulators and dynamos have been entirely done away with and have been replaced by dry batteries. These have been found most economical and satisfactory.

An Italian firm has recently turned out a type of generator worked by hand, that is found to be very useful as a stand-by.

Experiments have also been made with radio-telephony, which has the disadvantages of having a shorter range, of requiring a more complicated apparatus, and of being less secret than radio-telegraphy. It is usual to adopt different wave-lengths for transmitting and receiving messages.

An instrument was exhibited at the Civil Engineers' Exhibition that records Morse signals on a strip of paper in the same way as an ordinary telegraph instrument. Such an instrument would be of the greatest value in the proximity of batteries in action or of bursting shells, where the noise would otherwise make reception impossible.

A.S.H.

CORRESPONDENCE.

THE PRINCIPLES OF COMBINED OPERATIONS.

The Editor, *The R.E. Journal.*

DEAR SIR,

I have read with very great interest the article by Brigadier W. G. S. Dobbie, C.B., C.M.G., D.S.O., *p.s.c.*, on "The Principles of Combined Operations," published in *The R.E. Journal* of December, 1931. Without in any way disputing the principles laid down in this article, I cannot help feeling that the practical difficulties attending a landing on a hostile coast have not been given sufficient prominence by Brigadier Dobbie. I should like, if I may be allowed to do so, to call attention to some of them.

Secrecy.—A landing on a coast can only take place under suitable weather conditions, and under unfavourable conditions, it may be necessary to wait for days after the expedition is ready to move off before a landing is practicable. I believe it is correct to say that, unless the coast to be landed on is within some hours' steaming of the base of operations, a place of assembly within that distance will be almost essential, for example—Mudros, for the Dardanelles.

If the enemy have an air force, they may easily discover any such concentration of ships comparatively close to their shores.

Night landings.—I understand that the Navy may have considerable difficulty in hitting off any particular beach in the dark. The results of overshooting the mark were well illustrated in the confusion after the landing at Anzac in the Dardanelles.

The plan.—When we consider the plan for the actual landing, the difficulties appear to increase.

Presumably a landing cannot be carried out at the port required as the subsequent base because it is defended. As part of the defences of the port, there may well be a submarine or destroyer flotilla. If this is the case, we are at once up against the problem as to what will be the safe distance from that port at which the Navy will guarantee an uninterrupted landing for the expeditionary force, and for how many hours that guarantee will hold good.

It would appear that in some cases the distance may be such as to make the subsequent capture of the port itself by any *coup de main* virtually impossible. Furthermore, if the enemy have an air force equipped with torpedo-carrying aircraft, the selected landing-place may have to be as much as 150 to 200 miles from the defended port, and in some cases a battle for air supremacy may be a necessary preliminary to any landing operations at all.

As regards the actual landing itself, it would seem most unwise to assume that it will be unopposed. In view of the disastrous results of a repulse, everything ought to be organized on the basis of an opposition at least equal to that offered by the Turks at Helles and "W" beaches, *i.e.*, by infantry well equipped with machine-guns.

A reliance on covering fire from ships to support the actual landing would also appear to be misplaced. The Dardanelles Commission, I believe, came to the conclusion that any preliminary bombardment was a mistake, on the principle that not only was it comparatively ineffective, but that it also gave warning of the attack. As an attack at dawn would appear to hold out the best prospect of success, in any case any such bombardment could not be accurately directed. We are, therefore, faced with a demand for close support fire when the attacking boats are within, say, 200 yards of the beach. It is precisely then that naval guns with their flat trajectories are useless. As the light improves, and the advance progresses, they will, however, be of distinct value in engaging enemy batteries, which will have disclosed their positions by then.

I was also under the impression that the policy of sending men in open boats to land on a beach defended by machine-guns had been for ever abandoned as absolutely suicidal.

If it is worth while sending an expedition to land on a hostile coast, it must surely be worth while taking every possible precaution to make that landing a success under the most adverse conditions. In other words, if tanks are essential for a landing against machine-guns, we must have them, and we must have self-propelled lighters with collapsible bows, sliding and dropping gangways, or something similar, to carry them. There is no great engineering difficulty in the matter; and it is quite probable that certain experiments have been carried out in this direction. Again if close artillery support is required, we must have floating batteries of howitzers, moored, if necessary, behind protecting hulks, or something similar; or alternatively howitzers installed on the decks of naval craft.

We sacrificed one old boat, the *River Clyde*, at Cape Helles, but made the mistake of using it as an assaulting starting point for men. There is no reason, however, why two or more similar ships should not be sacrificed in a similar way, but they could be fitted as machine-gun posts or with mortars for close support of the actual landing, and filled with stores which could be landed by aerial ropeway as soon as a footing had been established.

I am not pretending to offer any solution to the tactical problem of an opposed landing, but I feel that the steps required to make any such landing a success are far more elaborate and involved than those outlined by Brigadier Dobbie in his article, and furthermore, that many of them will involve work which we as military engineers might do well to study, as they may fall on us to carry them out.

Yours faithfully,

G. B. O. TAYLOR, *Lt.-Col., R.E.*

NORTH WESTERN RAILWAY PORTABLE TYPE STEEL ROAD BRIDGE SPANS.

North Western Railway,
Headquarters Office,
Lahore.
14th January, 1932.

The Editor, *The Royal Engineers Journal.*

SIR,

I forward a note by Mr. Everall, Deputy Chief Engineer, Bridges, of the North Western Railway, as regards the Road Bridge Spans referred to in Lieut. Anderson's article in the December, 1931, *R.E. Journal.* This clarifies certain points as regards the design and fabrication. Mr. Everall has for years acted as advisor to the Military Engineering Service as regards girders for road bridges in the Northern Command and in the North-West Frontier Province.

This type of road span has been designed specially to meet conditions on the Frontier, and tables have been prepared giving the numbers of each item for each span and their weights. When a Frontier hill road is required urgently and no detailed survey is available, arrangements can be made in advance for girders by estimating total length of span from a map. This design was worked up from a request by Colonel (now Brigadier) Haswell for the design of a light type girder bridge which could be carried to site by camels.

W. MACRAE, *Lieut.-Colonel, R.E.*,
Chief Engineer, North Western Railway.

Lahore (India),
14th January, 1932.

DEAR SIR,

I read with pleasure the interesting article on "Bridging on the Chitral Road, with special reference to the N.W.R. Portable Type Steel Bridge," by Lieut. W. F. Anderson, which appeared in *The Royal Engineers Journal* of December last. May I ask your indulgence to publish a few remarks in the *Journal*, on my design of portable type bridge spans, which was adopted for the bridging on the Chitral Road.

These girders were the first of their kind to be built and tried out, and from the experience gained in their construction, certain details have since been considerably improved and simplified in order to give speedier assembly and erection in the field and a greater degree of interchangeability of the unit members. Quite recently a 112-ft. through-type span, with a 12 ft. width of roadway, was erected across a gorge, about 60 ft. deep, on the Abbotabad-Mansehra Road; the time taken to complete the steelwork for this bridge was 12 days. The work was successfully carried out by a gang of 10 ordinary Indian bridge *khallasies* (erectors), assisted by 30 of the local villagers, the latter had probably never seen a bridge erected before, and were sometimes more of an embarrassment than a help. From what I have seen, a well-trained Sapper and Miner Company should complete a span of this size in about 24 working hours.

Mention is made of the cost of the steelwork for this type of girder; this depends to a great extent on the number of spans required and the tonnage involved. Manufacturing girders in large quantities by mass production methods would considerably reduce the cost. The rate in India may be taken as £6 per foot run (Rs. 215 per ton), loaded into trucks at the place of manufacture, to this must be added the cost of rail transport to railhead, and then onward by road to the bridge site. The cost of erection at site, under fairly normal working conditions, should not be more than £1 10s. per foot run in India (Rs. 53 per ton).

The latest designs prepared include both deck and through-type

spans, ranging in lengths from 56 ft. to 120 ft. and increasing by increments of 8 ft. Provision is made for a 12 ft. clear width of roadway, and the girders are capable of carrying the following loads:

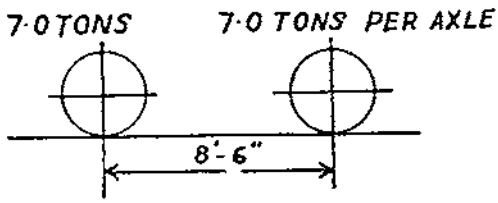
(1) British Engineering Standards Association loads x 6 units,

or,

(2) Table " F " of page 199 of *Military Engineering*, Vol. 3,

or,

(3) Single unit vehicle or tank of the following limiting weights and dimensions.



All the spans are made from the same interchangeable members throughout, and the connections are made with $\frac{3}{4}$ in. diameter bolts in two lengths. The members have all their holes standardized for the connections, and this is done on accurately made steel jigs and templates and by careful check gauging, thus ensuring that the parts are all interchangeable. The units are limited in size and weight to be within the carrying capacity of mules and camels.

For spans above 80 ft., bearings with rocker pins at both the fixed and expansion ends are provided. These bearings are robustly constructed of structural steel sections, riveted and welded together. The fixed and free bearings are of the same type and interchangeable, except that *shim* packings are inserted between the inner faces of the bottom frame and the link in the case of the fixed bearing. Supports for the spans, in the form of trestles where the height and conditions are suitable, can be built up from the standard units, or it may be possible to devise simple steel box cribs with the same members, on the lines suggested by Colonel Martel in his article, in the December issue of *The R.E. Journal*, entitled " Further Notes on the Roorkee Pattern Steel Crib."

Yours faithfully, W. T. EVERALL,
Bridge Engineer, N.W.Rly.

WATER SUPPLY IN THE FIELD.

A REPLY TO THE ARTICLE ON PAGE 61.

The Editor, *The R.E. Journal.*

DEAR SIR,

Lieut.-Colonel Sayer's article on Water Supply, which appears on page 61 of this number of *The R.E. Journal*, is more in the nature of an amplification of my original article than a criticism. It is a very useful amplification because it deals at some length with points

which I had omitted, and I think that many of us will agree with a good many of these points. At the same time there are a few criticisms in this article which I should like to answer.

In the first place I should like to clear up one point which many officers will not have realized. My original article was written after I had spent some nine months at Roorkee, and had seen this system at work in the field under various conditions. This was during the winter of 1929-1930. At that time I do not think any field units at home had any means of raising water from a depth greater than that of the capability of a lift and force pump. Although some experimental work had been done, the field units at home had no authorized power-plants for pumping, and it is no exaggeration to say that they were a long way behind the S. and M. units in water supply equipment. My article had then to be censored and slightly altered in India and then sent home to wait for a place in *The R.E. Journal*, and it did not appear in print until March, 1931. By that time some further progress had been made at home, and when the article appeared it may have seemed somewhat critical.

I can see no harm in this. Surely it is sound to learn all we can from other people. Personally I learnt a great deal from my service with the Bengal Sappers and Miners, and I am not in the least ashamed to own it. The article put the Indian view before home service readers, and enabled them to study it; I do not think there is much doubt that at that time India was ahead in this subject, but I entirely agree with Lieut.-Colonel Sayer that there is no reason why the home service should not go one better.

Taking Lieut.-Colonel Sayer's article as a whole, there are only two main criticisms to answer. The first is the question of the general equipment of a home service field unit. Everyone will agree, of course, that this equipment should not be specially selected for India, but the equipment should surely be of a type which is best suited for warfare in any country. There are several countries abroad in which the B.E.F. might have to fight, and in which *all* the water in a divisional area may be over 30 ft. deep. Often these deep wells will not yield 3,000-4,000 gallons an hour, as Lieut.-Colonel Sayer points out, but that is all the more argument for having a larger number of water elevators so that as many wells as possible can be tapped.

The second criticism is on the design of the Indian pattern combined water elevator and pump.

First of all as regards the engine. I pointed out the advantage of the long life of a Petter engine compared with the possibly short life of the small high-speed engine. At the time that the units were equipped with these sets in India (1927-28), no small high-speed engine had been found which would stand up reasonably well to the conditions in India. Lieut.-Colonel Sayer points out that this engine is carried in the lorry, which itself has a high-speed engine, but this statement is misleading. The lorry engine is a 16 h.p. rating engine

which is normally used on the level to develop about half that power, or even less. This has no comparison to a 5 h.p. high-speed engine which is asked to develop full power for hours on end. In the case of the lorry engine the bearings are fairly large and normally only half-loaded; in the case of the small high-speed engine using full power, the bearings are usually small and loaded very high. This is not to say that no suitable light high-speed engine can be produced to carry out this work; apparently the engine now proposed at home for this work fills the bill. No one wants to carry a heavy engine if a light one will do the work, but it should be remembered that these engines are only used for short periods and under good conditions at home, whereas they are used for very long hours and under the worst conditions abroad.

The next point is the combination of pump and elevator. It is nearly always necessary to use the pump to distribute the water from the spill tank of the elevator, hence although the pump can be used alone for shallow water, the elevator is seldom of any use by itself. I agree that there are advantages in having the two as separate units, but it is obviously a disadvantage to have to use two power units every time you establish a water point which needs the elevator. After all, the combined unit is not so very cumbersome when used as a pump only. When the elevator belt is left in the tool cart or lorry the combined unit only has "a pulley and a piece of casing" in addition to the pump. It is always important to keep to commercial patterns as far as possible, but without departing from the use of a commercial engine, pump and elevator, it would still seem possible with a little rearrangement to produce a light handy set in which you have one engine and can use this to drive either:

(*a*) A centrifugal pump,
or (*b*) An elevator,
or (*c*) A combination so that the pump distributes the water from the spill tank of the elevator.

Although it happens at times, I do not entirely agree with Lieut.-Colonel Sayer when he says that you often want to be able to use the elevator at one point and the pump elsewhere. In Eastern countries, which are the most important from a water supply point of view, the water in an area is usually either deep or shallow, and I do not agree that deep water is rare or very unusual in Eastern countries.

Lieut.-Colonel Sayer suggests that my original article was written to promote discussion. This is exactly what it was meant to do; apparently it has succeeded, and now that the whole subject is being thoroughly examined, we can rest assured that all these points will be thrashed out and that the R.E. Board will produce the best possible equipment for our use.

Yours, etc.,
G. LE Q. MARTEL, *Lieut.-Colonel, R.E.*

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.*]

GENERAL SIR CHARLES PASLEY, K.C.B.

THE articles which have been appearing on the above subject in *The Royal Engineers Journal* have been reprinted in pamphlet form, and can be purchased from the office of the Secretary, Institution of Royal Engineers, Chatham, price 1s. 6d. each.