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CONTENTS.

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Index to Authors.

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CONTENTS.

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CONTENTS.

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CONSTRUCTION OF BRIDGES IN THE FIELD TO TAKE HEAVY MOTOR TRANSPORT.

By CAPT. G. C. GOWLLAND, R.E.

ALL semi-permanent bridges built in war must be capable of carrying the heaviest form of motor lorry. Field engineers must therefore be prepared to span gaps up to 100 ft. with bridges that are able to carry a train of heavy lorries.

The material available will be planks, round and flat steel or iron bars, bolts, spikes, nails, etc. The type of design must depend on the material at hand. In the present case no attempt is made to put forward a type design. An ordinary gap is taken and three methods of bridging it are suggested.

A gap of 40 ft. is to be bridged. The loading to be a train of heavy motor lorries. The wheel track is 6 ft. 8½ in. Distance between wheel girders 8 ft. 6 in. Load on hind axle 17,700 lbs. Load on fore axle 7,100 lbs. When lorries are crowded it is assumed that there will be a distance of 10 ft. between the fore axle of one lorry and the hind axle of the one in front. It is assumed that the timber at hand takes 1,200 lbs. per square inch in tension or compression and that the steel will take 7·5 tons per square inch in tension.

To find the maximum bending moment under a train of lorries :—

In a 40-ft. span only two lorries can be on the bridge at once. It is obvious that the M_{ff} will occur when there are two lorries on the bridge and when the hind axle of one of them is near the centre, *i.e.* when the loads are in some such position as *Fig.* 1 in which case the M_{ff} will be under the load A.

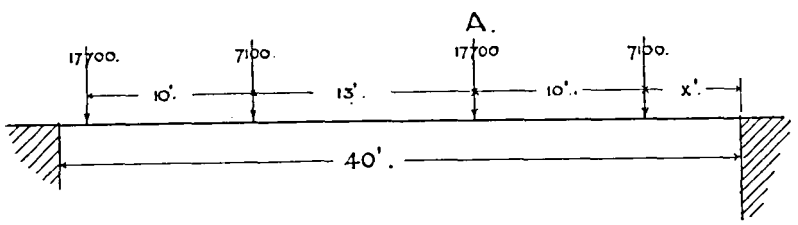


FIG. 1.

To find the actual position of the loads giving the maximum bending moment, find the centre of gravity of all the loads on the bridge and then arrange them so that the centre of the beam bisects the distance between the position of the centre of gravity and the load under which the M_{ff} occurs.

To find the C.G. of the loads.

Let the C.G. be distant x feet from the left-hand load.

Then $49600 \times x = 7100 \times 10 + 17700 \times 23 + 7100 \times 33$.

$\therefore$ $x = 14{\cdot}4$ about.

The M_{ff} will therefore occur when the loads are as in *Fig.* 2 and will be under the load A.

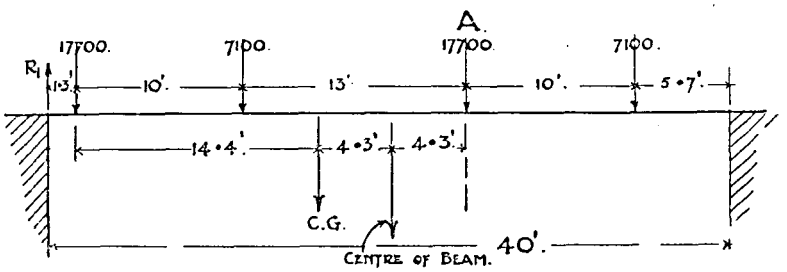


FIG. 2.

Find R_1 in *Fig.* 2.

$$R_1 \times 40 = 7100 \times 34{\cdot}4 + 17700 \times 54{\cdot}4.$$

Whence $R_1 = 30{,}178$ lbs.

$\therefore$ $M_{ff} = 30178 \times 24{\cdot}3 - 7100 \times 13 - 17700 \times 23$.

Whence $M_{ff} = 233{,}925$ foot-lbs.

If we consider the sum of all the weights on the bridge as being evenly distributed we have

$$M_{ff} = \frac{WL}{8} = \frac{49600 \times 40}{8} = 248{,}000 \text{ foot-lbs.}$$

This as a rough approximation is good enough as a rule in cases of ordinary loading. The actual maximum bending moment is 233,925 foot-lbs. This is caused by a live load and to reduce to equivalent dead load multiply by 2. This gives M_{ff} of 467,850 foot-lbs. over the whole bridge due to equivalent dead load.

Case I.—Suppose we have plenty of round steel bars, planking and means of cutting screw threads. Probably the best form of bridge will be an N girder using round steel rods as ties and carrying the roadway on the top boom. Before we can work out the stresses in the girder we must decide how the load is distributed over it.

DISTRIBUTION OF LOADING.

The M_{ff} is 467,850 foot-lbs.

Let W lbs. be an evenly distributed load that produces an M_{ff} in the girder of 467,850 foot-lbs.

Then $\frac{W \times 40}{8} = 467850$.

$\therefore$ $W = 93{,}570$ lbs.

Therefore if we load the bridge with an evenly distributed load of 2,339 lbs. per foot-run we obtain a bending moment equal to that produced when the lorries are producing their maximum bending moment on the bridge.

The span of the bridge is 40 ft. We can conveniently use panels 5 ft. × 5 ft., in which case each panel point takes 11,695 lbs. If we use two girders we see that each panel point has to take $\frac{11695}{2}$ lbs., say 6,000 lbs. In addition to this each panel point has a load due to the dead weight of the bridge.

The dead weight of each girder is say $1\frac{1}{2}$ tons.

Therefore the load per panel point due to dead load is 420 lbs.

The loading for each girder will therefore be as in *Fig.* 3 if two girders are used.

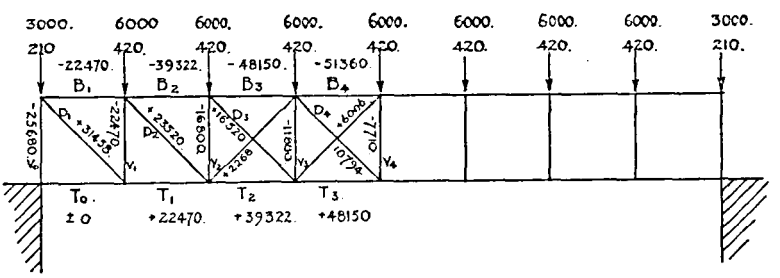


FIG. 3.—*Stresses if two girders are used.*

Having obtained the loading of the girder obtain the stresses by method of sections, forces acting upwards being considered negative.

The stress in V_0 is maximum under full load and equals the reaction.

$$\therefore \qquad V_0 = -25{,}680 \text{ lbs. compression.}$$

The stress in $T_0 = 0$.

To find $B_1V_1T_1D_1$. Take a section as in *Fig.* A. The sum of the vertical forces is zero.

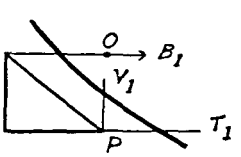


FIG. A.

$$\therefore \qquad +V_1+(6000+420)\left(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}+\tfrac{4}{8}+\tfrac{5}{8}+\tfrac{6}{8}+\tfrac{7}{8}\right)=0.$$

$$\therefore \qquad V_1 = -22{,}470 \text{ lbs. compression.}$$

Taking moments about P.

$$-B_1 \times 5 - (6000 + 420)\ (\tfrac{1}{8} + \tfrac{2}{8} \ldots \tfrac{7}{8}) \times 5 = 0.$$

$$\therefore \qquad B_1 = -22{,}470 \text{ lbs. compression.}$$

Taking moments about O. T_1 is found equal to B_1 but of different sign.

$$\therefore \qquad T_1 = +22{,}478 \text{ lbs. tension.}$$

Also $$-D_1 \sin 45 = V_1.$$

$$\therefore \qquad D_1 = +31458 \text{ tension.}$$

To find $V_2B_2T_2D_2$. Take a section as in *Fig.* B.

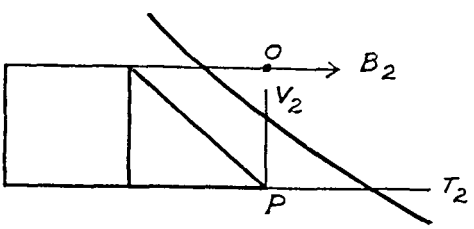


FIG. B.

$$+V_2 + 420\ (\tfrac{1}{8} + \tfrac{2}{8} + \tfrac{3}{8} + \tfrac{4}{8} + \tfrac{5}{8} + \tfrac{6}{8} - (1 - \tfrac{7}{8})) + 6000\ (\tfrac{1}{8} + \tfrac{2}{8} \ldots \tfrac{6}{8}) - 6000\ (1 - \tfrac{7}{8}) = 0.$$

$$\therefore \qquad V_2 + 1050 + 15750 - 750 = 0.$$

From this equation first omit the negative quantity -750 due to the moving load and $V_2 = -16800$. Next omit the positive quantity 15750 due to the moving load and $V_2 = -300$.

Therefore the stresses in V_2 range from $-16{,}800$ lbs. to -300 lbs. that is V_2 is always in compression under any position of loading.

$$-D_2 \sin 45 = V_2.$$

Therefore D_2 varies from 23,520 lbs. tension to 420 lbs. tension.

Taking moments about P.

$$-B_2 \times 5 - (6000 + 420)\ \{(\tfrac{1}{8} + \tfrac{2}{8} + \tfrac{3}{8} \ldots \tfrac{6}{8}) \times 10 + \tfrac{7}{8}\ (10 - 5)\} = 0.$$

$$\therefore \qquad B_2 = -39{,}322 \text{ lbs. compression.}$$

Taking moments about O. T_2 is found equal to B_2 but of opposite sign.

$$\therefore \qquad T_2 = +39{,}322 \text{ lbs. tension.}$$

To find $B_3D_3V_3T_3$. Take a section as in *Fig.* C.

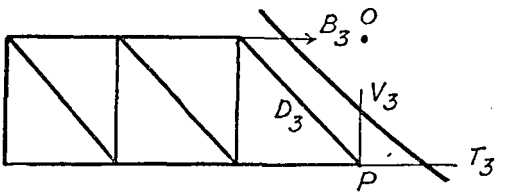


FIG. C.

$$+V_3+420\left(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}+\tfrac{4}{8}+\tfrac{5}{8}-(1-\tfrac{6}{8})-(1-\tfrac{7}{8})\right)+6000\left(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}\ldots\tfrac{5}{8}\right)$$
$$-6000\left(1-\tfrac{6}{8}+1-\tfrac{7}{8}\right)=0.$$

$$\therefore \quad -V_3=630+11250-2250.$$

Omitting first the negative and then the positive figure from this equation we have $V_3=-11{,}880$ lbs. or $+1{,}620$ lbs.

Also $$-D_3 \sin 45=V_3.$$

$$\therefore \quad D_3=+16520 \text{ or } -2268.$$

Therefore unless the third panel is cross-braced we shall have V_3 and D_3 in alternate compression and tension as the loads roll over the bridge.

Taking moments about P.

$$-B_3\times 5-6000+420\left\{\left(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}+\tfrac{4}{8}+\tfrac{5}{8}\right)15+\left(\tfrac{7}{8}\times 15-10\right)\right.$$
$$\left.+\left(\tfrac{6}{8}\times 15-5\right)\right\}=0.$$

$$\therefore \quad B_3=-48150.$$

Also by moments about O.

$$T_3=+48150.$$

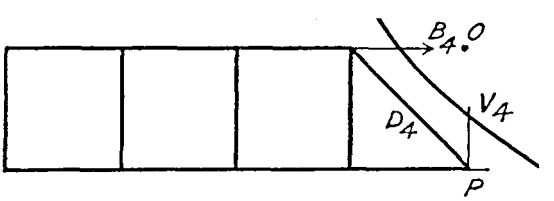


FIG. D.

To find $B_4V_4D_4$. Take a section as in *Fig.* D. Then

$$+V_4+420\left(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}+\tfrac{4}{8}-(1-\tfrac{5}{8})-(1-\tfrac{6}{8})-(1-\tfrac{7}{8})\right)$$
$$+6000\left(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}+\tfrac{4}{8}\right)-6000\left((1-\tfrac{5}{8})+(1-\tfrac{6}{8})+(1-\tfrac{7}{8})\right)=0.$$

$$\therefore \quad V_4+210+7500-4500=0.$$

$$\therefore \quad V_4=-7710 \text{ compression or } +4290 \text{ tension.}$$

Also $$-D_4 \sin 45 = V_5.$$

$$\therefore \quad D_4 = +10794 \text{ or } -6006.$$

Therefore the centre panel must be cross-braced.

Taking moments about P.

$$-B_4 \times 5 - (6000+420)\{(\tfrac{1}{8}+\tfrac{2}{8}+\tfrac{3}{8}+\tfrac{4}{8}) \times 20 + (\tfrac{5}{8}\,20-5) + (\tfrac{6}{8}\,20-10) + (\tfrac{7}{8}\,20-15)\} = 0.$$

$$\therefore \quad B_4 = -51360.$$

Therefore stresses may now be written down as in *Fig.* 3.

On examining the stresses in *Fig.* 3 we see that there is a tension of between 14 and 15 tons in one diagonal. The joints will become simpler if four girders are used. *Fig.* 4 gives the stresses in a girder if four girders are used. These stresses are half those in *Fig.* 3.

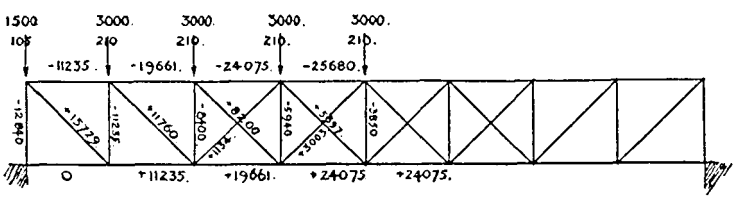


FIG. 4.—*Stresses if four girders are used over 40-ft. span.*

CALCULATION OF MEMBERS OF GIRDER.

Booms.—The greatest stress is 25,680 lbs.

Assuming that we have fir planks the working stress of the timber may be taken as 1,200 lbs. per square inch in tension or compression.

Therefore the number of square inches required in the boom is $\frac{25680}{1200} = 22$ about.

Therefore one 9 in. × 3 in. with a 9-in. × 3-in. cover plate would do. For convenience in construction three 9 in. × 3 in. are used. This gives a working section of 54 square inches.

Jointing of Booms.—Either nails, spikes or bolts may be available.

One 9 in. × 3 in. takes 27 × 1,200 lbs. = 32,400 lbs. in tension or compression.

(i.). Bolts. Suppose $\frac{3}{4}$-in. bolts are available.

Each $\frac{3}{4}$-in. bolt passing through a 9-in. × 3-in. plank can safely take $\frac{3}{4}'' \times 3 \times 1{,}200$ lbs. = 2,700 lbs.

Therefore the number of bolts required on each side of every joint is $\frac{32400}{2700} = 12$ bolts.

(ii.). Nails. Suppose 6-in. nails available.

Each 6-in. nail takes 200 lbs. laterally.

Therefore number of nails required on each side of the joint is $\frac{32400}{200} = 162$ nails.

(iii.). Spikes. Suppose 7-in. spikes available.

Each spike takes 700 lbs. laterally.

Therefore number of spikes required on each side of a joint is $\frac{32400}{700}=46$.

The joints in the boom are arranged as in *Fig.* 8.

NOTE.—When bolts are nutted up tight the friction between the members will strengthen the joint but friction should not be depended on as the wood will expand and contract under different climatic conditions.

A good substitute for bolts is round steel bars cut to length. A hole of slightly smaller diameter is bored through the booms and the round bars hammered in. If this method is used for jointing booms the compression members should be bound with hoop iron or wire to prevent them opening out when the stress comes on them.

Tension Bars.—1⅜-in. round bar of steel with Whitworth thread has effective area of 1 square inch; 1¼-in., ·8 square inch; 1-in., ·54 square inch.

Therefore using round steel bars a 1⅜-in. bar takes in tension when screw threaded 16,800 lbs.; 1¼-in., 13,440 lbs.; 1-in., 8,072 lbs.

The bars are therefore arranged as in diagram of completed girder (*Fig.* 7).

Verticals.—The greatest stress is 12,840 lbs. Length of strut is 51 in.

Using a 9 in. × 3 in. strut $\frac{l}{d}=\frac{51}{3}=17$.

Safe compression is 600 lbs. per square inch.

Therefore one 9 in. × 3 in. takes 16,200 lbs.

Or the strut can be looked out in curve for compression members, *M.M.E.*, Part IIIA.

Joints.—The verticals will be held by cleats to the top and bottom boom and nailed through the cleats.

The diagonals will pass through the boom and then nutted up so as to bear on oak cleats on the top and bottom of the two booms. It will be quite safe to bore holes through the boom to take the diagonal ties as the available section is 54 square inches and only 22 square inches is required to take the maximum stress.

The cleats are held to the booms by screws ¾-in. diameter (see *Figs.* 9 and 9A).

The resolved part of the greatest diagonal is horizontally about 12,000 lbs.

One ¾-in. screw takes 2,100 lbs. laterally. Therefore six screws must be used.

Bearing on Cleats.—The stress in the tie-rod will be distributed over the face of the oak cleat by a ½-in. steel plate.

Oak will take in bearing 1,600 lbs. The tension in the rod is 15,729 lbs. Therefore the number of square inches required is about 10. The number of square inches provided is 27.

Shear along the Cleat.—Oak in shear along the grain has a safe resistance of 450 lbs. per square inch. Therefore the number of square inches required is $\frac{12000}{450}=27$.

The number of square inches given is 36.

Therefore the joint is sound in all respects.

The girder is therefore put together as shown in *Fig.* 7, etc.

Four such girders will be used, two under each wheel.

Case II.—Supposing no round steel bars available but that flat steel bars are at hand.

The difficulty of making suitable joints with steel bars of small section is at once apparent as accurate drilling cannot be relied on in the field.

To make strong joints bolts will have to pass through various members of steel and wood and if the tie-bar has to take a big stress it will have to be made up of several bars.

With a tie-bar made up of several different members there is a danger of each member being unfairly loaded, unless all drilling of bolt holes is absolutely accurate.

Again, if holes are not accurately drilled, there is a danger that men in a hurry will enlarge holes so that bolts may pass through easily and by so doing the available working sections of members are reduced.

Therefore if flat bar steel is used it is sometimes useful to design a girder when the tension members are not so highly stressed up.

A simple form of girder which accomplishes this can be evolved from the girder already designed.

If the loads on the girder in *Fig.* 4 were only half what they are assumed to be the stresses in the girder would be exactly half those in *Fig.* 4 and eight such girders would be required to safely span the gap. That is eight such girders as are shown in *Fig.* 5 would be required.

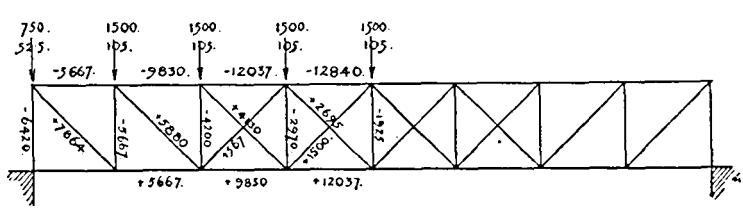


FIG. 5.—*Halved stresses in girder shown in Fig.* 4.

If two such girders with halved stresses are placed so that one overlaps the other by half a panel and if the stresses in the parts of the boom where they overlap are added a girder stressed as in *Fig.* 6

is obtained, the girder in *Fig.* 6 being able to take the same load as the girder in *Fig.* 4 but it will be noticed that all the stresses in the ties are halved.

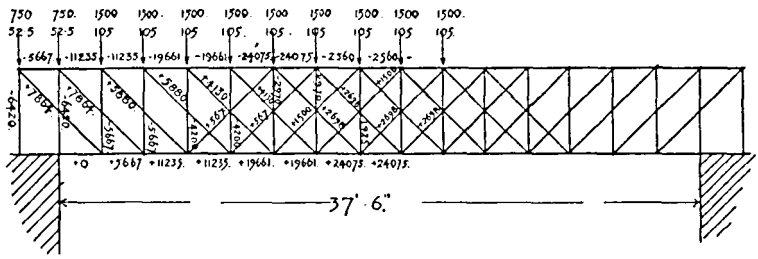


FIG. 6.—*Four such girders to be used. They are made by combining two girders with stresses as in Fig.* 5.

The objection to this girder is that it must be supported as shown and by so doing $2\frac{1}{2}$ ft. is taken from the span.

CALCULATION FOR MEMBERS OF GIRDER IN *Fig.* 6.

Booms.—Maximum stress is the same as in the previous case.

Therefore one 9 in. × 3 in. with one 9-in. × 3-in. cover plate will be sufficient for top and bottom booms.

The number of nails, bolts or spikes on each side of every joint will be the same as in the previous case.

Struts.—The maximum stress in a strut is 6,420 lbs., length of strut is 51 in. Using 6-in. × 3-in. fir

$$\frac{l}{d} = \frac{51}{3} = 17.$$

Therefore from Tables safe stress per square inch is 450 lbs.

Therefore one 6 in. × 3 in. takes 8,100 lbs.

Or the safe stress in a 6-in. × 3-in. strut may be found from curves in *M.M.E.*, iiiA.

Therefore 6 in. × 3 in. will be used for all struts.

For the struts on the abutment use two 6 in. × 3 in. nailed together and nails clinched.

Tie-Bars.—Suppose 2-in. × $\frac{1}{4}$-in. steel bars are available.

These bars will be fixed to the booms by bolts or screws $\frac{3}{4}$-in. diameter.

Each 2-in. × $\frac{1}{4}$-in. bar when bored for a $\frac{3}{4}$-in. bolt takes safely 5,025 lbs. tension.

We see therefore that by using two 2-in. × $\frac{1}{4}$-in. steel bars for each diagonal we shall be more than safe.

Fixing Bars to Booms.—$\frac{3}{4}$-in. diameter screws $4\frac{1}{2}$ in. long will take a lateral pull of 2,100 lbs.

$\frac{3}{4}$-in. diameter bolt passing through a 9-in. × 6-in. timber takes 5,400 lbs.

The simplest method of fastening the bars to the booms will be with $\frac{3}{4}$-in. screws. Two of these will be wanted for each of the end four diagonals and one for all the centre diagonals.

The completed girder with joint details is shown in *Figs.* 8, 9, 10. It will be seen that the bracing is too heavy in most cases but if narrower bars are used the $\frac{3}{4}$-in. screws take most of the metal. Any lighter form of bracing could be used in the centre panels.

Case III.—If no steel is available except in form of bolts, nails or spikes, it is assumed that plenty of timber planks are obtainable.

In this case a plank girder would be used.

The M_{ff} on the bridge is 467,850 foot-lbs. due to the equivalent dead load.

The M_{ff} due to the dead load of the bridge is 28,600 lbs.

Therefore the total bending moment is 496,450 foot-lbs.

Using four girders each one will have to withstand an M_f of 124,112 foot-lbs.

Using the formula

$$M_{ff} = RAd$$

where

R is safe working stress of timber in lbs. per square inch,
A is effective area of one boom in square inches,
d is the working depth of girder in inches,
M_{ff} is maximum bending moment in inch-lbs.,

d should not be less than $\frac{l}{14} = 33$ in., say 30 in., as this will not give us a weak web.

Then $124112 \times 12 = 1200 \times A \times 30.$

$\therefore$ $A = 42$ square inches about.

Booms.—The working area of either boom must be 42 in. Two 9-in. × 3-in. planks bored for $\frac{3}{4}$-in. bolts give a working area of 49·5 square inches.

Therefore the booms will be made up of three 9 in. × 3 in.

The fastenings in the booms will be the same as in the previous cases.

Web.—The maximum reaction due to the equivalent dead load is 61,200 lbs.

The maximum reaction due to dead load of bridge is 3,360 lbs.

Therefore the total maximum reaction is 64,560.

Therefore the maximum shear in any one of the four girders is 16,140 lbs.

The web will be of planks crossed, nailed and clinched (see *Fig.* 11).

The resistance of fir to shear with the grain is 150 lbs. and against the grain is 450 lbs. We can therefore assume that one web will take 300 lbs. safely in shear.

Let t inches be thickness of web.

Then $t \times 30 \times 300 = 16140.$

Whence $t = 1{\cdot}8$ in. say 2 in.

The web will therefore be made up of four thicknesses of $\frac{1}{2}$-in. planking two planks on each side of the booms.

Fastening of Web to Booms.—In a vertical length of web of 30 in. there is a shear of 16,140 lbs. Therefore in a horizontal distance of 30 in. there is the same shear of 16,140 lbs., using $\frac{3}{4}$-in. bolts to fix the 2-in. web to the booms. Each $\frac{3}{4}$-in. bolt in bearing takes $\frac{3}{4} \times 2 \times 1{,}200$ lbs. $= 1{,}800$ lbs.

Therefore the number of bolts in a 30-in. length of web is $\frac{16140}{1800} = 9$. Thus bolts will be spaced 3 in. apart near the abutments gradually spacing out towards the centre when the shear gets smaller.

The question of bolts tearing out of the ends of the web must be considered.

The bearing strength of a bolt is 1,800 lbs.

Let l inches be the distance of the bolt hole from the edge of the web (see *Fig.* 11).

The resistance of the timber to shear along the grain is 150 lbs. per square inch.

Therefore l is given by the equation

$$l \times 2 \times 150 \times 2 = 1800.$$

$$\therefore \quad l = 3 \text{ in.}$$

Web Stiffeners.—The maximum reaction is 16,140 lbs. Use 9 in. × 3 in. struts.

The length of the strut is 21 in. so $\frac{l}{d} = 7$.

Therefore safe stress in 9-in. × 3-in. strut is 27,000 lbs.

Space struts at $\frac{2}{3}$ of 30 in. is at 20 in.

Blocks of 4 in. × 4 in. × 9 in. to be placed as in *Fig.* 11.

Struts can be nailed to chocks or boom or be held by hoop iron.

An additional strut is placed as shear in *Fig.* 11 over the abutment.

In a recent article on a bridge erected at the front where the load was taken on the top boom there was a note to the effect that it would be simpler to take the load on the bottom boom.

If the load is taken on the bottom boom there will be difficulty with the transoms and flooring unless steel beams are used.

The distance between wheel girders is laid down as 8 ft. 6 in. Allowing 9 in. on each side of these the clear span of a transom is 10 ft.

The greatest bending moment that can be brought on this by the hind wheel of a lorry is 447,105 inch-lbs. equivalent dead load.

Suppose 9 in. × 3 in. is the biggest timber available, then each transom will have to be made up of nine 9 in. × 3 in.

If the load is taken on each panel point we shall have to put a span 81 in. × 9 in. on each point and have heavy roadbearers connecting the transoms.

Or, if the load is to be distributed evenly along the bottom boom the whole floor will have to be of 9 in. × 3 in. bolted up in bundles of nine.

Therefore if timber only is available it appears impractical to carry the load on the bottom boom.

Again if four girders are used it will not be easy to make each one do its fair share of work with the loading on the lower boom.

Of the three girders shown the quickest and easiest to construct is that shown in *Fig.* 8.

In all these examples the factors of safety used are high. It is good enough on long spans to multiply the live load by $\frac{3}{2}$ to reduce it to equivalent dead load.

If sound fir is available it may be safely stressed up to 1,500 lbs. per square inch in tension or compression.

A lattice girder of the type shown in *Fig.* 8 designed (with the above factors of safety) so that four such girders should carry a train of lorries over a 50-ft. span, was experimented with.

A single girder took a central test load of $6\frac{1}{2}$ tons and deflected 3 in. When the load was removed the permanent deflection was $1\frac{1}{2}$ in. The same girder was then tested with a central load of 13 tons and deflected 6 in., taking a final set of 2 in. when the load was removed. The dead weight of this experimental girder was 25 cwt.

GIRDER BRIDGE TO CARRY SINGLE ROADWAY FOR HEAVIEST MOTOR LORRIES (Crowded).

Four Girders required.

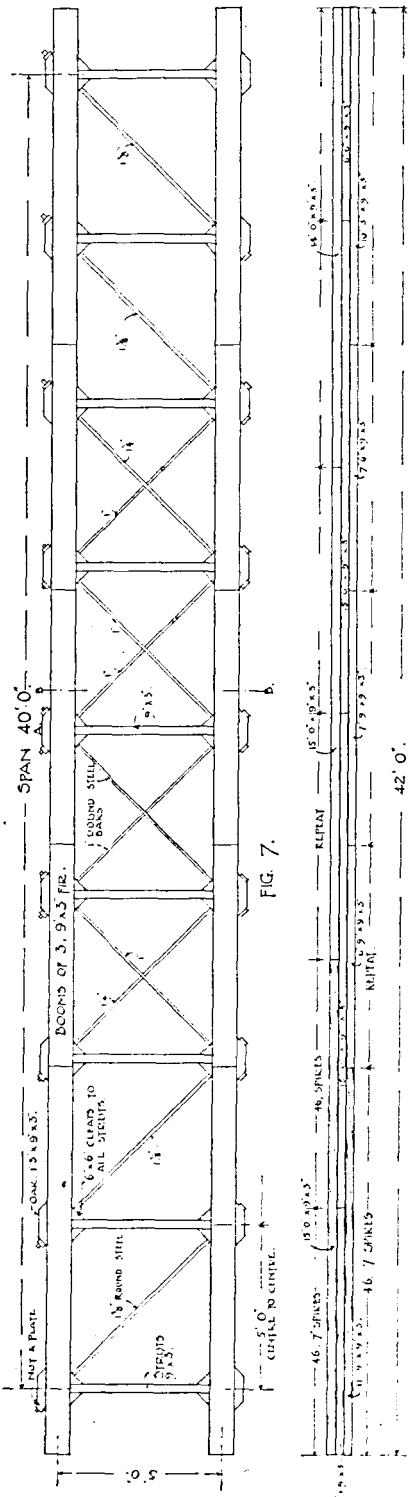


FIG. 7.

FIG. 7a.

GIRDER BRIDGE TO CARRY SINGLE ROADWAY FOR HEAVIEST MOTOR LORRIES (Crowded). Four Girders required.

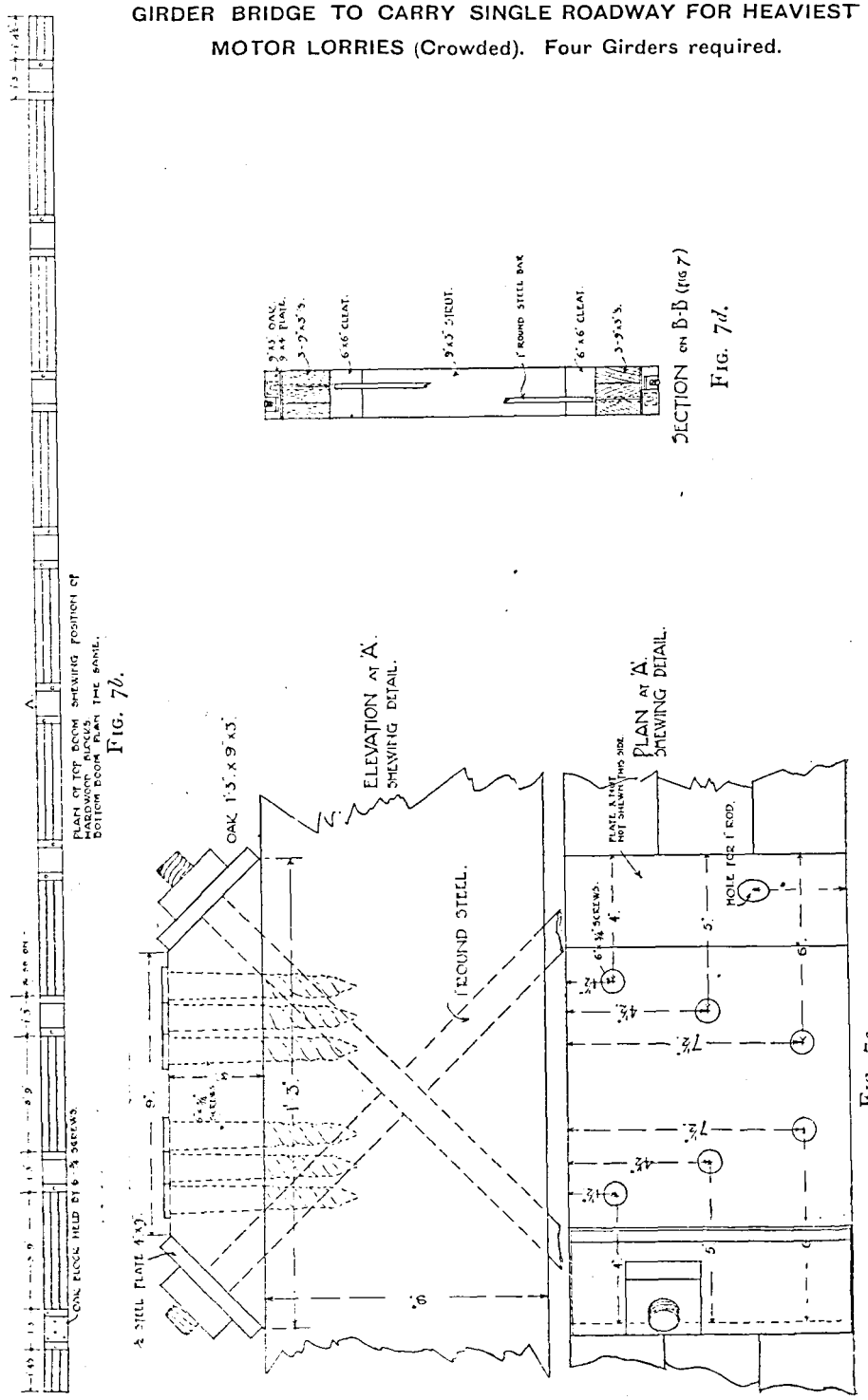


FIG. 7a.

FIG. 7b.

FIG. 7c.

FIG. 7d.

BRACED GIRDER TO TAKE HEAVIEST MOTOR LORRIES.

Four such Girders used.

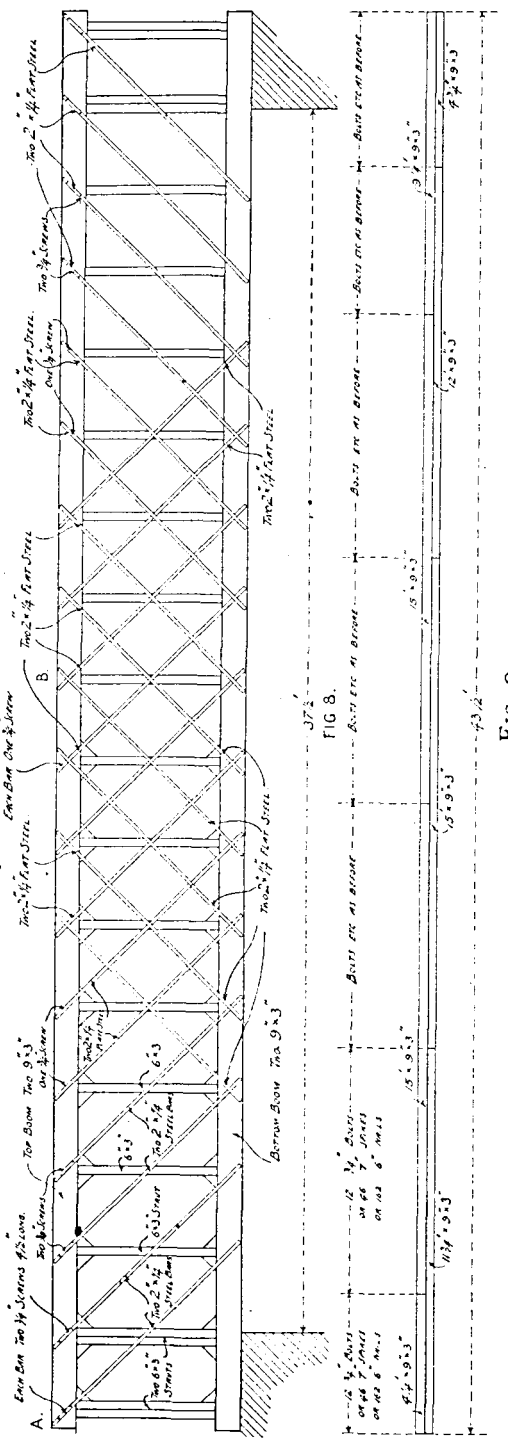
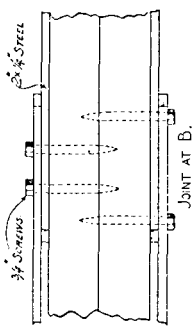


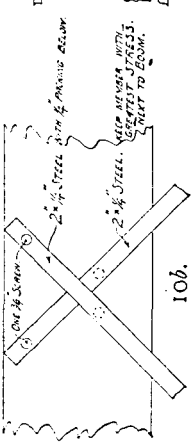
FIG 8.

FIG. 9.

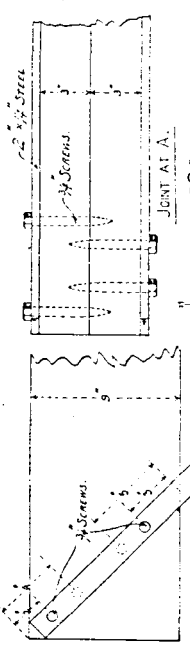


JOINT AT B.

10c.



10b.



JOINT AT A.

10d.

10.

NOTE.—If Booms are jointed with Bolts, one Bolt would be substituted for each pair of Screws.

PART ELEVATION OF PLANK GIRDER.

Four such Girders to carry heavy Motor Lorries over 40-ft. span.

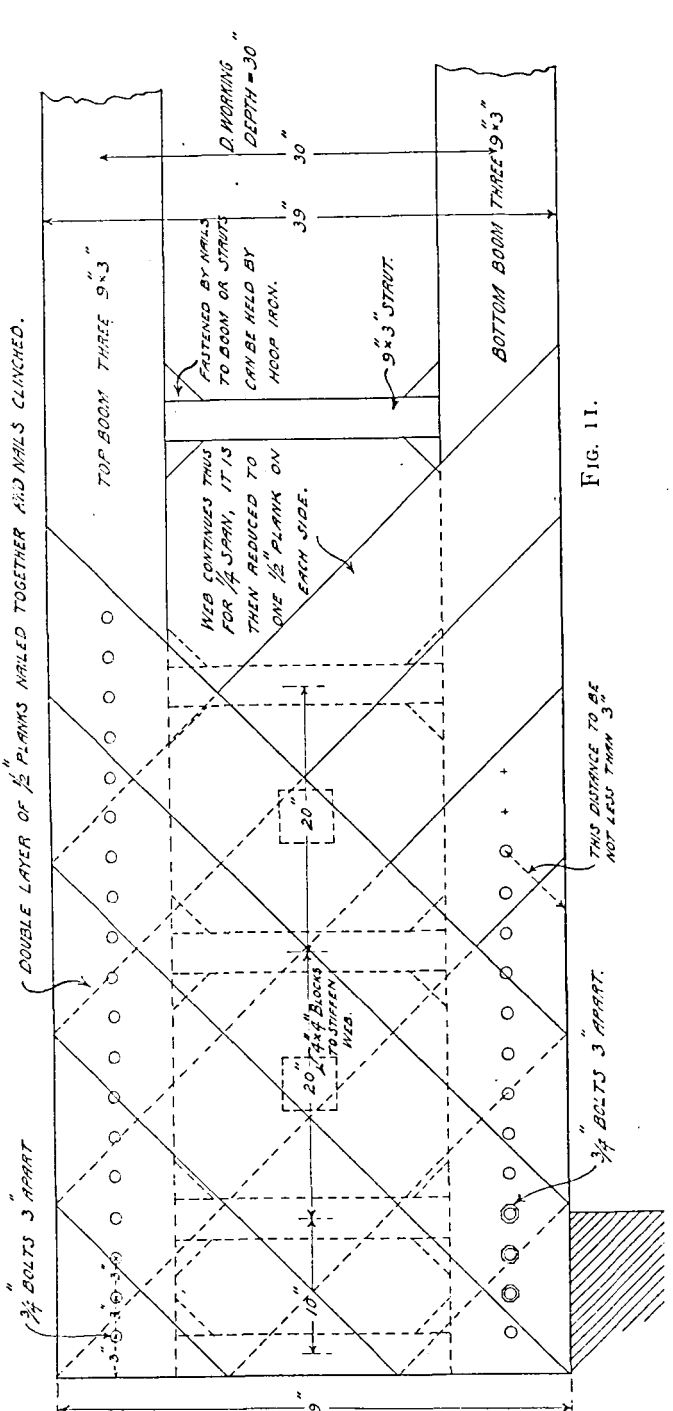


FIG. 11.

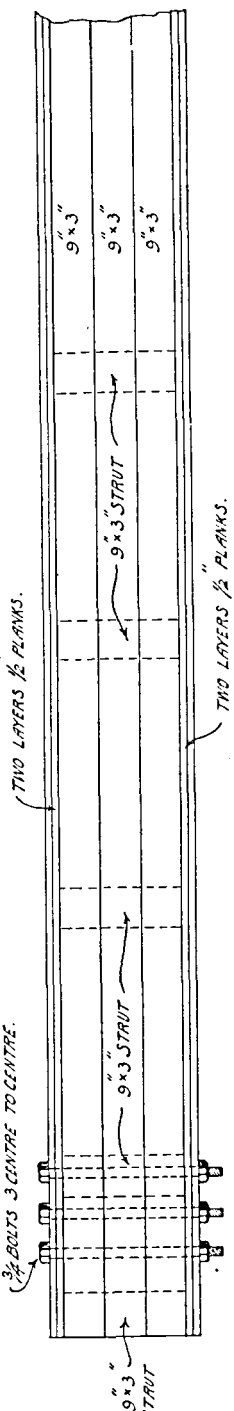


FIG 12.

SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

RELIEF OF LUCKNOW BY OUTRAM AND HAVELOCK, IN 1857.

Brig.-General Neill was pressed by the Commander of the Forces, Sir Patrick Grant, to hasten to Cawnpore to join General Havelock as soon as possible, in order that he might be on the spot to take command of the force should Havelock from any cause become unfit for the duty, and left Allahabad on the 16th July, and proceeding with all possible expedition, reached Cawnpore on the 20th.

On his way General Havelock informed him that he was anxiously awaiting his arrival, as, immediately he did, he intended "to strike a blow that would rebound through India." Neill on his arrival at Cawnpore was informed by Havelock that he intended to begin the passage of the Ganges on the morrow, leaving Neill in command at Cawnpore with about 200 men, the majority of whom were sick and wounded. In this arrangement, Neill anxious that Havelock should take with him every available man, entirely concurred.

Before deciding on making a desperate effort to relieve Lucknow, General Havelock had traced out a position resting on the river, which it would be easy for a small force to hold against very superior numbers. The work was being entrenched and some guns mounted there at the time of Neill's arrival. He was to complete and hold it.

Although General Havelock's force consisted of only about 1,500 men, owing to the breadth of the swollen river, the rapidity of the current alone presented formidable obstacles. The crossing occupied four days.

On the afternoon of the 24th General Havelock crossed, and marched the force about 5 miles on the Lucknow Road, halting for the night at the little village of Mungulwár. The force consisted of 10 guns imperfectly equipped and imperfectly manned; the remains of the 64th, the 84th, the 75th Regiments, the Madras Fusiliers, and of Brazer's Sikhs; and some 60 volunteer horse. Small as were the numbers they were possessed of the best spirit, and had unbounded confidence in their general.

On the night of the 24th of July this force bivouacked at Mungulwár. It remained halted at the village four days, to enable the General to complete his dispositions for carriage and supplies. On the 28th these had been completed so far as the disorganized state of the country permitted. At 5 o'clock on the morning of the 29th the force began its onward movement. After marching 3 miles the advanced pickets of the enemy were discovered. These fell back as our men pressed on, disclosing the enemy occupying a very strong position. Their main force rested on the town of Oonáo, a straggling place, extending about three-quarters of a mile, and which the heavy rains and the nature of the soil rendered it impossible to turn. In advance of this town, and between it and the British force, was a succession of walled enclosures, filled with skirmishers. These enclosures joined a village united with Oonáo by a narrow passage, and all the houses in which were loopholed and defended.

It was impossible to turn such a position ; it was murderous work to attack it in front. But if he was to get on at all Havelock had no option. After a steady reconnaissance, Havelock gave his orders. Covering his main body with skirmishers, armed with the Enfield rifle, he opened a heavy fire from them, and from his guns on the more advanced positions of the enemy. This fire drove them from those positions and forced them to take refuge in the loopholed houses. At these Havelock then sent the 78th Highlanders, and the Madras Fusiliers. Gallantly did they advance. But to dislodge an enemy from loopholed houses, singly, one after the other, is deadly work; Havelock therefore ordered up the 64th. Their advance decided the day. The enemy were either bayoneted in the houses or sought refuge in flight.

But the town of Oonáo was still in the enemy's possession, and, what was of more consequence, fresh troops were observed hastening down the Lucknow Road in its direction. Havelock at once made preparations to meet them. Drawing off his force to a dry spot of ground between the village and the town, he placed his guns in a position to command the high road, by which alone he could be attacked, and waited for the movement of the enemy further to develop itself. In a short time it was evident he would be attacked. The rebels were marching in dense columns upon him. Havelock's joy was great for he felt that he had them. Restraining his impatience until when they were well within distance, he suddenly opened a withering fire upon them from both arms. It stopped them and they attempted to deploy, but on either side of them were swamps and marshes. Consequently, their horses and their guns stuck fast, their infantry floundered. All this time they were exposed to a continuous fire. Meanwhile some of our men, wading in the marshes, made their presence percep-

tible on either flank. This was the final blow. The rebels gave way, and fled precipitately leaving in our possession 15 guns.

Notwithstanding that he and his men were under the terrible sun of India, he determined to push on after the enemy, as soon as his men should have satisfied the cravings of exhausted nature. He ordered a halt; and while the cooks prepared the food, and the doctors attended the wounded, he had the 15 captured guns disabled as he had no cattle to take them with him.

At the end of three hours the men again fell in, and pushed forwards, always towards Lucknow. They had marched 6 miles, when suddenly they came in sight of a walled town, situated in the open, and intersected by the road which they must traverse. This was the town of Bashíratgunj. It looked very formidable. In front of it was a large pond or tank, swollen by the surrounding inundation to the form of a river. On the Lucknow side of it was another pond or lake, traversed by a narrow causeway. It possessed besides a wet ditch, and its main gate was defended by an earthwork and four guns, and flanked on both sides by loopholed turrets. He poured a tremendous fire on the town, whilst the 64th made a flank movement to his right; then, when he deemed the moment to have arrived, he sent on his infantry to the main gate. But the 64th had not reached the causeway—and the larger body of the enemy escaped across it.

Still the loss of the rebels that day had been severe. It was computed that not less than 400 of them had been killed or wounded. On the British side 88 had been placed *hors de combat*, but two battles had been gained.

But the thoughts of the General that night were not consoling. It was not alone, or even mainly, that his losses in the fight had been heavy, for sickness also had done its work. On the morrow of the two battles he could not, deducting the necessary guards, place in line more than 850 infantry. He knew that in front of him were places to be traversed, or stormed, the means of defence of which exceeded those of the places he had already conquered. Then too he had no means of carrying his sick, and he could not leave them, for he could not spare a sufficient force to guard them. But perhaps his greatest difficulty lay in the fact that every step forwards would take him further from his base, and he had information that that base was threatened. Náná Sahib, in fact, had no sooner heard of the onward move of the British, than he sent a considerable body of cavalry across the river to cut off their communications with Cawnpore. No one can doubt that the resolution at which Havelock arrived on the following morning, to fall back on Mangalwúr, and to ask for reinforcements was the right one. From Mangalwúr it would be possible to send the sick and wounded to Cawnpore without permanently weakening his force. He effected

this movement the following day without haste, and in the most perfect order. From Mangalwúr he despatched his sick and wounded into Cawnpore, and a letter to General Neill, stating that he had been forced to fall back, and that to enable him to reach Lucknow it was necessary that he should receive a reinforcement of a thousand men and another battery of guns. Neill had assumed command at Cawnpore on the 24th July. He had not been satisfied with the state of affairs as he found them there. The location of the troops appeared to him faulty, the camp pitched without method or arrangement, no effectual steps taken to put a stop to the plundering in the city—a plundering carried on by our European and Sikh soldiers.* His first acts on the 25th were to appoint a superintendent of police, to re-establish order in the city and bazaars, to put a stop to plundering. He announced his assumption of command, and notified the measures above stated in a telegram the same day to the Commander of the Forces, Sir Patrick Grant. The spirit of the man showed itself in the last sentence of this telegram :—" All well here. I will hold my own against any odds."

Not only was Neill aware that Náná Sahib, distant from him but 24 miles, was threatening to cross the river and to attack him, but he had received information that the mutinous 42nd Native Infantry were within 8 miles of the station, and that other native regiments were gradually collecting on the right bank of the Jumna with the avowed intention of making a dash on Cawnpore. But Neill was not disturbed. " If the 42nd are within reach," he recorded in his journal on the 30th, " I will deal them a blow that will astound them." With the levies of Náná Sahib he did deal. On the 31st he despatched a party of 50 Fusiliers and 25 Sikhs, with two 6-pounders, and a $5\frac{1}{2}$-in. mortar, manned by six gunners, under the command of his aide-de-camp, Capt. John Gordon, of the 6th Regiment, Native Infantry, in the steamer to Jajamáo, to seize the boats in which it was reported Náná Sahib intended to cross the river. The party destroyed several boats, carried off six or eight, and returned to Cawnpore the next day.

On the 3rd August Havelock was reinforced by Olphert's half-battery and a company of the 84th. Hopes had been held out to him that the 5th Fusiliers and the 90th Light Infantry would reach Cawnpore early in August. But owing to the mutiny of the regiments at Dinapore these regiments were retained though grievously required to reinforce Cawnpore. The disappointment only roused Havelock to renewed exertion. On the 4th August having then about 1,400 effective men under his command, two heavy guns, (24-pounders), two 24-pounder howitzers, and a battery and a-half

* Private journal of Brig.-General Neill, unpublished.

of guns, he started a second time in the direction of the besieged Residency. Having heard that the town of Bashíratgunj had been re-occupied in force, he bivouacked that night at Oonáo. Leaving that place early next morning he found the enemy occupying a position very similar to that from which he had dislodged them on the 29th July.

Havelock ordered the advance by the road of the heavy guns supported by the Madras Fusiliers and the 84th Foot, whilst the 78th Highlanders, the Sikhs and Maude's Battery should turn the village on its left. The heavy guns speedily dislodged the enemy from the outer defences. Meanwhile the turning movement greatly disturbed them. Bewildered by the progress it was making, and much embarrassed by the firing in front of them, they were stricken with panic, and fled across the causeway. In their flight across the causeway the rebels came under the fire of the guns of Maude's Battery and were mown down in numbers. The heavy guns continued all this time their destructive fire, silencing the guns of the enemy and forcing them back. The rebels did indeed for some time longer hold villages to the right and left of the town, but in the end they were forced out of these.

Still though the enemy was beaten "the whole transaction" to use the language employed by Lieut.-Colonel Tytler to Sir Patrick Grant, was most unsatisfactory, only two small iron guns, formerly captured by us being taken.

The loss of our force had not been large. Two had been killed and 23 wounded. The loss of the rebels was stated to be 300. But there were weighty considerations to stay further advance, cholera had broken out in the camp and that disease and fever had placed 75 men on the sick list. In the action at Bashíratgunj one-fourth of the ammunition had been expended. Between that town and Lucknow was a deep river, the Saí, and three strong places, guarded it was believed by 30,000 men. The Zemindars, too, had risen in bodies of 500 or 600, independently of the regular troops. "All the men killed yesterday," wrote Colonel Tytler, "were Zemindars." But even were the force able to reach Lucknow what could it effect, enfeebled and worn out against the myriads who would oppose it in the streets? On the morrow of the fighting at Bashíratgunj it was impossible to parade 900 infantry. To what extent would this number be reduced in fighting its way to the Residency?

Intelligence reached Havelock on the 6th that the men of the Gwalior Contingent had successfully mutinied against their own Maharajah, and were threatening to move on Calpee, a position which would threaten Cawnpore, and menace the communication with Allahabad. The intelligence regarding the Gwalior force then brought home to Havelock for immediate decision the question of advance or retreat; the advance could scarcely be

successful, and yet failure in his opinion involved the destruction of his force, and with it possibly a disaster at Cawnpore. Retreat only risked Lucknow, while an unsuccessful advance subjected Lucknow to a greater risk.

No sensible man will deny that under the circumstances of the case, Havelock exercised a wise judgment in deciding to retire and wait for reinforcements and he fell back on Mangalwár, when he lay there for four days recruiting his men. On the 11th he purposed to recross into Cawnpore, but learning that the rebels had established themselves in considerable force at Bashíratgunj, with advanced parties at Oonáo, prepared to disturb him while crossing, he resolved to anticipate them. For the third time he advanced along the Lucknow Road, pushed the advanced parties out of Oonáo, and bivouacked near that town for the night. At dawn he again attacked the enemy. Under his orders the 78th Highlanders precipitated themselves, without firing a shot, on the earthworks in front, while the Madras Fusiliers, to whom the turning movement had been entrusted, took them in flank. The result was decisive. Two of the enemy's guns were captured and turned on them and they fled in disorder leaving about 200 killed and wounded. Our loss amounted to 35. Having thus scared away the enemy, on the 13th Havelock leisurely fell back, and by 2 o'clock on that day had recrossed into Cawnpore without a casualty. His troops were taken over in the steamers and in country boats towed by the steamers, the current being still too strong to permit the putting together of the bridge of boats for which materials had been prepared.

The private journal of General Neill showed that he still held to his previous opinion that Havelock, in retiring after his first victory on the 29th June, had committed an error which could not be redeemed until he had received large reinforcements. Sir John Kaye in his *History of the Indian Mutiny*, Vol. III., does not concur in this view, and considering the immense temptation to Havelock to advance, the pain which the order to retreat caused him, the historian of the Mutiny cannot but regard his resistance to that temptation as the most heroic act even of his great career.

After the action fought at Oonáo and Bashíratgunj by General Havelock, and after three strenuous efforts to reach Lucknow by the small force under that great General's command, the retirement of the force to Cawnpore in order to await reinforcements was imperative.

Sir James Outram had been sent to Cawnpore to command the force which was to relieve Lucknow. In accepting that command he superseded the man whose daring efforts with an inferior force to effect that relief had won for him the applause and admiration of his countrymen. To the generous nature of Outram, it seemed

revolting that he should obtain the glory where another had endured the trials and the dangers. He could not do it, and he was determined that it should not be done. Availing himself of the circumstance that whilst from a military point of view, he was commander of the forces about to march into Oudh, he would also enter that country in a civil capacity as its Chief Commissioner, he published, the day of his arrival at Cawnpore on the 16th September the following order:—"The important duty of relieving the garrison of Lucknow had been first entrusted to Brig.-General Havelock, C.B., and Major-General Outram feels that it is due to that distinguished officer, and to the noble and strenuous exertion which he has already made to effect that object, that to him should accrue the honour of the achievement. Major-General Outram is confident that the great end for which Brig.-General Havelock and his brave troops have so long and gloriously fought will now, under the blessing of Providence, be accomplished. The Major-General, therefore, in gratitude for, and admiration of the brilliant deed of arms achieved by Brig.-General Havelock and his gallant troops, will cheerfully waive his rank in favour of that officer on this occasion, and will accompany the force to Lucknow in his civil capacity as Chief Commissioner of Oudh, tendering his military services to Brig.-General Havelock as a volunteer. On the relief of Lucknow, the Major-General will resume his position at the head of the force."

On the 17th General Havelock found waiting him on his return from a successful expedition to Bithoor, and after the capture of that place, a copy of the *Calcutta Gazette* dated the 5th August, containing the nomination of Major-General Sir James Outram to the military command of the country in which he was operating. He learned in fact that he was superseded. He received this information from the *Gazette* alone. It was accompanied by no communication to break the news. He received the bald announcement only. Superseded as he regarded himself to be, he was as active, as daring, as devoted, as when he ruled, the unfettered commander of an independent force. Never indeed was the exercise of the great qualities of resolution and energy more needed than after his return from the expedition against Bithoor. Out of 1,700 English troops whom he had altogether under his orders from the time of his quitting Allahabad, but 685 remained effective.

Not only was he now compelled to abandon for the moment all idea of re-crossing into Oudh, but the action of the Gwalior Contingent threatening Calpee, rendered it doubtful if he could even hold Cawnpore. Were Calpee to be occupied by this force, consisting of 5,000 disciplined men with 30 guns, his communications with Allahabad might at any moment be cut off.

To the north, the Nawáb of Furruckábád was ready with 30,000

men—some sepoys, some raw levies—to take advantage of any difficulty which might threaten Cawnpore. It was too, in the power of the rebels in Oudh to cross the Ganges at any point below Cawnpore, and acting singly or co-operating possibly with the Gwalior troops, to endanger his communications. Of all these dangers Havelock had the fullest cognizance. Yet his judgment was never clouded. To remain at Cawnpore was undoubtedly a risk, but to fall back on Allahabad would have been a calamity. He resolved then to hold Cawnpore as long as possible and to await the reinforcements which were on their way.

(*To be continued*).

REVIEWS.

HISTORY OF THE CORPS OF ROYAL ENGINEERS, VOL. III.

By COLONEL SIR CHARLES M. WATSON, K.C.M.G., C.B., late R.E.—(Price: Members of the R.E. Institute, 7s.; Non-Members, 10s 6d. R.E. Institute, Chatham, 1915).

THE Council of the R.E. Institute was well inspired in deciding that the time had come for bringing the history of the Corps up to date. They were only just in time, for the work was practically finished in July of last year. It would not have been possible to have carried it on during the stress of the present war, and the share of the Royal Engineers in this war will need a volume to itself. The Council was equally fortunate in securing so competent an historian as Sir Charles Watson. He is not only distinguished both as a soldier and a writer; in dealing with parts of his subject he speaks with special knowledge and exceptional authority. For instance, his account of the Sudan Campaigns from 1885 to 1899 is masterly. Brief as it is, he brings out the character and connection of the operations which led up to the recovery of the Sudan; at the same time he does not forget that he is primarily concerned with the doings of the Royal Engineers. As a subaltern he had served under Gordon in the Sudan, and in 1882 he led the British cavalry into Cairo after Tel-el-Kebir. But for more than 10 years (1891—1902) he was employed at the War Office in connection with the Barrack Loans, and this enables him to write a chapter on "Barrack Works," which is the most valuable chapter of the book.

General Porter, who brought the history of the Corps down to 1886, had a large field to cover, but it is surprising that he should have made hardly any allusion to barracks, with which the Corps has had so much to do. Sir Charles Watson wisely decided, therefore, to begin at the beginning in this case, instead of confining himself to the last 30 years. During the 18th century, owing to the antipathy to a standing army, barracks were practically unknown in England except in garrison towns. There they might be said to form part of the defences, and were built and maintained by officers of Engineers under the Board of Ordnance. At the beginning of the great war, in 1793, Pitt realized that billets and encampments would no longer meet the case, and took in hand the provision of barracks on a large scale; but instead of entrusting the work to the Board of Ordnance, he created a new office, that of Barrack-Master-General, to which he appointed Colonel Oliver De Lancey, who was at that time Deputy-Adjutant-General. This officer undertook the work of barrack construction on the express stipulation that he was not to become a public accountant. All payments were to be made by the officers commanding the troops on the spot. At the end of ten years or so it was found that over nine millions

of money had been spent, but the accounts had not been audited and could not be cleared up.

Mr. Clode suggests in *The Military Forces of the Crown* that the object of this singular arrangement was to withdraw a large expenditure from the control of Parliament, the cost not being submitted in estimates, but charged to what was called "the Army Extraordinaries." But it seems not improbable that it was largely a personal matter. The Duke of Richmond, who was Master-General of the Ordnance at that time, had many enemies, who—as General Porter showed (Vol. II., p. 210)—succeeded in wrecking his proposals for the defence of Portsmouth and Plymouth. In dealing with a matter on which public feeling was so readily inflamed as that of barracks, Pitt and Dundas may well have thought it best not to connect it with so unpopular and so headstrong a person. But whatever the motive, there can be no question that the method adopted led to great waste of public money, and that the Duke of Wellington did well when, in 1822, he brought about the transfer of the barracks to the Board of Ordnance.

In 1855, when things were going badly in the Crimea, that Board itself was swept away, much to the regret of many able officers. Now that we are creating a Ministry of Munitions to meet an emergency, one cannot help asking oneself whether the Board of Ordnance might not have been remodelled, instead of destroyed. At all events it is interesting to read the evidence given by the Duke of Wellington and Lord Hardinge before the Commission which reported in 1837 on the civil administration of the army. They put the case for the Board so forcibly, and with so much personal weight, that the schemes for consolidation were postponed for nearly 20 years.

But the chapter on Barrack Works is not concerned only with ancient history. The particulars given of recent barrack construction and of the successive loans providing for it are most valuable.

More than 50 pages of the book are devoted to the South African War, and these can only be made to cover the varied work of the Corps in that long struggle by severe compression. They tell all that is strictly necessary for the purpose, but it would have been a good thing to supplement them by references to more detailed accounts of particular sides of the work, such as Colonel Bethell's paper on the Blockhouse System in Vol. XXX. of the *Occasional Papers*. The changes in the organization of the Corps and in the regimental units are carefully registered, and those chapters give information which would be sought in vain elsewhere, and must have cost much labour. The same may be said of the list, running to 20 pages, of R.E. officers who have been employed in various departments of the State on other than Corps duties. Service in India is not included. It is mentioned in the preface that the work done by the Royal Engineers in India during 1886—1912 has been so important as to need a separate volume, written by an officer who has served in India. As regards professional work the omission seems warranted ; but in the list of employments it seems needless to suppress the fact that Lord Kitchener was Commander-in-Chief in India as well as in Egypt, and that Lord Sydenham was Governor of Bombay as well as of Victoria.

The volume ends with short biographies of 30 distinguished officers whom the Corps has lost during the period dealt with, and here Indian Engineers have not been excluded. The biographical sketches were an excellent feature of General Porter's history, and they are well supplemented by Sir Charles Watson. He has had the help of the obituary notices which have appeared from time to time in the *R.E. Journal*, and of the memoirs written by Colonel Vetch for the *Dictionary of National Biography*. Special mention may be made of the sketches of Sir Lintorn Simmons, Sir William Jervois, Sir Gerald Graham, and Sir Charles Wilson.

The Corps is greatly indebted to Sir Charles Watson for having undertaken so laborious a task, and executed it with so much ability and success.

E. M. LLOYD.

PAGES D'HISTOIRE, 1914—1915.

(Librairie Militaire Berger-Levrault, Paris: 5, Rue des Beaux-Arts).

THE Librairie Militaire Berger-Levrault has, since the beginning of the year, altered the main title of its *Pages d'Histoire*, 1914, series of pamphlets to correspond with historical facts. The first 30 numbers were published in 1914 and complete the issues of that year; these numbers have already been reviewed in the *R.E. Journal*. The 31st number is the first of the issues for 1915.

The 31st and 33rd numbers are in continuation of the 11th, 13th, 14th, 16th, 17th and 19th numbers of the series published in 1914 and deal with mentions in dispatches, and awards of the Legion of Honour and the Médaille Militaire; the 31st number covers the period 11th to 21st November last, and the 33rd number covers the period 22nd to 25th November last.

The 32nd number contains a technical description by M. Th. Schlœsing, Junr., of the now famous "75" gun with which the French Field Artillery is armed and also of the carriage and the ammunition for the same; diagrams are provided of the more important details described. The most important feature of the gun is naturally the breech-piece, a full description of which is given. The gun-carriage is provided with a cradle, firmly attached thereto, in which the gun recoils freely on discharge. An important feature of this mounting is the hydro-pneumatic energy restorer which, on the discharge of the piece, permits the energy of recoil to be utilized for the purpose of automatically restoring the gun into the firing position directly it reaches the extreme limit of its rearward travel—a distance of 1·20 metres. The details of the hydro-pneumatic restorer were kept secret before the outbreak of the present war and are not described; however, since the Germans captured some "75" guns in the early days of the war the great secret relating to the French field piece has now been disclosed to them. In order to provide an immobile platform for the cradle in which the gun itself is mounted, in addition to the spade attachment fitted to the trail piece of the gun-carriage, special brakes having sharp projections on their exterior are also supplied. When the gun is in action these brakes are brought under the wheels of the gun-carriage and with the aid of the trail-piece spade attachment permit the gun-carriage to be firmly anchored in the ground. The weight of the gun, with its moving parts, is 500 kilogrammes (about 1,102 lbs.) and on the discharge of its projectile—weighing 7·24 kilogrammes (about 16 lbs.)—the maximum velocity of recoil is calculated to be 9 metres per second, so that the period which elapses between the discharge of the gun and the moment that it has been restored to the firing position, after recoil, is measured in parts of a second only. The cradle for the gun is pivoted on the axle of the carriage so as to admit of its traversed in azimuth through a small arc.

To facilitate the laying of the gun on targets situated on any horizontal plane, different to that passing through the points of support of the cradle in which it is mounted, the elevating gear provided is of the type known as "independent," that is to say, this gear is not directly attached to any part of the tube from which the projectile is ejected. Another of the special features in connection with this gun is the appliance provided for setting the time fuzes; an illustrated description of this appliance is given.

A comparative table, in which the principal details of the French "75" and the German "77" gun are set out, concludes the description of the French field piece. Actual experience, in the present war, has proved that the French field gun is immeasurably superior to the German one.

The 34th number of the series is entitled *The Germans in Belgium* and contains the experiences of Mr. L. H. Grondijs, a Dutch subject, who visited Brussels, Louvain, Aerschot and other centres during the early days of the war. He arrived at the Belgian capital on the 19th August last; on that date the Civic Guard in this city had already been disbanded and the high-power wireless station, only very recently erected, in the Palace grounds at Laeken for the purpose of establishing telegraphic communication with Belgian Congo had also been destroyed by the Belgians. On the 21st August, Mr. Grondijs set out on foot for Louvain, but he had only reached the village of Tervueren when he encountered German troops on the march to Brussels. He was allowed to proceed to Louvain; on his arrival there he found a state of things providing evidence of the great relaxation which had taken place in the discipline of Germany. He testifies to the fact that the Belgian people had continued to behave in a perfectly correct manner, in spite of the provocation experienced by them, and gives many details of the arbitrary conduct of German officers, non-commissioned officers, and men; examples are also quoted of the nature and extent of the excesses committed by the German soldiery against the civil population of both sexes and of all ages. The sack of Louvain is described and an attempt is made to trace the causes which may have moved the Germans to act as they did. He attributes the misbehaviour of the German soldiery to religious bigotry and, in support of his view, directs attention to the fact that a great deal of the German violence was specially directed against Papists. Several instances are recorded in which Roman Catholic priests were purposely singled out for brutal maltreatment. Mr. Grondijs returned to Holland *viâ* Aix-la-Chapelle on the 29th August last, after having been in collision with German officers more than once.

The 35th number is in continuation of the 6th to 8th, 12th, 18th and 26th numbers and contains the official communiqués, etc., sent to the Provincial Authorities by the Central Government during the month of January. In an appendix are given summaries of the principal events of the war during the month; the first of them deals with the period 5th—15th January and the second with the period 16th—26th January.

The 36th and 37th numbers of the series contain extracts selected from current publications voicing the opinions of many prominent

Americans on the subject of the present war. In a preface to the first of these numbers it is pointed out that Germany has left nothing undone since the beginning of the war to win over American opinion to her side. The German Ambassador at Washington, the ex-Minister Dernburg, and Professor Kuno Meyer have, among other writers, applied themselves with German thoroughness to promote the interests of their Fatherland by taking part in a widespread publicity campaign. Two factors existing in the United States of America appeared at the commencement of the war to be such as to tell in favour of the German cause, namely, the fact that 20 per cent. of the population inhabiting the land of the star-spangled banner are of German extraction, and the presumption that, among the people of Irish extraction owing allegiance to the Great Republic, there existed a large proportion who have not forgiven, and could never forgive, Great Britain for the treatment meted out to Ireland in times gone by. The failure of this publicity campaign is now patent, and the cause of the failure can, according to the *New York Herald*, be summed up in one single word—"Belgium." In thoughtful American circles, it would appear, the question is no longer whether Germany is in the right or in the wrong, but rather, how far would it be politic for the American nation to take steps to bring home to Germany that she is in the wrong. It is suggested that President Wilson regards the maintenance of a very strict neutrality on the part of the American Government and people of paramount importance; not only does he continue to hope that far-reaching advantages will accrue to his country by reason of the adoption of this course, but he further anticipates that the assumption of this attitude in his country will, when the opportune moment arrives, enable him to play the part of Peacemaker in Europe. It is pointed out also that ex-President Roosevelt insists, on the other hand, that the United States of America, having become a co-signatory with the belligerent powers to the provisions of the Hague Conventions, ought now to intervene in order to obtain from Germany respect for and compliance with those solemn obligations to which she was a party and is now ruthlessly disregarding. The ex-President does not advocate a resort to arms, but inclines to the view that diplomatic pressure will produce the desired result. Many of the 17 extracts contained in the 36th number are culled from the *New York Nation*, the great liberal periodical published in the commercial capital of the great Republic.

The first of the extracts in this number consists of an appreciation of the late Archduke Francis Ferdinand contributed to the *New York Nation* of 30th July, 1914, by Mr. Henry S. Pratt. The author of the article points out that the late Archduke was as unpopular in his own natal town as in the other parts of Styria, in which the population is largely German. The reason given for this unpopularity is that the late Archduke favoured Slav rather than German interests, and further, being under strong clerical influences, he was imbued with ideas hostile to liberty. Nevertheless, even those who loved the late Archduke least experienced sincere regret on learning of his assassination; they recognized that he had many qualities requisite in a leader of men and was possessed of good intentions.

In another of the extracts (taken from the *New York Nation* of 6th August, 1914) is discussed the subject of "The Responsibility for the War." The opinion is expressed therein that the entry of German troops into Belgium and the Grand Duchy of Luxemburg was nothing less than direct defiance to Great Britain and by these acts alone Germany placed herself in the position of an outlaw among the nations of the world. It is suggested that even if the German Emperor did not actually let loose the dogs of war, nevertheless he failed to hold them in check on the leash; a thing he could easily have done had he been so minded. It is recognized that whatever may be the outcome of the present struggle, neither Europe nor the disciples of humanity can possibly allow a return to a state of things whereby three crowned heads, bound by a pact, can again give the signal for the massacre of human beings and the destruction of private and public property—quite irrespective of whether they are actuated by good intentions or whether they merely allow themselves to be carried away by caprice.

The extract which succeeds the foregoing is taken from the *New York Nation* of 24th December, 1914, and is entitled "The Neutrality of Belgium." It constitutes a reply by Mr. E. H. Turner to certain views expressed by Professor John W. Burgess, of Columbia University, on the subject of the violation of the neutrality of Belgium. The Professor recently stated that, in 1870, the British Government was in doubt as to whether the Treaty of 1839 guaranteeing the neutrality of Belgium still remained in force. He draws attention to the fact that not only have political changes of considerable importance taken place which have altered the face of Europe during the latter half of the 19th century, but also to the fact that the British Government entered into separate treaties with the North German Confederation and also with France at the outbreak of the Franco-Prussian War. The terms of these two treaties were identical, and provided that the neutrality of Belgium should be respected by each of the belligerents during the period over which hostilities might extend and for one year more beyond the date of the termination of the war. Professor Burgess argues that the foregoing treaties (entered into in 1870) expired by effluxion of time in 1872, and states that, since the foundation of the present German Empire, the Imperial authorities have never pledged themselves by treaty to respect the neutrality of Belgium. Mr. Turner, in his reply, calls attention to the fact that, in 1870, both Earl Granville in the Lords and Gladstone in the Commons declared in clear and unmistakable language that the Treaty of 1839 had in no way lost any of its force or validity by reason of the conclusion of the two treaties entered into between Great Britain and the belligerent Powers in relation to the neutrality of Belgium. He further points out that the whole world, even including Germany itself, has never been in the least doubt as to the obligations of the German Empire with regard to Belgium; so clearly indeed did the German nation recognize their obligations in this matter that the Imperial Chancellor when addressing the Reichstag in August, 1914, without hesitation openly admitted that the violation of the territories of the Grand Duchy of Luxemburg and of Belgium were acts contrary to International Law and excused these acts on the ground that necessity recognized no laws.

In another of the extracts taken from the *New York Times* of 8th November, 1914, the views are given of ex-President Roosevelt as to the possibility of applying the principle of the "Posse Comitatus" in relation to international affairs. Among the other extracts published in the 36th number, one deals with "The Neutrality of Italy" and another with "The Neutrality of Roumania."

The 37th number contains eight extracts, which are preceded by a Preface from the pen of Mr. F. W. Whitridge, the Editor of the *New York Nation*, and in it is discussed the question as to which of the belligerents was really responsible for starting the present war. The opinion is expressed that no American jury, except perhaps one empanelled from the jury lists of either Hoboken or Milwaukee, would for a moment hesitate in returning a verdict that Germany alone was the aggressor. The illusions under which German diplomats appear to have been suffering, prior to August, 1914, with regard to the state of preparedness of the French and Russian Armies, and the relation of Great Britain with Ireland, India, and her Colonies are also examined; and finally, after drawing attention to the nature of some of the appeals made to America by Germany, the Preface is closed with the reply of America. In this reply, Germany is called upon to hearken to the prayers of a nation whose millions express their unalterable desire that the present war, when brought to a conclusion, shall be productive of the following results, namely:—That the German people shall henceforth renounce their false gods; that they shall turn their assiduous attention to their own home affairs—these affairs being on a sufficiently large scale and important enough to engage the whole of their attention and energies; that they shall give back to the world the Germany of Luther, of Beethoven, of Goethe, of Schiller and of Kant; that they shall finally persuade themselves to recognize that their destiny in this world is not to conquer other peoples and races, but rather to elevate the minds of these other peoples and races—a beneficent occupation which has been industriously pursued for a thousand years and more by people of their origin.

The extracts contained in the 37th number are of considerable interest; one of them, taken from the *New York Nation* of 24th September, 1914, describes the working of the "German machine" during the days preceding the retreat from the Marne. Within the space of seven days the great German General Staff set in motion some four millions of men, and a nation at peace with the world became a nation at war with three powerful belligerents; the components of the military machine moved with the smoothness of an accurately balanced engine and with the regularity of a good timepiece; there was not a single hitch in the carrying out of the programme drawn up by the Great General Staff. Hundreds of workshops ceased producing articles normally required for civilian consumption; these hives of industry were at once placed under the orders of the Great General Staff and, without loss of time, the energies of the workers, not absorbed into the ranks of the field armies, were diverted to the manufacture of uniforms, boots and other munitions of war required by the troops sent to the front. Metals and other materials of military value were commandeered on a considerable scale and paid for in cash. The German troops were soon in collision

with their adversaries. Astonishing as was the nature of the early successes obtained by the German Army, nevertheless this incredibly efficient machine, when on the point of putting the finishing touch to its career of great accomplishments, failed to effect its great purpose; it neither captured Paris, nor surrounded the Allied Armies with a wall of steel, nor did it maintain itself in the advanced positions which it had reached in Northern France. An explanation of this failure is sought, and it is suggested that those responsible for making the most efficient use of the "Great Machine" overlooked the fact that its parts were made up of flesh and blood, parts which had not the same qualities of resistance and hardness as mere inanimate materials. It may be that the complete physical exhaustion of the German troops, more than anything else, was responsible for bringing the wave-like onrush threatening to engulf Paris to a standstill. The opinion is expressed that this extraordinary machine is far from destroyed yet; with foresight and patient labour the Great General Staff has made provision for meeting many vicissitudes. The German leaders are now fighting for the safety of their Empire, and this incentive may still cause miracles to be effected with the "Great Machine." Among other extracts contained in this number, one deals with economic doctrines bearing on the war, whilst another discusses General von Bernhardi and the theories of war disclosed in his writings.

The 38th number of the series is a reproduction of the Second Russian Orange Book and contains the diplomatic correspondence relating to Turkish affairs. It contains copies of 98 dispatches, the first of them dated 1st August, 1914, and the last of them 1st December, 1914. In the first of the dispatches contained in this correspondence, the Russian Ambassador at the Turkish capital informs his Government that the Grand Vizir had confidentially mentioned to him that the Austrian Ambassador at Constantinople had endeavoured to force Turkey to act in concert with Austro-Hungary and to support the latter's policy. The Grand Vizir also stated, at the same time, that he had resisted the pressure exerted on him, in view of his conviction that in the interests of the welfare of his country it was essential for Turkey to avoid participation in the conflict impending in Europe, in spite of the desire of members of the young Turkey party to compromise their Government in favour of the Triple Alliance. Events moved apace in the near East and on the following day—2nd August—the Russian Ambassador telegraphed to St. Petersburg that the Grand Vizir had that day, on being questioned on the subject, admitted that a mobilization of the Turkish Army had been ordered and, at the same time, had explained that the concentration of 200,000 men in Thrace and on the Bosphorus which had been ordered was a purely defensive measure dictated by fears regarding the intentions of Bulgaria. The Grand Vizir further stated that his Government had no intention of effecting any concentration on the Caucassian Frontier. In a second telegram sent on the 2nd August, the Russian Ambassador informed his Government, that in view of the explanations offered by the Grand Vizir, he himself was of opinion that Turkey would only remain neutral so long as it suited her purpose and that he felt the Turkish Government had firmly resolved to take advantage of the European situation, at the opportune moment, in order to

obtain a modification of the Treaty of Bukharest at the expense of Bulgaria. The correspondence shows that the Russian Foreign Office had received information on the 8th August that the *Goeben* and the *Breslau* were doubling Cape Matapan with the object of entering the Dardanelles; in consequence of this report, instructions were at once telegraphed to the Russian Ambassador requesting him to take immediate steps in concert with the British and French Ambassadors at Constantinople to point out to the Sublime Porte the serious responsibility which would be incurred if Turkey allowed German war vessels to enter the Dardanelles. In subsequent telegrams, reference is made to the alleged purchase by Turkey of these two ships, and the thoroughly Oriental methods of evasiveness adopted by the Turkish Government in dealing with the situation created by the entry of these German vessels into waters under the jurisdiction of the Sublime Porte are fully set out; the fact is also disclosed that both the ships arrived in Turkish waters in a damaged condition. The Russian Government was not desirous of involving Turkey in the great conflagration and on the 10th August a telegram was sent to the Russian Ambassador at Constantinople instructing him to maintain a strictly friendly attitude towards the Ottoman Government but, at the same time, it was desired that he should impress upon the Turkish Ministers how seriously they would jeopardize the continued existence of Turkey as a European Power by the adoption of a line of action which did not conform with the views of the Entente Powers. Nevertheless, by the 20th August the situation within the Ottoman Empire had become extremely serious; so much so indeed that the Russian Ambassador reported to his Government, on the date in question, that the military had taken charge of everything and that, instigated by German officers who appeared intent on dragging Turkey into the war, the Turkish soldiery had become most arbitrary in their conduct and dealings.

The correspondence further discloses the fact that on the 8th September the Russian Ambassador had obtained information regarding the intentions of the Ottoman Government to annul the Capitulations, and two days later he announced to his Government that the Grand Vizir had delivered identical Notes to all the diplomatic representatives accredited to Sublime Porte declaring the intention of his Government to annul the Capitulations as from the 1st October, 1914. In order to justify this action, the Sublime Porte took up the attitude that the Capitulations consisted of concessions which the Sultan had made voluntarily to foreign Governments and could, therefore, be annulled whensoever he might think fit. On the 10th September, all the Powers, including Germany and Austro-Hungary, handed in protests in identical terms objecting strongly to the annulment of the Capitulations. Subsequent telegrams, however, indicate that Germany and Austro-Hungary withdrew their protests. The Ottoman Government later endeavoured to enter into negotiations with the Entente Powers in relation to the Capitulations with a view to introducing some modifications therein, in the event of an agreement being reached, whereby the nationals of the Powers interested would be made subject to the same fiscal laws as the subjects of the Ottoman Empire.

On the date last mentioned, the Russian Ambassador sent a second

telegram in which he informed his Government that he had learnt from a reliable source that Enver Pacha had, five days earlier, received a communication from the German Ambassador at Constantinople informing him that the Wilhelmstrasse was of opinion that the time had arrived for Turkey to play her part definitely as an ally of Germany. Financial difficulties alone seem to have created, at this time, the serious obstacle which prevented Turkey in completing her arrangements to join the Mid-Europe Powers. Matters dragged on for some time longer and the diplomatic correspondence clearly reveals that Turkey, during this period of suspense, lost practically all power of independent action. On the 16th October the Russian Ambassador telegraphed to his Government that he had learnt, through a reliable source, of a meeting which had taken place at the German Embassy on the 11th *idem*, at which Enver Pacha and Talaat Bey had been present. Further that at this meeting an agreement was signed whereby Turkey undertook to commence warlike operations against Russia in consideration for financial assistance to be provided by the German Treasury. The Ottoman Government took the final step which was to involve its people in the Great War on the 29th October.

On the date last mentioned Odessa and the undefended Port of Theodosia were bombarded by Turkish war vessels, and although the Grand Vizir at first offered apologies for these belligerent acts, later he alleged that the rupture of friendly relations with the Entente Powers had been provoked by hostile acts on the part of the Russian Navy. The final dispatch of the series is one from the Russian Ambassador to his Government dated 13th November, 1914, in which he sums up the nature of the German intrigues in Turkey which are likely to prove the ruin of the latter country.

The 39th number contains 32 sketch maps of the western and eastern theatres of war showing the positions reached by the German advance at various dates. On the first of the sketch maps of the western theatre is depicted the line occupied by the German front on the 10th August, and on the last of them is marked the line held by the Germans on the 31st December, 1914. In the case of the maps relating to the Eastern Theatre,on the first of them is indicated the line occupied by the German front on the 10th August, whilst on the last of this series is shown the line held by the German forces on the 30th December, 1914.

The 40th number of the series contains extracts from the sayings and writings of Germans belonging to every intellectual class of society. The extracts are preceded by a preface written by Abbé E. Witterlé, an ex-member of the Reichstag, and in it he points out that those who will take the trouble to examine the views to which prominent Germans have, at various times, given expression and to extract therefrom the pith and marrow of that which appears to have been most seriously preoccupying their imagination, cannot fail to be struck with the single theme on which one and all harp with persistent reiteration: German hegemony throughout the universe; the all-pervading domination throughout the ends of the earth of the chosen people of the modern world. And in every case the methods advocated for accomplishing the great purpose are identical: resort to terminological inexactitudes,

the holding in contempt of the rights of others, violation of the national word of honour, the cult of savagery of the blackest order. Providentially German calculations have proved faulty and in consequence their plans have gone awry; nevertheless the indiscreet utterances of the leaders of the German nation are on record. The Abbé expresses the opinion that these utterances will, in future ages, come to be regarded as the unperishing stones which the would-be constructors of a greater Germany used in the building of a monument erected by them as a memorial to the saucy arrogance and smug satisfaction of a crazy nation.

The contents of this number are arranged in chapters, the first of which is entitled, " The Word of the Kings of Prussia," and contains the principal articles of the Treaties guaranteeing the neutrality of Belgium and that of the Grand Duchy of Luxemburg. The subsequent chapters contain extracts from the sayings and writings of the Imperial Chancellors, of philosophers, of professors, of military writers, and of intellectuals; the extracts being grouped according to the calling or profession of each of these several classes.

The final chapter is entitled " The Words of Witnesses " and contains documentary evidence, wholly German, from which is learnt the conceptions regarding truth and the description of humanity to which the " kultur " of the Teuton race has, in modern times, given birth. The editors of this number of the series being desirous that opinions may be formed independently concerning the thoughts, ambitions, and philosophy of the important classes composing the German nation have merely collected together in one volume the actual language employed by the representatives of these classes in their utterances of a public nature and have refrained from adding criticisms or comments on the extracts published. One of the earliest extracts in this series is an excerpt from a letter from Frederic II. to his Minister of State, Podzwill. The august monarch in this letter instructs his Minister in the following terms :—" If our object is to be gained by acting honestly, we will do so; on the other hand, if deception is necessary to attain our end, then by all means let us become knaves."

In this collection is to be found Bismarck's own account of the part he played in connection with the candidature of a Hohenzollern Prince to the Spanish throne; he tells of the pains he took to ensure that the alteration in the terms of the now famous " Ems Despatch " should be such as to ensure a popular outburst in France, the consequences of which must lead to a rupture of friendly relations between France and Germany. Quotations are given showing that the intellectual leaders of Germany have even in recent times approved of the action taken by the Iron Chancellor; in one of these Delbrück puts his views on record bluntly and tersely in the phrase, " Blest be the hand which falsified the Ems Despatch." This contains the reflection of the opinions of others who give a more wordy expression to their thoughts. A striking extract is given from the views of Professor Lasson on " War and the Ideal of Culture " published in 1868. The following are some of the more remarkable expressions of opinion contained in this extract : " Absence of preparation for war in a country is sign of the physical and moral decadence of its people. . . . The development of the

technique of war is never labour lost. . . . The gun is the most efficient tool for carrying on of the trade of a weaver (in international politics). . . . Whatever may be the nature of the progress of intelligence, of the material and moral conditions of a people, not possessing the possibility of self-defence and of assuring results acquired, all their labour is vain, and this nation can serve no more useful purpose in this world than that of playing the part of a dung-heap on the field of culture of more vigorous people." In this extract the author explains in what sense he employs the word "culture." He states: "Civilization is the general progress of humanizing influences over barbarism. Culture is the individual form that this civilization takes in the case of any particular people. Diverse forms of culture mutually oppose one another; each form menaces the others, for each is believed to be the true and perfect form and its votaries strive to extend its influence. . . . Every war arising out of reasonable causes must be carried on by each belligerent according to the forms of culture adopted by its country."

Copies are also given of two letters dated Berlin, 29th and 30th September last, from the pen of Lasson which appeared in the *Amsterdammer*, a Dutch weekly review, of 11th October, 1914. In the first of them the writer states: "A man who has not German blood in his veins can know nothing of Germany. We are morally and intellectually superiors of all others and without a compeer. It is the same with our organizations and institutions." Then follow adulatory phrases concerning William II. and von Bethman-Hollweg; a defence of the destruction wrought at Louvain by the German hordes; an expression of the opinion that "England goes to her ruin, though France may yet be saved" and that Russia shall no longer remain a contiguous neighbour of the German Empire; the determination is expressed that after the war Germany will start with a *tabula rasa*. The writer concludes this letter with the customary German assurance: "God is with us and is defending our just cause."

In the second letter, Lasson alleges that the Germans are powerfully armed, partly to afford Holland protection, and to this fact it is due that this small kingdom has been enabled to lead a quiet existence and amass wealth. He declares that Holland is only a dependance of Germany and gives vent to veiled threats against the Dutch, since they are suspected of hostile intentions towards the German Empire. The writer concludes this letter with an admission that Germany has now no friends; the reason for this state of things, in his own words, arises from the fact that "All fear us and regard us as dangerous, because we are intelligent, active and morally the superior people. We are the most free people on earth, for we know how to obey." In an interview granted by Professor Ostwald to a representative of the *Dagen*, an important Stockholm newspaper, he is reported to have said that "Germany wishes to organize Europe." How this was to be done was explained by the Professor and his views are republished in this number of the series. This collection would not be complete without some record of Harden's views. Enlightenment on this subject is forthcoming from the pages of a recent issue of the *Zukunft*. He expresses himself in the following language:—"It is not against our wish that we have been drawn

into this colossal adventure. It has not been imposed upon us by surprise. We have wished for it; and we ought to have wished for it. . . . Our strong arm will create a new law in Europe. It is Germany which strikes; when she has conquered new dominions by her genius, then will the priests of all the gods extol to the skies this blessed war. . . . Germany has not made this war to punish the blameworthy nor to liberate oppressed peoples and then to quieten her conscience in view of the fact that she has acted with disinterested magnanimity. She enters on the war by reason of an unshakable conviction that her works give her the right to more room in the world and to still wider outlets for her activity. . . . Spain and the Low Countries, France and England have seized and colonized great territorities, some of the most fertile in the world. The hour of Germany has now sounded, and she must assume her place as the directing power in this world."

Among the other professors quoted is V. Seyden. In an article which appeared in the *Frankfürter Zeitung* he shows the bitterness of his feeling against Great Britain in particular; according to him, "When peace is re-established, no self-respecting German will ever consent to stay in the same room as an Englishman. . . . We must, under a solemn oath, declare a vendetta against the English; we must never rest nor cease our preparations for another war, nor should we neglect the smallest effort until we have destroyed for all time even the minutest trace of English power. . . . The Germans are the elect of the earth; they will accomplish their destiny which is to govern the world and to direct the efforts of other nations in the interests of humanity." A French rendering of Lissauer's remarkable "Hymn of Hate" is appropriately included in this little volume; a perusal of these lines creates the impression that German hatred sounds equally bitter in verse as it does in prose, as exemplified by the extracts which precede the hymn. Among the military authors who have been laid under contribution by the editors of this number is Clausewitz; among his views to which prominence is given being the one in which he states: "Every idea of philanthropy in relation to war is a pernicious error; he who employs physical force to its fullest extent without sparing blood will always acquire preponderance over the enemy who does not so act."

From another extract a glimpse is obtained of the views held by von Schellendorf, who expresses himself in the following terms:—"The style of old Clausewitz is too soft . . . The next war will be atrocious! In the case of Germany and France, it is only a question of a duel to the death. . . . We will annex Denmark, Holland, Belgium, Switzerland, Livonia, Trieste and Venice, also Northern France from the Somme to the Loire. The foregoing programme, which we lay down without the smallest fear, has not been prepared by an idiot; the empire, referred to therein, which we desire to found will be no Utopia. We have from this time forth the means of realization at our hand."

Extracts from von Bernhardi's recent works have also been drawn upon; his opinions on war are, to-day, nearly as familiar to the peoples inhabiting this globe as are the words of their national anthems. The oft-quoted passage, "War is an instrument of progress, a regulator in

the life of humanity, an indispensable factor of civilization, a creative power," reveals sufficiently the mind of von Bernhardi. The text of the somewhat remarkable Proclamation issued by the Kaiser to his Army of the East is given in full; therein William II. declares:—" I am the instrument of the Most High. Let the enemies of the German people perish! God demands their destruction, God Who by my mouth commands you to give effect to His wish."

Last autumn when the excesses committed by German troops in Belgium were uppermost in the public mind, there appeared in Germany manifestoes, one being an appeal to the civilized world signed by 93 intellectuals, as representatives of Science and Art in Germany, whilst another was a protest sent to Foreign Universities by 22 of the German Universities. These manifestoes are reprinted *in extenso* in this number, and it is quite evident that the signatories thereto cannot have had brought to their notice the letters of German officers, extracts from which are also contained in this number, wherein these officers bear testimony to the abominable behaviour of their men, who looted and destroyed on a wholesale scale. There exist in Germany, as is well known, groups and elements, by no means in sympathy with the doctrines which, in recent times, have obtained so strong a hold in their country. The dictates of fairness prompted that the views of this minority, who do not see eye to eye with their fellow countrymen, should have an equally wide circulation as the views of the other classes of the German nation whose public utterances have been laid under contribution in this little volume. Hence it is that there are to be found in this number extracts, in which opinions are expressed by no means in harmony with those forming the major portion of the contents of this little volume. Among the extracts containing the views of the minority are the protest raised in the *Reichstag* by Liebknecht in August last; the condemnation by German socialists of the crimes committed in Belgium and France by the Teuton hordes; a confession by Max Nordau that better treatment was meted out to Austrians and Germans in Paris than that meted out to the French in Berlin; and also a scathing denunciation of the dominant race in Germany by H. Heine, who says: " The Prussians? . . . nature has made wild beasts of them, and science has transformed them into evildoers."

The 41st number contains a collection of poetry inspired by the War.

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY.

(The Wireless Press, Marconi House, Strand, W.C.).

THE publication of the 1915 issue of the *Year-Book of Wireless Telegraphy and Telephony* reminds us very forcibly of the immense progress that has been made in the extension and development of this form of communication during the last twelve months. The new volume of some 800 pages which lies before us serves not only as an admirable book of reference for all who have to do with the subject either in its commercial application or in the field of research; but also includes a complete historical *résumé* of the development of etheric wave telegraphy from its inception to the present day. All of us like to know something about the main factors which play their part in modern life, and some of us like to penetrate a little further into the mysteries; whilst others again already well informed, are anxious to keep abreast of the latest developments. All three classes will find in the *Year-Book of Wireless Telegraphy* exactly what they require.

Dealing with the main features of the book we come first to a carefully-compiled calendar succeeded by the exhaustive chronological account of the progress of wireless telegraphy above referred to. Here we have a chronicle in diary form showing at a glance what inventions and improvements were introduced in any particular year. This is followed by the full text of the International Radiotelegraphic Convention—a contribution of great value embodying the concerted policy of all the Governments in relation to wireless telegraphy. Incidentally it exemplifies the high importance officially attached to the new form of communication. The Safety of Life at Sea Convention stands next, the prominent part played therein by the various recommendations with regard to the employment of radiotelegraphy being specially notable. We then proceed to the text of the laws and regulations which are applied by the various countries to the control of wireless telegraphy both in relation to land and ship stations. A further extremely valuable feature, and one which should make a particular appeal to all interested in wireless telegraphy is the complete list of all ship and shore wireless stations together with their call signals and many other particulars. A copy of the *Year-Book of Wireless Telegraphy* will be very useful in every office, as it shows at a glance what ships are fitted with wireless apparatus, and the coast stations through which communication with them can be established. This list, together with the large and excellent map of the wireless stations of the world which is also provided, goes further than anything else we know to impress on the mind of the reader the world-wide field covered by wireless telegraphy. For ready reference the volume also includes an alphabetical

list of call letters. In addition to the tabulated information which is a valuable feature of the book, our attention is drawn by a series of original articles. Mr. Archibald Hurd, the well-known naval critic of the *Daily Telegraph*, contributes an able article on "Wireless and War at Sea," and Colonel F. N. Maude describes the influence of wireless telegraphy on modern strategy.

Amongst the more technical articles we find a dissertation on "The Function of the Earth in Radiotelegraphy" from the pen of that eminent authority, Dr. J. A. Fleming. "Wireless Telephony," by Mr. H. J. Round, summarizes the progress that has been recently made. It is of particular interest to note that Mr. Round at Marconi House was able to receive telephone conversation by wireless from Berlin last year, although the success of experiments was not complete. When one considers that *wire telephony* with Berlin is a very recent achievement, the news that long-distance *wireless* telephonic communication has been in a measure achieved will come as a great surprise to many. Dr. W. H. Eccles, whose work in connection with wireless telegraphy is well known, contributes an article on Radiotelegraphic Research in 1914. Amongst further noteworthy articles we find important contributions on Wireless Long-Distance Service, Wireless Telegraphy and Meteorology, and International Time Signals.

Epitomized Biographical Notices of practically everyone of note in the world of wireless telegraphy, particularly of the various companies which are concerned in the development and exploitation of wireless telegraphy, and a long list of Patents and Patent Applications for the year 1914 all add to the volume as a book of reference, whilst the technical man and student will find the tables, formulæ and equations of the utmost value. Amateurs will welcome the Directory of Wireless Societies, and the learner will turn with pleasure to the reproduction of all the signs and signals of the Morse Code.

NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

February, 1915.

THE SIEGE OF ADRIANOPLE.

In the victorious campaign that the four Balcanic States conducted against Turkey, fortress warfare held a prominent part, especially in the Turkish-Bulgarian theatre of war. Owing to the importance of the tactical rules that the various armies have rightly attributed to siege warfare, it naturally follows that the general staffs of the chiefs of these armies endeavour to study on the spot the operations of the sieges, and being unable to do so during the war, on the conclusion of the armistice they hastened to send special missions of officers to visit the strong place of Adrianople, around which the most important siege operations of this campaign had been developed.

It is interesting to consider the report of the Belgian Mission published in the *Bulletin de la Presse et de la Bibliographie Militaires*, as it is one of the most complete and trustworthy accounts of the operations of the attack and defence of Adrianople from the 22nd October, 1912, to the 26th March, 1913.

The work may be divided into the following parts :—

1st. The geographical and topographical conditions of the forts of Adrianople.

2nd. The conditions of this strong place and its defensive organizations.

3rd. Their functions in the theatre of operations.

4th. Operations of the attack and defence of the place.

5th. Observations and lessons.

1*st. Geographical and Topographical Conditions.*—Adrianople is about 40 km. from the Turkish-Bulgarian Frontier, and owing to its importance as a habitable centre is the second city of European Turkey, and a great agricultural emporium of Thrace. It is situated in the last great loop, open towards the east, that the Tungia makes near to its confluence with the Maritza and precisely on the south-west spur of the chain of heights that constitutes the dividing waters between the course of the Tungia and the lower course of the Maritza.

The village of Karagatch, recently built, at a little distance from Adrianople, is situated on the right of the Maritza, was inhabited by the European colony ; and was considered as a suburb of the city as it was connected by a metalled road, 3 km. in length, which crossed the Maritza and the Tungia by two masonry bridges.

Adrianople lies in proximity to the great railway line Sofià—Constantinople which after passing along the Upper Maritza crosses the Arda by an iron bridge; and passes to the south-east end of Karavatch where before the war was the small railway station of Adrianople. The town was inhabited by about 110,000 persons, half of whom were Turks and the other half Greeks, Jews, Bulgarians and Armenians. The roads of Adrianople are narrow and winding, the houses generally built of wood. In the immediate vicinity of the city there are large barracks, schools for the under-officers and an arsenal. The surroundings of the place are bare, without trees, without great lines of communication, and without cover, except the crests of the hills and some vineyards. A few small villages sparsely inhabited surround Adrianople; and the houses of these are built of bricks, and with wooden or thatched roofs.

The ground during the winter is covered with marly mud which prevents the movement of carriages, of beasts of burden, and even of foot passengers. The fields all round the place are not ploughed, and the paths are impracticable during the bad season. There are a few metalled roads like that which runs to Kirkilepe to the south-east of Adrianople; and another which from this town runs to the south-west towards Karagatch; and also the road which on the left bank of the Upper Maritza bears towards the locality called Mustafà-pascià, at a little distance from the river and with a road raised about 10 m. from the surface of the water which is not covered during the floods.

2nd. Conditions of the Place, and its Organization for Defence.—In 1908 after the revolution of the young Turks, the new Ottoman Government had transformed Adrianople into a modern fortress by placing it in a state to cover, together with the two forts of Kirkilepe, the mobilization of the Turkish Army, and to bar the way to Constantinople to an eventual Bulgarian invasion of Thrace by the Maritza and Tungia Valleys.

In fact, the progress of transformation, designed by German military engineers in the service of Turkey, was only carried out in the North-West Sector, which the German Field Marshal, von der Goltz, had considered the most likely for attack, when in 1909, he directed the first great Turkish manœuvres. So that at the commencement of hostilities, 18th October, 1912, the place was found almost in the same condition as that of 1877; that is with a simple ceinture of old works constructed by means of field and mixed fortifications, and placed at a small distance from the inhabited nucleus. The place was now encircled with barbed-wire entanglements. The intervals between the forts were not generally speaking more than 1,000 m.

In the same North-West Sector there was not even a single permanent work that could be called modern; so that the new forts were in reality simple rectilineal trenches for infantry, without proper flanking defences, protected only on the front and flanks by lines of barbed wire.

Between the forts there were several exposed batteries some of which however were of armoured cement; and the latter were armed with old pattern guns brought from old forts which had been disarmed.

The several groups of forts armed with artillery were as follows :—

Group of Karakustaria, 54 guns.	A new fort : L'Yazu-Tepè. An incomplete fort to the west of the former. Two batteries of 6 guns of 15 cm. Two batteries of 6 guns of 12 cm. Five batteries of 6 guns of 8·7 cm.
Kurutchesme Group, 30 guns.	Two batteries of 6 guns of 15 cm. One battery of 6 guns of 8·7 cm. One battery of 6 howitzers of 15 cm. One battery of 6 mortars of 21 cm. Several entrenchments.
Gheitantaria Group, 24 guns.	An old entrenched fort : Karakus Tabia, with barbed-wire entanglements. Two batteries of 3 guns of 10·5 cm. Three batteries of 6 guns of 8·7 cm.
Kazan-Tepè Group, 39 guns.	Two new forts : Kazan-Tepè and Kazan-Kepra. One battery of 6 guns of 15 cm. One battery of 6 guns of 10·5 cm. One battery of 3 guns of 10·5 cm. Four batteries of 6 guns of 8·7 cm.
Kemer Bachiuk Group, 54 guns.	Two old forts : Bachiuk and Kemer. One battery of 6 guns of 15 cm. One battery of 6 guns of 10·5 cm. Six batteries of 6 guns of 8·7 cm. One battery of 6 mortars of 15 cm.

All the work of this sector except those of Uchtepeliè and Kadikeu were connected with the town of Adrianople by permanent railways, Decanville, Kazan-Tepè, Kemer-Bachiuk and Handerluk, and were connected with the interior of the fortress by ordinary metalled roads.

North-East Sector.—On the principal lines for about 16 km. there were arranged in steps nine forts and several batteries. Fronting towards the north there were in batteries and in the intervals of the forts Kaialuck-Tabia, Nuovo Tach-Tabia and Aivas-Babia :—

One battery of 6 guns of 15 cm.
Two batteries of 4 guns of 15 cm.
One battery of 6 guns of 12 cm.
One battery of 6 guns of 8·7 cm.

On the left on the Eastern Front there were in batteries in the intervals and in the vicinity of six forts 108 guns and mortars, viz. :—

Four batteries of 6 guns of 15 cm.
One battery of 6 guns of 10·5 cm.
Eleven batteries of 6 guns of 8·7 cm.
Two batteries of 6 mortars of 15 cm.

In rear of the before-mentioned principal lines of defence there were two old forts near to the Tungia, and behind the extremity on the other side of the principal lines towards the east there was the old Fort Kaik. In front of the salient Aivas-Baba there was the advanced group of Maslach, consisting of new modern but incomplete works, and three batteries each for 6 guns of 8·7 cm.

South-West Sector.—The principal lines of defence of about 10 km. in this sector comprise three groups of works :—

Bosnakeui Group, 6 guns.	One old fort (Bosnakeui). One battery of 6 guns of 15 cm.
Suiskli Groups, 24 guns.	An old fort (Domerdegh). Two batteries of 6 guns of 15 cm. Two batteries of 6 guns of 8·7 cm.
Karagatch Group, 30 guns.	Two old forts (Karagatch and Marach). Two batteries of 6 guns of 15 cm. Three batteries of 6 guns of 8·7 cm.

In these sectors there are no advanced works, but there is a line of external positions, as in the other sectors, about 6 km. distant from the principal lines. The Turks had also established advanced posts on the Hill Kastal Tepè.

West Sector.—The principal lines of defence at only 6 km. consist of trenches, excavated in front of the village of Marach, on the hill Papas Tepè. The lines of external positions protected by the right bank of the Upper Maritza and the left of the Arda, form as it were an arc of a circle with the centre at the confluence of these two rivers. Altogether, then, extending for about 50 km. of the principal lines of defence, the place opposes to the attack about 419 guns, placed in batteries on the lines of the old forts which had been entirely disarmed, except the new Tach-Tabia on the North-East Sector, and utilized either as protective places for the infantry, or as depôts for projectiles or other artillery material. The general reserve of artillery contained 138 guns.

As defended from outside the place presented to the attack the following defensive dispositions—One line of external positions consisting of trenches ; one principal line of defence, surrounded by formidable entanglements of barbed wire, and comprising places of protection for infantry, old and new forts, in connection with the trenches and field batteries. The barbed-wire entanglements of a depth of 8 to 10 metres distant from 50 to 100 metres from the lines of the work of the principal zone of defence. The field batteries generally constructed on the crest, were actually visible. Those of medium calibre which were situated on the lines of the old forts, presented easy targets to the attacking artillery.

Outside and behind the forts there were constructed recovering places of masonry for the troops assigned to the principal lines of defence ; and these recovering places were connected with the forts by trenches.

March, 1915.

THE FORTIFICATIONS AND THE STRATEGICAL IMPORTANCE OF THE PANAMA CANAL.

The republic of Panama has an area nearly equal to that of Scotland. The independence of the republic is guaranteed by the United States who assume the responsibility of its military defence. The country is sparsely populated and a great part is covered with forests.

The entire zone of the canal, a strip that extends for 8 km. on the two sides and for its complete length is prolonged for 5 km. into the sea at the two extremities, and is in the absolute possession of the United States. The two towns of Colon and Panama are not included in the zone. The Bay of Limon in the Caribbean Sea is partially closed by a dyke extending for about 3·2 km. from the point Toro towards the north-east.

The canal properly called commences in the bay, where it has a direction from north to south, and requires continually for its whole course dredges for the removal of the sand ; and proceeds after traversing the bay, for 4·8 km. in a low marshy zone, ending at Gatun where there is the great plant for the opening and closing of the locks. These are double. Each is subdivided into three compartments which are of such dimensions that each can contain one of the largest mercantile or war ships. In the locks, where the water can be raised to the level of the Bay of Limon and that of the Gatun Lake—the ships can follow one another at an hour's interval ; so that the locks being double 48 ships can pass in 24 hours. The whole course of the canal is illuminated at night for 15 hours.

Passing the locks at Gatun the ships traverse at a moderate speed the lake of the same name for 36 km., and then for about 13 km. the famous cutting of Culebra. This is the narrowest part of the canal which here is not more than 90 m. in width ; so that everywhere it allows for the passing of two ships at the same time. In the Culebra Cutting the canal lies at 12 m. below the level of the sea. The hydraulic plant at Gatun serves to regulate the level of the water of the lake in such a manner that in dry seasons the canal, in the stretch of the Culebra Cutting, has not less than 12·3 m. of water ; which is sufficient for secure navigation. At the southern extremity of the Culebra Cutting, near to Pedro Miguel, a second system of locks serves to lower the ships to the level of the small lake of Miraflores, at the extreme end of which there is a double lock of the same name to carry the ships to the lower level of the last stretch of the canal, which excavated in a marshy zone, leads to the Gulf of Panama. The total length of the canal, including the two stretches in the sea is about 81 km. ; excluding these stretches only 64 km. The canal from its entry at the Pacific, in the Gulf of Panama, is protected by a dyke 3·5 km. in length which joins the island of Naos on *terra firma* and is prolonged to the other two islands of Perico and Flamenco.

The Defences of the Canal.—The president of the commission charged with the study of the canal, Colonel Goethals, had advocated the necessity of permanently stationing a corps of 20,000 or 25,000 men, in the conviction that, with such a force, and with the assistance of the fortifications, a resistance could be made similar to that of Port Arthur. But under the peculiar conditions of the United States the troops des-

tined in peace times for the defence of the canal were reduced to 8,300 men, of which number 1,300 were coast artillery. The fortifications are designed to oppose attacks either by sea or land. There are also commodious barracks at Culebra and Miraflores for the troops which comprise 12 coast companies, 4 infantry regiments, 1 group of mountain artillery, 1 squadron of cavalry, 1 company of engineers, 1 company of signallers, 1 sanitary company. These troops are destined for the defence of the locks at the two extremities of the canal.

Gatun and Miraflores are connected by a railway (58 km.). There are also some excellent paved roads, and there are boats on the Gatun Lake for the supplies required by the troops. The forts at the mouth of the canal in the Pacific are arranged as follows :—Near Balboa on dry ground the Fort Amador with 2 batteries, each of 4 guns of 15 cm. In the group of the three islands, Naos, Perico, Flamenco (connected with one another and with the mainland by an embankment on which a railway will probably be constructed), there is Fort Grant which contains 6 batteries completely armed with guns of 40·6 cm, at Flamenco, 12 mortars of 30·5 cm., 2 guns of 15 cm. and 8 guns of 12 cm. At about 11 km. south of this island group, is situated the island Taboga for which no fortification has been projected. It was considered by the commission of defence for the canal, General Wedver, that the fire from the mortars at Fort Grant could reach this island. The objection has been raised by some that the island Taboga being undefended by forts might without difficulty become a place of refuge for an enemy's ships. So that there is a probability that in the future the island may be fortified. The locks at Miraflores distant 12 k.m. from Flamenco are not visible by ships from the Gulf of Panama, and are protected towards the south by a hill.

At the mouth of the canal in the Atlantic the defensive works are organised as follows :—On the island Margarita low down on the beach there is Fort Randulph ; on the slight elevation at point Toro there is Fort Sherman. These two works are the principal ones destined for the mouth of the canal in the Caribbean Sea. Fort Randulph consists of 3 batteries armed with 8 mortars of 30·5 cm., 2 guns of 35·6 cm. and 8 guns of 12 cm. Fort Sherman has the same armament distributed in 4 batteries. Both are connected with the Panama Railway. In addition to these principal works at the point Manzanillo near Colon there is Fort Lesseps armed with 2 guns of 15 cm. The principal works, both on the Atlantic and the Pacific, are defended by mine-fields. The zone of the fortifications is not subject to frequent mists, so that it is not likely that the enemy's ships except submarines would be able to pass unobserved. Submarines for defensive purposes are stationed at both ends of the canal. The locks at Gatun are visible by ships from the Caribbean Sea 11 km. from the Toro Point. One means of rendering the canal impracticable would be the damaging of the plant that serves to regulate the water in the locks. The destruction of the cemented embankment would require not less than two days ; but should it succeed the losses would be immense ; and the passage through the canal would be impeded for several months. To accomplish this the banks of Rhio Chagres in the middle of the dyke near Gatun would be an important object of attack. All the zone of the canal is

considered as a military zone, and no centres for inhabitants are permitted to be established within it. It is believed that the rank vegetation of this moist and tropical region would efface the traces of footpaths and mule tracks and would create such a growth of trees and bushes that for any detachment of troops to advance through it, the way would have to be opened, step by step, with the hatchet. Malaria is combated with all special precautions of mosquito nets, and good water; so that the annual mortality is now reduced to 11 per cent., while at an earlier period it was 35 per cent. The healthy zone does not extend far; so that an enemy's troops who might venture into the contiguous regions would suffer great losses from malaria and yellow fever.

Maritime Plant.—In the zone of the canal the following plant is furnished by the maritime department. At Caimito in the middle of the Isthmus of Panama there is a powerful wireless telegraph station, with a radius of 4,000 km., which can communicate not only with Washington, but also with San Francisco, Buenos Ayres, Valdivia and S. Vincenzo on the Cape Verde Islands. And it may be noted that no nation except the United States can establish wireless telegraphy in the whole of the republic of Panama.

At Balboa, protected by high hills, there is a great careening basin, near to which there are buildings and offices for effecting repairs. At Colon and Balboa there are also very large storehouses for coal of capacity of 290,000 tons and 160,000 tons respectively. There are also two depôts for petrol at the two extremities of the canal; and along the whole length of the canal there is a tube for the distribution of oil to the ships. There are now constructed depôts for provisions and refrigerators, and there are barracks for from 500 to 1,200 men.

Strategical Importance of the Canal.—The conditions of the Federal States on the Pacific coasts are such that naval forces taking refuge in their ports would not be sufficiently secure and would have to be reinforced by ships taken from the ports in the Atlantic. The strategical scope of the Panama Canal is that of allowing the United States in case of need to send ships from the Atlantic to the Pacific, by a route of 8,000 miles shorter than that formerly followed by the Straits of Magellan, and *vice versâ* to draw ships as reinforcements from the Pacific to the Atlantic. The duties of the Pacific Fleet are essentially the following:—

(*a*). The defence of the Californian States, of Oregon, Washington, and Alaska, against an invasion on the part of Japan.

(*b*). Protection of the Philippine Islands.

(*c*). Direct action to assure to the United States the possibility of exercising influence on the future development of China.

(*d*). Sustaining the Monro policy on the American-Latin coast, Mexico and Chili.

The distance from New York to San Francisco passing round Cape Horn is 13,700 miles or rather more than from Petrograd to Vladivostok by the Suez Canal, by the Panama Canal it is reduced to 5,300 miles. This also improves the situation of the United States indirectly insomuch as the migratory current from Europe tends more than in the past towards the Pacific, and would render more difficult the penetration of the yellow races into the Western States.

E. T. THACKERAY.