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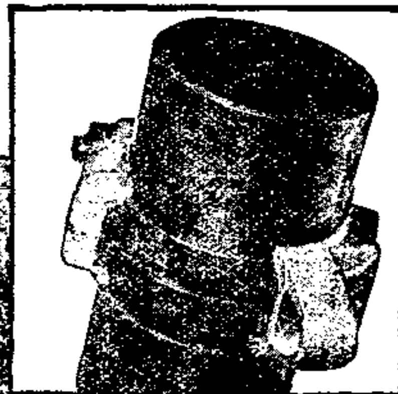

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CONTENTS.

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Lt.-Col. G. R. Chetwynd, M.C., D.C.M. (Royal Canadian Engineers) ...	14	4	41
Col. G. H. Cotton (South African Engineer Corps) ...	7	6	39
Lt.-Col. G. H. Clifton, M.C., *p.s.c.*† (New Zealand Staff Corps) ...	27	7	37

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2,300—1.6.42.

THE ITALIAN PARACHUTE RAID.

Planning a Rapid Demolition.

By T/Lieut.-Colonel J. F. Rock, R.E.

Problem.

To destroy an aqueduct bridge, of four 70 ft. spans, carried on three masonry piers, so that its repair would take at least a month.

The demolition must be quickly prepared and the stores such as could be carried in bomb-cell containers. As the dimensions of the bridge were only known approximately, the method must not be too rigid. The explosive must be such as could be obtained at a particular base.

Photograph taken during construction.

Solution.

To blow all three piers with gun-cotton charges. Should insufficient stores or men arrive at the site, only two piers would be blown. No attempt would be made to blow only one pier, for the effort would not be worth while.

The details of this bridge were obtained from a photograph, drawings and short description in the *Engineering Journal* of 1928. In this description the piers were said to be masonry. In the photograph they appeared to be concrete and they appeared to be only 3 ft. 6 in. thick, though of 24 ft. height. Should they prove to be of reinforced concrete, no attempt was to be made to blow them, but the R.C. girders of the aqueduct were to be blown at midspan on two adjacent spans on either side of an end pier, these piers having roller bearings.

Elevation of the Aqueduct
The dimensions shown were the only ones available.

The Italian parachute raid - opening page

CALCULATIONS.

The length of a pier was thought to be 19 ft. and its thickness 3 ft. 6 in. to 4 ft.

It was to be cut by two horizontal charges, one at the base and one 3 ft. higher, so as to blow out three feet of each pier.

Using the formula $2/3\ BT^2$, each charge is $2/3\ 19.4^2 = 203$ lb.

But the guncotton tins are 11 in. long by $6\frac{1}{2}$ in. by $6\frac{1}{2}$ in.

$\therefore$ it takes $\frac{19.12}{11} = 20$ tins to cover the length of a pier.

$\therefore$ 20 tins will be used in each row. This represents $20.17 = 340$ lb., nearly twice as much as is needed.

METHOD.

After some little experiment, a rapid method of fixing charges was evolved, which involved the use of the minimum of stores and was noiseless.

The top row of charges was hung from a steel wire strop, pulled tight by a ratchet tensioner, and passing, at the four corners of the pier, over grooves in an angle plate. This angle plate had toothed claws to grip the stonework.

It was found that the tension in the cable was equalized round the pier.

The bottom row of charges was hung from the top row.

Each row of charges was bound together and to the pier by a 50-ft. length of alpine cord, passed right round the pier and charges, and windlassed tight.

Each row of charges was split into units of four tins, held on a board of $1\frac{1}{8}$ in. pine. These boards had sheet steel brackets at each end and a small loop of webbing rivetted to the bracket both above and below the board.

To the webbing was tied a length of cord, attached to a small hook and eye and adjustable by means of a sheepshank.

The hooks were then dropped over the S.W.R. strop and each board could be adjusted to the right height with the sheepshanks. The lower board was hooked to the web loops of the one above it by small hooks held by a cord of fixed length. Each board was provided with both rope, sheepshank and hook and also short cord and hook, so that it could be used as a top or bottom board.

Ladders were used to fix the S.W.R. strop and hang the charges. Two were provided for each pier. They were 5 ft. 9 in. long and extended to 11 ft., the height of the plinth being uncertain.

All hooks were taped to avoid noise. The sag in the S.W.R. strop with all charges in position was about 9 in.

DETONATING AGENTS.

It was decided to fire all charges simultaneously, owing to the risk of the explosion of one charge dislodging another.

One slab of the centre tin on each charge-board was provided with a primer and 3 ft. length of cordtex. A ring main of cordtex was then taken round both rows of charge-boards on each pier and to a junction box at the foot of each pier. The cordtex lead from each charge-board was then taped to the ring-main with insulating tape.

The three junction boxes, at the foot of each pier, were then connected in series with cordtex and a cordtex lead taken from each junction box to a firing-point fifty yards from the bridge, where a detonator and six feet of safety fuze were used.

A duplicate firing system was created by taping a detonator and 2 ft. of safety fuze to the ring-main on each pier.

The firing system was tested and every length of cordtex detonated completely. The usual precautions were taken to prevent whip in the cordtex.

THE ITALIAN PARACHUTE RAID.

Taping up the Conltex.

Running out the Conltex.
The method of hanging can be clearly seen.

The finished job.

The Italian parachute raid - 98

Packing in Containers.

The standard arms container was modified slightly to hold two loaded charge-boards. The lids were removed from each tin of guncotton before loading and a primer and 3 ft. of cordtex inserted in a vertical slab in one tin of each charge-board. Thus each pier required ten charge-boards and five containers.

The two ladders were lashed together and fitted with a harness and parachute to hang in a bomb-cell. Between the rungs of the ladders were lashed all the small stores considered necessary for the job.

These were :—

S.W.R. Strop
Ratchet tensioner
Two cordtex strops
Two cordage lashings
Four angle plates
Ball kite cord
Ball spun yarn
Mash hammer
Two cold chisels
26 in. saw
Entrenching tool.

Each sapper carried a roll of insulating tape and a tin holding one detonator fitted with 2 ft. safety fuze.

Drill.

The party for each pier was an officer or serjeant and five men.

The total demolition party was two R.E. officers and 16 R.E. other ranks. It was anticipated that one man per pier might be injured on landing and the stores might have to be carried as much as half-a-mile to the pier.

On landing, Nos. 1 and 2 (one of whom was the officer or N.C.O. i/c pier party) carried the ladder assembly to the pier, unpacked it, laid out the stores and erected the S.W.R. strop. Meanwhile Nos. 3 to 6 carried charges and laid them out near the pier.

A container load of two charge-boards weighed 176 pounds and was a two man load.

Procedure after this depended on the length of carry. Normally, as soon as the S.W.R. strop was fixed, Nos. 3 and 4 remained at the pier and assisted Nos. 1 and 2 to fix the charge-boards. Nos. 5 and 6, having fetched all the charge-boards, ran out and fixed the cordtex in the firing circuit.

As soon as each pier was complete the officer or N.C.O. i/c inspected the charges and firing circuits, sent his men to the R.V. and reported to the officer i/c at the central pier.

When all piers were ready, the R.E. officer i/c and one man remained and fired a gun-cotton slab as warning signal to the covering party to go to the R.V. As the G.C. slab detonated he lit a length of safety fuze timed to burn three minutes and retired to a discreet distance to observe results.

If time allowed and there was no enemy interference, all 'chutes and containers were to be collected and dumped on top of the charges.

Aircraft Loading.

This was worked out for the journey out to the base, so that if as many as two of the aircraft failed to arrive there would still be sufficient stores to blow three piers.

For the operational trip from the base, three alternative loadings were worked out, according to the different number of aircraft which might be serviceable to do the operation.

If all the aircraft were available, the party of six Sappers and all the stores for one pier were to be carried in one aircraft. Three aircraft would carry the whole demolition party.

One set of complete stores for a pier was also to be carried distributed among the remaining aircraft carrying the covering party and one extra ladder assembly over and above these spare stores was to be carried. Thus, if only two R.E. aircraft landed their loads at the right spot, the two pier parties then available could, after completing their piers, collect the stores dropped with the covering party and prepare the third pier for demolition.

If one aircraft was unserviceable, the covering party was to be reduced by one aircraft load and the operation would proceed as before.

Were two aircraft unserviceable, only two pier parties were to be taken. The stores for the third pier were to be carried on the covering party aircraft.

All men of the covering party were taught the demolition drill, so that, if no opposition were met, they could be used as Sappers.

Every Sapper was armed with a .32 Colt automatic.

LANDINGS.

If all aircraft were available, the covering party detachments were to land first, at five-minute intervals, in a valley leading towards the bridge.

Ten minutes after the last covering detachment landed the first demolition party was to land and the other two were to land at five-minute intervals. These rather long time intervals were prescribed by the R.A.F. to avoid risk of collision in the narrow valley.

The first R.E. party to land was to tackle the central pier.

All containers were to be dropped between the 5th and 6th men to jump, so as to be as near the bridge as possible.

Difficulty was anticipated in finding the ladder assembly, which, being much lighter than the other containers, would drift further.

MOTOR CYCLES FOR MILITARY ENGINEER PURPOSES.

By LIEUT.-COLONEL T. C. W. BOWEN, R.E.

OBJECT.

THE object of this article is to lay before readers a general summary of the suitability for military engineer purposes of the modern British service motor cycle. The article summarizes advantages and disadvantages and gives some hints for getting the best out of machines. Where comparisons with other wheeled vehicles are made, the author refers to vehicles of a type likely to be available as an alternative to the motor cycle. Side-cars are briefly dealt with. American machines are not covered.

OUTLINE OF POSSIBLE USES.

By far the greatest current use of the motor cycle for military purposes is as a transport vehicle, rather than as a fighting vehicle. It is in its capacity as a transport vehicle for engineer warfare that it is now considered.

Military engineers want motor cycles for two main purposes, namely :—

(*a*) Despatch Riders (DR) work, with which I include the unit's own traffic control work in connection with engineer convoys, together with the carrying of plans, messages, etc., which form an important link in the engineer signal communication system.

(*b*) As a means of transport for making engineer reconnaissance and inspection, either in close proximity to the enemy or on the L. of C.

Advantages. Dealing with Solo Machines.

In both the above rôles the motor cycle has some very great advantages over other vehicles.

(1) Owing to its narrow width it can get past almost any traffic block. This is a bull point.

(2) It can turn completely round in a 12-ft. width road without actually stopping and hence the minimum of delay.

Both these advantages are obviously of vital importance for DR work and the first is in many cases vital for rapid engineer recce. in contact with the enemy.

(3) It provides unrestricted vision, which helps in finding the way quickly and particularly in asking for information.

(4) It has a cross-country performance comparable with any other military wheeled vehicle, except in certain circumstances which are discussed later under disadvantages. Its main advantages in this respect lie again in the fact that it can go through narrow gaps and along narrow paths and lanes. It can generally maintain a higher speed across country without detriment to itself or its human load than can any other vehicle of normal civilian general layout.

(5) It is fast enough in practical robust military form to claim equality or even superiority in overall time from point to point over its 4 wheeled rivals in normal road or ground conditions, provided the journeys do not exceed, say, 200 miles. This is largely due to superior acceleration and to narrow width in traffic or in difficult going.

In flat country, for journeys below one mile, the push bicycle is probably quicker.

(6) It is more economical in manufacture, and in fuel consumption, than any other mechanical conveyance for one or two persons (bar push bicycles).

(7) Being normally air-cooled it does not require frost precautions in cold climates nor make-up radiator water in hot climates.

Absence of the need for the most careful draining and filling up in severe cold is an advantage which only those responsible for a fleet of miscellaneous vehicles under war conditions standing in the open through a British winter can really appreciate.

The petrol economy of the air-cooled motor cycle shows up greatly in its favour as compared with water-cooled vehicles when used on short journeys in cold climates, owing to the rapid heating up of the air-cooled cylinder.

In hot climates the air cooling does not cause trouble, due principally to the fact that the fin design is generally ample. Design has been developed from the most severe racing conditions and is most effective.

(8) It is economical in garage or parking space.

(9) It is generally reliable when properly maintained.

(10) It is very simple to overhaul.

(11) It can be carried inside trucks from 8-cwt. up, if desired (*e.g.* if an unexpected move takes place when under overhaul or if it breaks down en route).

So much for advantages. They are very obvious and require no embellishment.

DISADVANTAGES.

These will be gone into in more detail. It is always the snags that count.

(1) Exposure to the elements in extremes of heat, cold or wet, or in rapidly changing combinations of these, is serious enough to restrict the lengths of time for which riders can carry on. Apart from the nature of the work, the extent to which this arises depends partly on the rider's physical fitness and what exposure he is accustomed to (this is a matter of training), and partly on his protective clothing.

Clothing is itself partly a matter of supply and partly intelligent foresight on the rider's part of the conditions before setting out. For engineer purposes runs are not likely to be so long as to make exposure a really serious factor, provided reasonable precautions are taken. The snag lies mainly in the time it takes an officer or N.C.O. not normally dressed for motor cycling to don an outfit which will protect him sufficiently, and afterwards to take it off and wash. The writer, who is an enthusiast in the early forties, well used to motor cycling, finds that it takes at least five minutes to change from office clothing to his all-weather motor cycling outfit, when it is all ready to hand. It takes slightly less to take it off again but longer to wash.

In battle conditions, where an officer might one moment be working in his office truck, the next jumping on a motor cycle in bad weather and later trying to do a rapid recce. on foot close to the enemy, may find the kit problem somewhat trying. An important factor will be how long and how fast the motor cycle runs are. For most purposes it is obvious that his ordinary battle kit will have to suffice. To ride pillion is much the most effective means of gaining reasonable protection without loss of time, for on the back protection from icy wind and rain is given by the driver. Then no time need be lost on dressing nor even in starting the machine nor propping it up at destination. On L. of C. work the time to dress will not be a serious matter but it is a definite nuisance.

(2) *Instability.* Naturally, any two wheeler that makes involuntary movement or gets out of control may fall over and perhaps hurt the rider and itself. This disadvantage shows up out of all proportion with semi-skilled riders It is the same with the horse. On roads it is only in certain very slushy snow conditions with frost underneath that this instability need be a drawback, provided the requisite riding standard is attained. But in these rare conditions any vehicle with a double track is faster.

In cross-country work it is only at night when lights are forbidden that the solo motor cyclist is at a disadvantage in respect of stability. This is so, no matter how well the route may be marked with glow lamps, luminous signs and the like. The only remedy is to ride at a walking pace and rely on good night sight. With such restriction the motor cycle may be out of place. In many cases it is probably quicker and certainly safer to run and walk. Night riding in a desert like Libya must be very trying.

(3) *Fording water.* For day cross-country work the solo motor-cycle when properly ridden is at least the equal of any small wheeled vehicle and in many ways is really superior. It is at a disadvantage only in respect of fording water exceeding about 12 inches deep (less if the water is running fast). The motor cycle will get through this depth under its own power without other than minor electrical precautions and correct riding technique. To go through deeper water it must be prepared against entry of water into the carburettor and then has to be manhandled, which is quite easy except in a strong current.

On the other hand, a solo motor cycle can often choose from a number of crossing places and in extremes can be put in the back of a vehicle in order to make the crossing. These expedients, however do lose time and on DR work or recce., even if they are available, time is all important.

(4) *Lack of facility for carriage of impedimenta, delay in map reading, etc.* It is impossible to carry much outside the normal tool kit on a normal solo

motor cycle. Provision of receptacles or straps for carriage of small equipment is usually lacking and it is often quicker and better to put anything in one's haversack, or pack, than waste time in tying it on the machine. Provision of panniers has in the past meant inaccessibility for puncture mending. Things cannot just be thrown into panniers. They must be packed tightly or they get damaged by vibration.

To consult a map means a stop and to compensate for this a memory for the route as seen on the map needs to be cultivated. It is of course not possible to do any writing or reading while moving and in this respect the solo motor cycle is at a great disadvantage for engineer recce. In solo form it does not lend itself to equipment with wireless.

(5) *Punctures.* The solo motor cycle has no spare wheel, yet its tyres are the thinnest in use on military vehicles. But it should only take 10 minutes to mend a puncture when you know how. The tyres must be looked over for nails and flints daily if puncture trouble is to be avoided. Hob nails from soldiers' boots seem to love motor cycle tyres. Punctures are far more frequent than any other form of breakdown in motor cycling and in the big civilian trials, which include much rough going at high speed, they are the chief source of anxiety. A puncture-sealing injection for the tyres is definitely required for military purposes and daily inspection of tyres is essential.

(6) *Weight.* Most motor cycles are so heavy that if they get seriously stuck in mud or sand or get in a ditch one man cannot get them out. Two men, however, with engine power to help, can get a heavy motor cycle out of almost any difficulty. Awkward ditches can be crossed and with the lighter machines two can lift them over obstacles such as low walls, hedges, etc. Weight, however, provides strength to resist rough handling and it is questionable whether the lightest known types of adequate power are strong enough to stand up to military use such as it is. But a lot of weight saving can be done by manufacturers simplifying the electrical system for lighting and horn.

(7) *Wear and tear.* The motor cycle on the whole is not as long-lived as the motor car unless it is very well maintained. All common makes suffer from exposed chain and sprocket wear, comparatively rapid cylinder wear, and tyre wear. The avoidance of these troubles necessitates redesigned transmission systems avoiding chain exposure, better carburation, and spring frames to make higher tyre pressures practicable. It may be that the necessary alterations would spoil the rugged simplicity and the cheapness of manufacture of the machine. Certainly they are improvements which cannot be effected quickly, but they would bring simplified maintenance, comfort and reliability in their train. All those features are desirable from a military point of view.

(8) *Noise.* The motor cycle as a recce. machine is certainly most inconspicuous to see but unfortunately it is very conspicuous to hear. Most army riders are not skilled at quiet driving because they will open the throttle too rapidly. Even so, the best rider cannot help making a considerable noise if any hill climbing or high speed has to be done. The noise may be serious in close proximity to the enemy. It is a source of considerable annoyance at one's own headquarters. On existing machines much improvement can be gained by training. The silencing arrangements of existing machines are capable of improvement. The complete cure, however, rests with designers and is largely to keep the cylinder size small and to have more than one cylinder.

General Hints.

So much for the general pros and cons for engineer use. The snags are considerable but in the author's opinion they do not outweigh the important advantages, especially in forward areas. Now for some hints.

Quite the most helpful suggestion I can make is to ask that where motor

cycles are provided every machine shall have its own rider and none other. This rider will be entirely responsible for its care and maintenance and refuelling. If an R.E. officer or N.C.O. who does not normally ride wishes to use a motor cycle he must then ride on the pillion. This system has three great advantages, namely :—

(1) The machine really will be maintained and cared for.

(2) Satisfactory all-round cross-country performance can be got owing to ease of manhandling (if need be) with two and the improved tyre adhesion.

(3) It is not necessary for short journeys for the pillion rider to be specially clad.

There are the added advantages that the pillion rider can leave the machine at any time in favour of other means of progress. He can also scan the country as he travels.

It is not claimed that the pillion rider then needs no motor cycle training ; he may in fact need to devote much time to practising pillion work under all conditions.

The wear and tear on the machine will be much reduced by having one driver only. Motor cycle owners understand this.

For pillion riding a proper pillion seat and footrests are essential. It would be dangerous to the spine to attempt cross-country riding without.

The next best tip I can give is to choose the riders of machines from men who like and are apt at motor cycling. Quite a number detailed for it have an aversion to the dirt, noise and exposure and some have not the necessary sense of balance nor the nerve for cross-country work. A little time spent in choosing the motor cyclists will repay handsomely. At least one person per squadron or company ought to be really skilled at riding and the same or another really skilled in unit repairs. A unit must get at least one of this calibre.

There are one or two points *re* maintenance and repair work that may be worth mentioning. Firstly, although a motor cycle may need more frequent maintenance and overhaul than a car, the work is of a nature that can usually be done entirely in unit lines and in a very short time. The ordinary car mechanic in civil life is not a motor cycle man. The driver mechanic of the army, as things stand to-day, is usually unable to learn both car and motor cycle technique in the time available. So the motor cycles in a unit need a special repair staff with their own repair garage. The repair garage can be very small and the staff in most cases probably not more than one man, assisted by the rider of the machine under repair. But the one man *must* know his job. A thousand mechanics who don't know will not suffice. Owing to dispersal of sections in static conditions it may be useful to run other small motor cycle repair garages, away from headquarters.

Motor cycle garages should adjoin vehicle repair shops for convenience.

The use of the words "repair garage" may be misleading. All it means is a place with a roof, walls on at least three sides and a hard dry floor. The writer has taken machines to pieces, repaired and rebuilt them entirely in the open, in a coal shed, potting sheds, etc. and even in his bedroom with very good results (to the machines!). In any condition but mobile war, something at least as good as those places can always be found. Good light is very important. The back of a lorry is quite a good place if the floor is flat and the canvas top can be rolled back for light.

Most units carry tools which when used in conjunction with the machine's tool kit will cope with anything a unit is allowed to undertake. There are, however odds and ends such as flat trays to catch the washings from crank cases and gearboxes and other trays in which to wash metal parts in paraffin which a unit should acquire. Funnels for oil and gadgets for injecting oil and grease into gearboxes are other handy acquisitions which the qualified motor cycle repairer will make up for himself.

Mechanical Hints.

As regards mechanical hints the following selection may be found useful. They are perhaps not so well known.

Keep the outer seals on tyre valves in order to retain pressure for the longest time and to keep the valve seats clean.

Keep the security bolts on tyres tight. The valve lock nut may then be loose. Any creep of the tyre can then be seen by any inclination of the valve before the valve tears away from the tube. In other words, don't use the valve as a security bolt if a security bolt is provided separately.

Keep steering heads well adjusted. It takes five seconds to test it for play. Proper adjustment makes all the difference to steering and the life of the head races.

Examine spring links on chains for correct positioning. Watch for wheels out of line by watching a rider in front of you. Offset of a wheel can be seen. Only one wheel should be evident from the direct rear.

To mend a located puncture quickly don't take the wheel out. After slackening valve and security bolts, insert tyre levers on either side of valve. Work wired edge of outer cover into the well of the rim starting 180 degrees opposite valve. One side of cover then comes off easily and inner tube can be pulled out. Remove the nail, or whatever it was, before replacing the tube. In replacing outer cover the part at the valve is the *last* bit to go in. Start 180° opposite and again get the wired edge in the rim-well, working round to the valve. Mind the valve doesn't slip back through its hole during the last stages. It will if you haven't put the nut on by a few threads.

The spare spark plug and all parts of tool kit must be securely packed and tool-box properly closed so that it is reasonably watertight.

In starting don't flood carburettor or close air control if machine is warm.

When leaving the machine always turn off petrol to prevent waste and difficult starting when hot.

Careful investigation is necessary when monthly miles per gallon average figure is 20% or more below the lower figures given in the table at the end. If poor consumption is due to mechanical condition it will not usually pay to let matters get worse before tackling the job.

Poor performance which cannot otherwise be explained is often due to weak ignition. This is extremely difficult to detect on some occasions. When all else appears perfect, suspect this. Ordinary "soft" M.T. spark plugs are no good for hard motor cycling.

Clothing and Comfort Hints.

The following hints may be of value to the uninitiated in regard to clothing and comfort for regular riding.

Comfort depends mostly on riding position. Individuals must suit themselves. Footrests, handlebars and saddle height are usually all adjustable. For cross-country work it must be easy to poise on the footrests.

Crash helmets are well worth while. They must be strapped on, otherwise they come off just before the head strikes a hard object. Peaks to helmets, as rain and sun shields, are desirable.

Goggles are essential by day.

Leg wear must be loose round the knees, otherwise the feet get extra cold.

An inner pair of cotton or wool gloves are a blessing in cold weather provided the gauntlets are not thereby made tight.

For really wet or cold weather, handlebar muffs are the thing. Mittens are also good.

Rubber-soled boots enable the slipperiness of the road to be tested by sliding the foot.

Protection for the ankles in cross-country riding is very desirable. A trench boot or gum boot gives it.

The ordinary mackintosh is more often than not useless for motor cycling. One of the best coats to wear is a Stormguard trench coat which, with its special warm detachable lining, is excellent for wet and cold. It has a proper oilskin lining and buttons up properly.

Wear nothing tight anywhere.

SIDECARS.

As sidecars are in use in the British Army, a reference to them must be made for engineer work.

The sidecar has only one disadvantage for engineer work, namely, its extra width. That removes in one fell swoop the greatest single advantage of a motor cycle. But for R.E. work it has some great advantages in military form, where optional sidecar wheel drive is fitted and the sidecar body is amply provided with lockers and is without doors. These advantages are :—

Weapons such as rifles, Brens or Tommy Guns are readily carried.

There is room for small engineer stores and tools.

Getting in and out is very quick.

Cross-country performance is outstandingly good, especially if three persons are carried.

Ability to turn round in a road is excellent.

On ice or slushy snow the stability is excellent.

It is about the safest vehicle on the road, largely due to direct control of steering and perfect vision of the driver.

One disadvantage is that, in military form, the manufacturing cost is not far from that of a small car. This is fundamentally because very large numbers are not required and the mass manufacturing facility did not exist in peace.

Another disadvantage is a surprisingly heavy petrol consumption and short range on a tank full of fuel.

There is no doubt that the sidecar has its place in military engineering work and especially on works services, where plans and small stores often have to be taken to the job.

GENERAL.

Other points concerning motor cycling generally may not be out of place, while not connected with the object of this article.

The motor cycle is an excellent training medium for mechanical work. Mechanical aptitude can be developed in a most interesting way by its use. Motor cycling is a great health giver. There is all the fresh air, the jogging of the liver and in cross-country work a degree of muscular exercise which is not generally appreciated.

As a sport, cross-country riding compares with ski-ing; great muscular control, concentration, nerve and ability to sum up a situation in a flash are required.

It is perhaps late in the war to make full use of the above advantages and it is a great pity they were not more widely known and used in the years preceding the war. All that happened in that period was that the German army carefully learnt all about motor cycles from our star civilian racers and Trials riders and then proceeded to take fullest advantage in the development of their military mechanization. We, with less mechanical aptitude, could have profited even more and at small expense. But it is never too late to mend.

BIBLIOGRAPHY.

The following civilian text books on motor cycling are recommended. No R.E. unit having motor cycles on charge should be without a copy :—

Motor Cycles and How to Manage Them. Iliffe & Sons, Ltd. .. 3/-
The Motor Cyclist's Workshop ,, ,, .. 2/6

TABLE OF USEFUL PARTICULARS.

Solos.

Cylinder Capacity.	Approx. Weight fully fuelled.	Approx. average normal monthly petrol consumption in military use.	Best all-round cruising speed.	Approx. range on full tanks using best cruising speed.
350 c.c. Side Valve	350	60–70	35–40	180
350 c.c. Overhead Valve ..	*325–370	60–70	40–45	180
500 c.c. Side Valve	400	40–50	35–45	150
	lbs.	Miles per Gall.	Miles per hour.	

* The lower figure applies to special lightweight models.

Sidecars.

Cylinder Capacity.	Approx. Weight fully fuelled.	Approx. average Normal monthly petrol consumption in military use.	Best all-round cruising speed.	Approx. range on full tanks using best cruising speed.
633 c.c. Side Valve	680	25–30 (3 up)	30–40	100

A GERMAN RIVER CROSSING NOT ACCORDING TO PLAN.

THE BRIDGING OF THE SEINE AT LES ANDELYS IN 1940 BY A GERMAN ENGINEER BATTALION.

(Translated from the *Militär Wochenblatt*).

By BRIG.-GENERAL SIR JAMES EDMONDS, C.B., C.M.G., D.LITT., *p.s.c.*†.

THIS account, besides showing the usual forgetfulness of the German General Staff as regards warnings to the engineers when work was required of them, contains a record of experience which seems useful and therefore deserving of translation. The German author is somewhat careless of place-names, Muids becoming Maid, and Andé, Adré.

On the 5th May, 1940, the X. Corps had forced a passage of the Somme below

Amiens, and by the evening of the 8th had reached an area south of Grandvillers, some 25 miles from the Somme. The corps had at its disposal the staff and the 2nd and 3rd Companies of the 41st Engineer Battalion (the 1st Company was on detachment with a cavalry division). These two companies during the night of the 8th/9th were sent forward to Feuquiéres, leaving the 1st and 2nd Bridging Trains and the battalion stores column behind in Croissault. These three latter units were to follow about midday, as it was considered out of the question for them to pass through Poix by night; for part of the village was burning, it was packed with troops and was suffering from air attacks.

The officer commanding the battalion had not been informed that it was proposed to reach the Seine next day, or he would have made every effort to get the bridging trains forward that evening. Corps orders, issued at 4 a.m. on the 9th, did not reach him until 8.40 a.m. They stated, amongst other things, that the battalion was placed at the disposal of the XX. Division, and that this division had the task of seizing the passages of the Seine at Andé, Les Andelys and Courcelles that day, sending advanced detachments forward for the purpose.

The battalion was at once fallen in and started on the march to Gournay. It was all-important to fetch up the bridging trains at once, and orders were duly despatched to them. The O.C. Battalion himself went forward to the divisional command post at a road-fork west of Gournay. There he received orders from the G.O.C. to take his battalion forward and report to the commander of the advanced detachments at Saussay, on the high road to Les Andelys; and, as Gournay was partly in flames, the battalion was to pass west of it. Orders to this effect were sent to the battalion.

The O.C. Battalion then went forward to report to the commander of the advanced detachments (C.A.D.) and obtain further orders. On the narrow road via Avesnes that he was forced to take (in his car), which is often in deep cutting, his progress was slow and difficult, as it was packed with troops from end to end, and he encountered much down traffic. Even after reaching the high road Gournay—Les Andelys it was frequently impossible to get through even on a motor-cycle; for, in the race for the river several columns were marching abreast.

After passing Puchay the O.C. Battalion saw no German troops until he was a few kilometres from Les Andelys, when he caught up mounted men, cyclists and artillery that had been sent forward by the division. At the eastern entrance of Les Andelys he learnt that the bridge was blown up and that the town was burning and had very few German troops in it.

It was quite clear to the O.C. Battalion that, as the bridge at Les Andelys was destroyed, he must employ all his available forces there, and that the detachment of any men to Andé and Courcelles, the other selected crossing places, would only mean a wasteful frittering of his small strength. As the last motor-cyclist had fallen out, the O.C. Battalion himself went back to Saussay, and ordered the battalion staff, which had arrived there, to follow to the Les Andelys bridge, and to see that the companies rendezvoused at the eastern entrance to the town, the company commanders then reporting to him at the bridge. In driving through the town it was discovered that the streets were blocked by a number of vehicles and that certain stretches of them were unusable owing to the débris of houses which had fallen on the roadway. Orders were therefore given to reconnoitre and clear alternative routes.

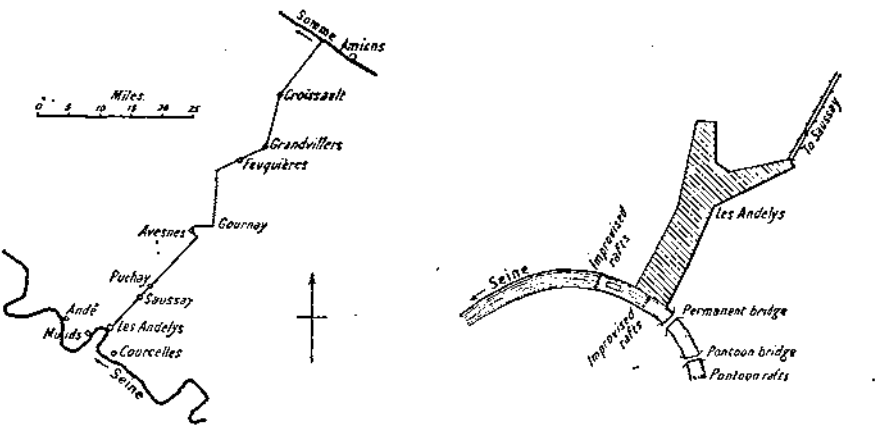
On reaching the Seine about 4 p.m. the O.C. Battalion found the following situation:

A few parties of infantry had managed to cross the river on rubber-floats and on boats which they had found, and they were in position on the far bank. They had lost contact with the enemy. Rumours that enemy riflemen were concealed in the houses had proved erroneous. The bridge, a wide span suspension bridge, had been demolished by the French just as the foremost

infantry arrived to seize it. No. 1 Company of another engineer battalion (47th) with the advanced troops, had arrived; it had no bridging equipment, but had begun to improvise ferry rafts with the service rubber-floats and boats. On one of these rafts the first tank-gun was taken over about 5 p.m. and others quickly followed.

As the early arrival of the bridging trains was not to be expected on account of the traffic difficulties, there was nothing for Nos. 2 and 3 Companies of No. 41 Engineer Battalion (2/41 and 3/41) to do when they should appear but to construct extemporized ferries; so the men of the battalion staff were directed to search for material and to fetch boats from the far side of the river.

The C.A.D., who was near the bridge, was persuaded to issue an order that all vehicles should halt at the eastern entrance to Les Andelys and, that until further orders, only the engineer transport and bridging trains should be permitted to pass through the town. The traffic post at the eastern entrance was to ensure



that these instructions were carried out, and they were shortly afterwards approved by the divisional commander.

The two company commanders of No. 41 Engineer Battalion, who arrived about 4.45 p.m. and the commander of the company of the 47th Battalion, were allotted the following places for constructing rafts (see sketch):

1/47 Company, immediately above the island;
3/41 Company, near the destroyed bridge;
2/41 Company, between the other two companies.

When, towards 5.30 p.m., Nos. 2 and 3 Companies reached Les Andelys, a French heavy battery began shelling the site of the destroyed bridge. No. 3 Company was therefore diverted to another site, already reconnoitred, below the island; it was not so suitable, in fact was fit only for the passage of infantry.

About 6.30 p.m. No. 2 could begin the transport of troops by raft, and about 7.30 p.m. No. 3 could do so, having been delayed by having to shift material to the new site.

The O.C. of No. 47 Engineer Battalion, who was also the senior engineer of the division (there was apparently no commanding engineer) placed all the men of his battalion employed at Les Andelys at the disposal of the commanding officer of No. 41, and made the latter responsible for the ferrying over of the strengthened infantry regiment and for throwing a bridge as soon as possible.

The further arrangements were made in close collaboration with the O.C.

Infantry Regiment, who meantime had arrived, the two command posts being fixed alongside each other. When, about midnight, the regimental headquarters were transferred to the far bank, a liaison officer was left with No. 41 Engineer Battalion, who issued the directions as to the movement of the infantry still remaining to be ferried over the river.

A hasty measurement of the river gave its width as 190 yards and, as no more than three bridging trains were likely to be available, only a light bridge could be constructed. A suitable site with good approaches was found about 550 yards above the destroyed permanent bridge. On the arrival of its bridging trains No. 1/47 Company was withdrawn from ferrying duty (in the centre), and about 9.30 p.m. began the construction of both shore-ends of the bridge. At the same time 2/41 Company, parts of 3/41 Company and a section of 1/47 Company were detailed to construct 4-ton rafts from the pontoons and superstructure of the bridging train which had arrived. The first of these service rafts was ready at 10.15 p.m., but the extemporized rafts were also kept in use as the tactical situation demanded that as many men as possible should be put over.

Enemy artillery ceased in the late hours of the evening. It became known later that the battery had been captured by some infantry.

During the night another engineer company was placed at the disposal of No. 41 Battalion. It took over the management of the extemporized rafts and thus contributed to hasten the construction of the rafts of service material.

Towards midnight the ferrying over of the I. Battalion of the infantry regiment, with its most important transport, was completed. The II. Battalion followed on at once, making use of the passage below the island, now available, as well as the others.

The O.C. 41st Engineer Battalion heard nothing of his pontoon trains during the night, despatch riders were sent to meet them, and officers and officials of the battalion staff were continually on the look-out for them. It was not until 4 a.m. that No. 2 Bridging Train was found and hurried forward. The trains had been forced to halt for hours outside Poix, as the town was in flames, and then could only get their cumbrous wagons forward very slowly. Other vehicles had interpolated themselves in the column and broken its continuity, so that some of the pontoon wagons were still missing. The divisional order, that the bridging trains should have priority over all other units had never reached them.

After the arrival of No. 2 Bridging Train more ferrying could be carried on. But as No. 1 Bridging Train had not appeared and nothing could be learnt of its whereabouts, there could be no thought of throwing a bridge, although, about 5 a.m., the shore-ends were ready.

Meantime, 3/41 Company had been detailed to construct service rafts about 500 yards above the selected bridging site, in order to avoid an accumulation of material at one place. In the early hours of the morning it was able to start ferrying. Strict traffic control in Les Andelys, for which Field Gendarmerie was now available, prevented any pause in the arrival of the infantry at the two ferrying places, the staff officer left behind by the division superintending the allotment of the troops. The traffic post at the eastern entrance of Les Andelys had a hard task in stopping vehicles not absolutely required, and it was found necessary to send an officer to take command of it.

After such material of No. 2 Bridging Train as had arrived—some pontoon wagons did not appear until the afternoon—had been put into bridge, it was possible to give parts of the companies a rest, as all the men were not required for ferrying.

Towards 9 a.m. the head of No. 1 Bridging Train came in sight. Unfortunately some of the pontoon-wagons had gone astray on the march, although the leader of the train had left nothing undone to shepherd them. The total number of pontoons available was not sufficient for the bridge; so for the moment ferrying had to be continued.

To enable the bridge to be built the senior engineer officer of the division ordered that a double-pontoon raft in use at Muids, downstream, should be floated up. This was, however, countermanded, as about 10 a.m. the leaders of both bridging trains reported the arrival of more of their vehicles. As the pontoons arrived they were formed into rafts: by 12.30 p.m. sufficient had been made and the floating of them into bridge was begun.

By 1.45 p.m. the bridge was completed, and the transport halted at the eastern entrance to Les Andelys was called up by telephone. To prevent blocks only one-way traffic was allowed through the town, and no delays worth mention occurred in the march over the bridge, and it was possible to place it at the disposal of a division on the left, which made use of it for some of its units.

From the surplus material four rafts were constructed as a reserve, which must be regarded as the minimum when 24 rafts are in continuous use. A net to catch floating mines, of which the French were making considerable use, was placed in position.

About 6 a.m. on the 11th, in thick fog, the bridge was attacked by aeroplanes; it was not damaged, but the sappers on duty suffered casualties. Further air attacks accomplished nothing except slight delays in the passage of the troops.

The bridging at Les Andelys had to be carried out in pursuit; speed was everything. It was hindered by the difficulties of getting the bridging trains forward quickly. Other arms, in their praiseworthy endeavours to push forward, must learn that when the passage of a river is on hand, priority must be allowed to the engineers and their bridging material.

CONSTRUCTION OF A BY-PASS HIGHWAY IN ENGLAND BY ROYAL CANADIAN ENGINEERS.

By Capt. J. P. Carrière, M.E.I.C. *R.C.E. Headquarters, Canadian Corps Troops, Canadian Army, Overseas.**

(Reprinted from *The Engineering Journal* (*Canada*) of January 1942.)

General.

The military engineers' operations, outside of actual fighting, often lead average members of the profession to believe that they consist mostly of carrying out engineering works of a pre-planned and standard type, and that all designs are empirical. The author himself confesses, without shame, that he was of this opinion before being initiated into this branch of the service.

The purpose of this paper is twofold:—

(*a*) To offset this false impression.

(*b*) To bring to the fore certain interesting technical points and statistics of road construction practice in England.

In the early fall of 1940, the General Officer Commanding Canadian Corps made plans to move his Army wherever and whenever needed. The author disclaims any knowledge of such plans, beyond the fact that certain roads had to be improved and certain by-passes constructed to accommodate the immense mechanical transport of this modern army.

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The construction of one of these by-passes will be the subject of this paper. In the case under consideration, the required by-pass had already been designed and planned in peace-time but its construction had been forcibly put off with the declaration of war. The problem, as regards location, consisted in building a road on the right-of-way of this proposed by-pass, and of such design as would not hinder the construction of the complete by-pass in the future. A scheme was finally agreed to by the Ministry of Transport, the County Council and the Canadian Corps whereby a 22 ft. concrete highway would be built on the exact site of one of the planned carriageways, except at a few sections where such a procedure was impracticable and where a tar-macadam wearing course overlying a " hard core " foundation was designed.

DESIGN.

(a) General.—The by-pass connects two main highways; one is at Elevation 265 and the other at Elevation 135.

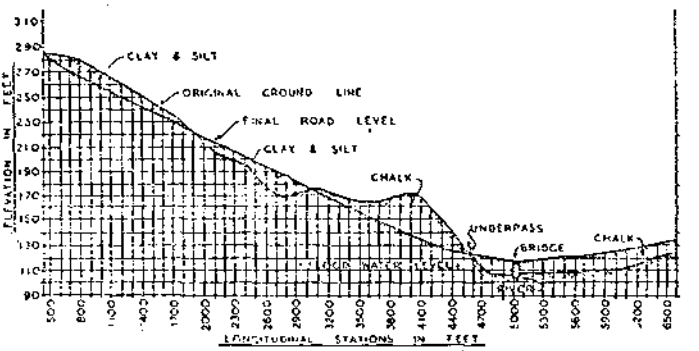


Fig. 1—Longitudinal elevation of road.

The by-pass is 6,500 ft. long and the topography of the ground between the two above-mentioned highways consists of a valley, with a temperamental river at the bottom and, to complete the modern pastoral scene, a main railroad on a 20 ft. embankment crossing at right angles.

(b) Grading.—The material required for grading consisted of 145,000 cu. yds. of balanced cut and fill. The soil to be excavated in the first 1,800 ft. consisted of a typical English clay and silt of a singularly sticky variety. The remainder consisted of material described as Upper Chalk with Flints (first named by W. Whitaker in 1865). The chalk is apparently fairly pure calcium carbonate composed of very fine granular particles held together by a weak calcarious cement which dissolves easily during rainy weather. This makes the handling of the chalk extremely difficult with consequent discomfort to all those engaged in the operation. The existence of flints in the material adds to the difficulties of handling it. These flints when struck by heavy road building machinery such as was used, break clean, presenting razor-like edges. The modern road-building machinery employed on the job was naturally fitted with rubber tyres which suffered considerably due to contact with broken flints.

(c) Drainage.—The design of the drainage system was a simple operation on paper. Its construction was quite another thing. One portion of the road had to be cut 39 ft. deep; the road bed in that cut has a 4 per cent. grade; the bottom of the cut is 124 ft. wide and the 20 ft. railroad embankment lies at the lower portion of the grade. The width of the road is controlled by an underpass 12 ft. wide under the railroad. The drainage system was designed

so that all surface water from the road above this point, together with surface water from part of the surrounding countryside, which partially drains in this artificial basin, could be collected and carried in sub-surface conduits through the underpass and eventually to the river. The only difficulty was that this work had to be carried out during the rainy season and consequently the site was normally in a very wet condition.

(*d*) *Consolidation of Fill.*—No special machinery was supplied for consolidating the fills. It was proposed to place the soil in thin layers and depend on the continuous traffic of heavy road-building machinery for consolidation. This proved to be an excellent procedure and gave extremely good results.

(*e*) *Design of Carriage-ways.*—The most interesting structural feature of the road is the foundation. This consists of three continuous longitudinal concrete beams 14 in. wide and 4 in. deep laid at 11 ft. centre to centre. Cross-beams of the same dimensions are built at every 80 ft. Where the grade is 4 per cent. or more, the cross beams are supported on short concrete piles 2 ft. 6 in. long and 14 in. by 14 in. in cross section. Between this maze of beams is poured

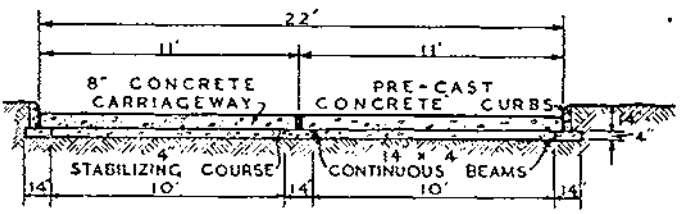


Fig. 2—Cross-section of concrete carriage way.

what is locally called a stabilizing course—this consists of a low grade concrete continuous slab 4 in. thick. Over this stabilizing course lies the carriage-way proper 8 in. thick; the carriage-way slab is completely isolated from the stabilizing course by a layer of special tar paper to prevent bond between the two courses. Expansion joints on the top slab are built at every 80 ft., except over portions of the fill where serious settlement is expected and where expansion joints are built at every 20 ft.

(*f*) *Underpass under Railway.*—An underpass already existed under the railway; it was more in the nature of a cattle-pass. For reasons of economy and to ensure that railway traffic would not be interrupted, it was decided to improve the existing underpass rather than build a new one. In order to get sufficient headroom it was necessary to lower the existing ground line and this necessitated underpinning the foundations of the abutments. These abutments are of brick and have been in position for over 50 years, resting directly on a clay base, and no settlement has ever been recorded. The design of the underpinning consisted of mass concrete blocks, poured in sections, 7 ft. high and 4 ft. wide. Bond between the new concrete foundation and the existing brick piers was achieved through the use of sections of steel rails acting as dowels.

(*g*) *Bridge over River.*—Borings along the banks of the river showed that a layer of chalk existed at a maximum depth of 12 ft. below bottom. This chalk layer was overlain with horizons of clay and gravel (locally called ballast). The location of the bridge to be built for military use was chosen outside the location of the eventual permanent bridge, which is to consist of a single concrete arch. The gap to be bridged was 79 ft. The controlling loads on the bridge were those to be applied during construction and due mostly to the moving of soil, excavated from one side of the river and transported to the other side for fill. The maximum dynamic load to be applied was estimated at 45 tons, consisting of a train of two vehicles. Another important factor affecting the

design was the availability of bridging materials. The material eventually employed consisted of 12-I beams 24 by 7½ in. at 90 lb., 8 of which were 24 ft. long and the remaining four, 31 ft. long; this allowed the construction of a three-span bridge, but the centre span had to be limited to a maximum of 27 ft. to keep the steel within safe working stresses. It is worth noting here that the above-mentioned steel beams were by no means new and had been used over and over again. In view of this condition, a working stress of only 16,000 lb. was used for design purposes.

The work on the road having started in November, it was imperative that the bridge be erected without delay in order to keep the work of excavation and transportation of the soil moving. This factor affected the choice of foundations as the river under consideration is 10 ft. deep at the bridge site and it

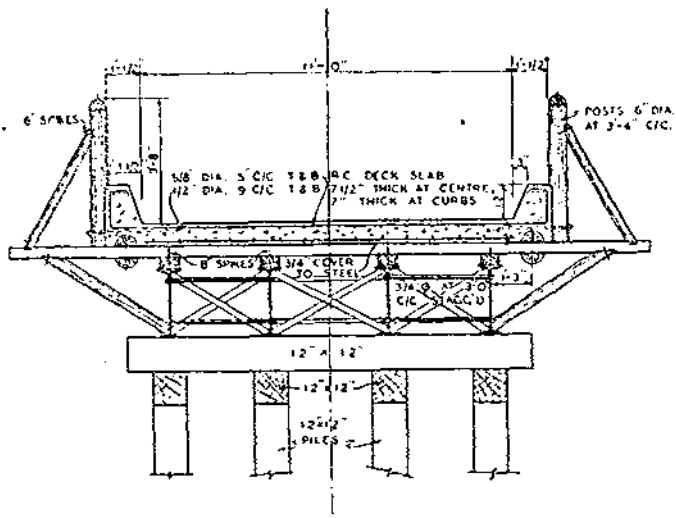


Fig. 3—Cross-section of bridge.

has the unpleasant habit of rising at a rate sometimes reaching 8 ft. in one day, as was actually experienced during construction. All those factors led to the choice of mass concrete abutments at each end of the bridge and two intermediate timber pile piers. In order to limit the centre span to 27 ft., double bent pile piers were designed, bents to be 4 ft. centre to centre, and each bent to consist of four piles 12 by 12 in. in cross section. The superstructure of the pile bents was designed of 12 by 12 in. timbers, cap sills being laid parallel to the length of the bridge and the bridge seats laid at right angles to the cap sills.

The unit working stresses in the bridging material under working loads were estimated as follows :—

Piles—Max. load on a single pile 7 tons.
Cap Sills—Max. tensile stress 973 lb. per sq. in.
Cap Sills—Max. shear 81 lb. per sq. in.
Bridge seats—Max. crushing stress 163 lb. per sq. in.
R.S.J.s (I beam)—Max. tensile stress 15,110 per sq. in.

CONSTRUCTION.

(*a*) *Earth Work.*—The equipment employed for cut and fill consisted of eight 60 h.p. tractors equipped with carryall scrapers; each tractor could be

equipped with angle-dozer blades when required. One trailer type heavy rooter was also used to loosen up the chalk before excavating it.

The job was started in early November, 1940, and 20,000 cu. yds. of soil were moved by December 31st—an average rate of 10,000 cu. yds. per month with an average haul of approximately 2,500 ft. From the 1st of January to the end of March, 1941, 21,000 cu. yds. were moved, averaging only 7,000 cu. yds. per month with a haul averaging only 2,000 ft. This lower rate of progress was due mostly to weather conditions. The remainder of the cut and fill, 104,000 cu. yds., was completed between April 1st and July 10th, 1941—an average of 30,000 cu. yds. a month with an average haul of 1,600 ft.

In all the above mentioned instances an average of six tractors and scrapers were being employed. These tractors and scrapers are of American design, and are a fairly common sight in Canada; their efficiency and all around usefulness is still being admired by all who have seen them at work on this job. It is worth mentioning that the sappers who operate these machines in Canadian Corps are the best that Canada can produce.

Fig. 4.—Home-made machine for testing shearing strength of soil.

No trouble was encountered in excavating the clay and silt in dry weather nor in using it as a fill. Unfortunately a few attempts were made to work this type of soil during wet weather to gain time. The results obtained point out very definitely the inadvisability of this procedure. In each case the machines not only ruined the already built-up fill, but also churned up the undisturbed soil of the cut to such an extent that it took days for the soil to dry up sufficiently for operations to be resumed. This is not an original observation, but only an addition to the already established fact that it is economical in the long run not to disturb wet clay.

The chalk cuts and fills were comparatively easy to deal with. The flints played havoc with rubber tyres at times and were effective in wearing down scraper blades and tractor treads quickly. However, taking everything into consideration, chalk proved no match for the equipment. During periods of dry weather, a heavy rooter was used to loosen up the undisturbed chalk ahead of the scrapers.

All material used for fill was spread in layers of a maximum thickness of four inches. The normal traffic of tractors, heavy lorries, etc., was depended upon for consolidation. All chalk fill was consolidated to a consistency far beyond what was expected, and no settlement is likely to occur. Clay and silt fills, however, presented another picture, especially in view of the fact that they were disturbed while in a wet condition and that climatic conditions did not

Construction of a by pass highway - fig 4

men, plus its weight. The unit weight of the soil was checked in place by weighing known volumes of it. The unit shearing strength of the soil was then arrived at by weighing the specimens, subtracting this value from the total recorded force, and dividing the remaining value by the sum of the shearing areas, at each end of the specimens. The following values were obtained :—

Average weight : 115 lb. per cu. ft.

Shear strengths : Average for top 12 ft. of fill : 384 lb. per sq. ft.

From 12 ft. to 13.5 ft. below top of fill : 156 lb. per sq. ft.

From 13.5 to 14.5 ft. below top of fill ; 74 lb. per sq. ft.

At its most critical point, the fill under consideration was 20 ft. high. Between elevations 16 ft., and 14 ft. below the top, a two-ft. layer of chalk was placed during construction as an attempt to overcome part of the damage done by working the clay in wet weather and to give a foothold to the machinery. This layer consolidated and formed a very stiff horizon of material, apparently not easily soluble in water of infiltration and which acts as an artificial water-table, the top four inches of this layer remaining very wet while the remainder is dry and solid. This artificial water-table apparently limits the downward movement of water of infiltration and causes the overlying mass of clay to retain moisture to degrees varying in intensity from maximum at the chalk layer to minimum at the top of the fill. The variation in shear strength of the clay at the various levels is thus plausibly explainable as the magnitude of this characteristic of cohesive soils is proportional to their water content.

There is no doubt that settlement will occur in this fill ; the extent of settlement will vary according to the height of the fill, and the magnitude could only be roughly estimated, due to lack of proper testing equipment. However, for the purpose of record, the County Council engineers set permanent brass plugs in the concrete slab at 20 ft. intervals in the highest fills to record the settlement over a period of years.

The characteristics and dimensions of the fill which presented the worst condition and appeared to have the weakest slopes, were used to make an analysis of stability of slopes. The soil composing the fill being plastic and cohesive, it was assumed (1) that failure of the slopes, should such occur, would take place along a cylindrical plane of rupture ; (2) that the centre of this cylindrical plane would be located on the vertical projection of the toe of the estimated failure plane ; (3) that the wedge or mass of fill above the plane of rupture would act as a solid body ; (4) that this solid body would tend to break away from the parent mass in a circular motion ; (5) that this tendency to motion would be resisted by internal cohesion and friction within the soil mass along the plane of rupture ; (6) that the sum of the values of cohesion and friction could be translated as internal shear strength ; (7) and finally, that the toe of the plane of rupture would not be lower than six inches below the top of the chalk layer described above.

The problem consisted therefore in finding the radius of a cylindrical plane to satisfy the following conditions :—

(*a*) Maximum shear stress.

(*b*) Minimum shear resistance.

By the method of trial and error, conditions were finally satisfied and the following values were obtained :

Shear stress : 7,245 lb.

Total shear strength along plane of rupture based on values obtained by tests : 9,320 lb.

The factor of safety of this slope against failure is therefore 1.27 and as this represents the worst condition on the job, all fills were assumed safe.

An attempt was made to estimate the rate of settlement, as follows :—

Plugs were driven into the fill at various points on which levels were to be

taken at regular intervals. Time being the essence of this job, the road had to be pushed through before sufficient data had been assembled to determine the rate of settlement. The intention was to plot curves of settlement against time, estimate the formula for the average curve thus obtained, and then develop the curve for whatever periods of time were required. It remains to be proved whether such a procedure would have been accurate enough to be of use. However, in order to offset part of the effect of settlement on the concrete carriage-ways, it was decided to build these two inches higher than planned, at the highest fills in clay ; as the road at these portions has a grade of 4 per cent., the drainage and other functions were not affected. It was also decided to build expansion joints at every 20 ft. in these portions.

(*b*) *Bridge : Pile-driving equipment.*—There were only 16 piles to be driven, each being 24 ft. long and requiring to be driven to a penetration of 10 to 12 ft. To do this job, a timber pile-driving frame (of uncertain age) and a 25-cwt. monkey, were provided. In order to drive the piles in a reasonably short time, it was decided to operate the pile-driving hammer by mechanical means. The power was supplied by the power take-off of one of the tractors, one drum being used to lift the monkey and the other for pitching piles. By providing a makeshift weighted trip-gear at the monkey, a single action, automatic, drop-hammer was obtained.

Each pile was fitted with iron shoes and bands and was held in place during the driving by strong falsework. In most cases, there was a tendency for the piles to shift out of alignment and to twist about their vertical axis ; this latter defect would have been most objectionable in this case and extensive precautions had to be taken to overcome it. This points out the advisability of using round timber piles for this type of work.

All piles were driven to their full penetration. The set per blow on the last five blows averaged ¼-in. with an average drop of 7 ft. This resistance to penetration approximates quite closely the maximum bearing capacity required.

The superstructure was erected by normal methods and presented no points of special interest.

The girders were launched by the derrick and preventer method, using the pile-driving frame as a derrick, with a tractor as the power plant on one side of the river, and a second tractor as a preventer on the other. This proved a most efficient and quick method.

As the first function of the bridge was to allow the transportation of 78,000 cu. yds. of fill across the river, and bearing in mind the damaging effect of tractor treads on concrete, strong timber decking was laid to take that traffic. Upon completion of the fill, this timber decking was removed and a reinforced-concrete slab was then built for permanent decking.

It is interesting to note that the bridge was submitted to greater loading and vibration before completing the decking than it will have to withstand under normal conditions and it is therefore reasonable to assume that no settlement or disturbance in the structure is likely to occur.

(*c*) *Underpass.*—The underpinning of the abutments of the underpass did not present any difficulty and was carried out in a normal manner. The railway traffic was not affected by the work and the regular half hour train schedule was carried out by the railway authorities all through the operation.

(*d*) *Drainage.*—The construction of the drainage system did not present any engineering difficulty, although it did involve many physical discomforts during the rainy season. Various makeshift implements were tried in attempts to increase the rate of progress of ditching, two of which are worthy of mention :—

The first consisted simply of a Fresno scraper rigged up fore and aft with steel wire ropes leading through blocks lashed to timber posts set solidly at

each end of the proposed trench to the front and rear of a three-ton dump truck. Advancing and retiring the truck along a given line of travel actuated the scraper along the line of the trench causing it to dig, transport and dump soil, thereby reducing manual labour to a minimum.

One trench had to be excavated four to five ft. deep in the chalk along a distance of over 3,000 ft. A ½-cu. yd. self-propelled bucket excavator was used for this purpose. It was placed so as to straddle the trench, heavy timbers being placed under and at right angles to the tracks, in order to guard against the possibility of failure of the sides of the trench. A heavy rooter was used to loosen up the undisturbed chalk ahead of the excavator. As the excavated soil was being dumped along the sides of the trench, for back-filling, this method was found most satisfactory.

All pipes laid were of concrete and were surrounded with from four to six inches of concrete.

Some inspection chambers and catch basins consisted of pre-cast concrete shapes which, once in place, functioned as the inner forms. They had to be surrounded with concrete so as to withstand the pressures of the soil deposited around them. Inspection chambers were also built of brick and were also surrounded with concrete.

(*e*) *Carriage-ways.*

(i) *Concrete.*

The three main operations in the pouring of the concrete carriage-ways consisted of :—

1. Pouring longitudinal and cross-beams, including stub piles.
2. Pouring stabilizing course.
3. Pouring carriage-ways proper.

These three operations were carried out by two groups. The leading group poured the beams and laid the forms on the beams for the carriage-way, and the second group poured the stabilizing course and the carriage-way.

The first operation was the longest, requiring the placing of forms for the beams, excavating and pouring concrete for stub piles, removing forms after two days setting period and placing and securing forms on the finished longitudinal beams ; all this work had to be carried out by hand.

For the second and third operations, a mechanical concrete distributor and two vibrators were utilized, reducing manual labour to a minimum and making possible a fast rate of progress. One vibrator had a vibrating beam 10 ft. long, the other vibrator being equipped with an 11 ft. vibrating beam. This necessitated quite a bit of hand finishing but did not delay operations. This special equipment was supplied by the County Council.

The concrete was mixed at a central mixing plant of a capacity of two cu. yds. per batch. The water-cement ratio, the proportions, grading, volume and moisture content of the aggregates were under constant supervision.

For the carriage-way, and beams, the water-cement ratio was kept at between .44 and .50 and the mix averaged :—

Cement	1 part
Sand	2½ parts
Stone (⅝" max.)	5 parts

(measured by weight of dry aggregates).

For the stabilizing course, water-cement ratio remaining as above the mix averaged :—

Cement	1 part
Sand	3½ parts
Stone	7 parts

Only graded aggregates were employed.

The mixtures resulting from the above had no slump.

The average rates of progress were as follows :—

1. Beams and stub piles, 200 lin. ft. per day.
2. Stabilizing course, 480 lin. ft. per day (10 ft. wide).
3. Carriage-way—320 lin. ft. (11 ft. wide) per day.

Note that 5 days of operation No. 1 (1,000 lin. ft.) equals 2 days of operation No. 2 plus 3 days of operation No. 3.

The average compressive strengths of concrete were as follows :—

Stabilizing course—500 to 700 lb. per sq. in.
Carriage-ways—4,000 lb. per sq. in.

(ii) *Tar-Macadam.*

As mentioned previously, some portions of the road which are not of a permanent nature were built of tar-macadam overlying a hardcore base. In order to provide good shoulders against which to rest the road metal and to provide a base for curbs, concrete beams 14 in. wide and 9 in. deep were built along each side of the carriage-way.

Hardcore was then placed between these beams to a depth of 6 in. and rolled with a seven-ton road roller to provide a good base.

It is interesting to note that all the hardcore employed consisted of brick, concrete, and cut stone originating from the " ruins of London " and it might be stated here, without idle fancy, that many a relic lies buried under the tar-macadam.

The tar-macadam was laid in two courses; the base course, 3 in. thick was made with graded aggregates, mostly limestone slag, of a maximum size of 2 in., while the wearing coat ½-in. thick is made with graded aggregates up to ⅜-in.

The tar-macadam was mixed by the County Council at their plant and a few experts were also supplied by the County Council to finish the tar-macadam according to specifications.

3. *Curbs.*

All curbs were pre-cast in sections 30 in. long. Along the concrete carriage-ways they were set upright on the projection of the concrete beams, while along the tar-macadam carriage-ways they were laid flat on top of the beams built for that purpose. In all cases, curbs were grouted in with a sand-cement grout.

4. *Farm Entrances.*

Accesses to a few farms along the road had to be provided. The surfacing of these farm entrances consists of what is called locally " hogging " laid over a hardcore base. Hogging is a type of soil stabilization consisting of mixing clay, chalk and gravel in the right proportions and with the right amount of water to reach optimum moisture. This mixture is spread over a prepared base and smooth rolled. When completed, it presents a hard surface not unlike the better type of Canadian consolidated gravel roads.

Official Opening of Road.

The road was officially opened on August 28th, 1941, by the Rt. Hon. William Lyon Mackenzie King, Prime Minister of Canada. He named it " Young Street " to commemorate the name of the Officer Commanding the company of Royal Canadian Engineers who built it, and then, (in a blinding rain), addressed the officers and men of the company. In his address, Mr. Mackenzie King brought out an interesting point, to wit: " War does not consist only of destruction but also of construction, often of a permanent nature and of general benefit to the advancement of civilization."

ACKNOWLEDGMENTS.

This paper would be incomplete without the following acknowledgments: To the Chief Engineer, Canadian Corps, for permitting its publication; to the C.R.E. Canadian Corps Troops Engineers for posting the writer to the company of engineers employed on this construction; to Major E. J. Young, M.C., Officer Commanding the company of engineers to whom the task was allotted and to whom credit is due for the efficiency of the company, and for allowing the writer free access to all records of the work and finally to the officers and men of the company for the efficient and exemplary way in which they carried out the work, and for the accurate records which they kept.

AXIS OIL STRATEGY.

By H. G. AUSTIN (*"Oilfield Engineer"*).

LONG before the outbreak of war, experts were assuring the British public that Hitler could not hope to wage any large-scale campaign, due to lack of sufficient reserves of oil products. Since the campaigns of Poland and of Western Europe, culminating with the Balkan and Russian Wars, repeated efforts have been made to convince people that the Axis powers were bound to collapse sooner or later on account of an oil shortage.

Rommel's secret administrative order, reported to have been found in Libya, is stated to have indicated clearly that the fuel situation in his armoured divisions, was becoming stringent. The latest authoritative statement on the question is that of Major-General Piotr Kotoff, of the Soviet Tank Army, who has presented figures of oil resources and consumption, purporting to show that all Axis oil reserves will have been exhausted before the Spring of 1942.

The main source of mineral oil for the Axis is Rumania, and if there *is* an oil shortage, the analysis of official Rumanian oil industry statistics for 1941 should throw considerable light on the subject. The data are obtained from American sources, and may be considered reliable, since rupture of relations between Rumania and America did not occur until December, 1941. In the opinion of the writer, who lived in Rumania until 1940, the figures given are fairly accurate, and any doubts which may be cast upon them must be that they are possibly on the high side—and thus are more favourable to the Axis.

Rumania is strategically placed as the main source of mineral oil to all present Western fighting fronts. In spite of claims by the Russians to have caused widespread damage to the refineries at Ploesti, the oil centre of Rumania, reliable news has filtered through, showing that effects of Red bomb damage were comparatively negligible, and that there is still far greater refining capacity than is needed for the rapidly decreasing crude oil production.

With modern plants in full working order, there is no need for the Axis to export any crude oil from Rumania, as petrol, paraffin, Diesel oil, lubricating oil, etc., can be produced on the spot.

When considering the Rumanian oil situation in 1941, it must be remembered that the Nazis mounted the successful attacks on Greece, Crete and Jugo-Slavia early last year, and that very considerable quantities of Rumanian oil products must have been shipped, ready in reserve, for the onslaught on the Russians in the middle of the year. Rumanian oil supplies have thus been dis-

tributed in every possible direction from that country, with every available transport facility used to the utmost, during most of the year. Since the fall of Crete, tankers from Italy have been able to go up through the Dardanelles, load up at Constanza on the Black Sea, and then creep back to Italy, or to Libya, round the coast of Greece, with small distances to travel over open sea.

In view of these facts, one would logically anticipate that every available drop of crude oil was produced from Rumanian wells, and that all refined products, aside from a small proportion for domestic consumption, would have been exported. Ever since the Germans took over the Rumanian oil industry intact, in November, 1940, their propaganda departments have assured the world that new pipelines were being built to reduce transit time on the long Danube river route; that single-track railways were being doubled; that vast numbers of oil barges and tugs have been assembled, not only to take oil up the Danube for distribution to Central Europe and Italy, but also to overcome restricted land transport facilities to the Russian front by shipping oil across the Black Sea to the south flank of the Axis armies in Russia.

A layman would justifiably be astounded to know that 1941 Rumanian crude oil production continued the rapid pre-war decrease in volume, and that, in spite of the obvious need for every gallon of petrol, only three-fifths of available oil and products were exported. Official statistics are as follows :—

Crude Oil Production.	*Metric tons.*
1941	5,200,000
1940	5,750,000
1939	6,248,000
1938	6,601,000
Exports.	
1941	3,100,000
1940	3,492,900
1939	4,178,000

The continued decrease in crude production in 1941—more than 10% when compared with the previous year—is not due to any lack of good oilfields, since pre-war research work showed, very conclusively, that many new potential producing areas were awaiting exploration. The main cause of continued decline is lack of local storage and of transport facilities for Rumanian oil exports, with lack of efficient oilfield equipment and of skilled workers as contributory reasons.

In regard to exports, the Danube is Hitler's main oil artery—frozen for several months during the past three winters, due to abnormally severe conditions, but lack of sufficient barges and tugs for long hauls upstream against a swift current has restricted the maximum possible transport volume on this great route.

Efforts to complete a large-diameter pipeline, using pipe taken from a French project, between Ploesti and Moldova Noua—on the Danube, above the Iron Gates—have apparently not been successful, although Goebbels himself told the world that the line would be in operation by April 1st, 1941, thus greatly increasing Danube oil traffic capacity.

Lack of railroad tank cars on the three single-track railway lines from Rumania towards Poland, Hungary and Jugo-slavia, respectively, may have caused efforts to increase oil transport by surface routes to fall short of estimated volumes.

With Rumania responsible for the production of nearly 50% of the annual oil supplies of every type available to the Axis, it is therefore, quite obvious that, whatever the oil fuel situation of the Axis may be, there certainly can be no substance for any statement that there is an actual oil shortage.

What may be said, however, is that, in spite of strenuous efforts known to have been made in every direction to increase export volumes of oil from Rumania, *the lack of transport facilities*, not only in that country, but in most

Axis areas, is responsible for the failure of distribution of available oil reserves and resources.

The statements which continue to be published in newspapers, and issued by other channels, to the effect that the Axis Powers may this year make determined efforts to invade the Caucasian, Persian, Egyptian, and Irak oilfields *for the reported purpose of gaining new supplies of urgently needed oil*, must—in the face of the facts presented in regard to Rumania—be regarded with considerable suspicion. If all the oil in such a focal point as Rumania, from which great and undamaged transport routes run, cannot be exported, how then can anyone claim that the Axis is preparing to waste men, equipment, precious oil supplies and time, in advancing over vast distances to capture oilfield areas which will be thoroughly demolished by the defenders before they retreat, and from which —should crude oil production ever be possible—transport facilities will be in such a condition as to render export problems for the Axis in Rumania a very simple matter by comparison ?*

* An interesting commentary on the subject of Axis oil supplies has recently been issued by the Ministry of Economic Warfare. In contradistinction to so many reports, from the same source, indicating the Axis Powers to be lacking sufficient oil supplies and reserves, it is now admitted that the Nazis and their Western satellites have sufficient oil with which to carry on large-scale and intensive warfare.

CONSTRUCTION OF SCUPPERS, I.E., IRISH BRIDGES.

By CAPTAIN A. CARRUTHERS, Indian Engineers.

MOST of us, during our travels at some time or other, have observed the road sign "Caution—Bad Bump Ahead." We have also, much to our regret, experienced the bad bump without having had the timely warning and we may, quite justifiably perhaps, have expressed what we considered was the correct punishment, for the road engineer responsible for the bad bumps. That attitude does not of course help the engineer to make a better scupper the next time.

The writer feels that the apparent lack of attention on the part of some engineers to the requirements of present day motor traffic is due in great measure to the complete lack of data or guiding principles for the construction of scuppers —sometimes termed Irish bridges—especially for scuppers situated on hill roads.

It is hoped that the principles outlined in the accompanying article will be of assistance to all road engineers who have such works under contemplation.

It has been written in such a manner that it will be understood by even the average road overseer, who at times is left too much to his own devices when he ought to be receiving expert assistance and advice—and does not receive either, presumably because the job is too far away to be visited very often by the Engineer-in-Charge, or the Engineer himself has no data to work on.

Scuppers have been constructed on the principles laid down here and tried out under motor traffic on—

(i) Straight sections of hill roads, up to 35 m.p.h.
(ii) Re-entrants on hill roads, up to 22 m.p.h., which was the maximum speed the bend in the road would permit, and proved a success. No bumps or jerks were experienced during the trials.

(1) *Scuppers are required on Hill Roads* to carry all water from catch-water and road-side drains across the line of traffic.

To be completely effective, scuppers must comply with the following conditions :—

(*a*) Be capable of disposing of all water in that particular area.
(*b*) Be so designed that wheeled traffic is not unduly slowed up on the straight or at a bend in the road.

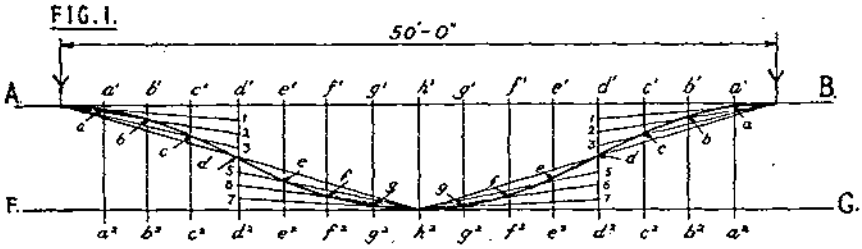
(2) To comply with condition (*a*), the required waterway should be calculated from the Dun Drainage Table (*M.E.S. Handbook, Vol. III, Table VIII*) or from known flood data for the area under consideration.

To comply with condition (*b*), the following rules must be adhered to, bearing in mind the fast moving motor vehicles of to-day :—

(i) No scupper will be less than 50 feet long.
(ii) The dip will be not greater than 1/60.
(iii) The gradient of the road at the scupper will be not greater than 1 in 40.
(iv) All curves should be parabolic to give as little " bump " as possible.

(3) A simple method of setting out a parabolic curve for a scupper is shown in figure 1.

FIG. 1.



(*a*) Let the line AB represent the outer edge of any gradient of road from " level " to a slope of 1 in 40.
(*b*) Plot the proposed length of scupper " YY " (say 50 feet) on line AB.
(*c*) Divide the line into 16 equal parts (*a*), (*b*), (*c*), (*d*), etc.
(*d*) Draw line FG parallel to AB. The distance of FG from AB will represent the calculated dip for the waterway required. (We will consider a depth of 10 in. as it is the maximum for a length of 50 feet).
(*e*) Draw lines a^1 a^2, b^1 b^2, etc. perpendicular to line AB.
(*f*) Draw lines Y h^2.
(*g*) Divide lines d^1 d^2 into 8 equal parts. (It will be noted that each space thus represents 1.25 in.)
(*h*) From Y draw lines 1, 2 and 3 and from h^2 draw lines 5, 6 and 7.
(*i*) Points a, b, c, d, e, f, and g of the parabolic curve are fixed as follows :—

Point " a "	where	line 1	cuts	line	a^1 a^2
" b "	,,	,, 2	,,		b^1 b^2
" c "	,,	,, 3	,,		c^1 c^2
" d "	,,	,, Yh^2	,,		d^1 d^2
" e "	,,	,, 5	,,		e^1 e^2
" f "	,,	,, 6	,,		f^1 f^2
" g "	,,	,, 7	,,		g^1 g^2

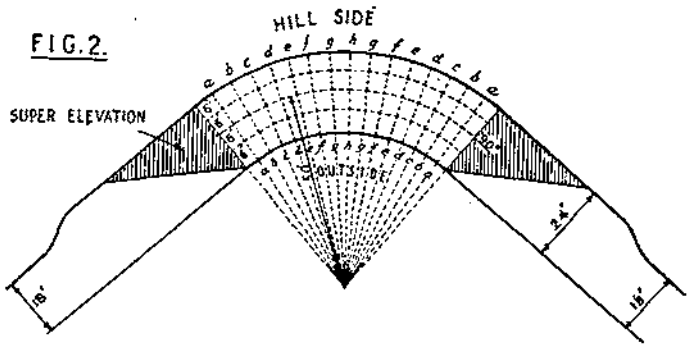
(*j*) Draw the parabolic curve from Y through points a, b, c, d, e, f and g to h^2. If the graph as detailed above is made on squared paper it will at once be observed that at

g	the rise is	$\frac{1}{4}$ of $1\frac{1}{4}''$	$= \frac{5}{16}''$
f	,, ,,	$\frac{1}{2}$ of $2\frac{1}{2}''$	$= 1\frac{1}{4}''$
e	,, ,,	$\frac{3}{4}$ of $3\frac{3}{4}''$	$= 2.8''$
d	,, ,,	$\frac{1}{2}$ of $10''$	$= 5''$
c	,, ,,	$10''-2.8''$	$= 7.2''$
b	,, ,,	$10''-1\frac{1}{4}''$	$= 8\frac{3}{4}''$
a	,, ,,	$10''-\frac{5}{16}''$	$= 9\frac{11}{16}''$

The levels may then be fixed at the site.

(4) In dealing with a scupper at a re-entrant, the following rules will be observed :—

FIG. 2.



(i) The radius of the bend should be not less than 50 feet at the centre of the road. (See Fig. 2.)

(ii) The width of the road at the re-entrant will be increased to 24 feet.

(iii) The gradient of this part of the road will be maintained at the outside edge of the scupper but see para. 2 (iii) and para. 7.

(iv) Super-elevation, at say 1/18, will be given before work on the scupper is commenced.

(v) The entrance and the exit of the scupper must be kept at right angles to the line of approach.

(vi) It will be observed from Fig. 2 that the side of the scupper at the hillside is very much longer than the outer side.

(vii) Care must be observed in dividing the inner and outer edges of the road into 16 equal parts as shown in Fig. 2 at (a), (b), (c), (d), (e), (f), (g) and (h) and fixing levels on each line according to the degree of super elevation required at each point of the bend.

(viii) It will also be necessary to divide the "width" of the road into four parts each 6 feet wide and fix three additional level points on each of the lines (a), (b), (c), (d), (e), (f), (g) and (h) and at the entrances, in order to ensure that the parabolic curve is maintained across the full width of the road and that the super-elevation of 1/18 is maintained from beginning to end of the scupper.

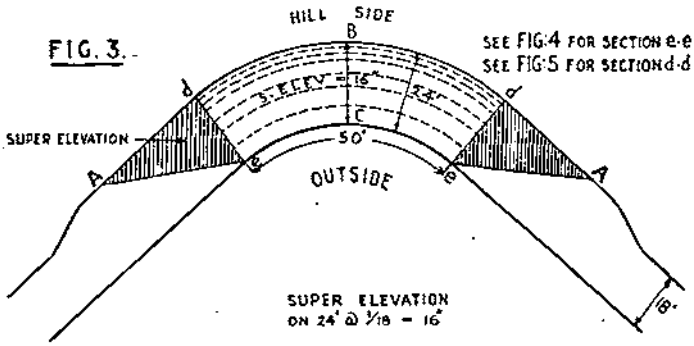
(ix) Super-elevation should commence outside each end of the scupper and reach 1/18 at the entrance.

(5) If we assume that the road is level at the bend and the super-elevation is 1/18, the plan and sections of the road at the bend will be as shown in Figs. 3, 4 and 5.

Super-elevation begins on the line "Ae" and reaches the maximum at point "d" and the rise between "A" and "d" should be parabolic to eliminate a bump on the line "de." Assuming the width of the road at the bend is 24 feet, point "d" will be 16 ins. higher than "e" and this difference is retained throughout the length of the scupper.

Fig. 4 shows a longl. section at " ee."

The length of the scupper is shown as 50 feet, as measured on the outside edge of the road.



The length at the hillside edge may possibly be 80 feet to 100 feet according to the nature of the bend.

(6) The procedure will therefore be as follows :—

(*a*) Fix the level points shown as " ee " in Fig. 3 bearing in mind the gradient. See paras. 2 (iii) and 7.

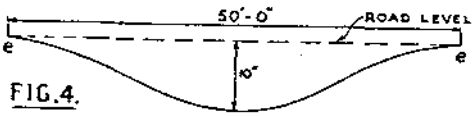


FIG. 4.

SCUPPER OUTLINE
SECTION e-e IN FIG: 3

(*b*) Fix the level point shown as " C " at 10 in. below " ee."

(*c*) Fix 14 additional points between " ee " to effect a parabolic curve as explained in para. 2 above.

(*d*) Fix the level points at " dd " (16 ins. higher than " ee ") and at right angles to the line of approach.

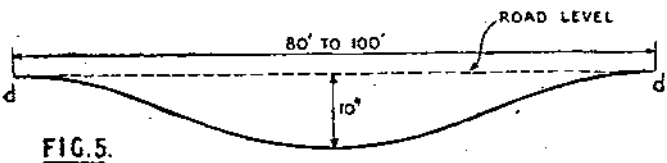


FIG. 5.

SCUPPER OUTLINE.
SECTION d-d IN FIG:3

(*e*) Fix the level point at B (16 in. higher than C).

(*f*) Fix 14 additional level points between " dd " to effect a parabolic curve. See para. 6 (c) above.

(*g*) Fix additional points as required across the width of the road connecting the points on the outer curve with the points on the inner curve. See para. 4 (vii).

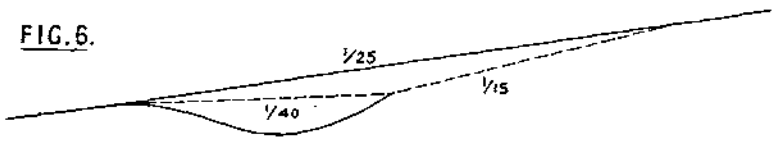
If the subgrade and the soling is laid according to the above method the result should be a first class " bumpless " scupper.

(7) If a scupper is required where the road has a gradient of say 1/25, the scupper will be laid at not more than 1/40, *vide* Rule (iii) in para. 2, and the road

surface cut down and taken at a slope of 1/15 for 60 or 70 feet until it connects with the original alignment to provide a smooth run on as shown in Fig. 6.

(8) If a number of similar scuppers are to be constructed, it will pay to make up a template of the parabolic curve.

FIG. 6.



If the scupper is to be constructed on a straight section of road, it offers no great difficulty and the template can be used at any part of the width of the road.

(9) If however the scupper is required at a re-entrant, as is usually the case, the template can only be used at the outside edge of the road and allowance will require to be made for increasing the width of the scupper at the hillside edge whilst retaining the parabolic nature of the dip and making due allowance for super-elevation.

(10) *Specification.*

Soling will be not less than 9 in. thick laid to parabolic curve, all interstices filled with small stones and *bajri* and rolled with a steam roller before applying a-3 in. premix surface.

Materials required for the 3 in. surface premix.

Size of metal.	Quantity of metal per 100 sq. ft. in cu. ft.	Emulsion per cu. ft. of metal in lbs.	Tack coat per 100 sq. ft. in galls.	Seal coat per 100 sq. ft. in galls.	Coarse sand per 100 sq. ft. in cu. ft.	Total Emulsion per 100 sq. ft. in galls.
1½"—¾" ¾"—½"	22.5 11.25	2.5 7	1.5	1.0	1.50	16

Aggregate should be mixed in rotary drums or mechanical mixer.

The surface premix will be laid in two courses. The larger graded aggregate providing the base for the finer aggregate surface course.

PROCEDURE.

Clean the road surface.
Spray or brush on tack coat.
Spread Base Course aggregate.
Leave for 24 hours.
Roll over 3 times, keeping wheels damp.
Spread surface coat aggregate evenly.
Leave for 24 hours.
Roll to compaction.
Spray seal coat.
After 2 hours cover with coarse sand blindage.
Open to traffic after 48 hours.

NOTE.—A drum of emulsion usually contains 40 gall. = 400 lb. and 220 gall. equal one ton.

PROPAGANDA AND THE SOLDIER.

By "OCTUPLE."

MUCH ink and paper have no doubt been spent both within and outside the Services on the subject of propaganda. Lip-service in abundance is paid to its importance, and all officers are enjoined to pay it the utmost regard.

We all know that the will of a nation is rarely overcome by force of arms alone, and it is the task of propaganda to attack the portions of the enemy front that cannot be approached by the armed services. The German rarely attacks with military force until propaganda has played its part in weakening resistance. When this has not been done, as in the case of Russia, their army's success has been far from complete.

Few will be prepared to deny that the part played by British propaganda in the present war, whether at home or abroad, has been, to say the least, disappointing; the reasons for this as seen by a humble regimental soldier may not be out of place, even though no novel idea or new principle is propounded.

We can never afford to neglect the lessons to be learnt from the enemy, and indeed from our own allies, and both Germans and Russians can teach us much in this, as in many other matters. It seems probable that Hitler and his advisers copied much of the art of impressing crowds and dominating nations from Napoleon. The resemblance between the two is sometimes startling—"Holland is French" quoth Napoleon in 1813. "No power on earth can take it away again." Holland was no longer French 2 years later!

As was pointed out in a recent article in the *Army Quarterly**, both paid scant regard either to truth or to consistency. Napoleon achieved much success in his use of the revolutionary enthusiasm of France as a weapon and, as with the Nazis, French enthusiasm steadily declined after he had started on his scheme for the conquest of Europe; it is significant that in Napoleon's Russian adventure less than half of his Grand Army was made up of Frenchmen.

Hitler has many resources for the spread of propaganda that were not available to Napoleon, but he has used the same technique. Right from the start he has appealed to two instincts—the sense of grievance and the sense of danger. Together with these he has used a fresh theme of his own—the value of race and blood in an alleged new concept of life. The German is taught that he is fighting in a noble crusade for the conquest of the world by a so-called superrace, and for the overthrow of privilege and plutocratic world control.

It is certain that we shall never get far with British propaganda on such fantastic lines but it is equally true that we *must* have a master idea, and revolutionary seed to sow in the minds of the nation in general and of our own soldiers in particular. The principles of the Atlantic Charter are all very well but we want something less verbose and more concise. President Roosevelt was perhaps nearer the mark in the four war aims that he gave to the U.S.A. in a famous speech. These were (1) freedom of thought and speech, (2) religious freedom, (3) economic security, and (4) freedom from the fear of war. These can also be cited as the positive aims of the British peoples, but we have had religious freedom for so long that this has come to be taken for granted, and many thoughtful men would add equality of opportunity as another important objective. But the sense of fear is the main cause of the plight in which the world finds itself to-day. It is the need for security that is so vital, nor can there be security for any Power, great or small, unless it is a security in which one and all have equal share.

* 'The Tankenstein Monster' by Lt. Col. Graham Seton Hutchinson. *Army Quarterly*, January, 1942.

Few will deny that democracy as practised in this country, and still more so in the U.S.A., stresses freedom to the utmost, but in practice it is mainly freedom for pleasure and comfort. Our politicians were always insistent that we must lose none of our social gains—their defence was hardly considered! Moreover, democracy in its present form is far too slow and too unwieldy. Lord Baldwin, when Prime Minister, in a moment of unusual frankness, virtually admitted this as an excuse for his own disregard for advising more rapid re-armament.

We are hampered on every side in the Services because our recruits join us saturated with "safety first" ideas and knowing little of the ideals for which they are required to fight. They want to win the war, but they want to lose as little as possible of comfort and convenience in doing so. A commanding officer has only to compare the money subscribed to his unit savings scheme with that spent on beer and tobacco in the various canteens to appreciate this.

The Germans and the Russians fully appreciate the importance of propaganda among the young, and we shall never get far with our own propaganda in the Army unless the right outlook is instilled into the nation at large, at an early age. Something is being attempted in registering youths at 17 and attending to their early training in such admirable organizations as the Air Training Corps, but we must travel along this road much faster and much quicker.

The recent outcry in Trades Union circles against income tax is symptomatic—an outcry by men whose gross income is double and treble as much as that of the soldier and his dependents. Moreover, we all know of offenders in a greater or less measure against the many restrictions that are necessary in time of war, and the worst feature is that there is little wholesale condemnation of such practices by public opinion. We shall never get the right outlook towards vital issues in the soldier until the nation at large purges itself of the many abuses. There must be far more drastic measures against black markets, food profiteers, petrol scroungers and the like. If such offences were regarded as high treason and a few death penalties inflicted in grave cases, there would quickly be an abatement of the many scandals. Sir Stafford Cripps, who knows the Russian system so well, has complained vigorously about the lack of urgency in our national outlook; he emphasizes that we shall only achieve victory if we devote one hundred per cent of our energy to the nation's war effort.

In the field of national propaganda there is room for vast improvement. The picture is so much more effective than the written word; even in an officers' mess one has only to compare the crumpled condition of *The Daily Mirror* and *The Daily Sketch* early in the day, with the unsullied state of *The Times* and *The Telegraph* late at night to appreciate this. The Russian comic strip-posters, with laconic verses of an explosive wit and violence, are admirable. Everything is concentrated upon satire and upon exposing and deriding the enemy. The workers in the factory and the soldiers and guerillas in the fields are encouraged to redouble their efforts to smash the enemy and to win the war. Contrast this with our passive and anæmic slogans such as "Your courage and your steadfastness will bring us victory" and "We can take it!" The Ministry of Works is getting nearer the mark with their "Will the Beast invade?" pictorial posters, and of our newspapers, the *Daily Express* is the most realistic in its outlook, and of the weeklies, the *Picture Post*, with such illustrations as those of Japanese troops bayonetting live Chinese prisoners. It is significant that these pictures produced the very next week a torrent of objections on the score of bad taste, and on the ground that it was desirable to keep people in ignorance of Japanese barbarism!

In the cinemas, the Ministry of Information films are fairly good, but broadcasting at home has little propaganda value. To the ordinary man the long Parliamentary broadcasts during the news-hour when the House is sitting, are maddening—the same House of Commons, be it remembered, that echoed with tumultuous applause at the Munich settlement that was to give "peace in our

time." Our Broadcasting must be less defensive, more realistic, and above all absolutely truthful. The war commentaries of such men as Air-Commodore Goddard and Group-Captain Helmore are on the right lines.

In our contacts with the soldier there are certain fundamentals that we must always bear in mind :—

(1) The only propaganda that the British must use is the truth, and we must be meticulously careful of this.

(2) We *must* have our own "revolutionary" ideals to set up against the bastard faith of the Nazis. Hence the importance of cleansing our own national life of its worst features. We must stress the necessity for the clearance of slums, the purge of ugliness and the end of exploitation in the reconstruction after the war. We want a *Pilgrim's Progress* up to date—a modern mechanized Mr. Greatheart, possessing a sense of humour that was so lacking in Bunyan and the Puritans.

(3) Service to the community, not self, must be the underlying motif. The men understand this and appreciate the importance of all pulling together. No man will do his best unless he feels that he is one of a team; the old Regular Army understood this even better than the present-day citizen soldier.

Sir Richard Gregory, *M.P.*, has stressed the ideal of service to the community in *The Forward March* and other books. He emphasizes the importance of transferring to the tasks of peace the enthusiasm so readily called forth by the business of war, maintaining with much cogency that a new conception and a new outlook on these lines will alone give us full victory over Nazi-ism.

(4) It was the rape of Belgium that gave inspiration to countless thousands in the British cause during the last war and this time we have a dozen nations prostrate under the Nazi jackboot. We must teach our men that there dwells in the heart of Europe a warped and a twisted people that has become a menace to the civilized world. It is a country whose love of power and regimentation has developed a gigantic war-machine and an aggressive nationalism that has turned it into a bandit nation.

Since it must be accepted for good or ill that love of fighting for its own sake is far from being a characteristic of the Anglo-Saxon race, we must work up a lively hate against the German and the Jap. It is the defence of his hearth and home that will inspire in the British soldier a feeling of hate for the enemy who is burning to destroy them. Our men will never give the service that is necessary in total war in an atmosphere of peace and apparent security.

The War Office has given us some good training films and these are helpful, but the Powers-that-be sometimes trip up in this important task. In a recent series of pictures of the German Army, purposing to give to all ranks an idea of the appearance of the German soldier and reproduced no doubt straight from German sources, the Hun soldiers are represented as most magnificent and handsome specimens into whom no one would wish to insert a bayonet! The Russians would never make this sort of mistake.

The Army Bureau of Current Affairs could do much more in descriptions of the rape of Poland, the murder of Russian civilians, the wholesale starvation of the Greeks, the agony of the Czechs. Moreover, the soldier of a non-professional army wants reminding again and again that the war is very much *his* affair. Short graphic accounts of deeds of courage in recent fighting are admirable but it is pictorial representation that counts for most. Many units have draughtsmen—official or otherwise,—who can make their own posters with local colour. Such subjects as the avoidance of waste, the importance of salvage, security, war savings and so on can all be introduced. The British soldier is terribly wasteful, slapdash and easy-going in his habits and he wants reminding at every

opportunity that such practices are actively helping the greatest pest that the world has ever known—Hitler and his Huns. In the Officer Cadet Training Unit which the writer had the honour to command, a minor feature was an hour a week—strictly voluntary—devoted to debates, brains-trusts, discussions and the like. One such period was devoted to this matter of propaganda, and the cadets generally agreed that the reality of total war would never be fully appreciated in those sections of the wage-earning classes that were being paid so much more in war than in peace, and who were suffering no real hardships or even discomfort. The importance of realism in training was also stressed, with the use of real bullets on occasions on the lines of training in the commandos.

In the light of the aftermath of the last war it was generally felt that the less said about post-war development the better. With reference to Roosevelt's four points, one cadet remarked with much cogency that compulsory church parade was hardly a suitable feature in an army that was fighting for religious freedom! It was agreed that the officer was the right person to supply propaganda teaching in the army, but it was also felt that many officers were not temperamentally suited for this.

What is crystal clear, is that the soldier wants to know the truth, however unpalatable it may be. That is one reason why the speeches of the Prime Minister are listened to in the Forces with so much more respect than those of some other Ministers. There is, however, much impatience at the muddles perpetrated by so many departments which direct or often misdirect the vital business of a nation at war, and it is felt that the penalties for gross ineptitude should be far more severe and far more strictly enforced. Total war can never be a kid-glove affair, as we are learning to our cost. It is mental alertness that is so much wanted and anyone who has dealings with O.C.T.U.'s and the training of officers knows that this is so often lacking, especially in the product of the state educational machine. Our leaders, both in and outside the Services, must possess the ability to devise and to improvise quickly and efficiently, so as to cope successfully with the many tricks of a skilful, cunning and resolute enemy in Europe and in Asia. War and peace are so utterly different, and the methods and mentality that were hardly good enough for peace, are hopelessly inadequate for war. Soft-soap and excuses are no good, and to cut out the dead wood is the first task in order that the young sap may get its chance to run freely. The trouble is that so much of the young sap seems to refuse to run freely when it gets its chance!

SHORTCOMINGS OF COMMERCIAL STEAM DISINFECTION APPARATUS.

By LIEUTENANT-COLONEL A. G. GADD, M.I.MECH.E., R.E., and MAJOR A. W. TURNER, A.M.I.MECH.E., R.E.

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(1) PRESENT PROCESSES.

STEAM disinfection by Field Units is normally carried out with "current steam" apparatus at, or slightly above, atmospheric pressure, using one of the Disinfectors Portable Field or an improvised substitute. Disinfection in hospitals, and sterilization, is usually done in commercial pattern apparatus working at

15 or 20 pounds pressure per square inch. Commercial current-steam disinfectors are also employed.

In all cases the apparatus is relied upon to give contact with the disinfecting steam throughout the "charge" of articles treated for the full period required for disinfection. As regards the Service apparatus, full care is taken, before adoption of the type, that such confidence is justified. Tests and theory agree, however, that all commercially designed plant has inherent failings which render its operation unreliable.

"High-pressure" disinfectors all work on the same principles. The charge is put into a "container" made of wire-mesh on a steel framework. For treatment the container, which is fitted with wheels, is run into a cylindrical or oval "chamber" which has a door at each end. The doors being closed on the loaded container a vacuum is created inside the chamber. When a sufficiently high vacuum exists the air outlet is closed and the steam inlet turned on. Steam is admitted until the pressure reaches that specified for the apparatus and is held at that pressure for the disinfecting period of ten to twenty minutes. The steam is then allowed to escape and hot air is passed through the chamber to dry the charge. After the specified period of drying the hot air is shut off, the exit door opened, and the container is run out for unloading.

Commercial current-steam disinfectors have the same general construction as the high-pressure type but no vacuum is created prior to steam-admission. An exhaust vent in the bottom of the chamber is opened when steam-admission begins and air is thus flushed out of the chamber. Steam is then passed through continuously, for say half an hour, after which drying follows as before.

(2) Failure of Various Commercial Designs.

(*a*) *Disinfector No. 1 (High Pressure).*—15 lb. per sq. inch, portable, capacity between 50 and 60 cubic feet. Load scheduled in Appendix 15 of *Army Manual of Hygiene*, 1934—50 to 60 blankets.

In January, 1941, a number of high-pressure disinfectors, adapted for field use, was offered for sale to War Department. One was ordered as a sample and went to the Army School of Hygiene for test and report. The tests were arranged and supervised by the staff of the School, as medical experts, and attended by one of the authors as engineer-inspection specialist. The tests were carried out with Army blankets in which temperature-indicator tubes were buried. Since the operating pressure was 15 lb. per sq. inch, the indicator tubes should have been such as would indicate the attainment of the temperature of steam at this pressure—namely 121° C. Such tubes were not available, however, and the 100° C. tubes made for testing the Service disinfectors had to be used instead. There is a negligible time-element in these tubes, which change colour almost immediately on subjection to a temperature of 100° C. The colour-change may begin, however, at a slightly lower temperature—say 94° C.—and must be complete to be satisfactory. Tubes remaining unchanged prove the maximum temperature reached in their locality to be well below 100° C.

The test load was 60 blankets, that is roughly one per cubic foot of chamber-volume, and was a normal full-load for the size of chamber and container. Out of ten indicator tubes used, five failed to change colour. A repeat test on the following day gave a similar result.

Following this failure, strenuous efforts were made to "turn" the tubes by doubling the time of subjection to pressure-steam, by raising the pressure to 20 lb. per sq. inch (126° C.), and by varying the method of loading the blankets. All the tests failed. The disinfector had been shown to be unreliable, even defining disinfection as the attainment of only 100° C. in an apparatus subjecting the charge to steam at a temperature of 26° C. higher.

These results engaged the serious attention of those witnessing them. The

manufacturers concentrated on making the plant effective by experiments on a similar model at their works while the authors looked for, and found, the basic causes of failure and the means of correcting them. It was, of course, realized generally that the immediate cause was the presence of unwanted air.

At their works the makers tried various expedients—improving the ejector, repeating the air-evacuation, reducing the load—but these were unsuccessful or impracticable. The results threw suspicion on the effect of a baffle-plate intended to prevent hot drying air from impinging on the charge. This was reduced in area by nine-tenths and, simultaneously, the effect of flushing the air out by steam, instead of using the ejector, was tried. The combination gave satisfactory results with a reduced load of 46 blankets. The necessary parts for conversion of the disinfector still lying at Aldershot were sent forward and fitted but a re-test after conversion was unsuccessful, one tube out of six remaining unchanged in the first trial, and two out of eight in the second. A visit was paid by the authors, who took with them various new parts to convert the plant to correct principles, which they had meanwhile deduced. On arrival, however, they found that the Army School of Hygiene had not been advised of the internal alterations necessary and, assuming this to be the reason, abandoned their project. As will be seen later, their proposals involved the use of a well-equipped workshop and moreover would have delayed acceptance of the disinfector which was now urgently required for use. The staff of the Army School of Hygiene then decided to remove the baffle-plate entirely, after which the disinfector gave good enough results to be put to use with a restriction placed upon the load. It must be remembered, however, that the indicator tubes were still of the 100°C. type though the pressure had been raised to 20 lb.

(*b*) *Decision to Test Other Designs.*—During this time a decision was taken to conduct a series of tests of different commercial designs purchased by the War Department, with Army School of Hygiene and Inspection Department, Engineer and Signals Stores, co-operating therein. As far as possible new plant was tested, operated by the makers at their works with steam from a steam main, thus obtaining the most favourable working conditions for the plant. Army blankets, as being the most commonly treated articles, were to be used and the load was to be a reasonably full one—that is, a quantity within the capacity of the container to hold without heaping, such as the operator would normally load up. The loads were generally below those scheduled in Appendix 15 of *Army Manual of Hygiene*, 1934.

(*c*) *Disinfector No.* 2 (High Pressure).—15 lb. per sq. inch, stationary. Capacity between 60 and 70 cubic feet. Load scheduled by Appendix 15 of Manual, 60 blankets.

This was of different design from No. 1. It had just been installed in the Aldershot area and was tested by the Army School of Hygiene. The tests failed. With a load of 50 loose blankets, 2 tubes failed to change out of 12. Loading the same number of blankets in 5 rolls each of 10 blankets, 5 tubes remained unchanged out of 15.

(*d*) *Disinfector No.* 3 (*High Pressure*).—15 lb. per sq. inch, stationary, capacity between 30 and 40 cubic feet. Scheduled load 30 blankets.

This was generally similar to Disinfector No. 1 but a stationary model. In three tests, with a load of 30 blankets in rolls of 10 blankets each, the tubes found unchanged numbered 9, 11 and 8 out of 11, 15 and 15 respectively. The disinfector was then altered in the same way as No. 1, after which it treated 30 loose blankets successfully.

(*e*) *Disinfector No.* 4 (*High Pressure*).—20 lb. per square inch, stationary; capacity between 115 and 125 cubic feet. Scheduled load 120 blankets.

The above results apparently created some discussion in the disinfector world for the authors were then asked by the makers of yet another design to test their standard apparatus at their works. The request was at first declined, as there

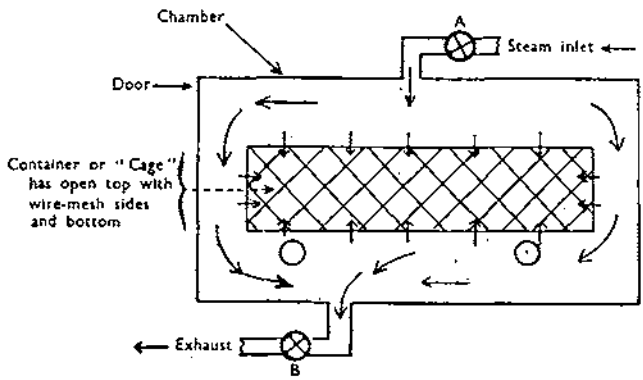
were no War Office orders open at the time with this firm, but was granted on being repeated and pressed a few days later. In the first test 47 tubes were used in a charge of 98 folded blankets and no fewer than 30 tubes remained unchanged. A repeat test with 60 loose blankets gave 9 tubes unchanged out of 26. A third test was made also with 60 loose blankets but with the evacuation process carried out twice over and the period of holding at disinfection pressure lengthened by 50 per cent. In this test, which took 127 minutes, all the 23 tubes used were changed, but the blankets were all rendered unserviceable and had to be "written off."

(*f*) *Disinfector No. 5 (Current Steam).*—Pressure virtually atmospheric. Stationary, capacity between 55 and 65 cubic feet. Scheduled load, 50 blankets.

Two months later a current-steam disinfector ordered for a Reception Station came up for acceptance tests at the makers' works. With an easily permeable load of one flock mattress success was obtained but, with a load of 40 loose blankets, 6 tubes out of 18 failed to change colour. The makers thought they could correct matters and were given an opportunity to do so. They split the load into two by a horizontal grid half-way up but with 40 loose blankets 5 tubes out of 18 remained unaffected. The cold spots were concentrated around and above the exhaust vent. The only way to make this disinfector acceptable now appeared to be reconstruction to the authors' ideas, of which an explanation follows.

(3) Reasons for Failures (*see* diagrams).

It will be realized that any air remaining in the charge during the period of treatment will be a grave deterrent to proper sterilization or disinfection,

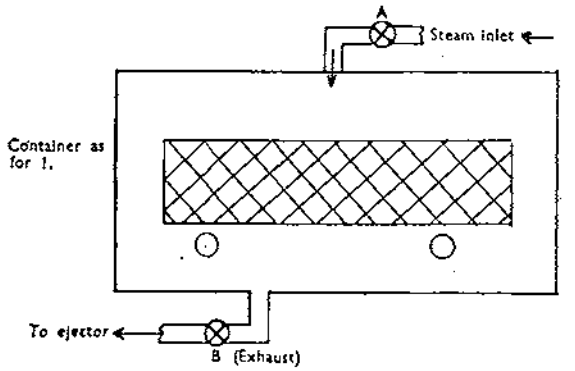


I.—Current Steam Disinfector. Present design.
Arrows show steam flow.

Operation.—Cocks A and B both opened, steam is passed through continuously for disinfection, but finds easy passage to exhaust, round sides and ends of container. No compulsory passage through charge in container.

firstly because air is an efficient heat-insulator and secondly because bacterial organisms have a much greater resistance to hot air than to steam. With all high-pressure steam disinfectors or sterilizers, air-extraction is carried out with a steam ejector in which steam at high velocity is directed through a nozzle past an orifice opening from the chamber containing the charge. The steam flow draws air from the chamber, creating a partial vacuum. The extent of the vacuum so formed depends on the efficiency of design and use of the ejector and may vary from about 16 inches of mercury up to 24 or 25 as a maximum. A complete vacuum, *i.e.* the extraction of all air, is represented by the barometric pressure—say 30 inches—and is unattainable. It is thus impossible to extract

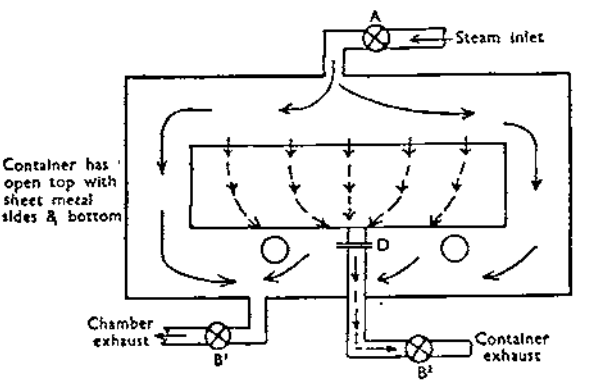
the whole of the air from chamber and charge. With a vacuum of 20 inches, (an average figure in practice) and assuming constant temperature, about one-third of the original air-content remains. With a chamber of say 120 cubic foot capacity, the quantity of air retained is seen to be huge.



II.—High Pressure Disinfector. Present design.

Operation.—(i) A, shut; B, opened. Some air extracted via B by ejector, leaving up to one-third remaining within chamber and charge. (ii) B, shut; A, opened. Steam admitted to fill chamber and build up pressure. Air and steam in unknown state of mixture fill chamber and charge. Steam penetrates charge from all sides without expelling air therefrom.

When the vacuum is sealed and the steam admitted all this air is trapped. Exactly how it behaves is problematical. That which surrounds the charge will intermix readily with the incoming steam condensing some as it heats up; that



III.—Both Types as Converted.
D is automatic valve or coupling.

Operation.—(i) A, B^1, B^2, all open, incoming steam rapidly displaces "free" air from chamber via B^1, during which time partial penetration of charge occurs from top only, as shown by arrows. (ii) B^1 is closed as soon as free issue of steam from it shows displacement of "free" air to be complete. Incoming steam can now only escape via B^2, *i.e.* downwards through charge, completing penetration and air expulsion as shown by arrows. Penetration complete as soon as steam issues full bore from B^2. (iii) Current steam type. Steam passage from A to B^2 continued for as long as is considered necessary for steam at 100° C. to kill bacteria. High pressure type. Valve B^2 shut and steam admission continued until required pressure is built up. Pressure then held as long as desired.

which occupies the interstices of the charge may be forced inwards as the steam pressure, to which the charge is exposed on all sides, rises. The extent of admixture with steam of the contained air will be greatest at the surface of the

charge and least towards the heart. Since air is heavier than steam, the areas where air is richest will be somewhat below the actual centre-line, and it is here that "cold spots" will be found.

The richer the air the cooler the mixture. With the customary rate of steam admission, therefore, the situation at the moment when the pressure has reached that specified (say 15 lb. per square inch) will be that there exists in the chamber a temperature gradually diminishing from a maximum somewhere near that of saturated steam (121° C.) to a minimum which may be little above that of the ambient atmosphere. It is misleading to say that the "disinfecting period has begun." The disinfecting temperature within the charge is a long way from being reached. More steam has to penetrate the outer layers of the charge until it is condensed in giving up its latent heat to warm up the air and the material. Still more must follow it, reaching a little further, and so on until the heart is reached and then sufficiently heated. How long it will take before the air-steam mixture in the heart reaches even 100° C. cannot be stated and there is no visual or other sign to indicate completion.

In the current-steam commercial designs a somewhat similar result is obtained in a different way. The chamber is not sealed, so no air is trapped. The "free" air is rapidly displaced from the chamber altogether by the incoming steam. So far, so good. Now the steam has to remove, or heat up, the air contained in the charge. Finding an easy path through the chamber from inlet to exhaust around the sides and ends of the container it naturally takes it, avoiding the charge itself, and we are back to the same gradual penetration and intermixing as before. Moreover there is now no "spare heat." The steam is at virtually 100° C. itself whereas its temperature is 121° or 126° C. in the high-pressure types. An air-steam mixture at a temperature 20° below that of the pure steam will still suffice in the high-pressure apparatus—or so we hope. With current-steam it is virtually useless, regarded as disinfection and not mere disinfestation.

(4) Method of Correction.

It will be as well to compare the machines so far discussed with any of the Service Disinfectors—for example the Disinfector Portable Field No. 3—particularly since the correction of the failings follows the design and operation of this apparatus. The Disinfector Portable Field *does* achieve the full disinfecting temperature by contact with steam in every part of the charge—in one of very many tests, carried out without a single failure, over 150 indicator tubes were used in a full charge of 32 blankets, *i.e.* 256 thicknesses. It does this with a load of three blankets per cubic foot of chamber compared with one, or under one, ineffectively treated in commercial models and in less than half the time.

These results are due to the rapidity, reliability and completeness of air-displacement, which is achieved as follows: The charge is held in an impermeable sheet-steel open-topped container which it closely fits. Steam is admitted to the top of the charge only and the exhaust opening is arranged so that steam can only escape to atmosphere by passing right through the charge itself in a downward direction. The difference of density between steam and air, and the pressure built up above the charge, combine to urge the air gently through the charge and out of the exhaust at the bottom. No air is trapped and there is an almost negligible amount of intermixing. The uninterrupted emission of pure steam from the exhaust is a visual indication that the expulsion of air is as nearly complete and perfect as can be and a few minutes of steam passage is enough to ensure that the charge is wholly filled with pure steam at atmospheric pressure. Any higher temperature could now be reached merely by closing the exhaust and continuing steam admission until the pressure equivalent of the desired temperature was attained. For now we are dealing with pure steam, not with

air-steam mixtures of varying and unknown composition, while, since the container is steam-jacketed, there is no heat-loss through the walls.

All that is necessary in commercial designs, therefore, is to apply these principles of construction. The container, instead of being made of wire-mesh, will have sheet-metal sides and bottom with an open top. From an opening in the container bottom an exhaust-pipe will be led through the chamber-wall to atmosphere. The container will be so loaded that no gaps or easy paths are left down which steam will flow in preference to passing through the mass of the charge. There are other details to attend to—for example the fitting of a cock to the container exhaust-pipe outside the apparatus, to be closed for building up pressure, and the provision of a coupling to the container-exhaust *inside* the chamber, capable of being broken or made from either end of the chamber, to enable the container to be run in or out. But these offer no constructional difficulty. The main principle is merely " downward displacement " which has been the feature of all Service disinfectors for many years.

(5) Tests of Reconstructed Disinfectors.

(*a*) *Disinfector No. 5.*—With the approval of the Directorate of Scientific Research full details of conversion of Disinfector No. 5 were given to the manufacturers of this current-steam plant by the authors and the work was at once put in hand. After some delay owing to difficulty in obtaining certain materials the altered disinfector was ready for test by July 21st. The disinfector-container had been provided with an automatically operating exhaust coupling and the whole plant was a workable outfit ready for immediate installation. The shape of the container had not been altered and was normal for a cylindrical chamber.

Instant success was achieved with a remarkable shortening of the total time taken for each cycle. Forty loose blankets were effectively disinfected in eleven minutes and forty folded blankets in thirteen minutes. After adjustment of the automatic valves the time to disinfect 40 folded blankets was reduced to eight-and-a-half minutes from closing the entrance door of the chamber to opening up for unloading. Remembering that the indicator tubes required the full saturated steam temperature of 100° C. to liquefy them, it will be realized how rapidly and thoroughly every vestige of air had been expelled and replaced by steam. The improved disinfector was at once accepted and its despatch to site for installation was ordered.

After installation, the authors attended its first putting to service, taking indicator tubes. A load of 60 blankets (20 per cent higher than the scheduled figure) was laid down as the standard maximum. The piping layout, having been designed for the original model, was unfavourable but its correction had to be deferred and, in any case, its effect was only to lengthen the operating cycle. The first operation was allowed to be carried out by the R.A.M.C. Corporal in charge, without fully instructing him, so as to prove to him the necesssity for the simple precautions to be taken. Before the disinfector was unloaded, he was told that the tubes, which had been evenly distributed throughout the charge of 60 blankets, would reveal failure. In fact 5 tubes out of 19 failed to respond, the unchanged tubes being found in the precise places which had been forecast. Next, the correct handling of the plant was demonstrated with satisfactory results. Check tests were carried out on four occasions in the following weeks—once to verify that the operator was still working correctly, once to observe the effect of the altered piping layout and twice to carry out overload tests. On October 1st, 1941, a load of 6 *rolls* of 10 blankets each, with 7 extra blankets added, was tried using three tubes in the middle of each roll. This is an unfavourable way of preparing blankets and had proved incapable of giving 100° C. disinfection in any high-pressure apparatus so tested, even when in Disinfector No. 1 a pressure of 20 lb. per sq. inch had been maintained for forty-five minutes.

The second overload test was made on November 14th, when no fewer than 90 folded blankets were crowded into the heaped container with forty tubes evenly distributed throughout the charge. Both of these severe tests were passed by what the authors hold to be the first commercial steam disinfector ever installed which can be relied upon to do its job.

(*b*) *Disinfector No. 6 (High Pressure)*.—15 lb. per sq. inch, 120 cubic foot chamber, 11 cubic foot container. Special model.

Meanwhile the manufacturers of Disinfector No. 4 had independently constructed a high-pressure disinfector working on the same downward displacement principles. They demonstrated this plant to us on July 18th. It was of an experimental type, consisting of a normal 120 cubic-foot cylindrical chamber in which had been fixed a container which was an exact duplicate of that of the Disinfector Portable Field No. 3. This container is rectangular, of capacity only 11½ cubic feet, and looked odd in such surroundings. It was fitted with an exhaust of screwed steel pipe with no coupling so that, although there was no chance of steam leaks, there was equally no possibility of withdrawing the container from the chamber. The container was loaded (with difficulty owing to the heat inside the steam-jacketed chamber) with 32 blankets folded as prescribed for the Disinfector Portable Field No. 3. Buried in the charge were indicator tubes of a different type, of which a description must be given. These are glass tubes containing a red liquid. On being heated, this liquid changes colour gradually through amber and olive to bright green and the temperature to which it is subjected is indicated by the time taken to effect the complete change—or, alternatively, the extent of the colour change in a given period of time. The tubes are designed to change from red to green in a temperature of 115° C. (equal to 10 lb. steam pressure) held for twenty-five minutes, but will do so at higher temperatures for shorter periods or lower temperatures for longer periods. The heat effect is cumulative—that is to say, a tube partly changed by subjection to 115° C. for ten minutes will, after cooling, complete its colour-change on being re-heated to the same temperature for the other fifteen minutes. Similarly a tube heated at 100° C. for five minutes will afterwards require less than twenty-five minutes at 115° C. to complete its change, while a tube not completely "turned" after twenty-five minutes' subjection to an unknown test temperature may finish its conversion to green if afterwards subjected to a lower temperature for a few extra minutes. All these factors, though rather involved, have a bearing on tests conducted with this type of control.

The test of the "mock-up" high-pressure apparatus was entirely successful. Since the load consisted of 32 blankets only this may at first sight be unimpressive, but that is only due to the choice of a container of unsuitable size and shape for the chamber. Even so, the load amounted to a solid wad of 256 thicknesses of blankets and, when it is remembered that the test was now 115° C. held for twenty-five minutes, not 100° C. for a few seconds, the immense improvement in air-expulsion and steam-penetration is manifest.

(*c*) *Disinfector No. 7*.—120 cubic foot capacity, 15 lb. per sq. inch, scheduled load 120 blankets.

In October, 1941, these manufacturers produced their first commercial model—a 120 cubic foot disinfector, to a War Department order, which was operated by them at their works. The container was found still to follow the Disinfector Portable Field No. 3 design, being a long rectangular sheet-metal box divided by removable vertical slides into four compartments each similar to the Disinfector Portable Field No. 3 container. The slides would be taken out to accommodate mattresses. Sixteen 115° C. tubes were used in a charge of 98 folded blankets. No more blankets were available.

The design and operation revealed an incomplete understanding of the principles involved and the authors were not altogether surprised when one of the tubes failed to complete its colour-change. The test conditions were not

unfavourable to the apparatus. The control tubes were sensitive to a temperature of 6° C. below that of the steam while the effect on them of their subjection to steam at varying pressures from atmospheric to 15 lb. during the periods of air-expulsion, building-up pressure, and releasing pressure must be taken into account, as well as the twenty-five minutes of actual disinfection. It is clear that the "unturned" tube shows that this particular disinfector still falls short. It can, however, be easily converted to a completely reliable apparatus by the authors and probably will be.

(6) Discussion of Tests.

Lack of space prevents the publication of full details of all the tests. These have been tabulated with remarks and a copy can be obtained by any interested reader on application to either of the authors at Shepherd's Green, Chislehurst, Kent (Telephone: Chislehurst 1953). The extracts already given will, it is hoped, suffice for this discussion. The tests show the inability of apparatus of present design to disinfect with certainty a normal load of blankets in the specified times. They indicate also that doubtful results may be obtained even with much-reduced charges.

(*a*) *Inadequate Testing.*—This situation has arisen, in our opinion, through the use of too few "tell-tales" in the customary disinfector tests. Except in the Service, tests are customarily made with bacterial tubes, using only a few at a time. Such tests may easily fail to find the "cold spots" in a bulky charge. In the Service this has always been realized and Service-designed apparatus has always been subjected to tests even more rigorous than those now discussed. In most Service tests of disinfectors, however, the temperature-indicating tube is used for convenience instead of cultures.

(*b*) *Characteristics of Temperature-Indicating Tubes.*—The temperature-indicating tube has great advantages over the use of cultures. It is cheap, small, easy to handle, visibly responsive, and can be used in abundance to give a true picture of what actually happens. But its use outside Service circles seems to be almost non-existent. None of the manufacturers concerned in these tests had ever used them—most, if not all, had never seen one. Perhaps on that account, some reassurance regarding its accuracy is desirable. Most of the 100° C. tubes used in these tests were made either by the Army School of Hygiene or by the Royal Army Medical College and the others were specially developed for us by the makers of the 115° C. tubes. A percentage was checked in boiling water or atmospheric steam while those which failed to react in the disinfector tests were usually either put into boiling water or put back in the disinfector *on top* of the load in the next test. In no case did the tubes fail to respond.

Since, however, the Army School of Hygiene and Royal Army Medical College 100° C. tubes start to colour a few degrees *below* 100° C. they are a better indication of *failure* to disinfect (when they remain unaffected) than as positive proof of disinfection. For the latter purpose, complete liquefaction is necessary, and owing to re-cooling this requires speed as well as judgment by the observer.

The 115° C. tubes could not be so simply checked owing to the heat-accumulation effect. Of these, therefore, a proportion was tested in thermostatically-controlled muffles in the Inspection Department Engineer and Signals Stores, a further proportion being similarly tested in the laboratories of a well-known instrument firm. Time-temperature curves were plotted which agreed well with each other, while the results at 115° C. were close to the twenty-five minutes specified by the makers. The reliability of both types of tube was therefore adequately demonstrated.

(*c*) *Lessons of the Tests.*

(i) *Irregularity of Results.*—Failure to "turn" indicator tubes was found to occur in apparently different places and to a different extent when

trying to repeat a test in any particular plant. This may be partly due to the tubes not being in exactly the same position but is more likely to be caused by slight variations in the packing of the blankets such as will occur in use.

There is apt, however, to be a weak feature in any one design causing a persistent "cold spot"—for example the baffle plate in Disinfector No. 1 and the exhaust-hole in Disinfector No. 5 before its conversion. So that not only is an adequate margin of safety to cover variations in packing necessary in the operation of the plant but special study is desirable of the weaknesses of any particular installation.

(ii) *Maximum Load.*—The loads given in Appendix 15 of the *Army Manual of Hygiene and Sanitation*, 1934, are far too great. It is almost certainly fatal to disinfection to load up the container level with blankets to the top.

(iii) *Method of Packing.*—Blankets should be loaded loose. Rolls of ten should be forbidden.

(iv) *Permeability.*—It is the compactness and depth of a charge, *i.e.* its nature and the distance to its heart, which affect results most. The bigger the container the bulkier is a full load and the worse are the results. Refer para. (2) (*e*) above. The load of 98 blankets was well below that given in Appendix 15 of the *Manual*.

(v) *How to Test.*—In an investigation a multiplicity of tell-tales should be used, at first, say 30, fewer as the story unfolds. Finally, as a check on measures taken, about 30 again, evenly distributed in the mass.

(vi) *Further Tests.*—There is a case for more thorough and scientific investigation which should be extended to steam sterilizers also.

(*d*) *Improvement of Existing Plant.*

(i) *Reconstruction.*—We advise against Medical Officers attempting, (unless experimentally) the reconstruction of their apparatus to the principles expounded in paragraph (4). Each design of plant needs special treatment with a fuller understanding of the process than is there explained. The construction is the subject of patent applications though the State will no doubt have "free user" rights.

(ii) *Improvement without Reconstruction.*—There is some possibility of improvement by variation of the technique. Displacing the "free" air by steam, instead of creating a vacuum, may or may not bring any definite gain. But the effect of using *both* methods—that is, first flushing out the free air by steam and then "drawing a vacuum" in the steam-filled chamber is worth trial. So also is the use of a wire-mesh "core," either cylindrical or of the same cross-section as the container, around which to pack the charge. We suggest loading say one-quarter of the blankets first, then laying the core on them, then loading the remaining blankets around the sides and over the top of the core. The objects are to increase the area of surface open to steam penetration and to reduce the thickness of the charge. The core must extend from end to end of container, of course, and its ends be left unobstructed. An automatic limitation of load will be obtained. Repeating the air-evacuation will also improve matters.

Splitting the charge horizontally by a mattress-like wire grid may also be worth further trial.

In general, however, the weaknesses of the particular plant should be studied first.

(*e*) *Immediate Action Advisable.*

We believe that meanwhile it is necessary to impose drastic limitations on the number of blankets loaded. Disinfector No. 1 was restricted to 30 blankets,

i.e., one per 2 cubic feet of chamber-volume, and we believe this to be the limit of safety for 60-foot disinfectors. Twenty is our idea of the limit for disinfectors of 30 to 40 cubic foot capacity and 40 for those of 120 cubic feet. The proportion of blankets to volume should diminish with the increase in volume to avoid increasing the depth of the charge appreciably.

With the above charges, a minimum of twenty minutes at full pressure should be given and we prefer thirty. We assume that a minimum of 20 inches vacuum is obtained. Forty minutes' " contact " in a current-steam disinfector should be given.

The output of the plant, which is already costly, clumsy, uneconomical and slow, will be made even worse. About 200 blankets a day will be the output of a 60-foot disinfector. This is one hour's output of the Disinfector Portable Field No. 3, or eighty minutes with the Disinfector Portable Field No. 1. It is only four hours' output even of the little Disinfector Portable Field No. 2 which a couple of men can carry about.

(7) Drying Blankets.

During these tests some interesting points arose in connexion with the drying operation. Designs were seen in which the drying air is taken from inside the " dirty " room where the loading is done—with Disinfector No. 2 the air intake was actually only about 18 inches from the floor where lay dust and fluff from " dirty " blankets.

The drying air is heated to an unknown temperature, probably well below that which is necessary to sterilize it. A thermometer in the air-outlet from the heater might give surprising readings.

Finally, to establish a conviction that hot-air drying was ineffective, we weighed a loaded container before treatment, after disinfection but before drying, after drying, and after vigorous shaking. The results were as follows:

Number of blankets ... 46.

Weight of blankets and container	before disinfection ...	298 lb.
" " " "	" drying ...	309 lb. Gain 11 lb.
" " " "	" after 30 minutes' drying	306½ lb. Loss 2½ lb.
" " " "	" shaking out ...	301 lb. Loss 5½ lb.

Final gain in weight 301 — 298 = 3 lb.

In steaming the gain was roughly 4 ounces per blanket. Half an hour's drying removed an average of less than 1 ounce. Of the balance, two ounces were removed by shaking, leaving a final gain of one ounce per blanket. The fact is that hot-air drying affects the outside of the charge only, the heart remaining as full of steam as ever. Prompt and vigorous shaking is necessary in any case. It is quite sufficient by itself.

HINTS FROM HISTORY.

(Part I).

The Supply of Engineer Stores and Equipment.

By Brigadier-General W. Baker Brown, C.B.

Experience teaches and one of the objects of writing the history of past events is to inform the coming generations of the successes and failures of their predecessors, of the reasons for the success or failure and of the methods adopted to overcome difficulties.

One of the essential differences between the Engineers and other branches of the Army before the days of mechanical transport was that the Engineers

required for the proper execution of their duties an equipment of tools and appliances and in many cases special stores. During an active campaign such tools and stores must be carried with the troops in the field, so that from very early days a transport organization called a " train " was formed to accompany the Engineers. Thus we read of " bridging trains " and " siege trains " in the Peninsular War. But in the early days such trains were broken up after each campaign. In the Crimean War (1854–55) a further step was taken in the formation of a special mounted unit, later called a troop; this was not formed in time to take part in the fighting, but at the end of the campaign the officers of the newly formed Corps of Royal Engineers succeeded in keeping a nucleus of the troop in existence and during the next 20 years various mounted units came into being, each with its own transport and with special equipment. These units included the bridging troop, the telegraph troop, the field company, the field park, the balloon section and a mounted detachment which developed later into the field squadron and field troop.

The decision as to the establishment of units and the quantities of equipment they should take into the field rested with the D.A.G., R.E., in the War Office.

The selection of equipment for these various units was made by the R.E. Committee; this Committee was reconstituted for the purpose in 1865 with the Commandant S.M.E. as President and the three senior Instructors as members. To these were added the A.A.G., R.E., representing the D.A.G., and a representative of the Inspector General of Fortification. Other officers representing technical branches, such as the War Department Chemist from Woolwich, were added as Associate members, to be consulted when required.

With the growth of Submarine Mining, which was finally adopted into the service in 1871, there was a large addition of special equipment which was distributed on a station basis and this was followed by the introduction of Defence Electric Lights in 1880 and the gradual use of Military Telegraphs in fortresses and garrisons. All these came under the control of a senior officer in the I.G.F.'s office who was called the Inspector of Submarine Defences; this officer was made a member of the R.E. Committee.

This Committee considered all proposals for tools and stores for engineer work which might be referred to them by the different branches of the War Office or suggested by members, instituted experiments and submitted proposals to the War Office with full drawings and specifications. If approved, a pattern of each new article was sealed and passed to the Army Ordnance Department, who were responsible for the purchase and issue of all equipment and for the inclusion of a special sub-head in the Annual Estimates for the necessary funds, but the D.A.G., for field units, and the I.G.F., for garrisons and fortresses, remained responsible for the scale of equipment and the I.G.F. through various branches of his office controlled the expenditure of the funds provided in Estimates.

In 1871, the influx of the first big order for Submarine Mining Stores overwhelmed the staff of the A.O.D. at Woolwich, so a party of sappers under an officer was sent to that station and this arrangement was found so helpful that from this date an R.E. Officer at the War Office was attached to the A.O.D. as Inspector. In 1894 this appointment was graded as " Inspector, R.E. Stores " and the officer was transferred to Woolwich, where a large office grew up in the Dockyard. The Inspector was made a member of the R.E. Committee, and carried out some of the minor experimental work for that body. Experiments and trials were also carried out by the Instructors at Chatham and by selected units at other stations.

The detail of all stores issued by the A.O.D. was given in the *Priced Vocabulary of Stores* in which two Sections (Nos. 28 and 29) were allotted specially to R.E. Stores, but the R.E. were interested in many other items, such as vehicles, explosives, tradesmen's tools, entrenching tools and some consumable stores.

The R.E. Committee had frequently to advise on details of such stores; thus in 1877 they selected and sealed complete sets of tradesmen's tools, samples of which used to be exhibited in the old model room at Brompton Barracks, and twenty years later, they were asked to advise on the adoption of standard patterns of screw cutting tools for the Army. They also naturally selected the patterns of entrenching tools and appliances and such stores as sandbags, and when the use of barbed wire became general during the South African War, they advised on the patterns of wire and posts and of the pliers used when erecting the wire. All the items issued by the A.O.D. were known as "Vocabulary Stores." In addition to these, there were required by the R.E., other articles which may be classed as Machine, Works and Electrical Stores.

Machine stores included such items as Prime Movers, Machine tools, Pumps, Cranes, Boilers, also Shafting and other forms of steel work and were dealt with in a branch of the I.G.F.'s office under an officer called the Inspector of Iron Structures. This branch was originally formed in 1867 to deal with the supply of armour plate for the large schemes of fortification commenced in 1860, and the officer was an Associate Member of the R.E. Committee.

Works stores include building materials, such as cement, timber in many forms, corrugated iron, roofing material and minor stores such as nails and screws. Some of these stores were included in the *Vocabulary* for issue in small quantities to A.O.D. work shops but it was early agreed that the A.O.D. would not supply stores for ordinary Works services. At home the materials for these services were obtained either by being included in the contract for large services or in the series of triennial contracts for minor services and repairs. In the case of stations abroad, when such stores could not be obtained in the locality or could be supplied more economically from this country, the C.R.E. concerned sent home annually a demand for the stores required in the following year; these after approval were handled by a buying branch in the I.G.F.'s office, which maintained a list of contractors and in some cases placed a permanent contract for any store in general use, such as cement or steel girders.

In the case of Electrical Stores, whether for lighting or communications, many of the articles required were in the *Vocabulary* for use in forts or military buildings, but all stores not in the *Vocabulary* and any special orders for large contracts were arranged by the Inspector of Submarine Defences following a similar procedure to the above.

All stores not in the *Vocabulary* were called "Non-Vocabulary Stores."

When the use of Railways began in the Egyptian campaign of 1882, the supply of railway material of all kinds was placed on the Inspector of Iron Structures.

To maintain the supply of stores during a campaign certain reserves were formed in this country, which should have been sufficient to last for the first two or three months, during which the War Office would have had time to place further orders and obtain delivery. For equipment, the A.O.D. held a stock in peace-time equal to three years' consumption at peace expenditure, but this did not provide for non-consumable stores, such as vehicles or pontoons, and during the S. African War there was considerable shortage of such stores for all services. A special Committee was formed in 1900, under the Presidency of Sir Francis Mowatt, to consider this and recommended the immediate expenditure of over a million pounds on a reserve. The Committee worked quickly and for Engineer units adopted a scale of 100 per cent of the equipment taken into the field. This reserve was collected and formed at Woolwich quite independent of any peace stock. It was known as the "Mowatt Reserve."

For non-vocabulary stores there had been from the time of the Egyptian campaigns a special R.E. Reserve which included articles which might be required in a hurry and could not be obtained from civil stocks. The list of these was reviewed yearly and submitted to the R.E. Committee for remarks. During and after the South African campaign it was considerably extended, by the

addition among other things of two sets of portable machine tools, with oil engines for power, suitable for workshops in the field and several miles of portable 2 in. watermain with pumps both machine and hand, also lengths of steel wire rope for suspension bridges, heavy lifting tackle with wire falls and many other articles, the whole printed list covering several pages of foolscap size. These stores were purchased by the I.G.F.'s office and stored at Woolwich in the custody of the A.O.D. Such stores and all other Works stores were to be sent out to the seat of war in charge of the A.O.D. following the ordinary peace procedure.

For the receipt of stores at the seat of war there was a mobile unit called a field park which carried some heavy equipment not included with the field company and also additional entrenching and other tools. One park was allowed for each Army Corps and worked under the control of a C.R.E. (Lt.-Col.) close behind headquarters, where it was proposed to establish a store depot and to collect works stores purchased locally or sent out from England. It was further intended that an Engineer Store depot should be formed at the Base, alongside the depot of the A.O.D., through which the stores from overseas would be sent to the front.

In all defended ports where there was a defence by Submarine Mines a special Store staff was provided in charge of a Quartermaster R.E. This staff included "Submarine Mining Storekeepers" with ranks from Staff Serjeant to Warrant Officer. When the mine defences were transferred to the Navy in 1905, this staff was continued for charge of Electric Light and Telephone stores and in 1910 this system was extended to include all Works stores, Quartermasters being appointed to all important stations, the Subordinate staff being called Ledger-keepers or Store-keepers. In the *Army Book of the British Empire* which was published in 1893 on the authority of the War Office a chapter (No. XIII) is included on the Royal Engineers. In the section dealing with their duties in War it is laid down that for each Army of two or more Army Corps there should be on the staff of the Officer Commanding an "Engineer-in-Chief" and on the staff of each Army Corps a "Chief Engineer," while each Division should have a Lt.-Col. as C.R.E. Among the duties laid down for the Engineer-in-Chief was the preparation of the list of stores for Engineer Services to be sent from England (in addition to the equipment carried by units or taken from the Reserve by the A.O.D.) and to indicate the order in which the stores are likely to be required. To carry out this duty it was essential that the E.-in-C. should be acquainted with the intentions of the G.O.C. in command of the Force, with the nature of the country which was likely to become the seat of war and with the strength and equipment of the probable enemy. Information on these points covering all possible theatres of war was prepared in peace by the Director of Military Intelligence.

For the campaign in South Africa the above organization was followed, an Engineer-in-Chief was appointed and the first three Divisions sent out were organized as an Army Corps. The force had the advantage of starting from British Colonies, which had British garrisons, with a Chief Engineer in Capetown and a C.R.E. in Natal. The local organizations could therefore be used for collecting and distributing stores, whether obtained locally or received from England. But other store centres had to be organized as required, notably a large depot for the Railways, which was formed under a Quartermaster R.E. first at Capetown and then at Bloemfontein.

During this campaign all the Equipment used by the R.E. received a practical trial and frequent reports on the efficiency of the various stores were sent home and considered by the R.E. Committee and at the end of the war full reports on all items and scales were obtained by the War Office.

The consideration of these Reports was delayed by the changes in War Office organization introduced by the Esher Committee, which may be said to have cut the R.E. into ribbons and put these together again in a different pattern. The

effects on the organization for handling R.E. Stores may be briefly summarized. The R.E. Committee was criticized as being too big, but this was due to a misunderstanding of the arrangement of Associate Members and actually the membership was not much altered; but the changes in the organization of the S.M.E. Chatham, made it necessary to move the headquarters of the Committee to the War Office, where one of the Assistant Directors of Fortification and Works was made President in place of the Commandant S.M.E. The status of the D.A.G., R.E., in the Adjutant General's branch had been reduced to A.A.G. in 1902, and the appointment of his assistant, who had been graded as a D.A.A.G., was abolished in 1906. The post of Inspector General of Fortification was abolished and most of the work transferred to a Director of Fortifications and Works. Under him the Inspector of Submarine Defences was continued, but the appointment of the Assistant Inspector was abolished and when the submarine defences were transferred to the Admiralty the title of the head of the branch was altered to Inspector of Electric Lights. This branch had always dealt with the stores required for all electrical services, including the field telegraphs, and when the appointment of D.A.A.G., R.E. was abolished, the responsibility for all equipment questions was transferred from the A.A.G., R.E. to the D.F.W. and allotted to the I.E.L. The appointment of the Inspector of Iron Structures was continued, and this branch undertook the supply of Works stores, except those dealt with by the I.E.L.; this work had expanded a good deal and occupied the whole time of two Quartermasters, R.E. and a subordinate staff. The work connected with Railway and Steam Road transport, which had also expanded, was transferred to the Q.M.G., under whom a new Directorate was formed under a Director of Movements and Quartering, which was officered largely by R.E. This branch dealt with all equipment tables for railway units, but the supply of material remained under the Inspector of Iron Structures.

The organization of the Field Army was controlled by the War Establishment Committee under the Director of Military Training, a branch of the newly formed General Staff. The A.A.G., R.E. was the responsible adviser of this Committee as regards personnel and transport, but the I.E.L. was for a time a member of the Committee for questions of equipment.

Among other responsibilities handed over to the I.E.L. was the editing of the volume of the *Equipment Regulations*, which regulated the scales of issue of equipment to the R.E.; the preparation of the Mobilization Store tables, which showed the application of the scales to a particular War Establishment and the portion of the equipment which could be used for training in peace; and the *Field Service Manual* for each class of unit, which regulated the organization of the unit for war, and the packing details of each vehicle and pack animal in the War Establishment. The revision of the *Equipment Regulations* was difficult as the old form included a comprehensive table embracing all units, which could not be completed until the details of every unit had been decided. It was found, however that the Artillery had got over this difficulty by splitting their volume into sections and when approval had been obtained to adopt this method for the R.E., it was possible to prepare for each field unit, as soon as its details were settled, a section of the *Equipment Regulations*, a *Mobilization Store Table* and a *Field Service Manual*. To cope with the extra work a Quartermaster and two Storekeepers were employed from those released from the Submarine Mining Service and this arrangement, which was made permanent the next year, continued to function efficiently all through the Great War, new publications being prepared following each change in Establishment or each new kind of R.E. unit which was formed.

The branch for the inspection of R.E. Stores at Woolwich had also expanded during and after the South African War. The grading of the head of the branch was raised to that of Chief Inspector (C.I.R.E.S.) and an Assistant had been added. These officers were always selected from those who had been through

special courses in Electricity (Submarine Miners) or Machinery (Machinery Officers.)

In March, 1905, the writer of this article was appointed Inspector of Electric Lights at the War Office and from this date until he left in September, 1908, on foreign service, the review of all R.E. stores in the *Vocabulary* which had been commenced in 1902 was completed, improvements recommended in the reports from S. Africa were tried and the improved stores were introduced into the equipment. Packing trials were carried out, mainly at Aldershot, under the Lieut.-Colonel Commanding Troops and Companies, Lieut.-Colonel J. L. Irvine, who had commanded the Pontoon troops in South Africa; Telegraph and signal stores were tried by the 1st Telegraph Division under Major H. B. H. Wright; while Balloon equipment was in charge of the Commandant Balloon Factory, Lieut.-Colonel J. E. Capper. Sets of stores were prepared for a Printing Section to accompany Headquarters in the Field, and also for a Lithographic Section and a Photographic Section. In the preparation of these the Ordance Survey at Southampton and the Instructor in Survey at the S.M.E. were called on for assistance. Major G. H. Harrison was Secretary R.E. Committee for most of this period.

Of particular stores, the changes in vehicles involved a good deal of work. By this time the R.E. units in the Army had in use over twenty different kinds of vehicles, most of which were specially designed or adapted for use by the R.E. The best known of these was the double tool cart designed by Major J. E. Tyler after the Egyptian War of 1882. This was originally a limbered framework to which were attached chests containing sets of tools, but during the South African War the pattern had been changed to two single two-wheeled carts, each with a body to carry tools and materials arranged to form a seat for a couple of sappers. The Royal Carriage Factory at Woolwich had for some years been engaged in a system of standardization of wheels and axles for the many types of guns in use and on their suggestion it was found possible to adopt wheels and axles of standard patterns for the R.E. tool carts and other vehicles instead of the special patterns formerly in use, this change simplifying manufacture and making easier the replacement of parts in the field. Pontoon and Telegraph waggons were altered to embody the somewhat extensive changes recommended, while a new limbered Cable Waggon was designed to replace the Cable Cart. Similar changes were made in the Balloon vehicles, while in time new vehicles were introduced for wireless telegraphy, for telephone work in the field and for field searchlights.

Of other changes in equipment, mention may be made of the new designs of guncotton slabs, resulting in the adoption of a single form of slab and primer for all services, a change which involved the re-pulping of all guncotton in A.O.D. charge; also the introduction of steel pulley blocks, which had been under trial for about 8 years, instead of the old wooden blocks of naval type, and the use in war equipment of white cordage, which gave an increase of breaking strain of over fifty per cent. as compared with the old tarred cordage which was in future to be used for peace only.

All telegraph stores were revised and extensive experiments were started in the use of telephones in the field, while wireless equipment was developed, though this was delayed by a somewhat unusual action on the part of the Admiralty, who made a contract for the exclusive use of the Marconi patents, to the exclusion not only of all Foreign powers and civilians, but also of the War Office and other Government departments. These latter had to rely on other patents by Poulsen and others.

The abolition of the submarine mine defences made possible a reform which had been in contemplation for some years, to combine the Submarine Mining Companies with the Fortress companies which worked alongside them. It was found possible to treat the men trained in Electric Lighting and also the small

detachments for telegraph work as special trades, so that the whole of the N.C.O's and men in the combined service were on one list for promotion and foreign service. At the small stations at home and abroad one company organization contained men of all branches, but in the larger fortresses—Portsmouth, Plymouth and Chatham at home and Gibraltar, Malta and Hong Kong—separate companies were formed for Works and for Electric services, thus enabling the Works companies to be withdrawn to supplement the Field Army. This change did not much affect the stores organization in fortresses. At home the Works company allotted to Chatham was employed in peace in the Workshops at the S.M.E., but was also given a War Establishment as a Stores and Workshops Company on the Line of Communications of the Expeditionary Force.

One of the first acts of the General Staff, when it started in 1905, had been to get into informal contact with the French Army authorities, a step which was accelerated by a war scare in 1906, due to the action of the Germans at Algeciras. Among other details discussed were the position which would probably be taken up by a British Force in France, the arrangements for its disembarkation in France and the Line of Communication which would be used for moving troops and equipment to the front. The details were kept very secret but the War Establishment Committee invented a typical Line of Communication which was based on the actual detail discussed and was used as a basis for the preparation of Establishments for the Line of Communication. This theoretical distribution started from a base port, connected by 100 miles of railway with an Advanced Base where the Inspector-General of Communications was to be stationed. The Advanced Base was assumed to be connected with the troops at the front by two roads each 30 miles long.

For this theoretical line the D.F.W.'s office prepared a scheme which included a C.R.E., or similar organization at the Base and at the Advanced Base, with an establishment for a Company to provide store depots at each point where stores would have to be loaded or unloaded, also a portable workshop at each base and with a scale of equipment which would include some of the special stores held in the R.E. reserves, such as lifting tackle, pumps and other machines.

To provide subordinate staffs for the above, fourteen members of the supernumerary staff with ranks from Warrant Officer to Staff Serjeant were included in the Establishment, also four Quartermasters for charge of the four store depots. The general staff demurred at the provision of C.R.Es., as they said the French had promised to prepare the bases and to arrange everything for the movement of the Expeditionary Force, but the War Establishment for the company was approved.

Many changes were made in the organization of the Army from that in force before the South African War. The size of the Infantry Division was increased to include three Infantry Brigades instead of two; each Division was to have two Field Companies instead of one, but the C.R.E. at Army Corps headquarters and the Field Company under him were omitted; the Telegraph units were increased and attached to the General staff of the Army; the Bridging companies were replaced by trains of bridging equipment only, with their own transport but without any working personnel; the Balloon Sections were absorbed in the new Royal Flying Corps, which was independent of the R.E.; the Field Park was abolished. The name Army Corps ceased to be used but a staff for a group of two or three Divisions was substituted; the Chief Engineer allotted to each Army Corps was omitted; the appointment of Engineer-in-Chief was omitted and also his staff. In place of these appointments a Colonel R.E. was to be attached to the headquarters of the Army and of each Army Group of two Divisions, but these had no staff other than one Clerk and had no executive authority.

The inclusion of two Field Companies in each Division was nominally a concession to an opinion put forward by all the leading R.E. officers after the S.

African War, that the proportion of R.E. units should be increased. Actually in the new organization there was a reduction of about one-third, as in a group of two of the new Divisions there were now only four Field Companies while in the old Army Corps there had been four Field Companies, a strong Bridging Company and a Field Park.

In the new scheme all the responsibility for the execution of Engineer Services, including the Supply and Distribution of Stores was placed on a Director of Works, who was under the orders of the Inspector General of Communications and at the same time was to be controlled by the Quartermaster General of the Army.

Space does not admit of following in detail the story of how this organization broke down in the early weeks of the war, and how the C. in C.—Sir John French—ordered the R.E. officer attached to his headquarters—Brig.-General G. H. Fowke—to take up the duties of an Engineer-in-Chief. But meanwhile an essential link had been snapped in the chain of responsibility. It will be seen from above that had an E. in C. been appointed in the first place, one of his first duties, *before embarkation*, would have been to arrange for that portion of the Reserve Equipment and the kind and amount of the Works stores which should be taken overseas by the A.O.D. This had not been done.

The special Workshop Company—29th Company—was duly mobilized and sent overseas to Havre which was the principal Base and when the D. Works went up to join the I.G.C. at the Advanced Base—Amiens—he took a section of the Company with him. The remainder was employed at Havre and when the Channel ports were abandoned early in September, 1914, the company moved by sea to St. Nazaire, the portable workshop was erected at Nantes and work began on camps and huts. The company returned to Havre when this port was reoccupied in October and detached a store section and workshop to Boulogne, which was an auxiliary base, while the section which had gone to the front with the D. Works was sent to St. Omer, where G.H.Q. was stationed. The D. Works moved in October with the I.G.C. to Abbeville.

The D. Works—Brig.-General A. M. Stuart—had had considerable experience in handling R.E. stores both as I.R.E.S. at Woolwich and also in the War Office and he at once began buying stores in France and forming store depots, at the ports, but he found the supply of stores from England was unsatisfactory, partly owing to the want of definite demands from the G.H.Q. in France and partly because the A.O.D. was over-worked and could not deal adequately with the transit of Engineer stores. Visiting England at the end of 1914, he arranged with the War Office for the formation of a new branch in the War Office under the D.F.W. to represent the Director of Works, this was called F.W.5. and placed under Lieut.-Colonel D. Brady, and proved most useful and successful. He also arranged for a separate organization to take over from the A.O.D. the transit of Engineer works stores. This was formed under a Quartermaster—Lieut. A. N. Tucker—at Southampton, but was soon moved to the London Docks, where it remained during the war. This depot received Works stores direct from contractors, and arranged for their loading into vessels allotted by the Naval Transport Officer. It should be noted that the supply of Vocabulary stores, which included equipment and such stores as sandbags and barbed wire, continued to be made through the A.O.D. and so continued during the whole war. Also that the term "R.E. Stores," which in peace time included all Vocabulary stores inspected at Woolwich, was gradually used in France and possibly in other theatres of war, for non-Vocabulary stores only.

Immediately on the outbreak of war the branches of the War Office responsible for supply under I.E.L. and I.I.S. were enlarged and in the absence of special demands made an effort to anticipate the probable requirements; the list of contractors was overhauled, their stocks investigated and, if thought inadequate, further orders were placed. A special Committee was assembled to consider the

possibility of our Army having to undertake a siege in France, lists were prepared and stores ordered. These included a complete railway of 2 ft. 6 in. gauge. Unfortunately this could not be used in France, as the French had adopted a narrow gauge of 60 cm. But the 2 ft. 6 in. railway came in very useful when ou Armies advanced into Palestine, when the whole plant, which included loco-r motives and trucks, was sent out to Egypt and used to cross the desert from the Canal to Gaza.

A third centre of supply arose in connection with timber, for which large quantities were required in England for the new schemes of hutting. Also the supply of timber from Russia was much reduced by the closing of the Baltic. The deficiency was met by increased orders on Canada and a Timber Committee was formed in London on which Lieut.-Colonel Brady represented the D. Works.

In France the D. Works, in addition to Havre and Boulogne, opened store depots at Rouen and Dieppe and later at Fecamp, Calais and Treport, and added largely to the wharfs and cranes at all ports. He also opened a buying office in Paris which, under Lieut.-Colonel C. W. Davy, kept in touch with the French authorities and purchased stores in Paris, the south of France and in Switzerland. At the end of 1914 the staff of the Director of Works was increased and the Line of Communication was divided into two parts, each with a Deputy Director in charge, with headquarters at Boulogne for the northern line and Abbeville for the southern line. For each line there were to be two companies for store duties, one of these to be called a Base Park Company was to have an establishment similar to the original 29th Company—9 officers and 227 other ranks—and the other was to be called an Advanced Park Company to provide forward store depots, with a smaller establishment. The companies selected for the Base Park were the 24th Company from Malta, which went to Boulogne and the 32nd Company from Gibraltar, which went to Havre in relief of the 29th Company which was then concentrated at St. Omer as the Advanced Park Company for the northern armies. The fourth company selected was the 1st Company from Gibraltar which should have become the Advanced Park Company at Abbeville to supply store depots for the Southern Armies, but before this company arrived in May, 1915, the Armies were allowed to form their own stores staff and the 1st Company was sent to Calais where berths had just been allotted to the British by the French authorities.

On the opening of the campaign the D. Works had been given full financial authority to carry out any works or purchase any stores required by the troops without any previous authority from the War Office and under the regulations prepared before the war he should have been attached to G.H.Q., while his Deputy Director should have been representing him at the H.Q. of the I.G.C. carrying out the duties of a Chief Engineer for the L. of C. But the D. Works was placed by the Q.M.G. under the I.G.C. and had to carry out both sets of duties. Early in 1915 arrangements were made to appoint one of the officers who had joined the staff of the E.-in-C.—Lieut.-Colonel W. A. Liddell—as a Deputy Director of Works, representing the D. Works with full financial authority similar to that of the D.W. And as the forces in France were formed into Armies the Chief Engineer at the headquarters of each Army was placed in executive charge of all Engineer services in his area and given the same full financial authority as that given to the D. Works. By these changes, which took effect from March, 1915, the latter officer was relieved of all work in Army areas and was freed to give his whole time to work on the L. of C.

At the same time, each Army in addition to its portion of the fighting front was allotted a portion of the L. of C. in rear of the front, in which it could form rest camps or construct aerodromes, hospitals, schools and many other miscellaneous establishments, such as workshops; these areas were constantly changed with each change at the front. Among other results from this policy was the formation of forward store depots called Corps dumps at or near rail-

head where R.E. stores were accumulated and from which Corps and Divisions could draw supplies; two Corps dumps were usually provided for each Army front and these absorbed two store sections which had been sent forward in January, 1915, by the 29th Coy. Each Army and Corps appointed a Stores officer with a small staff to control the local purchase of stores and the demands on the base depots, and each Army Chief Engineer sent demands direct to the War Office.

At headquarters, the office of the Engineer-in-Chief grew slowly. Col. J. E. Edmonds took charge of the trench warfare appliances and standardized patterns and demands, which included trenchboards, trench frames, revetting hurdles and many forms of shelters of timber and corrugated iron, also machine diggers; orders for the trenchboards and similar stores were placed on the D. Works for supply locally, but the corrugated iron shelters were demanded from England in very large quantities; Mining developed into a separate branch under Colonel R. N. Harvey and required many tons of timber, usually 9"×3", with special forms of listening appliances and tools. The Works side of the office under Liddell carried out a careful study of all bridges in the areas in France and Belgium which might have to be replaced in case of an advance, and a large stock of over 600 bridges was accumulated in the Base Park at Havre. These included steel sectional bridges for spans of 30 ft., 60 ft. and 85 ft. which were designed by Major R. Oakes, I.I.S., at the War Office. They were stacked under a gantry and so arranged that a bridge of any particular length could be put on train complete with nuts, bolts and spanners in two or three hours and could reach railhead at the front within 24 hours. Masses of machinery were also ordered for water supply, land drainage, workshops and forestry work in Army areas, with large orders for corrugated iron sheets, wire netting, and timber. A depot for spare parts for all machinery at the front was formed at the Havre Base Park. During the first year of the war the troops behind the front were accomodated in existing buildings, but there was an increasing demand for huts and the E.-in-C's. office developed the Nissen hut; the first order for these at the end of 1916 was for 27,000 huts with a second order a few months later for 20,000 more. Each hut involved three contracts for supply, one for the curved sheets, one for the woodwork for floor and ends and one for the steel framework with nuts and bolts. These three sets of components came out separately and had to be assembled in the depots in France. There were also demands for 53,000 stoves and many other hutting accessories.

On the Line of Communications which had been divided into Works areas, each under a senior officer, who was called at first an A.D.W., but later was graded as a C.R.E., most of the work was done by contractors, both French and British, but each A.D.W. ordered direct from the War Office (following the usual peace procedure) the stores he required for maintenance and repairs. These amounts were not large in the aggregate but included a large number of different articles and patterns.

(To be continued.)

HUNTING AND TRAINING FOR WAR.

By MAJOR-GENERAL A. V. T. WAKELY, D.S.O., M.C.

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IN *The Onlooker* of October, 1941, an article was published on Hunting and Training for War. The chief points made in that article were, first, that training of very great value to a soldier can be obtained while hunting, and that the mechanization of the Army has increased the value of hunting as training for officers. Secondly, it was suggested that each day's hunting could and should be used to give officers a type of training that is not easy to obtain in the ordinary way.

The object of the present article is to describe the type of exercises that have been set this season to officers hunting with a pack of foxhounds in Northern India, and to give anyone who wishes to do this training some idea of the sort of exercises which can be usefully set.

When these exercises were started this season, some doubts and criticisms were expressed about them. These crystallised in two directions :

(*i*) Hunting is a recreation, and should be treated as such. Therefore officers engaged in recreation in their spare time should not be asked to do work !

(*ii*) In any case, most people would be so busy riding their horses that they couldn't possibly do any work without falling out of the hunt for that purpose. In fact, the exercises would ruin the sport.

As regards the first argument, it should be remembered that there is now no such thing as spare time. We are engaged in a war against efficient and ruthless enemies, who have been preparing themselves for it for many years. We are far behind them in our preparations, and we have many junior officers whose training has so far necessarily been of the most elementary kind. We have no time to lose and we must make ourselves fitter and more efficient than our enemies. Nearly a year ago, our late Commander-in-Chief in India said, " Nothing else matters now, except that you should get yourselves ready for war in the shortest possible space of time. Your leisure and comfort or leave do not count. Of course you must have time off, in order to avoid getting stale, but there can be but one object for every one of us and that is to make and keep ourselves mentally and physically fit to beat the Germans." Incidentally, he is now demonstrating in no uncertain fashion how well he has carried this out himself.

The prime necessity for making ourselves fit for war should now never be absent from our thoughts for a single moment, and we cannot afford to miss a single opportunity for training. Any form of recreation which involves an expedition into the country is an opportunity for training. Hunting, shooting, golf, and an afternoon's walk are instances of such opportunities. At the present stage of the war, when time presses, all these chances of doing some small exercise should be seized.

There is an old English saying that " Battles are won on the playing fields of Eton." This is all right for a gentlemanly war, but something more has to be done about it in *total* war. To win a *total* war we must have *total* training.

The second criticism about the hunting exercises has more in it. Most of the exercises required accurate map reading and it is certainly difficult, if not impossible, to do that on a restive horse at a tearing gallop. This is exactly where the value of these exercises comes in. When moving at speed across country, a rider

is forced to rely on his memory and observation to keep track of where he is going. In war in a cross-country vehicle the same situation will arise. It will be very difficult to read a map accurately without stopping to do so, and it may be most inadvisable to stop!

In an Eastern theatre of war when dealing with mechanized forces, or partly mechanized units, every officer should be a good cross-country leader. If he is not actually driving the vehicle himself he will in all probability be responsible for two things, picking the way and finding the way. Riding across country gives good practice in picking the way. Finding the way may be more difficult. In the desert with an armoured formation the navigator does it, but the trucks of an Infantry Unit, supply vehicles and many others will have to find their way on their own, and possibly singly, across country, sometimes in close proximity to the enemy. The man in charge of these vehicles must be able to know exactly where he is on the map at any moment and he must know where he is going. Otherwise he may drive straight into the enemy. In Eastern countries roads are not numerous and most of the driving is cross-country. Good training for this type of driving can be obtained while hunting. When the map cannot be used, the ground must be memorized, direction and location should never be lost and the map position should be regained at the first opportunity.

These exercises with hounds can be conveniently done in three stages:

(*a*) Officers bring their maps with them, the exercise being given to them the day before hunting.

(*b*) The exercise is given the day before hunting, but officers do not carry their maps with them.

(*c*) The exercise is set *after* hunting. Maps may be carried out hunting.

Almost any kind of exercise can be set, but at first it is better to make them very simple. With the first two stages it is impossible to say how a problem set will turn out. There is no previous Directing Staff solution. There is a D.S. solution afterwards, but it may be liable to severe criticism, since the D.S., who may be the Master or the C.O. of the unit, can quite easily make mistakes the same as anyone else. These exercises give great opportunities for catching the D.S. out in an error and he will be caught out unless he keeps his eyes very much wide open, has a good memory for country and, above all, a good "bump of locality" and an "eye for country." The exercises develop all these things and are therefore excellent training.

The exercise set after hunting is much more difficult, both to set and to do, but there is a much wider scope.

To get a fair picture of the exercises set this season a brief description of the country hunted by these hounds is necessary. It is generally undulating. There are good landmarks at a great distance, but practically none in the actual country run over by hounds. It is, therefore, easy to tell whether you are going North, South, East or West; but extremely difficult to locate exactly where you are. This difficulty is accentuated by the map makers. There are hundreds of nullahs in the area, some are very wide sandy nullahs, others not so wide; some are narrow, while others, shown on the map, cannot be distinguished on the ground at all. Except for the wide sandy nullahs the map makers show no difference in all these, marking them all with a thin black line; so it is very easy to get mixed up in them. They offer no obstacle to horses, except in a few places. The country also has many very small hillocks, all of which look exactly the same. The going is light sandy plough, perfect for galloping on and there are few fences. Therefore when hounds run, there is nothing to stop them, and when there is a good scent they go at a terrific pace. Horses have to gallop all out for considerable distances to keep near them. On a good day the average pace is 3 to 4 minutes to the mile. In such circumstances map reading is at a complete discount, and the rider has to trust to his memory and powers of observation. These conditions, however,

approximate closely to those experienced by the driver of a cross-country vehicle and that is why exercises with these hounds are such good training.

A brief description will now be given of some of the exercises done this season. When considering the results obtained the conditions described above must be remembered, because the map reading is really difficult, and unless one knows the country pretty well it is very easy to get lost.

The first exercise set was intended to be very easy. Owing to unexpected action by the hounds (a fast hunt straight away) it turned out to be very difficult, but many lessons came out. It was :

1. *Mark on the 1-inch map the route taken by hounds during the morning.*
2. *The Master did not take the direct route from the meet to the first covert. Why did he do this ?*
3. *If an enemy M.G. post were located in the first covert, by what route would you lead a platoon from the meet to attack it ?*

The first thing that happened was that officers brought out only the map on which the meet was shown. Hounds soon ran off that map. The first lesson was, therefore, always bring out sufficient maps for the job in hand.

The second question was intended to produce the answer that a circuitous route was taken, first, because the direct route lay through very thick country in which the hounds would necessarily have to be kept packed up. Secondly, it crossed two tank obstacles which, if full of water, would be difficult to cross and there were bridges on the circuitous route, and thirdly the longer route lay through open country where the hounds could move, spread out and had a good chance of finding the line of a travelling jack. This is what actually happened and hounds went off at a very fast pace. It was quite difficult to follow where they went. Thus, many officers got their route as much as 2 miles wrong and never located the first covert, which was drawn after the first hunt and was approached from an entirely different direction from that first intended. This produced the answer to question 2 that the Master had taken a ciruitous route because he had found a jack, and it spoiled the third question, which would have been a very interesting one.

The result of the exercise was to show that several officers were not sufficiently good at map reading to lead troops in war, except for a limited distance and at a walking pace. This war is being waged at a greater pace than that, and it is essential that officers should take a much wider view of the country they may be called upon to traverse and be able to find their way both with and without a map across country over very much larger areas than we have been accustomed to in the past.

Subsequent exercises confined to marking the route on the 1-inch map showed a great improvement in the solutions. It was quite clear that those who did the exercises were in fact getting valuable practice in map reading and that it was producing good results.

A senior officer reported that the practice had greatly improved his map reading. He developed a sort of instinctive triangulation for checking up his initial estimate of his position by memorizing what he could see at checks and at places where hounds changed direction. This will not pin-point the position, but it will indicate at once whether the first estimate is badly out.

Another exercise set was as under :

You are commanding a Coy. of Inf. (Higher Scale Mech.) engaged in pursuing and trying to round up a large number of Germans who have escaped from the main battle. For various reasons the Germans are likely to take an unpredictable route (that taken by hounds).

Your men are lightly equipped and it is essential that the trucks should keep near them. Your Coy. is advancing on the route taken by hounds and is moving two up, covering a wide front.

1. *Mark on map the route taken by your Coy.*
2. *Mark any deviation from that route which you would order your trucks to take.*
3. *How would you send your orders to the trucks?*

Problems 2 and 3 proved to be beyond the powers of a number of officers, whose only solution was to move the trucks "by bounds."

If, as in this case, the direction taken by the enemy is unknown, previous orders to move to certain bounds will not work, and did not work in this case. Incidentally, the "enemy" (the hounds) went much faster than real Germans could go (those now in Cyrenaica excepted).

The D.S. solution was to divide the five trucks into two groups and move these on two tracks about 1½ miles apart, keeping in touch with them by signallers on chosen hillocks, which abounded in the area.

This solution was not ideal, and it was subjected to much criticism, the chief one being that the truck is a platoon vehicle and should go with the platoon. In this case, however, it couldn't accompany the men. Anyhow, no one could produce a better solution, but the country was very difficult.

The exercise showed that sufficient attention had not been given to the problem of moving these trucks across country, and most officers had very vague ideas about how to get orders to the trucks.

Another exercise was:

You belong to a force advancing towards the East.

At 0730 *hours* (*time of the meet*), *you started on a reconnaissance in a light tank* (*along route taken by hounds*).

At 0800 *hours precisely you were fired on by an isolated hostile M.G. from a point* 500 *yards from where you are* (*the place where hounds are at that hour*).

The true bearing from you to the enemy M.G. is 100°.

You decide to send an Inf. fighting patrol to clear up the enemy M.G. You arrange this on return to your own lines near the camp, but, owing to the conference on your reconnaissance, you can't lead the patrol yourself. You, therefore, have to explain to the patrol commander where to go and what to do.

1. *Give the map reference of the enemy M.G.*
2. *What advice would you give the Patrol Commander?*

This exercise entailed synchronising watches and memorizing exactly where hounds went during the half hour between 0730 and 0800 hours. Everyone got the position of the enemy M.G. accurately. As luck would have it the exact point happened to be marked by a prominent lone tree. But where many officers failed was in giving advice to the Patrol Commander. This required a wide consideration of the ground and a knowledge of its tactical significance.

There is no doubt that we do need more training in the appreciation of the value of ground and in memorizing the main tactical features of country as we pass through it.

An exercise which gave rise to much argument was the following:

Make a mechanized movement map of the area covered by the hounds during the morning.

(See *Army in India Training Memorandum No.* 2 *para.* 13).

The area covered by the hounds may be taken to be a strip one mile wide (½ *mile on each side of the route taken by hounds*). *No one need leave hounds to reconnoitre the area and no area outside the above need be considered.*

In order not to spoil maps the 1*-inch map should be shaded in lead pencil, which can afterwards be rubbed out. The term "cross-country movement" will refer to* 15 *cwt. trucks.*

The following shading will be used:

(*a*) *Areas suitable to cross-country movement—horizontal shading.*

(*b*) *Areas impassable to mechanized movement—vertical shading.*
(*c*) *Areas difficult but traversable—diagonal shading.*
(*d*) *Obstacles to mechanized movement—ringed in pencil.*

At first sight this was very well done, but when we came to move trucks across some of the horizontally-shaded country, they all got stuck in the sand.

This showed that the making of a mechanized movement map cannot be lightly undertaken, and, if this map is to be of practical use it must be done by people who have considerable experience of cross-country driving and who know the capabilities of the various vehicles.

It will be seen from the above examples that the exercises set included map reading and simple tactical problems suitable for platoon commanders. They are good examples of the sort of exercise that can be set during any expedition into the country. It has been proved this season that they do provide good training of a type that is not easy to obtain in the ordinary way, because to do them, much time during working hours would be taken up in getting out into the country. When they are combined with hunting that time is not normal working hours, *e.g.*, before dawn on Sundays. It is true that the number of officers doing them is limited to those who hunt, but it is better that these should have training which can be done without any extra expenditure of time and petrol rather than that they should lose an opportunity for doing something useful. Furthermore, those officers who do the exercises can devise similar ones for their companies and platoons on route marches and on other occasions when the men move out into the country. This is good training for the men. It keeps them on their toes, and relieves the monotony of route marches and long treks to manœuvre areas and training camps.

A BRAINS' TRUST FOR THE ARMY.

By LIEUT.-COLONEL D. PORTWAY, R.E.

A RECENT feature in the B.B.C. programme has familiarized the British public with the idea of a Brains' Trust. As the purpose is mainly for entertainment, the proceedings are for the most part flippant and trivial, but it has served a useful purpose in the widespread dissemination of the importance of planning.

Coincident with this is cogent evidence of the remarkable and unprecedented progress of Russia from a position as a backward peasant country, mainly devoted to agricultural operations of a crude and inefficient nature, to that of a highly industrialized nation. This has been brought about in the last 15 years by gigantic 5-year plans which have been carried through with ruthless efficiency.

It is difficult to imagine the British, or even the Americans with their high-speed industrial efficiency, uprooting and dismantling whole industries and transporting them hundreds of miles to resume production after a few weeks' break, and no doubt this is only possible with large-scale planning and the complete elimination of private and sectional interests.

No doubt we in Britain pay lip-service to this idea of planning—indeed, committees are constantly being set up by all sorts of public bodies and associations—architectural, town-planning, educational and the like, and particularly in connection with reconstruction after the war—but we shall never attain the success achieved by the Russians with our traditional "muddling through"

methods, and while so much respect is paid to vested interests of various kinds.

In the Army we preach the importance of planning, and the young officer is taught the value of " appreciations " at an early stage, but we are continually being caught napping, often as a result of financial restrictions, but also from a lack of clear and consistent thinking. It may be argued that the General Staff is the Army's brains' trust. and in the field of tactics and strategy this is partly the case. But any officer who has had any experience at all of Staff duties must be aware of the burden of routine work with which all Staff Officers are encumbered. Heads of Staff directorates in particular find little time for the quiet intensive thinking that is so necessary in the study of important problems.

Supposing, for example, that a small team of the leading brains in the Army, young staff-college graduates whose ideas have not been canalized into one mode of thought and stereotyped by the experience of the 1914-18 War (which exercised so powerful a bias on the opinions of the French General Staff), had reviewed in all its bearings, and with full information placed at their disposal, the strategy and tactics of the Germans in their invasion of Poland, is it not likely that we, and still more the French, would have been far less defensive in our fighting and far more prepared for what was in store ?

But it is in the peace-time Army that this principle of planning is even more necessary. It is only too true that a vigilant Treasury scrutinizes every penny of peace-time defence expenditure, and every new proposal that involves expense is violently resisted. But, relatively speaking, brains are cheap whereas material is expensive—indeed, in some departments this principle of planning is wisely realized. In bridging, for example, where the 1914-18 War caught the British Army without any equipment or even ideas for heavy bridging other than complete extemporization, it was realized after the war that a " brains' trust " in this particular subject was necessary, and the Experimental Bridging establishment came into being, enabling the British Army to keep fully up to date in bridging devices of all kinds.

Certain other technical subjects also received special treatment on similar lines, and of course the R.E. and Signals Board existed for the exploitation of such inventions as came to their notice ; but no organization attempts to any extent the long distance planning of scientific developments for military purposes. Indeed, it cannot be pretended that the Army in time of peace has close contact with research of a scientific or technical nature, and one of the functions of the " brains' trust " would be to co-ordinate this.

It is well known that the British and the Americans are right in the fore-front in making new discoveries, and we then leave it to such imitative nations as the Germans and the Japs to put in the painstaking and laborious spade-work which is so necessary to develop the discovery. The Fleming Valve is a notable example of this—in the 1914-18 War, the Germans were using the amplifying properties of this British invention for the purpose of overhearing British and French signals, long before we had developed it for this purpose.

The Universities in particular, have a large number of graduates and students engaged in research in time of peace, much of which introduces possibilities of military use in all sorts of directions.

A small example—one of many in the scientific field—can be taken in the development of research on corrosion. The study of this subject in peace-time is mainly for the purpose of prevention, but in connection with this it has now been ascertained that it is possible, by certain means, vastly to accelerate the process, and it is not beyond the capacity of research experts to devise means whereby corrosion of enemy metal structures could be brought about in a few days, instead of in the normal period of years.

Nor is the suggested " brains' trust " a matter for the scientific faculties only—such faculties as geography and history come into the picture as well. It is hardly possible to make a serious study of any venture in the many wars in the

last century, without realizing how much the various armies were hampered by the lack of a strong historical section in the various General Staffs.

In a short monograph on the history of railways in war*, the present writer has shown how in campaign after campaign, the same faults and errors were committed in the military operation of railways; the whole course of the Franco-German War of 1870-71 might have been different if the French had learnt a lesson from the shortcomings of the American railways on both sides in the American Civil War of 1861-65. Marshal Niel, the French War Minister, drew up in 1869 a project for railway reform, but it was never adopted, otherwise he might have gone down to history as the saviour of France, instead of being recalled to memory for a brief moment every summer when the rose that bears his name bursts into bloom.

Example after example can be quoted of the dangers that follow the lack of a serious study of history. The latest and most pregnant example, and one for which we may all be devoutly thankful, is provided by Germany, for it can hardly be doubted that Hitler would never have attacked Russia on June 22nd, 1941, if he had been a student of European history.

It may be argued that the soldier has not the academic type of brain that lends itself to efficient research. This will not be admitted for a moment by those who have been in touch with the young Sapper officers during their Cambridge course, and who have seen how successfully they compete with civilian students in a severely academic examination, in spite of the handicap of 2 years' study as compared with the normal 3 years. The atmosphere of a resident University would seem ideal for the apt functioning of such an Army brains' trust, its members having full access to libraries and to the staffs and students of various faculties. The idea is not altogether a new one, for Oxford has already its Chair of Military, and Cambridge its Chair of Naval History, and men of such distinction as General Swinton and Admiral Richmond have graced these chairs.

But such Professors are men who have already finished their service careers, and have no responsibility to the defence departments. It would not be difficult to arrange for certain officers to be seconded for a period. Some of these could be attached to certain Universities, others might well be affiliated to the Department of Scientific and Industrial Research, and to large combines such as Imperial Chemical Industries, which undertake considerable research.

Team work is essential for successful results, and indeed all three services should be represented on such a brains' trust. There are many fields of research—rocket propulsion, for example—in which all three services are interested, and which necessitate close combination between academic study and practical work in the field. Once the idea of an inter-Service brains' trust was approved, the details could be easily arranged, and these few lines are merely a "cockshy" with no attempt to work out details.

The cost of such a venture would be a mere flea-bite in the defence estimates, and the results might be of the utmost value if long-range planning was thereby improved. The British are prone to regard themselves as a practical nation, and to mistrust any abstract planning, but it may be that this is a mere excuse for our besetting sin of mental laziness. Certainly we have much to learn from the long-range planning, both of our Russian allies and of our German and Japanese enemies.

*Chap. II. *Science and Mechanization in Land Warfare.*

AN OLD LETTER-BOOK.

"FORWARDED to the Director-General of Contracts with a recommendation that Mr. Smith's tender be accepted. Lord Panmure* wishes to have the foundations of the Hospital at Netley proceeded with as rapidly as possible so that they may be going on while the detail plans and working drawings and the specifications of the Buildings are being prepared with a view to calling for tenders for the erection of these buildings by public competition. Mr. Smith, an eminent contractor, has been charged with the execution of all the work necessary for the laying of the foundation stone by Her Majesty, and he now tenders to lay down the pipes required for conveying water to the spot so as to enable the bricklayer to proceed with these works. This tender is reasonable and as it would give rise to great delay to resort to public competition I recommend that it be accepted."

Such was a minute written on 28th May, 1856, and discovered in an old letter book in the War Office, which has recently come to light. Even in those days they resorted to single tender in case of emergency, and it is to be noted that Sir B. Hawes, the Director General of Contracts, signified his consent the same day. The tender in question was to supply and lay 4 inch cast-iron water pipe $\frac{1}{2}$" thick, including excavation, jointing and filling in for eight shillings and sevenpence per yard run including all bends. The cost of similar work to-day would be about twelve shillings.

The letter-book in question, a fine calf-skin volume, foolscap size, in excellent preservation, belonged to the Surveyor of the Inspector General of Fortifications (I.G.F.) a Mr. R. O. Mennie. The I.G.F. was the forerunner of the D.F.W. and according to our records there were I.G.Fs. from 1802 to 1904. At the time of this letter-book, entries in which date from 5th October, 1855, to 26th June, 1861, General (later Field-Marshal) Sir J. F. Burgoyne occupied the chair.

Mr. Mennie, the Surveyor, was a man of parts! Not only did he perform the duties of a Quantity Surveyor, but he also was in charge of the drawing office and appears to have acted to a great extent as a business manager for the I.G.F. for we find him asking for shipping tonnage, arranging for the consignment of stores, and dealing with inventors!

For these labours he was rewarded with the salary of £450—£600 a year.

Quite a wealth of interesting material is to be found in the book, of which the following must serve as samples :—

(1) The C.R.E., Aldershot, objected to the use of yellow pine for the internal lining of temporary hospitals. Mr. Mennie did not agree that it was unsuitable. Unfortunately we do not know the decision of the I.G.F., to whom the case was referred.

(2) There were shipping troubles in those days, too. On 10th October, 1855, a telegram was received from General Simpson (? in the Crimea) that none of the Gloucester huts had arrived. The plans, however, had been received.

(3) The duties of Clerks of Works were set out fully in a lengthy submission from the Surveyor in January, 1856. They prepared drawings, compiled specifications, took off quantities and supervised the execution of work. They also had a hand in the preparation of the Annual Estimates. Truly Admirable Crichtons! From a minute of S. of S. we learn that they are always procurable for something *above* architects prices. What would the R.I.B.A. say to this now?

(4) Deviations from plans were not looked upon with any favour in those

* Secretary of State for War, 1846-52 and 1855-58. Became 11th Earl of Dalhousie in 1860.

days. In the case of the Cavalry Barracks at Aldershot, the S. of S. directed that no deviation from the plans was to be made without resubmission to Her Majesty who had signified her approval of them. It may be mentioned that two months later the Q.M.G. writing from the Horse Guards asked for copies of these plans for the inspection of the Field-Marshal C.-in-C. These were supplied in a month.

(5) In January, 1856, the Surveyor was requested to report on Anston stone, a sample of which had been submitted to the I.G.F. It was stated that this stone was used for the construction of the Houses of Parliament. He reported that it was a useful and durable material for building purposes where not exposed to the effects of the atmosphere of large towns, and remarked that there were symptoms of decay in several parts of the Houses of Parliament.

Later we find that the price varied from 1/11 to 2/11 per ft. cube, delivered according to locality. An average price for Portland stone to-day is five shillings and sixpence.

(6) Even in those days they were worried about "paper," for in January, 1856, the I.G.F. was asked to report how many letters, memoranda or orders were received during one week in his Department.

(7) Our Crimean huts must have attracted the Greek Government, as the S. of S. ordered a model to be made and handed over to them.

(8) As regards new barracks at Gosport, the plans for which were being drawn in 1856, it was decided that the part facing the defensive works should have walls 4 feet thick—later reduced to 3 feet.

(9) Punkahs were tried out in a hospital ward at Woolwich in 1857. It is stated that they were invented by Lieut. Cook, R.N., F.R.S.

(10) A new type of cooking apparatus was invented by Captain Grant and tried out in 1857. As a result of comparative tests it was found that cooking by the Grant system used $\frac{5}{8}$ lb. of fuel per man per day compared with $\frac{7}{8}$ lb. used by the system then in vogue. Accordingly some of the new apparatus was ordered. It would be interesting to know whether this Captain Grant later became Lieut.-General Sir R. Grant, who was I.G.F. from 1891-98.

(11) There was some perturbation in 1856 when it was found that the cost of the new hospital at Netley would much exceed the sum taken up in Estimates. The first rough estimate was for 1,000 men at £120 per bed with £30,000 added for externals, contingencies, etc., making £150,000 in all. After tenders had been invited it was found that the cost would be £239,000. The matter had to be referred to the S. of S., who personally accepted the tender.

(12) A few minor details. Working hours at the War Office were 9 a.m. to 5 p.m. The I.G.F. apparently moved in the winter of 1856. Previously letters were headed War Department, Pall Mall, and afterwards, War Office, Whitehall.

A long list of newspapers is given in which War Department advertisements were inserted. These were in the main provincial journals, but it is curious to see how many of the London papers are now no more.

CHARLES' ARMY.

By "BUCCANEER."

FOREWORD.

I wrote this article in the spring of 1938—pre Munich—when I was serving a previous sentence.

I think that my friend Charles' ideas may be of interest to those who are considering the form of a very post post-War Army.

Author's Note. A generation ago Rudyard Kipling wrote *The Army of a Dream.* This is an attempt, designedly put in light-hearted language, to tell of an Army which might be.

I met Charles in the Club smoking-room after lunch.

"Hullo, you poor old quill driver," he called out, "have some coffee, and tell me how the War House is faring."

"The War House," I said, when we had seated ourselves in a comfortable corner, "is much as usual. The *tempo* is a bit faster in certain ways, but otherwise it's much as it was when I was there fifteen years ago."

"Amazing place," grinned Charles. "I was once there for three months, and spent most of my time losing myself in it."

"When I come out of my shell for lunch," I complained, "I like to hear of the wide open spaces. Where have you been lately?"

"Just back from Egypt, old boy. Splendid time. No Pyramids or tourist muck. Just sunshine and shooting."

"Fine! you make me quite envious."

"On the way home—I came long sea—I amused myself by planning out a new army."

"Why, what's wrong with the present army?"

"What's right with it? It's all wrong, it's a—let's think of a good word—archaic anachronism."

"Come, come, Charles," I replied with hauteur, "our army is becoming highly mechanized and most efficient."

"Quite so, and about 20,000 under the paltry establishment. Man more mechanized than the officer who still clings to his horse. No, it's all wrong, the whole bag of tricks. It doesn't fit into our national life. The lads are all right, bless them, but the system's hopeless. You take a chap of 18, if he'll come, put him into another world, so to speak, for the best years of his life, and then fling him back into civil life with some perfunctory preparation. All sorts of valiant palliatives are being tried to bolster up the present system, but they won't work for long. No, it's either conscription——"

"Unthinkable!" I interjected.

"Or," said Charles, "my kind of army."

"My dear old thing, do you really think that you've solved a problem which has been engaging the keenest brains for years?"

Charles sipped some coffee.

"Why not?" he replied, "it's said that young men see visions, and old men dream dreams. Why shouldn't a middle-aged chap like me see a vision for a change?"

"No particular reason, except that you aren't the dreamy sort."

"Well, if you like, you can put it down to the Egyptian sun. Look here, have you half an hour to spare?"

"Twenty-five minutes before I start back for my stool."

"Oh, well, that'll do to give you a rough outline, if you care to listen."

"I am all attention."

"Good. Now, to start from the beginning, I would take my lad of 18, 17 would be better, and enlist him into the ARMY, *not* into any particular arm; that would come later, after the recruit had shown his aptitude and preference.

"Next, I should not hurry his military training to start with. The first year I should devote to physical and educational training, and the teaching or development of a trade. Very little purely military training would be attempted, the main thing being to inculcate habits of obedience, punctuality, sobriety—all that we mean in the truest sense by discipline. After this preparatory period I should expect to find a well-set-up, disciplined, reasonably intelligent lad with moderate skill at a trade. There would naturally be continuous weeding out of the 'unfit'— perhaps 10 per cent would fall by the way. Then the balance would be shifted; and the next period of, say, six months would be devoted mainly to military training, with enough work at a trade to enable them to keep their hands in.

"After, say, eighteen months would come the time when the choice of corps would be made. Where possible individual preference would be given due weight, but the decision would be based on the opinion of the training staff as to the most suitable place for each individual."

"There's a snag here. I expect there would be ructions when you had to send the bulk to the infantry."

"Not at all. The infantry in my army would be very different to our present infantry. No fatigues for one thing, and everyone treated as the intelligent being that he would be. A jolly open-air life."

"You make me gasp for it. But someone has to do the fatigues."

"Of course. Barrack labourers under the Administrative Corps."

"What's this Administrative Corps?"

"Oh, that's another obvious necessity. Another curse of our Army is paper work. I should take the whole of that away from the fighting soldier and give it to an Administrative Corps. It would be responsible for all the, so to speak, housemaid jobs, all the feeding, clothing, equipping and housing."

"Rather a dull life, and how would you find the men for it?"

"Well, in the first place, I should have *no young* men. I should make it a rule that no man under 40 was eligible. Then of course too there would be a lot of women in it."

"What a revolutionary idea!"

"Certainly. All my ideas *are* revolutionary. This army of mine will be nothing like the present one. But to go back to the women. Aren't they best fitted for cooking, sewing, washing, typing, and so forth? All or most of my kitchen work will be done by women, with a man or two to help with the heavy work. It'll be the W.A.A.C. over again, but better."

"Stop a minute. My mind moves but slowly. Hasn't it always been a recognized principle that the C.O. should take the responsibility for the feeding, clothing, housing, paying, and so forth of his men?"

"To be sure. And a jolly rotten principle too. How can any human being do all that, get to know them, and train them? And you mentioned the word pay. Now my Pay Corps would pay the men instead of thinking out ways to avoid it! And by the same token there'd be no more nonsense about pennies a day. A soldier would get a definite number of shillings a week and no deductions except fines for misconduct. I think too that banking accounts for soldiers should be organized, but that's rather a long story."

Charles paused for breath. "And what's the next objection?" he continued.

"I can think of so many that I don't know where to begin. Let's take the first—barracks. You'll never do all this in our present barracks."

"Naturally not. We shall have to make a clean sweep of most of them, and start fresh. That's where most of the expense will come in. But it needn't be terrifying. Lots of the sites are rotten for soldiers but excellent for commerce. I should get a good rake-off that way. Most of the repairs too would be done by the troops themselves—they'd be fit and able to tackle them. Then again I shouldn't build my new barracks to last 100 years. I should build mine to tumble down in 30."

"Oh, tin huts!"

"Not a bit of it. I loathe and abominate the sight of them. No, there are plenty of modern materials which will produce reasonable housing comfort at much less than the cost of your present monstrosities, and in 30 years I expect we shall have invented better still. It's the planning and lay-out which make for comfort."

"It may be so, but I think that you take the cost rather light-heartedly."

"Oh, no. I'll give you a thumb-nail estimate in a moment. How many soldiers have we got?"

"Something like 200,000."

"Well, we're pretty short, aren't we? Let's make it a round 250,000. I shall house them in new barracks at £200 a head and do 'em proud. Fifty millions, and that'll include land."

"Do you think the old country will stand that?"

"Of course. We can't build all this at once. Make a 10-year plan and devote 5 millions a year to it. Incidentally, you'll save a lot on the dole when once my army gets going. Then there's another thing. One of your difficulties is building to precise establishments of units, isn't it?"

"It is."

"Now my idea is this. Take a place like Shorncliffe for example. It's decided that we want 5,000 soldiers of all arms there. Well, I build for 5,000, but I don't bother about dividing up my accommodation, so much for gunners, so much for infantry, and so on. All accommodation is pooled and run by my Administrative Corps. O.C. Battalion comes along with 700 braves. Right. It's 10 to 1 they won't all live together. Why should they? They just have 700 men-spaces in barracks. Mix up all the arms. Get away from the regimental spirit, and have an army spirit. They come together for their work, but off duty the C.O. doesn't have to worry about them."

"I must say, Charles, that you make it all sound wonderful. But there's one major problem which you haven't mentioned, and that is the foreign service question. After all, it's one of the great difficulties which we are faced with in getting recruits."

"I agree, and I thought about it for hours. To my thinking there were three snags. First, we sent our lads abroad a bit too young, secondly, our troopers are pretty rotten, though I admit that they are improving, and thirdly, we didn't change stations enough. Now I shouldn't send anyone abroad under 21, I should build a little fleet of really comfortable troopers, and I should never keep anyone more than two years at any one station, and finally no one would stay abroad more than four years unless he wanted to do so."

"This will cost a lot."

"Isn't it worth it? At present we spend about half a million a year on trooping. Suppose we treble it. Isn't the extra million well spent if it's going a long way to solve the recruiting problem?"

"You seem to demolish my objections very successfully, but I never was much good at argument. By the way, what about church parades? Have you thought of them?"

"Rather! I had a talk with a padre on the subject. He quite agreed that the church parade had to go, in fact he was refreshingly broad-minded about it. When I told him about my army, he suggested that the lads should have religious instruction as part of their educational training during the first year. He said that any padre would welcome the idea of chatting to them informally, say half an hour a week, and that lots of them would come to church voluntarily on Sundays. By the way, he thought that the padre ought not to be a commissioned officer—he ought to be *above* rank—and naturally I agree with him."

"So do I, whole-heartedly. But that's brought up another question—officers. So far we've only dealt with other ranks. No doubt you have a scheme for officers too."

Charles sat back, and appeared to ponder.

"Well," he said, "they're a bit of a problem too, but nothing like so difficult as the men. After all, we *are* getting officers, and quite a good type, and though there are lots of little things which might be improved at comparatively small cost, we haven't had a bad time, have we? The tremendous success of the King's annual camp for schoolboys gives one food for thought. It might be possible to fix part of the education of the officer cadet and of the recruit side by side. They mix well at 16, why not a little later? I'm sure there's something in it. I should like to see the subalterns having dinner in barracks with their platoons. And of course in my army N.C.O's would have much more responsibility, and there would be a lot more commissions from the ranks. My word——"

I held up my hand.

"You really mustn't get going again, and I'm late already. Perhaps another day you will get down to brass tacks, and explain how your army could come into being. At present it's a dream."

"Right, old son, and while I'm working out the details, you find me someone that matters to take an interest in my army."

And it is in the hope of finding him that I have ventured to set down Charles' ideas on paper.

U.S. ARMY USES NEW THROWING DEVICE TO SPEED LAYING OF FIELD WIRES.

(From *The Journal of the Franklin Institute.*)

United States Army Signal Corps engineers have developed a wire thrower designed to speed up the laying of field wire used in maintaining communications under combat conditions, the War Department recently announced. The new equipment will be used by Signal Corps units operating with Army Corps and Divisions, establishing communications between Corps or Division Headquarters and units under their command. With the new thrower, wire can be thrown from a moving vehicle to distances up to 125 feet away and at vehicle speeds up to 35 miles an hour. An operator has control of the distance and slack by varying the speed of the thrower. By using the new wire thrower, wire can be laid at greater speeds and placed farther off the road, thus requiring a minimum of servicing. Field wire has been laid and recovered in the past by Signal Corps troops with a unit mounted on a vehicle and possessing a self-contained power drive for reeling out and recovering wire from directly behind the vehicle. Faster-moving mechanized troops and greater distances between command posts in the expanding army have made it necessary to provide a faster means of laying field wire for communication circuits off the road in order to require a minimum of servicing.

MEMOIR.

BRIGADIER-GENERAL SIR VALENTINE MURRAY, K.B.E., C.B., C.M.G.

BRIGADIER-GENERAL SIR VALENTINE MURRAY, who died at Bourne End on April 8th, was born in London on the 13th February, 1867, the son of George Murray, a very well-known barrister of Lincoln's Inn, who had chambers for many years in Old Square.

This branch of the Athol Murrays was a cadet of the Murrays of Philiphaugh, now extinct. His immediate ancestors adopted the legal profession, his father, grandfather and great-grandfather were either barristers or solicitors. His great-great-grandfather, Dr. John Murray, after serving many years in the Navy, settled at Norwich, where he founded the Scotch Society of St. Andrews, at whose annual St. Andrew's day dinner in 1926, the subject of this memoir attended as the guest of honour.

After the usual preparatory schooling, Murray obtained a scholarship at Malvern College which he took up in January, 1881. Having reached the head of the modern side by the end of 1882, he elected the Army as his future career, and from that date formed by himself the first Army class ever constituted at that college.

After successfully negotiating the Sandhurst preliminary, he entered the Royal Military Academy, Woolwich, direct from Malvern (it was a period when Army crammers were much in evidence) in midsummer 1884, passing in 26th on the list out of 50 successful candidates. General J. F. M. Browne was Governor at the time, the Adjutant at the time was Captain W. E. Hardy, the Company officers were three gunners, Synge, "Bummy" King and Cooper Key. At that period one of the usual recurrent Russian war scares was on, which resulted in the courses at the Shop being cut down from two years to eighteen months. Consequently, Murray, after serving as an under-officer of the 2nd Division during his last term, passed out fourth of his batch and received his commission in the Sappers on the 17th February, 1886, taking away with him as a souvenir of his stay at the Shop a leather despatch box, the prize for Fortification, as taught in those pre-historic days. H.M. St. A. Wade was Senior Under-Officer and head of his batch, E. McLeod Blair and S. C. Babington being the other Under-Officers.

The Russian scare was of such a nature at the time that some 17 direct commissions, dated 18th February, 1886, were given in the Corps, these latter gentlemen were known as "the Persons" because of the unfortunate wording of the advertisement notifying the vacancies. The same scare was also responsible for the direct appointment to the Royal Engineers of some 23 graduates from Kingston, Canada, and Coopers Hill with commissions dated June, 1885. Among these might be mentioned W. G. Stairs, who accompanied Stanley to Central Africa in search of Livingstone, and H. C. Nanton and P. H. Casgrain, who were probably the first Y.Os. to join the S.M.E. having already seen war service and sporting a medal. Consequently, with all this number of Y.Os., the S.M.E. in 1886, was fuller than usual.

After the usual two years' course at the S.M.E., Murray proceeded to India with the majority of his own batch and of the "persons" who had either been elected or selected for a tour of Indian service. He landed in Calcutta in March, 1888, and on arrival was posted as an attached officer to the Military Works Department and directed to proceed to Chakrata, the summer headquarters

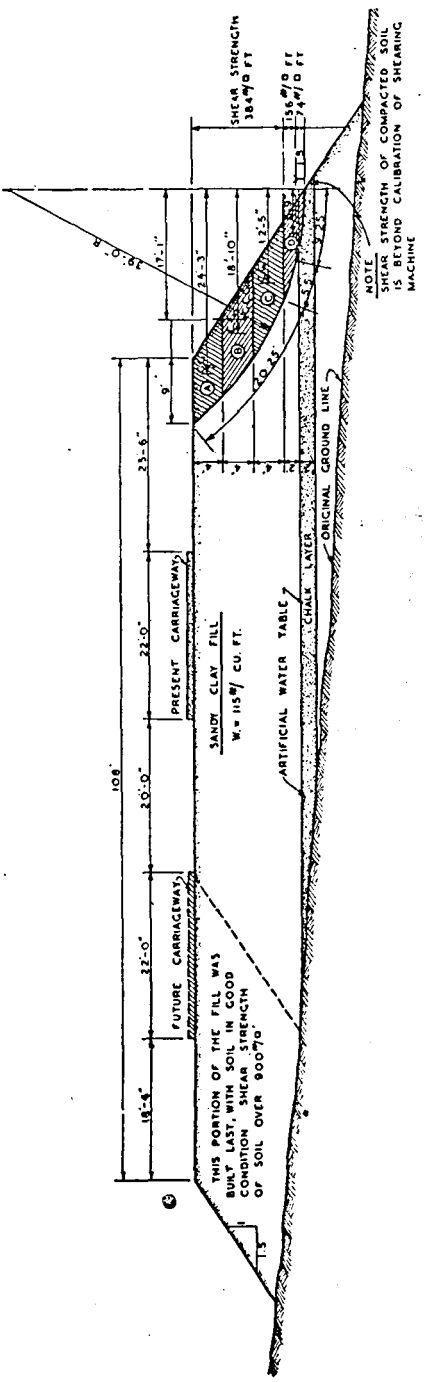

Fig. 5—Diagram of fill showing study of stability.

offer proper drying. Notwithstanding this condition, the road had to be pushed through over the fills. The critical sections of these fills were the slopes. The ultimate loading and the position of the loads being known it was decided to analyse the stability of the slopes before attempting to lay the carriage-way.

In view of the lack of soil testing equipment, most tests were carried out by "rule of thumb" methods; but the approximate internal shearing strength of the soil at various levels had to be estimated quite closely to give any value to the analysis. For that purpose, a machine was rigged up, consisting of one cross arm fitted with hooks to which were attached two spring balances, each calibrated to 40 lb. A piece of sheet iron 12 in. wide bent to a radius of 3 in. and connected to each spring balance completed the machine. Small trenches were dug at various levels along the worst portions of the fill, deep enough to reach a part of the fill unaffected by exposure. These trenches were so shaped as to allow full use of the testing machine and "bridges" of soil, 12 in. long and of various cross-sectional areas at each end, were carefully shaped in the undisturbed soil. The piece of sheet iron was then placed so as to bear evenly under each "bridge" and connected to the spring balances hanging from the cross arm. Upward forces were then applied at each end of the cross arm, as evenly as possible, until the specimen or "bridge" sheared from the parent mass, and the magnitude of each force, as registered on the balances, was recorded. The sum of the forces was considered as one force evenly distributed and equal to the ultimate shearing strength of the speci-

Brig-Gen Sir Valentine Murray KBE CB CMG

of the Meerut division, whose G.O.C., Sir George Greaves, was reputed to be the hero of Rudyard Kipling's ballad about General Bangs.

Murray served for some nine months in Military Works, and on the advice of his executive engineer, Algernon Hildebrand, R.E., applied for and obtained a transfer to the P.W.D. railway traffic branch in January, 1889, and from that time on devoted the whole of his time to railways.

At this period the P.W.D. was almost exclusively in the hands of R.Es., and a certain amount of resentment among their civilian colleagues was the result. The atmosphere at the time was reflected in the then familiar lines of the *Departmental Ditties :*

> " By the laws of the family circle it is written in letters of brass,
> That only a Colonel from Chatham can manage the railways of State,
> Because of the gold on his breeks and the subjects wherein he must pass
> Because on all matters that deal not with Railways his knowledge is great."

The years 1886 to 1896 probably saw the Sappers at the peak of their prosperity. R. C. Pemberton was Secretary—M.C. Brackenbury was Under-Secretary —Conway Gordon, Director-General of Railways, and most of the big Railways, both Company and State, were governed by R.Es. G. F. O. Boughey was Manager of the N.W. Railway—R. A. Sargeaunt of the O.R. Railway—W. V. Constable of the E.C. Railway—R. Gardiner, Agent of the East Indian Railway— W. S. S. Bisset, Agent of the B.B. & C.I., and the senior appointments in the Consulting and the Inspection Engineers' branch were filled by R.E., notably T. Gracey, subsequently Director-General Railways, and T. F. Dowden.

But the tendency now was to make the young R.E. joining the Railway branch, particularly the traffic department, start at absolutely the bottom of the tree ; in this way somewhat stultifying Kipling's ballad.

Murray was accordingly posted to the O. & R. Railway as a probationary assistant traffic superintendent, and after passing examinations similar to those undergone by his civilian contemporaries, and being employed in various capacities in the Engineering Traffic and Management branches, reached the grade of District Traffic Superintendent in 1895, in which grade he was transferred to the Burma State Railway, which line was about to be handed over to a company. He was promoted Captain in 1896 and acted as traffic manager of the line in 1898.

During these first ten years of his Indian service, Murray had no opportunity to see any active service, as it was his misfortune to be always at the bottom of the list when trouble began on the Frontier.

In 1898, he took two years combined leave and left Bombay in the s.s. *Carthage*. This might have been a most unfortunate voyage, plague was raging virulently in India, and broke out on board soon after leaving Bombay, resulting in the ship proceeding direct to Plymouth, thus entailing the loss of a week's leave ; this it is believed was the first P. & O. boat to carry the plague.

Soon after his arrival in England, Murray was present at the complimentary dinner given to Lord Kitchener at Chatham, on his return from the Egyptian Campaign.

In 1899, while still on furlough, Murray was permitted to join the Refreshing Course at Chatham for R.E. officers who had permanently elected for the Indian service; this course was known vulgarly by the Y.Os. as the "Wild Beast Show."

It was while doing this course that Murray's first executive engineer in the M.W.D., A. Hildebrand, who had in the meantime retired and joined the A. & N. Stores as their Manager in India, tried to persuade him to leave the Service and join the Stores to succeed him in India, and though considerable pressure was brought to bear, Murray refused to entertain the proposal on the grounds that he had not yet seen any active service.

At the close of the Course he was ordered to proceed to South Africa with Girouard in anticipation of the impending outbreak of hostilities.

There was some difficulty about this as Murray before leaving India had elected for permanent Indian service and the War Office in England refused to give him any definite orders, and it was not till he was actually boarding the train at Waterloo on the 7th October, 1899, that definite orders came, together with the grant of the local rank of Major.

Accompanying Girouard and Murray on the *Mexican* were a number of the young R.E. officers who had been doing such good railway work with Lord Kitchener in his most recent Egyptian Campaign, notably H. A. Micklem, A. G. Stephenson, Graham Manifold, E. O. Newcombe and H. L. Pritchard; and J. H. Twiss and E. H. M. Leggett were also of the party.

Much of the time on the voyage was spent in studying the work of M. Jacqmin of the Nord Railway, describing the grave disorganization which took place on the French railways in the war of 1870-71, a study a proper appreciation of which became invaluable during the subsequent campaign and years later during the Great War of 1914-18.

It was not until the s.s. *Greek*, homeward bound, was met on October 23rd that it was known that war had been declared on the 13th *idem*, there being, of course, no wireless in those days.

Murray was in South Africa during the whole campaign from October, 1899, to July, 1902, serving as Assistant Director of Railways at Cape Town, Bloemfontein, Johannesburg and Pretoria. During this period he saw a good deal of Lord Roberts and Lord Kitchener, in fact he accompanied Lord Roberts in his final journey to Durban on his way home in May, 1900, and was standing behind him when he made his celebrated speech at Peitermaritzburg saying the war was over—when it had hardly begun.

For his services in this campaign, Murray received the brevet of Major.

Towards the end of 1901 the Burma Railway Company tried to get Murray's services back to take up the appointment of Agent in Burma, but failing in this appointed another young R.E.—W. A. S. Kincaid.

After a short spell of leave in England, Murray returned to India in the autumn of 1902, in time for the first Delhi Durbar. He was posted to the N.W. Railway as District Traffic Superintendent, and after serving first as Deputy, then as Traffic Manager, took long leave home from April, 1907, to April, 1909. During part of this time, he did an extensive tour on the Continent, mainly in Italy, studying Roman antiquities, and on return to England in July, 1908, discovered and took up residence on the private estate of Abbotsbrook at Bourne End, which over 30 years later became a refuge from Hitler's *blitz*.

On his return to India in 1909, he rejoined the N.W. Railway till 1911, when he was transferred to the O. & R. Railway as Traffic Manager, Colonel C. H. Cowie, another R.E., being Manager of this line at the time.

While at Lucknow, he attended officially the great Coronation Durbar of December, 1912, and there earned his first and only Piccadilly medal.

Murray was promoted to Lieut.-Colonel in 1912, took short leave to England in the summer of 1913, and on return to India in October, was transferred to Calcutta as Traffic Manager to the E.B. Railway, where he found still another R.E. as Agent, Colonel Clem. Brown. On Colonel Brown's taking leave in the summer of 1914, Murray was appointed to act as Agent. His tenure of this post did not last long, as on the outbreak of war in 1914, he was immediately ordered on active service. He sailed from Bombay in September as a special service officer with the 7th Meerut Division, a number of young R.E. officers extracted from various branches of the P.W.D. being in the same boat. He landed at Marseilles on 26th September and after various vicissitudes, including a visit to Ostend with Dent, the General Manager of the Southern Railway, to report on the position as regards the Belgian Railway, went to France with Girouard and

Twiss and took up his appointment as Deputy Director of Railways at G.H.Q., St. Omer, at the end of October. From that date he served continuously in France until June, 1919. With the arrival of Geddes and the reorganization of the various transportation directorates, Murray became finally Director of Railway Traffic (D.R.T.).

For his services in France he was five times Mentioned in Despatches, received the C.M.G. in 1915, the C.B. in 1918, and K.B.E. in 1919, and in addition was made a Knight of Grace of the Order of St. John of Jerusalem, and first an "Officier" and then "Commandeur" of the Legion d'Honour.

On return to England Murray was offered the Agency of the O. & R. Railway, but decided it was too late to go back to Indian service, so after taking long leave he retired in March, 1921, with the rank of Brigadier-General.

Murray had decided to take up his residence in London, where the opportunities of civil and social work for retired officers are not quite the same as in the country. However, the War Office employed him for a short period in 1921 to write in conjunction with A. M. Henniker the *Manual of Movement War*, the first edition of which was issued to the Army in 1923, the next edition some ten years later.

Soon after his retirement, Murray took a house in Regents Park, Crown property.

He was appointed by Government a member of the Crown Estate Paving Commission. This was a body of gentlemen, selected mainly from the Crown Ratepayers, who looked after the Crown property in Regents Park, Carlton House Terrace and Richmond Terrace, on lines somewhat similar to the adjacent Borough Councils. He served as a Commissioner till his death.

It is interesting to note that when hostilities broke out in 1939, he closed down his London house and retired to the small cottage he had acquired at Bourne End, referred to previously.

He married in 1909, Flora Constance, elder daughter of Ralph Entwistle Peters, of Eastington, Gloucestershire, but leaves no family.

Major-General Sir Ernest Swinton writes :—

"Val" Murray will be missed by very many officers in the other branches of the Army, as well as by his friends in the Corps, for his duties, especially when on active service, brought him into close touch with officers of every rank and in all branches of the Service. To many of his contemporaries of the Indian Railways his death will come as a personal loss.

I first met him in 1890, in Lucknow, when he was employed on the O. & R. Railway. I also saw a great deal of him during the South African War, when I, too, was working under Girouard, and again during the first year of the last war, when we were both at G.H.Q., France. Our friendship continued until his death.

In his own line Murray was an admitted expert. His record of service speaks for his professional ability and attainments; but it does not give any idea of his pleasing character as a man. Always kindly, genial and loyal, he had the knack of making friends, without in any way seeking popularity. Modest, equable in temperament and imperturbable, he was endowed with a strong sense of humour, and his presence was welcome in any society. In difficult times he was a tower of strength to those round him. He will be mourned by many.

All Reviews of Books on military subjects are included in the provisions of K.R. 547(c) *1940*.

BOOK.

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

STEAM BOILER YEAR BOOK AND MANUAL, 1942.

(Paul Elek, 39, Parker Street, Kingsway, W.C.2. Price 20s. + 7d. postage.)

The technique which this book describes, explains and illustrates in the field of steam raising and prime movers, and makes a notable contribution to our powers of attacking a wide variety of practical problems. It is fascinating to see how one class of problem after another is brought within its scope. Only by solving similar problems in detail will it be believed that the labour involved is not excessive, and realized how simple and direct are the steps.

The book presents in a clear readable style the most up-to-date information on the manifold problems which normally confront and materially affect the steam and combustion engineer. It is well planned and for general purposes it is of exceptional value from the standpoint of reference.

The book is specially valuable as it gives, along with entirely new matter, the gist of a series of papers which are embodied in a condensed version of the Report of the Edison Electric Institute and which has no counterpart in this country.

In each chapter the reader is provided with sufficient background to enable him to appreciate the value of new methods as alternatives to methods already available. The result of a first reading is a feeling that here is a book which is going to be useful in many of one's own problems, and that time will have to be found for a more thorough study. G.M.F.

MAGAZINES.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA.

Vol. LXXI, No. 305, October, 1941.

The number was received in this country in March. The Editor has refrained, perhaps wisely, from "dating" the Editorial too much; there is however an apt comparison between the state of affairs now, and at the corresponding period, the end of 1916, during the last Great War. He gives good reasons for hoping that it is now that the German leaders, as did Ludendorff in 1916, may be beginning to feel the first cold onset of doubt.

One is getting so tired of slavish adulation of Soviet methods since Russia became our ally, that it is refreshing to read *Nazi-ism and Communism* in which they are frankly criticized. The author comes to the conclusion that while Nazi-ism is doomed, there is hope for Communism, as practised in Russia, especially as some of its corners had worn off before the war, and further abrasion may be expected as a result of present hostilities.

Manuscript found in a bottle is the title given to an article written seven years ago. The parable is that it was consigned to the deep, and has only just been washed ashore. It would have been better if it had been published, and studied, then. The importance of dive-bombing, of the transport of troops and supplies by air, and the necessity for the army to have its own air force for tactical jobs, are all stressed.

Hummet West is the story of the transportation part of the battle for Keren. The railway, by which our troops in the forward area were supplied, climbs up a very steep mountain side, and it fell to the Sappers to repair it, to use it for the maintenance of the front line, and to prepare for the final advance. One of the methods employed was to use lorries with wheels on the track outside the rails (it was 95 cm. gauge) to pull up flats laden with water, food and ammunition. At railhead there was no turntable, and so the lorry backed up a ramp on to the flat, which then proceeded downhill under gravity, always with a Sapper as brakesman. The "Night Hawk," ably described in the March, 1942, number of *The R.E. Journal*, comes in for favourable mention. The author is enthusiastic in praise of the Sappers, for their ingenuity, ability, drive and courage.

Perhaps one item of friendly chaff might be reproduced. " One night when a small water lorry met a wagon and was smashed the Sappers hardly commented ; it was not their lorry. Next night, when a petrol tin on the line derailed a wagon, they were quite furious and called for discipline and the removal of obstructions."

Mosul to Deir-ez-Zor is an amusing sketch of a journey in a hired car between those two places. An incident on the way was the appearance of a man with a rifle who loosed it off at the car (hitting the radiator) ; the author is unable to say whether the action was due to a desire to hold up the car, or to chagrin at being refused a lift, the car being already full.

Operations in the Southern Desert, 'Iraq, 1927–28 ' were undertaken by the R.A.F. with some armoured cars and the 3rd/5th Mahratta L.I. and some of the 'Iraq army as ground troops. The operations became necessary owing to raiding by the Akhwan from Najd(throughout the article called Nadj). Bombing raids effectually dispersed these parties and, it is claimed, prevented the invasion of 'Iraq by 40,000 well armed tribesmen from Najd. Capt. Prain, R.E. is mentioned as having produced an excellent map of regions previously almost unknown. The difficulty of locating from the air machines grounded on desert is noted. It is an article well worth reading.

African medals awarded to Indian soldiers records the presence of a party of the Q.V.O. Madras Sappers and Miners in Nigeria in 1898–1900, a far cry even for that much-travelled corps.

The Decline of Foreign Prestige in China is written by an officer cadet, who has spent many years in a British firm in China, and obviously knows what he is talking about. The prospects of the status of our nationals after the war in the Far East are not rosy. The author considered it possible, but not probable, that Japan would go to war with the Western democracies, and hardly considered the problem from that point of view. Is it correct, by the way, to state, as the author does, " In August, 1917, at the insistence of the British and French governments, China declared war on the Central Powers ? ', It would be a bold man who would venture to make any prophecies about the state of the world after the war.

Some Aspects of Forest Warfare deserves study ; as far as can now be judged, the author's views have been borne out by events in Malaya, Burma and the Dutch East Indies.

Democracy and the Training of Leaders, beginning with the dictum that " it is the unfortunate defect which accompanies all the blessings of Democracy, that elected governments do not seem to be able or willing to educate the electorate, and to save the nation from mass ignorance and mass neglect, to support in sufficient time military measures for self-preservation " with which few will disagree, recommends some drastic changes in our national educational system, as well as in Army institutions for the training of company commanders and officers.

In the correspondence is a letter from a Gunner Officer who was through the retreat to Dunkirk, and it is heartening to read how his battery put it across the Boche.

Vol. LXXII, No. 306, January, 1942.

The Western Desert contains an extraordinary amount of information. Here are items. The character of the desert varies almost from mile to mile ; in a dust-storm the water consumption of an A.F.V. may be 3 miles to the gallon ; the climate in summer is by no means too hot to prevent operations, it is in fact preferable to the winter owing to the rarity of dust-storms ; the best defended positions are found to be one- or two-man slits, occupied by day ; at night the garrisons retire to section posts behind ; the effect of dive-bombing on the hard ground is very considerable, a 250-lb. bomb makes hardly any crater, but expends all its force laterally ; wire is almost unknown and its place is taken by minefields ; " Sappers lay mines and work compressors to make vehicle-and gun-pits. The number of compressors and mines which are available is limited, so they get time off to eat and sleep ; otherwise they would not. . . . Anyone who thinks of mines in units of less than 100,000 is probably unable to ride a bicycle." Co-operation with the R.A.F. is about as perfect as it can be ; the Germans invented a very deadly A/T obstacle consisting only of a rough stone wall ; as our tanks mounted this they were shot in the belly by concealed weapons.

In the same article there is a condensed account of operations up to the eve of our advance in November last. The German comeback in April, 1940, is said to have been due to our seasoned veterans having been replaced by troops new to the country, who however by their stand at Tobruk speedily proved themselves as capable as their predecessors. Operations round the Halfaya pass are lucidly described, while an account of a normal day's work should be read by everyone in the army, or at least in any part of the army engaged in desert warfare.

Politics and Publicity in Greece is by a Director of the British School of Archæology at Athens. There are some amusing stories of the love of the Greeks for politics, and a saying is quoted, that " wherever there are two Greeks there are five political parties " ; but the main theme is the great affection of the people for Britain. German propaganda served only to intensify this feeling, which was unshaken by our withdrawals from Norway and France. In June, 1940, an agitated Greek taxi-driver said to the author

" Do you think *we* will win " ? We owe a deal to the Greeks, who, it must be remembered alone of organized nations fought on our side during the dark days of 1940-41 with such courage that " it needed a nation of eighty millions to go to the rescue of one of forty millions to defeat one of six millions " !

Trout Fishing Notes for Beginners contains some valuable hints as to outfit and *modus operandi*, the chief item needed being an unlimited stock of patience.

A Glimpse of Shanghai, written obviously pre-war, is a good and lively account of the international settlement, which, started a century ago by Britishers living in wooden shacks on a flat muddy swamp, has grown into one of the finest cities of the world. British enterprise has sunk £150,000,000 in the place, money which has presumably gone west until the final day of reckoning with the Japs.

Jarboiyah, 1920, is the account of a minor siege of a post which can best be described as a double bridge-head on the Euphrates. Major, now Colonel E. Bradney, R.E., is mentioned as having given useful advice regarding the siting of the posts. An unnamed Sapper officer with a platoon of S. and M., shared in the defence, one of the remarkable features of which was that the insurgents resorted to sapping by way of attack. A good but condensed account is given of the whole of this little-known campaign, the Arab Rebellion.

Those who have had similar experiences will congratulate " Mugger " in successfully overcoming his difficulties in *Raising a Labour Battalion*. To begin with he had only one B.O. and some civilian clerks, who knew nothing of army routine, to deal with a steady flow of recruits who needed food, accommodation, equipment and drill. An epilogue gives a picture of the unit on service (in S.W. Persia ?) rather reminiscent of Kipling's *Ship that found herself*.

The Battle of Amba Alagi by Capt. Shaukat Hyat is an excellent description of the fighting which led to the surrender of the Duke of Aosta and 12,000 men with 200 guns, occupying a position which a panorama sketch depicts as truly precipitous. Our forces consisted of 1 cav. regt. (mechanized), 4 battalions of infantry, much under strength, with 2 regts. of 25 prs., 2 batteries of 3.7 hows., and two 60 prs., helped by some patriots and later by a S.A. bde. which completed the enemy's encirclement from the rear. The author sums up the reasons for our success—superior morale, better training, determination and initiative, greater confidence, cohesion and co-operation. Even the best Italian troops would not face the bayonet.

Two Wars.—The Napoleonic and the present—by Captain L. P. Chenevix-Trench, consists of a comparison between the conduct of those struggles. In both we have the explosive force of a new idea overrunning Europe, by arms, propaganda and treachery. In both we made overseas expeditions which ended in evacuations. The Battle of Belgium is aptly compared with Austerlitz, Trafalgar with the Battle of Britain. The author tentatively suggests that Libya in this war may be the " Spanish Ulcer." Whether Hitler has passed his 1812 will be more apparant in the next few months.

" Rs. As. Ps. retired " in *The Qu'Hailands of England* compares the advantages and disadvantages of life on a pension in London, in some large city, in a seaside town, in the country, and finally in a spa surrounded by " Koi Hais." He has tried all and plumps for the last.

F.C.M.

THE MILITARY ENGINEER.

(*January*, 1942.) *Engineers Rush Alaskan Defences.* By Lieut.-Colonel J. R. Hardin.

The Corps of Engineers is busily engaged in building America's defence outposts in the far reaches of Alaska. Work is being carried on in spite of the most adverse weather conditions. In the central section winter temperatures as low as 50 degrees below zero are not uncommon. These severe temperatures are sometimes accompanied by high winds.

In some parts of Alaska a ground substance called *muskeg* complicates construction work. This material, sometimes 15 feet thick, is a vegetable growth, ranging from a substance resembling peat at the base to a sponge-like living vegetation of various colours on the surface. Before a road can be constructed through it, the *muskeg* must either be removed, or the road must be carried on trestles.

In many places the annual rainfall is as much as 150 inches.

Nearly all construction material must be shipped from the U.S.A. Only a small quantity of timber can be obtained locally ; aggregates for concrete are usually available. Skilled labour is scarce.

Concealment Needs. By Lieut.-Colonel H. Saint-Gaudens.

The peace-time Camouflage Section of the Engineer Board at Fort Belvoir, Virginia, consists of about 10 officers and 70 civilians. In war time it is planned to have a G.H.Q. battalion of 23 officers and 389 men who will make up a factory unit. With each army will go a camouflage battalion of 30 officers and 391 men.

There are two kinds of camouflage, because camouflage is not always absolute hiding. There is front-line camouflage for total concealment against camera detection and artillery fire. There is rear-area camouflage of vital areas known to the enemy, which should be blurred from the visual observation of bombers.

Front-line camouflage has not changed much since the first World War. The writer quotes instances of work correctly and incorrectly carried out.

Rear-area camouflage is applied to guard against an oblique view from a bomber who may be at a height of 20,000 feet. As a rule, little can be hidden from direct overhead view, but that is of little consequence, as a bomb will land about 3 miles ahead of the point from which it is dropped. The writer makes suggestions as to the methods that may be adopted for concealing artillery, buildings, air fields, and industrial plants.

Engineer Defence against Tanks. By Lieut.-Colonel F. W. Gano.

The writer describes experiments made at Fort Belvoir in constructing obstacles to stop the advance of tanks. The obstacles consisted mainly of logs. He lays down certain fundamental rules for their construction.

Always assume that attacking tanks are being operated by tough, daring and determined drivers. Never expect to immobilize tanks by a single line of obstacles. Always build in depth. An experienced driver will invariably pass the first obstacle and will be stopped only when the tank has been slowed down and the driver has lost his keen sense of balance. Log hurdles are excellent for disturbing the driver's sense of balance: hurdles are most effective if located askew to the line of the obstacle. Hurdles should always be used in connection with anti-tank ditches. Build well, solidly and unevenly.

From Railroad Cars to Combat Tanks. By F. A. Stevenson.

The writer, who is Senior Vice-President of the American Car and Foundry Company, describes how his company switched over from the construction of railway carriages to that of combat tanks in a very short space of time. Two years ago the organization knew nothing about tanks or armour plate.

The Artillery Engineer Team.

Captain W. C. Hall shows how survey companies collaborate with the artillery in producing surveys for map firing. In this class of work maps are required on scales of 1 in 20,000 or 1 in 25,000. Very few maps on these scales exist in America.

Engineer Board Notes. Maintenance of Engineer Equipment.

Millions of dollars' worth of new engineer equipment has been placed in the hands of engineer troop units during the tremendous expansion of the past two years. One of the most important tasks in the engineer maintenance programme now being carried on by the Engineer Board has been to ascertain the tools required by mechanics of engineer units to enable them to take proper care of their equipment. Experimental trailer- and truck-mounted mobile repair shop units are worked out and tested to determine the simplest effective equipment for each particular type of organization.

Several different types of mobile repair shops, welding trailers, etc., are described and illustrated in this article.

Engineer Operations, Fourth Army Manœuvres, August 1st to 25th, 1941. By Colonel W. A. Johnson.

A description of the work carried out by engineers in recent army manœuvres.

The writer offers some criticisms, amongst others, that engineer troops would have received additional and better training if demolitions could have been handled on more realistic lines. In spite of much improvement, Engineers are not yet trained to fight as fighting is now done in Europe. More realism is required in their training.

Interpretation of Aerial Photographs by Company Officers. By Captain T. A. Fuller.

The writer stresses the importance of officers learning to read a map prepared from aerial photographs. He writes: "The best means of study is to obtain photographs of a scale smaller than 1/5,000 and try, with the aid of a stereoscope and a magnifying glass, to identify the objects which are barely visible, all the while attempting to determine the reason for the object's presence. While it is possible to obtain stereovision with the naked eye, it is greatly facilitated with a pair of cheap spectacles."

Crossings of the Red River. By Lieut.-Colonel M. J. Young.

Six pontoon bridges were built by the VII Army Corps across the Red River during the Arkansas and Louisiana manœuvres. Of these the shortest was 487 feet and the longest 952 feet long. The river was at its lowest, having a maximum depth of 15 feet and a current of 2.5 to 3 miles an hour. Shoals required the use of many trestles and frequently added to the difficulties of placing the boats in the bridges. The bed was soft, and trestle shoes had to be placed on brush mats. The labour requirements for the approaches averaged two to three times those for the bridges.

The new pontoon equipment, including the heavy bridge equipment and the truck-tractors and semi-trailers, gave good results. The difficulties of night work were, however, not fully realized. Training will reduce the handicap, but with well-trained units it takes two or three hours on a dark night to accomplish what can be done in an hour by day. Short bridges can be built during a single night and an enemy can be surprised. But long bridges, such as those built across the Red River, cannot be constructed in one night. Hence the advantage of night work is doubtful, especially as the men are not fresh, and it would probably pay better to commence work an hour before dawn.

(February, 1942.)—Construction in the Islands of the Pacific. By Colonel W. T. Hannum.

A description of the harbour improvements carried out in the Midway Islands. These islands lie approximately 1,140 miles north-west of Honolulu, and consist of two low lying sand and coral islands situated inside a lagoon enclosed in an almost circular barrier

reef six miles in diameter. The improvements, which were carried out between 1938 and 1940, consisted of the dredging of a sea-plane basin, 8 feet deep, the construction of a pier, and the cutting of a ship channel through the reef. Except for a little brackish water in wells, there is no drinking water on the island, but the rainfall is fairly heavy.

Protective Concealment in Snow. By Major P. Rodyenko.

In snow-covered country it is important to provide protection against aerial photography as well as against visual observation. Experiments have been made with "snow paint"—a mixture of china clay, casein, borax and ammonia, with ground mica added. It is mixed with water and applied with a brush. In order to make its reflectivity equal to that of snow, ground asbestos, marble dust and tiny colourless glass globules are added.

Regular protective concealment may also be used, but, in order to avoid shadows, side drapes should be fixed, sloping from the ground at 10° to 15° to a flat top, and then down to the ground on the other side.

The Military Railway Service. By Lieut.-Colonel L. T. Ross.

After a brief account of the history of railways for military purposes from 1846 onwards, the writer goes on to describe the system adopted in France during the first World War.

The system now obtaining in the U.S.A. has been organized on a tentative basis. The Military Railway Service has been placed directly under the Chief of Engineers. The basic unit for transportation and maintenance is the operating battalion, employed on a small railway division of 75 to 100 miles. For traffic control there is a regulating officer, functioning directly under G.H.Q. and assisted by a superintendent of the Military Railway Service.

The Manager, M.R.S., has no construction troops under his direct control. New construction is carried out by Army and Communications Zone general Engineer troops.

It seems doubtful if trained railway construction troops will always be available on call, but the idea is to form a nucleus of such troops, capable of expansion when the time comes.

Protection of Gasoline Storage in War. By W. A. Austin and J. Escobar.

The storage and distribution of petroleum in its various forms is as important in war time as the machines of war, and as the men who use the machines.

America is dotted with tank farms large and small, which supply the public service stations. Each farm consists of one or more steel tanks, either cylindrical or spherical in shape. A simple modern rule for the location of tanks is: "one tank diameter between tanks and a 100% capacity basin round each, formed by earth banks or concrete walls, to contain the liquid if the tank should be punctured."

Camouflage of tanks is useful, but difficult to attain.

Protection against direct hits would necessitate burying the tank at such a depth as to make the idea impracticable, but walls should be built round each tank above ground extending to 80% of the tank's height, to resist damage from splinters.

As a safeguard against damage by fire, the pipe lines should be in duplicate. For extinguishing fires water is useless; it is only useful for keeping non-blazing tanks cool, and for preventing flames from spreading. Foam chemicals are the only known agents for extinguishing blazing pools of petroleum.

Old and obsolete pipes and valves should not be scrapped: they might come in handy for emergency repairs.

Sanitation in the Field of the United States Army. By Second-Lieutenant S. A. Goldblith.

Previous to the first World War, deaths from disease in war time largely exceeded in number the deaths caused in battle. Sanitation in the field is a matter of extreme importance.

The writer first discusses the disposal of refuse and waste in the field, which is not primarily one of the functions of the Corps of Engineers. He next deals with water supply.

To each Field Army is assigned an Engineer Water Supply Battalion; a battalion is also assigned to General Headquarters Reserve for each Field Army. The battalion is equipped with nine mobile water purification units, and each of the three companies has 36 water tank trucks.

Water is chlorinated in any suitable containers, and is usually distributed to troops in the field in Lyster bags (heavy canvas bags of 36-gallon capacity).

Engineer Board Notes.

This article contains descriptions of some of the machinery used in connection with water supply, *viz.*, a percussion-type well rig, a rotary (truck-mounted) well rig, a portable shower bath, and portable water purification units.

A Graphic Method of Progress Control for Construction Contracts. By A. R. Ware and R. A. Gridley.

The writers explain a system of graphs they have adopted for comparing anticipated expenditures on large contracts with actuals, and how the graphs may be affected by change of orders given in the course of work. Normally, monthly expenditure is slow at the start, it increases gradually as the job gets under way, and decreases again as the job nears completion. The result is a curve of flattened S form.

Engineer Operations in the Second Army Manoeuvres.

Captain R. L. Harriman describes some of the work carried out by the Engineers in the Second Army operations. The bridging work has been described by Colonel Young in the January issue.

Demolitions entered largely into the defence scheme: 351,900 dummy TNT blocks were issued to the Engineer troops during the five days' final exercise, and about 2/3rds of them were used. The ultimate responsibility for blowing up bridges was in the hands of the bridge guards at the site. The guards were N.C.O's or privates. The responsibility was well placed, for no bridges were captured, and there were few premature demolitions.

Of other Engineer services, water supply was perhaps the most important. Every effort was made to keep the use of municipal water to a minimum, so as to give the troops as much training as possible in providing their own water supply.

Actual Bridge Demolition in a Manœuvre. By Lieut.-Colonel C. F. Baish.

In these manœuvres permission had been obtained to destroy an old bridge over Chaney Creek, the bridge having been abandoned on account of the construction of a new by-pass highway near by. The main span of the bridge consisted of a Howe truss 105 feet long. The explosive used consisted of four 5-lb. charges of dynamite, two ½-lb. charges and two 4-lb. charges of the same explosive. After a partial failure the final result was quite satisfactory.

(*March*, 1942.)—*Strategic Timor.* By Stuart St. Clair.

Timor is one of the Lesser Sunda group of islands that extends from Java, eastwards in a great arc. It lies about 600 miles east of Java and at about 125° east longitude and 9° south latitude. The island is 300 miles long and at its widest and central part is 50 miles in width tapering to both ends. The western half is owned by the Dutch; the eastern part by the Portuguese.

So little is known of Portuguese Timor that a brief description of the island may be of interest. Dili, the capital and government centre, lies on the north coast and in the western part of the territory.

Dili is enclosed on three sides by low ground which is swampy most of the year. Fever is prevalent although the climate is not bad when compared with other tropical places. Dili has a population of about five thousand of which two hundred are Portuguese and the balance Chinese, Arabs, Malays, and Timorese. The Chinese and Arabs carry on most of the commerce and trading. It would be very difficult to develop an air field near Dili, but the barrier reef, 1 mile out from shore, would afford protection to submarines and other small craft of the "hit quick" and "run-fast" type. There is no good harbour on the Portuguese strand.

The mountains rise directly from the shore except on part of the south coast where, in a few places, there are considerable areas of low grassy lands. The central chain of mountains that extends from end to end of the island has peaks up to 10,000 feet, and many up to 8,000, 6,000 and 4,000 feet. With such elevations and the narrow width of the island, erosion is rapid and steep canyons slash into the mountain sides and uplands. There are no rivers of navigable size and few carry much water except in the rainy season, when they make up for lost time.

The island is peppered with military posts and small forts. These are necessary, or have been in the past, to maintain order among the natives, administer justice, and to collect the yearly head-tax. The Portuguese and Dutch maintain forts along their boundary line near the centre part of the island.

The rugged terrain and the lack of landing facilities on the coral coast would aid in the defence of the island, although it has been demonstrated that a landing in force can be made anywhere and anytime. The advantage is usually with the initiative.

Any campaign on Timor must take cognizance of the rainy seasons. On the north coast the heavy rains start the latter part of December and continue into March. In the mountains close by the rains start earlier. On the south coast the rainy season usually starts the latter part of November and continues to the last of June, with a break during the month of April.

Up to ten years ago nothing more than trails connected the interior places with the coast. The coming of the automobile has slowly made changes and to-day there are more than 400 kilometres of fairly good roads. Their extensive use, however, in the rainy season must provide many difficulties.

Timor could produce many export agricultural products. No place grows better coffee. Cattle and copra could be made important industries; quinine and spices and many other valuable products could be produced successfully.

A mining industry is out, as no valuable minerals have yet been found in economic quantity on Timor. There are, however, petroleum possibilities and both Australian and Japanese interests have endeavoured to get exclusive concesssion for the development of the possible petroleum reserves. It would seem, however, that petroleum has not much to do with Japan's attempted thrust at Timor and that the movement is strategic and not economic. A.S.H.

REVUE MILITAIRE SUISSE.

(*December*, 1941.)—*La Bataille des Alpes.* A continuation of last month's account of the campaign on the French Alpine frontier. The operations are described by valleys, since the front was naturally broken up into a series of valleys, in which the fighting took place almost independently. These separate sectors were the Tarentaise, Maurienne, Briançonnois, Queyras and Ubaye. Each is dealt with in turn; and finally the battle for Nice is described.

In the Tarentaise, the French had 4 battalions, three of which were Alpine fortress battalions, and 44 guns; the Italians attacked them with 52,000 troops. Some posts on the French side were defended with spirit, and the enemy were unable to cross the frontier except opposite Bonneval, where they were checked.

In the Maurienne, the defenders had to cover Modane. They numbered about 9 battalions and 90 guns. On June 10th, when hostilities began, the Mt. Cenis tunnel was blown in. For the next ten days, the sector was quiet; then on June 21st the Italians attacked with some 40,000 men. The French made a stiff resistance, and although here and there they were driven in, in no part was their line broken.

In the Briançon sector, some six French battalions opposed three Italian divisions. Here again, the Italians made little headway, the French artillery work being very effective.

The Queyras was a sharp salient in the frontier towards Mont Viso. Its defenders were less than two battalions with 28 guns; the enemy brought up six battalions of Alpini.

In the Ubaye valley, the French had only four battalions and four artillery groups; four Italian divisions were deployed.

In all these operations, the inequality of the opposing forces was remarkable, and if we must make some allowance for exaggeration on the French side, it is clear that the Italians made no great showing in the campaign. If the French troops had not already learned of the disasters occurring to their main armies in the north, it is more than likely that the Italians would have been severely defeated.

The defence of the Nice sector was in the hands of the XV Corps, which had the fortress troops (nine battalions and nine artillery groups), the 65th infantry division, two battalions of machine gunners, one battalion of Senegalese, and 40 ski sections.

The main operations of the battle for Nice are left for the next issue.

Commentaires sur la guerre actuelle.

A short account is given of some of the foreign contingents fighting on the German side. Italy, Hungary, Rumania, Slovakia and Croatia may be called actual Allies of Germany. Contingents from all of them were fighting on the Russian front under von Runstedt. There are also the foreign legions from Spain (16,000 volunteers of the blue division), from France (under Colonel Ducros), from Belgium (Walloon Legion) and even contingents from Holland, Denmark and Norway.

Finland makes war on her own accord against Russia, profiting by the willing aid of Germany; or at least, that is how the Finns like to regard it.

Of the allies of England, more is to be said in the next number; but it is remarked now that none of the Governments seeking refuge in London dispose of any forces capable of putting Hitler's power into peril. "The principal military force at the disposal of the Anglo-Saxon coalition is undoubtedly that of the U.S.S.R which, in spite of the violent blows it has sustained since the 21st June, is still existing."

The commentator is guarded in his remarks on the Axis prospects at the close of 1941. The industrial capacity of the Allied nations is the determining factor.

The Japanese attack had just begun as the commentary went to press. Japan could only hope for success by striking before the Allied blockade could strangle her. She is even now living on her stocks. She has thrown in everything to gain a rapid decision. (This was written on December 11th, 1941.)

W.H.K.

ARMY EDUCATION.

(*March*, 1942.)—The March issue, broadly speaking, is divided into two parts. One deals with Education generally, and is mainly concerned with the opportunity that is now offered to the Educational authorities in the Army, of preparing and laying the foundations of National Education after the War.

The second part, which many will think of more value, gives sound practical advice for getting on with the immediate task of stimulating the minds of those now in the Army, on the soundness of which the success of the general plan depends.

In *Re-education* the Director of Army Education (Mr. F. W. D. Bendall, C.M.G.) states the problem briefly, but most admirably, in the following words, "How, in short, can we make good and happy citizens." He condemns the pre-war plan for determining the mental capacity of individuals, *viz.*: the intelligence test, on which the future of most children's education, and to some extent their whole lives depend; giving five reasons for his views, that are most convincing. He suggests as an alternative that the

Army's present method, of fostering qualities, mainly mental, which exist but are not at present valued sufficiently, should be used to influence our educational system and form part of it.

Dr. G. H. Green, M.A., Ph.D. (a civilian lecturer) in *Eighty Per Cent!* a title and subject suggested by the foreword to the first issue of the present series, examines the causes which have brought about the lamentable fact that "eighty per cent. of the men in the Army are not interested in education."

He suggests that the situation now existing in the Army could be used to find a remedy by means of carefully prepared *Questionnaires*, and also with some help from psychologists, thus obtaining a guide to the way young people should be educated so that they would realize the importance, and the delight and interest, of developing themselves continuously throughout their lives.

There is another article, following that by The Master of Balliol in the previous issue, giving the views of Professor F. A. Cavanagh on *Post War Education*.

The Professor advocates "almost universal adult education" by "all the means that can be devised to enable young people to develop all their powers" and claims that the heavy expense involved can and should be borne by the nation.

There is in these and previous articles only perfunctory reference to the education of women. Apart from its direct importance, the influence of women interested in education is bound to affect considerably the attitude of their men friends and relations to such matters.

Of the articles dealing with practical present day needs, *Practice not Precept*, by Lieut. E. F. Wilson, B.Sc., A.E.C., describes the work done in a Young Soldiers' Battalion, in which the difficulties are, on the whole, greater than in a Service unit; this Battalion seems to have taken the advice given by the teacher in *The Constant Nymph*—"Experiment." It seems most likely that the results will be (as suggested in the song on the subject) that these Young Soldiers will be "led to the light" and "afforded infinite joy and merriment."

Capt. N. G. Fisher's article *Art and Music in Adult Education* is well thought out, and shows, in outline, how a start can be made to interest men in the study of these subjects, the increased understanding of which will also increase their enjoyment of them.

A.R.A.I.

THE INDIAN FORESTER.

(*November*, 1941.)—The number records the death of an elephant by lightning; it occurred in Assam.

Silt-bearing Streams. Much trouble was caused, in the early years of the present century, by the wandering of certain streams, rising in the Yomas in Eastern Burma, and flowing westwards through the flat country known as the *laha*. As is the way with streams in such terrain, they had raised their beds with the result that the ground sloped away from the banks; floods were apt to breach the natural embankments so made and inundate the *laha* with disastrous results to cultivation. The evil was aggravated by forestry operations; tree felling in the mountains produced erosion and greater floods; logs floating down the stream jammed and formed new breaches; streams changed their courses and carried devastation to new areas. High and low embankments were tried, neither method being very successful, and the former very expensive. A much simpler method was then tried and found most efficacious. The deepest or otherwise most convenient channel of each stream was selected, and low bamboo fences erected along the banks. These collected floating material from the first floods, and silt accumulated round and outside the fences until stable banks were formed, and streams restricted once for all to stable channels. The area is now in the temporary occupation of the enemy.

Beautiful trees gives useful advice as to the planting and care of flowering and other handsome trees. Sappers very often have the task of planting alongside roads, or in compounds attached to pumping stations and so forth, where ornamental trees are a great improvement on the dull varieties which one often sees there. *Ornamental trees*, by Kamta Prasad Sagreiya, is reviewed in this number, and seems to be a useful work on the same subject.

The world's toughest woods are said to be *phasi* (*Anogeissus acuminata*) growing in Orissa; *dhaura* (*Anogeissus latifolia*) and *kardhai* (*Anogeissus pendula*). The last two are natives of most parts of Central India.

There are two extracts bearing on the war contribution of the Indian Forest Services In addition to timber, which one naturally thinks of first, Indian forests supply wood pulp, resin, turpentine and an enormous variety of drugs and spices.

(*December* 1941.)—*The Sacred River of Hindustan* is a good description of the upper reaches of the Ganges and of the pilgrims, priests and others to be met there.

The *Report for* 1939–40 *of the Forest Research Institute* at Dehra Dun refers to the manifold war activities of the Institution—identifying timbers, testing bamboos for

aircraft and tent-poles, finding substitutes for walnut for rifle butts, testing wood for army boot-boxes, toothbrushes for troops, training Ordnance personnel, and many other jobs of even greater importance.

A revised edition of *The Common Commercial Timbers of India* by H. Trotter, has appeared; it is a most useful work.

(*January*, 1942.)—*What's in a Name?* points out the difficulties and mistakes that occur when timbers are not correctly described; owing generally to ignorance on the part of the purchaser, an inferior wood may be accepted instead of a better kind. Thus, a motor company in Bombay was advised to try *poon* (*Calophyllum tomentosum*) for lorry building. They reported adversely. It was then found that an inferior timber had been passed off on them.

The Proof of Climatic Change is an analysis of rainfall figures at Chaibassa in Bihar. There is considerable evidence of a four-years cycle in its periodicity. It would be interesting to know whether such a cycle can be traced in other parts of the world.

F.C.M.

CORRESPONDENCE.

EASTERN BATTALION, ROYAL ENGINEERS.

April, 1942.

To the Editor, *The Royal Engineers Journal.*

SIR,

As an old Commanding Officer of the Hong Kong Company for 1901 to 1904 I can fully endorse Sir George Macdonogh's appreciation of the Chinese portion of this unit, but I was rather surprised to find he did not know the origin of the Eastern Battalion, R.E., which he describes as a strange organization.

When detachments of the Submarine Mining Service were first sent to the Eastern ports in 1878, the strength of the detachments was very small and they were supplemented by natives engaged as civilians. To give these detachments adequate training, it became the custom to assemble the parties from Ceylon and Hong Kong each year at Singapore, where they could carry out an annual practice on a larger scale with the detachment at that station, using Malays for the manual work. The good qualities of the Chinese as boatmen and labourers were recognized, but for political reasons it was not thought desirable to encourage their training as soldiers.

When in 1885 the whole organization of the Royal Engineers was investigated by an important Committee under the Presidency of Lord Morley, a proposal was put forward by the Inspector General of Fortifications, Sir Andrew Clarke, to form a Battalion of Malays to carry out the Submarine Mining work at the Eastern ports, to which Mauritius was now added. This organization was to be called the Eastern Battalion and have its headquarters at Singapore, where recruits would be enlisted, trained and clothed and drafted as required to the different ports. This was approved and a Battalion Staff was formed on 11th November, 1886, under Major M. D. Whitmore as Commandant, with an Adjutant, Quartermaster and Serjeant-Major. There was also a Major of the Battalion who was stationed at Hong Kong in charge of the defences at that port.

The scheme failed, not from any difficulty in administration but because the Malays, who were reluctant to enlist in any case, stoutly refused to serve away from their homes. When this was realized Major Whitmore visited Ceylon and Mauritius in 1887 and arranged for the enlistment of local natives to complete the companies. This change made the Battalion organization redundant, and Major Whitmore and his staff were recalled in February, 1890. The future of the Hong Kong Company was still unsettled, but in 1891 it was decided, as Sir George has told us, that Chinese might be enlisted.

Yours very truly,

W. BAKER BROWN.

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