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PROFESSIONAL NOTES.

BRIDGING.

The re-design of the pontoon equipment has now been under consideration for some time and many officers in the Corps are anxious to know what progress has been made in this direction; the following notes may therefore be of interest.

The equipment must be capable of being built up into various forms to take the different loads, and the first step was to decide what loads should be carried by the equipment. It was agreed to be essential to retain the lightest and most rapid type of bridging equipment which would enable the fighting troops to cross a river; this load would include all field guns, horse-drawn transport, and infantry in fours; in fact the new equipment in its lightest form should carry the same loads as the old medium bridge with the existing pontoons. It was not considered necessary to design the equipment so that half pontoon (*i.e.*, the old light bridge) could be used.

In the next form it was thought that the equipment should be capable of being built into a bridge which would carry all the troops and transport of the Field Army with the exception of siege artillery and tanks. The heaviest load in this connection is the commercial lorry which has an 8-ton axle load.

In the heaviest form the equipment should be capable of being formed into a bridge which would carry all siege artillery and tractors, and the lighter forms of tanks (the latest tanks are comparatively light).

These loads have now been classified as light, medium, and heavy loads. In addition there are three other load classifications (see table). Bridges are required to carry a load of infantry in file for forcing a passage across a river. Then in mountainous country the heaviest load is often pack transport and bridges are only required to carry this load. Lastly there are the heavy tanks which weigh up to 35 tons and form a class by themselves. It was not thought necessary to take these special loads into account when designing the pontoon equipment. It was further decided that the bridge must be able to carry the medium loads crowded at a check, but that in the case

of the heavy loads, the traffic could if necessary be regulated, so as to reduce the total load on the bridge.

When considering the loads brought on to a bridge by various orms of traffic there are three points to consider :—

(*a*) To determine the maximum concentrated load which the traffic will bring on to the bridge at any one point. This is usually the maximum axle load.

(*b*) This load is the greatest load which the bridge will have to carry up to a certain span which depends on the spacing of the wheels, etc. For instance if a bridge or span is 20ft. long the greatest load which can be brought on to this span by lorries is a concentrated load equal to the weight on the back axle of the lorry. On spans greater than 20ft. the greatest load would depend on the weight on the front axle of the lorry. Hence the second point is to determine up to what span does the axle load remain the maximum load

(*c*) Lastly, as the span increases the traffic may take the form of a distributed load more than a concentrated load and the stress in the bridge is proportionately reduced. Hence we must determine the equivalent uniformly distributed dead load for different spans produced by the various forms of traffic. Beyond a certain span the load settles down to the equivalent of so much dead load per foot run.

This information is contained in a concise form in the table.

For the bridge in the lightest form there is little doubt that the existing superstructure is very satisfactory and the problem is to design the best form of bridge to carry medium and heavy loads. Major Inglis suggested that a bridge for carrying either medium or heavy loads could be constructed by using a continuous steel girder over the pontoons as shown in *Fig* 1. As a heavy concentrated

FIG. 1.

load passes over the bridge the girder deflects but at the same time distributes the weight over several pontoons ; this avoids the necessity of making each pontoon or pier of pontoons capable of carrying the heaviest concentrated load. In the bridge as designed by Major Inglis, the weight is distributed by two lattice work girders some 3ft. 6ins. high, and the roadway is placed on the top of these girders. Sufficient pontoons would be used to enable medium loads to be crowded on the bridge but the traffic would be controlled with

heavy loads. The advantages with this system of continuous girder are:

(i) The pontoons can be spaced as desired under the girders and damaged pontoons can be removed without disturbing the bridge.

(ii) The bridge provides a comparatively rigid roadway and the switch-back effect of the ordinary pontoon bridge is avoided.

(iii) The continuous girder work enables a clear span of 60ft. to be spanned for the approaches and so avoids the necessity of trestle work.

(iv) By regulating the traffic with heavy loads a saving of 50% in pontoons can be effected in the heavy bridge.

The disadvantages are:

(i) It is very difficult to devise a method of forming cut with this bridge.

(ii) An arrangement whereby the ramp can slide at the shore end has to be incorporated so as to allow for the rise and fall of tide.

(iii) The bridge is rather heavy and would be perhaps a trifle slow in erection for medium loads.

Some 200ft. run of girder work is to be constructed for preliminary trials with this system.

In the meantime designs are being prepared and experiments carried out for a pontoon equipment which shall carry the medium and heavy loads in a manner which is somewhat similar to the Bridges B and C in the S.M.E. Circular No. 25A. Further work in this direction will be described when more progress has been made.

TABLE A.

The following Troops and Vehicles come under this Load Classification in their present Form, and can be crowded at a check.

Class of Load.	Maximum Axle.	Equivalent Uniformly Distributed Dead Load (For single line traffic).				
Infantry in single file.	—	1¼ cwts. per ft. run. *				Infantry in single file. * For a fighting bridge a lower distributed load can be allowed.
Pack Transport.	—	2½ cwts. per ft. run.				Infantry in file. Cavalry in single file. Pack mules. Camels.
Light Loads.	2	6 tons for all spans up to 15ft.	7 tons for spans between 15ft. and 24ft.	8 tons for spans between 24ft. and 32ft.	5 cwts. per ft. run for spans over 32ft.	Infantry in fours. Cavalry in file. G.S. wagons, field guns, howitzers, motor cars and ambulances.
Medium Loads.	8	24 tons for all spans up to 20ft.	27 tons for spans between 20ft. and 30ft.	30 tons for spans between 30ft. and 50ft.	6 tons per ft. run for spans over 50ft.	6in. howitzer and limber. 60pr. gun and limber. All types of motor lorries and omnibuses.
Heavy Loads.	16	48 tons for all spans up to 30ft.	50 tons for spans between 30ft. and 50ft.	—	1 ton per ft. run for spans over 50ft.	Heavy artillery. All types of tractors, and the lighter varieties of tanks.
Tank Loads.	35	105 tons for all spans up to 105ft.	—	—	1 ton per ft. run for spans over 105ft.	An unrestricted stream of traffic except that heavy tanks must maintain a clear distance apart of 75 ft.

THE RÔLE OF THE ROYAL ENGINEERS IN MECHANICAL WARFARE.

By Bt. Major G. Le Q. Martel, d.s.o., m.c., R.E.

During the war the Tank Corps grew from three companies to over thirty battalions, and this increase in fighting strength brought with it a great demand for assistance in various ways from the other branches of the service. For instance, the Tank Corps asked for and received special information and protection from the Air Force, and from the Royal Artillery special measures were required against anti-tank guns. The assistance rendered by the Royal Engineers to the Tank Corps was very varied, but was not fully developed during the war. If a similar war occurs in the future the Tank Corps will play a much greater part, and we must therefore have our ideas quite clear as to our rôle so that we may give the maximum assistance to this form of mechanical warfare. It was with that idea n view that this paper was written.

The Tank Corps in France was constantly faced with the necessity and difficulty of providing specialist tanks to perform various duties. Wire-pulling Tanks, Cable-burying Tanks, Bridge-laying Tanks, Sacrificial Tanks, and Mortar Tanks were all tried or suggested at various times. The main difficulty about the introduction of these specialist tanks was that fighting tanks had usually to be withdrawn from battalions and the crews trained at short notice in these special duties. If we consider the organization of the other arms of the service, we see that the fighting troops are relieved of specialist duties, such as the passage of obstacles or rivers, and demolition work, by the Royal Engineers. If therefore we can devise a universal type of R.E. Tank to carry out most of these requirements of the Tank Corps, we shall save withdrawing fighting tanks and crews for this purpose, and at the same time reduce the number of types of specialist tanks considerably. Trained sappers could adapt themselves to these varying duties far more easily than the crews of fighting tanks, and a higher state of efficiency would be obtained.

Many of these requirements deal with the passage of obstacles. Let us therefore now consider the question of the passage of tanks across tank obstacles under fire (when not under fire this work presents little difficulty, and can either be carried out by the Tank

Corps themselves, or with the assistance of any R.E. unit). There are at present three classes of tank obstacles :—

(*a*) Gaps which may take the form of deep ditches or water obstacles, and which have at present to be bridged to enable tanks to pass.

(*b*) Barricades which have to be blown down with explosives to enable tanks to pass.

(*c*) Minefields which must be exploded or removed before tanks can pass.

Each of these three types of tank obstacle can be effectively dealt with by using one type of R.E. Tank such as is shown in *Photo* I. A Janney pump is fixed inside the tank and driven off the engine ; this supplies oil under pressure which works the hydraulic ram A above the tank. This ram pulls directly on the lever B which in turn actuates the jib C. The lever and jib are strong steel frames, triangular in shape, and are pivoted on the front of the tank.

As regards obstacle (a) this tank can be used for transporting and laying the 20-ft. tank bridge. The bridge consists of two steel girders, 26-ft. long ; the bridge can be laid in less than a minute and this is carried out from inside the tank ; in this way no one is exposed to fire and the bridge can therefore be laid under rifle or machine-gun fire. The bridge was originally designed to enable tanks to cross canals at the locks, but any small stream or gap up to 20ft. can be spanned in this way. The tanks cross on the two steel girders, but the bridge can be decked later to take wheeled vehicles. *Photo* IV. shows the tank carrying the 20-ft. Tank Bridge across country. *Photo* V. shows the bridge being laid across a gap of 20 ft., and VI. shows the tank crossing the bridge. For gaps which are wider than 20 ft., the R.E. Tank can often be used to assist in launching single span bridges. In some cases it is possible to launch the complete bridge and to arrange that the whole of the work shall be carried out from inside the tank, so that the bridge can be launched under fire. *Photo* VII. shows an Inglis Rect. Mark II. bridge being pushed across country by a R.E. Tank. The bridge is mounted on idle tracks and can travel at about 1 mile an hour. On arriving at the gap or river the bridge is pushed across until the idle tracks fall over the edge of the near bank. The R.E. Tank then draws back, which releases the hook on the jib, and any fighting tanks can now cross the gap. The first tank can be across the gap within three minutes after the time that the bridge arrives at the river. *Photo* VIII. shows the bridge in position ; the idle tracks have fallen over the edge of the gap and the R.E. Tank has drawn back to release the hook ; a fighting tank is about to cross the bridge. Gaps up to 70 ft. can be bridged in this manner. *Photo* IX. shows the details of the hook and arrangements for pushing the bridge. The Light Inglis

Bridge can also be launched under fire by means of this tank. As the bridge is so light it can be pushed across country at 3 or 4 miles an hour and launched across a gap without any appreciable pause. In this way a passage can be forced by infantry across any river or gap up to 90 ft. If the ground was very firm and level a gap of 110-ft. could probably be spanned in this manner.

As regards obstacle (*b*) this tank can be used for laying and exploding demolition charges under fire. *Photo* XI. shows a boom fixed to the jib and a charge suspended from this boom. There are many occasions in war when a device of this nature would be of great value. In street fighting a strong house which could not be crushed by a tank could easily be blown down by using this method.

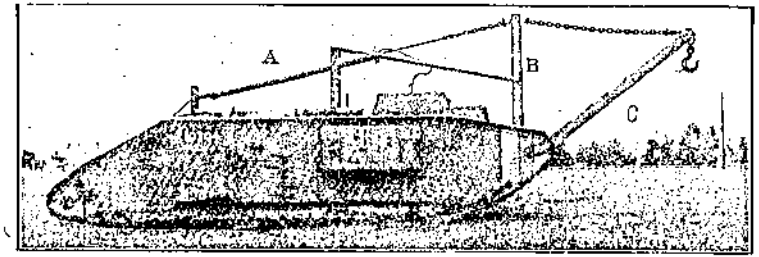
In a retreat if a charge on a bridge failed to explode, and the enemy gained possession of the bridge, a tank could sometimes return and lay a fresh charge and so demolish the bridge. The charge can be fired in several different ways. The tank can advance and lay the charge, light a time fuse and retire; or if desired the tank can withdraw a few yards with wires leading back from the charge which can be fired electrically. With any charges containing up to about 100 lbs. of explosive the tank can advance and hold the charge in position and detonate the explosive without fear of damage to the tank.

As regards obstacle (*c*) this R.E. Tank can be used for pushing a steel roller for mine-sweeping, as shown in *Photo* X. The enemy were using small contact mines as an anti-tank defence towards the end of the war, and some type of small contact mine is likely to be extensively used in the future. By means of this roller a passage can be swept in such a mine field, and fighting tanks can then pass through this passage. The rollers explode the mines and are blown one or two feet into the air, but are not damaged by the explosive, nor is the tank affected when any of these small contact mines are exploded in this manner.

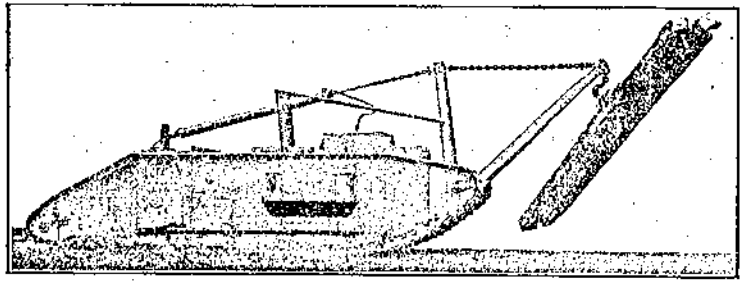
In addition to the requirements of the Tank Corps this tank can be used in many ways to assist in the normal R.E. duties in the Field. For instance, the tank can be used as a very powerful mobile crane. *Photo* II. shows the tank lifting the rear wheels of a 14-ton tractor which is ditched and replacing them on the road. *Photo* III. shows the tank carrying a bundle of girders weighing about 8 tons. The jib can be raised or lowered through an angle of 65°; in the lowest position the end of the jib is 2 ft. 6 ins. from the ground, and in the highest position it is 16 ft. from the ground. Loads up to 10 tons can be raised through this distance in 2 minutes. Over 10 tons the loads must be raised more slowly so as not to overload the hydraulic pump. The maximum load that can be raised is 15 tons. For clearing roads of débris such as broken bridges, this tank would be invaluable in war. It is also probable that this tank will be required

to act as a tractor for excavating and cable-burying devices. It may further be possible to adapt the jib for use as a mechanical shovel.

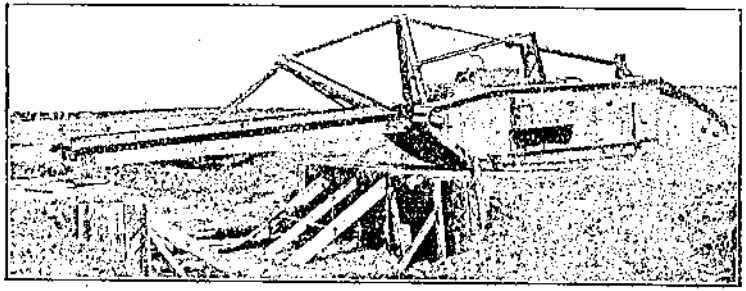
We have now seen that the tank can be used in a multitude of ways to assist the Royal Engineers both as regards their ordinary work and with respect to the R.E. requirements of the Tank Corps, and we can now suggest what further steps should be taken. There are two ways in which the Tank Corps may expand. The Corps may either grow up as an adjunct to the Army, and this is the present position of the Tank Corps, or tanks may be gradually incorporated into battalions and artillery units in much the same way as the old rifleman was incorporated and gradually ousted the pikeman from the infantry units. In the event of the Tank Corps remaining a separate body the Royal Engineers should form mechanical Field Companies to carry out their requirements in the same way as Field squadrons carry out this work for the Cavalry. These mechanical companies should be self-contained units; they should be organized in four sections, each section having four tanks. The tanks would carry much the same tools and explosives as a Section of a Field Company. If the Tank Corps becomes incorporated with the remainder of the Army then the right policy would appear to be to introduce tanks gradually into the Field Companies. At first one section in the Field Company would be converted into a section of a mechanical Field Company and given four tanks, and later, as mechanical warfare progressed a greater proportion of the company could be mechanicalized. As the tanks become faster and increase their radius of action, they will carry out raids on the enemy's communications. In this duty they will require considerable assistance from the Royal Engineers in demolition work, etc. Sappers will therefore have to accompany these raiding tanks and will be required to be mounted on fast tanks; in fact this will be one of the main duties of these suggested mechanical R.E. Units.



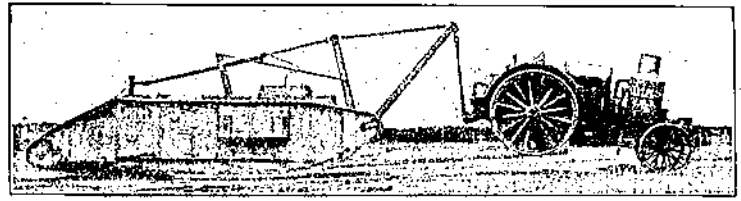
1. The R.E. Tank.



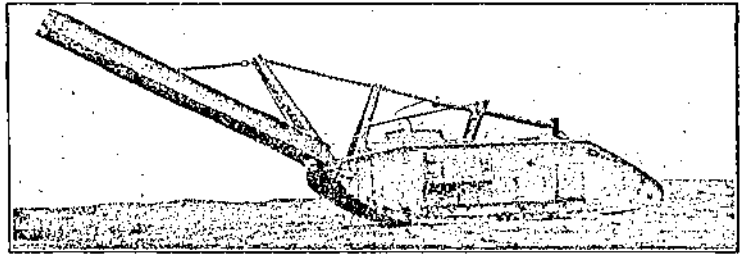
3. The R.E. Tank carrying girders weighing 8 tons.



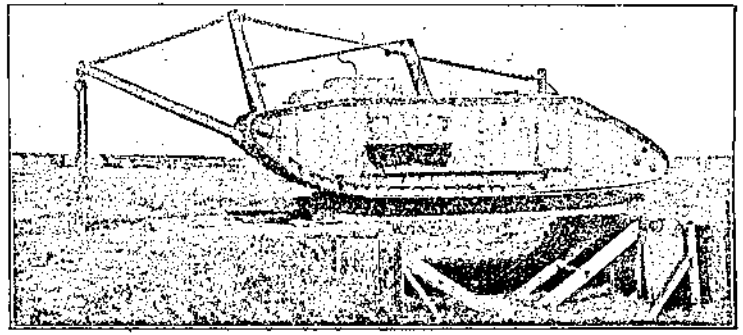
5. The bridge being laid across a gap.



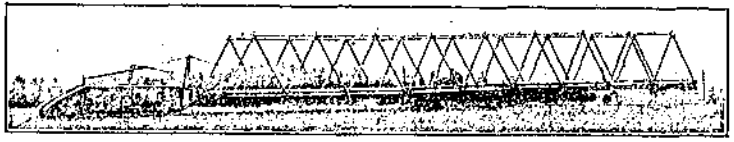
2. The Tank lifting the rear wheels of a 14 ton tractor which was ditched.



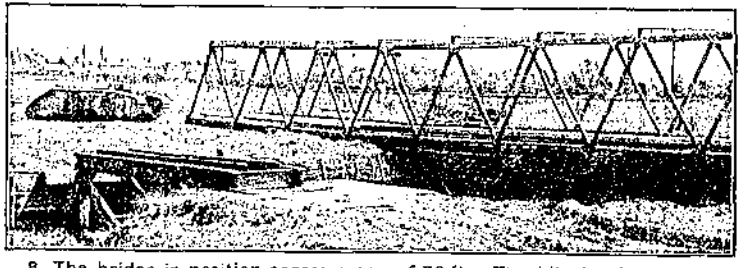
4. The 20-ft. tank bridge in the carrying position.



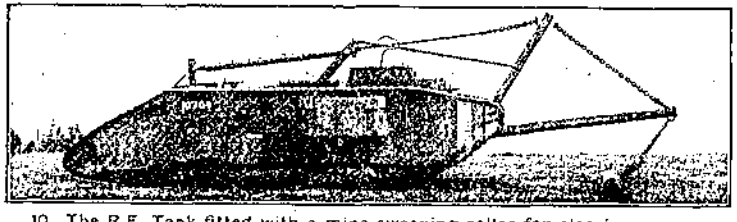
6. The tank crossing after laying the bridge.



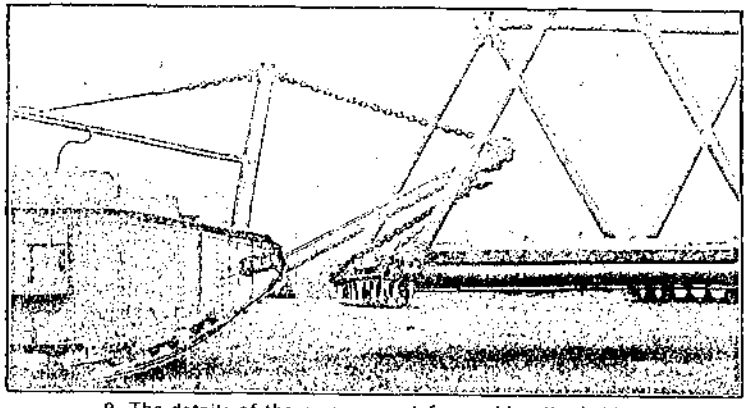
7. The R.E. Tank pushing a heavy tubular bridge across country. The bridge is mounted on the idle tracks.



8. The bridge in position across a gap of 70 ft. The idle tracks have just fallen over the edge of the near bank.



10. The R.E. Tank fitted with a mine sweeping roller for clearing a passage through an anti-tank mine field.



9. The details of the arrangement for pushing the bridge.

11. The R.E. Tank fitted with a bowsprit with a charge at the end for carrying out demolition work under fire.

SANITARY CONGRESS, BIRMINGHAM.

By MAJOR-GENERAL E. H. HEMMING, C.M.G., F.R.S.I.

THE thirty-first Congress and Exhibition of the Royal Sanitary Institute was held at Birmingham, July 19th to 24th, 1920. For the benefit of those who have possibly never attended a sanitary congress of this kind, I may say that, apart from the necessary inaugural meetings, addresses, and receptions, the programme usually consists of daily and simultaneous meet ngs of the respective sections which deal with the ever-varying and far-reaching subject of sanitation as applied to the different branches and professions of science and administration. At these meetings, papers on subjects of contemporary interest are read and discussions are invited, under the Chairmanship of eminent authorities of the particular branch with which the section deals. The afternoons are spent in visits to engineering and other works illustrating the application of modern sanitary science, and the evenings are devoted to popular lectures and re-unions. Throughout the Congress a Health Exhibition is held under the auspices of the Institute, and many of the newest and best inventions connected with applied sanitation are shown. I was very glad to take advantage of the invitation of the R.E. Institute Council to attend this Congress in the interests of the Corps and in my own interests, both in my connection of many years with the Royal Sanitary Institute, and in my immediate connection with "Housing" under the Ministry of Health.

Although there are in such a Congress as this a great many subjects and opportunities which are of special interest to the sanitary expert and also of common interest to the public as intelligent citizens, and co-operators in the world-wide work of sanitation, I do not propose to attempt to cover more ground in this report than will, I hope, appeal directly to the Corps.

The Presidential Address by Viscount Astor, and the Public Lectures on "Mind and Body" by Sir Frederick Mott, and on "Links with the Tropics" by Dr. Andrew Balfour, were extremely good hearing but hardly sufficiently technical for any detailed reference in the *R.E. Journal*.

Of the various sectional Meetings I give below an extract of those that may interest the R.E.

ENGINEERS AND SURVEYORS.

Address by the President, Sir H. P. Maybury, K.C.M.G., C.B., M.INST.C.E.

1. "The Hygiene of Road Pavements," by Ernest Worrall, F.S.I., Engineer to the Stretford U.D.C.
2. "Arterial Roads and Road Classification," by C. F. Gettings, M. INST. C.E., County Surveyor, Worcestershire.
3. "The Evolution of the Road," by J. Willis-Bund, C.B.E., LL.B., Chairman Worcestershire County Council.
4. "The Local Surveyor," by F. G. Fisher, Superintending Valuer, Central East Division, Inland Revenue, Birmingham.
5. "The Conservation of Water Supply in England and Wales," by F. W. Macauley, M.INST.C.E., Birmingham.

ENGINEERING AND ARCHITECTURE.

Address by the President, W. E. Riley, F.R.I.B.A., M.INST.C.E.

1. "Reconstruction of Slum Areas," to be opened by Lieut.-Col. W. J. Travers, O.B.E., F.R.I.B.A.
2. "The Case for Higher Buildings," by Delissa Joseph, F.R.I.B.A.
3. "The Renovation and Re-modelling of Cottages in Country Districts," by Miss A. Churton, Secretary, Rural Housing and Sanitation Association.
4. "The De-watering of Sewage Sludge, with special reference to the Birmingham Method," by F. R. O'Shaughnessy, A.R.C.SC., F.I.C.
5. "Notes on Domestic Drainage," by J. Stuart King, A.M.I.C.E., M.I.M. & C.E. (Birmingham).

Most, if not all, of these papers and discussions are printed and published in due course in the *Journal of the Royal Sanitary Institute*, and if any sapper would like to have copies of any special papers, I will do my best to obtain them.

The visits to public works and institutions included inspections of the Frankley Water Works, the Sewage Farm, the Garden Village of Bournville, the Electric Generating Station, Destructor Works, and the Sanatorium for Tuberculosis. Of these, the Garden Village of Bournville was particularly interesting from the Housing point of view—some of the public buildings in the village are also architecturally noteworthy. The other works mentioned above would also be of interest to the Corps generally, but are, for the most part on a larger scale than would usually come within the scope of R.E. work.

The Exhibition was unique of its kind, being thoroughly representative of really up-to-date sanitary science and of modern labour-saving appliances and refinement of living. There was a noticeable

absence of the more ordinary sanitary fittings in common domestic use which evidences the fact that the general public, thanks in no small degree to the energies of the Royal Sanitary Institute, no longer need to be reminded of the fundamental elements of sanitation in connection with the disposal of waste products, and excreta.

The needs of the small house where economy, cleanliness, and self-contained labour-saving apparatus have become essential, were well catered for, such as, for instance, gas and other cookers or ranges, combining sitting-room and kitchen fires with heating and hot water supply, combination kitchen dressers and furniture, electric sweepers, modern baths of moderate size, steam-consuming coppers, disinfecting sprays, etc.

Models of some of the housing schemes were also shown with communal hot water supply, heating and laundry work. These are particularly worthy of note to the Officers of Engineers who are employed on building works and are specially concerned with the housing of married soldiers, which must keep pace, both in fittings as well as in design and grouping, with the present advances in the housing of the working classes.

Of general engineering interest to the sapper, the exhibition included among other devices, a pipe-bending machine, an extracting cowl, drain plugs, reversible and folding casements, a device for repairing slate roofs, labour-saving wall plugs, electric floor-planing machine, concrete water-proofing materials, etc.

I have selected a few of the exhibits which I think are worthy of special attention :—

Stimex combined gas fire and range is economical in practice and avoids the use of naked burners in the oven. This is rather an expensive fitting. (J. J. Chettle & Co., 185, King's Cross Road, W.C.)

Electric Suction Sweepers.—Of the various Electric Suction Sweepers, the Hoover and the Canadian are the best examples of these articles and represent a high and a comparatively low priced article. These are of general interest and constitute one of the greatest advances in domestic hygiene, and are worthy of consideration in connection with the hygiene of Military Barracks as a substitute for the still prevailing and primitive methods in use for spoiling floors by swilling them with water. (The Hoover Suction Sweeper Co., 288, Regent Street, W. and Napier Kimber Ltd., 109, Great Portland Street, W.)

Esavian Windows and Screens.—By this patent, long lines of casement windows are made to fold to one or both ends, leaving an unbroken opening. Useful for sanatoria and open-air schools ; any pair of casements can be folded separately where a smaller opening is required ; the casements are quite weather-tight when closed. The same principle is applied to folding screens and shutters which

can be used in lieu of sliding doors. These were used for Aeroplane Hangars during the war. (Educational Supply Association Ltd., 40–44, Holborn Viaduct, E C.)

Rawlplugs are a special form of wall plug consisting of a fibre tube made in various sizes and lengths to suit different sizes of screws; the hole is jumped by a special tool corresponding to the plug. They are extremely neat and strong and very rapidly put in, and constitute a great advance in every way on the old fashioned wall plug for all kinds of fittings, electric switches, etc., etc.; stronger and quicker and do not spoil the wall; can be fixed equally easily in tiles, bricks or plaster. (Rawl Plug Co., Ltd., Lenthall Place, Gloucester Road, S.W.)

Blackwell's Bitumen Roofing Felt and pure Bitumen dampcourse, are good and not expensive. (R. W. Blackwell & Co., Ltd., 36, Emperor's Gate, S.W.)

The Simplex Floor Planing and Treatment System, consists of an electrically-driven planer from an ordinary lighting current, followed by a sand-papering machine. The rest of the treatment which is optional, consists of filling and waxing. This method effects a great economy of time and labour in the planing of old and new floors, on a large scale, and would form a valuable adjunct to R.E. shops in a large military station or district. (J. & M. Steingold, 23, City Road, E.C.)

The Activated Sludge Process.—This is a substitute for the ordinary biological installation of septic tank and filter; existing tanks can be converted. This system involves practically no loss of fall, is compact, and cleanly, and said to be free from smell, leaving a pure effluent and a valuable sludge. It is especially applicable where power is available. The principle is roughly as follows:—After a preliminary screening, the sewage is agitated and aerated by forcing air through diffuser plates in the bottom of the aerating tank. After a certain time, the sewage passes into a settlement tank, thence the sludge passes to sludge beds for drying, and the clear effluent remaining is discharged to a suitable outfall. A fuller description will be found in the revised War Office Drainage Manual. (Activated Sludge Ltd., 14, Howick Place, Westminster, S.W.)

The Foresight Combination Range.—Consists of a range and oven with back boiler worked from an open fire. It is an effective and useful pattern where cooking is done in the living room. (S. Smith & Sons, Beehive Foundry, Smethwick).

The Japkap Water Waste Preventer is one of the best. It is very quiet and effective, the novelty of the principle being that the water rises through a flap valve in the plunger, which fits the cyclinder exactly, instead of through an annular space around a loose-fitting plunger. The flush will act with a small quantity of water and cannot act continuously. (Claughton Bros., Ltd., Bramley, Leeds).

Scols Pipe-Bending Machine, Extract Ventilator Cowls, Iron and Steel Cements, etc.—These are all worthy of note. The Scols pipe-bending machine is very portable and suitable for use on site of works, eliminating delays and cost of obtaining special bends, makes a great variety of cold bends in various sizes of pipes, would be a useful adjunct to any shop catering for water and gas work and repairs. The extract cowl of "Visor" pattern is very effective. The iron and steel cement, elastic cement, etc., are also recommended for foundry use and for repairs. (Thomas Ash & Co., Berkley Street, Birmingham).

Owen Patent Hot Water Tank.—This is an ingenious arrangement in which the ballcock supply is fixed inside the hot water tank or cylinder. It is suitable for cottages and married quarters, and is very economical in piping, and probably has a slightly greater heating efficiency than the ordinary system owing to the water in the supply pipe being warm when it enters the boiler. (Rowe Bros. & Co., Ltd., Berkley Street, Birmingham).

Wifesjoie Cooker.—This is a one-ring gas cooker, with special boiler for hot water circulation and baffle in oven to keep the flame from the meat, etc. It is very efficient and remarkably inexpensive. A great advance in economical gas ranges for small houses. (London Warming & Ventilating Co., Ltd., 20, Newman Street, W.)

Rigifix Bolt Hanger Sockets and Slotted Inserts.—This is extremely useful for fixing shafting, etc., in workshops, etc., of reinforced concrete construction. (Building Products, Ltd., 44, 46, King Road, Chelsea, S.W.)

Tenter Slate Clips, Tenter Casement Hinge, Tenter Drain-testing Plug.—The slate clips are rivetted to the slate to be inserted for a repair and the latter is pushed up under the slate above until the clips pass the batten, where it is firmly fixed and cannot be withdrawn, very ingenious and simple; a vast time saver in roof repairs and cost nominal. The hinge is most ingenious and makes it possible to hang a casement sash from either side at will—according to which-ever way the wind is blowing; can be used for hoppers in the same way and solves the cleaning difficulty—a very ingenious invention. The drain plug is a combination of three sizes in one, very strong and simple and makes for portability. A square gully plug is made for use with the drain plug. (Sheffield Hardwares, Ltd., Tenter Street Works, Sheffield).

This list omits many interesting exhibits, but comprises the best of those that are of immediate interest to the officers of the Corps. Some of these may be already known to our officers but they are good enough to bear repetition.

There is one very special and important exhibit from the active service point of view which had been arranged for the War Office by the Professor of Hygiene at the R.A.M. College, consisting of a

collection of models of sanitary apparatus and devices in connection with the Military Hygiene of the War. These included Latrines, Incinerators, Baths, Water Supply Arrangements, etc., etc. These models will be permanently housed in the R.A M. College Museum at Millbank, and will be well worth inspection by the Corps.

I met the Director of Hygiene at the Congress, and he informed me in answer to enquiries that a number of plates were to be published illustrating the best of these fittings. I was glad to hear also that a Joint Committee of Engineers and Medical Officers had been entrusted with the task of standardizing these fittings for use in various possible theatres of war.

I must apologize if I have failed to make my record very interesting reading. The Exhibition, however, in connection with this Congress is really something quite out of the run of the ordinary building trades' exhibition; indeed it is the object of the Royal Sanitary Institute to make these Exhibitions educative rather than commercial. And if my report will induce any Officers of the Corps to seek election as members of the Royal Sanitary Institute, or will help them to a livelier interest in sanitary matters in peace or war, or to the introduction of modern improvements and economies in the fittings and repairs of military buildings or in workshop equipment, it will not have been written in vain.

THE 106th FIELD COMPANY, R.E., AT LE BIZET AND ROMARIN.

On the 9th April, 1918, the enemy attacked south of Armentières. The 25th Division had recently arrived in the Ploegsteert Area, after heavy fighting in the neighbourhood of Bapaume. Losses had been made good. The R.E., consisting of the 105th, 106th and 130th Field Companies, R.E., and the Pioneers, the 6th Battalion South Wales Borderers, together with the rest of the Division, were busily engaged in bringing up their fighting efficiency. Capt. E. P. D. Cator, R.E., had recently arrived as 2nd in command of the 106th Field Company and, Major Lynam being on leave, was commanding the company. On the 8th April Company Headquarters and one section were at Nieppe and the three forward sections at the Laundry, Venne. The company was employed on the Right Brigade Sector strengthening forward defences.

Narrative of Events, 9th–19th April, 1918.

Nieppe. 9. 4. 18.—Company H.Q. at Nieppe shelled by H.V. guns. Forward sections at work in line. Company H.Q. and No. 2 Section moved to Romarin Camp. Sections in line joined them at 5 p.m. Company placed under the orders of Lt.-Col. Fitzpatrick, D.S.O., 6th South Wales Borderers (Pioneers).

9 *p.m.*—The whole Company, inclusive of dismounted H.Q., batmen, etc., marched to Pont Nieppe and dug in on left bank of river Lys with the 6th S.W.B. on right, 130th Field Company on left, 105th Field Company in support.

10. 4. 18.—7 *a.m.*—Enemy reported to have pushed forward between Ploegsteert and Le Bizet. The Company was immediately ordered to Le Bizet and assembled for counter-attack under Lt.-Col. Fitzpatrick. Later, the Company held a line in rear of the village. The infantry were gradually forced back, and at noon the Field Companies' position became the front line.

1 *p.m.*—Conforming to withdrawal on their left the Company withdrew to a shallow trench and ditch line 200 yards in rear. This position was held for 4½ hours against repeated enemy attacks.

5.30 *p.m.*—Enemy reported to have turned left flank. Heavy enemy M.G. fire, enfilading Company from left, made position untenable. The Company, together with approximately 200 men of the Border Regiment, in order to avoid destruction or capture, withdrew

in dark across the open under terrific M.G. fire and took up position in line with the Vanne-Romarin road, the right flank resting on bank of river Lys. Casualties—1 O.R. killed, 13 O.R. wounded.

11. 4. 18.—The Vanne-Romarin road position was held till 3 a.m., when the three Field Companies marched to Dou-Dou Farm and joined the S.W.B.'s, taking up a defensive position in front of this farm. This position was held against repeated enemy attacks.

6 *a.m.*—An enemy 2-seater plane firing on our positions whilst flying at very low altitude was fired upon and brought down, behind the line, by Lewis gun and rifle fire. It was immediately seized by units of 34th Division in rear. Another plane brought down by the Sappers fell in enemy lines.

8 *a.m.*—Enemy could be plainly seen in small parties on the Ploegsteert–Le Bizet road, apparently placing M.G.'s and laying telephone wires; these parties were fired upon and casualties observed.

9 *a.m.*—Enemy attacked all along the front; he was apparently easily held.

10 *a.m.*—Message received that our troops on the extreme right were withdrawing to Army line. Capt. E. P. D. Cator went at once to verify this message, and on return ordered the Company's withdrawal to Army line. The Company on its withdrawal was attacked by the enemy, who suddenly appeared close behind in large numbers. The enemy artillery placing a very heavy barrage over the area of withdrawal, which, in spite of its intensity, caused few casualties. At time of reaching Army line enemy were only 150 yards in rear, some of whom were wearing forage caps. They undoubtedly captured a few men suffering from wounds and fatigue. At time of reaching Army line it was found to be unoccupied. The Company took up positions in the line and immediately prepared for vigorous defence, opening up rapid fire on the enemy, who could now be seen less than 120 yards away firing from the standing position; our fire had certainly the effect of checking his advance. We had only occupied this position for a few minutes when an order was passed from the right to the effect that the right flank was withdrawing. Verification of this message was asked for by officers of this Company as we were under the impression that this was our last line of trench; before an answer could be received troops on our right and left could be seen to leave the Army line. The enemy by this time could be seen advancing on our flanks, firing as they came forward. It was now evident that we were in danger of being outflanked as we were apparently the only unit in the trench. The enemy in places managed to reach the wire and again opened rifle fire. Rapid fire was ordered to put the enemy out of action in order that we could withdraw, and this withdrawal was carried out by sectional rushes, the men passing through heavy hostile artillery barrage with very few casualties in this withdrawal. Some 500 yards to the rear

we came upon units of the 34th Division holding a line of rifle pits. We immediately placed ourselves at the disposal of a Brigadier of this 34th Division, who ordered us to go in support of units of his brigade on the left flank, and re-take the Army line. Our men, though very much exhausted by the strenuous fighting during the past 40 hours, joined up in two waves, the first wave under Lieut. Saxon, R.E., and 2nd Lieut. Kennedy, R.E., the second wave in charge of 2nd Lieut. Rice, R.E. and 2nd Lieut. Turner, R.E., and in conjunction with the aforesaid unit took the village of Romarin, except the eastern edge, after four hours' attack, during which time the enemy relied very much upon his M.G.'s. (During this time we were without the Company Commander, Capt. Cator, who had left us whilst we were in the Army line in order to get in touch with people on our right flank; it was afterwards reported to us that he had been killed in front of Brune Gaye). In the advance upon the village of Romarin our left flank was held up by enemy M.G. fire, and the right flank of second wave, in order to avoid this fire, worked forward under cover of houses and ditches, and eventually reached the S.W.B.'s in the village. This position was held until dusk when the enemy opened heavy fire (artillery) on the village. A message was received that the right flank was withdrawing from the village. This message was verified by a R.E. officer and to conform to this movement our left flank also withdrew. The units had now become very scattered, and in the dusk an attempt was made to re-assemble the R.E.'s of the 105th, 106th and 130th Field Companies. On assembling the party numbered about 45 O.R. It was then decided to report for orders to Brigadier of the 34th Division, and the party made its way with difficulty to the main Armentières-Bailleul road, which we found being heavily shelled from both sides. The road was crowded with troops and transport moving towards Bailleul, and on enquiry we ascertained that the 34th Division was withdrawing towards Bailleul. The situation for us became very obscure, and in view of the fact that the men were with difficulty prevented from falling out from exhaustion it was decided to report at once to the C.R.E. of our Division. We arrived at St. Jans Capelle at midnight. Casualties—Capt. E. P. D. Cator killed; O.R., 3 wounded.

12. 4. 18.—Having reported to C.R.E. 25th Division, we were ordered to our Transport Lines, where men rested pending orders.

5 *p.m.*—The Company received orders to proceed and take up position on Asylum Hill, where it dug and occupied strong points, putting out wire entanglements with wire found near the position. Lieut. Ellen, R.E., was temporarily placed in charge 130th Field Company, and Capt. Musgrave, M.C., R.E., in charge 106th Field Company. Casualties—O.R., 2 wounded.

13. 4. 18.—The Company was ordered to proceed to a defensive position in front of Dranoutre, and dig in. The Company was in

support to the 105th Field Company, on the left, and the 130th Field Company on the right.

14. 4. 18.—The position was wired during the evening. 2nd Lieut. Kennedy, R.E., was temporarily transferred to 130th Field Company. Patrol work was carried out during the evening and night.

15. 4. 18.—Lieut. Saxon, R.E., was temporarily transferred to command the 105th Field Company, R.E. Position was shelled throughout the day. At about 3 p.m. hostile shelling of great intensity was observed along Ravelsberg Ridge about 800 yards in front of our position. At 3.30 p.m. British troops were observed coming over the ridge in small parties, apparently withdrawing. Lieut. Cooper, M.C., R.E., and 2nd Lieut. Rice, R.E., proceeded forwarded to ascertain situation. They found stragglers, who informed them that they had been forced back. The enemy were observed coming over the ridge in force; they also saw a party of 12 soldiers in British uniforms being marched way as prisoners by the enemy. These two officers collected a party of these stragglers and pushed forward to the foot of the hill and opened out vigorous L.G. and rifle fire on the enemy, causing heavy casualties, and then sent back for reinforcements and ammunition. The enemy in the meantime moved to the right in large bodies offering a very favourable target to the three L.G.'s with this party. Reinforcements having arrived, the remainder of this party withdrew to a position behind the railway, 300 yards in rear. The R.E. officers having reported to an Infantry captain returned to take charge of their own units.

16. 4. 18.—Our position was heavily bombarded. Our line was now apparently the front line, the troops who had been holding the position in front of us having been withdrawn. Enemy attacked our position in the afternoon, but was beaten off by artillery and rifle fire. An enemy aeroplane was brought down by our L.G.'s rifle fire and fell 500 yards to our left front. The Company formed a fighting patrol, which brought back valuable information. Casualties—1 killed, 3 wounded.

17. 4. 18.—Position heavily shelled by hostile artillery of all calibres. Enemy attacked repeatedly and succeeded in gaining a footing in farm on our right flank; we assisted the H.L.I. in ejecting him from this position. A few prisoners were brought back by the H.L.I. (one a N.C.O. wearing gray German uniform, with coloured tabs on collar and double eagle design on buttons of tunic; he carried excellent contoured maps of the locality, a Véry Light pistol, and an automatic pistol) which were taken charge of by Major Chalmers, of the H.L.I.; the Major being killed five minutes afterwards by an enemy shell, and we had no further opportunity of examining prisoners' equipment. Part of our front line became untenable, being blotted out by hostile artillery fire. Casualties—Lieut. Ellen, R.E., wounded; O.R., 4 killed.

18. 4. 18.—A quiet day after heavy early morning bombardment, snipers and M.G.'s alone were fairly active. Enemy frequently exposed himself in small numbers and many casualties were inflicted on him by our well-directed rifle fire. The companies were relieved between midnight, 18th–19th and 12.30 a.m. 19th. Casualties—1 O.R. killed, 1 wounded.

19. 4. 18.—Marched to Aragon Camp and rested, and proceeded later to Transport Lines behind Abeele.

The Company was unfortunate in losing the services of some excellent Officers and N.C.O.'s. Captain Cator was only in command for 8 days, but during that period had shewn himself possessed of great courage, energy, resolution and ability. His handling of the Company during operations was admirable. The splendid example of indomitable cheerfulness and complete personal disregard of danger shewn by Lieut. C. W. Ellen had an excellent effect on the men. Even when severely wounded he displayed the same characteristics. Sergt. H. J. Stevens (killed) and Sergt. A. Smith (died of wounds) shewed themselves worthy of the best traditions of the Corps.

TWO GERMAN BOOKS ON FIELD FORTIFICATION

By BRIG.-GEN. J. E. EDMONDS, C.B., C.M.G.

DER PIONIERDIENST IM KRIEGE MIT EINEM ÜBERBLICK ÜBER DIE ENTWICKLUNG DES FESTUNGSBAUES AUF GRUND DER KRIEGSERFAHRUNGEN,

BEARBEITET VON MAJOR TOEPFFER.

(Berlin, Mittler 10 marks).

This is not a text book of field engineering but a summary of the various activities of the German *Pioniere* (Field Engineers) during the War, with a section on the development of permanent fortification. It leaves the impression that the author was directed to write a paper on the duties of engineers in the field, founded on the German text books and memoranda issued during 1917 and 1918, for inclusion in the next edition of Field Service Regulations, Part I. As such it is a convenient record of principles that do not differ from our own. It is divided into three parts :—Engineer duties, Means of Illumination and Signal Service, and Construction of fortresses. The short introduction is worth translation in full :—

" A knowledge of engineer duties and of the work of engineer troops " should be acquired by officers of all arms.

" Engineer officers must make proposals for the best employment of " their arm to further the intentions of the commander of their formation, " and assist the troops in their execution. A knowledge of the tactics " and duties of other arms is therefore indispensible.

" Engineer companies or platoons must be employed as units (not " frittered away in small parties) and supported by working parties from " other arms as necessary.

" The preparation and execution of engineer work demand time. It " is most important therefore that requirements should be recognized " early and reconnaissances carried out, and arrangements made for " bringing up men, stores and transport in good time.

" The work that will probably be wanted from the engineers must be " borne in mind in drafting orders of march and in quartering troops."

Part I on " Engineer duties " has sections on field fortification in open warfare, trench warfare, demolitions, mining, bridging, roads and tracks, and camps and bivouacs. There is little to remark in it ; in addition to the usual matter it contains sub-sections on inundations, protection from aerial bombs and defence against tanks. As regards the second, the book says:

"Compared with artillery shell, aerial bombs strike perpendicularly, "and only the roof of a building is hit directly, although a bomb falling "near to a side may exert effect on the walls by explosive force or air "pressure. The roof must therefore be made specially thick and the "walls may be thin, though of course sufficiently strong to carry the "weight, if the roof overhangs . . . Definite data for the roof "thickness cannot be given as there are so many different kinds of "bombs."

Tank defence is divided into active defence by guns and trench mortars, and passive defence by obstacles, either natural ones improved, or minefields or craters (on roads). Under demolitions, there is a page on liquid air as an explosive. It is recommended as economical and suitable for blasting dugouts and tunnels, even in the hardest rock.

The third part on fortresses is of most interest. It commences with a good definition :—

"A modern fortress is a well prepared battle field, on which the defender must, as elsewhere, appear with considerable forces and the most up-to-date weapons." There is no fixed form; there must be the fullest use of ground and a proper tactical employment of guns and rifles.

To summarize the principal remarks :—In the first period of the war the value of fortresses was considerably under-estimated. After the fall of the Belgian and some of the French fortresses the rôle of permanent fortifications seemed played out; and this opinion was confirmed by the rapid surrender of the great Russian entrenched camps. After the fighting at Verdun judgment was revised; it was recognized that the Belgian fortresses and Maubeuge were far from up-to-date—long and short range guns, O.P.'s, searchlights and shelters were all crowded together in small forts offering splendid targets. The armour was inefficient even against the older types of howitzers, and the concrete was poor, too thin, and seldom reinforced. There were no precautions against the effect of blast and inadequate ventilation against gas. The tactical siting of the works was indifferent. The Russian fortresses were more or less out of date or not ready. They were for the most part evacuated on account of the strategic situation or of the lack of energy on the part of leaders and troops. The Italian barrier forts in the 12th Battle of the Isonzo failed because their armour and concrete were hardly sufficient, and there was no protection against gas.

On the other hand the Russians in 1914 and 1915 failed to capture the small fortress of Lötzen (in the Masurian lake district; it is the first we have heard of its action), and the small Austrian works on the South Tyrol front held out though bombarded with 12-inch howitzers for months. Verdun showed the value of permanent works when held in the battle line; they would have been easily captured if the fortress could have been surrounded.

There is no mention of camouflage in the book, and there are no illustrations.

UNSERE PIONIERE IM WELTKRIEGE HERAUSGEGEBEN AUF VERANLASSUNG DER EHEMALIGEN GENERAL-INSPECTION DES INGENIEUR UND PIONIER-KORPS UND FESTUNGEN.

(Berlin Kyffhaüser, 25.90 marks).

This much advertised book, brought out under the official auspices of the last Inspector-General of the German Engineer and Pioneer Corps and Fortresses, General-Major Marschall von Bieberstein, is somewhat disappointing. It consists of some 40 short articles by different hands, written in very popular style without technical detail, describing incidents and work in which the *Pioniere* took part, *e.g.*, the passage of the Save, Before Verdun, War Underground, Bridge Demolition, German *Pioniere* in Palestine, At Mort Homme, *Pioniere* in Attack, Gas *Pioniere*, Ancre, The Death of Bapaume. We hear, however, for the first time it is believed, of " Landing Companies." In peace time a battalion stationed in Schleswig-Holstein made a special study of, and carried out experiments with the boats, piers and other apparatus required for landing on an enemy's coast, in conjunction with the Navy. The units so trained were used on the Danube and its tributaries.

The flame-thrower, it appears, was invented 12 years before the war.

General von Telle, Ludendorff's Engineer adviser, in a preface enumerates the various branches of *Pioniere* work. He gives particular praise to the Ingenieur-Kommittee, whose title, as it sounds foreign, he translates as meaning " Engineer Experiment and Supply Office." This organization, which had a staff of " 40 officers in peace and several hundreds in war time," conducted, before and during the war, trials of inventions, etc., and arranged the supply of all engineer stores (which included signal gear and " weapons of close combat, grenades, trench mortars, etc."). He gives the following figures (apparently much lower than our own) as regards stores supplied :—13,000 electric light projectors, 10 million shovels, 1,500 train loads of cement, 600 million sandbags, 635,000 tons of barbed wire, nearly 5,000 dynamos, 80,000 Granatenwerfer, with 30 million rounds, 270 million hand grenades, 160 million firework signals.

There are 28 pages of excellent photographs depicting various engineer activities, mostly bridging : in this respect at any rate the Germans were evidently much behind us.

Bt. Lieut.-Col. Gerald Brice Ferguson Smyth, D.S.O.,
Royal Engineers.

MEMOIR.

BREVET LIEUT.-COLONEL GERALD BRICE FERGUSON SMYTH, D.S.O., ROYAL ENGINEERS.

GERALD SMYTH was, I believe, one of the most distinguished Royal Engineer officers who served in the late war, through which he survived, only to meet his death at the hands of dastardly assassins in the Cork Club on 16th July, 1920.

Smyth was the son of the late George Smyth, Esquire, I.C.S., of Milltown House, Banbridge, Co. Down, and of Mrs. Smyth, daughter of the late Thomas Ferguson, Esquire, of Edenderry House, Banbridge. He was born at Dalhousie, Punjab, on 7th September, 1885. He was educated first at Strangways Private School, going thence to Shrewsbury for two years, then to W. J. Kirkpatrick, Esquire, M.A., and the R.M. Academy, Woolwich, passing first on the list into the latter in September, 1903. At the "Shop," where I knew him as a Cadet, he was distinguished by his brain power, force of character and zeal for all things good, and although not a great player of games, was a thorough sportsman.

Smyth was gazetted 2nd Lieutenant R.E. in July, 1905, and, after the usual two years at the School of Military Engineering, went through the Railway course. He then went to Gibraltar in 1908, where he served in the 32nd and 45th Companies for five years. Here he early showed promise of his outstanding characteristics, viz.: his utter fearlessness and his deep love and care for the men under him. As an example of the former, at the first Point-to-Point race, although he had only lately arrived in Gibraltar and could have known little of the country, he took his own time and showed the way to the whole field down the most appallingly steep and stony hills. He was a bold and fearless rider and hunted regularly with the Calpe Hounds, acting as one of the Whips for several seasons. He was one of the most prominent members of the R.E. Polo Team which was fairly successful in those days. He was an ardent naturalist and lover of nature, and spent much of his time in riding and walking in the Cork Woods and hills in the neighbourhood, studying bird life, but on principle he never took a bird's egg. In order to go freely about the country he studied Spanish and became a first-class interpreter; he spoke Spanish fluently and correctly, but his slight Irish accent caused much amusement to the Spaniards. Even in those early peaceful days he showed great promise, skill

as an Engineer and boundless energy, and was universally popular, both with his brother officers and the N.C.O.'s and sappers of his Company.

On leaving Gibraltar in 1913 he was appointed to the 17th Field Company at the Curragh at the special request of the O.C. Company, with whom he had served in the 32nd Company at Gibraltar.

In August, 1914, he went to France with the 17th Field Company, and had many opportunities of showing his worth; no words can do justice to his services during the Retreat in 1914; he was the life and soul of the company, his Irish humour and pluck did wonders in maintaining the discipline of the company. He carried out a large number of bridge demolitions in the most gallant manner. On the Aisne he, with his section, were for a considerable time living in the village of Missy, then in the front line, where he assisted the Infantry in every possible way, and was awarded the D.S.O.

He was wounded and lost his left arm when putting up wire entanglements in front of the trenches at Givenchy in September, 1914. His section was caught under heavy shell fire and took refuge under a steep bank; Smyth would probably have escaped unhurt if he had not gone out to assist a N.C.O. of his section who was wounded. He was a most gallant officer and far above the average in brains, power of concentration and hard work, and care for his men.

Brig.-General C. W. Singer writes of him:—"He was up in arms at once at the smallest suspicion of injustice to those under him; the last time I saw him in the Spring of 1918 he walked about my "Armstrong" hut for an hour declaiming against what he considered the inadequate amount of leave granted to the men of the battalion that he then commanded; as he said, no private of an Infantry Battalion could count on being anything but wounded or killed in six months, and that all they had to live for was leave, and yet this was often only granted at intervals of a year or more, so that most men got none."

After recovering from the wounds which cost him his left arm, he joined the 90th Field Company in the 9th Division, and with this Division he served until practically the end of the war. I met him with the 90th Company in June, 1915, near Nieppe. They had just had a very bad shaking up, as their bomb factory had blown up and they had had very heavy casualties—5 officers and many men killed and wounded. Smyth was in command, and had his head bound up, the result of having been blown out of a window. He remained second in command of the 90th Field Company until the battle of Loos, at which the C.O. (Maj. J. D. Monro) was wounded. He then succeeded to the command of the company, and remained with it at Ypres during the winter of 1915–16 and subsequently during the Somme battle. For his services during this period he received a brevet majority.

He was wounded in the throat on July 13th during the fighting round Trones Wood, and on his return to France was selected to command the 6th (Service Battalion) King's Own Scottish Borderers, with which unit he served continuously, except when in hospital on account of wounds, until October, 1918.

He was altogether four times wounded, once most seriously, during this period, and won a bar to his D.S.O. The circumstances of his winning the bar to the D.S.O. were thus described in the *London Gazette* of 18th July, 1917:—"For conspicuous gallantry and devotion to duty. Although seriously wounded, he remained at the telephone in an ill-protected trench for many hours during a critical time to report the course of events to Brigade Headquarters. He realized that there was no officer of experience to replace him and his sense of duty may cost him his remaining arm, the other having been amputated as a result of a previous wound. He was five times wounded."

An officer who served under Smyth in the 6th King's Own Scottish Borderers writes thus of him:—"I have never met any man who made such an impression on me as Colonel Smyth, and I should have been proud and glad to have done anything for him. He is one of the few men I have met who struck me as really great, and I believe that he would have had a remarkable career if he had lived. It is of interest to know that the members of his old battalion purpose to erect a Memorial to his memory. It is melancholy to think that this is the only thing that we can now do to show our respect and affection for him. The 6th K.O.S.B. knew him as a man of proven courage when he came to command them in October, 1916. All the officers and men considered it a great honour to serve under one who had already singled himself out as a most remarkable leader. At first naturally the men were chiefly impressed by his physical courage. It was freely said that the C.O. never asked a man to do a job which he was not ready to do himself. And the greatest disgrace a man felt that he could incur was the contempt rather than the punishment of the C.O. Many men whose courage had not been above suspicion soon proved themselves to be stout-hearted soldiers under the leadership of Colonel Smyth. I know of several men whom officers had regarded as wasters, who became the most reliable N.C.O.'s of the battalion. But the men also realized that their welfare was looked after in a more thorough manner than was ever the case before. And this they all appreciated greatly; they knew that wherever they went the C.O. would not rest until he had done everything that was possible for them. Similar feelings were shared by the officers. All understood that it was their job to look after the men, but they never knew until Colonel Smyth came how very much could be done. 'Looking after the comfort of the men' was no longer a

phrase, but became a regular practice. During Colonel Smyth's absence in hospital it was easy to distinguish the officers who had been trained under him. Those of us who were most closely associated with him admired perhaps most of all his moral courage. He was never afraid to risk a rebuff from his superiors if by his action he could help his battalion. One instance among many will illustrate the point. After a battle near Arras on the 12th April the battalion was holding a reserve line of trenches at the Point du Jour. The shelling was intense and caused us numerous casualties. Colonel Smyth was convinced that there was no necessity to hold these trenches at all and he importuned the Brigade until he received permission to withdraw his men to a safer place. Two other points about Colonel Smyth we often remarked on. None of us had ever met a man who could pick up the lie of a country with such amazing facility, and in a battle his grasp of a situation was so clear and quick that it seemed to us almost uncanny.

"We all recognized that he would have risen to the top in whatever profession he entered. That much-abused phrase 'magnetic personality' was rightly attributed to him."

In October, 1918, Smyth was promoted to command the 93rd Infantry Brigade, 31st Division, and remaind with that formation until it was disbanded in 1919.

He then went for a year to the Staff College and on the completion of the course went to command the 12th Field Company at Limerick. He had by this time attained the rank of Bt. Lt.-Colonel. I think he was happy at Limerick, though the peace command of a Field Company must have been a dull occupation for one of his ardent nature; still he was in his own country and could hunt, which meant a great deal to him. While serving at Limerick, he was offered and accepted, a few months ago, an appointment as Commissioner of Police in the province of Munster. His duties being connected with the pacification of the country, and stopping the apparently organized system of police murders which had grown up. Here he had full scope for his great energies and, as the sequel seems to show, proved himself to be an inconvenient adversary to the malcontents in Munster.

He was in London about the 12th July, on duty connected with his work, and that was the last time I saw him alive. Apparently he had been accused by some of the Irish papers of ultra-energetic action of which he was emphatically cleared by the Chief Secretary for Ireland in the House of Commons. He told me, however, that he found the work much more nerve-racking than the war and concluded by saying that he did not think his life was worth five minutes' purchase.

He returned to Ireland from London on Thursday, the 14th, and was murdered in cold blood, in the smoking room of the Cork

Club, on the evening of Saturday, 16th. This is a thing concerning which his friends can with difficulty write temperately. That he died a soldier's death just as much as if he had died in battle, and that his death was directly due to his devotion to his duty to the King and Empire, is incontrovertible; but it is hard to bear when such a man is called upon to meet such a death.

Sir Hamar Greenwood writes:—"Although my personal acquaintance with the late Col. Smyth was limited to talks I had with him a few days before his death, I can assure you that I share your admiration of his sterling qualities.

"He impressed me greatly by his splendid courage and strong sense of duty. The Irish Government recognized him as a brave and capable officer of the Government, and I, personally, deeply deplore his loss."

Smyth's record of service is as follows:—2nd Lieut. R.E., July, 1905; Lieut. R.E., July, 1908; Captain R.E. October, 1914; Bt. Major, June, 1916; Bt. Lt.-Colonel, June, 1919; Acting Lt.-Col. commanding 6th Bn. K.O.S.B., December, 1916; Tempy. Brig.-Gen. Commanding 93rd Infantry Bde., October, 1918. He was wounded five times—25th October, 1914 (lost arm); 13th July, 1916; 9th April, 1917; 3rd May, 1917; 23rd March, 1918.

His war honours were as follows:—Mentioned in Dispatches, 19. 10. 14; D.S.O., 11. 11. 14; Dispatches, 17. 2. 15; Brevet Major, 3. 6. 16; Dispatches, 1. 1. 16; Dispatches, 15. 6. 16; Bar to D.S.O., 18. 7. 17; Dispatches, 18. 5. 17; Dispatches, 23. 12. 18; Dispatches, 5. 7. 19; Bt. Lieut.-Colonel, 3. 6. 19. He also received the French and the Belgian Croix de Guerre A glorious record, truly.

After the murder in Cork there seems to have been some difficulty in transporting the body to the North of Ireland for burial, as no driver could be found who would drive the train. However, motor transport was provided as far as Dublin, and the rest of the journey to Banbridge was carried out by train.

The funeral was largely attended. It was carried out with full military honours, a firing party of 100 men with band being furnished by the Bedfordshire Regiment. A large detachment of the Royal Irish Constabulary also attended. The following officers, amongst others, were present:—Major-General H. H. Tudor, C.B., C.M.G., lately commanding 9th Division; Brig.-General Sir Hacket Paine, K.B.E., C.B.; Major Leather—representing Brig.-General Carter Campbell, C.B., D.S.O. Amongst the flowers sent were wreaths from the Royal Irish Constabulary, Officers 17th Infantry Brigade, and Royal Engineers, Cork. The route to the cemetery was lined with thousands of sympathisers

Such is the record of Lieut.-Colonel Smyth's public life. It is permissible, however, to say a word about the man. I knew him as a boy at the "Shop" and served with him afterwards both in

peace and in war. He was a peerless soldier, in every true sense of the word, and the *beau idéal* of a British officer. He was a tiger in battle, but withal the most human and sympathetic of men. Some of his greatest friends were children, and his life was as simple as a child's. His courage was of an unequalled variety. Physical fear he did not recognize but it was his moral courage that was his greatest ornament. He feared no man in standing up for what he thought was right and true; and hypocrisy was his horror. You could always count on Gerald Smyth telling the truth, no matter how unpleasant, without dismay to anyone, whether above or below him. His regard and care for those placed under him was pathetic: I wonder if they ever realized how much their welfare meant to him?

The memory of such a man is a priceless thing—we older people have not long to follow his example, but, to the rising generation, that example of fortitude, of honour and of truth, is of more value than many exhortations.

G. WALKER.
Brig.-General.

REVIEWS.

A SHORT HISTORY OF THE 6TH DIVISION.
AUGUST, 1914—MARCH, 1919.

By MAJOR-GENERAL T. O. MARDEN.

The title is somewhat of a mis-nomer. "History" it is not, at least as generally understood, but as a brief narrative of events this little volume will serve the purpose of its author, which is, as he explains in his preface, "that all who served with the Division for any period between 1914—1919 may have a record to show that they belonged to a Division which played no inconspicuous part in the Great War." In the 80 pages of the narrative are crowded the events of five years, so that many minor events, full of interest to those who took part in them, are necessarily omitted or only just mentioned; but where General Marden has allowed himself a somewhat fuller scope to his descriptive powers, and to give some little detail, the relation is so crisp and clear that one can only regret that he was not rather more ambitious and had expanded his work to greater dimensions, accompanying it with some detailed maps. Let us hope he may do so later, for it is only by such "sectional" histories that the true history of the conduct of the war in detail can be really learnt. No doubt official and other comprehensive histories will appear, but to the normal brain they will contain so much extraneous matter that the details of how a division carried out the various duties entailed upon it will be lost to the student of after-times and remain buried in immense masses of general information. The 6th Division, like all the Old Army Divisions, was essentially what may be termed a "County" regiment unit, with a leavening of the Rifle element. It carried no glamour of overseas or special national characteristics, and its history is typical of many others, which, not appealing to the general public by dint of newspaper reporting, nevertheless inspired in their members and in those Higher Units under whom they served, a quiet confidence in their adaptability, steadfastness, resourcefulness and discipline. Launched in the War, under commanders and staff second to none, the division maintained the high reputation it gained in the early phases. Perhaps the most trying period of all for the division was that in the Loos salient, and it speaks volumes for its efficiency and morale that so shortly after its experiences there it should have been selected to take part in the Cambrai attack. During the whole of the time it was in front of Lens the main object of the Army and the Corps appeared to be to secure and hold Hill 70 by means of a battalion attack. Time after time did the 16th Brigade secure the

objective only to be driven out by a concentric fire of most powerful hostile artillery from the North, East, and South. Four battalions supplementary to its own four were passed through the 16th Brigade for this purpose and large casualties were incurred; no doubt the object, to turn the enemy out of their post of observation, was highly important, but throughout the small local attacks is illustrated the impossibility of holding a very limited objective in the face of heavy artillery concentration. This division learnt that fact at Hooge and truly it was a case of "theirs not to reason why." One could wish that General Marden had expanded a little over our Territorial Units which joined about December, 1914. How thoroughly and warmly they were welcomed all who were there at the time can remember, and their keenness and soldierly qualities from the earliest days of their arrival cannot be too highly praised. Experience gained of them at that time was of much value to those connected with them in later stages of the war. Not the least interesting and useful portion of this little volume are the Appendices. The Battle Casualties, List of V.C.'s, Diary, Order of Battle at different periods, and changes in Commands and Staffs. A perusal of the volume leaves the impression that the 6th was an essentially "happy" Division. It certainly was during the early period; at a time when much was new, much had to be learned, when our needs were greatest, the junior ranks knew that those above them had a true appreciation of their welfare and shared their dangers and their troubles. So may it always be.

G. C. KEMP.

THE CHEMICAL ANALYSIS OF STEEL WORKERS' MATERIALS.

By F. IBBOTSON, B.Sc., F.R.Sc.I, etc. (Longmans, Green and Co.) is intended chiefly for the use of the chemist, and deals with the quantitative analysis of iron and steel, steel making alloys, ores, fuels, slags, and of refractory materials.

H.L.L.

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1920.

"The Year-Book of Wireless Telegraphy and Telephony" for 1920 has been published by the Wireless Press, Ltd., within the past few weeks. The volume is the eighth annual issue of the well-known handbook, and fully comes up to the high standard of its predecessors. In order to keep the volume within bounds, as regards bulk, much of the matter contained in the current issue has been printed in smaller type than that used in the case of the earlier issues—at the same time some rearrangement of its contents has also been carried out. A considerable amount of new matter appears in the current issue, but the size of the handbook has not been increased in consequence; indeed, the Year-Book for 1920 contains 15 pages fewer than last year's issue. The volume under notice contains 33 excellent photographic illustrations of wireless

apparatus and plant; in several of these illustrations valves, as might be expected from the important part they play in wireless telegraphy and telephony now-a-days, occupy a somewhat prominent position. So far as its contents are concerned, the range of subjects dealt with in the volume for 1920 remains practically the same as that in its immediate predecessor. The notes dealing with the Record of the Development of Wireless Telegraphy have been brought up to date. The year 1919, it is pointed out, brought forth no revolutionary changes in the field of radiotelegraphy: it has constituted a transition period from war-time activity to a return to conditions of ordinary commercial work. This feature of the wireless situation has been more or less reflected in the many papers dealing with wireless matters which have been read before the various Societies and Institutions. In the Section of the volume dealing with National and International Wireless Laws and Regulations the most noticeable feature among the changes introduced consists in the sketch maps of the various countries referred to in this Section. These maps show the positions of the wireless stations in each of the countries, the distinctive character of the stations indicated on the maps, *e.g.*, in the case of Great Britain the stations are indicated as belonging to one or other of the following categories, (1) Public correspondence with ships; (2) Naval Official Traffic or Government Traffic; (4) Direction Finding Service; (5) Transocean Public Services; (6) Experimental stations or Instructional stations; (8) High power special service to ships (Transmission) only; (9) Lightships; (11) Private stations; (12) Under construction; and (13) Aviation station only. These maps undoubtedly add much to the value of the information contained in this handbook. The amount of the information contained in this Section of the volume shows a growth in relation to that published in the issue for 1919. This increase is due to two causes; first there is the inevitable new legislation, etc., in the countries concerning which information has been given in preceding volumes, and, secondly, there are the laws and regulations in force in various parts of the world, not included in previous issues, *i.e.*, laws, etc., which now appear in the handbook for the first time. The additional information included in the case of Great Britain comprises the Air Navigation Regulations, 1919; the Circular to Owners and Masters of British Merchant Ships issued in November, 1919, by the Admiralty relaxing the restrictions on the use of Wireless Telegraphy; the Merchant Shipping (Wireless Telegraphy) Act, 1919; and an extract from the Convention relating to the International Air Navigation (1919). Among the parts of the world which find mention in this Section for the first time are:—Ascension Island, Bolivia, Cocos-Keeling Island, Costa Rica, Crete, Cyprus, Korea, Liberia, Malaya, Poland, etc. The lists of Land Stations and Ship Stations have been brought up to date, and the notes, which in former issues were printed at the ends of these lists, have been brought up and are now placed against the appropriate stations in a Column of Remarks, thus making the notes more convenient for reference purposes. Again, in many cases in which the ranges of stations were omitted (no doubt designedly) in last year's issue the blanks have been filled in with the required data. The steady growth in the numbers of the stations is

evidenced by the increased numbers of pages devoted to this Section of the volume: the Land Stations occupied 65 pages in the volume for 1919, they occupy 85 pages in the current volume; the increase in Ship Stations is very marked, the number of pages devoted to them has gone up from 159 to 232. The scope of the Section dealing with International and Weather Signals has been somewhat widened; it has in consequence been re-named and is now designated the Meteorological Section. This Section contains two articles of considerable interest, viz:—(a) "Radio-Communication and Meteorology," by Lt.-Col. E. Gold, D.S.O., F.R.S., and (b) "Wireless and Time," by Arthur R. Hinks, M.A., F.R.S. The remaining part of this Section deals with International Time and Weather Signals and describes the arrangements current in relation to these matters in various countries. A new feature in the current issue of the handbook, and one which adds much to the interest of the volume, consists in the enlargement of the Special Articles Section by the inclusion therein of National Resumés containing an account of the Technical Progress made in Radiotelegraphy in certain countries during 1919. The countries dealt with in the volume for 1920 are:—France, Germany, Great Britain, Holland, Italy, Japan, Norway and the United States of America. The General Articles in this Section are five in number, and are of the same high standard and equal in interest to those contained in previous issues. The subjects dealt with are:—"The Progress of Wireless Telephony," by W. T. Ditcham; "Valve Amplifiers for Shipboard Use," by F. P. Swann; "Wireless Telephony and its Application to Aircraft," by Major C. E. Prince, O.B.E.; "Direction Finding," by G. M. Wright; and "The Berne Bureau." In the Patent Section is contained a most valuable summary by I. Shoenberg of the Valve Patents for 1919. Tables are also given of British Patent Specification relating to Telegraphy published during 1919; a name index to the British Patents published during 1919; and two similar tables relating to the U.S.A. Patent specifications. By way of innovation there has been added an Aviation Section; it contains (a) an article entitled "Radiotelegraphy and Aviation," by Major Robert Orme, B.A.; (b) a tabular list of Aviation Stations; and (c) miscellaneous items of interest. The Useful Data Section has undergone contraction. The Editor points out that the general increase of matter renders it impossible to continue the development and expansion of this Section. In consequence, in order to meet the phenomenal growth of the radio art, a separate volume has been compiled and is being published by the Wireless Press, Ltd., under the title of "Standard Tables and Equations in Radiotelegraphy," a title which is descriptive of the contents of the publication. The portions of the Section dealing with Wireless Terminology and General Information are included in the volume; many new definitions appear under the heading "Wireless Terminology." The value of the Literature Section has been much enhanced by the re-arrangement which has been introduced in the current issue. The matter contained in this Section is now arranged under three heads:—(a) New Books published in 1919; (b) Resumé of Articles published in 1919; and (c) Standard Publications on Wireless. As in former years, so in the case of the current issue, much useful information is given in

relation to the Companies engaged in the Commercial Development of Wireless Telegraphy. Further, the Biographical and Code Signal Sections are also included in the volume as in past years. It will be apparent from the foregoing brief review of the contents of the Year-Book for 1920 that the volume is indispensable to those who are interested in Wireless Telegraphy and Telephony, whether as a hobby or commercially or officially.

W. A. J. O'MEARA.

NOTICES OF MAGAZINES.

THE MILITAR-WOCHENBLATT.

No. 113.—*The Strength of the German Army.*—The leading article consists of an argument to prove that the German Army should not be less than 200,000 strong. It is stated that this number was just, and only just sufficient to prevent a complete collapse during March, and this in spite of the fact that Berlin and the whole of Bavaria remained comparatively—and very fortunately—fairly quiet, and also that the auxiliary forces were still in existence and helped to maintain order. Further arguments are that Foch himself favours 200,000, knowing that such a number need cause no anxiety to France and that with less the fulfilment of the Treaty would be impossible; also that the flooding of the labour market with 100,000 demobilized soldiers and 15,000 naval troops of thoroughly unreliable and self-seeking moral would be disastrous under the present conditions of German economic life. Surprises may be expected from the East, and it must not be forgotten that in Berlin alone there are 63,000 Russians, disciples of Bolshevism; and what will happen when Germany joins the League of Nations and is called upon to take action on its behalf? Conditions now are quite different to those in force when the Treaty was drawn up and unless the *Entente* wishes to see all European culture fall a victim to Bolshevism, it will have to leave Germany her 200,000 strong army. It must be admitted that a strong case is made against a further reduction, and the outcome of the Spa conference seems to show that it is so recognized. At the moment the references to action on behalf of the League of Nations, presumably against the Bolsheviks, appear to have a prophetic ring about them.

The Genesis of the Battle of the Marne.—General Le Gros' book is hailed as one of the few emanating from French sources which treats this much-discussed campaign in a professional manner. The others, it is said, handle it either with a view to propaganda, or as a romantic miracle. Its favourable reception is perhaps due to the fact that it gives more credit to Galliéni, who is dead, than to Joffre, who lives; or to the English Army, which also lives.

The Fulfilment of the Turkish Treaty.—The difficulties of the *Entente* in view of Mustapha Kemal's nationalists are discussed. Kemal will, the *M.W.B.* thinks, take to guerilla warfare in the interior of Asia Minor and become a thorn in the flesh of the *Entente*.

The Belgian Garde Civique in 1914 is another "hate" book which throws all the blame for the Belgian atrocities on the Belgian Government. It is probably intended to take effect in the forthcoming Leipzig trials of war criminals.

No. 114.—*The March on Paris and the Battle of the Marne,* 1914.—Generals von Hausen and von Bulow have already published their accounts of the actions of the 3rd and 2nd Armies in 1914, and now we have by von Kluck his account of the 1st (right flank) Army in "The March on Paris and the Battle of the Marne (1914)." It is based on reports written in the winter of 1914, when the memory of events was still fresh. Von Kluck begins with an account of how he passed his 5 corps through the defile between the Dutch frontier and the 2nd Army; no easy task, and one only accomplished by much careful staff work. After the fall of Liége he was placed under the 2nd Army and found this inconvenient though necessitated by the inaccessibility of G.H.Q. at Luxembourg. Another circumstance which made his task harder was the ignorance of G.H.Q. as to the moment when the British forces would make their presence felt. After the fight at Mons and during the subsequent following up of the British Army, he had indifferent help from G.H.Q., whose orders were seldom clear and sometimes contradictory, but the steps taken to meet the threat from Galliéni and Maunoury had placed him in the best of positions when "Fate in the person of Lieut.-Colonel Hentsch brought orders from G.H.Q. to break off the fight and retire." Von Kluck personally neither saw nor spoke to Hentsch. The riddle of the Marne is apparently but little nearer solution. Hentsch based his decision on the situation of the 2nd Army, but von Bulow has already stated that he was anxious not about his Army but about that of von Kluck. It is extraordinarily unfortunate, that the one man in whose hands these so far-reaching decisions lay, should have died without, it appears, ever committing to paper a record of his decisions and the considerations which influenced him.

The Legend of the Superiority of the French Artillery in the War is declared to be based on what von Tirpitz calls "That trait in the German character which always belittles whatever is German, and delights to look on the worst side of things." The writer seeks to prove that the German gun was better by stating that in August, 1914, a detachment of German gunners, after examining a captured French gun, declared that they preferred their own. It would have been extraordinary if they had not done so.

Military and Political Events in the Anglo-Asiatic Empire.—This is an account of the proposed re-organization of the Persian forces, which states that the greed, laziness, and conceit of the Persians will make the English task a difficult one. England, however, will spare neither men nor money to erect a buffer State on the "glacis of India" to withstand a resurrected Russia.

Seaweed as Forage for Horses.—A brief account of French experiments in the use of seaweed as forage for horses is given. Apparently horses in light work could be kept going on a ration of three parts seaweed to one part oats, the seaweed being specially washed and dried before use.

No. 115.—*The Military and Political Situation in the World.*—Comments on the Polish operations lead to a comparison between German Poland in pre-war days and Ireland as at present. The British Government is looked on as a model of determination and firmness and regret expressed that Germany treated her Poles with such excessive moderation and weakness in the days before the war. The condition of the French Army is stated to be far from satisfactory. In spite of talk, very little has been done to make conditions of life for the French officer and particularly for the married ones at all bearable, and large numbers are stated to be leaving the Army for civil life whenever they get a chance.

The German Retreat in 1914.—Lieut.-General Tappen, who was Moltke's Director of Military Operations Branch of the General Staff, attributes the failure, as usual, to the lack of the two Corps which had been withdrawn from the right wing for Russia. He adds, however, that it was at that time the intention to withdraw 6 Corps, 2 from each wing and 2 from the centre, and that the 2 from the right wing were only the first instalment. The others were, however, never taken, owing to the unfavourable situation which developed in France. The position of G.H.Q. is also blamed. Tappen says it should have moved from Coblenz on the 25th August, and not have waited till 30th, and when it did move it should not have gone to Luxembourg, but to Charleroi, or at any rate have sent an advanced echelon there. He attributes the lingering in Luxembourg not only to the technical difficulties in moving G.H.Q., but also to "a certain sluggishness" that apparently existed.

Hatred of Officers.—This is apparently still being stirred up. By pamphlet and cinematograph the officer is held up as an object for scorn and hatred, and no abuse is too vile to fling at him, in spite of the fact that he bore during the war a quite disproportionately heavy share of the casualties.

No. 116.—General von Hausen, who commanded the 3rd Army, gives some interesting comments on Tappen's book, mentioned in No. 115, and discusses in some detail the orders given to the 11th Corps for its move back to Malmedy on the way to Russia. These appear to have been curiously inexact and, like so many of the more important orders given by G.H.Q., to have left a great deal of latitude to the subordinate commander. Probably the strict uniformity of German training and doctrine obviated the dangers which from such latitude might otherwise be expected to arise.

No. 117.—*Strength of the German Army.*—Further arguments in favour of a stronger army than the 100,000 men hitherto decided on are given. Austria with six million inhabitants has a 30,000 strong army, but Germany, with sixty million, has not 300,000, but only one-third of this number. Quite apart from the unsettled internal conditions of Germany, the increased length of her land frontiers demands an adequate army. Before the war she had 1,000 kilometres of Eastern frontier, well fortified and often defined by well-marked natural features with a properly organized railway system behind them. Now she has 1,500 kilometres of undefended frontier, drawn without regard to natural features, and naturally finds her railways no longer appropriate to their defence.

Consideration of the present situation in Eastern Europe leads the writer to demand a minimum of 300,000 men if Germany is ever to be in a position to pay, by her steady labour, the enormous damages levied on her.

Bestiality in the War.—Another series of the pamphlets alleging cruelties of all kinds on the part of the French towards German prisoners of war appears; also one entitled "England's crimes at sea." The purpose of the books is, of course, to prejudice the Leipzic trials.

No. 118.—*The Organization of the new German Army.*—The writer points out that quite apart from the insufficiency of the numbers allowed (100,000 men) the organization is quite inappropriate to the most probable tasks which this army will have to perform. It is at present divided into 7 Infantry Divisions (*Reichswehr* Brigades) and three Cavalry Divisions. The Infantry Division has 9 Battalions, one squadron and 9 batteries, besides a pioneer battalion of 3 companies and a bridging company. The addition of Army troops in the shape of Heavy Artillery, aeroplanes, anti-aircraft defence and railway troops is urgently required. The mere doubling of 100,000 will not meet the case, and internal defence cannot be assured unless the correct organization is allowed. This, the writer thinks, should take the form of 4 Corps, 12 Infantry Divisions, 3 Cavalry Divisions, and 5 Mixed Brigades with appropriate Army Troops as above mentioned and, for the present at any rate, some special frontier brigades as well.

With Field-Marshal von Mackensen from Bukarest to Salonica describes how the veteran Field-Marshal was taken near Budapest on his way back from Roumania in November, 1918, and sent down to Salonica "at the instance of the French, who, finding they could not conquer him in honest warfare tried to arrange it that he should die of fever in Salonica."

L. CHENEVIX-TRENCH, *Major, R.E.*

REVUE MILITAIRE GÉNÉRALE.

March, 1920.

EXTRAPOLATIONS.

(This article is headed by an Editorial note disclaiming responsibility for the opinions expressed, and hoping they may lead to useful discussion).

It is somewhat presumptuous to attempt to determine the form that the battles of the future will assume, by prolonging, with suitable interpolations, the curve of determined results, but our deductions may not be without use. Recent writings have drawn attention to the scientific evolution of warfare, and the military organization which may result from it. Many of our arguments are borrowed from the Navy, which is the child of industrial art, and has evolved with it. The probable aspects of war, tactical and strategical, will be studied; the military organization which may be the result is only touched upon.

The superior arms are first considered. By this term is meant those the evolution of which has affected the tactics of all the other arms

The arms will be taken in the following order:—aviation, the artillery of attack, artillery, fortification, infantry, cavalry.

Although aviation was not the decisive arm in the late war, time for its development being wanting, it may end by proving its superiority over all others. So far the only other arm which has avoided its attentions is the submarine. Aircraft are incontestably superior to all terrestrial appliances, combining as they do power of fire and mobility. They must submit to the same laws as the other arms in that they must engage a similar arm on the side of the enemy, and must also act intimately with the other arms of their own side. The mastery of the air depends almost entirely on the superiority of the chasing aeroplanes, and on its acquirement depends all the other duties of aircraft. Mastery of the air alone ensures concealment of one's own movements, and usurps one of the functions of cavalry.

Bombardment of the rear areas has its uses, but at the moment of attack it would be preferable to combine all arms, including aviation. If this is not possible during the artillery battle, aircraft must be brought up directly the infantry advances. Insignificant obstacles often stop the progress of infantry, and it is allowable to hope that aerial bombardment may dispose of these. Besides aerial bombardment may take the place of all heavy artillery fire, the high cost of the machine, and the imprecision and intermittence of its fire being the only arguments so far against its use.

Aeroplanes are now commonly used for transport, but their capacity is so restricted that for many years to come they are not likely to be much used except for carrying bombs, and airships are too slow and unwieldy.

While now the freedom of the seas is being bitterly discussed, there may come a time when the freedom of the air may become a more intolerable tyranny. The British air service is now the finest in the world. Confusedly, no doubt, England recognizes that she can only reign at sea so long as she can reign in the air. It is difficult to forecast what submarine navigation may develop into, but in this may be found the means of controlling the all-powerful British air-power.

It is possible that the aerial army may triumph over all terrestrial methods of attack and defence, and become the exclusive arm of the future. At present its radius of action is too restricted, nor can it ensure the possession of the ground it dominates; still, it might deal such a blow on a vital point as to oblige an enemy to capitulate without any necessity for occupying his territory.

Attack artillery has been one of the elements of victory, and foremost comes the tank; still it must be remembered that aviation will rapidly develop commercially, while attack artillery can only evolve slowly. The tank may replace infantry; it has all the mobility and power of resistance of the latter, and perhaps greater destructive power. The employment of masses of tanks may be foreshadowed; even duels between opposing fleets when, owing to unfavourable weather, aircraft and artillery cannot participate. Comparison with naval engagements is not quite possible; tanks can obtain cover from ground which is not

possible at sea. Motor-drawn guns could intervene with effect if, already possessing superior speed, they are of larger calibre, unless the tanks are sufficiently armoured. Aircraft are a formidable antagonist to the tank, and duels between them may be expected.

The tank is reproached with being unable to secure possession of conquered territory, but in a war of movement it would appear to be as capable as infantry of doing so, on condition that it can conceal itself and always be ready for action. Tanks must be of different design for various duties. Against fortified positions the light tank showed its superiority, since its worst enemy at that time was artillery firing direct, and it offered a small target, but to meet large heavily-armed tanks similar vessels of high speed will be necessary. The greatest obstacles to tanks are water courses, and tanks must be accompanied by bridging material.

Artillery perhaps received the greatest attention during the war and its proportion to the other arms, and its calibres, increased. Gas shells were used against troops. It is possible that bombing aeroplanes may replace the costly heavy artillery, and tanks or similar engines and fighting planes will use the medium and small calibres. Against fortified positions artillery will be largely used, but must be of great mobility, and the difference between artillery as at present carried, and the tank, will continually decrease. Anti-aircraft guns will also be requisite. Artillery has for the present proved its superiority to fortifications. Tanks have made lines of trenches obsolete. Natural obstacles such as mountains and rivers will form the framework of future fortifications, but such positions can be reduced by appropriate bombardment.

This is the era of machinery, but machines are costly, and subject to continual improvement. Will a false security be sought in fortification, which also to be of use must be kept up to date? It would be better during peace to spend the money on engines of war, and to construct the fortifications in time of war. Probably permanent fortification will be confined to the minimum imposed by the necessity for protecting the war machines in subterranean shelters, since in the future aircraft will be the arm of surprise.

While the strength of armies has increased during the war, the proportion of infantry has decreased. At this date the foot-soldier only occupies the ground; he does not conquer it. In the age of the sword infantry fought in masses; on the introduction of fire-arms he extended in line, and now he fights in extended order and must have cover. Trenches have taken the place of rifle-pits, mining is almost impossible. Man cannot fight against machines. The weight of material he must carry is excessive, but during the last war rapid transport for him from place to place was found necessary, and fitness for marching was a secondary consideration. Certainly in future rail and motor transport must be provided for the infantry.

In old days the cavalry decided the battle; rifle fire has converted it into mounted, *i.e.*, very mobile, infantry. Other more rapid means of conveyance are used at the present day, and the air service has taken

the place of cavalry in reconnaissance, the more so as it cannot be held up by parties of infantry. The day of cavalry is over; pursuits will be carried out by tanks to break up resistance, with the higher-paced armoured car and lorries with materials for surmounting obstacles, motor-drawn guns, and infantry in motor vehicles, connection, and perhaps supply, being maintained by aircraft.

Science has also improved methods of communication and other services. The proportions of the various arms will alter as science advances, and generally in favour of the superior arms.

Aircraft being the most mobile arm, overwhelming attacks by them may be expected directly hostilities are declared, but the enemy aerial army conquered, the question will not be entirely settled until the air service has acquired complete supremacy over the other war machines. The shock of the land armies will come later, and in it the aircraft will participate. A decision once obtained will be more complete than of old; machines can be replaced less easily than men. Naval battles present an analogy. Future wars will be more rapidly launched, and more promptly terminated.

This scientific conception of war brings into prominence the strategic unity which ought to exist between all operations, aerial, terrestrial, and marine.

As victory should incline to the nation which possesses the most modern and numerous machines, preparation for war will demand great sacrifices. Armaments may be limited tacitly or by agreement, but even total disarmament will not guarantee peace, as commercial machines would be brought into use. But the more scientific engines of war become, the more they differ from the similar appliances of peace, as exemplified by the battleship. Progress leads to specialization, and the modern army will have to be professional if it is to make the best use of its machines, but can be of reduced numbers, owing to the scientific appliances with which it will be equipped.

Transformations in the German Army

(From 11th Nov., 1918, to 11th Nov., 1919).

The Reichswehr.—The support of the volunteer corps enabled the Government to pass victoriously through the troublesome period following the revolution of November, 1918, and gave the idea of voluntary recruiting tempered by selection. The Reichswehr is organized on the model of and retains the personnel and traditions of the old army. In the press of the extreme left, *Die Freiheit*, 5th April, 1919, this is fully brought out. Briefly it states:—"The army is the direct continuation of the old army; it is the consolidation of re-action and of the counter-revolution, and a provocation to the proletariat." The German Government has done its best to hide this fact from foes at home and abroad, and the task has been rendered more easy by the curbing of the Spartacists, and dissensions among the Allies.

The Act creating the Reichswehr came into force on 6th March, 1919. The force was to consist of two categories (i) The Reichswehr properly

so called, comprising *Reichswehr truppen* (the large territorial commands) *Gruppen truppen* (not brigaded) Mixed Brigades, heavy or light, and (ii) the *Volkswehren*, intended to maintain public order, but attached to and under the same regulations as the *Reichswehr*. Recruiting was to be regional. The initial proposal prescribed 18 brigades (6 heavy, 12 light) organized in 2 *Gruppen kommandos*, a total of 241,000 men, At first matters progressed slowly, but from May to October progress was more rapid and continuous. In the latter month the *Reichswehr* consisted of 450,000 men, or 43 brigades (23 heavy, 20 light) organized in 4 *Gruppen kommandos* comprising also *Gruppen truppen* of unknown quality and numbers, and bodies of *Volkswehr*.

Tables are given showing the composition of the 43 Brigades. They are practically divisions at reduced strength, and could quickly be put on a war footing as such, since the staffs of formations have been retained. The depots, demobilization centres, etc., of the old army are also still in existence. Officers are still being appointed, not to fill vacancies, but as a reserve, lieutenancies being granted to senior N.C.O.'s to give the force a veneer of democracy.

The students of the universities are generally pan-Germans and militarists, and provide useful recruits for the N.C. and commissioned ranks.

A table of pay and allowances shows that a soldier with three children and ten years' service would receive 5,000 marks a year in addition to food and quarters. Leave is at the rate of 15 to 35 days a year according to length of service.

In place of soldiers' councils, confidential agents (*Vertrauens leute* are elected by the secret ballot of their comrades and delegated to the next higher unit, and so on, up to and including the War Ministry. Their powers are strictly limited, and do not embrace interference with the command, but are confined to questions of interior economy, and on the whole strengthen the bonds of discipline by providing the commanders with a means of probing the feelings of their subordinates. Sports of all kinds are encouraged. The result is that the *Reichswehr* has a military value scarcely inferior to that of the pre-war army.

In August, 1919, the War Minister ordered the reduction of the *Reichswehr* to 225,000, organized in 20 mixed brigades. This was a mere blind ; by that date the reserves were well organized, and repatriated prisoners were about to arrive. The brigades were distributed in 7 *Wehrkreise*, replacing the suppressed Army Corps regions, grouped in 4 *Gruppen kommandos*. Even this reduction was deferred on various pretexts, and on 11th November, 1919, the *Reichswehr* still comprised about 30 brigades (say 450,000 men) composed of the best of the 43 original brigades, the remainder being re-named *Überplan mässig*, and to be retained until 1st February, 1920. The new organization is therefore not a reduction, but a distinct step towards the consolidation (*i.e.*, Prussianizing) of the Army. Also to the Minister of the Reichswehr has been delegated the supreme command of the land and sea forces.—(*To be continued*).

GERMAN OPINIONS ON THE WAR.—DEDUCTIONS FROM THE WORLD WAR. By Lieut.-Gen. von Freytag Loringhoven, translated by M. Forget, and continued from the January number.

It must be allowed that if trench warfare assumed such importance in this war it was due to the ineptitude of our enemies, and had the contending forces been equal in efficiency it would have been impossible for us to have maintained our position so long, owing to their numerical superiority. They should have been able to ensure a war of movement, but failed to do so, and our weakness in numbers prevented us from advancing. All we could do was to forestall the enemy's attacks in some cases, as at Verdun, and in the Venetian Alps, but generally the initiative was with our foes.

A method we adopted to give some appearance of manoeuvre to the struggle and to save losses among our troops, was to allow the enemy to penetrate our lines on narrow fronts, and then repulse him with reserves collected in rear, but owing to our lack of artillery the procedure could not be applied on extended fronts. An essential condition for success was the presence of sufficient reserves for the counter-attack, and if the latter had failed on a wide front it would have entailed the abandonment of large tracts of enemy territory, and we could not afford to forego the industrial riches of the North of France, or risk the bad moral effect of such losses. Our withdrawal from certain sections of the front near the Ancre, Somme, and Oise at the end of the winter of 1916–17, was only made when the general situation had been considerably modified and stronger and more favourable positions had been prepared in rear. It resulted in a surprise, and considerable losses, to the enemy, gained us time and greater security, and prevented waste of strength.

Arguments follow, drawn from the writings of Frederick the Great and Napoleon, justifying a resort to field fortification as a means to conservancy of force in certain circumstances, but it is not intended to imply that trench warfare will necessarily play such an important part in future wars. A war can only be won by beating the armed forces of the enemy, but may be distinguished by many of the characteristics of trench warfare, and owing to the necessity for bringing into action the numerous appliances now obligatory, will be a slow process. For a struggle of this nature the German training is exactly what is required, and is in fact superior to that of all other armies. Moltke wrote that a strategical offensive may well be combined with a tactical defensive. If in 1870 the Germans always took the offensive, and captured the enemy's strongest positions, it was at the price of severe losses. It may be wiser not to attack until several enemy attacks have been repulsed.

The fundamental ideas of warfare as held prior to 1914 should be retained, but improved by the experiences of the late war. Perfection may be reached for, but is never attained. So the recent lessons must not be given weight out of proportion to those of earlier wars. It must be remembered that the campaigns on the East and West fronts were entirely different. Although Napoleon said that for a commander to achieve success he ought to change his tactics every ten years, a leaven of conservatism is desirable in military progress, which should proceed gradually, and not by leaps and bounds.

A. R. REYNOLDS.

RIVISTA DI ARTIGLIERIA E GENIO.

April—May, 1920.

MAGNETIC-MECHANIC ANALYSIS OF IRON AND STEEL.

Up to the present time the methods largely in use for the analysis of the characteristics of iron and steel (chemical analysis, micrographic, proofs of hardness, resistance to strain, etc.) have been limited to a small portion of the material under examination. It is now reported in the *Ingegneria Italiana* that a rigorous scientific method has been adopted based on the precise correspondence between the mechanical properties of iron and steel and the magnetic characteristics. This new method is founded on the principle that there is only one series of magnetic characteristics corresponding to a given series of mechanical characteristics; and, inversely that there is only one series of mechanical characteristics that corresponds to a given series of magnetic ones. The magnetic characteristic that can be practically measured is its *permeability*; and the method now employed is the invention of Foley of a *permeametro*, a simple and practical apparatus, by which the results of the operations can be read on a galvanometer. Varying according to the intensity of the magnetic field, the instrument, which is properly graduated, indicates the quantity of the lines of force that traverse one square centimetre of the surface under examination. It is easy to construct a diagram shewing the relationship between the intensity of the current and the number of the lines of force induced, thus obtaining a characteristic curve for each description of metal. This new method of measurement presents special advantages of which the following may be mentioned:—

(*a*) the possibility of continuous proofs in the various stages of work, without causing waste of material;
(*b*) the possibility of recognizing the special products, which, owing to various circumstances cannot be precisely seen at the first view obtained during the production;
(*c*) the impossibility of errors of a kind so frequently made in the ordinary systems—for example, the difference between two proofs of tempered steel made in a different manner, which are not noted by means of mechanical mensuration, but which are clearly seen in magnetic diagrams;
(*d*) the possibility of following an entire production step by step; for example, each article produced has its characteristic curve; a steel wire for an aeroplane can be completely tested and the smallest defect of homogeneity detected.

From this simple enumeration it may be seen that this new method of measurement will give certain great advantages in industrial metallurgy.

E. T. THACKERAY.

CURIOSA MATHEMATICA, No. 2.

Solution by Lt.-Col. A. J. C. Cunningham, late R.E.

All integers from 1 to 100 expressed by four 4's.

The only symbols here used—(besides the usual arithmetical symbols)—are

$n!$ means $n(n-1)(n-2)\ldots\ldots 3.2.1$. Γn means $n!\div n$.

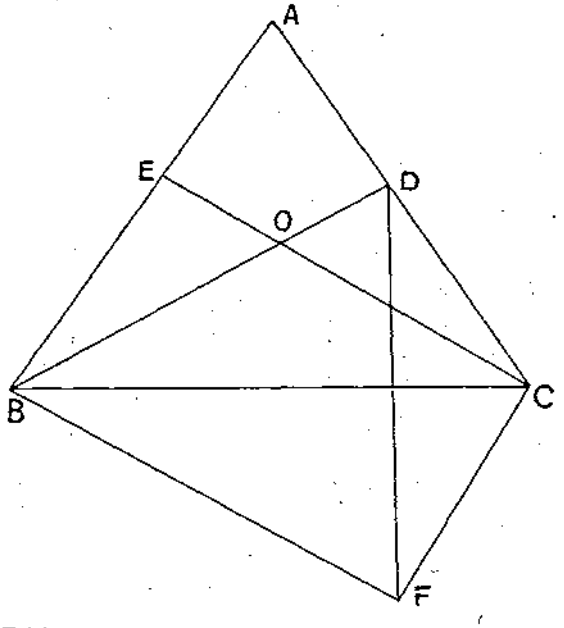
1 $4\div 4+4-4$	26 $4!+(4+4)\div 4$	51 $4!+4!\div 4-\Gamma\sqrt{4}$	76 $4\times(4!-4)-4$
2 $4\div 4+4\div 4$	27 $4!+4-4\div 4$	52 $44+4+4$	77 $(4-\Gamma\sqrt{4})^4-4$
3 $(4+4+4)\div 4$	28 $4(4+4)-4$	53 $4!+4!\div 4+\Gamma\sqrt{4}$	78 $4\times(4!-4)-\sqrt{4}$
4 $4+4(4-4)$	29 $4!+4+4\div 4$	54 $4!+4!\div 4+\sqrt{4}$	79 $4\times(4!-4)-\Gamma\sqrt{4}$
5 $4!\div 4-4\div 4$	30 $(4+4)\times 4-\sqrt{4}$	55 $4!+4!+\Gamma 4+\Gamma\sqrt{4}$	80 $4\times 4!-4\times 4$
6 $4+(4+4)\div 4$	31 $4(4+4)-\Gamma\sqrt{4}$	56 $4!\div 4!+4\div 4$	81 $4\times(4!-4)+\Gamma\sqrt{4}$
7 $4+4-4\div 4$	32 $4\times 4+4\times 4$	57 $(4!+4)\times\sqrt{4}+\Gamma\sqrt{4}$	82 $4\times(4!-4)+\sqrt{4}$
8 $4+4\div 4-4$	33 $4\times(4\div 4)+\Gamma\sqrt{4}$	58 $4\times 4\times 4-\Gamma 4$	83 $(4-\Gamma\sqrt{4})^4+\sqrt{4}$
9 $4+4+4\div 4$	34 $(4+4)\times 4+\sqrt{4}$	59 $(4!+\Gamma 4)\times\sqrt{4}-\Gamma\sqrt{4}$	84 $4\times(4!-4)+4$
10 $4+4+4-\sqrt{4}$	35 $\Gamma 4\times\Gamma 4-4\div 4$	60 $4\times 4\times 4-4$	85 $(4-\Gamma\sqrt{4})^4+4$
11 $4!\div\sqrt{4}-4\div 4$	36 $4(4+4)\div 4$	61 $(4!+\Gamma 4)\times\sqrt{4}+\Gamma\sqrt{4}$	86 $4\times(4!-4)+\Gamma 4$
12 $4!\div\sqrt{4}+4-4$	37 $\Gamma 4\times\Gamma 4+4\div 4$	62 $4\times 4\times 4-\sqrt{4}$	87 $4\times(4!-\sqrt{4})-\Gamma\sqrt{4}$
13 $4!\div\sqrt{4}+4\div 4$	38 $44-4-\sqrt{4}$	63 $4\times 4\times 4-\Gamma\sqrt{4}$	88 $44+44$
14 $4+4+4\div\sqrt{4}$	39 $44-4-\Gamma\sqrt{4}$	64 $(4+4)(4\div 4)$	89 $4\times(4!-\sqrt{4})+\Gamma\sqrt{4}$
15 $4\times 4-4\div 4$	40 $44-\sqrt{4}-\sqrt{4}$	65 $4\times 4\times 4+\Gamma\sqrt{4}$	90 $4\times 4!-4-\sqrt{4}$
16 $4+4+4+4$	41 $44-4+\Gamma\sqrt{4}$	66 $4\times 4\times 4+\sqrt{4}$	91 $4\times 4!-4-\Gamma\sqrt{4}$
17 $4\times 4+4\div 4$	42 $44-4+\sqrt{4}$	67 $44+4!-\Gamma\sqrt{4}$	92 $44+4!+4!$
18 $4\times 4+4-\sqrt{4}$	43 $44-4\div 4$	68 $4\times 4\times 4+4$	93 $4\times 4!-4+\Gamma\sqrt{4}$
19 $4!-4-4\div 4$	44 $44+4-4$	69 $44+4!+\Gamma\sqrt{4}$	94 $4\times 4!-4\div\sqrt{4}$
20 $4(4+4\div 4)$	45 $44+4\div 4$	70 $4!+4!+4!-\sqrt{4}$	95 $4\times 4!-4\div 4$
21 $4!-4+4\div 4$	46 $44+4-\sqrt{4}$	71 $4!+4!+4!-\Gamma\sqrt{4}$	96 $4\times 4!+4-4$
22 $4\times 4\div 4+\sqrt{4}$	47 $4!+4!-4\div 4$	72 $44+4!+4$	97 $4\times 4!+4\div 4$
23 $4!-\sqrt{4}+4\div 4$	48 $4(4\div 4+4)$	73 $4!+4!+4!\div\Gamma\sqrt{4}$	98 $4\times 4!+4-\sqrt{4}$
24 $4\times 4\div 4+4$	49 $4!+4!+4\div 4$	74 $4!+4!+4!+\sqrt{4}$	99 $4\times 4!+4-\Gamma\sqrt{4}$
25 $4!\div\Gamma\sqrt{4}+4-4$	50 $44+4+\sqrt{4}$	75 $(4-\Gamma\sqrt{4})^4-\Gamma 4$	100 $4\times 4!+\sqrt{4}\div\sqrt{4}$

This is an *old* problem. It was proposed in the *R.E. Journal* about 30 years ago by Capt. W. Turton, R.E. His solution was (I think) *incomplete*.

PROBLEMS.

PROBLEM 9 (Solution).

THE following solution has been received from a correspondent, who states that it was published in 1859.



BD and CE bisect the base angles and are equal:

Then the base angles ABC, ACB are equal.

Let BD and CE meet in O.

Suppose $\angle OBC > \angle OCB$.

Then in triangles EBC, DCB two sides are equal, but $\angle DBC > \angle ECB$.

$\therefore$ $CD > BE$.....(1) (Enc. I. 24).

On the other side of the base BC make $\triangle BCF = \triangle CBE$, and join DF.

Then since $BF = BD$,

$\therefore$ $\angle BFD = \angle BDF$ ....(2).

And in triangles DOC, EOB,

$\angle DOC = \angle EOC$, and $\angle OCD < \angle OBE$.

$\therefore$ $\angle ODC > \angle OEB$ (Enc. I. 32).

i.e., $\angle ODC > \angle BFC$.

Take away the equal angles (2) BDF, BFD.

Then $\angle FDC > \angle DFC$.

$\therefore$ $CF > CD$ (Euc. I. 19),
i.e., $BE > CD$.

But by (1) $CD > BF$; which is absurd.

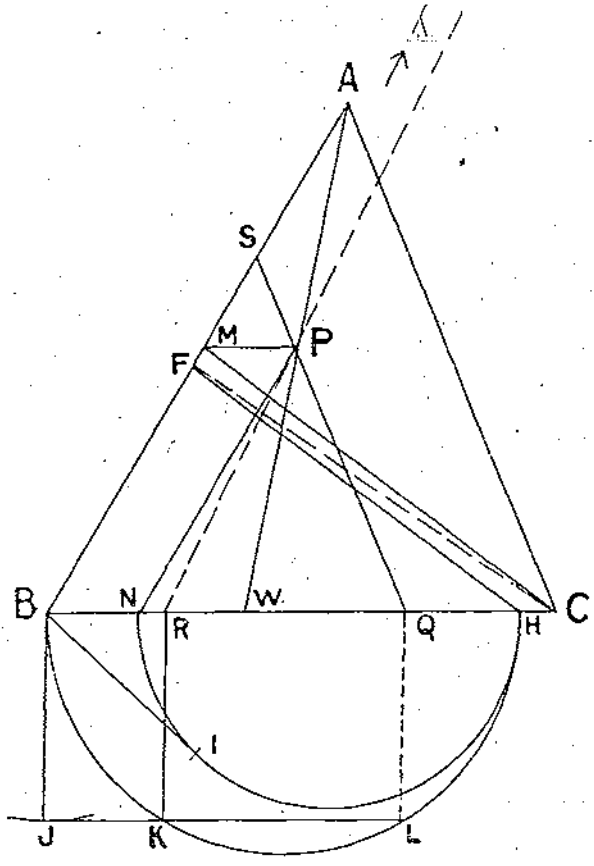
Therefore $\angle OBC \not> \angle OCB$, and similarly $\not< \angle OCB$.

$\therefore$ $\angle ABC = \angle ACB$.

Q.E.D.

PROBLEM 11 (Solution by Lt.-Col. Wade).

It is required to bisect $\triangle ABC$ by a line through P.



F is the centre of AB. Draw PM, PN $\parallel$ to CB, BA and FH $\parallel$ to CM, on BH, NH describe semicircles. Make KR, LQ equal to BI the tangent to inner semicircle from B. Join QP, RP cutting AB in S and T, it will be shown that $BSQ = \frac{1}{2}$ ABC, $BQ \cdot QH = LQ^2 = BI^2 = BN \cdot BH$.

$\therefore$ $\dfrac{BN}{BQ} = \dfrac{QH}{BH}$. $\therefore$ $\dfrac{BS \cdot BN}{BS \cdot BQ} = \dfrac{BM \cdot QH}{BM \cdot BH}$ .....A.

Then if $BS \cdot BN = \lambda\, BM \cdot QH$, then $BS \cdot BQ = \lambda\, BM \cdot BH$ .....B.

now $\dfrac{BN}{BQ} + \dfrac{BM}{BS} = 1$

$\therefore$ $BN \cdot BS + BM \cdot BQ = BQ \cdot BS = \lambda\, BM \cdot BH$ .....C.

But $BS.\ BN = \lambda\ BM.\ QH = \lambda\ BM\ (BH - BQ)$,

$\therefore$ $BS.\ BN + \lambda\ BM.\ BQ = \lambda\ BM.\ BH$ ..... D.

$\therefore$ from C and D by subtraction

$$(\lambda - 1)\ BM.\ QB = 0.$$

$\therefore$ $\lambda = 1$

$\therefore$ by B $BS.\ BQ = BM.\ BH$ ..... E.

and since HF CM are parallel

$$BM : BF = BC : BH.$$

$\therefore$ $BM.\ BH = BF.\ BC.$

$\therefore$ by E $BS.\ BQ = BF.\ BC.$

$\therefore$ $\triangle SBQ = \triangle FBC = \frac{1}{2}\ ABC.$

$\therefore$ provided S lies in AB and not in AB produced this construction solves the problem.

I cannot do more than indicate how to determine the positions of P which give possible solutions.

From elementary properties of the hyperbola 4 or 6 lines can be drawn through P touching 2 or 3 of the hyperbolas having a pair of AB, BC, CA as asymptotes and touching a pair of medians at their centres, these lines intercept with a pair of the sides of ABC an area equal to $\frac{1}{2}$ ABC, but by drawing the curves it will be seen that 3 lines at most can bisect ABC.

Other similar constructions to that given are obtainable by drawing PM, PN $\parallel$ to another pair of sides, and one or more of these constructions will give the possible solutions.

(Solution by Captain N. M. Vibart, D.S.O., M.C.).

Let ABC be the given $\triangle$ and P the given point.

The $\triangle$ when bisected will be divided into a $\triangle$ and a quadrilateral.

It appears that C will be the apex of the $\triangle$.

Bisect the $\angle$ ACB by CS.

Bisect the $\triangle$ABC by the median BM.

Draw BH perp^r to CS.

Determine N as shewn so that $CN^2 = CM.\ CH$.

Draw NK parallel to HB cutting CS at D.

Then $\dfrac{\text{area } \triangle NKC}{\text{area } \triangle MBC} = \dfrac{\triangle NKC}{\triangle HBC}\ \dfrac{\triangle HBC}{\triangle MBC} = \dfrac{CN^2}{CH^2} \cdot \dfrac{CH}{CM} = \dfrac{CN^2}{CM.\ CH}$

$\therefore$ $\triangle NKC = \triangle MBC$ in area for $CN^2 = CM.\ CH$ by constr.

$\therefore$ NK and MB are tangents to a hyperbola whose asymptotes are CA and CB.

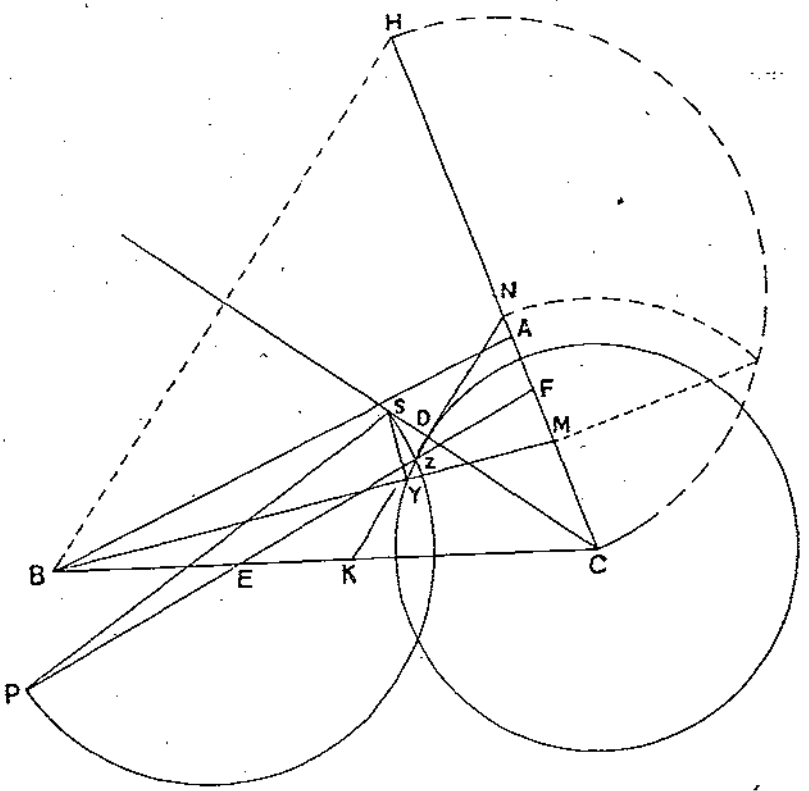
CS is the axis of this hyperbola by symmetry, and D is its apex, for NK is a tangent at right angles to the axis.

Draw the auxiliary circle centre C and radius CD.

Let it cut the tangent MB at Y.

Draw YS perp^r to the tangent MB, meeting the axis CS at S.

Then S is the focus from the properties of a hyperbola.
Join SP and describe a semicircle cutting the auxiliary circle at Z.
Join PZ cutting CA and CB at F and E.
Then SZ is at right angles to FE and Z is a point on auxiliary circle.
$\therefore$ FE is a tangent to the hyperbola.
$\therefore$ area $\triangle FCE$ = the constant area = area $\triangle MBC = \frac{1}{2}\triangle ABC$.
$\therefore$ PEF is the required line bisecting the $\triangle ABC$.



(Q.E.F.).

PROBLEM 12 (Solution by Lt.-Col. A. J. C. Cunningham, late R.E.).

To find the remainder of 47^{7385} when divided by 17.
This is an elementary problem of congruences.

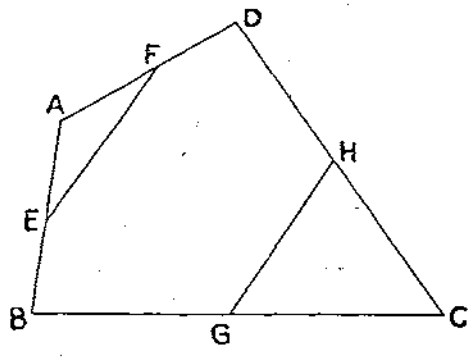
$47^{7385} \equiv (51-4)^{7385} \equiv -(2^2)^{7385} \pmod{17}$.
$\equiv -2^{14770} \quad \equiv -2^{8.1846+2}$,,
$\equiv -2^2 \quad \equiv -4 = +13$,,

Since $2^8 = +1 \pmod{17}$.

PROBLEM 15 (Capt. H. M. Johnstone, late R.E.).

Of all the pyramids standing on a given (scalene) triangle and having the same volume, which has the greatest inscribed sphere?

PROBLEM 16.



Four rods are freely jointed together at ABCD and lie on a smooth horizontal plane.

E, F, G, H are the centres of the rods, and the points E, F and G, H are joined by bars smoothly jointed at EFGH. If the system is in equilibrium and if the tension in EF is P, find the stress in GH.

J. M. WADE, *Lt.-Col.*