The Royal Engineers Journal

VOL. LIX MARCH, 1945

CONTENTS

Published Quarterly by
THE INSTITUTION OF ROYAL ENGINEERS
CHATHAM, KENT
Telephone: Chatham 2669

AGENTS and PRINTERS: W. & J. MACKAY & CO., LTD., CHATHAM.
LONDON AGENTS: HUGH REES, LTD., 47, PALL MALL, S.W.1.

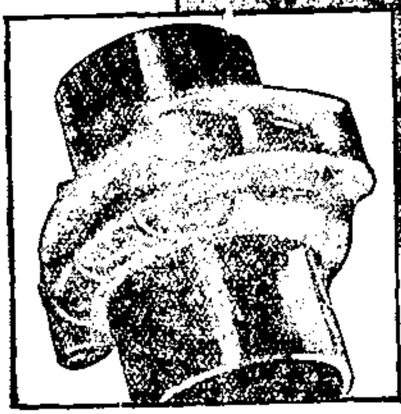
THE ROYAL ENGINEERS' JOURNAL—IV. 1945. Pages 1—74.

PIPE LINES WITH VICTAULIC FLEXIBLE JOINTS FOR SERVICE WORK. The ideal joint for emergency purposes. The standard bolted joint can be fitted by unskilled labour in under two minutes per joint. The toggle joint, without bolts, is automatically fastened mechanically in a few seconds.

The War Office and India Stores Department have standardized Victaulic Joints for mobilization work.

Copy of our Victaulic Catalogue will be sent on request.

Air main with Victaulic Joints slung on two steel cables across the gorge of the Hikonege River, Japan. View shows a 200-ft span of 8-in. line.



THE VICTAULIC COMPANY LTD.

Brook House, 113 Park Lane, London, W.1.

THE ROYAL ENGINEERS JOURNAL

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

VOL. LIX CONTENTS MARCH, 1945

THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

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

Patron—HIS MAJESTY THE KING

President

Lieut.-Gen. Sir Lionel V. Bond, K.B.E., C.B., *p.s.c.*†. 1945

Vice-Presidents

Maj.-Gen. A. G. B. Buchanan, M.Inst.C.E. 1942
Maj.-Gen. H. B. W. Hughes, C.B., D.S.O., O.B.E. 1945

Elected

Col. H. W. Tomlinson 1942
Col. E. E. B. Mackintosh, D.S.O. 1942
Lieut.-Col. F. L. Stroud 1942
Col. B. C. T. Freeland 1943
Brig. G. E. H. Sim, D.S.O., M.C., *p.s.c.*† 1943
Brig. J. R. T. Aldous, M.C., *p.s.c.*† 1943
Brig. H. H. Bateman, D.S.O., O.B.E., M.C. 1944
Col. J. L. Lishman, D.S.O., T.D. 1944
Brig. B. K. Young, C.B.E., M.C. 1944
Lieut.-Col. G. E. H. Philbrick 1944
Brig. B. C. Davey, C.B.E. 1944

Ex-Officio

Col. W. D. Robertson, D.S.O.
Brig. H. T. S. King, O.B.E.
Maj.-Gen. D. J. McMullen, C.B., C.B.E., D.S.O., M.I.Mech.E.
Brig. F. C. W. Fosbery, *p.s.c.*†
Brig. H. E. Hopthrow, O.B.E., M.I.Mech.E.
Major D. C. Cameron
Lieut.-Col. G. T. H. Capron

Corresponding Members

Maj.-Gen. T. R. Williams, C.M.G., D.S.O., *Australian Staff Corps* ... 28th January, 1930
Lieut.-Col. W. H. Blake, M.C., *Royal Canadian Engineers* ... ... 15th June, 1943
Col. G. H. Cotton, O.B.E., M.I.Mech.E., S.A. *Staff Corps* ... ... 7th June, 1939
Col. G. H. Clifton, D.S.O., M.C., *p.s.c.*†., *N. Zealand Staff Corps* ... 27th July, 1937

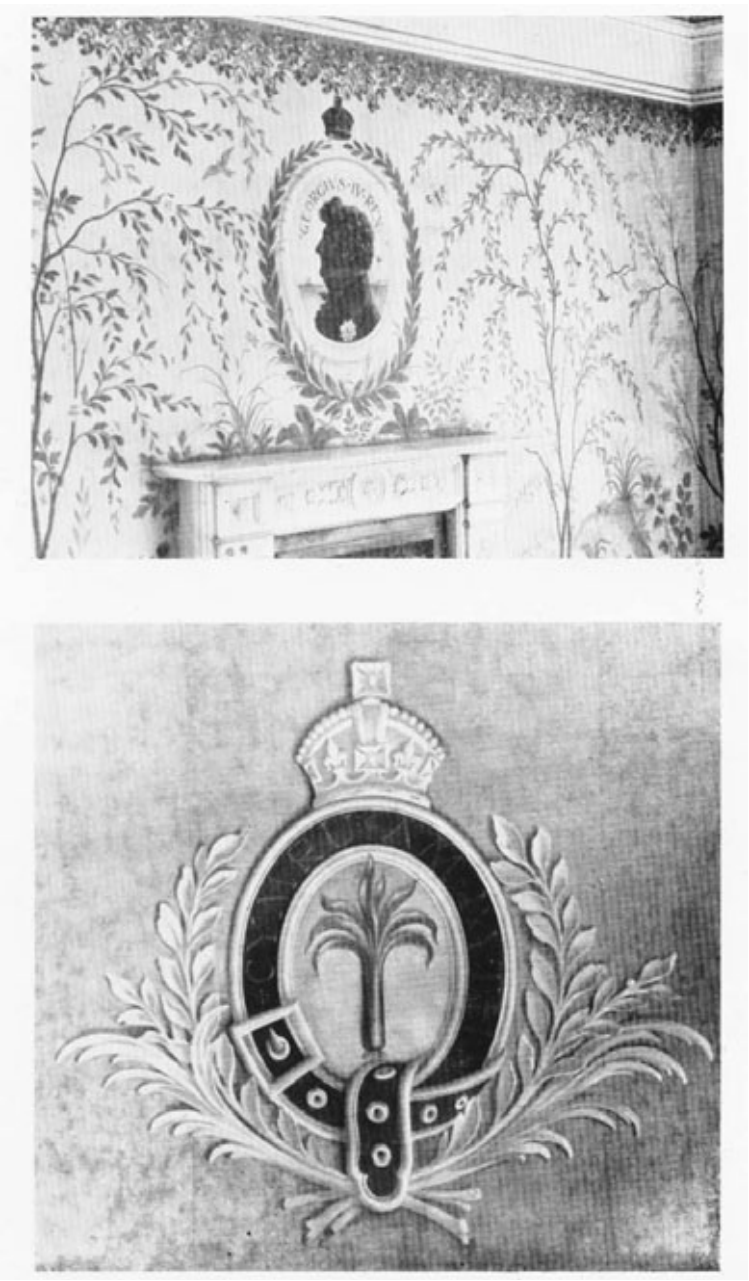
Secretary and Editor R.E. Journal :

Brig. C. C. Phipps, C.B.E., M.C. ... ... 13th January, 1945

Bankers

Lloyds Bank, Ltd., Cox's and King's Branch, 6, Pall Mall, S.W.1.

2,350 1.3.45.



A unique case of 'Barrack Damages'

A UNIQUE CASE OF "BARRACK DAMAGES"

By Lt.-Col. A. Slater, R.E., M.Inst.C.E.

WHEN the Welsh Guards recently moved overseas they passed through Sussex and for a time used a requisitioned building as a Mess. Among their officers was the late Lieutenant Rex Whistler. In his spare time he apparently set about decorating an otherwise somewhat ordinary and drab room with examples of his genius. Two of these have been photographed and are reproduced here.

The first illustration shows a plaque of H.M. George IV on the South wall: it measures approximately 3′ 6″ × 3′ 0″ while in addition the whole wall and part of the West wall have mural decorations over the plain wall-paper.

Perhaps the second illustration, the crest of the Welsh Guards on the East wall, is the most striking of all the decorations. This measures 5′ 9″ × 5′ 0″, and is done in blue and white. The motto and the leek being gilt. So delicately have the lights and shades been treated that in actuality it stands out like a plaster cast even with the eye at a distance of 2 feet. One has to touch it with the hand almost to realise that it is flat. The illustration also gives this effect but not perhaps to the same extent.

The above are both dated June 5—7 1944.

Lieutenant R. Whistler was not only a great artist but a very gallant and experienced officer. He joined the Welsh Guards on the 17th May, 1940, and served with them until his death. No doubt he could, with his talents, have easily chosen other work than that of regimental officer, but his heart was with his regiment and his men, and nothing would have induced him to leave them.

He was killed in action in Normandy in July, 1944 and two obituary notices appeared in the "Times" on July 31st, 1944, by Mr. John Gielgud, and another by Sir Osbert Sitwell on August 7th, 1944.

I think it may be said that seldom, if ever, has a Garrison Engineer had to cope with a "Barrack damage" of such distinguished genius.

THE PLANNING AND CONTROL OF WORKS SERVICES

By Col. E. S. de Brett

Foreword

The original article, which was much longer, was written by Col. E. S. de Brett as a useful form of occupation during a period of temporary inaction. Paper restrictions have compelled the Editor to publish it in the following reduced form, a précis of the original.

THIS article is an attempt to show how our military training can and should be applied to the planning and execution of Works Services. It is a matter of common agreement that in this war engineer problems have a greater importance than ever. Much is heard of engineer feats in the field but very little of the Works Services, although they are a major item when the timing of an operation is being considered. Failure to complete a Works programme to schedule may wreck an operation through loss of surprise, through inability to build up sufficient reserves of men and materials, or pass them through the base and assembly areas at an adequate rate.

Works Services take time to plan and carry out. Great forethought and careful planning are needed at all stages or they will be completed too late. Therefore careful reconnaissance and a well devised plan are as necessary to a Works Programme, or an individual project, as they are to any other military operation.

Terrible examples could be quoted of projects abandoned for lack of labour, unfinished for lack of stores, unwatered or flooded through ignoring local knowledge, completed too late to be of use, delayed unnecessarily for want of co-ordination between the agencies at work, and costing the moon when they should have cost sixpence, all for the lack of a PLAN.

Strict economy of labour and materials, and strict control of the volume and progress of work undertaken, is imperative during wartime stringency, and demands a sound "Works" plan.

The drill required to prepare the plan and effect control is the same as in any military operation namely :—Reconnaissance, Appreciation, Operation Orders, Intelligence Reports. These are essential at every level throughout the organization, though the amount of detail and type of information varies with the degree of control which can be exercised. Without them, chaos, followed by a blot on the escutcheon of the Corps, is certain.

Reconnaissance

Time spent on this should be invaluable, but it is so often wasted because people do not know for what they are looking. The information needed obviously depends on the problem to be solved. For instance, in determining the force required to carry out a mixed programme of works it is essential to know the "scale type" of construction, the cost per head for accommodation, etc., and the value of the output of the type of labour available. The exact size and location of individual installations probably does not matter and the

output of any particular trade is immaterial, unless there is a known shortage likely to effect overall progress.

Alternatively the determination of the force required for an individual installation involves an accurate knowledge of the type and quantity of every grade of work and the probable output of every trade, to ensure the building up of a balanced labour force, i.e., decide upon your needs before starting your reconnaissance. To do this decide first on the object in your appreciation and the factors which are likely to be relevant, and thus avoid chasing red herrings and the loss of time and energy involved therein.

It is difficult to amass all the information needed to complete these factors, which will even more rarely remain constant after your plan has been made. Therefore fill in the gaps by making intelligent guesses and labelling them firmly as assumptions, before weighing the factors as a whole.

The Object

The definition of the object is as important as the definition of the target in calling for fire from the artillery, and consequently it is, generally, as impossible for the engineer to define the object without reference to the user as for the gunner to shoot without the help of the infantry. The user must say whether the main plan depends on the date by which the whole programme can be finished or on the amount which can be done by a certain date. It is *vital* to tie the user down to a very definite statement of policy at this stage or you will be chasing each other round in circles.

Factors

Avoid irrelevancy in the selection of factors. After each statement of fact a definite answer must be given to the question "So what?" which may depend on the answer for another factor. For example, the possibility of delay in completion, owing to shortage in a particular trade, may depend on the date by which delivery of their special stores may be effected. So beware of rash conclusions and make sure that a factor which you have knocked on the head does not come to light again under the influence of a new one.

The process of weighing the factors is most important in the making of a plan, and remember that the plan of the staff depends in no small degree on yours. See to it, therefore that the weights are true, neither short by undue optimism nor burdened with over caution. The former will mean that you will fall behind schedule, the latter that you will be ready too early, a very rare occurrence, and in that case the plan might have been launched earlier.

Be strictly honest with yourself during this stage. Don't imagine that your labour will work faster than average, that you will experience nothing but fine weather, that your transport and plant will never break down, and so on. Paint a realistic if sombre picture, which the user may at first dislike, but whose colours are fast.

Avoid at all costs :—*Alternative Plans*—which are not so at all!

They give rise to a number of pros and cons which require a reconsideration of the factors to give them their correct value. The book tells us not to put up alternatives for the sake of knocking them down—a worthless alternative should never even occur to you if you have done your thinking logically.

The *genuine* Alternative Plan is a very rare article. It implies two equally good plans after the right weight has been given to proper deductions from all the factors. Therefore scrutinize the alternatives closely to ensure that a factor is not missing or that a deduction is not false.

The Plan

There are four essential parts to a Works Plan, namely :—
A Priority List.
A Work Table.
A Stores Table.
A Transport Table.

The priority list will depend on both user and engineer considerations. The former is more likely to predominate in a large programme and the latter in building a specific project. The user may regard the completion of one section of a programme as first priority, but this may not be possible owing to a bottleneck in some store, or the uneconomical use of labour by such concentration. In effect the priority of work in an individual project must depend mainly on engineer considerations, tempered by the users early need of a certain portion. There should be no argument about it, provided the factors have been properly assessed and the correct conclusions drawn.

It is always as well to get the user in on your appreciation early, i.e., during the " consideration of factors " stage. Otherwise you may be forced to change the priorities after the plan has been launched. It may happen that the factors change after work has begun, in which case an alteration in priorities will be inevitable. Such a change, however, is equal to a calamity and every possible precaution must be taken to avoid it.

The Work Table is the most important part of the plan. It covers the conclusions reached from the consideration of all factors, incorporates the priority list, and is the basis for working out deliveries of materials and transport requirements. From it you make up the Progress Charts, and the map for plotting changes of course, dictated by alterations in factors during the work ; without such a map you will end in a bog.

The stores and transport tables are really corollaries of the Work Table but are a very necessary part of the plan. A shortage in either stores or transport may call for an alteration of the work table and the whole must be co-ordinated.

It is essential that the degree of detail be commensurate with the amount of control which can be exercised. This depends on two considerations :— the time lag between order and action by the man on the job, and the amount of staff at your disposal.

Control

In order to know how the plan is going once it is launched Intelligence Reports from your subordinates become essential. In framing the form of these never ask for more information than is necessary ; it only makes work and may lead to worry over matters which are not your direct concern. Make sure, however, that full details are recorded at the proper level, so that when things go wrong the facts can be analysed and the fault put right ; to compare the information in your reports with the requirements of your plan, progress charts are required. These must compare FACT with FORECAST, for the days of estimate, guessing, rule of thumb, etc., are over. Work is now in hand, it can and must be measured and recorded against your plan, or forecast ; otherwise you will be living in a land of dreams and will eventually wake up to reality with a rude shock. Also you must be able to compare the actual labour and materials used with those planned ; labour is probably best shown in a graph, and materials in a simple ledger.

There are many methods ; the best is one that shows exactly how you stand and, what, if anything, is wrong.

The need for control of this sort when Military or Directly employed labour is being used is obvious; but there may be some doubt as to the amount of control necessary for work done by contract. In times when there is a shortage of labour and material there must be high level control to ensure that the contractor will get a fair crack of the whip when the contract has been placed. In order to make the high level control effective, progress reports are essential with work tables and appreciations.

The contractor is responsible for the detailed administration and control of the work, but a supervising officer cannot carry out his duties properly unless he knows how the job ought to be going, which means working out details as a whole beforehand. Otherwise the S.O. will spend most of the time during the job working it out in bits and pieces, and never being quite sure where he left off last.

Moreover, the time taken to prepare these tables is small compared with the time spent on design, layout, drawing, bills of quantities and so forth. The B. of Q. supplies the data for your stores list, and, with the aid of any book of labour constants, for your work table—the progress Chart becomes simply a draughtsman's job direct from the "Work Table."

In the working of any system of this kind remember the "law of the swings and roundabouts." Estimates of time and labour will never be accurate. Don't let this depress you. The estimates have been worked out on quantities which may have to be varied as work proceeds, and with labour constants which are averages for varying skill and varying weather and site conditions. The availability of certain labour has been assumed which may not materialize, but you should have allowed a certain safety margin for unforeseen contingencies, and it is very unlikely that all the errors will work against you. Therefore don't panic if the actual rate of progress falls below that planned, hold your horses, find out the cause, and look back to your tables. It may be necessary to speed up supply, and readjust the order of work; or possibly the rate of progress has been wrongly assessed and the work will go faster at a later stage. Only when the limit of elasticity has been reached is there need to consider altering completion dates or shouting for help.

The type of Table in Fig. I (see Folder at end of article) is based on the assumption that the output of labour is £50 a man month, and a broad idea of the maximum number of men employable on the job at one time.

For instance, serial A2 can be pushed through in eight months at the rate of £60,000 odd a month because machinery can be massed to polish off clearance, levelling, and roadwork quickly; after which hordes of men can rush at it and slap up Meccano huts. On the other hand, Serial B2 involves much tricky and skilful work and the seven months shown is probably optimistic.

Priorities are a matter after consultation with all users, but the starting dates are an E problem. Serial B2 cannot start before February because a contract cannot be placed in time, or B3 before April because there will be no labour, and so on.

The progress of each project expressed as a percentage, and number of men employed on the last pay day of the month, are reported direct to District, Command, and W.O. by the man on the spot. As a job goes on so the rate of progress can be better judged and the forecasts become more accurate. Labour is allocated individually to these jobs. Military labour is shown separately.

Similar tables are made for jobs between £2,500 and £20,000. These are recorded individually but commands are given a bulk allocation of labour to cover them together with jobs under £2,500 and maintenance, with an indication of the amount allowed for each in the W.O. Calculations. The same

is done for each command and on the whole total must be written the allocation from the Ministry of Labour. The inaccuracies in this method are many and obvious, but it serves its purpose in preventing the pattern being too big for the cloth; a more accurate control would be uneconomic as regards staff.

The "Stores" control at this level consists in warning the supply branches of the bulk requirements by commands. The supply branches then place orders for articles which take a long time to produce or of which stock is low. Transport control is of the same order but is rarely a bottle-neck at this level.

Analysis, without which all the preceding become waste paper, gives actual output per man when final costs are known and a check is kept on the output figure for forecasting.

A similar type of control is all that is possible at Commands and Districts, but each will want to know more about the lower value jobs for administrative purposes. They can also effect a closer control on stores through their Central Accounting Organization. Considerable improvement in labour forecasts and allocations can be made by forecasts based on work tables.

As regards working out a job in detail, take Serial B3, Fig. I which has hitherto appeared as a single line for labour and possibly a few entries to earmark special stores. The requirements, layout and type of construction having been agreed by R.E.M.E., who should sign on the dotted line, detailed drawings can be prepared and quantities taken off.

The type of Work Table in Fig. II must be calculated to give the length of time and the labour force required, for contract work it serves as a useful guide to the contractors efficiency, through the weekly or daily, allocation of labour in his job.

Calculations must show the details of plant, skilled and unskilled labour, for each part of the job. Serial 9 of Fig. II would be somewhat as follows:—

(i) Headwalls for culverts and manholes x bricks @ 400 bricks man day $= \frac{x}{400}$ b'layer days.

(ii) Retaining Hut and Shed Founds y bricks @ 800 bricks man days $= \frac{y}{800}$ b'layer days.

(iii) Lats and Ablns z bricks @ 600 bricks man days $= \frac{z}{600}$ b'layer days.

Total—500 b'layer days & 580 Labourers = 1080 man days.

Next come the calculations for the Work Table. First consider every tradesman's work, but whether the result be recorded right down to tradesman's operations, or grouped by buildings or sections of the work, depends on the control that can be directly exercised.

Priorities have already been decided in the appreciation which you will have to face if not already done. From your appreciation you know whether men, time, or numbers workable on the job is the limiting factor and so the time or numbers for each section of the job can be determined. It is then a perfectly simple matter to fill up the Table in the logical order for carrying out the job. Then decide the dates during which each section will be built and order your Stores and Transport accordingly.

It will be seen that Figs. I and II show a considerable difference. The output of £59 per man month instead of £50 is probably due to the large

amount of machine work in serials 1 and 2 and the big proportion of expensive shedding. Actually £50 man month is rarely correct but is a good average.

The progress Charts, are made directly from the Work Table and its calculations. In this case there are two methods of tackling measurements and progress, i.e. :

(*a*) By keeping Trades separate as in the example. This would probably be the better on a civil job, where it is necessary to know when to take on or lay off tradesmen.

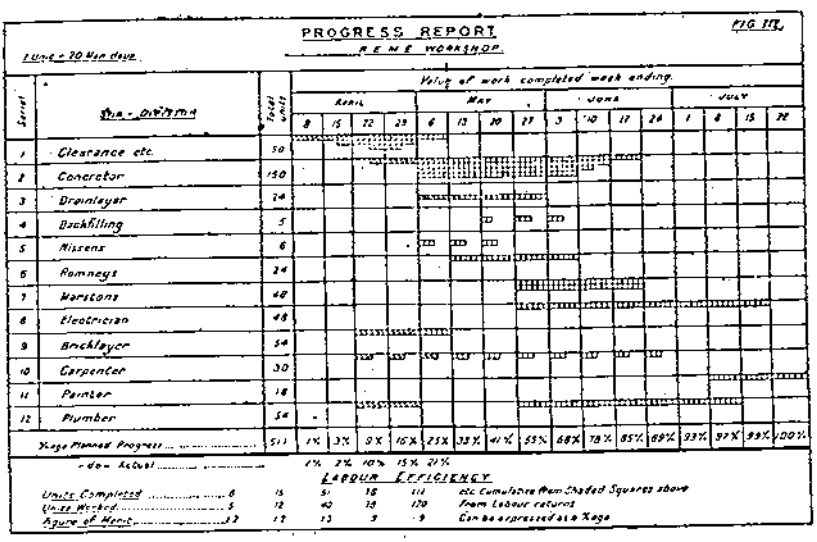
(*b*) By dividing the project into its components, i.e., store sheds, offices, workshops, etc. and adding together the relevant trade man-days for each from your calculations. This is probably better when the work is to be done by a R.E. Coy., who may allot a part to each section which has a fixed number of tradesmen, or by contract.

The first essential is to choose the period and unit of measurement. The period must be short enough to prevent errors taking charge and not too short to become a labour. Once a week will generally be suitable on a job of this size and duration. The unit should represent an amount of work easily measurable by inspection, though this is not so important in a contract job if measurement is really kept up to date.

In D.E.L. work, particularly with military labour, the best unit is a number of man-days and in this case 20 man-days looks reasonable, giving a total of 511 units.

In contact work, where the value in £-s.-d. of every item is known, money is the best and here £100 is probably about right, giving a total of 250 units.

Treating this job as a D.E.L. civil job, and keeping tradesman's work as the sub-division and 20 man days as the unit, you can draw a progress chart as in Fig. III. Each little square represents 20 man days *worth* of work. The total number of squares opposite a sub-division in any week being the value of any work you plan to do in that week.



Now you also know the make up of the sub-division from your calculations. For instance, the Bricklayers work might be :—

(i)	Headwalls and manholes	6 units
(ii)	5 Nissen founds.	5 ,,
(iii)	2 Romney ,,	8 ,,
(iv)	Ablns.	10 ,,
(v)	Lats. and so on up to the total	10 ,,

These must be extracted and tabulated for the benefit of all because it is " the Bogey for the course," and forms the basis of the score card or measurement card which must be kept on the site. It should be entered up daily and checked weekly.

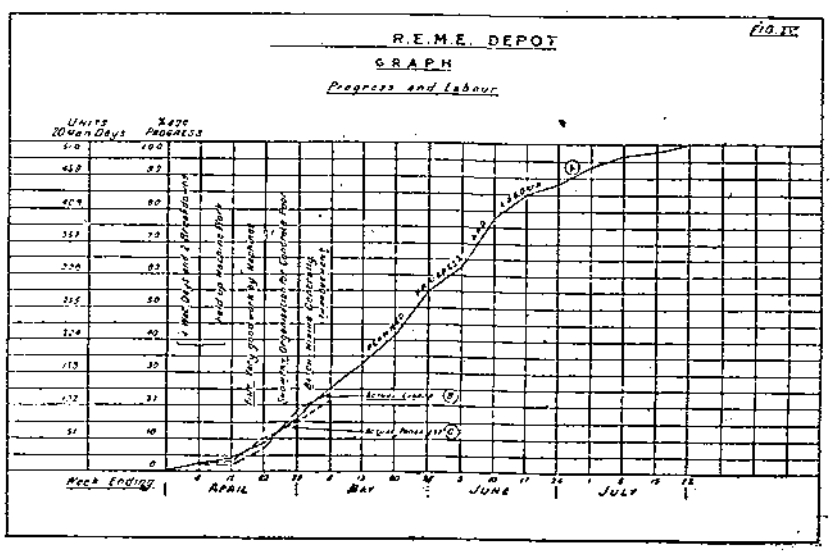
Checking measurement is simple, as the pieces making up each sub-division are small enough to make completion the only criterion in most cases. The " Bogey value " of work completed each week is shaded-in and the percentage of the job recorded.

Dividing the Bogey by the number of man units worked (taken from the labour returns) gives the figure of merit. Any figure greater than 1 means that the organization is sound and the men are working well. Anything less than 1 means that something is wrong and needs examination. The " Figure of Merit " is a great spur to interest and competition when more than one unit is on the job.

It is generally convenient to record your vital figures on a graph (Fig. IV) which will show the tendencies of progress and labour. The ideal is to keep (B) below and (C) above (A). The main reasons for departure from the planned rate can be noted each week. The state of affairs on May 6th gave no cause for alarm.

NOTE :—It is very interesting to read the above article in conjunction with the Ministry of Works pamphlet, 1944 :—

> " Programme and Progress " which deals with the preparation of charts for building contracts.



WAR OFFICE WORK TABLE

PROJECTS OVER £20,000

FIG. I
20th December

WESSEX COMMAND — *CIVIL LABOUR*

Serial A	Description Projects in Hand	Value £	Man Months	Labour Required During Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.
1	. . . . . 600 Bed Hospital . .	150,000	3,000	400	250					(5 mon	ths gon	e)
2	. . . . . Depot	500,000	10,000	1000	1500	2500	2000	1500	500	(2 „	„	)
3	. . . . . 500 Camp	30,000	600	150	250	100				(1 „	„	)
B	Approved—Not Begun	Total A.		1550	2000	2600	2000	1500	500			
1	H.A.A. Battery	40,000	800	100	150	200	200	100	50			
2	A.F.V. Range	80,000	1600		150	300	500	500	150			
3	. . . . . R.E.M.E. W'shp. . .	25,000	500				50	180	220	50		
		Total B.		100	300	500	750	780	420	50		
	Total Over £20,000			1650	2300	3100	2750	2280	920	50		

WORK TABLE

1 *WEEK* = 6 *DAYS*.
1 *DAY* = 8 *HOURS*.

. . . . . R.E.M.E. WORKSHOP

FIG. II

Serial	Sub-Division	Man Days	Men	Days	Men Required During Week Ending April 8	15	22	29	May 6	13	20	27	June 3	10	17	24	July 1	8	15	22
1	Clearance, Levelling, Excavation, Foundations, Drainage, Water-Mains	1000	33*	30	20	30	50	50	10											
2	Concretor	3000	55*	54			10	20	80	80	80	80	80	50	20					
3	Drainlayer	480	20	24					20	20	20	20								
4	Back-filling	108	6	18							6	6	6							
5	Erect Nissens 16′ x 36′ No. 5	108	6	18					6	6	6									
6	Ditto Romneys 35′ x 96′ No. 4	480	20	24						20	20	20	20							
7	Ditto Marston High Sheds 150′ x 45′, No. 2 . .	960	40	24								40	40	40	40					
8	Electrician	960	20	48								20	20	20	20	20	20	20	20	
9	Bricklayer	1080	20	54			20	20	20			20	20	20	20	20	20			
10	Carpenter	600	10	60			10	10	10	10	10	10	10	10	10	10				
11	Painter	360	20	18														20	20	20
12	Plumber	1080	20	54			20	20				20	20	20	20	20	20	20		
		10216			20	30	110	120	146	136	142	236	216	160	130	70	60	60	40	20

*Average.

Average Men/Month — 70 | 165 | 144 | 45

cf. Fig. 1 Serial B.3.

TURA CAVES

By Brig. G. Streeten, C.B.E., M.C.

About 12 miles South of Cairo and 2 miles East of the Nile, near the village of Tura, rises a limestone escarpment some 200 to 300 feet high. The face of this escarpment is studded with openings, some rectangular, some square but mostly of an irregular shape. These holes are the entrances to enormous caverns, whose mouths are largely choked with debris of broken stone. In days of peace they were the resort of that peculiar type of holiday-maker who loves to explore the depths of the earth, crawling on his belly and tearing his clothes in an endeavour to reach the rock wall at the end of a cave. Doubtless one of these suggested the use of these caves for the storage of ammunition as an alternative to the construction of a new ammunition depot at Abbassia.

Be that as it may, the proposal was followed up and a detailed examination of the place was made by the authorities. It was decided that, with a comparatively small expenditure of labour, it would be possible to remove the debris and utilize the caves for this purpose.

Before describing the results of this decision, it may be of interest to consider the origin of these burrows into the face of the escarpment. They are not the work of nature; the vertical and horizontal lines of walls and roof leave no doubt that they have been excavated by man, but they seem to be too regular to have been ordinary quarries.

The caves lie about equidistant from the Pyramids of Gizeh and those of Sakkara, but on the opposite side of the Nile. In the days when these pyramids were built, the Nile had not yet been harnessed and in times of flood its waters would have licked the foot of the escarpment on the one side and approached the sites of the Pyramids on the other. Discoveries that have been made during the work in the caves have given good grounds for the assumption that they were, in fact, quarries from which stone was won for the building of the Pyramids.

Plaques and cartouches have been found which are said to date from that time. The limestone of which the Pyramids were built is of the same type as that in the escarpment. In one cave a large block of stone was uncovered, the dimensions of which approximated to those of the base stones used in the construction of the Great Pyramid of Cheops, *circa* 3730 B.C. This stone which had been accurately cut to rectangular shape 15 ft. by 6 ft. by 3 ft., weighing 20 tons, was found to be resting on small stone pillars and levelled up with timber wedges. Moreover underneath it were one or two cylindrical wooden rollers which had obviously been set for rolling the block to the entrance of the cave.

There would seem, therefore to be good reason for the belief that this was the origin of the Caves.

In February, 1940, work was started on the first cave which was named Zero. Its advantages, as an ammunition store were obvious. A very large storage space could readily be made available, roofed with from 150 to 200 ft. of solid rock, whose proximity to the Nile made transport comparatively easy.

Zero cave when cleared was found to consist of a large domed space extending for about 70 ft. from the entrance, with six galleries of lengths from 60 ft. to 250 ft. spreading into the heart of the rock. The height, when the rubble had been removed and the floor levelled, averaged about 25 ft. The galleries in no case exceeded 25 ft. in width. The walls were straight and plumb and the ceiling smooth and horizontal. The general effect was of the interior of some prehistoric place of worship. There is no doubt that the ancient Egyptians had instruments of precision to set out such accurate work. Their methods appear to have been as follows. A number of holes were cut in the vertical face of the wall, so fashioned as to serve as footholds and hand grips. Using these as a ladder, workmen climbed to 25 ft. and, probably by means of wooden wedges made to expand by being wetted, cut out the first block. Further blocks were cut by working along the ledge so formed and so on down the face of the wall. Steps were then cut in the new face and the same procedure repeated. Pieces of rope, probably used for lowering the blocks, were found in some of the caves.

It is likely that the original design was a series of galleries with dividing walls of rock reaching to the entrance. Probably at some later date less industrious or more ignorant quarrymen attacked these dividing walls from the entrance inwards so forming this enormous vestibule. Later the roof, being of too great a span for stability, flaked off and so formed the domed ceiling. Whatever the cause, under the dome was found a large pile of debris which had fallen from above. Most of the caves, which were excavated later, had this same plan ; a domed entrance 70 ft. to 90 ft. in width with 25 ft. galleries radiating from it.

The floor of Zero cave was found to be covered with rubble to a depth varying from 3 ft. to 15 ft. The sizes of the lumps of stone were so great in some cases as to necessitate blasting before removal. When this had been cleared away the floor was levelled and finished with concrete. A decauville railway was laid to connect all the galleries with the entrance and the whole cave was provided with electric light. It was taken over for use by the R.A.O.C. in June, 1940, after about 5 months' work.

So successful did this experiment prove that caves were demanded for many other purposes and work was still in progress in March, 1943, when the writer left the country. Up to that time an area of some 30 acres of covered accommodation had been provided. In addition, other caves were cleared and occupied by the R.A.F. and Egyptian Air Force.

In general, the caves were similar, but in some cases the galleries were not so clearly defined, isolated pillars having been left instead of the dividing walls. Many of the caves had more than one entrance. In these the ventilation was good and they proved to be remarkably cool even in the heat of summer. In others artificial ventilation had to be provided.

In some cases, notably at the entrances, cracks in the ceiling appeared and widened until flakes of stone fell to the ground. This happened more frequently in the survey cave than in others and continued to do so after occupation, so that evacuation was contemplated. However, it was considered that the safety from bombing was such as to counteract the danger from falling stone. Actually no casualties from this cause were reported.

A considerable amount of work was undertaken in supporting the ceilings directly cracks made their appearance, and the services of a South African mining engineer were constantly engaged for his advice as to where support was needed. Pillars of stone were built and the ceiling supported by reinforced concrete beams spanning between these columns. On the advice of the mining engineer timber baulks were inserted as cushions between the beams and the ceiling.

Photo 1.—Road serving caves.

Photo 2.—Entrance to cave before clearing.

Photo 3.—Clearing a cave entrance.

Tura Caves 1 - 3

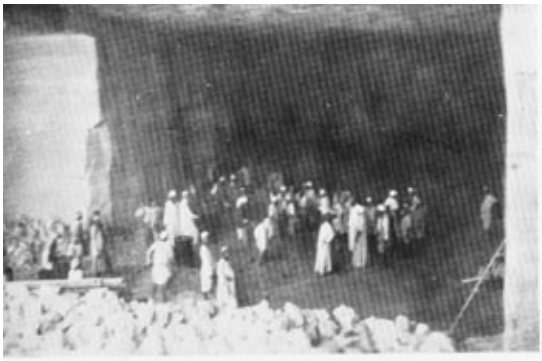


Photo 4.—Moving rubble from interior.

Photo 5.—General construction outside caves.

Photo 6.—Supports to roof.

Tura Caves 4 - 6

Another example of a dangerous ceiling was that of the Power station. Here a false roof of reinforced concrete was erected over the plant to safeguard it from the danger of falling rock. The Power Station itself contained five 150 kilowatt generating sets for the supply of electricity throughout the caves.

The ground outside was very uneven and in some cases the floors of the caves were a considerable height above the plain which lay between the escarpment and the Nile. Many miles of road were built to connect the standard gauge railway sidings on the plain with the decauville railways in the caves. Accommodation for the housing of personnel on a large scale was also constructed, mainly in stone, in the rough ground of the plain. Advantage was taken of the unevenness of the terrain to make these buildings as inconspicuous as possible from the air. In fact, the question of camouflage was never absent from the minds of the engineers responsible for the work, nor was the area ever bombed.

The whole work was carried out by direct labour, up to 5,000 men being employed at one time. The D.C.R.E. under whose charge the work was done, himself a building contractor in peace time, considered the use of contracts impracticable owing to the difficulties of measuring. No mechanical equipment was used. Such as was available in the country was needed nearer the front line where civilian labour could not be employed. Moreover, Egyptian labour is cheap, and good when properly supervised. A system of daily tasks was adopted for the removal of the rubble and proved to be most successful. The scene when this work was in full progress was reminiscent of Dantes' Inferno. A crowd of semi-naked Egyptians in a cloud of dust positively running with large blocks of stone, but still preserving enough breath to make the cavern echo with their singing and shouting.

The reception station, in one of the caves, had twenty beds and was provided with an operating theatre, dental centre and waterborne drainage with a small sewage disposal plant, the cost of this installation including staff quarters, kitchen etc., worked out at just under £60 per bed.

The average cost of clearing and concreting the floors of the caves in labour only amounted to PT 60 (12/6) a square metre and the total cost of the undertaking including accommodation, roads, electric lighting, water supply, railway and decauville came to a figure in the neighbourhood of 1½ million pounds sterling.

Such are the Tura caves in war time. It remains to be seen whether they can be put to some useful purpose when the war is over, or allowed to go back to rack and ruin until such circumstances arise again—if ever.

WAR BOOKS AND OTHER BOOKS

By J.E.E.

A STAGE has now been reached when it has become necessary to talk not only of war books but also of post-war books; for writers and publishers look well ahead and encourage the reader to do likewise. At the moment, the study of war is still the fashion, the progress of the struggle is duly chronicled, and the description of the operations from various points of view, is continued.

The Art of War on Land, by Lt.-Col. A. H. Burne is much to be commended; for the knowledge and the clear thinking of the author cannot fail to instruct without confusing the general reader. Murray Harris, in *The Logic of War*, has for his theme the importance of communications and the problem of transportation, more complicated and more important to-day than ever before; he does not use the fashionable word "logistics" and handles his subject well. *Jungle Warfare*, by Maj.-Gen. H. Rowan-Robinson, is a clear and informative little study of jungle conditions and the training of troops.

The general history of the war edited by Philip Graves maintains its high standard, *The Seventeenth Quarter* (October–December, 1943) devoting much attention to the political and strategical discussions between the representatives of the United Nations. *The Daily Telegraph Story of the War*, edited by David Marley, is in diary form, but also includes first-hand accounts of battle episodes; the third volume covers the year 1943. There are more than a thousand excellent photographs reproduced in *Hutchinson's Pictorial History of the War* (October, 1943–April, 1944), and the summaries of operations are well done.

The well-established single-handed narrators have lost neither their industry nor their judgment. Some will think that *The Tide Turns* (El Alamein to Cape Bon, Stalingrad, New Guinea and the Solomons) is the best volume which "Strategicus" has yet produced; it is his sixth. *The War: Fourth Year* (October, 1942–September, 1943) by Edgar McInnis deals more than capably with this crowded period and has an introduction by Field-Marshal Lord Wavell. From New York comes *Four Years*, a review of the major events, month by month, compiled with a touch of the dramatic from "books, broadcasts and public records" by Adrian van Sinderen. *A Traveller's War* is an entertaining account of Alaric Jacob's visits to Africa, India, Burma and Russia. He saw a great deal.

The War Effort of the United Kingdom, an official publication which appeared towards the end of November last is of particular importance. Much, of course, cannot yet be revealed, but this is a valuable record of fact, the statistics being extremely impressive. Also *Men Behind Victory* by Donald Stokes should not be neglected: it is a tale of many inventions:—the counter to the magnetic mine, the development of radio location, the methods of detecting land mines, and the discovery and adaptation of other devices which have helped, or are helping, towards the defeat of our enemies.

Students of the war at sea will find in *Brassey's Naval Annual*, 1944 a study of the expansion of sea power during the past five years, and an account of the growth of the Fleet Air Arm. The official publication *The Mediterranean Fleet : Greece to Tripoli* is a sequel to *East of Malta, West of Suez*, and covers the period April, 1941 to January, 1943; it is admirably illustrated, but holds too much to tell within such a small compass. It may be supplemented by Commander George Stitt's *Under Cunningham's Command* which treats of the Mediterranean period, 1940–1943, the high lights being the Battle of Matapan and the exploits of the Fleet Air Arm at Taranto. *Corvettes* is Nicholas Monsarrat's third book and he now writes as the commander of his ship; in *Home from Sea* Godfrey Winn, ex-newspaper correspondent, relates his experiences as an ordinary seaman in a cruiser; and Captain Frank Shaw's *The Merchant Navy at War* recalls in popular style some of the deeds of the mercantile marine.

It may be confidently expected that in due time Australia will produce an official history of the highest category. Meanwhile two little books on the Australian navy, the oldest of the Dominion navies, have been published: *H.M.A.S., H.M.A.S. Mk. II.* which consists of official accounts of various engagements, some being personal narratives, with good illustrations; and *The Silent Service*, a series of ship's actions related by Torpedo-Man T. M. Jones and Ion. L. Idriess.

The Royal Canadian Navy, written by E. H. Bartlett, one of its own officers, describes the growth and the achievements of the service as well as can be expected considering the modest size of the book.

The prolific A. D. Divine in *Navies in Exile* writes of the Polish, Norwegian, Dutch, French, Yugoslav, Belgium, Danish, and Greek war-vessels which have maintained, or are still maintaining the fight at sea.

Books on the war in the air are few, but the second volume of Capt. Norman Macmillan's *The R.A.F. in the World War* covers the period May, 1940–May, 1941, thus including the campaign in the Low Countries and in France and the Battle of Britain: a comprehensive and well balanced work. *Camera at War* is a record of the work of Flight-Lieutenant H. Hensser, an Air Ministry official photographer, and to the admirable illustrations he adds his story of experiences in France and Africa, in Asia as far east as Iraq, and in Iceland and Greenland.

There are several reminders of the German invasion of north-western Europe in 1940 which now seems so long ago. *The Campaign in Northern Norway* by Col. Munthe-Kaas, military attaché in Washington, is a short official account, based on war diaries and the author's own experience of the Norwegian 6th Division in the Narvik area from April to June. In *Military Operations in the Netherlands*, May, 10th–17th, 1940, Lt.-Col. P. L. G. Doorman, a Dutch staff officer, provides a tactical study which shows, if anyone still doubts, that, in the circumstances, the defence of Holland was not a feasible military operation. *The Lion Rampant* by L. de Jong and J. W. F. Stoppelman, two Dutch journalists of repute, depicts the sufferings of Holland and the resistance of the inhabitants during the German occupation which, at the time of writing, is, unhappily not yet ended. Gen. J. M. Eon's little book on the Battle of France is now available in English and deserves to be widely read; it is a tribute to the fighting powers of the French soldier. *War Diary* by Jean Malaquais, a French "intellectual" who served in a pioneer battalion may not be to everyone's taste but is not to be ignored. Peter Hadley's *Third Class to Dunkirk* is the plain tale of a British infantry subaltern who shows how indifferently equipped and trained were our troops in 1940. *Hazards of War*, by Stanley Rogers, contains well-authenticated tales of civilian escape from the occupied countries to Britain, such

as, for instance, from Norway via Moscow, China, Australia and the U.S.A.

Our interest in Russia should increase rather than diminish, and those who wish to understand the military traditions of our Ally may well turn to K. Osipov's *Alexander Suvorov*, the biography of a great captain and an interesting personality who to-day is not without honour in his own country of Soviets, although he served a Tsar. Also, *Russian Cavalcade* by Albert Parry, published in New York, should hold the attention, for its theme is the Russian soldier and his commanders from the time of the Russian entry into Berlin (1760) up to and including the present German war. *Red Surgeon* is the life story, partly in diary form, of one Maxim Pavelich Murov who served in the field with a U.S.S.R. medical unit. The siege of Leningrad is the subject of *Leningrad* by Alexander Werth who was born and brought up there and has gathered the experiences of soldiers and civilians, and of *The Siege of Leningrad*, an American book with lavish illustrations, by Boris Skomorovsky and E. G. Morris who have followed the same method in collecting their material. *The Russian campaigns of* 1941–1943, by W. E. D. Allen and Paul Muratoff, in the Penguin series, is an admirable summary considering that so few details have been revealed by the Russian High Command.

The fighting in Italy has lacked the spectacular movement which, perhaps, inspires the press correspondent. It has not yet been written about to any extent, but Henry Bateson, who saw the first two months of the operations, writes well and proves something of a military critic in *First into Italy*.

With *Unser Kampf auf dem Balkan* the Germans supply an account of their successful invasion of the Balkans—almost their last success—in the series which has already covered Poland, Operations at Sea, Norway, Flanders, and France in separate volumes. This one, which is, as usual, the work of several contributors, includes the capture of Crete.

Marshal Tito by Michael Padev, a Bulgarian writer, tells us a good deal concerning the Yugoslav leader and as much about the modern history of Yugoslavia; the Marshal does not seem to possess desire for publicity.

Of the books on Africa mention must first be made of the admirable official publication *Tunisia*, lavishly illustrated, which describes the final defeat of the Axis forces. One would like to know whether the credit for this production belongs to the Ministry of Information or to the War Office. *Pipeline into Battle* by Peter Rainier is of particular interest to the Corps, for the author is an R.E. officer who was engaged on forward water-supply services from Wavell's first advance until the victorious conclusion in Tunisia: an excellent book on an all important factor and one which reveals as few narratives have done, the ordeal of hardships through which the Eighth Army passed. *The Tiger Kills*, another official publication, is a concise account of the achievements of the Indian divisions from June, 1941 until the end: a very proud record. The correspondents, all Americans, are represented by Russell Hill's *Desert Conquest* which one enthusiastic critic dubs "excellent military history;" *Ten Years to Alamein* by Matthew Halton is not about the African campaigns exclusively; *War and Diplomacy in North Africa* by John MacVane who accuses the Allies of political bungling in their relations with the French; and *The Road Back to Paris* by A. J. Liebling, which contains some very frank impressions of Generals de Gaulle and Geraud. *The First to be Freed* is an official record, with excellent maps, of British administration in Eritrea and Somalia, 1941–1943.

Burma is represented by *Wingate's Raiders*, Charles J. Rolo describing the 1943 operations which paved the way for the more successful expedition of the following year. This is a story of jungle fighting with no supply

except by air and no communication except by radio. Lord Wavell provides an introduction.

God is My Co-Pilot is by Col. Robert L. Scott who, as an airman, for some time fought the Japanese single-handed in China. He is a very good American, but his story will interest many who are not.

Eye-witnesses of the Singapore disaster speak with one voice. *Who Dies Fighting* is by Angus Rose, an officer of the Argyll and Sutherland Highlanders, who discourses of the inadequate defences and preparations and the failure to appreciate the strength of the Japanese. The late Arthur Gerald Donahue, an American in the R.A.F. and since lost in action, wrote *Last Flight from Singapore;* Douglas Bailey, a young engineer of the Malaya P.W.D., in *We Built and Destroyed* shows that he had not been long enough in the Far East to have acquired any prejudices.

American readers who seek more knowledge of their Pacific enemy may turn to *Ten Years of Japan* by Joseph C. Grew, U.S. Ambassador in Tokyo from 1932 until the Pearl Harbour attack; although he liked the Japanese people the author had no illusions regarding their rulers. *Blood for the Emperor*, by Walter B. Clausen, is a collection of narratives of operations from Pearl Harbour to the naval battle off Guadacanal in November, 1942, the editor being the chief of the Associated Press Bureau and attached to the U.S. Pacific Fleet; his contributors include press correspondents and members of the three fighting services. Willard Price's *Rip Tide in the South Seas*, re-issued under the title *Japan's Islands of Mystery*, contains excellent descriptions of the Japanese Pacific bases and outposts, many of which have already been captured by the Allies. In *Bataan the Judgment Seat* Lt.-Col. Allison Ind, Chief of Air Intelligence, tells in diary form the story of the U.S. Philippine Air Command. The hardships of campaigning in the Aleutian islands are well depicted in *Bridge to Victory* by Howard Handleman who saw the re-capture of Attu and the re-occupation of Kiska. Douglas Coe's *Road to Alaska* is a popular account, with some technical details, of the construction of the Alaska highway by U.S. Army engineers.

With victory over Germany drawing nearer it is, perhaps, no matter for surprise that so many writers should be concerned with the nature of our enemy, and how he shall be treated when his final defeat is accomplished. On the military side must be noticed two little books published by the *Infantry Journal* (Washington): *The German Soldier*, describing his martial and other qualities, adapted from an instructional film and therefore well illustrated; and *Hitler's Second Army* by Dr. Alfred Vogts, an account of the S.A., S.S. and similar organizations. Major Erwin Lessner, an Austrian ex-officer, in *Blitzkrieg and Bluff* (translated) sets out to destroy for the American public the legend of Nazi invincibility in which we have never much believed in this country. He contends that in contrast with the old German General Staff the Nazis are devoid of strategic ideas, understanding nothing but bluff, treachery, and brute force.

The People's Verdict is a full report of the trials at Krasnodar and Kharkov of Germans charged with atrocities against Russian men, women and children; it contains some dreadful revelations. "Robert Guerlain" in *A Prisoner in Germany* tells a grim story of his four years caytivity.

A. Wolf in *Higher Education in Nazi Germany* provides a fresh exposure of the German professor class; *How to Treat the Germans*, by Ernest Ludwig, explains to the American public how little the German people are able to understand lenient treatment; *Max Weber and German Politics* by J. P. Meyer shows a well-known German "Liberal" in his true colours.

As for the problem presented by a defeated Germany, Brig.-Gen. Sir

George Cockerill, one time D.S.I. at the War Office, very usefully points out the mistakes made by the Allies in 1918–1919, in *What Fools We Were.* The American diplomat, Sumner Welles, in *The Time for Decision* advocates the partition of the *Reich*; he sees the German General Staff as the evil influence, although he has no illusions regarding the axis leaders, all of whom he has met personally. He assumes that the U.S.A. will lead the counsels of the United Nations. *Problems of the Peace* by Wilson Harris considers the German nation as a whole responsible for the war and his common-sense suggestions certainly provide a basis for discussion. An American journalist, Allan A. Michie, who sees things with a single mind, expresses his opinion in *Keep the Peace Through Air Power*; he would have no troops in occupation of Germany, only "Allied investigators." Louis Nizer, another American, advocates that German sovereignty be suspended and the nation put on probation. *Germany After the War*, however, a pamphlet issued by our own Liberal Party, contends that "Germany must not be treated worse than other nations as regards economic, financial, and welfare matters."

On the subject of rebuilding the world to ensure peace in the future *Total Peace* by Ely Culbertson has attracted much attention; the famous bridge expert has an elaborate scheme for organizing the nations in regional federations of powers great and small, with a rather drastic redistribution of colonial possessions, legions of "foreign inspectors" to see that all keep faith, and a mobile international police force. Walter Lippmann in *U.S. War Aims*—presumably peace aims are meant—envisages an Atlantic Community of nations and another *bloc* which he calls a Russian Orbit. Only universal good-will is needed for these two schemes to succeed; yet to remind us that such must not be reckoned upon too confidently comes Stanislaw Mackiewicz's *Colonel Beck and His Policy* which deals somewhat drastically with Poland's inadequate Foreign Minister at the time of her disaster, but has nothing very significant to suggest for the Polish future. Dr. Kunosi, however in *The Bases of Czechoslovak Unity* contends that the kinship of Czech and Slovak is a real thing.

Turning to our own domestic concerns, Sir Ronald Davison's *Remobilization for Peace* urges that we should plan and organize for peace with the same determination and self-sacrifice as we have done for war.

A pre-War book which provides a good answer to German propaganda is Lindley Fraser's *Germany Between Two Wars*, founded on the author's radio talks: the true courses of the German defeat in 1918 and of the present War are well stated. In the post-War category come *Primer of the Coming World*, by the German "Liberal" journalist Leopold Schwarzschild who wrote "World in Trance," and *A Preface to Peace* by Harold Callender an "anti-isolationist" American. The former book, not very constructive in suggestion, contains some home truths which will shock the idealists; the latter is candid and fair regarding British-American relations and has something interesting to say upon United States co-operation with Russia and Great Britain after victory comes. Walter Lippmann's *U.S. War Aims* is written for the American public, but has been serialized in the "Sunday Times." It is lucid, reasonable and informative, and goes on inevitably to discuss and adumbrate peace aims. There are ideas in plenty for the reconstruction of the post-War world.

THE ORIGIN AND EARLY DEVELOPMENT OF THE ARMOURED SCOUT CAR

By Brig. W. M. Blagden, O.B.E.

IN the current type of mobile warfare, wherein much of the tenacity of an elastic defence is derived from the lavish sowing of mines and booby traps, to say nothing of wholesale demolitions, the Sapper becomes an indispensable element in the spearhead of the attacking force; an advance column is therefore commonly headed by a Royal Engineer officer riding in an Armoured Scout Car. It has, therefore, been thought that the history of the development of this small vehicle, and the reason for some of its structural peculiarities, may be of interest to members of the Corps, especially to those who have had occasion to make use of it in the course of their service.

The Original Requirement

In 1937 the General Staff was preoccupied with the problem of protecting a column of tanks, or other M.T., advancing along a road from running unexpectedly into road blocks defended by infantry with anti-tank rifles fired from the shoulder, such as the Boys .55" or the Hotchkiss 13.2 m.m. Weapons of this type were likely to be widely distributed among the troops of any European Army, and they required some 25-30 m.m. of "homohard" armour to keep them out. The tanks and armoured cars of the period carried 14 m.m. of armour or less, so that these anti-tank rifles were likely to constitute a serious menace to them.

A requirement was accordingly formulated for the development of a small, wheeled reconnaissance vehicle, the body front of which was to consist of a loop-holed shield of thick armour plate, specified in the first place as 25 m.m., behind which would sit the driver and a Bren gunner. The sides and back were to be of plywood or canvas, and no roof was to be provided.

This vehicle would head a road reconnaissance patrol and on meeting with a road block and coming under fire from anti-tank weapons it was to be withdrawn hastily in reverse, keeping its shield between the crew and the enemy, who was to be discouraged during this manœuvre by fire from the Bren gunner.

It was at about this time that very strenuous attempts were being made to improve the cross country performance of wheeled vehicles, with particular reference to the desert conditions of the Eygptian frontier; the importation into this country of certain special foreign machines, such as the American Marmon Herrington tractor, the German Tempo staff car, and the Czech Tatra cars and lorries, showed the great advantages to be gained by driving on all four wheels. It was rightly decided that the chassis for the new Scout Car must at all costs be of the 4-wheel drive type, and it remained to find a manufacturer sufficiently enterprising to undertake the design and development of something that was hitherto unfamiliar to the British automobile industry.

The First Design

The first candidate in this new field was Mr. Percy Riley, of the Riley Engine Works, who produced an extremely interesting and original design for a small all-wheel-drive all-independently suspended 4-wheel chassis, which appeared to be quite suitable for the particular purpose in view.

At this stage it becomes necessary to explain one of the principal headaches that afflict the designer of a 4-wheel drive vehicle. This is the problem of disposing of the engine and gearbox unit, without getting in the way of one or other of the axles and of the propellor shaft that has to drive them both.

If it is located between the axles it takes up valuable body space, and having to be put on one side or other of the propellor shaft it gives a lopsided layout with the possibility of an unsymmetrical centre of gravity.

If it is put over the top of one of the axles, it has to be unduly high in the air in order to let the differential gearcase clear the sump, and this applies with greater force where conventional suspension with beam axles is used than it does with independent springing.

If it is put either in front of the front axle or behind the rear one it will be considerably overhung, and give a bad front or rear ground clearance angle which will render the vehicle incapable of negotiating the banks or ditches that may be expected on normal cross country going.

In the Tatra vehicles the last mentioned drawbacks were accepted and, in the case of the 4-wheeled Staff Car of that make, were minimized by the use of a 4-cylinder horizontally opposed aircooled engine with an extremely short crankshaft. This was mounted together with the gearbox on the front of a long tubular backbone, which formed the chassis, housed the propellor shaft, differential gears, and the drives to the wheel axles.

Mr. Riley's design also involved the use of a tubular backbone, but his plan was to put the engine at one end of it and the gearbox on the other, thus minimizing overhang, which was to be further reduced by the use of a special shortened design of 4-cylinder-in-line engine based on that of the famous Riley 9 h.p. car. The engine was to be at the back and the gearbox in front.

When the project had reached the stage of a ¼ scale wooden model, this was one day left in the hands of the Officer-in-Charge of the Wheeled Vehicles Test Section of the Mechanization Experimental Establishment, with the suggestion that he should consider the possibility of mounting on to it the armour plate shield with loopholes for which the General Staff had asked.

An enquiry into the needs of the Bren gun, together with some rough and ready anthropometric investigations, soon revealed the fact that it is not a practicable proposition to put a plain shield in front of a man sitting in the driving seat of a motor car. If it is far forward enough to clear the foot pedals, it is too far away to see through unless it is sloped back at a very steep angle.

The kind of driver's visor then in vogue, as well as the structure of the Bren gun, of which the magazine had to be behind the plate, made it imperative that the back of the plate which contained the loopholes should be vertical. The result of specifying these conditions was the production of a fairly complex frontal plate assembly.

It soon became obvious that the best way of supporting this frontal plate was by fixing it to side plates and possibly providing a back plate in addition, to give stiffness; thus the simple armour shield which had been asked for was turning into a kind of armour body, and it became nec-

essary to consider how much room would be required inside it for manning the Bren gun and accommodating the driver.

The first job was to decide on the seating arrangements, having regard to the special characteristics required. A revolving seat was devised for the gunner which had a tubular structure with laced-on canvas upholstery inspired by the pipe cots of "Ilex." It had on its right hand an arm to support the Bren gun, which was secured to it by a quick release ball mounting.

This seat was of the rise and fall type; in the up position the gun mounting just cleared the loophole plate and could be traversed round over the driver's cringing head through 360°. On releasing a catch, which was copied from the spacer bar of a typewriter, the seat could be lowered into the down position with the gun and its mounting in the loophole.

The total up and down movement required was 13" and to help in the upward motion, springs were provided to counterbalance the weight of the seat so that the gunner had only to raise himself and let it come up beneath him and hold its position by means of a ratchet.

The problem of the driver's seat needed different treatment as the change in height from the position of seeing over the top of the loophole plate to the position of cowering behind it was only some 6". A lever operated seat on the lazy tongs principle was accordingly designed for this, in which the seat was raised from one position to the other by pressing down a lever on the right hand side.

This seat was set at an angle of about 17° to the fore and aft line to facilitate driving in reverse. It was felt that the driver would soon get used to it going forward, and it made a great difference when looking back over the left shoulder; it is the last few degrees which wring the vertebræ.

Around these two seats and the driver's foot pedals, was draped the smallest possible quantity of armour plating of thickness calculated to give frontal protection on a 30 m.m. basis, the sides and back being 6 m.m. plate. The back plate which was 6" lower than the front and sides, could be seen over by the driver when in the down position.

The body was made as low as possible, the height from the lowest seat level to the top of the armour being only 31", so that in the "position of funk" the crew had to keep in a very crouched attitude if they were to get full protection from the front plate. It was hoped that this would only be temporary.

The body was also narrow, being only 48" wide at floor level and 56" wide at the top, which was, of course, open. The sides were thus sloped outwards at an inclination of about 8 in 1 and gave the elbow room just where it was required. The width might have been further reduced but for the desire to allow the gunner room to rotate his seat in the up position.

No armour whatever was to be provided for the engine; this, being in the rear of the chassis, was considered to be at least as well protected as it would have been if the original General Staff requirement for a plain shield had been slavishly satisfied. It was a most desirable limitation from the point of view of weight as the plating already taken up for worked out at some 6 cwt.

Outline drawings of this body giving dimensions, angles and thicknesses of plate, were provided to Mr. Riley, and a full scale wooden mock-up was duly constructed. This, unfortunately, was as far as the matter got, as the subsequent liquidation of the Riley Motor Company led to the abandonment of the whole project.

The Alvis Dingo

In the meanwhile Messrs. Alvis, a firm which had specialized in front wheel drive motor cars, had been encouraged to proceed with the development of a small 4-wheel drive chassis of their own design, and when this project was nearing completion it was decided that they should be asked to equip it with an armoured body similar to that which had been designed for the would-be Riley Scout Car.

Contact was accordingly established with the firm and it was soon found that with minor modifications to the chassis, it would be possible to fit it with an armoured body having the same internal arrangements and seating as had been devised for the Riley, and keeping all the same leading dimensions.

The Alvis chassis also consisted of a tubular backbone but in this case the engine was mounted on the offside of it, immediately behind the driver's seat. It was completely cowled in; cooling air was sucked in via a louvred plate in the side armour, through the radiator, and after passing over the engine was expelled through the rear of the cowling by an exhauster fan.

The engine-cum-gearbox unit was that used in the 4-cylinder 12 h.p. Alvis car that was in production just before the war; it was a smooth running engine with an astonishing output for its Treasury rating, and the synchro-mesh box was a pleasure to handle. Open half-shafts were used on both front and rear axles, with Hardy Spicer constant velocity universal joints.

Independent suspension was provided by the use of transverse half elliptic leaf springs, anchored to the chassis tube at their centres. In the case of the rear axle, this anchorage had a limited freedom of rotation round the chassis tube, which resulted virtually in a 3 point suspension. This was a most ingenious feature but it led to lateral instability and had later to be abandoned.

The body, which was made of mild steel to facilitate the inevitable cutting about, was a welded structure, open at the back, and reminiscent of a Roman chariot. It was extremely short and owing to the 7′ wheel base and a front wheel lock of 37°, the car could turn round in a 30′ roadway. The reverse gear was made rather higher than usual to give a better speed when retiring under fire.

The first and only Alvis Dingo (see Figs. 1 and 2), as it was called by its makers, was delivered to M.E.E. for trial in May, 1938, and it proved to be an extremely effective little vehicle. It was well powered for its weight, which started off at a trifle over 30 cwt., and its hill climbing powers made light of all the most formidable test hills in the neighbourhood. Much time was spent scouring the countryside for new slopes to conquer.

It came through its reliability trials at M.E.E., and some troop trials with the Queen's Bays, with great credit; the only significant defects were the rather short life of the leaf springs, and the tendency of the vehicle to overturn towards the offside on account of the position of the centre of gravity which, owing to the location of the engine, was to one side of the centre line and a trifle high.

The first time that it showed off its paces to the General Staff it was received with some acclamation, but we were told that the lack of rear protection was an obvious defect; it was bad for morale to feel that you might at any moment be shot in the back. This was easily remedied at the expense of adding a little weight and slightly complicating the engine cooling.

FIG. 1.

FIG. 2.

THE ALVIS DINGO AS FIRST CONSTRUCTED.

These photographs show the position of the radiator, which was at first left unprotected, and the open back.

Origin and early development of armoured scout car 1 & 2

FIG. 3.

FIG. 4.

The front and back views of the B.S.A. Daimler Scout Car, as first produced, showing the open top and unarmoured engine.

Origin and early development of armoured scout car 3 & 4

The B.S.A.—Daimler Design

While all this was going on, a third firm, the B.S.A. Company, began to take an interest in this peculiar market. They felt that their experience with their small front wheel driven car, which they called the B.S.A. Scout, should give them some advantage in tackling the problem of an armoured 4-wheel drive car.

On offering their services in this matter to the War Office, they were told to apply for information and general guidance to the M.E.E., and in March, 1938 some of their engineers, including Mr. H. Perkins, a designer of B.S.A. motor cycles, paid a visit to the M.E.E. They brought blue prints of their proposals and were taken for a ride.

It was immediately apparent that none of the components of the B.S.A. car could be used for the new project and this made it possible to start with a more or less clean sheet. It was, of course, essential that the vehicle be built round an existing engine and gearbox, but, apart from this, it should be also possible to incorporate into its design some of the special characteristics called for by its operational role.

The only engine of approximately the right power and size available to the firm, was the power unit designed for the new Daimler 2½ litre car, the Daimler Company being a member of the B.S.A. Group. This engine was equipped with the usual Daimler fluid flywheel and Wilson epicyclic "Pre Selecta" gearbox, features which were then regarded as likely to prove unsuitable for handling by troops and army workshops.

The engine was longer than the proposed Riley or the Alvis engines. It could not be put behind the rear axle because of overhang, and it could not be put between the axles without making a long wheel base and spoiling the body layout. It was also a high engine, and if sited on top of the rear axle would have prevented the driver from seeing backwards when driving in reverse.

It was therefore suggested to the firm's designers that they adopt an entirely unconventional system of transmission and use two propellor shafts, one on each side of the vehicle, driving the wheels on that side through separate bevel gears. This would enable the engine sump to be dropped between the rear wheel bevel boxes and so bring the engine down by nearly 1 foot.

The drive from the gearbox would have to be taken into a transfer box where it would be split two ways by a differential gear, being coupled by double helical pinions to the near and offside propellor shafts respectively. The single differential would provide compensation between the combined offside pair of wheels and the nearside; it would be running at propellor shaft speed and so be turning faster, but carrying lower torque, than a normal differential.

Now, experience with the continental 4-wheel drive vehicles showed that the limiting factor in their performance on heavy uneven going such as sand dunes, or in the diagonal crossing of ditches and sunken roads, was the tendency for the wheels to become unequally loaded, and for the lightly loaded wheels to lose adhesion and start spinning through one side of a differential.

Whereas the weight of a symmetrical vehicle is likely to be distributed equally between its near and off sides, it is possible for it to be supported on diagonally opposite wheels so that nearly all the nearside weight is concentrated on, say, the nearside front wheel, and the offside weight on the offside rear one, like a playing card lifted by two diagonally opposite corners.

In these circumstances the offside front wheel and the nearside rear one, which are on the other diagonal, would find themselves with practically no weight on them, but by virtue of the differentials in the front and rear axles they would still be getting half the torque supplied to each axle; "diagonal wheel spin" would therefore start and traction would be lost.

The use of a single central differential prevents this by making it necessary for both wheels on one side to spin simultaneously. As one of these wheels at least must be carrying load, there is no possibility of losing traction by wheel spin through load transference. Thus, the adoption of this unconventional transmission system, would be killing two birds with one stone.

In the design of the transfer box a reverse gear was to be incorporated, which, coming behind the gearbox, gave as many backward speeds as forward ones; this would enable the car to be driven in reverse nearly as fast as it would go forward, which would be of great value in making a hasty withdrawal.

For speed across country it was considered to be essential to adopt some system of independent suspension, and here we were fortunate as Mr. Perkins had already worked out a trapezoidal wishbone coil spring suspension, with cased in half shafts driven through Tracta constant velocity universal joints in spherical housings.

We also had ideas on the subject of steering. To obtain full value from the ability of the car to travel backwards at about 40 m.p.h., and to make the task of the driver easier and safer, the steering ought to be transferable from the front to the rear wheels at will. This would avoid the dynamic instability inherent in a 4-wheeled vehicle which is steered from the trailing instead of the leading end.

At the same time the fitting of steering axles to all 4 wheels would make it possible to steer them all simultaneously, and so very nearly halve the minimum turning radius. Having found by trial on two continental vehicles equipped with optional simultaneous 4-wheel steering that they were unstable above 20 m.p.h., we decided that the steering should be made "progressive." By this meant an arrangement in which all normal steering is done on the front wheels only, but that when they reach full lock the rear wheels are automatically brought into play by further turning of the steering wheel. On straightening up, the rear wheels centralize first and become fixed, after which the front wheels are released from the full lock position and can be centralized.

Surprisingly enough, the B.S.A. representatives accepted all these frills, and the design of the chassis was started. It was by then a simple matter to draw out a third variant of the armoured body and seating. The body was provided with a back of 6 m.m. plate, but, as in the case of the Riley design, no armour was indicated for the engine, which was to be given an ordinary bonnet and cover. The body and automotive components were to be mounted on the normal type of channel section chassis frame and the nature of the transmission and suspension made it possible to provide a flat belly plate on the underside of this frame with a ground clearance everywhere of about 10".

Collaboration between the firm and M.E.E. continued briskly, and the design of the vehicle was finished and frozen in the April following. Its lack of respect for the conventions seems rather to have alarmed the War Office, who told the manufacturers that if they proceeded with it they must accept the risk that it might prove mechanically unsound from start to finish. Messrs. B.S.A. decided to go ahead. They had no suitable conventional components of their own to use, and on the other hand they felt

that unless they were able to produce something out of the ordinary, they would stand little chance of overcoming any competition from the larger "popular" car combines, if ever these firms were brought into the picture.

The work of detailed design and manufacture was then entrusted to the Daimler Company, who, by a most creditable effort on the part of their experimental shop, managed to deliver the first *pilot* vehicle to the M.E.E. in mid-September of the same year. (See Figs. 3 and 4).

As a first effort, it seemed most promising. The suspension was excellent and the hill climbing and cross country performance first class. The weight came out at about 35 cwt. which was a little more than we had hoped for. The progressive steering was rather too highly geared and a trifle stiff, but it worked according to plan.

It certainly was possible to drive the vehicle backwards at over 40 m.p.h., and the turning circle was small enough to turn the car in a 20′ road. Besides overall reverse, there was the pre-selecta reverse on the Wilson gearbox which could be used for normal manœuvring. The engagement of both reverses at once gave a forward ratio rather lower than the normal bottom gear.

On completion of performance trials, life mileage followed, and while this was going on occasion was taken to give a demonstration to the General Staff of both the Alvis and the B.S.A. Daimler together, in order that a decision might be given as to whether the vehicles were likely to be suitable for the duties required of them. The two exhibits were accordingly put through their several paces, and exciting rides were given to senior officers.

The chief decision was that both vehicles were insufficiently protected and must be supplied with a roof; when you were going through an enemy-held village anyone might easily lob a grenade into your lap. Futhermore, the 6 m.m. side armour must be brought up to the 14 m.m. standard, and the engine of the Daimler must be given an armoured bonnet of not less than 6 m.m. thickness.

It was also stated that there was a secondary requirement, apart from reconnaissance, for this type of vehicle, i.e., intercommunication and liaison on the battlefield. The Alvis seemed most suitable for this, its frontal armour could then be reduced to the 14 m.m. standard. The Daimler would be more useful for the original role and its front must remain at 30 m.m.

This was a heartbreak for the designers. It meant raising the side walls by 4″ to enable the crew to adopt a reasonable attitude when the roof was shut down over them. The front visor plate could not be raised as that would have made it necessary to raise the driver's seat in the up position by an amount which would have brought his knees into conflict with the steering wheel.

The gunner's Bren mounting with all round traverse had to be abandoned, as it could no longer clear the side walls, and a plain rubber pad was put for the gun at the bottom of the loophole. The revolving seat was shorn of its arm but otherwise left unaltered. The driver's seat was unchanged and has remained so to this day.

A new body on these lines was accordingly designed for each vehicle. The armour plate curves for the 14 m.m. standard were most carefully studied, and every attempt was made to save weight by sloping the armour at those profitable angles at which the thickness of a plate may be reduced in a proportion greater than the increase in its slant height, thus "cheating the cosine."

In spite of all efforts, a crippling weight was added to each car, the worst sufferer being the Daimler, which had to keep a 30 m.m. front and acquire a 6 m.m. engine casing. An attempt was made to restore its tractive effort

for hill climbing by taking out the reverse gear train from the Wilson box and putting in its place an extra low ratio for emergency use.

The new bodies were made with astonishing rapidity, Messrs. Alvis having got theirs done in about a fortnight, and, in addition, taken the opportunity to widen the wheel track of their car in order to give it improved stability. The two transmogrified vehicles were re-inspected by General Staff in January, 1939, and by dint of considerable overtime on the part of all concerned the 10,000 mile running test of the B.S.A. Daimler was completed in the same month.

Actually, we might have taken things a little easier, as the School of Thought which had formulated the original requirements for an Armoured Scout Car appeared to have broken up for the holidays; for the next six months, no official interest was shown in either of our specimens. When finally the General Staff clarified its policy and made up its mind that there was a real demand for cars of this type, no firm preference was expressed for either vehicle; a momentous decision was made to order 52 Scout Cars of one kind or another, and the ruling as to which it should be was left in the care of the tender box.

Much to the surprise of all, the price quoted for the Daimler was lower than that for the more simple Alvis, and the whole order was given to the makers of the former vehicle. As subsequent events proved, this was a pity. The demand for Scout Cars has increased ever since and the supply has never succeeded in catching up with it; there was plenty of scope for both types.

The Alvis Dingo was dropped altogether and the design and manufacturing capacity which might have been available was thus lost for good. No trace remains of the vehicle except for the obstinate tendency of certain Armoured Regiments to refer to all Armoured Scout Cars as "Dingoes," having caught the name from the Queen's Bays.

Scout Car Mark I.

The moment that the Daimler Scout Car was accepted into the service, shocked official designers of A.F.V's. descended upon us in a body. We were initiated into the mysteries of "splash proofing" and reproved for our hardihood in imagining that armour plate could be welded. In spite of its shortcomings over normal tank standards of protection, however, the vehicle was not subjected to any significant modifications.

The next stage in its development followed the receipt of the stowage list, when we looked aghast at the 101 miscellaneous oddments that had to be carried and wondered where to put them. It was at this point that the prism shaped "junk box" that sits across the nose of the vehicle, was provided as a desperate expedient for accommodating some of the more awkwardly shaped articles.

The result of all these changes, and additions in weight was catastrophic. They necessitated the provision of larger and heavier run flat tyres, which had to be designed specially for the vehicle. By the time that everything had gone on, the car weighed over 3 tons, a figure that has been rising ever since.

Gone was the superior cross country vehicle which we had hoped to produce. No longer would it romp up Red Road and Tunnel Hill test slopes like a scalded cat. It had turned into a more sluggish animal with a much lower power weight ratio, and with every part bearing a much greater stress than that for which it had been designed.

The effects of this overloading soon became apparent in the first production

machines and called for mechanical modifications, but, in spite of all, the few that were sent across to France with the 50th (then " Motor ") Division and the 1st Armoured Division, appear to have acquitted themselves with credit.

After the fall of France intensive efforts were made to improve the general reliability of the Scout Car Mark I, as it was by then called. One of the first points to receive attention was the 4-wheel steering which, since the weight of the vehicle had been nearly doubled, had become very stiff indeed.

Messrs. Daimler had made up a sample car having a new steering box with a 50% lower steering ratio ; this cured the stiffness but it was a long way off the production line. Meanwhile the only active theatre of war was the Libyan Desert, in which there was plenty of room to turn round.

The need for 4-wheel and reverse steering having for the time departed, it was not considered worth while to make any attempt to perfect the system ; the line of least resistance was to eliminate it altogether, and this was done in production in the later marks of car.

The operational role of the Scout Car made it particularly subject to danger from anti-tank mines. A Commander of a certain Armoured Brigade told a story of a young Sapper officer in his Command who, in the course of clearing minefields, was blown up three times in one morning in three successive Scout Cars, and though dazed, had escaped bodily harm.

It is of the utmost importance that vehicles of this type should give there crew sufficient protection to prevent them from becoming casualties when they run over a mine ; the body of the Scout Car Mark I seemed to be reasonably successful in resisting our own local pattern mines, which the Germans used in Libya, but was often blown in by the tellermine.

The cry went up for improved protection under the floor of the crew space and a scheme was worked out in the experimental establishment in Cairo for reinforcing the underneath with extra thicknesses of armour plate. The project was dignified by the code name of " winter drawers."

As it was considered by all concerned that it would be madness to add further weight to the vehicle, a demand was made for permission to remove the armour plate roof and provide instead a canvas cover. Many users were asked their opinion on this and all agreed that the roof might be abolished, except for one officer who flatly denied that there was one.

Apart from this no change had been found desirable in the outward form of the vehicle, which remains in very much the same state as that in which it first went into production, five years ago. The heavily loaded mechanical components having now been brought up to a satisfactory standard of reliability, the Daimler Scout Car has been allowed to live down the stigma of its irregular begetting and is now accepted as a respectable member of the family of A.F.V.

Any successful product will sooner or later call forth imitations, and apart from this, the growing margin between the demand for Scout Cars and the production deliveries, made it essential to set up alternative sources of supply. This resulted in the development and production of Scout Cars by Messrs. Ford, in Canada, and Messrs. Humber, in England.

In neither case was any attempt made to copy the Daimler design. Each firm was anxious to use its own standard components and the resulting functional differences between their products and the Scout Car Mark I were accepted as a matter of expediency by the General Staff. These vehicles are now in the Service and must be well known to many readers, who will have been able to form their own opinion of their merits as compared with those of the original Scout Car Mark I.

THE FUTURE OF THE CORPS OF ROYAL ENGINEERS

By Col. J. V. Davidson-Houston, M.B.E.

Introduction

"IT takes all sorts to make a Corps." Certainly the opinions of Royal Engineer officers are as diverse as their operations are ubiquitous, and at the present time there is a great variety of views on what the Corps should be and how it should develop. Nearly all of them, however, can be sorted into one of two camps: those which deplore a tendency to excise specialist growths from the body of the Royal Engineers and apprehend their reduction to the status of Pioneers, and those which accept the fact that the field of modern engineering is too comprehensive and too specialized to be controlled by a single corps.

Classifying them respectively as the "Engineer" and "Pioneer" schools of thought, let us examine their arguments in detail and endeavour to see how far they can be reconciled.

The "Engineer" School

It is generally agreed that the function of the Royal Engineers has always been the adaptation of civilian practice to military needs, from the use of agricultural labour for undermining castles to the employment of modern road-making machinery. It follows that only a trained engineer can bring this about; and the more engineering science develops, the greater the knowledge required to utilize it properly. Improvisation is also a necessary condition of military engineering; the civilian is not normally worried by shortage of time, men, or material, whereas his military counter-part is faced with the chronic difficulties of making bricks without straw. It is obvious that a man whose training is based on rule-of-thumb, or the use of standard equipment, will soon fall down when it comes to extensive improvisation.

It is argued with some reason that engineers in the field are largely employed on semi-skilled or unskilled work, which could be undertaken by other troops. In the last war this was early apparent as regards digging and wiring, and it has since been recognized that it applies to such fieldworks as minefield breaching and the use of Bangalore torpedoes. "There are never enough sappers," and as soon as any type of work has been reduced to a drill with standard equipment it is time to withdraw them and concentrate on more highly skilled tasks.

At the other end of the scale there are activities which become so specialized that they are from time to time handed over to newly-formed corps. The objection to this is that military engineering, like M. Litvinov's Peace, is "indivisible." It is argued, for instance, that the R.E.M.E. now absorb the cream of the electrical and mechanical trades; and that the efficiency of the R.E. will suffer from a lack of men trained in those branches, since engineering in the field demands an ever-increasing amount of mechanical aids. Transportation is another case in point; should railway, dock, and I.W.T. specialists be organized in a separate corps, with no interchangeability of their officers, both they and the R.E. would be the poorer. There

would develop an unnatural distinction between road and railway bridging, between railway demolitions and other demolitions, between building construction in ports and elsewhere. This tendency would, moreover, result in the Royal Engineers becoming merely one of many engineering branches of the Army, with a consequent loss of their prestige and influence.

Against the above it is contended that the subject of engineering has become so vast and diversified that, just as the civilian is constrained to specialize in one or other of its branches, the R.E., with the additional task of military training, cannot hope to do more. Should the Corps attempt to hang on to all activities connected with engineering, it would become a huge and unwieldy agglomeration of specialist organizations, the senior officers of which could not have the training or experience requisite for intelligent direction of the whole. Furthermore, the Sapper Officer, as we know him to-day, would cease to exist; the fieldworks expert would be at a loss when called on to salvage a captured power-station, and the railwayman would hesitate to give an opinion on protection against bombs. A commander, instead of relying upon his Engineer adviser, would find himself surrounded by a host of experts whose advice, as is the way with experts, would often be diverse and contradictory.

The "Pioneer" School

The point of view expressed in this camp is that the Royal Engineers have always been, and should continue to be, *pioneers* in the highest sense. That is, they should be ready to seize on any engineering development and adapt it to military use. It is obvious that no officer can nowadays be fully trained in every branch of engineering. Some confusion of thought has been caused by the change in meaning of the term "engineer." Derived from the Latin *ingeniator*, it had originally a purely military significance, being applied to those who worked with "engines of war" and who were naturally the most "ingenious" members of the forces. Until the beginning of the Nineteenth Century the word *Engineer* was usually taken to mean a military engineer, one who, a libellous world alleged, was apt to be "hoist with his own petard."

But just as science has since entered more and more into civilian life, so it has come to affect every branch of the Army, to an extent which makes it impracticable to centralize its direction or development. Civilian engineering has, moreover, now expanded far beyond the requirements of the military art, so that many aspects (e.g., marine, hydro-electric, or metallurgical practice) will rarely enter the orbit of the fighting engineer.

It is suggested therefore, that the Sapper should concentrate on the pioneering work necessary to place new scientific developments at the service of the Army, but that he should hand over to some other organization all such activities that have been so formalized as no longer to require "ingenuity."

Conclusions

As usual, the truth will be found to lie between two extremes. Every war discovers the Royal Engineers saddled with new commitments, and since 1939 we have "pioneered" bomb disposal, minefield breaching, rapid airfield construction, bulk petrol supply, and the development of beaches in combined operations. It is axiomatic that there are never enough Sappers, and if we endeavoured to retain hold of all our past activities, it could only be by sacrificing quality to quantity. The sensible answer seems to be the

discarding of all those duties which are no longer in the embryo stage and which should be placed in the hands of users. Common sense and natural development have decreed such a fate to aeronautics, signals, chemical warfare, maintenance of mechanical equipment, and those fieldworks which other arms are capable of carrying out for themselves. There seem to be equally strong reasons for ridding ourselves of the Postal Service, which might logically be considered a concern either of Signals or Supply, but which can hardly be described as within the domain of engineering. By these means a fairly constant balance would be obtained, and there is little danger of the Corps ever finding itself with too little work to do. Such a policy would also obviate the risk of R.E. officers becoming so absorbed in the tasks of routine services that they lose that priceless faculty of original thought characteristic of the best Sappers.

What, then, should be the training of the Royal Engineers? Examination of the scope of our activities from the earliest times shows that we have always been, and still are, more concerned with Civil Engineering than with any other branch. Fortification, demolition, bridging, development of communications, water-supply, airfields, building, and survey loom largest in our view. Added to these are the transportation agencies and the handling of electrical and mechanical plant, which under active service conditions call for a degree of improvisation and ingenuity more suited to the R.E. than to a maintenance or user service.

The above seems to indicate that the Corps continues to develop on sound lines; we are still largely Civil Engineers with a fair proportion trained in other necessary branches.

AERODROME ABSTRACTS

(462. Observations on tank traffic and carriageways: G. LOWE: *Surveyor, Lond.*, 1944, 103 (2733), 271-2.)

The problem of maintaining roads subjected to extensive tank traffic involves (1) keeping the roads safe for ordinary traffic and (2) finding materials that will give satisfactory service under heavy track-laying vehicles. Damage to the carriageway by tanks results from (*a*) large turning movements, (*b*) weight of tank, and (*c*) speed. Brief descriptions are given of three types of tar carpet, laid to a compacted thickness of 1½ to 2 in., that were tried with varying success for repairing damaged surfacings. Mastic asphalt was also used in small areas, and withstood turning movements well at all atmospheric temperatures. The general conclusion drawn is that satisfactory results would probably be obtained with a 3-in. surfacing of 2-in. to ¼-in. graded hard aggregate, with a proportion below 3/16-in. to fill the voids and give a reasonably close texture, the normal amount of filler, and a medium-viscosity tar (cf. Abstract No. 366). At selected intersections an 8-in. unreinforced concrete surfacing was provided. Concrete made with all-in ballast (12 cu. ft. to 2 cwt. cement), with an addition of sand if mixes seemed too stony, gave reasonably good results, but this type of concrete does not appear to be entirely satisfactory for tank traffic, since the gravel cracks and finally breaks away under the impact of the tracks. Better results were obtained when the top 2 in. consisted of concrete made with an angular 1-in. granite aggregate (proportions, 9 cu. ft. of granite, 2 cu. ft. of sand, and 2-cwt. of cement). It is concluded that a well-proportioned concrete containing a hard angular aggregate will be satisfactory in all respects for tank traffic.

BUILDING EXPEDIENTS: IRAQ

By Col. E. M. E. Cogilan, M.B.E.

THE subject of this article is the construction of accommodation for men and stores in an L. of C. Area, devoid of military risks, but having considerable extremes of climate and few local resources.

The Military Engineer "On Active Service" does not build for posterity, and he usually has to make use of the materials most easily obtained, and improvise accordingly. There has been much improvisation of this sort in Iraq of which I propose to tell.

A certain amount of standard steel shedding of various types has also been erected, but with these this article is not concerned.

The climate of Iraq is one of extremes. In summer, maximum temperatures (on the screen) of 125° F. have been recorded, which means something nearer 135° F. in tents. In winter, night-frosts are usual, and in the north the temperature has been known to remain below freezing point and snow to lie for two or three weeks. The rainfall, however, is nowhere very great, so that mud covered roofs are usually a practical proposition. The climate, in fact, is similar to that of the Punjab and Sind, with rather greater variations between winter and summer, and between north and south.

Without importing from abroad, Iraq cannot offer a great variety of building materials. The principal ones are sun-dried mud bricks, burnt bricks, matting made from reeds, reeds, and a limited quantity of poles, mostly poplar, from the Kurdish provinces or from Iran. Sun-dried mud bricks cannot be made in the rainy season, as they have to be dried in the open and a batch may be ruined at any time by sudden rain. But the greatest difficulty is in finding material for supporting roofs at times when imported materials are lacking.

I must now introduce the reader to Juss, Arabic for "gypsum," a building material not mentioned so far, which has had a great influence on the design of war-time accommodation. You can pronounce "Juss" to rhyme with "juice," with "puss" or with "bus." It remains a form of plaster of Paris and, after mud, is the favourite material for mortar or plaster in native construction.

It is found in the raw state in most parts of Iraq. In its commonest form it is in a thick horizontal stratum of granular crystalline structure, just under, or on, the surface of the desert, and containing a small percentage of sand and pea gravel. Elsewhere it is found in slab-like beds of almost pure and transparent crystal, or as a soft stone something like marble to look at, and as such, used in building.

The native method of preparing juss for use is to burn the raw material with brushwood in kilns dug on the spot. The resulting lumps of whitish material, resembling dirty chalk, are ground to a powder under stone rollers drawn by donkeys. Scientifically designed rotary and vertical kilns have also been introduced both by the military and by civilian firms. They produce a rather better product more quickly and more cheaply, subject to the breakdowns which form such a feature of machinery in this country. The best juss so prepared is not far removed in purity and chemical composition from commercial plaster of Paris.

Whether as a mortar or as a plaster for walls, it is used neat, mixed with water just before application. In dry warm weather it sets so quickly that it is possible to build brick arches without the use of centreing. Each brick is just stuck on to the next and is sufficiently firmly established to hold the weight of the next a few moments later. In plastering, juss gives a brilliantly white wall with a very fine surface.

Juss has certain disadvantages. Firstly, it is not a very strong mortar, not as strong for instance as lime mortar, still less comparable with cement mortar. But good enough, generally speaking, for ordinary two-storey building work. Secondly, it is very susceptible to damp. Any building involving juss must have a damp course, otherwise, in a rainy season the plaster of the walls may become blotched and damp stained, and begin to deteriorate. If the bricks of the wall contain certain mineral salts, the disintegration will be very rapid. In damp weather on damp walls, newly applied juss plaster will hardly set at all.

The use of juss is well understood by the local inhabitants, who consequently expect cement to act the same. It takes a lot of driving and supervision, when cement mortar is being used, to make them soak the bricks, keep the work wet for several days and mix a suitable amount of sand with the cement, as all this is directly contrary to the procedure when using juss.

The deterioration of juss mortar, when used with a certain type of brick found principally in the south, led to the manufacture of juss blocks in large quantities at Shuaiba and Margil, and it must be admitted that they make a very handsome building material, easily laid, easily worked, with clean-cut edges and smooth surfaces which require no further treatment whether inside or out, unless a brilliant white is considered too glaring, in which case they are easily coloured.

The dimensions of these blocks are 17½ in. by 8½ in. by 4½ in., and they weigh about 36 lbs. They are made by hand in moulds, without being compressed by machinery, although a machine for this purpose was being designed and would have turned out a stronger block. Hollow blocks were also tried, but the saving of weight was offset by the weakness of the material which led to excessive breakages, and the hollows were not really necessary, the juss block having a very high insulating value in any case.

During a period of acute shortage of wood of any kind for roofing, a further development of the use of juss took place. This was the construction of living huts and hospital wards with arched roofs made of juss ribs reinforced with palm tree branches, and filled in with a single or double skin of reeds plastered with juss. A drawing is better than a verbal description and Fig. 1 explains the form of construction. The ribs were usually pre-cast in two parts—two half-arch open channels, which were placed in position on the dwarf walls. Palm branch reinforcement was then laid on the bottom of each channel and bonded well at the crown, and into recesses left in the dwarf walls, and the channels were then filled in with juss and flushed up, and made good at the crown and the abutments so as to make a continuous solid arch. Next, reeds connected together roller-blind fashion with string, were placed into position between the arches, resting on the formed rebates provided. They were first tacked into place with pats of juss and then plastered with juss so as to give a smooth finish inside and out.

At the approach of the rains, all these huts were given a coat of bitumen over the roof.

This type of construction is cheap and easily put up. It cannot be guaranteed to remain good for more than two rainy seasons. Care must be taken that wet does not affect the foundations, for if the walls shift at all the arches fail and the roof collapses. Pools of water standing around huts after rain are a

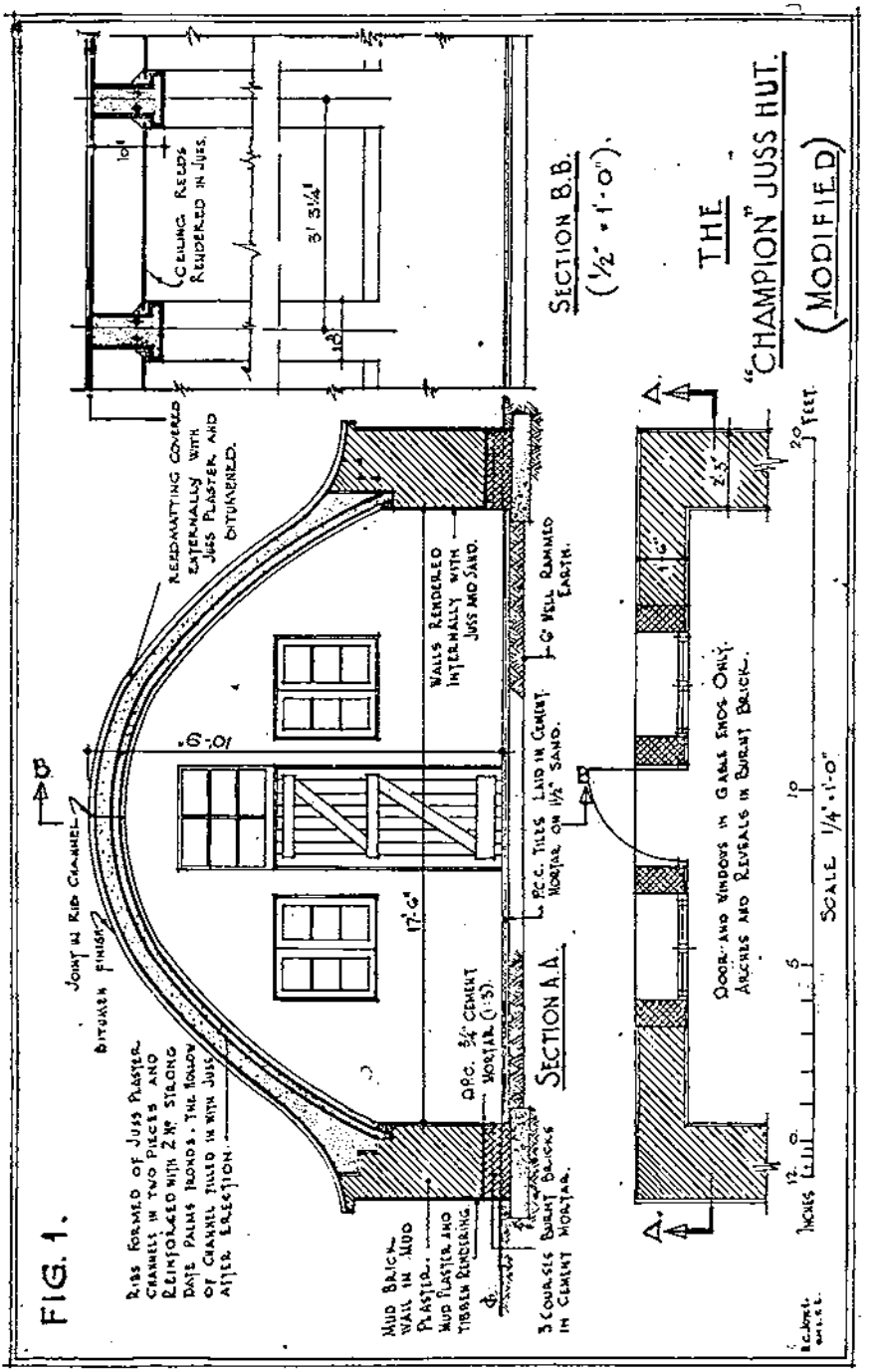
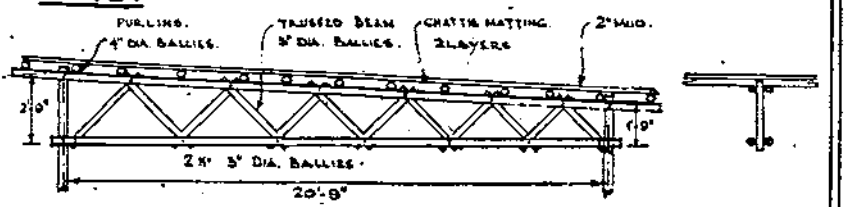


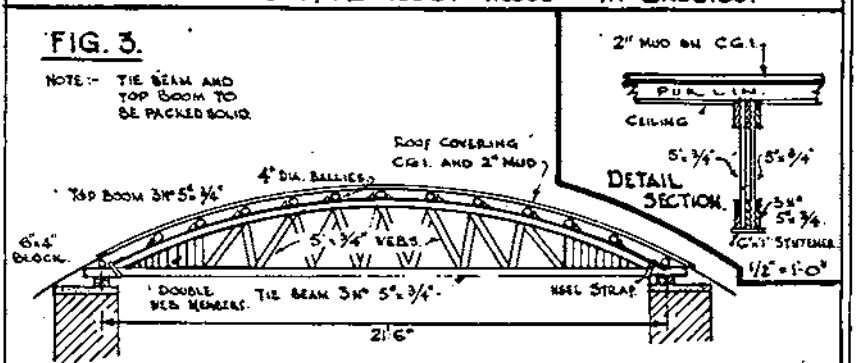
FIG. 1.
THE "CHAMPION" JUSS HUT. (MODIFIED)
SECTION B.B. (½" = 1'-0").
SECTION A.A.
SCALE 1/4" = 1'-0"
FEET
INCHES
CEILING REEDS RENDERED IN JUSS.
REED-MATTING COVERED EXTERNALLY WITH JUSS PLASTER AND OITUMENED.
WALLS RENDERED INTERNALLY WITH JUSS AND SAND.
6" WELL RAMMED EARTH.
R.C.C. TILES LAID IN CEMENT MORTAR ON 1½" SAND.
R.C.C. ¾" CEMENT MORTAR (1:3).
3 COURSES BURNT BRICKS IN CEMENT MORTAR.
MUD BRICK WALL IN MUD PLASTER.
MUD PLASTER AND TIBBEN RENDERING
RIBS FORMED OF JUSS PLASTER CHANNELS IN TWO PIECES AND REINFORCED WITH 2 No. 8 SWG. DATE PALMS IRONED OF CHANNEL FILLED IN WITH JUSS AFTER ERECTION.
JOINT IN RIB CHANNEL
BITUMEN FINISH
DOORS AND WINDOWS IN GABLE ENDS ONLY. ARCHES AND REVEALS IN BURNT BRICK.
A
B

FIG. 2.



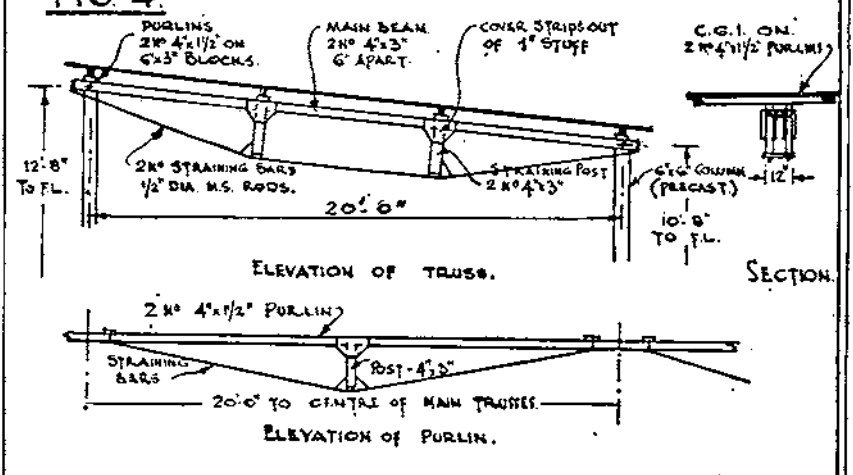
WARREN GIRDER TYPE ROOF TRUSS — IN BALLIES.

FIG. 3.

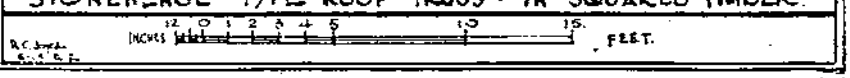


BELFAST ROOF TRUSS — IN BETA PACK TIMBER.

FIG. 4.



"STONEHENGE" TYPE ROOF TRUSS - IN SQUARED TIMBER.



source of danger. A certain number of failures, none of them tragic, did occur this way.

Another improvisation, familiar throughout the Middle East, perhaps worth describing here for the benefit of some readers, were roof trusses made from " ballies " and from " Beta Pack." Ballies are poles, hard wood or soft (poplar), varying from 4 in. to 9 in. mid diameter and 10 to 30 feet long.

Standard designs for Warren girders made of ballies were generally successful (see Fig. 2).

Beta Pack is material saved from the packing cases in which vehicles and machinery from America arrived in this country, and the immediate sources of supply are Vehicle Assembly Units. The material varied from good straight-grained pine, 5 in by 2 in. by 20 ft. or over, to scrap match-boarding 5 in. by $\frac{3}{4}$ in. by 3 or 4 feet. Most of it was $\frac{3}{4}$ in. by 5 in. by 10 feet or so.

From the latter a variety of Warren and Belfast trusses were made in spans of 20 to 60 feet (see Fig. 3), and were generally successful. Where there were failures it was a case of trying to make do with such very short lengths that it was difficult to distinguish between cover-plates and main members, or of brittleness in the short pieces, or careless nailing by contractors. Supervision and inspection are everything in this kind of production.

Lastly, there are the famous " Stone-Henge " structures :—store-sheds and verandahs made with reinforced concrete stanchions and concrete beams and purlins ; or, more usually in Iraq, with " Stone-Henge "-type wood trusses and purlins, covered finally with C.G.I. sheeting (see Fig. 4). These wood Stone-Henge trusses were not altogether a success ; the " Posts " had a tendency to turn over so that the tension came off the tie bar and the truss then failed. The design does not allow for a layer of mud on the C.G.I. which would make a cooler roof and one less liable to blow away. As it is, whenever there is a storm, it is the Stone-Henge roofs which become airborne. A particularly unfortunate expedient, due to the shortage of the right stuff, was the substitution of a number of strands of barbed wire, windlassed tight, for the $\frac{1}{2}$ in. round MS straining bar. This always gave trouble in the end.

More could be said on the subject of improvisation—of buildings made from petrol tins and from various sorts of native matting and fencing. In conclusion a description of a native wall seen in Bahrein, said to be common practice and very successful, may be of interest.

Here, a wall framed of ballies wound with a grass rope (to form a key) was filled in and finally plastered over with juss. The filling consisted of flat slabs of coral, something like crazy paving but crazy in three dimensions. Each piece was stuck in place with juss mortar, the mason (himself precariously supported on a rickety scaffolding) maintaining sufficient stability to hold the piece in place until the juss set. As the pieces of coral only met at one or two points, there was a lot of filling to be done with smaller pieces. But the result, flushed up and finished off with juss plaster, was good and stronger than lath and plaster.

GREEN PAINT

By K. S. Verdad.

ONCE upon a time there was a Sapper Subaltern who was troublesome. Troublesome Sappers are not entirely unknown, but this particular Subaltern was gifted. His name has not come down to posterity, and it is not even known whether he be still alive. If so, he is probably in a high position in one of those Ministries where the gift of being troublesome is more highly rewarded than it is in the Army. So we will call him Brown—Lieut. G. Brown and hope for the best.

Throughout the period of the episodes described below, Brown was Garrison Engineer in a small out-station on the N.W. Frontier (we will call it Kurramshah) which lay well outside what might be described as the C.R.E.'s zone of blast. The journey from H.Q. took two days by tonga, and the road was not infrequently unsafe through the playfulness of the local tribesmen, so that Brown saw his chief not more often than once a month.

But they corresponded officially, and it was the correspondence which first marked Brown as a somewhat unusual product of the S.M.E. He had considerable skill as a free-hand draughtsman, and occasionally illustrated his official letters with marginal sketches in Indian ink, not always relevant, nor even entirely respectful, but always minor works of art. Also, like many other artistic souls, he was given to procrastinate in mere matters of formal routine.

Now there was a rule on the Frontier that, owing to the unsafeness of the roads, the arrivals of all officials of the "Barrackmastery" (Indian euphemism for Works Services) at Kurramshah had to be reported by the next post. It happened that a Bengali clerk was posted to Kurramshah probably as punishment for some misdemeanour down-country, but no report came to tell of his safe arrival. After two telegrams, the second of them most peremptory, the arrival report came to hand. This was a half-sheet of foolscap bearing the words "Received-One Fat Babu as per margin," and signed G. Brown, Lieut. R.E. In the margin was a beautifully executed sketch of a large Bengali gentleman, complete with dhoti, large umbrella, spectacles, and a most unhappy look on his face.

Amongst the C.R.E.'s other correspondence came occasional letters of protest from a Major X, the Cantonment Magistrate of Kurramshah. Major X was apparently a somewhat humourless and livery gentleman who took even his pleasures sadly, and it was obvious from his letters that he did not consider Brown as one of them. He disliked his flippancy, his lack of respect for senior officers, and above all, his failure to pay due attention to such of his official duties as came within the orbit of the Cantonment Magistrate. Thus, he considered that a demi-official reply from Brown apologizing for some such remissness, and couched in the most correct language, was entirely negatived by a postscript in the shape of a pen-and-ink drawing of a foaming tumbler with a spoon in it, and a bottle of Eno's Fruit Salts in the background.

The cause of another protest to the C.R.E. was an incident at the G.O.C.'s annual inspection of the outstation. Major X was a stickler for the rules,

and one of these was (and perhaps still is) that every bungalow should have the name of the occupant, and his job, clearly displayed on the gate-post or other visible place. Brown had been asked politely, asked again less politely, and finally ordered peremptorily to carry out this formality, but up until the morning of the day before the Great Man's visit, when X took his daily ride round the Cantonment, Brown had not seen fit to comply. A hasty word to Brown in the Mess at lunch received the reply " Don't you worry. It'll be all right on the night."

The next morning X rode round the station with the General and, passing Brown's gate, found it still innocent of a name board. Luckily the General had noticed nothing, but X, glared up at the bungalow, very red in the face. He became purple when he saw that Brown had kept his promise. On the white-washed wall of the bungalow over the verandah were the words, in letters that all could read :—

Lieut. G. BROWN, R.E. GARRISON ENGINEER
REPAIRS PROMPTLY & NEATLY EXECUTED
ESTIMATES FREE

History unfortunately does not relate the circumstances of Brown's departure from his frontier station, but it is hard to believe that it was entirely unconnected with the incident of the green paint.

Brown had been entrusted with the rebuilding of a senior Officer's Quarter to a design prepared in the C.R.E.'s office. When the latter inspected the Quarter some weeks later he found that Brown had made considerable alterations in planning—alterations which pleased his artistic soul, but which most assuredly did not please his C.R.E. A few days later Brown received the C.R.E.'s Inspection Notes, which contained a categoric order that on no account was he in future to depart in any detail whatsoever from plans sent to him for execution.

Brown's " come-back " was an indent for ten tons of green paint. The Storekeeper brought this to the C.R.E. who wrote to Brown for an explanation, and in due course the following reply was received :—

" With reference to your letter of——, and to your previous instructions that on no account was I, in future, to deviate in any detail from plans sent to me, it will be observed that the plans of the Officer's Quarter now under reconstruction show the garden and trees as green in colour. At the estimated date of completion of this quarter the trees and gardens at Kurramshah will be brown, hence the indent for ten tons of green paint."

THE CORPS OF INDIAN ENGINEERS

COMMUNICATED BY THE ENGINEER-IN-CHIEF INDIA

The following notes on the organization of the I.E. may interest officers who have previously served in India, or who are expecting to serve in the South-East Asia Command in the future.

1. FORMATION OF THE CORPS

Sappers and Miners came into existence at the end of the 18th and beginning of 19th centuries as part of the armies in the three Presidencies of Madras, Bengal, and Bombay. Engineer officers in the three Presidencies became R.E. after the Government of India was taken over from the East India Company by the Crown, but Sappers and Miners continued as three separate Corps.

In 1931 the first Indian trained at R.M.A., Woolwich and S.M.E. was granted a King's Commission in the Indian Army (I.U.L.), and was followed later by others trained in England. In 1932, it was decided that a proportion of the Indian Cadets trained at The Indian Military Academy (I.M.A.), Dehra, should receive Engineer Commissions and that they should be commissioned into a new corps known as the " Corps of Indian Engineers." The Indian Officers trained in England became the first officers of this new Corps. To avoid confusion between these Indian Officers with King's Commissions and existing Indian Officers commissioned from the ranks by the Viceroy, the latter became known as V.C.O.'s

From 1932 also, Sappers began to be enrolled into the Indian Engineers instead of into their Sapper and Miner Corps.

2. EXPANSION AND GROUPS

Expansion for the war, which began in 1939, started initially in the Sapper and Miner Corps, and such units as a Workshop and Park Company, and a Railway Construction Company were raised by Sappers and Miners. It was realized in 1940 that it would be difficult for the three S. & M. Corps to compete with the whole production of the many and various types of Engineer Units which would be required by the rapidly expanding Indian Army. Expansion of S. & M. was already considerable for production of the existing types of units, and recourse was had to civilian tradesmen for the raising of Technical Corps and Army Engineer Units, including Transportation units. Various Engineer Depots were formed to raise the new types of I.E. units :—

No. 1 for E. & M. Coys., Workshops and Stores units.
No. 2 for Railway units.
No. 3 for Artizan Works Coys. and Heavy Bridging Coys.
No. 4 for Pioneer Bns.
No. 5 for Docks and I.W.T. units.
No. 6 for Excavating Machinery units.

Towards the end of 1941, the nomenclature of "Group" was introduced for the various categories of Indian Engineers. Not only S. & M., but also Nos. 1, 3, 4, and 6 Depots became known as Groups of Indian Engineers.

Transportation units, which originally were formed under the Engineer-in-Chief, had meantime passed under the control of the Quarter-Master-General and the original Nos. 2 and 5 Engineer Depots had been re-designated as Nos. 2 and 1 Transportation Training Centres respectively.

Owing to the confusion which resulted when Labour Battalions raised by Q.M.G. were re-designated Auxiliary Pioneer Bns. the Bns. based on No. 4 Group I.E. were re-designated "Engineer Battalions" in 1942, the Group became known as "No. 4 Engineer Group" and the men of that Group became "Sappers" instead of "Pioneers."

3. Composition of the Indian Engineers.

There are three main branches of the Indian Engineers controlled respectively by the Engineer-in-Chief, the Quarter-Master-General and the Chief of the General Staff. These branches of the Indian Engineers include the following groups,

(*a*) Under the Engineer-in-Chief :—

Q.V.O. Madras Sappers and Miners Group, Indian Engineers.
K.G.V's.O. Bengal Sappers and Miners Group, Indian Engineers.
Royal Bombay Sappers and Miners Group, Indian Engineers.
No. 1 Group, Indian Engineers
No. 3 Group, Indian Engineers.
No. 4 Group, Indian Engineers.
No. 6 Group, Indian Engineers.
The Military Engineer services, Indian Engineers.

(*b*) Under the Quarter-Master-General :—

Indian Railway Construction and Maintenance Groups, Indian Engineers.
Indian Railway Operating Groups, Indian Engineers.
Indian Railway Workshop Groups, Indian Engineers.
Indian Transportation Stores Groups, Indian Engineers.
Indian Docks Groups, Indian Engineers (Docks and Ports Units).
Indian Inland Water Transport Groups, Indian Engineers.

(*c*) Under the Chief of the General Staff :—

The Survey Group, Indian Engineers.

4. Raising of Units.

(*a*) Units raised by I.E. Groups

The main types of units raised by the various I.E. Groups under the E.-in-C. are indicated briefly below. In addition to the units listed, there are many different types of sections raised for particular roles.

S. & M. Groups.

All divisional units I.E.
All units of similar types to divisional units employed in Corps and Army Tps.
Quarrying Coys.
Pipeline Operating units.
Army Troops Coys.

No. 1 Group.

Electrical & Mechanical Coys.
Workshop & Park Coys.
Engineer Base Workshops.
Stores units.

No. 3 Group.

Artizan Works Coys.
Bridge Coys.
Bomb Disposal Coys.
Forestry Coys.

No. 4 Group.

Engineer Bns.

No. 6 Group.

Mechanical Excavating units.

(*b*) Units raised by Transportation Service

The main types of units raised by the Transportation Service, under the Q.M.G. are listed below. There are other minor types of units and sections for special purposes. Indian Transportation units are now operating in the Central Mediterranean Theatre, Middle East, Persia-Iraq Command, and South-East Asia as well as in Ceylon and India proper :—

Railway Units

Indian Railway Survey Coys.
Indian Railway Bridging Coys.
Indian Railway Construction Coys.
Indian Railway Maintenance Coys.
Indian Railway Telegraph Maintenance Coys.
Indian Railway Operating Coys.
Indian Yard Operating Secs.
Indian Railway Control Groups.
Indian Railway Workshop Coys.

Transportation Stores Units

Indian Transportation Stores Coys.
Indian Transportation Stores (Docks Liaison) Secs.

Docks and Ports Units

Indian Docks Operating Coys.
Indian Docks Maintenance Coys.
Indian Stevedore Units.
Indian Boat Coys.
Indian Port Operating Coys.
Indian Port Construction Coys.

INLAND WATER TRANSPORT UNITS

Indian Inland Water Transport Operating Coys.
Indian Inland Water Transport Workshop Coys.
Indian Inland Water Transport Floating Workshops Coys.
Indian River Salvage Coys.
Indian Z Craft Operating Coys.
Indian Craft Erection Coys.
Indian Riveting Coys.

5. OFFICERS

The only officers granted regular commissions in the Corps of Indian Engineers are Indians who have completed a course of training similar to that of the regular R.E. Officer. During the war, many emergency commissions into the Indian Engineers have been granted to officers, both Indian and British.

In addition, types of officers serving with Indian Engineers include R.E. officers of all categories, departmental officers of the Indian Unattached List, and civilian gazetted officers.

6. BRITISH W.O.s & N.C.O.s

R.E. N.C.O.s are included in the establishment of most I.E. units, primarily to assist in trades and field engineering. A small number of Military Mechanists and Foremen of Works also serve as S.D.O.s in the M.E.S.

The India Unattached List (I.E.) includes W.O.s and N.C.O.'s drawn from all arms of the Service, who are posted to fill S.D.O. (Military) vacancies both in I.E. units and formations and in the M.E.S.

7. V.C.O.s. I.W.O.s. & I.O.R.s

Prior to 1932, each S. & M. Gp. was responsible for its own recruiting. All that was necessary when recruits were required was to send out post cards to men, who had previously come to Group H.Q. at their own expense, to be examined and have their names noted on the waiting list of volunteers for enrolment. Every man put on the waiting list was vouched for by some relative or connexion already serving in the Corps. In 1932 orders were issued that all recruiting for S. & M. in future must be done through Recruiting Officers controlled by the Adjutant-General's Branch.

All men were initially enrolled as sappers, and promotion to N.C.O., and Viceroy's Commissioned Officer, was obtained by sappers selected after good service. I.W.O.s were introduced with increasing Indianization but only a few men of this rank exist at present, since it is difficult to find tradesmen qualified for this rank who are not also suitable for commissions as V.C.O.s.

Boys' Battalions were formed in each S. & M. Gp. in 1941, and after a training period of 18 months Boys are remustered as Sappers. Such Sappers are all well educated, good tradesmen, and are a source from which many N.C.O.s and V.C.O.s are likely to be obtained.

Indian classes recruited vary with the different Groups as shown below :—

MADRAS S. & M. Madrassi classes. These include Tamil, Telugu, and Malayalam speakers. Hindus, Christians, Mussulmans, and Buddhists all eat similar food and no class distinctions are made.

BENGAL S. & M. Three main classes are enlisted :—

Mussulmans	—Punjabi Mussulmans, Pathans, and Meos.
Hindus	—of Brahmin and Chathri classes from the districts of Garhwal, Almora, Ghazipur, and Oudh.
Sikhs	—nearly all of whom are Jats.

BOMBAY S. & M. Three main classes are enlisted :—

Mussulmans	—Punjabi Mussulmans.
Hindus	—Mahrattas.
Sikhs	—Mazbis and Ramdasias only.

No. 1 GROUP & No. 3 GROUP. These groups take recruits of all classes, including Hindus, Mussulmans, Sikhs, Madrassis, and Christians.

No. 4 GROUP. Units of this Group are composed of men of the following classes :—

> Madrassis, Mahrastra Classes including Mahrattas and Mahrs, Shilpkars, Punjabi Mussulmans, Mazbi and Ramdasia Sikhs, Pathans, and Meos.

No. 6 GROUP. Most of the personnel of this group are of similar classes to those in Bengal S. & M., but the Group also includes a few Madrassis.

8. M.E.S.

(*a*) FUNCTIONS

The Military Engineer Services under the control of the E.-in-C. are responsible for the construction and maintenance of buildings, defence works, and airfields, together with the accessory services such as roads, E/M services, water supply, drainage, ranges, furniture, etc., and also the internal fixtures required by the Naval, Army and Air Forces.

The normal method of execution of works in India is by Contract and for this officers down to the appointment of Garrison Engineers are given certain powers of acceptance of contracts.

In certain cases work may be carried out by labour directly supervised by M.E.S. Staffs. This is the normal method in operational areas where mobilized Ind. C.R.E. Works and Ind. Works Sections carry out work with military transport and military labour, supplemented by local labour when available.

(*b*) COMPOSITION

The M.E.S. includes officers, both R.E. and I.E., besides officers of other types indicated in para 5. Subordinate personnel are mostly civilians, though a few of the senior subordinate ranks may be held by R.E. and I.E. personnel as indicated in para. 6. Civilian subordinates may be British, Indian, or Anglo-Indian, and of any religious class. The civilian subordinate grades include S.D.O.s Surveyor Assistants, Overseers, Superintendents, Supervisors, Clerks, Storekeepers, and Draughtsmen.

(*c*) M.E.S. DEPOT

This Depot, established at Jullundur, maintains the records and accounts of M.E.S. subordinate personnel on the war system of accounting. These are mostly men employed in I.E. units in the field, but M.E.S. personnel in concessional areas also have their accounts maintained on the war system.

The M.E.S. Depot also holds a pool of M.E.S. subordinates from which the reinforcement demands, submitted through G.H.Q. 2nd Echelon, are met initially.

9. THE SURVEY GROUP I.E.

(*a*) Before 1940 there was no military Survey service in India. All surveys and mapping for military purposes were carried out by the Survey of India, which is a civil department corresponding to the Ordnance Survey of the U.K. About thirty military officers of the R.E. and I.A., and a few trained Indian soldiers, were on civil duty with the department.

For generations the Survey of India had provided detachments of Surveyors for practically every military campaign or expedition on and beyond the Indian frontiers. These detachments remained civilian, even including the military officer in command, but were attached to the army for supplies and transport.

This arrangement persisted throughout the war of 1914-1918, detachments from the Survey of India being sent to Macedonia, Mesopotamia, and Persia. In no case were Indian military survey units raised on the lines of the British Field Survey Companies and Battalions.

The necessity for such military units was recognized some time later, and by 1939 provision had been made for military survey units suitable for service with Indian forces, that were to be raised and equipped by the Survey of India. Regular military training was given to selected officers of the Department with a view to the handling of these units.

(*b*) In 1940 a Survey Depot I.E. was formed, and a start was made in the raising of a limited number of units from the few regular military officers and surveyors in the Department and from the many volunteers from the civil staff. Several units proceeded overseas in 1941; a Director of Surveys was appointed at G.H.Q. from the Surveyor-General's Staff, and an army Survey Directorate was formed in Iraq.

Since the entry of Japan into the war in December, 1941, the Survey Directorate has greatly expanded, and a large number of Survey units of a diverse nature has been added. At the same time the civil department of the Survey of India has been further expanded and even more fully harnessed than before to the war effort, with increased staff and machinery. Its main responsibilities are the training of technical staff of all classes, both for military and civil employment, and for the drawing and printing of maps for the military needs of India and the East. Whilst the Surveyor-General is responsible for this whole effort, one of his officers fills a dual role as Director of Surveys at General Headquarters, and Director, Military Circle, in the Survey of India. The retention of civil status is particularly valuable in facilitating the flow of trained technical personnel from the Survey of India, and in safeguarding their civil rights of the men who are enrolled or commissioned in the Army, but retain their position in the Civil Department.

(*c*) Officers for the Survey Group I.E. are found from the following sources:—

Military Officers of the Survey of India, R.E., I.E., I.A., temporarily reverted to military duty.

R.E. Officers from the U.K.

I.A. and other Officers, with previous suitable experience, who are given a short course with the Survey of India before being attached to I.E. (Survey Group).

Gazetted Officers from the Survey of India, who are granted commissions into the I.E.

(*d*) Viceroy's Commissioned Officers and Havildars are found firstly from the non-gazetted technical staff of the Survey of India, who are granted military rank in accordance with their civil status. To supplement this source, soldiers are drawn from the Indian Army and attached to the Survey of India for training. Those who qualify at the end of twelve months are in due course posted to military survey units.

Soldiers below the rank of Havildar are drawn from the lower ranks of the Survey of India where suitable, but mainly from certain districts of India allotted to the Survey Group.

(*e*) The Survey Group I.E. comprises the following :—

The Survey Depot ;
Survey Directorates serving with military formations ;
Indian Field Survey Companies ;
Indian Air Survey Companies ;
War Supply Units ;
Survey Park Sections ;
Drawing Sections ;
Map Reproduction Groups and Sections ; etc.

10. TRANSPORTATION

The Transportation Service in India began in May, 1940, when a railway Construction Company was formed by the Madras Sappers and Miners.

In June, 1941, a Transportation Directorate was set up, under Q.M.G., for Transportation planning. This was followed in August, 1941, by the conversion of Nos. 5 and 2 Engineers' Depots into Nos. 1 and 2 Transportation Training Centres as already mentioned. No. 1 Centre deals with Docks and Inland Water Transport training and No. 2 is for Railway trades.

At this date also the Transportation Directorate took over from the E.-in-C. stores provision for items peculiar to Transportation. Depot holding, issue, and shipment remained an E.-in-C.'s responsibility until in May, 1942, a Central Transportation Stores Depot was created, which was followed by other depots until by the end of 1943 almost all depot holding of Transportation stores was a Transportation responsibility.

Following the institution of the Transportation Training Centres, Technical Training Groups were organized on the civil railways who provided Instructors and all facilities and accommodation.

Later similar organizations known as Technical Training Battalions were formed at various ports for the training of Docks and Inland Water Transport personnel.

These technical training units are under the control of the Commandant of the appropriate Training Centre, all arrangements between the Centres and the civil agencies being co-ordinated by the Director of Transportation.

After technical training at a suitable group recruits are trade tested and classified and then proceed to the parent Transportation Training Centre for military training. Military Training Wings were added to the Training Centres for this purpose. On completion of the whole of his training the soldier is posted to a unit or held in the Training Centre pending formation of a new unit at the Centre.

By this means the Transportation Service has raised units for Railways, Docks, Inland Water Transport, and Transportation Stores employment, covering operation, construction, repair and maintenance in each branch as required as detailed in para 4 (*b*).

Initially, recruiting was carried out direct by the Technical Training Groups and Battalions, but subsequently all new entrants and direction of intakes were dealt with by the A.G.'s branch as with other arms.

The arrangements respecting enrolment and commissioning of personnel and the general organization of Transportation units are now in line with those for other Engineer units as described in sections 5, 6, and 7.

The operation of transportation agencies in India itself is a civil function and the principle task of the military organization has been to raise a Transportation Service for employment elsewhere, and a large number of units has been despatched to other theatres. The Transportation Directorate does, however, advise departments as to military requirements and assists with the provision of Transportation stores, e.g. permanent way, locomotives, etc., for civil use to facilitate handling the additional load of traffic under wartime conditions.

In some cases the Transportation Directorate has carried out, with troops of the India Command, works and operations in the territory of South-East Asia Command to the requirements of the Commander of that theatre, this arrangement being convenient for geographical reasons. These functions are controlled by the Ops. section of the Directorate which was formed at the period of the threatened invasion of India proper to govern the disposition of personnel and stores in the zone of active operations.

Pending despatch elsewhere Transportation units are located where they can be of most assistance to civil agencies, particularly in areas liable to experience difficulties as a result of enemy action. To give closer control and maintain direct liaison with the civil organizations, the immediate direction of the activities of these units is decentralized among sub-branches of the Transportation Directorate located at various centres of transportation activity.

When the defence of India scheme was inaugurated considerable numbers of the staff of the civil agencies were organized into units on a military basis under the general supervision of the Transportation Directorate. As a further precaution the personnel of suitable military Transportation units were made available for employment as " Railway Servants " to assist in the operation of Indian railways where necessary owing to the evacuation of the civilian employees.

Another contribution of the Transportation Service in India to the general war effort has been the releasing or seconding for employment with the civil railway and water undertakings of a number of suitably trained and experienced officers, both I.E. and R.E.; there have also been cases where officers have gone from Transportation for service with the Royal Indian Navy.

SAPPER OR CIVILIAN?

By Maj.-Gen. A. G. B. Buchanan, M.Inst.C.E.

SHOULD the Works Services for the Army be staffed by the Royal Engineers or by civilians?

This is a controversial subject which is always cropping up and it may be useful to examine briefly yet once again the pros and cons from a point of view as nearly unprejudiced as possible.

In the first place we have had plenty of experience at the job. In the D.F.W.'s office there is a board showing the names of Chief Engineers of England, Inspectors-General of Fortifications, and Directors of Fortifications and Works from 1627 to the present day. While one is not sure as to the functions of the Chief Engineers of England, it is quite certain that under the I.G.F.'s (1802-1904) a Works Service was maintained on lines not dissimilar to the present one. In the notes on "An Old Letter Book" published in *The R.E. Journal* in June, 1942, we saw that at the time of the Crimean War there were Clerks of Works, Surveyors, and C.R.E.s much as at present. Netley Hospital was built at this time.

It is submitted that on the whole the Army has been well served by us and would be sorry to see us give up the job; on the other hand we must remember the words of Kipling,

"We build them nice barracks, they swear they are bad."

Now for a "con." Both Admiralty and Air Ministry Works Services are staffed by civilians; why should not the Army copy their example?

In any theatre of war outside this country all Works Services are perforce undertaken by R.E. This would be impossible unless the R.E. had experience and training at the job. If the Army Works Service were civilianized, there would be no opportunity for this.

"Ah," say the critics, "but in war the Regular Army is rapidly expanded by the Territorials and the civil population, and it would be easy to form a Works Service for a foreign theatre." It is true that this could be done in time, but what would happen at the start before these people were mobilized and learnt their job?

This answer appears to be conclusive, but let us proceed. Would the Army at home in peace-time be well served by a Civil Works Service?

Before attempting to deal with this question it must be borne in mind that there are two possibilities:—

(*a*) A Civil Works Service under the direct control of the War Office similar to that which functions for the Air Ministry.

(*b*) All engineering and building work to be undertaken for the War Office (and all other Government Departments) by a separate organization.

Let us first examine (*a*).

In the early part of this century an attempt was made in this direction by the introduction of a Civil Director of Barrack Construction to undertake all new work of any magnitude, leaving minor works and maintenance to the Corps. This experiment was not successful and was abandoned after a short trial. It is unnecessary to go into the reasons for its failure, and the fact is only recorded to show that in the past mere conservatism has not been allowed to prevail.

There are certain works of an essentially military character, e.g. those in connexion with fortifications, ranges, defences, and training establishments which are obviously better served by a military engineer than by a civilian. Furthermore the work of repair and maintenance of military buildings is so intimately connected with military arrangements and activities that it is difficult to see how a civilian organization could cope with them as well as a military works service. Doubtless a civil staff would acquire the necessary knowledge and background in the course of time, but this does not appear to afford a good reason for upsetting the existing service. It is very much to be doubted whether Commanders and staffs would get service from a civilian body comparable to that which they now enjoy.

The protagonists for change usually make much of the argument that the civilian is more competent professionally than the sapper. It is certainly true that sappers are not expert architects for example, nor should they be. But they can and do employ architects where necessary. One has only to look at some of the recently constructed barracks to see that the standard of architectural merit is by no means low. Public money does not allow for " frills." It is certainly more economical to call in the expert where his services are essential than to maintain a corps of experts.

We will now take (*b*) the second possibility.

It has been suggested that the whole of the building work of the country should be supervised and carried out by one single organization or Ministry. It is claimed that this would produce economies through a central control of labour and materials and also in overhead staffs. At first sight the idea possesses some attractions, but the following points must be remembered :

(i) The War Office would still require a works staff both for planning, i.e. translating military requirements into terms of bricks and mortar, and also for liaison with the civil organization concerned. Hence the saving in overheads would not be so great as might at first be imagined.

(ii) The volume of building and engineering work, especially in the period of reconstruction after the war, will be so great as to be incapable of being controlled by a single organization in London. Extensive decentralization would be necessary. This might of course be achieved in a regional direction, but if it be accepted that decentralization is necessary why not decentralize to user Departments as at present, and avoid the tremendous disturbance which the new departure would create ?

(iii) The War Office would not be master in its own house as regards works. If the execution of work were in the hands of a separate civil organization urgent Army Works would have to compete for priority with those of other Ministries, the difficulties of secrecy would be much enhanced, and experience shows that it is not long before an executive claims a voice in shaping policy.

(iv) The arguments against civilianization noted under (*a*) hold good.

There are in addition two other points for notice. Training in the works service has a great value for the sapper officer. It teaches the essential duties of organizing work, managing men, and financial responsibility. It is true that much of the work in peace time is of a pettifogging kind, but it is quite possible to learn a lot from even the proper maintenance of barracks, and opportunities for larger works especially overseas constantly occur. Furthermore the rank and file get a most essential opportunity for practising their trades. The works service therefore could not easily be replaced as a training ground for the sapper.

So far we have only considered works at home and in theatres of war, but there are also those in our colonies and other foreign stations. It would be possible in course of time to set up a civil organization to deal with these, but experience shows that it would be expensive. The soldier can be sent anywhere, the civilian must be paid his price for bad climates and other risks. A sudden emergency like the despatch of the Shanghai Defence Force would be apt to produce chaos.

Readers of the address given by Lt.-Gen. John C. H. Lee, U.S. Army to the Institution of Civil Engineers, and published in the June, 1944, issue of *The R.E. Journal* will remember that the United States Government entrusts to the Corps of Engineers not only work for the Army but also the improvement of harbours and navigable waterways. Though it would be interesting to speculate on the reactions produced in this country by a proposal that the R.E. should take over the control of certain large public works, such mental exercises are outside the scope of this article.

We can now sum up the arguments for and against civilianizing the works service.

Pro.

1. Greater technical efficiency, and hence a higher standard of work.
2. Saving through central control of labour and materials
3. Saving in overhead staffs

} if all works controlled by a single civil organization.

Con.

1. Work of essentially military character best controlled by soldiers.
2. Saving in 3 above is not so great as first imagined.
3. War Office not master in its own house.
4. Loss of essential training ground for sappers.
5. Increased cost of providing foreign staffs.
6. Disturbance due to change, and loss of long experience of Corps.

The above are the main arguments. It can be claimed, I think, that they have been fairly put. The answer is now left to the reader's judgment.

FITTING THE ARMY BACK INTO BARRACKS

(An Extract from unpublished Corps History)
Compiled from the Work of Various Authors

WHEN the Great War ceased in November, 1918, the Royal Engineer works service was faced with some very difficult problems, from 1919 onwards, in fitting the army back into barracks.

The Government's policy regarding the size, organization, and location of the army necessarily remained indeterminate for some years. There were high hopes that the Millennium was arriving, and that the League of Nations would enable us to reduce our Forces to vanishing point: that point was nearly reached but not the Millennium.

In 1919 there was a violent reaction from the lavish outpouring during the war of money on the army. Every penny was now grudged for a Force whose future existence was in doubt. There was, therefore, great delay in obtaining rulings on policy for building from the Treasury, except that there was little money and that there would be no big war for ten years, a policy which was not reversed till 1934.

The army that returned from the war was very different in organization from the army that left its barracks in 1914. Two new Corps, the Royal Signals and the Royal Tank Corps, had emerged and were to continue. Although the Machine Gun Corps, created in the war, ceased to exist as a separate organization, the numbers and importance of M.G. detachments would be permanently increased and a special school to develop their training and doctrine was required. For this purpose sacrilegious hands were laid on the Cavalry School at Netheravon, which the R.E. were required to convert to this very different purpose, while the Cavalry were told to squeeze their school into the Equitation School at Weedon, a hunting paradise hitherto exclusively reserved for the Gunners, and one R.E. officer who, on his return from hunting, attended to their barrack accommodation. Gunners and Cavalry at Weedon concentrated on the Sapper to demand more accommodation.

The treaty with the Irish Free State caused us to abandon barracks which, before the war, had housed a whole Division and many departmental units who now sought a home elsewhere.

There were many lesser changes in army organization which necessitated the revision of accommodation.

Numerous hutted camps had been constructed during the war all over the country, and the public demanded to know at once whether the Government intended to retain and purchase the sites; and, if not, how soon they would be re-instated completely to their pre-war condition. In the absence of a clear-cut Government policy about army matters, the fate of several hutted camps remained in doubt, but for the large majority orders were given to the R.E. to complete re-instatement with the least possible delay.

During the 4½ years of war, labour and materials could not be spared to maintain barrack buildings which were now much in need of repair, but money for the purpose was not forthcoming on the scale required.

The war had killed off large numbers of skilled building artisans, and the apprentice system for training up the next generation had been in abeyance. The fortunate survivors were able to demand high wages, but were far too few to compete with the requests from the whole population for buildings. The manufacture of building materials, other than those required for war purposes, had almost ceased. For instance, for several years there was an acute shortage of bricks, and this led to research for suitable building substitutes. Ingenious productions came upon the market but it is noteworthy that nothing was found so suitable as bricks for living accommodation.

Under these circumstances, it is not surprising that building costs for four or five years after the war were exactly *three times* the pre-war rates. Consequently, the sums doled out by the Treasury to the Army for building and repairs would only produce one-third of the amount of work that we were accustomed to expect. From about 1924 building costs slowly dropped till they reached a satisfactory level in 1935, since when they have tended to rise again.

In the absence of definite rulings on permanent policy as to the size, organization, and location of the Army; and owing to the shortage and high cost of building labour and material, and the unwillingness of the Government to provide money, it was necessary to adopt many building expedients that we would have preferred to avoid. The meagre supply of expensive bricks was utilized in a type of building known as "light construction," i.e. a light steel skeleton filled in with brick panels only 4½" thick and the whole covered with rough-cast, or single-storey buildings with brick piers and 4½" brick panels. This form of construction is quite weatherproof but the interior, although provided with fireplaces is somewhat chilly in the winter. For young, hardy soldiers in barrack blocks, and for very many army buildings, this type of construction served its purpose very well but it was not used for married quarters.

Great use was made of existing war huts but with adaptations and improvements to make them more habitable. Every war leaves the army a legacy of huts. There was a superabundance of huts of the Great War; but, in addition, many sites in barracks were still occupied by a much better type of corrugated iron hut on brick foundations, erected during the South African War, and even a few Peninsular and Crimean huts were still doing duty. Some concrete huts had been erected in the Great War of various types. Of these, many, notably at Catterick, were of exceedingly light construction, thin reinforced cement panels between light steel uprights, so that the whole hut swayed in a gale and cracked. The meagre supply of bricks was used to surround these huts with a brick wall 4½" thick between piers, leaving an air-space between the old and the new walls. Brick foundation walls, brick fire-places in every hut, and brick sanitary annexes and wash-houses connecting pairs of huts, made them much more habitable. Rubberoid on the roofs gave them a life of another 10 to 15 years.

In 1924, after considering the matter for five years, the Government at last agreed that the War Office had proved the necessity for the establishment of a permanent cantonment at Catterick to replace a portion of the accommodation abandoned in Ireland. Provision of funds, however, was limited to £1,150,000. Building prices were still high so the estimate was drastically cut, and building expedients adopted to provide the accommodation which was becoming exceedingly urgent. Catterick was built to house most of the 5th Division, and the new Signal Corps Depot with its Training Centre.

The Signal Units at Aldershot were given new barracks on the site known

Modern Improvements in Barracks

In spite of the financial and building difficulties of post-war years which have been recounted, the Army Council, from the very beginning of the peace, determined to effect considerable improvements in the scale of accommodation and amenities in barracks. These were carried out with commendable speed. The first demand was for the abolition of the age-old custom of the men feeding in their barrack-rooms, the food being carried for some distance across the open from a cook-house, and placed congealed before the soldier, who required a very healthy appetite to consume it in that condition. Separate dining huts attached to existing cook-houses were at first provided. These were quickly followed by permanent dining establishments specially designed and built complete with modern cooking installations, hot plates, and wash-up rooms with mechanical washers.

The next great improvement was the replacement of gas lighting by electric light. If the scale of electric lighting was somewhat below the desired standard it was an enormous advance on the gas lighting of the type hitherto serving barracks.

One of the greatest improvements affecting the comfort of the soldier was the inclusion within the barrack block, or in an annexe, of washbasins and W.C.'s, previously at a distance.

The provision of recreation grounds for troops had formerly been a matter for regimental initiative and funds. It was wonderful how much had been provided under this system, especially at Aldershot under the stimulation of General Sir Horace Smith-Dorrien during his command there, but in 1921, thanks in great part to the untiring efforts of General Sir Charles Harrington, the War Office definitely assumed responsibility for providing recreation grounds as part of their Works programme, and a suitable scale of provision was laid down. Annual allotments for this purpose have enabled the authorized scale to be reached in most places, the Royal Engineers being responsible for this work as part of their Works Service.

Regimental Institutes and N.C.O.'s Messes were much improved and enlarged. Hot and cold shower baths and slipper baths were provided for the men.

Great improvements have been carried out since the war in the married quarters of other ranks. Quarters which contained only one bedroom, known as " A " quarters, almost ceased to be built. The general type was now " B " quarters with two bedrooms convertible into " A " or into " C " (with three bedrooms) as required. A large number of quarters were built at all stations. Sanitary annexes were included in all married quarters so that the dreadful system of a communal W.C., at some distance from the quarter, disappeared. Baths and hot water supply were also provided.

Accommodation for married officers was put on an entirely new footing. Before the war only the commanding officer and the quartermaster were given married quarters in barracks; all other married officers had to make what arrangements they could to house their families, often at great expense. The national shortage of housing after the war frequently made it impossible for an officer's family to join him, and those that did might have to put up with exceedingly restricted accommodation. In 1922, the War Office decided to play their part in reducing both the national housing shortage and the inconvenience to officers, by providing married quarters in or near barracks for roughly one-third of the establishment of officers.

The high cost of building caused the accommodation provided in the quarters to be somewhat limited, but it was a vast improvement on the accom-

modation previously available for officers. An annual allotment for this purpose has gradually but considerably increased the accommodation for officers' families.

These are only some of the many improvements in barrack accommodation effected since the war, in spite of the difficulties in obtaining money, labour, and building materials. It required considerable perseverance and ingenuity on the part of Royal Engineer officers employed on Works Services to get them done.

The shortage of bricks and money after the war, and the consequent necessity to adopt building expedients, and the great rush to have accommodation ready for the returning Army caused the question of the most suitable and agreeable form of architectural design to receive scant consideration.

But in 1929, when administration was becoming more normal and Major H. E. Moore, D.S.O., M.C., R.E., took over the design branch at the War Office, the architectural appearance of new Army buildings received close attention and the most happy results soon became very noticeable.

It was found that a simple Georgian treatment was generally appropriate, correct proportions and a proper choice of materials being relied upon to give the desired architectural effect.

The reprinting in 1933, of the Handbook of Design and Construction provided a welcome fillip to interest in Works Services, and the compilation of a series of attractive standard designs enabled real progress to be made in stimulating a desire for architectural quality in W.D. structures.

Less frequent became the combination of red brick, blue slates, and red ridge tiles, which at one time threatened to become the hallmark of barrack construction.

Asbestos cement slates were forbidden in roofs of permanent buildings, and sandfaced tiles surmounting multi-coloured brickwork became the order of the day, while encouragement was given to the improvement of existing structures by the planting of non-injurious creepers.

Meantime steady pressure was being maintained by the Synopsis Committee at the War Office to bring living conditions of all ranks into line with contemporary civilian standards.

The Economy Campaign of 1931-33 caused a temporary set-back in all proposals for such improvements, but by 1934 it began to be realized that, unless these were again taken in hand, recruiting would be adversely affected. In 1936, came the Sandhurst Block in which a central dining room was incorporated in the same building as the living quarters, and baths (h. and c.) were included in the sanitary annexes, also such additional luxuries as wardrobes, equipment cleaning rooms, suitcase stores, drying rooms, and hot water to lavatory basins. Sitting rooms also made their appearance next to the barrack rooms at the expense of N.C.O.'s bunks which were promoted to the Serjeants' Mess.

About this time steps were taken to introduce central heating throughout barracks, steam or hot water being circulated from a central boiler-house. Successful efforts were made to improve the design and quality of fittings generally, cooking appliances particularly being modernized by the introduction of steam cooking for larger installations, and heat storage ranges for messes and officers' quarters.

Steady improvement in accommodation in Serjeants' Messes, and in the Corporals' rooms of Regimental Institutes accompanied these developments, while the married families benefited by the provision of recognized Children's Playgrounds and greater recreational facilities in the Army Children's Schools.

as Smallshot, accommodation was also provided for them on Salisbury Plain and at Colchester. The Tank Corps was housed in a war hutted camp at Bovington much improved by adaptation and considerable additions.

The situation at home, created by the foregoing difficulties, would have been quite impossible if the whole regular army had returned to barracks immediately the war was over. Fortunately, it was very busy abroad for some years and returned piece-meal. It was occupying the Rhineland, portions of the Turkish countries, and many other places, creating for the Royal Engineers a very varied set of problems in temporary accommodation abroad which were solved in many different ways.

In Egypt, many of the older barracks, which had been taken over from the Egyptian Army in 1882, were in a state of dangerous disrepair; while the new cantonment at Moascar, and much of the accommodation at Abbasia, consisted of huts unsuitable for the climate during peace. Here again policy was indeterminate. A treaty with Egypt, which was not concluded until 1936, was under consideration long before that date. This treaty would have required us to evacuate the barracks in or near Cairo and Alexandria and build new ones in the Canal zone. This naturally caused us to hold our hands on building to remedy the unsatisfactory accommodation, except with temporary expedients.

Returning to the Home Country in 1926, it was realized that it was essential to look ahead and provide for the eventual collapse of the reconditioned huts. Although Army estimates were still being cut down, it was decided that a quarter of a million pounds must be provided annually to replace reconditioned huts of the Peninsular, Crimean, South African, and Great War architectural periods by permanent buildings of really satisfactory modern type. With building prices now falling it was calculated that £5,000,000 spread over 30 years would probably complete the programme. At that time it was quite impracticable to expect the Treasury to speed up the programme by a more generous annual provision.

From 1927 onwards, mechanization of the Army increased rapidly. Whilst this was in the experimental stage, garages were at first provided in temporary structures, or by conversion of stables, but the fluctuating establishments of experimental units made it difficult for the R.E. to ascertain the scales of accommodation required. Large central Mechanical Workshops were required by the R.A.O.C. and provided at Aldershot, Tidworth, Catterick, and Colchester. A big war-time munition factory at Chilwell, near Nottingham, had fortunately escaped disposal and was adapted to serve as a central R.A.O.C. depot.

An aerodrome at Feltham was converted for use as a mobilization depot and workshops for the Motor Transport of the R.A.S.C.

In 1931 and 1932, the financial crisis caused a slowing down in improvements to barracks.

In 1933, it was realized that our defended naval bases throughout the world could no longer remain in the denuded condition to which they had been reduced by the policy of no big war for ten years. In 1935, there was a possibility that that period might be reduced to ten minutes. Increased accommodation and defences overseas became a very urgent matter, throwing a considerable strain on the Royal Engineer works service. The work done at Singapore and Hong Kong from 1928 onwards is told separately as a sample of what is implied in bringing an overseas fortress up to date. At the same time, the coast defences of naval ports at Home were being modernized and equipped.

Several interesting campaigns were waged to improve the conditions under which officers were housed, basins (h. and c.) in bedrooms were at first strongly resisted on the ground that they would become slopsinks—or worse! They were generally authorized in 1935. An effort to provide a more liberal scale of built-in furniture was defeated owing to the loss of furniture allowance that this would entail.

Garages were incorporated (nominally on a rental basis) in group IV and V quarters in 1936; and a second bathroom for a group III quarter, and a dressing room in a group V were approved about the same time.

The year 1936 saw the beginning of the vast building programmes which had to be undertaken in circumstances of extreme difficulty.

As shown above, building designs were in a state of flux. Junior R.E. officers were practically unobtainable for duty in the Works Services, but many retired R.E. officers were recalled for this duty. The organization of the army was in process of radical revision and no one was qualified to indicate with certainty the size or nature of the units for which accommodation should be provided.

This brings us to the period of "Re-armament" which threw a great strain upon the Works Service as indicated by the astronomical figures of annual expenditure thereon, still continuing. It must be the task of a future historian to relate the events of this period when it terminates, and to record the remarkable efforts of the Director of Fortifications & Works and his staff at the War Office and of Chief Engineers and their personnel in all Commands at Home and Abroad, to take their full share of the strain thus thrown on the whole Empire.

Note—The reader will find all the information he requires about the proposals for barrack accommodation, and the history of the subject in the past in articles published in *The R.E. Journal* beginning in December, 1937. These are written by Mr. A. Lloyd Spencer, A.R.I.B.A., a member of the building design branch in the War Office.

MEMOIRS

MAJOR-GENERAL THE RIGHT HONOURABLE SIR LOVICK B. FRIEND, P.C. IRELAND, K.B.E., C.B.

LOVICK BRANSBY FRIEND was the fourth son of Frederick Friend of Woollett Hall, North Crays, Kent, out of a family of eleven children. He was born in April, 1856, and educated at Cheltenham College, where he won three scholarships, and at the R.M.A., Woolwich. At the shop he was a U.O., obtained his " rep " for cricket and football, and passed out second to C. F. Hadden (Master General of Ordnance) who took Royal Artillery. Friend was thus top of the R.E. batch gazetted in February, 1874, but antedated later to 11th September, 1873. After short periods of service at Dover, Chatham (for long course of signalling) and the Curragh, he rejoined at Chatham on H.M.S. " Hood " for a course of Submarine Mining, on the conclusion of which he was ordered to Hongkong in command of a detachment of the 33rd Company, to start the submarine mining defences at that station. He returned home in 1881 and in September, 1883, he was appointed Instructor in Field Fortification and company officer at R.M.C., Sandhurst where he remained till the end of 1884. During this time Lord Haig, Lord Rawlinson, and General F. S. Maude were cadets in his Company.

In 1884, just before his promotion to Captain, he came to Chatham as Secretary, R.E. Committee, which he held for five years. During this period many important questions were referred to the Committee, e.g., the purchase of the Brennan torpedo, the development of Templar's inventions connected with balloons, the double tool-cart for field companies, and many improvements in submarine mining, telegraphs and search lights.

In 1890 he was ordered to the West Indies to raise and train the West Indian Fortress Company, to be stationed at Jamaica, St. Lucia, and Barbadoes for engineer works. He returned home in 1893, and from 1894 to 1897, as a Major was Staff Officer at Portsmouth to the Commanding Royal Engineer, Southern Command.

In 1897 he was posted to Cairo and served in Egypt for nine years. The advance to Omdurman was being prepared and Friend was made the Staff Officer at Aswan from January to June, 1898 ; he organized a system of supply through Aswan, which proved vitally important for the subsequent operations. Friend was Provost Marshall of the force under Sir Herbert Kitchener and during the battle acted as galloper to the Commander-in-Chief. For his services, he was mentioned in despatches, earned two medals with clasps, and was given the Order of the Medjidie. For the next two years, he was employed on R.E. works at Cairo and Alexandria, and in October, 1900, now a Lieut.-Colonel, was appointed Director of Works with the Egyptian Army. " Stores " were added two years later and Friend then became responsible, according to Sandes, " for all military and civil works in the Sudan, all military works in Egypt, and the clothing and equipment of the Egyptian and Sudanese Troops." He was responsible for the completion of many buildings in Khartoum including the Palace, the Gordon College, the Mosque, barracks for the troops, and various hospitals, offices and quarters, and similar work at other places. For his services he was promoted Miralai in the Egyptian Army and received the Order of the Osmanieh. In 1904, now a Brevet-Colonel, he reverted to the British service becoming C.R.E., Egypt, until in January, 1906,

he went to the War Office as Assistant Director of Fortifications and Works. His duties included the charge of all W.D. lands, and the responsibility for the military and civil staff employed directly under the D.F.W.; he was also President, R.E. Committee.

In March, 1908 he was selected to command the Scottish Coast Defences, receiving the C.B. in 1908 and being promoted Major-General in June, 1912. In January, 1913 he was appointed Major-General in charge of Administration, Irish Command, and on the outbreak of war in 1914 was placed in temporary Command of the Forces in Ireland and was thus responsible for the formation and training of the three new Divisions which were formed there up to April, 1916. Friend was sworn a member of the Privy Council in Ireland early in 1916 and was in command of the troops during the Irish rebellion of Easter, 1916. For about a fortnight there was fierce fighting in Dublin, but Friend's measures were effective and he had the gratification of receiving the surrender of the rebel leaders on 29th April, 1916. He remained in Ireland in charge of Administration until June, 1916, when he was appointed President Claims Commission B.E.F. at G.H.Q. in France. Next year he became, in addition, Director of Hirings, Requisitions and Billets, forming this new Directorate. At the conclusion of hostilities he was awarded the K.B.E. having been four times mentioned in despatches, he was also made a Commander of the Legion of Honour and of the Order of the Couronne, and received both the French and Belgian Croix de Guerre.

He remained in France till March, 1921 as Chairman of the French Committee of the Disposal Board. Enjoying the full confidence of both governments and the British Treasury he was given full power to settle all small claims at once and for cash down. The total of such payments exceeded two million pounds. He had also to assess the value of the land needed for the 1,200 miles of broad gauge the British constructed, also the damage done to the canals by British usage.

Friend retired from the Army in June, 1920 after nearly 47 years service; he then spent some time in travelling, visiting South Africa and South America, but he made his headquarters in London at the United Service Club where he was a well-known and very popular member. He passed away on 19th November, 1944.

L.J. writes:—"Friend, whom I knew well and liked very much, was a difficult man to write about. Very quiet and reserved, he never talked about himself but seemed to take life as it came, almost with indifference. His work was always sound, but he never spoke of it or cared to discuss it. With that, always a pleasant companion.

He may be summed up as a fine type of English gentleman. Modest, but entirely efficient both in work and play, he certainly ranked as an ornament to the Corps. For his friends he is one to be remembered after others are perhaps forgotten; remembered with affection and regret."

In his early days Friend was one of those fortunate people who can play all games and play them well. He played cricket for the R.E. and was a regular member of the famous R.E. team of 1884 under the captaincy of Renny-Tailyour. Friend generally opened the batting and was well up in the batting averages, heading the list in 1885, and was the wicket-keeper of the team. It is recorded that he also played for the gentlemen of England. In 1878 he played for the Corps in the final of the Association Cup, and later represented the Corps at racquets against the R.A.

W.B.B.

Major General Rt Hon Sir Lovick B Friend PC KBE CB

Colonel Frederick E G Skey

COLONEL F. E. G. SKEY

IT is not given to everyone to work as late in life as Skey did. He became Secretary of the Institution of R.E. in 1919; served as Secretary until 1927; came back twelve years later and took up the secretaryship again until July 1943, when he was nearly seventy-nine years old. It will be of interest to many officers of the Corps to know something of the career of this brother officer of theirs, who had been so well known as an excellent Secretary and Editor of this Journal, during so many years.

Frederic Edward Guthrie Skey was born in the Close at Bristol on the 6th October, 1864. His father, who was then the precentor, afterwards became for very many years, the Vicar of Weare in Somerset. His grandfather, Dr. Skey, was a very distinguished member of the medical profession, who was at one time President of the Royal College of Surgeons. The subject of this memoir was educated at Norwich Grammar School and the Oxford Military College. He passed into the R.M.A. in 1882 and was commissioned in the R.E. on the 5th July, 1884. He was in the same batch as Hills, Macdonogh and Harper, who also, alas! have joined the majority. His few contemporaries who are left will remember Skey as a tall, fair-haired, well-built young man, not at all self assertive, helpful and with plenty of common sense, an excellent and reliable officer of the type that the Corps greatly depends upon.

At the end of 1885, on leaving Chatham, he was sent to St. Lucia and from there to Bermuda, where he joined the 12th Company R.E. with which Company he went a few months later to Gibraltar. He did not stay long here but applied to go to India and early in 1888 rejoined the S.M.E. to complete his courses—the batch had been hurried off in 1885 on account of a coaling-station scare. In India he joined the Military Works Department and served at Meerut, Peshawar, and Nowshera, and in 1895 was appointed Assistant Field Engineer on the Chin-Lushai Expedition. He says, "I spent a year in that appalling forest, in incessant rain, trying my best to keep open the hundred-mile track between Demagiri and Fort Tregear, which included five major river crossings." H. P. Leach then offered him a company in the Bombay Sappers; he joined and enjoyed his time at Kirkee, but no company command became vacant so he was transferred to the Bengal Sappers, joined at Roorkee at Christmas, 1892, and commanded A Company which included the pontoons.

In 1895, he commanded the 6th Company, Bengal Sappers and Miners, in the Chitral Relief Expedition, and was with his company at the storming of the Malakand and helped to build the trestle bridge over the Swat River. After another spell at Roorkee the company joined the Chitral garrison; then Skey went again to Roorkee, returned to England and became Division Officer at Weymouth.

In 1900, he was posted to Jamaica, where he was D.O. Port Royal, and in 1903 came home, was sent to the Curragh, and was given the command of the 5th Field Company, which was later moved to Aldershot. After promotion to Lieut.-Colonel he was appointed C.R.E. Weymouth and in the autumn of 1909, was sent to Ceylon as C.R.E. Whilst in Ceylon, during two periods, he commanded the troops, with the acting rank of Colonel, and sat on the

Executive and Legislative Councils of that Island. In 1912, he was appointed C.R.E. of the 6th Division at Fermoy. He was promoted Colonel in 1912 and retired in March, 1914, having been offered the Secretaryship of the R.E. Institute.

But the First World War broke out in August, 1914, and Skey became C.R.E. of the 33rd Division, went to France in September, 1915, and into the line near Bethune. In April, 1916, he was invalided home and finished the war as C.R.E. Dover.

In July, 1919, he was appointed Secretary of the R.E. Institute and served in that capacity for more than eight years which included the granting of the charter and the change of name from Institute to Institution. He then, at the age of 63, returned to Dover and took up Municipal work, sat on the Council and was Deputy Mayor in the Coronation year. On the outbreak of the Second World War he offered to serve again as Secretary of the Institution of R.E., and his offer was accepted. He was then about 75 and he remained in this employment until July, 1943, grappling very efficiently with the war-time difficulties of paper restriction, censorship and shortage of information.

On laying down his task for the second time, in recognition of his great services the Council of the Institution appointed him, on leaving, " Permanent Honorary Secretary ; " an honour which has never been awarded before. He still wrote for the Journal after his second retirement ; a faithful friend and loyal servant of the Institution until the end.

In 1900, he married Stephanie, daughter of the Rev. W. H. Whitting. There are five children, three daughters and twin sons. All the daughters are married, the eldest to Lt.-Col. Ord, R.A. One son is in the Royal Tank Corps, and the other, who is a Major, R.A., is a prisoner of War in Japanese hands.

This memoir may fitly include an extract from a letter which Skey wrote in July last, on the occasion of the sixtieth anniversary of his passing out of Woolwich :

> " What a panorama one can look back upon since that very hot day 60 years ago. The Corps has given us fine experiences and I think I achieved all the success I deserved. . . . .Now at length I am contented to spend an idle existence, taking pleasure daily in doing coolie work in our charming garden and glad to be still fit enough to do it. We are so glad to be at home again and these eleven months have been as happy as any I have ever experienced. The outstanding feature is the happiness of our home life. Surely no one spent a happier old age and was better cared for."

He died a few months later, in December, 1944, at the age of 80.

C.F.A-C.

MAJOR H. E. BURTON, G.C., O.B.E.

MAJOR HERBERT BURTON, of the Royal Engineers, who died at Beadnell, Chathill, Northumberland, on the 4th December, 1944, in his eightieth year was a distinguished soldier, yachtsman (he held a master's certificate of the Board of Trade) and life-boatman.

Gen. Sir Henry Lawson, in the *Royal Engineer's Journal Supplement* of February, 1925, aptly described him as a " veritable child of the Corps." He was the son of a Quartermaster Serjeant Instructor, R.E., and he joined at Chatham as a boy of fourteen in 1878. Rising rapidly he went out to the South African War in 1900 as a Warrant Officer, and in June, 1902, he was given a commission for his general good work in the field. On returning home Lieut. Burton was stationed at North Shields as a Coast Battalion Officer. He got command of the Company in 1905 and was promoted Captain in 1911. He was on the Tyne when the war broke out in 1914 and a few months later he was made Commandant and Chief Instructor of a Command School of Signalling, Field Engineering and Bombing. By the end of the war he had over 1,000 officers and men under his command. He was promoted Brevet Major in 1917 and awarded the O.B.E. in 1918.

His work as the founder and organizer of that school was brilliantly successful, but I think that it was as a life-boatman that the greatest work of his life was done. When he went to the Tyne, as a young subaltern, at the end of the South African War, he became a member of the committee of the Newcastle and Tynemouth Branch of the Royal National Life-boat Institution. This was just at the time when the Institution was making its first experiments with motor life-boats. It was largely because it had in Burton a man who was both a skilled engineer and yachtsman that the Institution decided to put its first experimental motor life-boat at Tynemouth in 1905, and Burton was made Honorary Superintendent of the boat, a post specially created for him. He had undertaken a difficult job, for the local fishermen, brought up to oar and sail, would have nothing to do with this new means of propulsion. Undismayed Burton manned the boat with a crew of his own sappers. Their success was such that eight months later a crew of local men was found to man her. They did it on the condition that Burton remained as the Honorary Superintendent. In 1911 the experimental boat was replaced by the " Henry Vernon," a boat to become famous a few years later. In her Burton won the silver medal of the Institution in 1913 when he went out in very heavy seas with only half a crew and was in sole charge of the engine. For that same service he was given the gold medal of the Tynemouth Trust. The next year came the greatest of his life-boat services.

In the third month of the war, on October 30th, 1914, the hospital ship " Rohilla," outward bound to bring back wounded from Dunkirk, was driven by a gale on the rocks at Saltwick Nab, near Whitby. She had 229, medical staff, nurses and crew, on board. Four pulling and sailing life-boats went out to her help. One of them had to be hauled over a sea-wall eight feet high. Another was lowered down the cliffs. Only one of the four succeeded in getting to the " Rohilla." She did it twice, rescuing 35, but was then so battered that she could not be launched again. The other three failed in their repeated attempts, although one got within fifty yards. This struggle went on for 36 hours, and some of those waiting on the wreck, giving up

hope that a boat could save them, attempted to swim ashore. Several reached it alive. Others were overwhelmed at once.

It was evident that only a motor life-boat had any hope of reaching the "Rohilla," and a telegram was sent to Tynemouth. The "Henry Vernon" had 45 miles to travel by night against the gale without the help of any lights, but Burton knew the coast intimately and brought her into Whitby next morning. There she took on board one of the Institution's inspectors and a supply of oil, and, just as day was breaking, put out again. She went to seaward of the wreck, discharged her oil and then raced shoreward again into the surf, turned broadside on to it, and came up under the "Rohilla's" lee. Those watching from the cliffs had many anxious moments. They saw two enormous seas roll over the wreck and fall upon the life-boat. She disappeared, but each time she rose again, and in twenty minutes all the fifty men on board the "Rohilla" had dropped into her. Again, as she came out from under the shelter of the wreck, those on the cliffs thought that she had gone when a great sea struck her broadside on and threatened to throw her on her beam ends, but she rose clear of it, still under command, and came safely into Whitby harbour.

That tremendous struggle of two days and two nights was the greatest life-boat rescue in the war of 1914 to 1918. It is among the half dozen greatest in the records of the Life-boat Service, and Burton and the coxswain of the life-boat were both awarded the Institution's gold medal, which is given only for conspicuous gallantry. Burton was also awarded the Gold Cross of Honour of the United States, which had been awarded only once before to any man in Great Britain, and a presentation was made to him by the grateful inhabitants of Tynemouth.

When the Life-boat Service completed its first 100 years in 1924, Burton, with the seven other gold medallists of the Institution still living, was awarded the Medal of the Order of the British Empire for Gallantry, for which the George Cross was substituted in 1941. In the same year he was chosen to respond to the toast of the life-boatmen of Great Britain proposed at the centenary dinner by Mr. Winston Churchill. He did it with the same confidence and skill with which he handled the life-boat against a gale. In 1927, when he left Tynemouth, he was appointed an honorary life governor of the Institution. He had then played a distinguished part in its work on the Tyne for over twenty years.

His active career was, however, by no means over. On the occasion of the great expansion of the Territorial Army in 1939 he was appointed an Administrative Officer to a Divisional Engineers at the age of 75. Some fifteen years previously Burton had been Adjutant of the 50th Northumbrian Division R.E. He was still so active and had kept up to date so well with his military knowledge that in 1939 he was again able to take on the duties of Adjutant and provided a magnificent inspiration to the many young officers who had just been commissioned. When he finally retired he joined the Home Guard!

Besides being a fine seaman and a great life-boatman, he was a powerful swimmer and he held the Bronze Medal of the Royal Humane Society for rescuing life.

It was the tragic irony of his life that he, who had done so much to save others, should have lost his own son at sea. A few months later he said: "It is a great consolation to me to know that at the hour when my lad's ship was sinking I was on duty with our life-boat crew ready for any call for our help."

His was truly a wonderful record of service both on land and sea.

C.R.S.

LIEUT.-COLONEL F. S. GARWOOD.

FREDERICK SCOTT GARWOOD, who died at Eastbourne on October 17th, 1944, was born at Meerut on November 21st, 1872. His father was Col. J. F. Garwood, R.E. and his brother John has welcomed many members of the Corps to Coombe House, Croydon. Now his son Lt.-Col. J. C. Garwood, R.E. carries on the family tradition of service.

Fred went to Marlborough and Woolwich, and was commissioned in February, 1892. In 1894, he joined the Bombay Sappers and Miners at Kirkee, and in 1897-8, took part in the operations on the N.W. Frontier for which he received the medal with three clasps. On returning to England in 1904, Garwood was appointed to the Training Battalion at Chatham, after which he was Staff Officer to Col. Ferrier in the Thames and Medway Defences. During his stay at Chatham he was Secretary of the Yacht Club for which he sold the famous old *Buccaneer* and purchased the *Fulmar*.

In January, 1909, he became Adjutant to the Lowland Divisional Engineers, and remained with them until war broke out in 1914 when he joined the 5th Division and went to France to serve under Gen. Capper. In 1916 he was commanding the 5th Field Company, and then went to Mesopotamia where he remained till 1919. After another four years in India spent at Kirkee, Ahmednagar, and Mhow, during which he was promoted to Lt.-Col. (June, 1920), he returned to England, and was C.R.E. South Midland Area at Oxford until his retirement in 1924.

As a young man Fred Garwood's chief interests were in rowing and swimming. He had the pen of a ready writer, and readers of this Journal will recall his recent articles on the origin of the R.E. settlement at Chatham, and the work of the Royal Staff Corps. He published privately several small volumes of poetry, and was a valued correspondent to his family and many friends. In retirement at Eastbourne he brought out a sprightly little journal called *The Blue Tit*, containing his close and whimsical observations on bird life in his garden as well as many articles on local historical research.

Early in the present war he was evacuated from his home at Eastbourne, and when staying with relatives near Worcester he came across the diary of his ancestor Maj. Thomas Scott, R.A., in 22 small volumes dating from 1811 to 1834. This proved a godsend to the exile. It began in Sicily, and went via Spain, Belgium, and the Army of Occupation in Paris, to Woolwich and Chatham. It was a great disappointment to Garwood that paper shortage made its publication in wartime impossible. However, he had the satisfaction of giving the old document a new lease of life, and perhaps some day his labours will make Tom Scott take his place amongst diarists of note. Tom Scott was mentioned in Garwood's article, *The S.M.E. comes to Chatham*, published in the September, 1944, *R.E. Journal*.

On October 6th, 1903, Fred Garwood married Ella Corry. He had a son and four daughters, all now married, and they gave him ten grandchildren.

In his latter years, Garwood took a generous and heartfelt interest in the affairs of ex-Servicemen. Six standard bearers from various Old Comrades Societies attended his funeral at Eastbourne to pay a final tribute to a valued friend.

A.G.B.B.

BOOK REVIEWS

(Most of the books reviewed may be seen in the R.E. Corps Library at Brompton Barracks, Chatham)

THE WAR OF 1812

By HENRY ADAMS

(*The Infantry Journal*, Washington. Price $3.00.)

During 1889-91 Henry Adams (1838-1918), great-grandson and grandson of Presidents of the U.S.A., and son of the American Minister in London during the Civil War, published a *History of the United States* 1801-17 in nine volumes. *The Infantry Journal* has obtained permission—it is a curious time to revive bad memories—to issue separately the portion dealing with the war between Great Britain and the U.S.A. 1812-14. It takes up 375 closely printed pages. Every border skirmish and every encounter between little ships is related at full length. The whole story is given adequately, at least for British readers—but lacking of course, Adams's charm of style—in 12 pages of *The Cambridge Modern History* Volume VII, "The United States."

The dust cover describes the 1812-14 war as "the unhappiest war in our [U.S.A.] history." It roused intense ill-feeling on both sides—which lasted long, and much longer on the western shores of the Atlantic than on the eastern. The excerpt from Henry Adams's history does not enter at all into the ostensible causes of the outbreak of hostilities—which were certain British Orders in Council directed against the sea commerce of France—nor does it mention the exasperation of England that in the midst of a life and death struggle with Napoleon she should be attacked by a nation of men of her own blood. Otherwise the story is fairly and truly told.

President Jefferson seized the opportunity to invade Canada and expel the last holding of British in North America. It looked an easy task; for to defend a 1,000 miles of frontier only 7,000 troops and militia were available in Canada. The U.S.A., however, entered the war unprepared and with indifferent leaders. In the first encounter the American commander and his force were taken prisoner. After much "scrapping" near the frontier between small bodies of troops, though the Americans gained command of the Lakes, the invasion entirely failed. The war with Napoleon over, reinforcements began to reach Canada, and the British invaded New York State west of Lake Champlain. The British fleet, too, at first negligible, was gradually increased until it had command of the sea, and it blockaded and harried the whole eastern seaboard of the U.S.A. In retaliation for the burning of Toronto and other towns in Canada, an expedition was landed under Gen. Ross, which burnt the Capitol and other buildings in Washington. Another landing expedition, without loss, gained possession of the north-eastern Maine. American privateers, the U-boats of those days, caused inconvenience, but the U.S.A. were exhausted, having, as Adams points out neither men nor money to carry on the conflict.

In the spring of 1814, the Americans began negotiations for peace. "Experience had not convinced the British Government that in dealing with the United States, it required the best ability it could command." The British press expressed the general surprise at the weakness of the team selected by the Foreign Office to meet five of the ablest men in the U.S.A. and it thus

"sacrificed whatever advantage diplomacy offered; for in diplomacy, as in generalship, the individual commands success." The British Government aimed at a rectification of the frontier so as to retain the gains in Maine and on the shores of the Lakes; but the Treaty signed at Ghent on the 24th December, 1814, "became simply a cessation of hostilities, leaving every claim on either side open for future settlement."

By placing the chapters on the British failure to take New Orleans before the peace negotiations, the text leaves the impression that this defeat entitled the U.S.A. to obtain their own terms. The dates require attention: actually the peace terms, signed on the 24th, were agreed to on the 19th December, 1814, and Pakenham's unlucky attack was made on the 9th January, 1815. This event was not known to the negotiators until many weeks after—in fact they signed in the expectation that New Orleans would be taken by the British if they did not sign. To balance the unfortunate set-back at New Orleans after peace had been restored, "the worst disaster [to the U.S.A.] of the naval war occurred on the 15th January," when the *President*, under Decatur, the favourite ocean hero of the American service, suffered defeat and capture within fifty miles of Sandy Hook."

J.E.E.

GRACE UNDER MALTA

By Sybil Dobbie

(158 pp. with 1 map and many illustrations; published by Lindsay Drummond, London. Price 7/6.)

Reviewers in the Press have greeted this book with such a chorus of approbation that it is difficult at this late date to find new words in which to commend it to readers of *The R.E. Journal*.

It is generally agreed that as a "War-book" it is in a class by itself; and this is, no doubt, partly because the authoress enjoyed quite unique opportunities for observing Malta in its years of greatest trial. The vividness of her descriptions and the grace of her style are beyond question; and it may be added that her book is rendered more attractive by the glimpses which it gives of the island's history,—of its former sieges, of its Knights and of its Religious Orders. The book is well-balanced and written with great restraint. The horror of the bombardments is not minimized, but neither is the comparative peace of the lulls between them; and Miss Dobbie has the saving grace of a sense of humour. Moreover, the tale she tells is full of variety, it is, to quote the *Daily Telegraph*, "a simple, human story in which comedy as well as tragedy has its place."

Well as the tale is told, however, many readers may find an added value not in the written word but between the lines. Many pages, for instance, are illumined by the expression of a quite exceptional degree of human sympathy, and the recital of Malta's fortitude furnishes recurring proof of the influence of example on courage. It was, indeed, hardly necessary for the authoress to adduce evidence of this from isolated instances observed by herself, for all readers will recognize that, although religion and tradition played their part, it was the example of the supremely brave—from the Governor and his family in San Anton Palace, through all ranks and classes, down to the small trader in his gutted shop and the peasant-mother in her shattered shack—which inspired the island with the courage to endure all things.

 T.F.

MR. CHURCHILL

By PHILIP GUEDALLA

(Hodder and Stoughton, price 8/6, 347 pp.)

"No man ever rendered greater service to his people than their spokesman in those summer weeks of 1940. Perhaps it was his major contribution to their history."

This is just one of the many forceful passages in the final chapter of Mr. Philip Guedalla's book, a chapter which he entitles "Mr. Churchill's War," and which has at its head words from Macaulay's Essay on Chatham, "My Lord, I am sure that I can save this country, and that nobody else can," and for its conclusion, "For Mr. Churchill is not far from Chatham."

It must be difficult indeed to write a biography of a man who is still with us, much more so when he is a man of Mr. Churchill's calibre and temperament. This, however, is not a biography, but a portrait, vigorously drawn on a large canvas, and executed none the less with that delicacy of touch which Mr. Guedalla has led us to expect from him.

One can say without fear of contradiction that the final chapter is the best, and this is natural, as it is only in these last few years that Mr. Churchill has come into his own, and has demonstrated to the world that amazing capacity for leadership for which his ancestry, his training, and the bludgeonings of fate, had destined him. These bludgeonings have been grievous. He has fought no fewer than five unsuccessful elections, he has suffered much from "the resentment and jealousy of mediocrity against genius," he has fallen from high office, and he has filled the depressing role of a voice crying in the wilderness. But these reverses, which would have killed the career of lesser men, have served only to stimulate Mr. Churchill. They have taught him to say as the mouthpiece of England, "We may show mercy—we shall ask for none."

It is well to be reminded, as we are in this book, that in addition to being a great war leader, Mr. Churchill is in the ranks of the great historians. "Sometimes," says Mr. Guedalla, "his keen appreciation of the drama of events led him to over-dramatize a little . . . but when the situation called for a touch of drama his method was impeccable, and nothing could be better than his treatment of Von Spee's horrified discovery of Sturdee's battle cruisers at the Falkland Islands." In Mr. Guedalla's judgment, however, *Lord Randolph Churchill* is perhaps its author's most satisfying book.

One delightful little touch must be mentioned. "His first campaign in Cuba began to satisfy a lifelong passion for active service and cigars."

With such a good book—almost a great book—it is somewhat ungracious to find fault, but there are some small points which are capable of improvement.

The quotations in the chapter headings are for the most part surprisingly jejune.

Much as we admire Kipling, the frequency with which he is quoted in the opening chapter becomes wearisome.

In a book by such a master of style it is surprising to read (p. 34), "He had overcome obstructive mediocrities as well as grave suspicions of his orthodoxy —or had he?" which recalls the language of the gangster thriller.

These are, however, trifling blemishes in a book, which though it leaves us a trifle breathless at times, is worth reading and re-reading.

A.G.B.B.

GORDON AND THE GORDON BOYS

By Lt.-Col. Seton Hutchison, D.S.O., M.C.

(Published for the Gordon Boys' School, Woking.) Price 5s.

In this attractively printed little book, Colonel Seton Hutchison has given a summary of Gordon's life which is not only skilfully compressed but brilliantly written. In 32 pages, he has sketched the life of one of Britain's noblest men in language fitted to the character he describes. The impression left after reading it is a wish that the author would undertake to write a full biography of Gordon.

The book is a memorial specially written for the occasion of the Diamond Jubilee of the Gordon Boys' Home at Woking, and it includes an account of the Home illustrated with excellent photographs. The Home is run on the lines of an English public school, and of all memorials to Gordon it is surely the most fitting and best deserving. Gordon himself could not have wished for a happier outcome of his life's work. The School at Woking has its counterpart in the Gordon University College at Khartoum, and included in this book is a letter from Sayed Sir Abdel Rahman el Mahdi, a son of Gordon's opponent, which refers to the Mahdi's respect for Gordon and his desire that no harm should be done to him.

Combined in this little book are the stories of one of the nation's great men and of one of the ways in which his memory is cherished. Gordon's life recalls dark days, when great mistakes were made and great abuses flourished, but his light shines through, and if the photographs of the Gordon Boys' School are looked at with the story of Gordon fresh in the mind as a background, the achievement reached through Gordon's example shows up as a lasting tribute to the true British way of life. The book, introduced by a characteristic Foreword by Gen. Sir Ian Hamilton, is a credit to the author and the producers.

W.H.K.

ISLAND VICTORY

By Lt.-Col. S. L. A. Marshall

THE CAPTURE OF ATTU

(U.S. *Infantry Journal*)

These two interesting booklets are published by the *U.S. Army Infantry Journal*. *Island Victory* is an account of the battle for the KWAJALEIN group of islands in the Pacific. One particular phase of this battle was described in the August, 1944, edition of the *Infantry Journal* and reviewed in the December number of *The R.E. Journal* under the heading of *One Day on Kwajalein*.

Both books have been compiled as a result of the personal interrogation of a large number of all ranks very shortly after the battle. They express the personal feelings of the men during the stress of battle and explain many small details of the fighting which may often effect major issues. This method of getting detailed information of battles should be of great value in learning lessons for the future. It provides a much fuller picture of events than the method of collecting the information from War Diaries, which are often very incomplete, and from individual officers after the War, when much may have been forgotten and many of the psychological facts get overlooked.

C.C.P.

MAGAZINE REVIEWS

EMPIRE SURVEY REVIEW

October, 1944

Brig. Sir Clinton Lewis contributes a very readable account of his experiences as a survey officer in India in the early part of this century. It includes a visit to the valley of the Apa Tanangs, a little known and most remarkable tribe which, peaceable and unarmed, occupies an area in the midst of fully armed and aggressive savages.

A. J. Morley discusses the relative merits of the methods of bearings and angles in triangulation, and G. H. Menzies continues his treatise on the M.S.E. of Point Determinations. J. E. Jackson describes a method of computing a resection which in certain conditions may be quicker than other methods.

An anonymous article which is too modestly described by the author as "a humdrum subject hardly deserving much serious thought" contains information and suggestions of the greatest value to surveyors on the subject of "The Keeping of Survey Records."

E.M.J.

GEOGRAPHICAL JOURNAL

June, 1944

This number calls to mind the question that has frequently been asked, "What is Geography?" Of the three articles which form the main part of the number, one is almost entirely Meteorological, and another is mainly Geological.

Gordon Manley reviews the climate of Great Britain, and the principal effects of its topographical features.

Thomas Hay, in an article illustrated by excellent photographs, deals with mountain forms in Lakeland.

E. P. Goldschmidt, who in 1914 was studying early printed books, mostly in Franciscan Convents in Dalmatia, describes a very interesting manuscript chart of the Caspian Sea, of date probably prior to 1525, which he found in the Convent on the island of Lesina.

There is a detailed account, for some reason not put among the other Reviews, of "Hydrology," the ninth and last of a series of monographs on the physics of the earth. This volume, the chapters of which are by different authors, is edited by O. E. Meinzer of the U.S. Geological Survey. Though subject to some criticism by the two reviewers, it is agreed to be a timely work of considerable value, as bringing knowledge on the subject up to date.

E.M.J.

THE ENGINEERING JOURNAL

(Published monthly by the *Engineering Institute of Canada.*)

The *August*, 1944, number begins with a Presidential address delivered to the Society for the promotion of Engineering Education on *The Engineering Profession Tomorrow.* The qualities and standards of its future members will be largely moulded at College, consequently a tremendous responsibility will rest on the teachers in engineering colleges. A point which was emphasized in Colonel D. Portway's article in the December, 1944, *R.E. Journal.*

Among the lessons of the war, two, the President pointed out, affected engineers directly. The first that along with other professional men—American citizens engineers were unprepared to contend with a global conflict. The second that, though engineers arose magnificently to the technical jobs the war imposed, the engineering profession found itself near complete paralysis when there was need for unified action on matters of common concern in connexion with the war effort.

The *September* number has on the cover an excellent picture of the "Sexton"—a 25 pounder full-tracked, self-propelled mount, manufactured in Canada. The leading article deals with the development of the Combustion Gas Turbine. The majority of the recent work on this form of prime-mover has been carried out by Messrs. Brown Boveri, Switzerland, who constructed the first combustion gas turbine for a direct power generator in 1939. The output was 3,000 k.w. and the thermal efficiency, at the generator coupling, at full load 18%. Since then considerable improvements have been made with intermediate re-heating, etc., and provided a suitable steel for turbine blades, with a high creep strength can be obtained to stand a temperature of 1200°F. an efficiency as high as 33% should be obtained.

In 1941, this firm constructed the first gas-turbine locomotive with an output of 2,000 h.p. and an efficiency of some 18%. This figure does not compare with that of the Diesel locomotive at present, but even at this stage the difference may be fully compensated for, financially, by the lower costs of turbine fuel oil. Furthermore, the turbine locomotive can produce very nearly double the output for the same size as the Diesel. The article ends with an interesting glimpse into the future, in which the field of the gas turbine may well be extended to cover traction generally, also aircraft and ship propulsion. Exhaust-gas driven turbines have already proved of great value for super-charging large aircraft power units.

The number finishes with a short, but very interesting, article on the "Bailey Bridge," which is described by the Director of Engineering Development (National Defence, Canada) as :—

"The World War II. Military Bridge, which has been universally adopted by the United Nations." There are two photographs of the bridge in use, one being "London Bridge," built over the Caen Canal in July. The following points have been proved by experience :—

No tools are required for the erection except standard spanners. Thus it becomes possible to eliminate noise, so necessary for work carried out under cover of darkness.

Another feature is that the bridge suffers but little damage from bombing, for all parts are interchangeable and repairs are easily made. An article on the conception of this bridge appeared in the December, 1944, *R.E. Journal.*

October, 1944. In this number our interest is first attracted by the cover picture, and another on page 546, which give a clear idea of the difficult work that faced the Royal Canadian Engineers when pursuing the retreating Nazis in France and Belgium.

H.M.F.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA

July, 1944

The Story of Singapore (continued from the April number). All our troops fought well, often defeating others, including the Japanese Imperial Guard, numerically stronger; but superior air power, greater numbers and local command of the sea, defeated us. The possibility of French Indo-China passing into enemy hands did not enter into our defence scheme, and this, combined with our struggle for very existence nearer home, led to the neglect of Malaya.

Leaders of the Future describes a visit to a boys' training centre, a recent addition to our war preparations. Boys up to the age of 17½ are taught, physically and mentally, to become instructors and leaders of the Indian Army. A marked feature is the total absence of communal feeling—among other things the boys mess together. The author writes with an enthusiasm which is certainly infectious.

Burma : A Story of Courage relates the adventures of some 20,000 British and Indian refugees from Burma, the Indians largely predominating in numbers. They marched from Myitkina to Assam through trackless country on very meagre rations. The official forecast was that 500 might get through, but actually 15,000 did. Food was desperately short, and one diarist records that python tastes rather like chicken. Rations dropped by the R.A.F. helped, and the few natives met with, Mishmis and Kachins, were most friendly.

F.C.M.

THE INDIAN FORESTER

Aug., 1944.—*A Note on catchment afforestation in N.W. India.* While the article treats of catchment areas on the largest scale, referring particularly to the valleys of the major rivers of the Himalayas, it is of value to Sappers as the principles apply equally to the smaller areas above the head-works of water supplies. Afforesting a catchment greatly increases its storage capacity. The author recommends certain species of trees, not of course universally applicable, and gradual planting over a number of years so that an even aged community of trees would be avoided.

An editorial note comments on a lamella roof hangar made by the O. i/c Timber Testing Section, Lahore, at the request of the Engineer-in-Chief. It was made entirely of timber, except for bolts, fishplates, etc., and had a span of 155 feet. It is believed to be the largest structure of its type in India.

Oct., 1944.—*Influence of forests on rainfall.*—This subject has often been discussed, and the article sums up the results of observations. One point of very practical importance emerges, namely, the beneficial effect of afforestation on water supplies, thus underlining the statements in the August number.

Central Provinces problems of post war forest policy. Hardly affects us, but points out that a very large amount of land, not at present under cultivation, and of little use for grazing could be afforested, giving the villager fuel close at hand, thus allowing the present fuel—cowdung—to go to fertilize the soil. These points are elaborated in Editorial Notes, which records the proceedings of the post-war policy committee on Agriculture, Forestry and Fisheries. The first two are closely linked. Only 36% of the area of India is cultivated. Much of the remaining 64% could be afforested.

F.C.M.

AN COSANTÓIR

The article on "Leadership" this month deals with "Energy" as a fundamental requirement. Quotations show how physical as well as mental energy always seems to have struck the observer as a salient feature of great commanders. But the energy must be intelligently directed and conserved for essentials—which brings in the medical aspect of how best to rest, to encourage powers of endurance and good health generally. The need for research on these points is indicated—and it is certainly a truism that the best "physical" specimens are often not good examples of even physical energy.

An original article by a doctor, on the "Testing of Intelligence" draws attention to the sort of work being done in most armies by the "Personnel Selection Branch" of the A.G's department; methods and results, however, are not discussed in any detail.

The usual reprints, all from U.S. Journals this time include one of a jungle patrol in Guadalcanal and one of an Infantry Bn. getting its first practical experience of war in the N. Africa campaign. All are good of their kind, but elementary.

November, 1944.—This number contains less than usual of what might interest the advanced student—but plenty for Officers and N.C.Os concerned in the detailed training of troops, who may get a new angle on an old problem or some novel ideas for exercises from the articles.

The "Training and Handling of Men" (original) and the "Management of the Soldier" (U.S.) discuss the underlying principles rather generally; "The N.C.O. Problem" (original) which stresses the great importance of Junior Leaders in modern warfare, deals with the special problem of how to handle, train, and select your N.C.Os.

In spite of all the special weapons in a modern Infantry Bn., it remains true that the rifle can still be of decisive importance, both in attack and defence. But the user must be capable of good shooting, at least at the shorter ranges, even under the most unfavourable conditions. "Men at Work" from "The American Rifleman" points this moral in the story of an Infantryman in some typical "Western Front" fighting. It is again brought out in the article on "Infantry Training" which also touches on the other manifold activities of the "Queen of Battles" in a modern army.

"Is your O.P. O.K." (U.S.) and "Observation at Night" (Br. Home Guard Monthly) both contain valuable suggestions on the training of Unit Intelligence personnel. The former is based on lessons learnt "the hard way," by a raw unit in the N. African campaign and rubs in the fact that many of them could have been taught so simply in normal training by easily organized exercises.

"Are your messages well written" (original) contains some suggestions which the R.C. of S. would undoubtedly endorse heartily, though the actual forms in use, etc., are not identical with ours. "The Common Task," by a British Motor cyclist, is a very practical plea for proper maintenance at all times; it stresses the fact that the Daily Task system as laid down in regulations, becomes more, not less, important when the unit goes on service. The regular work, including filling up of records, must NOT be regarded as necessary only to satisfy interfering inspectors from outside the unit.

D.R.ff-M.

THE MILITARY ENGINEER

(Published by the Society of American Engineers)

August 1944.—*Coral Reefs of the South Pacific.* By H. E. Stocking. The writer gives an interesting account of the coral reef formations in the South Pacific, which have an important bearing on amphibious operations in that part of the world. Many of the Japanese strongholds in the South Seas are either islands surrounded by reefs or islets of coral debris surmounting a reef. In amphibious operations approaches to the shore, as well as the character of the beach itself, are of vital significance.

Reef-building corals cannot survive temperatures lower than 68° Fahrenheit, nor can they survive in fresh water, hence the distribution of reefs is limited to shallow warm seas.

Three types of reef are met with: (1) fringing reefs, (2) barrier reefs, (3) atolls. Fringing reefs are confined to a narrow strip fringing the shore, and are usually found in places where the ocean floor adjacent to land dips steeply. Barrier reefs, usually circular in form, are separated from land by a lagoon several miles in radius. The two portions of the same reef may, however, have the characteristics of both fringing and barrier reefs. An atoll is a circular coral reef that contains no land, e.g., Cocos Keeling and the Wake Island groups.

Rainfall soaks immediately into the pores of the coral sponge of which reefs are composed. It is only in regions of excessive rainfall that the higher portions of a coral island will provide a limited supply of water from shallow wells.

Combat Engineers in the Solomon Islands.

Lt.-Col. W. B. Eubank described the activities of a Combat Engineer Battalion at Guadalcanal in the new Georgia campaign, and in Bougainville during 1942 and 1943.

These campaigns gave the battalion valuable experience in engineering and as combat troops. Bridges were constructed as well as miles of roads and trails. Experience was also obtained in dealing with Japanese anti-tank mines.

Among the lessons learned in these operations were :—

(1) An Engineer Combat Battalion must be thoroughly trained in infantry tactics.

(2) The present equipment allowance is adequate : i.e., seven D-7 bulldozers in addition to the basic equipment table.

(3) An Engineer Battalion must bring with it its own supply of maintenance and repair parts.

(4) The Battalion should be kept together as a unit under the direct control of its commander. The three companies should not be allocated to separate infantry units.

Aviation Engineers as Lumber Dealers. By Lieut.-Col. J. B. Lamper.

The writer gives an interesting and amusing account of the arrangements made to obtain a supply of timber in one of the Fiji islands. No troops could be spared for the work, and the only sawmill available was privately owned, and 80 miles distance from the depot, in the mountains 3,000 feet above sea-level. Power was supplied by a dilapidated wood-burning steam boiler. A crude narrow-gauge tramline brought logs to the sawmill. The rails were 4 by 6-inch hardwood timbers laid on rough sleepers. The locomotive was an antique farm-type tractor, mounted on flanged steel wheels. It was just able to pull three cars, each carrying three 30-foot logs, and frequently got out of control.

September, 1944.—Engineers in Britain's Attack.

Brigadier B. K. Young, C.B.E., M.C., describes the main classes of work that the R.E. have been called upon to carry out during the present war, particularly with reference to the North African campaign.

He summarizes these duties during the advance across the Western Desert as follows :—

(1) Preparation of landing strips.
(2) Repair of existing runways.
(3) Removal of enemy mines and booby traps.

Under the head of *British Information Service* a short description is given of the Bailey Bridge, which is now standard United States army equipment. Component parts manufactured in both Britain and the United States are interchangeable.

October, 1944. The Bulldozer—An Appreciation. By Colonel K. S. Anderson. After nine months' experience in Italy the writer is of opinion that the bulldozer stands first of all the weapons of war. It can be used to get a gun into position through a sea of mud, to make a roadway, to smooth a runway, to ramp down an approach to a stream, or execute any similar task. When the history of the campaign comes to be written the homely bulldozers and the men who operate them should not be forgotten. The advance of the army in practice is just as fast as a dozer can walk.

Engineer News. A number of articles of Engineer equipment has recently been revealed by the War Department.

(1) *Mat, Airplane Landing, Aluminium Alloy, Pierced Plank Type.*

Steel mats are used by the Corps of Engineers when normal transport facilities are available. Where landing mats have to be carried by air, something lighter is necessary and an aluminium mat has been designed weighing only half as much as a steel mat, and capable of being laid at nearly twice the speed. The mats are formed of aluminium sheets 3/16-inch thick and are approximately 10 feet in length by 15 inches in width.

(2) *Armoured Cabs for Tractors.*

Armoured cabs of ½" armoured plate have been designed to protect tractor operators from small arms and machine-gun fire. Vision, provided by slits in the older models, is now provided by periscopes.

(3). *Tankdozer.*

The tankdozer is a medium Sherman tank, fitted with a bulldozer blade. The dozer blade is operated by a hydraulic jack, which receives power from a pump inside the tank. A quick release mechanism actuated from within the tank allows the bulldozer blade assembly to be jettisoned in about ten seconds, thus freeing the tank for fighting purposes.

The tankdozer has three main characteristics :—

(*a*) Fire power of the tank unimpaired by the bulldozer blade.
(*b*) Ability to move earth comparable to that of a heavy tractor dozer.
(*c*) Great weight and momentum.

It has been used with marked success in Normandy and in Italy.

(4) *Steel Treadway Bridge M2.*

The steel treadway bridge M2 is used for rapid stream crossings for all vehicles except a few of the largest and heaviest. It may be constructed on either floating or fixed supports, or a combination of both. The roadway consists of two continuous tracks formed of steel channels. Floating spans are supported on pneumatic pontoons spaced at 12 feet centres ; fixed spans are supported on adjustable steel trestles. Each treadway has a clear width of 45½ inches and is made up of 12-foot units. An Engineer treadway company carries enough equipment to build an 864-foot bridge.

A.S.H.

INFANTRY JOURNAL

(Published by the U.S. Infantry Association)

September, 1944.—*German Smoke Tactics.* By Brig.-General A. H. Waitt. The Germans have made a skilful use of smoke throughout the present war, as an accessory to other weapons. They have not made use of white phosphorus with its great capacity for producing casualties as well as screening. The German method of attack under the cover of large area smoke screens goes far beyond the American practice.

The writer proceeds to describe the principles laid down in the German manual *Attack under cover of Area Smoke* (*Flächen-nebel*). "Area Smoke" means covering an extensive area so as to resemble a thick fog. It is an important accessory in an attack against an enemy, on a stable front, in a field defensive position, or behind a water obstacle. Since it renders observation and observed fire either difficult or impossible, except at close range, it is a help to infantry close combat. Surprise is a most important factor in attacking.

Uncertainty as to what may be mixed with the smoke may compel defenders to wear gas masks. The attacker can fight without them.

The main objective of the attack is the enemy's artillery positions, but if the battle zone is of great depth and strength, it may be necessary to select intermediate positions, which must be easily recognizable in the smoke. Early morning is the best time for the beginning of an attack. A head-on wind gives the attack the best smoke protection. A lateral wind offers good possibilities, but a wind blowing in the direction of the enemy is unsuitable, as it precludes the use of a screen for close combat. The screen can be supplemented during the attack by the use of smoke hand grenades, candles and smoke shells.

The following methods of maintaining direction are suggested :—

(1) The magnetic compass.
(2) Radio beam operated by a transmitter and several receivers.
(3) Direction shells, scattering coloured powder, fired before the attack.
(4) Signal lines carried by rockets.
(5) The gyro compass.
(6) Direction tapes carried by units through the smoke.

One of the requirements of a large-scale smoke operation is control of the air over the area attacked.

October, 1944.—The first four articles in this number deal with hedgerow fighting. They are entitled "*How we Cleaned Out the Hedgerows*," "*Baptism in the Hedgerows*," "*Three Days with the Third Battalion*," "*The Hedgerow Country is Tricky and Mean.*" The type of country in which the Allied armies were called upon to operate after the landing in Normandy on 'D' day is intersected with hedgerows. The fields are usually not more than fifty yards wide and two hundred yards long.

The Germans prepared the country for defence by digging one position after another on which they could fall back, while checking the advance of the Allies. Sometimes they would prop up machine-guns with strings attached, to fire over a hedge without getting out of their holes; or they would cut out a section of the hedgerow and hide a big gun or tank in it, covering the latter with brushwood. Infantrymen were concealed all along the hedgerow with rifles and machine-pistols.

Long Range Penetration Groups. The writer, Lt.-Col. J. W. Bellah, had the good fortune to serve for a few days as a volunteer stop gap on General Wingate's staff in Burma. In this article he gives us an insight into the work done by the Long Range Penetration Groups (LRPG).

A.S.H.

REVUE MILITAIRE SUISSE

July, 1944. *L'Evolution actuelle de notre organization militaire.* By Lieut. R. H. WÜST.

After the Great War, the Swiss were confronted with the same problems of disarmament as the rest of us. Placing confidence in the League of Nations, whose headquarters lay in their midst, the Swiss reduced their military establishment to a dangerously low level, and like everyone else had to hastily rebuild in the ominous years of Hitler's rise from obscurity. The Chief of the Staff warned his countrymen in 1919 that the War had not changed human nature; the situation of Switzerland in the midst of great powers remained the same. Thanks to the persistent efforts of certain far-seeing officers, the overhaul of the military system was taken in hand, and by 1939 the Swiss Army was ready for its task of protecting its frontiers. Its Higher Command was reformed, to the end that the forces were commanded, not merely administered; they were organized into combatant formations, not only quartered and fed. The State assumed the position of Armed Neutrality between peace and war.

The value of the measures taken may be judged from the fact that the Germans up to now have respected Swiss frontiers. Whether they will do so right up to the end will depend as much upon the continued state of readiness of the Swiss to defend their territory as upon the natural difficulties of their country.

Commentaires sur la guerre actuelle.

Attention was everywhere focused on Normandy. The forces of invasion, having established their bridgehead and increased it to such a size that constant reinforcement was in progress, were engaged in wearing down the German field army, while on the Eastern front the Russians had started their summer offensive on a large scale, and in Italy, Kesselring was slowly retreating under continued Allied pressure. Such was the picture in the middle of July, 1944. For how long could the Germans stand this pressure on three fronts ?

German propaganda had been busy during the months preceding the invasion, harping on its favourite themes: the fear of the Allies of attempting a landing, which must break itself against the Atlantic Wall; the cunning selfishness of Britain and America in leaving Russia to bear the whole weight of the war; the postponement of Allied intervention until the German army had been seriously weakened. These very obvious lines for German propaganda were suitable meat for the stolid Teuton with the Hitlerian pistol in his back.

Then when the invasion did take place, it was because Moscow had ordered it ! Finally, when Russia was thought to be limiting her operations to Finland, it was said that the Russians had let down their partners. The docile German pays his money and takes his choice of these variable winds. Most of them must bring him icy comfort.

The commentator remarks that if for one reason or another a lull occurs on any front, it is not Germany who benefits. Her war machine goes on wearing out; that of the Allies is quickly reinforced. The attrition, though slow, is sure.

The new Russian offensive, begun on June 21st, already covered a vast front from Finland to Lemberg. Large German forces were cut off in Vitebsk, Orcha, Mohileff and Bobruisk. The vaunted bastions of the East Wall made only a brief resistance. The Germans were giving up ground which Hitler had declared would never be yielded. The conservation of armies was more to them now than even the vast territory they were losing.

W.H.K.

CORRESPONDENCE

General Headquarters,
Accra,
Gold Coast,
West Africa Force,
2nd September, 1944.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

Colonel E. St. G. Kirke in his interesting article on Airfields in War includes a set of curves for deciding the thickness of runways. Unfortunately he does not say upon what data these curves are based, i.e., tyre pressure, size of tyre ellipse on ground, and type of carpet: Furthermore, the bearing capacity of certain soils, with high internal friction, increases appreciably in proportion to the lesser width of the load pattern and no account is taken of this fact.

Very interesting curves are given in the new Engineer-in-Chief (India) Pamphlet No. 1 on Landing Grounds published in Jan. 43 which do not agree with Colonel Kirke's curve by a considerable margin—so big a margin in fact as to cause a difference of many thousands of tons of material. I have, by trial, proved that the curve for pressure intensity given in the Indian Army Manual is based on the simple formula :—

$$t = -\frac{d + D}{4} \pm \sqrt{\frac{Ddp}{4P} - \frac{Dd}{4} + \left(\frac{d + D}{4}\right)^2}$$

where
- t = thickness of tyre in inches.
- P^2 = tyre pressure in lbs. per sq. in.
- p = safe ground pressure in lbs. per sq. in.
- D = Major axis of ellipse formed by tyre in ins.
- d = Minor axis of ellipse formed by tyre in ins.

which assumes that the pressure P is spread evenly by the carpet at an angle of 45° to the subgrade where it is reduced to p.

As a matter of interest the chart from the Indian Army pamphlet is reproduced here. Superimposed is a curve (7) which is similar to Colonel Kirke's curves but exterpolated for 70 tons for comparison. It will be seen to vary greatly from curve (1).

This subject is as yet in its infancy and the theory is difficult owing to the great variety of soils, hence some rough and ready methods for use in the field are essential, but which is the best one ? We cannot afford to waste time or materials.

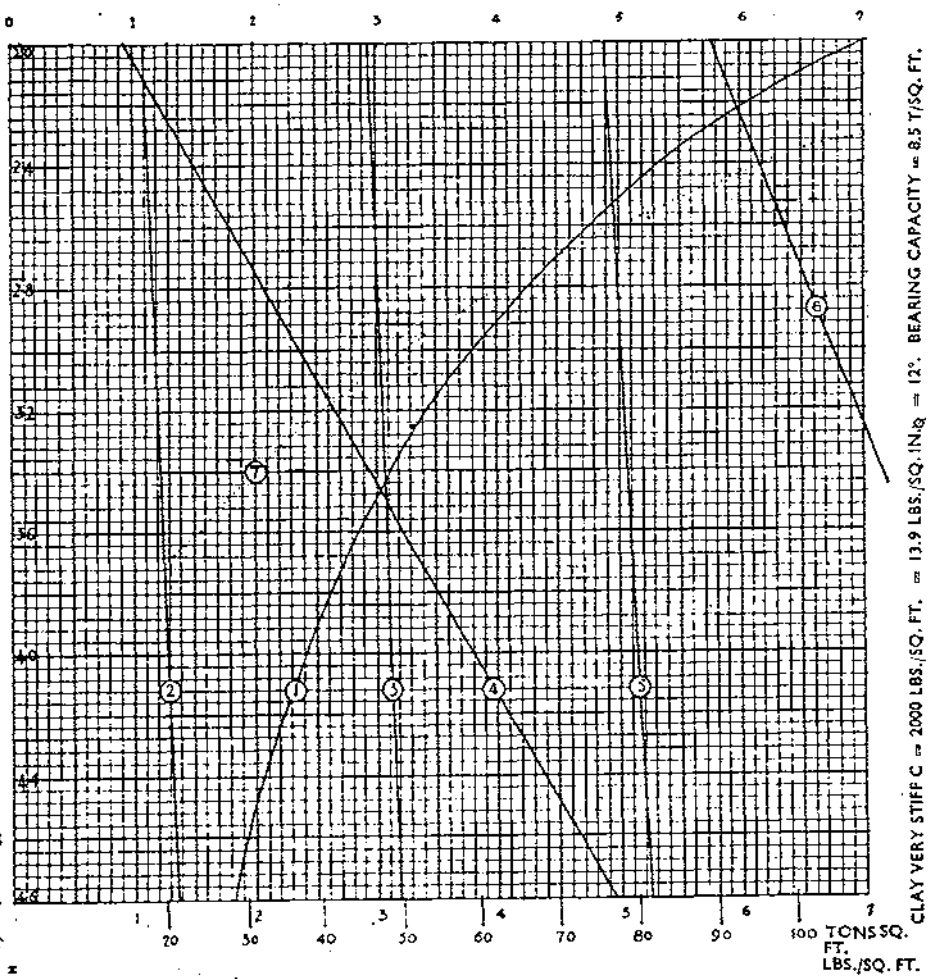
Perhaps someone who has had more practical experience will state his views.

Yours faithfully,
H. A. Barker, Col.

(Editor's note—writer has been asked to explain ref. to P^2.)

FROM E.-IN-C. INDIA PAMPHLET No. 1.

GRAPHS SHOWING--
PRESSURE INTENSITY ON SUBGRADE AGAINST RUNWAY THICKNESS
& BEARING CAPACITY OF DIFFERENT SOILS AGAINST RUNWAY THICKNESS.



① PRESSURE INTENSITY DUE TO SURFACE LOAD OF 7TONS SQ FT OR AN ELLIPSE 20"x45" LOAD 54·4TONS
② BEARING CAPACITY SOFT CLAY C·400LBS SQ. FT·278LBS/SQ INCH ϕ·4°
③ BEARING CAPACITY FAIRLY STIFF CLAY C·1000LBS/SQ FT·6 96LBS/SQ INCH ϕ·6°.
④ BEARING CAPACITY DRY SAND ϕ·34° C·NIL
⑤ BEARING CAPACITY STIFF CLAY C·1500LBS SQ FT·1042LBS. SQ INCH ϕ·6°
⑥ BEARING CAPACITY SAND PREDOMINATING WITH SOME CLAY C·400LBS SQ FT·278LBS/ SQ INCH ϕ·30°
⑦ CURVE EXTRAPOLATED FROM ALL OF CURVES GIVEN IN COL KIRKES ARTICLE IN R E JOURNAL MARCH 1944 FOR 7TONS SQ FT. (ELLIPSE NOT KNOWN)

NOTES
1 BEARING CAPACITY IS FOR 20" WIDE TYRE IMPRESS ON RUNWAY SURFACE, SPREAD AT 45° THROUGH RUNWAY TO SUBGRADE
2 "SURFACING" IS GIVEN BY RUNWAY WEIGHING 150LBS/CU FT
3 WEIGHT OF SOIL 100LBS/CU FT
4 C·COHESIVE STRENGTH OF SOIL, ϕ ANGLE OF INTERNAL FRICTION
EXAMPLE. MINIMUM RUNWAY THICKNESS FOR DRY SAND IS 74", IE WHERE BEARING CAPACITY LINE (4) CUTS PRESSURE INTENSITY LINE (1)

GEOLOGY and DOWSING

Department of Geology
University of Cambridge.
3rd January, 1945.

SIR,

I am replying to the letter by Col. A. H. Bell in December's number of the *Journal* to correct some points of fact. Referring to the 60 bore-holes sunk in Northern France in 1939-40 the impression given by Col. Bell's letter is that a diviner visited all the sites except two and that these two were failures. This is far from an accurate picture. The following is more in accordance with the facts.

The bore-holes sunk during this period fell into three categories; the first and third need not be considered as they were not visited by a diviner and yet all proved successful. The second category included the bores sunk on the chalk plateaux. It was in the majority (not all) of these cases that an officer of great repute as a diviner, accompanied the geologist and pegged the exact site of the bore. In one case certainly the first hole sunk on the geologist's site was dry while the diviner's site near-by yielded a supply but of insufficient volume for the purpose required. In another case the bore on the geologist's site was nearly dry and the diviner in the absence of the geologist chose a site down in the valley some distance away which on general grounds might have been expected to be more hopeful. This bore gave the required yield.

These are presumably the two sites referred to by Col. Bell as being "selected by the geologist without technical assistance" which were failures. What Col. Bell did not state is that in one case the diviner stated emphatically that there was no flow anywhere near the area to be supplied but that when a bore was sunk in a dry valley at what appeared to the geologist to be the most likely spot it yielded over 3,000 g.p.h., although the geological arrangement of the strata was not highly favourable.

In another case the diviner, in the absence of the geologist, sited a well over a quarter of a mile from the camp as being the nearest place for a good yield, later the O.C. of the Boring section drilled a second hole much nearer the camp and obtained as good a yield as at the first site, thereby saving several hundred yards of rising main. The most successful of the 20 odd bores sunk in this chalk country was one which yielded on test over 10,000 g.p.h. This was sited on geological evidence only.

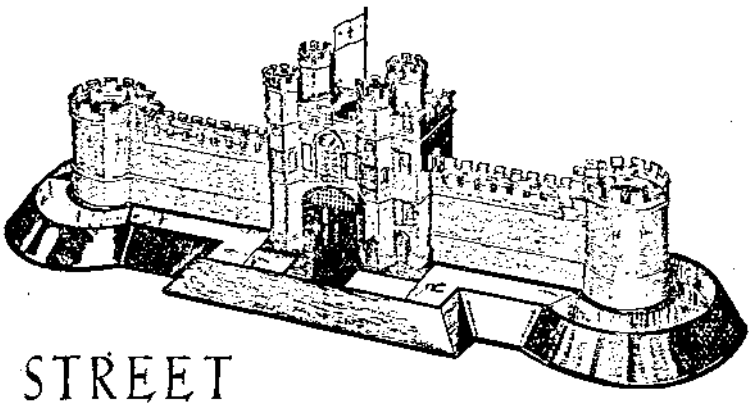
The above account does not read as a conclusive proof of the overwhelming success of divining over geology which Col. Bell's account suggests.

As regards the other cases quoted; statistical evidence is the only thing worth while. If a record of all the boreholes sunk in a clay formation, such as the Lias in this country on the recommendation of diviners, with accurate records of the pumping results, were published the results would make it difficult for the diviners to justify their undampable enthusiasm.

Perhaps Col. Bell will state the official opinion of the British Society of Dowsers on the problem of divining for water from maps. The claim of many dowsers to do this is difficult to reconcile with their claim to be scientific.

Yours faithfully, W. B. R. KING.

Woodwardian Professor of Geology in the University of Cambridge—formerly Geologist on Staff of E.-in-C., B.E.F., 1939-40.



STREET IMPROVEMENTS IN 1762

Cripplegate was situated in the North Wall (just where Wood St. ends today) erected over the Roman Way. Mentioned in the laws of Ethelred (978-1016) as Crypelsgate, it was rebuilt in 1244 by the Brewers Company and again in 1483 when Edmund Shaw, goldsmith and ex-Mayor, bequeathed 400 marks towards its cost. In 1663 it was again "repaired and beautified."

THIS model of the Cripplegate is a fitting example of the Silversmith's craft in producing commemorative plate to mark an occasion or keep alive the memory of the past. For in a world of movement, quite apart from what man destroys in anger, old things must go which are deemed an impediment to progress. All the old city gates were removed about the middle of the eighteenth century. The Cripplegate was the last to go and was sold for £90. *O tempora! O Mores!*

The GOLDSMITHS & SILVERSMITHS COMPANY LTD.

112, REGENT STREET, LONDON · W.1.

ONLY ONE ADDRESS

TELEPHONE REG. 3021