THE ROYAL ENGINEERS JOURNAL.

Vol. I. No. 1. JANUARY, 1905.

CONTENTS.

PROFESSIONAL PAPERS OF THE CORPS OF ROYAL ENGINEERS.

OCCASIONAL PAPERS SERIES.—VOL. XXX., 1904.

PAPER I. **Convoys in War**, by Col. C. St. L. Barter, C.B., C.S.O., Thames District ..... 1s. 6d.

" II. **The Anglo-Liberian Boundary Commission, 1903**, by Lieut. E. W. Cox, R.E. ..... 1s.

" III. **Fortification in its Tactical Application**, by Capt. H. F. Thuillier, R.E. ..... 2s.

" IV. **Pumps and Air Lifts for Raising Water**, by Percy Griffith, Esq., M. Inst. C.E. ..... 1s. 6d.

" V. **The Protection of Foreshores**, by W. H. Wheeler, Esq., M. Inst. C.E. 1s. 6d.

" VI. **Sewer Ventilation**, by Wm. Brown, Esq. ..... 2s.

" VII. **Salvage and Destruction of Shipwrecks**, by Lieut. P. G. H. Hogg, R.E. ..... 6d.

" VIII. **A New System of Reinforced Brickwork as Applied to Above-Ground Cylindrical Water Tanks**, by Major E. Stokes Roberts, R.E. ..... 1s.

" IX. **Notes on Fire Protection in Barracks**, by Capt. E. H. Harvey, R.E. ... 1s.

" X. **Metallography**, by Capt. R. K. Bagnall-Wild, R.E. ..... 2s. 6d.

" XI. **Pieter's Hill: A Tactical Study**, by Major F. A. Molony, R.E. ..... *In the Press.*

" XII. **The Blockhouse System in the South African War**, by Bt.-Col. E. H. Bethell, D.S.O., R.E. ..... *In the Press.*

The price of separate Papers as above, in paper wrappers, is net.
They may be obtained from Messrs. W. & J. MACKAY & Co., LTD., Chatham, or from any Bookseller.

CONFIDENTIAL SERIES.

No. 15. **Electric Lights for Coast Defence**, by Major W. Baker Brown, R.E. Revised edition ..... 3s.

Obtainable, only by Officers of the Navy and Army on full pay, from the Secretary, R.E. Institute, Chatham.

CONTENTS.

Contributions should be written *on one side only of the paper*, and preferably on white paper of foolscap or bank post size.

Each article must be accompanied by the name of the author, but the question of publishing it anonymously or under his name is left to his discretion. *Noms de plume* are inadmissible.

Authors are allowed six re-prints of accepted contributions, provided a request to this effect is forwarded with the manuscript.

Manuscripts, whether accepted or otherwise, will not be sent back to contributors unless their return is specially asked for at time of submission.

PREFACE TO NEW SERIES.

THE *Royal Engineers Journal* was started in 1870 as a monthly newspaper for private circulation amongst subscribers; it was published by a Committee in London. At first it included a "Distribution List of Officers of the Corps," but from January, 1873, this List was printed separately as a *Supplement*. The *Journal* proper contained:—(1) articles on military, technical and miscellaneous subjects, and (2) matter of a more or less private nature concerning the Royal Engineers and their various regimental institutions and funds. At the end of 1875 the publication was taken over by the Royal Engineers Institute, which had been founded early in the same year.

The *Professional Papers of the Corps of Royal Engineers* were commenced in 1837 for circulation amongst subscribers, and were also published by a Committee of officers in London. They included technical articles on subjects connected with the multifarious duties of the Corps, were issued in annual volumes, and were on sale to the general public. They were taken over by the Royal Engineers Institute in the year 1876.

The Committee of the Institute have recently decided that the requirements of the present day necessitate some modification in the form and period of the above publications.

From the commencement of the current year the *Professional Papers* will be issued in separate pamphlets, and will be bound in volumes when and as often as sufficient Papers have been printed to fill a volume of convenient size. They will be practically confined to contributions of a highly technical nature and to others which are necessarily accompanied by numerous illustrations.

The *Royal Engineers Journal* will be published as a magazine available for purchase by the public, and will contain articles of interest to the Army at large as well as those of a technical character. Matter of a purely private or regimental nature will be printed in a separate *Supplement* in the same size, the present *Supplement* retaining its folio shape but changing its title to the *Royal Engineers Monthly List*. These last two will be strictly limited to private circulation.

Fig 1. Short Lee-Enfield – Free Recoil

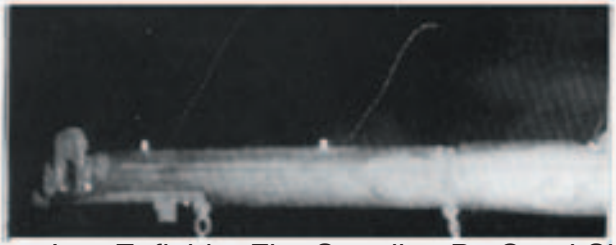


Fig 2. Short Lee Enfield – Fire Standing By Good Shot

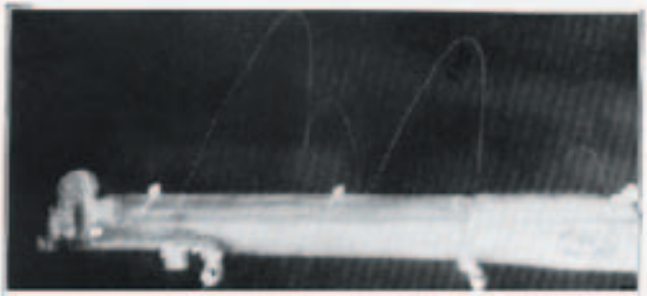


Fig 3. Short Lee Enfield – Fire Standing by Bad Shot

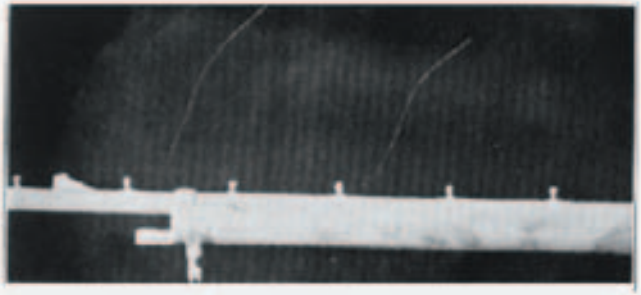


Fig 4. Short Lee Enfield – Fire Standing By Good Shot

THE RECOIL OF SMALL ARMS.

By LIEUT. F. V. THOMPSON, R.E.

PREFATORY NOTE BY MAJOR C. F. CLOSE, C.M.G., R.E.

IN the year 1897, Major (now Lieut.-Colonel) C. B. Mayne, R.E., drew attention to a paper published in the *Journal of the United States Artillery*, Vol. IV., entitled "Note on a photographic method of determining the complete motion of a gun during recoil," and written by Dr. A. C. Crehore and Dr. G. O. Squier, U.S.A. The experiments described in this paper were of a rough-and-ready nature and no quantitative results were obtained, but they served to indicate the possibility of arriving at valuable information if more refined methods were adopted.

Accordingly, with the approval of the authorities, the writer of this note undertook a series of experiments which lasted for some weeks during 1897. Capt. (now Major) E. H. Hills, R.E., contributed much to the success of the experiments and lent a small motor and also a micrometer which was used for measuring the plates; the micrometer was again kindly lent for the 1904 experiments.

The 1897 experiments, which dealt with the Martini-Henry rifle, the Lee-Metford rifle and the Webley revolver, brought to light several previously unknown facts. The most important of these was the existence of vibratory movements of the rifle, materially affecting its shooting. The next was the determination of the maximum free velocity of recoil and the portion of this due to the rush of gas out of the barrel. Other interesting results were the exact paths and instantaneous velocities of recoil of rifles fired from the shoulder kneeling and standing, and the amount of rotation round a longitudinal axis. An account of these experiments was published in 1897 as No. 8 of the Confidential Series of the *Professional Papers of the Corps of Royal Engineers.*

1904 EXPERIMENTS.

The following experiments were undertaken by the direction of the Commandant, S.M.E., with the sanction of the G.O.C. IVth Army Corps. The intention of the experiments was to determine the recoil velocity and barrel vibrations of the Lee-Enfield short rifle.

Before discussing results it will be as well to describe briefly the apparatus used.

DESCRIPTION OF APPARATUS.

The method consists in photographing the track described on recoil by luminous spots on silvered studs fixed to the rifle.

The luminous spots were images of the crater of the positive pole of a small arc lamp (requiring 40 volts and a current of 15 ampères) on the spherical surface of highly-polished silvered studs.

As the rigidity of the rifle was to be investigated, three or more studs were required and these were soldered on to the barrel of the rifle.

The weight of the studs was small, but was allowed for in making corrections.

So far we have the means of obtaining the form of the path along which any point of the rifle travels. To obtain the velocity of recoil at any instant a measure of time is necessary, and this is obtained by rotating a fenestrated disc (by means of a motor and secondary batteries) at known speed in front of the camera or light, so that light is cut off from the plate or studs (both methods were employed) at known intervals of time.

The disc most used in these experiments had 50 equal sectors, 25 open and 25 closed. It completed 1,000 revolutions in times varying from 80 to 90 seconds. A counting apparatus and stop-watch were used.

The disc thus gave exposures of about $\frac{1}{600}$ of a second, and the track of the studs appeared on the photographic plate as an interrupted line or series of dashes (see *Fig.* 1).

The plate was exposed about one second before the explosion took place.

By measuring the interval on the plate between successive exposures, knowing the scale, a measure of the velocity is obtained over a very small portion of the path described by the studs.

SOURCES OF ERROR.

In measuring velocities from photographic plates, the following are possible sources of error :—

1. Error in the counting apparatus of the rotating disc. This apparatus was tested and found correct.

2. Error due to the light not being cut off instantaneously. This error was eliminated by so placing the disc that each sector had its edge horizontal as it crossed the optical axis of the lens. The lens was fitted with a narrow slit-shaped stop arranged horizontally and itself a sector of a circle.

3. Error due to change of rate of motor. This was found very constant.

4. Error due to inequality of dashes and spaces. This error was eliminated by making all measurements form the end of a dash to the similar end of the next dash to it.

5. Error due to the proper motion of the reflection of the light on the spherical surface of the stud. This error does not exceed three in a thousand; the correction was calculated and applied. The radius of the spherical stud used was 0·12 inches.

6. Error due to plate not being parallel to rifle. This is too small to need correction.

7. Errors in measurements. These were made with a micrometer reading to 0·001 m.m., and are obviously more accurate than at all necessary.

8. Errors in scale. This is merely a question of careful measurement of the distance between centres of studs.

9. Error due to weight of firing spring, string and silver studs. This weight was carefully ascertained and the necessary correction made.

FREE RECOIL.

Theoretically, if the rifle and ammunition are at rest and quite free to move, on the explosion of the charge, the momentum of the bullet and charge in one direction will be equal to that of the rifle in the other.

Hence, assuming that the gas is expanding uniformly at the instant the bullet leaves the bore and that the velocity of the bullet is 2,000 f.s., and all weights being known, it is found that the velocities of the Lee-Metford, Lee-Enfield, Mark I.* and Lee-Enfield Short Rifle are 7·2 f.s., 7·29 f.s. and 7·72 f.s. respectively at the instant the bullet leaves the bore.

This takes no account of the moving column of air in front of the bullet.

In practice, a near approximation of a rifle free to move is a rifle hung by a long fine wire, in which case the rifle is nearly free to move horizontally.

For this experiment therefore the rifle was hung horizontally by a wire about 12 feet long. To fire the rifle without affecting its movement, the following device was used:—The trigger was held back by a spring attached to the butt swivel; it was then pulled forward by a string and made fast; the string was burnt and the rifle thus fired without affecting the true velocity of recoil.

The rotating disc as described was used to obtain a measure of the velocities.

The detail of the results of measurement of these plates is given below. The maximum velocity was measured from the track of each of three studs on each of the three plates, and a mean taken in each case.

Corrections were made for errors (5) and (9).

The rifle was fired without sling or bayonet and with magazine empty.

No. of Plate.	Interval in Seconds from Time of Explosion.	Maximum Measured Velocity in f.s.	Corrected Maximum Velocity.
52	$\frac{1}{50}$	9·70	9·910
78		9·85	10·06
79		9·75	9·960

Average maximum velocity, 9·98 f.s.

Thus the maximum free velocity of recoil of the Lee-Enfield Short Rifle with cordite ammunition is 9·98 f.s., and this is attained within $\frac{1}{50}$ of a second after explosion of the charge.

The maximum free velocity of the Lee-Metford Rifle measured by Major Close in 1897 was 9·3 f.s., and occurred within $\frac{1}{100}$ of a second after explosion of the charge. With black powder the velocity was 9·5 f.s.

The maximum velocity of free recoil of an ordinary 12-bore shot gun has been measured and found to be 17·3 f.s. with amberite.

Taking the maximum velocity of recoil of the Short Rifle with cordite ammunition as 9·98 f.s. and the weight as 8·5 lbs., the momentum* of recoil is 2·63.

Now it has been shewn that, neglecting the effect of the rush of gas out of the barrel and the disturbance of the air caused by it when the bullet has left, the velocity of recoil is 7·72 f.s. The difference (2·26 f.s.) multiplied by the mass of the rifle is the increase of momentum due to the rush of gas, and equals 0·59. Knowing the weight of the charge (31 grs.) it appears that the velocity of the centre of gravity of the issuing gas at the moment is about 4,300 f.s.

RECOIL AT THE SHOULDER.

Figs. 2, 3 and 4 shew the tracks of the studs when the rifle is fired at the shoulder standing.

* In calculating momentum of recoil, the formula $\frac{W \times v}{g}$ was used, where W = weight in lbs., v = velocity in f.s., $g = 32{\cdot}2$.

From these and similar photographs it appears that the rifle recoils approximately in the line of the axis for about 0·5 inch.

During this space it is engaged in compressing the clothes and flesh and forcing back the shoulder of the firer, the resistance in this direction continually increasing and the velocity diminishing till the butt becomes nearly stationary; the remainder of the momentum is absorbed in a rotary movement about the shoulder due to the fact that the centre of gravity and the part of the butt in contact with the shoulder are below the axis of the barrel.

Fig. 3 shews where the bad shot "bobbed" before releasing the trigger and the large amount of error in his aim when the bullet left the bore.

FIG. 5.—Fire kneeling.

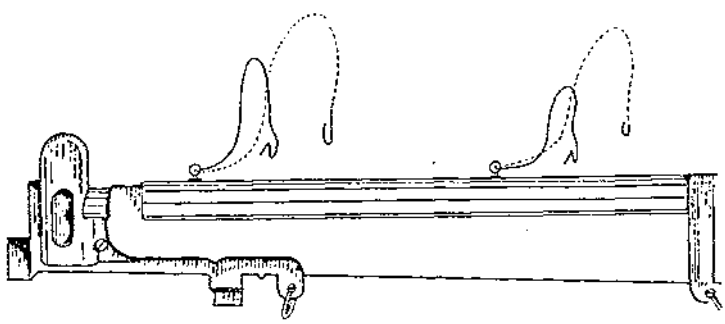
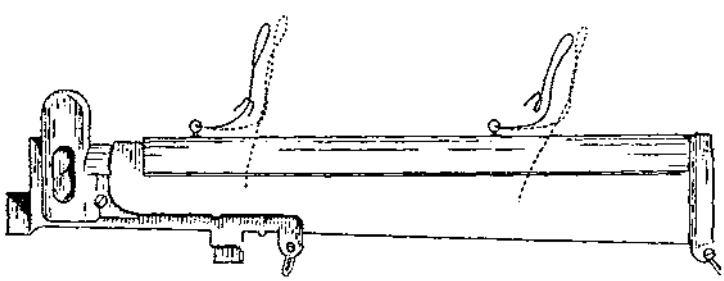
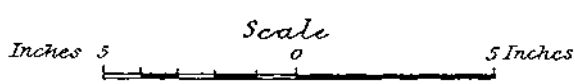


FIG. 6.—Fire lying down.





Good shot—continuous line.
Bad shot—dotted line.

Figs. 5 and 6 are accurate tracings of the tracks of the studs when the Short Rifle is fired at the shoulder kneeling and lying by good and bad shots.

The velocity of recoil at the shoulder depends on the tightness with which the rifle is held, and varies from 7 to 9 f.s.

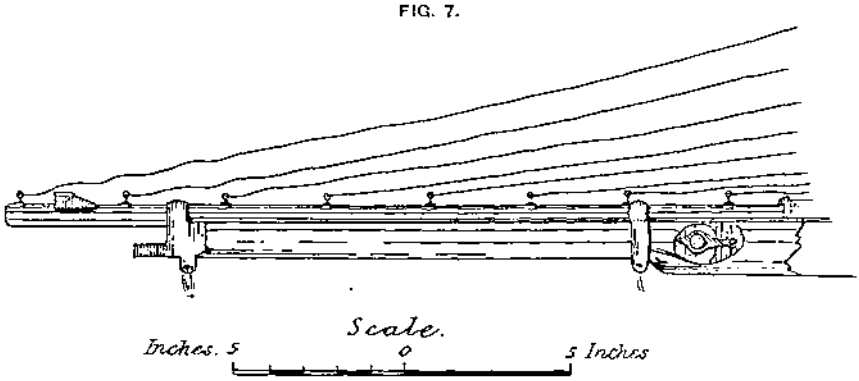
VERTICAL VIBRATIONS OF THE BARREL.

In the photos of free recoil it is found that the successive positions of the barrel are approximately parallel, so that the mean curve described by any point on the barrel is a simple one.

It is noticed however that the studs do not follow this curve but deviate from it in a series of small waves.

These waves are most noticeable at the muzzle, disappear at a point between the bands, and reappear again near the backsight (see *Fig.* 7, which is an accurate tracing of the paths described by studs on the Lee-Enfield Rifle).

FIG. 7.

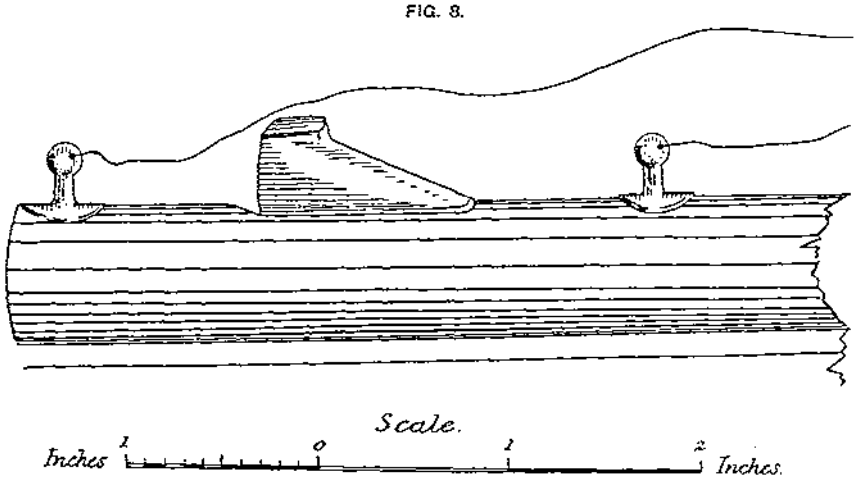


These waves in the tracks are obviously due to vibrations of the barrel on discharge, and from photographs taken full size (*Fig.* 8) it appears that there are two sets of vibrations in the Lee-Enfield Rifle :—

(1). The major vibrations seen in *Fig.* 7.

(2). The minor vibrations seen in the track of the front stud (*Fig.* 8). Any vibratory movement of the muzzle taking place at the instant

FIG. 8.



the bullet leaves the bore will obviously affect the shooting. Vibrations after discharge will only affect the life of the rifle.

Now, the distances moved by the bullet and rifle whilst the bullet is in the bore should be inversely as their weight, so that when the bullet has reached the muzzle the Short Rifle has moved back 0·090 inch and the Lee-Enfield 0·103 inch.

In *Fig.* 8 it will be seen, on reference to the scale, that the Lee-Enfield muzzle, owing to the minor vibrations, has actually moved in a vertical direction during its recoil through this distance, so that any slight alterations in these vibrations will cause an alteration in the path of the bullet.

In this case of the Lee-Enfield the period of the major vibrations is about $\frac{1}{60}$ of a second and that of the minor vibrations about $\frac{1}{300}$ of a second.

The most important factor is obviously the amplitude and period of the minor vibrations, and their regularity would appear to depend upon :—

(1). Strength of charge.

(2). Uniformity of expansion of gas.

(3). Rigidity of barrel, governed by elasticity of steel, adjustment of bands and position of points of support.

(4). Uniformity of resistance offered by grooves to passage of bullet.

Since these are variable factors it would appear desirable in rifle construction to arrange that the secondary vibrations shall be as small as possible, and this condition is fairly well fulfilled in the case of the Lee-Enfield Short Rifle.

Figs. 9, 10 and 11 are tracings from photographs (full size) of the tracks of the front, centre and rear studs seen in *Fig.* 1 on the Lee-Enfield Short Rifle.

From these it would appear that the barrel in vibrating vertically forms a node near the centre stud and vibrates as shewn in *Fig.* 12, in which *c* represents the centre stud, *a* and *d* the front and rear ones.

The centre stud (*Fig.* 10) shews slight deviations. These were afterwards found to be due to the stud having worked itself loose. The node was accurately found in the case of the Lee-Enfield rifle (*Fig.* 7).

Fig. 13 shews the vibrations of a stud soldered to the foresight of the Short Rifle. The foresight being let into the barrel, the stud shews the vibrations of a point close to the muzzle and from this it appears that the minor vibrations are very small. This track presents a marked difference to that in *Fig.* 8.

On attaching a stud to the breech end of the barrel it was found that similar major vibrations existed there, and a stud fixed to the heel of the butt also shewed major vibrations; neither gave a trace of minor vibrations. There is only one node formed.

The period of the major vibrations of the Short Rifle are $\frac{1}{75}$ of a second and their amplitude 0·108 inch. The corresponding figures for the Lee-Enfield are $\frac{1}{60}$ second and 0·136 inch.

FIG. 9.

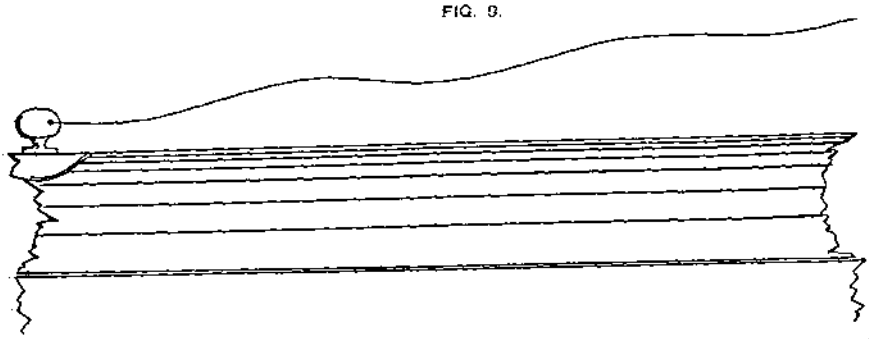


FIG. 10.

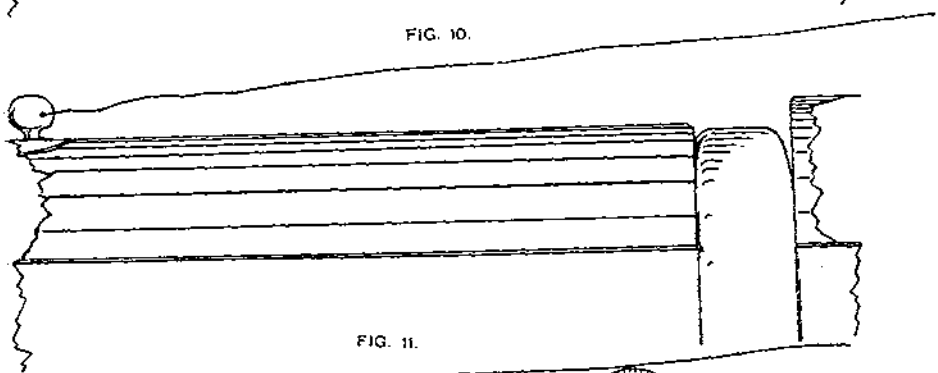
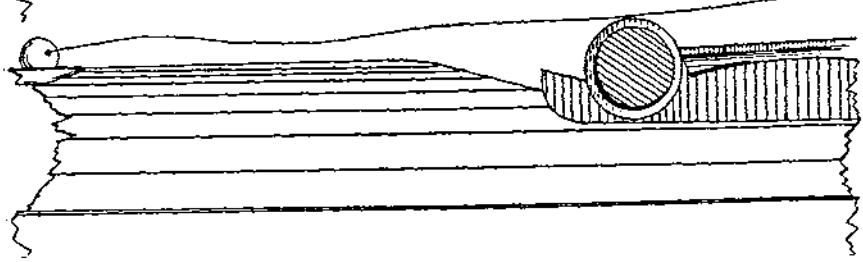


FIG. 11.



Vibrations of Short Lee-Enfield barrel.

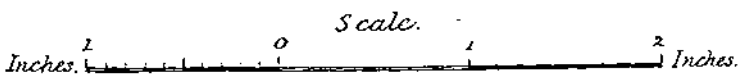
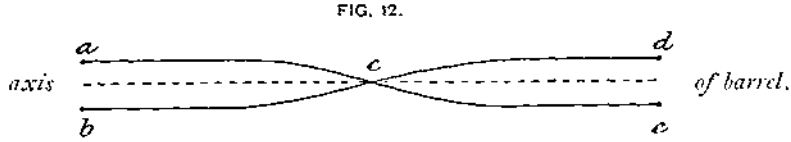


FIG. 12.



state of stress may be imparted to the fore portion of the barrel in wave form more quickly than the bullet travels, thus setting up a minor vibration before the bullet has time to leave the muzzle.

It was thought that the upward movement in the first minor vibration might be due to a tendency to resist Bending Moment. This was found to be erroneous, as a photograph of the rifle fired when suspended from both ends, with a heavy weight placed near the backsight, shewed a vibration of similar direction. Also a photograph taken of the rifle turned through 90° about the axis of the barrel shewed very insignificant vibrations.

It was then thought that the rifling might influence the minor vibrations but it was found that a smooth bore gave similar vibrations. Probably the unsymmetrical shape of the rifle with respect to the axis of the barrel is solely responsible for the magnitude and initial direction of the vibrations.

SUMMARY OF RESULTS.

On explosion of the charge the rifle recoils at first in a nearly axial direction; during its motion it compresses the clothes and flesh of the firer, and after moving back about 0·5 inch it begins to rotate about the shoulder, the foresight describing an arc about 5 inches in length when fired in standing position.

The moment that the bullet has left the bore the powder gas rushes out with greatly increased velocity, the centre of gravity of the gas moving at a rate of not less than 4,300 feet a second.

The force of the blow of recoil absorbed by the firer is measured by the momentum of free recoil :—

i.	The Short Lee-Enfield has a momentum of	2·63
ii.	The Lee-Metford	2·61
iii.	An ordinary 12-bore shot gun	3·70

During the passage of the bullet along the barrel the rifle is subjected to varying strains, the maximum pressure occurring when the bullet is about 6 inches from the breech.

This state of tension or dilatation is communicated to the muzzle more quickly than the bullet travels, so that the bullet arrives at the muzzle when the latter is in a state of vibration, thus affecting the path of the bullet and the sighting of the rifle.

The direction of the vibrations is probably influenced by the unsymmetrical shape of the rifle with respect to the axis of the barrel, which prevents the recoil being taken up axially.

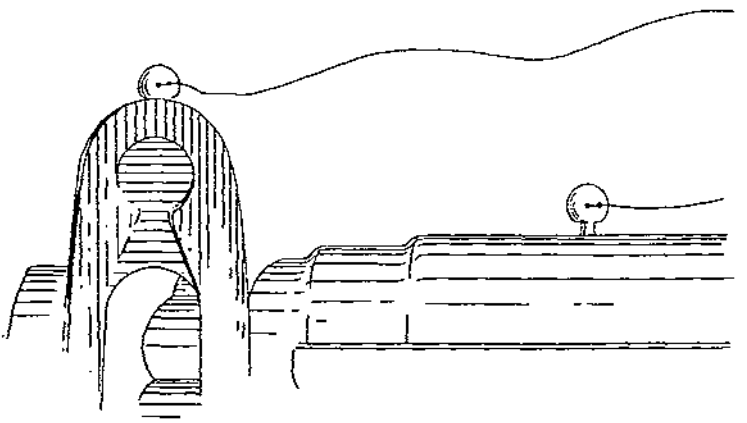
The projection of the path of a vibrating point near the muzzle on a plane perpendicular to the axis of the barrel may be considered to be an elongated ellipse, whose major axis is vertical and has a maximum length of 0·108 inch in the case of the Short Lee-Enfield, this length not being attained till after the bullet has left the bore.

LATERAL VIBRATIONS OF THE BARREL.

So far only the vibrations in a vertical plane have been dealt with. To ascertain the amplitude of any existing lateral vibrations, a series of photographs was taken from a point vertically above the muzzle, some with the rifle free to recoil and others with the rifle fired from the shoulder.

From an examination of these photographs it was found that there were no appreciable lateral minor vibrations and only a very slight deviation corresponding with the major vibrations in period. Unfortunately the photographs were too indistinct to take measurements from.

FIG. 13.



Vibrations of Short Lee-Enfield Muzzle.

From this it seems that a projection on a plane perpendicular to the axis of the barrel of the actual path described by the muzzle partakes of the shape of an elongated ellipse whose major axis is vertical and has a maximum value of 0·108 inch in the case of the Short Rifle.

It will be noticed that in each case the first movement of the muzzle is an upward one and it is in the course of this movement that the bullet leaves the bore.

It was found that the direction of this first minor vibration was the same whether the rifle was at the shoulder or free to recoil.

From the pressure curve diagram (page 226, *Textbook of Small Arms*, 1904) it will be seen that a maximum pressure of about 16 tons per square inch is attained when the bullet is 6 inches from the breech. Evidently this small portion of the breech end is suddenly put into a high state of tension and dilatation. This

Superimposed on these are the minor vibrations.

As would be expected from its shorter barrel, the new Short Rifle has much smaller vibrations than the Lee-Enfield.

On account of the impossibility of ensuring absolute uniformity in the charge and the rate of explosion, and on account of the varying state of the bore, the vibrations themselves cannot be absolutely uniform, and, since they affect the shooting, the less a rifle vibrates the better.

FIELD COMPANIES, R.E.

By Colonel Mark S. Bell, v.c., late R.E.

In December, 1897, the *Journal of the Royal United Service Institution* contained an article by me on the "Fourth Arm," in which I mentioned that there appeared to be no satisfactory exposition setting forth the duties and scope of action of Engineers in the modern battlefield in co-operation with Infantry, and stated my conviction that there is a *rôle* before the Fourth Arm in the forefront of a battle as glorious as that which they enjoy when a siege is being actively pressed or a defence stubbornly conducted. I endeavoured to supply deficiencies in the then drill-books so far as the employment of Engineers in action was concerned, and made certain observations from which the next ten paragraphs are extracts.

"To gain information Engineer officers are required with the advanced Cavalry reconnaissance, and from this reconnaissance they should be able to foresee and arrange beforehand for rapidly fortifying important positions to be gained by the Infantry and for the passage of Cavalry and Artillery over partially destroyed bridges, etc. A few specialists will also be required with the advanced Cavalry to assist in destroying or re-forming communications, to tap and repair telegraphs, etc.

The bridging section must be well to the front; and the telegraph battalion must connect up the various sections of the battlefield with headquarters, and maintain this connection.

Obviously, therefore, the Engineer-in-Chief must be intimately acquainted with the plans of the General in command; and Commanding Royal Engineers, though they should frequently proceed to the front to ascertain what engineering works are required and to ensure the effective co-operation of the engineer arm, must constantly rejoin the headquarters of their units to keep touch with the views of their own Generals.

The company training of the Infantry must suffice to enable them to entrench themselves in the firing line, though Sappers may occasionally have to be pushed forward to assist in the defence of specially important points or the fortification of *points d'appui* to prevent a check degenerating into a rout.

The Engineers with offensive sections use their rifles when required to do so, and the Infantry soldier must also be taught

that the entrenching tool is second only to the rifle in importance and that he must use one or the other as the exigencies of the fight may direct.

An attacking force must ever be ready to assume the defensive and to entrench themselves; the want of time to carry out this precept in manœuvres leads to a lack of reality and to a vicious training. The modern battlefield is a slow and weary wearing away of opposing forces; the advance can only be made step by step; and here comes in the increasingly important *rôle* of the Fourth Arm.

It is often essential that Engineer officers should take the initiative in carrying out their special field duties,—such as reconnaissances of positions, passages of rivers or swamps, preparations for defence, construction of bridges, re-establishment of communications—in order to aid in the development of a fight; but they must keep commanding officers informed of their work and its objects, and initiative must be duly subordinated to the aims of the chief.

The application of field works to tactics should be practised during manœuvres. All units should be accustomed to test the use of field entrenchments in various circumstances, in the firing line, in an extended 'holding' position, etc.; and staffs should be organised to give unity of action and effort. The training of Infantry on "field-work grounds" gives no idea of the application of works to tactical requirements; in all tactical exercises and manœuvres lines of entrenchment or redoubts might be represented by lines of implements and men at their digging posts. Time for construction of works in the field does not fail so often as the presence of tools and engineers at the right time and place.

A retirement gives ample scope for the action of the Fourth Arm, both independently and in co-operation with Infantry. Why not practise this in peace time, instead of employing our Field Engineers as Infantry or in arranging water supply of camps?

Paucity of numbers has led to the value of Engineers in the field being overlooked. Their numbers should be largely increased; and this might be best and also economically effected by adding to each artisan company one or more companies recruited from labourers, porters, navvies and miners and thoroughly trained in field duties. We might see a section of artisans working with a company of pioneers, one such section and one company at least to a brigade of Infantry."

During the succeeding year and the early part of 1899 a most useful discussion was carried on in the *R.E. Journal* on the organization and training of Field Companies; and at the end I wrote the following letter which, however, was not published.

My final words on this subject, so important and ever vital to the Corps, may still be of interest. I still hold that the Engineers are a fourth tactical arm, and not the least important of the four, and that training and organization alone are required to establish this. I would also draw attention to the concluding paragraphs of my letter, referring to the duration of battles, and to the night work that must now-a-days complete the day work. I pretend to be no prophet; but I had endeavoured to keep my tactical knowledge on a level with that of soldiers of foresight, and had the conditions of modern battle been clearly understood and accepted by us and acted on in South Africa it might have been better for us.

The letter was written when I was still an officer of the Corps. Service conditions have since landed me on the rocks whence I can see nothing, and as I can only hear what is going on I propose to enter no further into the discussion of R.E. tactical duties. I did what I could in my day, and it is now for others to do what they can. What I hear I do not like, for I hear of the same folly of representing field works by tapes and flags; and this is as distasteful to me now as it was 30 years ago, when, occupying such an imaginary work, I refused to turn out of it, on being called upon to do so in half an hour, refusing also to consider my command as prisoners. I remember we compromised matters by both sides adjourning home to lunch. What folly it all was; neither of us had any tools, or any means of carrying them; nor, if we had had them, would we have used them even to the extent of marking the tasks of the men who had been supposed to construct them, and this was the very least that should have been required of us.

LETTER OF MARCH, 1899.

My object in drawing attention to the Fourth Arm was to indicate what work it is considered to be capable of doing, and ought to do, on the battle field in co-operation with Infantry in all stages of the attack and defence; that the important duties which fall to it can be best done by itself; and how unfitted it is by its present organization, training and numbers to efficiently perform them.

Incidentally, from the perusal of the paper on "The Fourth Arm" in the *R.U.S.I. Journal*, the attention of the R.E. Officer is drawn to the Field Company, which, it is maintained, is its mobile, tactical battle unit, and not a garrison or line-of-communication unit, except when not required for tactical purposes; and to carry out its mobile tactical duties it is supposed to be efficiently organized.

Extracts from a long paper are always unsatisfactory, and I fear that those who are interested must carefully read the article on the "Fourth Arm" for themselves. Therein is shown what

work falls to Engineers and Infantry respectively; and how the Engineer numbers may be increased by raising, as an integral portion of the Corps, pioneer companies, to be brigaded with artizan companies, and recruited from miners, navvies, agricultural and dock labourers, etc. I might add that garrison and line-of-communication Engineers would naturally take up the duties of the Field Engineers where the latter left them off; that the Engineers have nothing to do with supplying Infantry with tools or with doing their spade work for them; that spade work ought to be a potent factor in the modern battle, but that whether it will be or not must be left for the future to decide. What is maintained is that the General who can utilize it as a potent factor will score greatly over the one who cannot; that to gain this advantage is certainly worth trying for; and that to use Engineers as transport or on communications, when their services as experts on tactical field works might gain or save the day, thoroughly disheartens and demoralizes all ranks and means fighting with the disadvantage of not using all the activities and resources available.

A bridge cannot be destroyed or restored, works executed, or positions strengthened without proper means and organization and co-operation of units, any more than a position can be shelled and occupied by Artillery without guns and co-operation of units; and the more thorough we are in manœuvres the better we are likely to do in war; and yet again we must use a little common sense and not tear a building to pieces to get at its timbers.

All the duties detailed as falling to the "Fourth Arm," and that it is desirable they should do to obtain the best results—and remember that the best results may mean victory, and lesser results a check—it is considered they can and should do when efficiently organized and trained. This organization requires not only proper inter-communication between the Chief Engineer (who is the mouthpiece of the General for all engineer services) and his subordinates, by one of whom he will possibly be best represented in the Cavalry reconnaissance, but also proper inter-communication within the Field Company, between its sections. The Company must have suitable numbers and a good organization into working sections and even squads, with a suitable proportion of men of various trades, for extending working parties and re-assembling, for issuing and re-packing tools, etc., etc.

In addition to the Field Engineers and Pioneers with brigades would be those with divisions and army corps, a company of the former and a wing of the latter (or more) with each, all trained to field and railway engineering.

The perplexity that may arise in the minds of some regarding the interlacing of duties is due to present want of organization and training; supply these wants, and to me the Engineers are all sufficient to perform all the duties of co-operation that legitimately fall to them and to perform them better than anyone else can

for them. With a good chain of command and with the Engineers suitably represented on the Staff, there is, as pointed out in the article on the "Fourth Arm," little fear of work being done when the General does not contemplate it; but of one thing I think we may be pretty confident and that is, that the officer who, seeing an opportunity for employing his arm, awaits the written order of the Chief-of-the-Staff to co-operate will certainly not be judged to be the "right man in the right place" and will deserve to be roughly treated.

Action by intuition and an initiative subject to the aims of the General are essential to success; and the less we hear the better of such methods as that of the subaltern, who, when ordered to bridge a small stream in the hills of India, is said to have retired to the shade to work out strains and dimensions and to have found on his return that the bridge had been completed by a few practical men.

Success in war requires of us our very best of body, brain and moral,—no second best will gain it—,our best of effort, courage, self-sacrifice and co-operation to its attainment.

Every arm can best work out its own tactics. To the "Fourth Arm" this virgin duty now falls; and this can possibly be safely left to the rising generation of the Corps, to the captains and subalterns whose young, vigorous and impressionable minds will find in it a task worthy of their steel. Innovations will always be received with caution and many difficulties have to be overcome; but let us be practical, and solve them practically and not academically. To this end let us hope to see the Field Companies concentrated yearly in camps under selected R.E. Officers, working at tactical field work problems over haphazard country, gaining that eye for country which will alone enable them to adapt works to ground and to intuitively seize on points of advantage during an advance or retreat, etc.; all this without at the same time neglecting to render themselves efficient in all the practical constructional details of field engineering, and to elaborate a thoroughly efficient equipment and organization, etc. A training by half companies (to suit the convenience of the Works' Branch) on the field work grounds generally available cannot be called "field" training.

And now having said so much, I propose to say no more, except to recommend that we should endeavour to organize and train for what we ourselves feel confident we are capable of, and not for that to which others would limit us; not for a three-hour sham-fight to please the sightseer, which to us is worse than useless, tending to dishearten the men and to make them think themselves of no value in determining the issue of the battle that is raging around them; but for the modern battle, which, it is predicted, will last from one to three days and during which the work of the Engineer will not

cease with nightfall, for he will have to take a chief part in strengthening positions already carried or those seized during the night as vantage ground whence to initiate the next day's encounter.

Finally let me express the opinion that we may sooner or later, and perhaps sooner than many expect, have to fight such battle or battles for empire; for empire can be lost by losses on land, by the loss of India, as well as by losses on sea.

NOTES ON ENGINEERING WORK IN NORTHERN CHINA.

By Bt.-Colonel G. K. Scott-Moncrieff, c.i.e., R.E.

One of the first duties of the officer who has to undertake the direction of engineering matters in a campaign in a given part of the world is to decide what special tools or stores should be taken to suit the peculiarities of the country or climate. To a great extent provision has been made for this in the various Regulations and Lists of Equipment which have been compiled in our army from time to time, based upon the experience of war in countries differing so much from each other as the bare rocky highlands of the Afghan frontier and the desert stretches of the Soudan. Certain articles of equipment have in any case to be taken and about them there is no question; but the problem in the case of every expedition to a new country has to be viewed in the light of several considerations, the nature of the country and its natural resources, the capability or otherwise of the inhabitants to supply skilled labour, the probable obstacles to be overcome, and the possible tasks which the army may have to undertake.

All these points had to be weighed when we were preparing to start for China in 1900, in the few busy and hot days at Calcutta, when time was precious and information of our objective by no means defined. As the information of the resources of the people and the country was also scanty and not very accurate (as it turned out), it may possibly be of interest if I relate here what our forecast was, how far our arrangements suited the case, and what assistance one could rely on, both from the material resources of the country and the skill of the people.

It was understood that we had to operate in a flat country intersected with ditches, with many roads (which were, however, heavy for wheeled traffic), densely populated, but deficient in trees, and altogether wanting in all building material.

It was also understood that we had to force our way into an ancient city with great old-fashioned fortifications, surrounded by deeply sunk roads and by buildings which approached so near to the fortress that cover for attacking troops could easily be obtained prior to a rush or escalade. As regards accommodation for our troops, it was believed that the Chinese houses were either in themselves suitable or that they could be easily adapted, but that the supply of

materials and the numbers obtainable or anything in the way of skilled artisans were few.

Further we were proceeding on the assumption that as regards railway or telegraph work, our business would be to repair partial damage, restore traffic, and then work the lines so renovated.

So far this was the general idea, and, like most general ideas in war, it turned out to be partly true and in many important respects wholly mistaken. The country is flat and the roads heavy for wheeled traffic, but, on the other hand, it is full of animals and carts which are accustomed to traverse those roads. (At first, however, we could get very few of these). There are trees in the neighbourhood of most of the villages, and in the important towns there are large supplies of timber. There are many boats, and the most skilful boatmen probably in the world.

All the information we had about Peking was in the main correct; but, as it turned out, the very size of the fortress proved its weakness, and the attack on one part enabled the advance on another to be unopposed and completely successful.

Our assumptions as to the railway and telegraph were utterly mistaken. Anything more thorough than the destruction of these important adjuncts to the advance of a modern army it would be hardly possible to imagine.

Finally our ideas of the skill and willingness of the natives were wholly and agreeably disappointed. About this I shall say more presently.

However of course first arrangements had to be made in Calcutta with the limited information then possessed.

As we might have to rebuild railway bridges or might have to construct a landing pier, arrangements were made for sufficient timber for three hundred yards of railway bridge work. As a matter of fact we found a very good wharf at our base, and also a good supply of timber in the country. But the material we brought with us was badly wanted at Wei-hai-wei, and so it was very usefully employed.

To destroy the Chinese defences we took two tons of dynamite in addition to the usual allowance of explosives laid down for an expedition. This dynamite for the most part lay buried during the winter at Peking. A small amount was expended in the demolition of Chinese defences in the Paoting-fu and other expeditions, but the greater part was most usefully employed in the spring in clearing sunken junks in the Peiho river between Tientsin and the sea. Seventeen wrecks were thus removed, and this not only gave good practice to our sappers, but it did a valuable service to the commercial community in clearing away obstacles to navigation.

For scaling ladders, field observatories, and a variety of other purposes which might arise in the attack of a position such as that which we expected at Peking, the biggest and strongest bamboos in

Hong Kong were purchased. As a matter of subsequent experience we found that, although we purchased every bamboo of sufficient length and quality that the Hong Kong market could produce, to the number of about two thousand, this number was far below our requirements. Of all the trees in the forest the bamboo is the most useful to the military engineer, though little required for permanent works by the builder. Of it we made roofs, ladders, screen walls, bridges, telegraph poles and a number of other things. Its toughness and light weight make it a particularly useful article.

To connect our landing stage with our camp, which might be situated at a distance from the shore, I ordered, at the General's suggestion, five miles of light tramway, with a number of wagons. This was not required at first; but when Shan-hai-kwan was occupied, it was sent there and put down. I think it is right to say that we lent this line to our Allies and placed a certain amount of our rolling stock freely at their disposal, and they used it to a very great extent. I do not know that in any case we were allowed the use of any of their special equipment; but at all events none can say that we treated our Allies in an ungenerous manner, for this was only one out of several cases where we either lent them stores or else waived our unquestionable claim to rights won by our troops.

Besides the above we took with us barbed wire, cordage and a few other things in excess of the usual scale, in view of the requirements of detached defensible posts or the construction of bridges.

Most of the above stores were ultimately of use, although, as will be readily understood from the above, the actual employment of them was not under the conditions which were at first anticipated.

One question which was referred to me was the taking of a pontoon train. On the whole I concluded that it would not be required and I am glad that this view was not falsified by later events. In a country intersected by creeks, no doubt a pontoon train would be useful, but it would take up a lot of room in a ship and involve the transport and feeding of many men and animals, besides which it would be itself difficult to drag about in a sticky country. On the other hand where there are rivers and creeks there are boats and ropes, and with the aid of poles and lashings bridges could surely be extemporised. This proved to be fairly correct.

One of our first tasks at Tientsin was to extemporise a floating bridge out of the junks used in the river traffic, and, although it was not of course so good as a regular pontoon train, it served its purpose well enough. The Chinese junk is peculiarly well adapted for floating bridges. It is indeed very much like our service pontoon in shape, and the smaller junks or sampans are arranged so that they can be made longer or shorter by being fastened together longitudinally, just as in our more recent pattern of pontoon. Then they are built in compartments, and are fitted with anchors and steering gear, very

ingenious, easily repaired, light, and well adapted for the various uses to which they are put. Hence the necessity for European-made pontoons really never arose. The Germans brought out some of their pontoons, which they used in the construction of a bridge at Hanku; it was a good bridge, but it was not any better than one made up of junks would be. I believe a pontoon train was taken to China by our army in 1860. I saw it at Hong Kong where it has been ever since; and, although I had some doubts in my mind as to whether it would be advisable to use it again, I concluded that it would be unnecessary and that opinion I still hold.

The Chinese are wonderfully skilful mechanics, but their labour is much in need of scientific direction. This no doubt arises from the fact that all application of labour to practical purposes is looked down upon by the educated classes. Thus the whole of their building work is in the hands of uneducated men, and the result is great waste of material and labour. The quaint carved roofs, with which pictures have made us so familiar, are very pleasing in design; but the quantity of timber used in their construction is enormously in excess of requirements, and, although great practical skill is shown in the way the various parts are put together, it is evident at a glance that no scientific unity exists between those parts. Again, as no Chinaman trusts the walls of a house to carry the weight of the roof, it is evident that the height of his house is limited by the length of the wooden pillars he can obtain. A double-storied house is therefore uncommon, while a house of more than two stories does not exist in any part of a Chinese town. The floors of the upper stories are as weak, relatively, as the roofs are strong, and even a single person walking across the room causes the whole to vibrate.

The Chinese are exceedingly clever sawyers and carpenters. Their tools in many cases are very ingenious and a very great improvement on ours. This remark also applies to much of their fittings on board the junks, which combine simplicity and cheapness with thorough efficiency. Space does not permit me to describe any of these tools and appliances in detail; are they not written in official chronicles?

They are also singularly good at copying any foreign production. At Tientsin I wanted to buy some cooking ranges for kitchens, but the price of them in the European shops was very high. A Chinaman produced a copy so exact that it had not only all the essential parts but the very name of the patentee cast upon it. I did not buy it, however, although the price asked was about one-third of the other.

But in building walls the Chinaman fails. His idea of a wall consists of two outer thin skins of brick or stone, filled up with any rubbish between. Many of the walls in Peking are built with only the outside of brick, and clay rammed in layers inside. Such a wall is frequently sixteen to eighteen feet high, and about six or eight feet thick; it requires a regular roof of tiles to keep the rain from

washing away the clay inside! The bricks of the country are small, about one-half the size of an English brick, always of the same slate grey colour, but well shaped, well burnt and apparently durable. The old walls in cities are built of huge grey bricks, three or four times as big as our bricks, wonderfully well made. I do not think, however, that any of these are made nowadays. For mortar the natives use a very white lime, which they mix, contrary to all our rules, with a sandy earth; this makes a marvellously hard mortar. They also make concrete of broken brick with the white lime and clay, mix it dry and ram it as tight as heavy stone rammers can pound, and then sprinkle water over it. I insisted upon their making concrete in our fashion; of course they obeyed orders, but did so with a shrug of the shoulders, disclaiming all responsibility. Some of the old concrete in the Tartar City Wall in Peking is as good as any I ever saw.

An engineer of long experience in China told me he had tried again and again to instruct the bricklayers in the mysteries of *bond*. He said he had given it up after many attempts as hopeless. In my case I generally made the Sappers build a small portion as a sample and insisted upon the Chinese copying it, which they generally did – as long as my back was not turned.

During the early days at Peking we had a hard time with our Chinese labour. At first few of them came to us, and few had sufficient confidence to take up contracts or piece work. When however they found that we looked after them, gave them regular pay, and, beyond making them work, left them otherwise alone, they came freely enough; and soon, both there and at Tientsin, I learnt to appreciate the very valuable qualities of the Chinese contractor. A respectable Chinaman is an admirable man of business, and as an enterprising contractor I never met anybody like him. The work they do is extraordinarily cheap, and the way they organise and subdivide their labour is most instructive. We paid not only far less for the work than we should have done in England—that of course was only to be expected—but considerably less than we should do in India, which I was most surprised to find.

Our usual method, when a particular work had to be done, was to assemble three or four contractors together and explain fully the work required, and whether we proposed to provide the materials or not, and any similar conditions. Then we set the men apart from one another, and asked each separately what he would do the job for and how soon. Generally the replies did not vary much from each other, and usually the lowest tender was taken. From the nature of the work, we knew what it would have cost in India, so that enabled us to know whether the offers were exorbitant. I have often wondered how on earth they could do it for the money they asked. But they did it well and seemed to make a fair profit.

On one occasion I wanted to build certain quarters for railway employés in a great hurry. The weather was bad, snow was lying deep on the ground, and the country roads all but impassable, while the Chinese artisan could hardly be persuaded to face the severity of the elements. I went with Major F. V. Jeffreys, R.E. (who spoke Chinese) to the place, accompanied by three contractors, respectable men who had already done a good deal of work for us. We explained the work to them, and then, sending them away to three different spots a little distance apart from one another, we consulted together and made a rough estimate of the cost, based upon measurements which we made and upon an exceedingly low unit price. Then we went to each man, who had been standing vacantly staring in front and apparently much bored by the whole proceedings, and asked for his tender. To my astonishment each man's estimate was within 4 per cent. of our calculation. We gave the lowest tenderer a contract to do the work in a fortnight, which I thought was driving a very hard bargain. He finished it in ten days.

After such an interview as that which I have described we made out a written contract in Chinese and English. I believe this really to have been unnecessary. The contractors always stuck to their word, and were most obliging in the matter of minor alterations. But I think one essential point lay in using Chinese (*i.e.*, non-European) interpreters as little as possible. With a Chinese-speaking Englishman one got on far better with them than with an English-speaking Chinaman. This fact came before me one day at Peking in a very prominent manner. I wanted to make a bargain with a man for some road metal, delivered at certain places. I went round with him, told him as well as I could what amount he was to bring and what price he was to get (we each knew a few words of the other's language, and signs did the rest), and he seemed quite satisfied. I then went back with him to my quarters, and it happened that on the way I met a Chinaman who was employed by us as an interpreter. He and the contractor talked with one another while I wrote out the conditions of our bargain. I then gave it to the interpreter who read it in Chinese. When he was done, he said "But, sir, this man not sign. He say too little." And nothing would induce the contractor to stick to our bargain. Evidently the interpreter had arranged to have his "squeeze."

I am aware that the satisfactory opinion I have of these Chinese contractors is different to the experience of some well-known residents in the country. I only give my opinion for what it is worth, based of course upon a very slight acquaintance with the people. Possibly also the fact that the men I speak of came mostly from Tientsin, and were therefore accustomed to dealing with Europeans, may have had something to do with their business qualities.

Chinese labourers are very clever at moving heavy weights. Little

mechanical devices—many of them very ingenious—are common among the working class, and they understand how to work in unison so as to apply their united labour to the best advantage. All the work of shifting and lifting heavy articles—such as is called in the Artillery "repository drill"—is done by them marvellously well; and it is clearly possible to train them to be skilful engine drivers and fitters. After we took over the railway, the greater part of the engine driving was done by natives, who not only did the ordinary work well but on one occasion at least behaved with extraordinary presence of mind and courage.

I think it would be possible to raise most useful and efficient companies of Sappers out of the Chinese. I believe they would take to the work very readily, and would turn out first-rate men. There are Chinese Sappers already at Hong Kong, but these are chiefly boatmen enlisted for submarine mining.

To sum up, any engineer proceeding to North China will find in the people and in the resources of the country ample material to his hand. They are clever mechanics, most hardworking, patient and willing, but they require guidance and supervision. They have little skill in brickwork or mason's work, but they can be taught almost anything, and they have not a little natural aptitude for such work.

The houses of the Chinese are generally built on one plan, which, as far as I could see, was the same whether built for the Emperor or for a village farmer. They consist of a series of courtyards, leading into one another by labyrinthine passages of the most bewildering description. In the case of the rich and noble the court is paved, and has possibly a garden or rockery, or tanks for goldfish, in the centre. On three sides of this yard there are houses, each consisting of three rooms, and with the floors (in the case of all but the poorest) raised some little way above the ground and approached by a broad flight of steps. The entrance to each house is in the centre, to the sitting room. On either side of it doors or screens lead into bedrooms, which are usually fitted with a raised "kang" or platform with flues beneath, which in winter are heated. This method of heating resembles the hypocausts constructed by the ancient Romans, and the method of constructing the flues is much the same as we find in ancient Roman villas.

The Chinese also have portable earthenware stoves for burning charcoal, but they have no fireplaces of our pattern, nor do they apparently employ fixed stoves. There is little difficulty however in building open fireplaces and chimneys in Chinese houses, or in fixing stoves. We did this to a large extent in all the quarters occupied by us during the winter.

The method of building their houses in a series of squares, opening into one another, has certainly the great advantage of privacy. As

most of the dwellings, even of the rich, are single storied, it is impossible for one person to see what his neighbours are doing, and thus the Chinaman's house is his castle to an extent the Englishman's seldom is. Those streets of a town, such as Peking, which are not used for shops consist simply of two lines of grey brick walls with doors at intervals, the doors being sometimes ornamented by carved lintels or bright painting and frequently adorned with pictures of hideous tutelary gods. These doors are almost invariably shut, but even if open we should have no glimpse of anything beyond, as the view inside is always obstructed by a screen, the idea being that evil spirits can only move in straight lines and that a screen across the entrance to a house absolutely bars their further progress.

If we were to go inside we should usually find the outer courtyard containing common and indifferently ornate dwellings, probably such as would be used by menials or only fit for stables. A passage in some corner, always winding so as to avoid the straight lines, will take us into another court, and possibly out of this we go into a third or a fourth, the innermost ones being generally the most select.

The effect in the streets is deadly monotony. No windows open on the street, all houses in it are exactly alike ; and if, as sometimes happens, there are side streets or alleys leading out of it, the bewilderment as to where one is to get out becomes most exasperating. Even those who have a fairly good "bump of locality" will lose their way under such circumstances.

The buildings of the nobility are slightly different from the above in respect of general arrangement, though they also adhere to the method of squares. There is usually an imposing gateway with a green-tiled roof, and a flight of steps flanked by two marble lions (this animal is not really like a lion, it resembles most a pug-dog, but it is conventionally called a lion). Inside the gateway there is usually a large open court with menials' houses round. These houses in the case of the Chang-Wang-Fu at Peking afforded stabling to about 150 horses. Then there is a large open pavilion, usually approached up a flight of steps, leading into another courtyard which also has an open pavilion at the far end. I understand that in such pavilions the host meets his guest, and exchanges compliments or does any public business. At the sides of these courtyards there are smaller buildings, sometimes two storied. Those at the Chang-Wang-Fu appeared to be used as granaries. Behind these side buildings come the private apartments in successive squares, generally leading out of one another and frequently opening into gardens and pleasure grounds further on, but all surrounded by high walls so as to ensure privacy.

It will be readily understood how a set of buildings such as that described above lent itself to military occupation. The large open

spaces near the entrance were suited for the stabling of horses, the inner pavilions for gun-parks, harness, forage and other store rooms, the side buildings for barracks and recreation rooms, and the small squares for officers' quarters. The Chang-Wang-Fu, for instance, made an almost ideal barrack for a battery of artillery, everything that the men usually have in cantonments being there, not perhaps quite as usual, but at all events in all essential points complete.

Thus the large courts are only used for public functions, the real social and domestic life going on the while in the small squares.

The rooms opening on these domestic portions are often most beautifully and tastefully ornamented. With us a door or a window is almost always oblong in shape, though sometimes with an arched or pointed top. In a Chinese house no such monotony of shape is permissible. The openings may be round or hexagonal or any other quaint shape imaginable. At the Winter Palace I counted in one wall thirty-two windows, every one of which had a special shape, the general effect being very pleasing. Again, the glass in the windows is rarely uniform, it is very frequently broken up into a maze of patterns like the proverbial "Chinese puzzle." Sometimes the screens separating one room from another are of wood carved with exquisite skill. In one house, occupied by some Japanese officers in the north of Peking, the whole of one such partition was carved in the semblance of a bamboo forest, each branch and the leaves being wholly distinct and complete. In one part the leaves and twigs were intertwined so as to leave an opening, circular in shape, for passage through the screen, the whole design being most beautiful. The most ordinary way of exhibiting this wood carving is under the main beams of the roof, two or three of which divide the ceiling into equal parts. From these beams, and vertically down the side walls, there appears to be what might at a little distance be mistaken for a curtain, caught up by a band at the angle between wall and ceiling; but on closer inspection we find that it is all made of wood, carved into leaves and twigs and frequently with birds and squirrels here and there among the branches. No doubt the general idea of this was taken from a curtain made of silk or other fabric. In the room in the Winter Palace used by Field Marshal Count von Waldersee as a reception room, there were two or three of these beautiful curtains of wood, each representing some different plant, *i.e.*, one bamboo, one black-thorn, etc. It is sad to think that all the art treasures of that splendid room were swept away in the fatal fire of April 17th when poor General von Schwarzhoff lost his life.

In the country villages the houses are much better built and are fitted with more civilised accessories than the dwellings of the same class in India. Although in Chinese towns filth and squalor of the most disgusting sort prove the constantly-heard accusation of the want of cleanliness of the people, the country villages are much less

offensive in this respect, and they compare most favourably with Indian villages. Indeed there is little that offends the eye or the nose in the rural village, because all noxious substances are made use of in agriculture, as they ought to be everywhere. Round all the villages are neat vegetable gardens, carefully laid out, well watered and evidently tended with scrupulous care. The wells for these gardens are numerous; they are usually lined with brick and have the mouth raised sufficiently far above the ground level to prevent surface water from flowing in. The water from these wells is cool and sweet; it was very largely used by the troops of all nations, and so far as I know there were no ill effects.

In the larger villages there are always some houses, built on the principle of squares, of a better class than the average, and in these houses many articles of comfort and refinement are in common use; so that a European will find himself far less uncomfortable there than he would in the best native houses in an Indian village, with its bad sanitation, dirt, and want of furniture. All the way along the Lines of Communication between Tientsin and Peking our officers lived very comfortably during the whole winter in Chinese houses, and obtained much furniture and crockery, etc., from the adjacent villages. I lived during the winter of 1879–80 in an Afghan house, but it needed a great deal of alteration to make it reasonably comfortable and I had no other furniture than that which I brought.

In the towns and large villages one of the chief institutions is the pawn shop, recognisable by the fact that it is surrounded by very high walls. The rural pawn shop occupies in a Chinese town the place that a branch of a bank occupies in an English town; for besides being a place where loans can be negotiated, it is a useful place of security wherein to put one's property during a temporary absence. I visited one of these at a walled town called Wu-chien-tsien, not far from Lofa station on the railway, one day in November. I was accompanied by some of the head men of the town; they had come to meet my companion, a cavalry officer, who had done them some service in protecting them and to whom they professed great obligation. I asked them if I might see over one of the two principal pawn shops, to which they readily consented. We first entered a sort of counting house, where a number of clerks were busy transacting affairs with clients across a counter, very much like a country bank. Behind the counting house was a large warehouse, in which were collected and labelled all sorts of miscellaneous articles, clothes, agricultural implements, books, etc., behind this again was another large warehouse, divided up with racks, and packed from floor to ceiling with chests and leather trunks. I asked if I might see the contents of a few of these, and my wish was at once complied with. Garments of every sort and colour, both for men and women, rolls of silk, embroidered jackets, fur-lined coats appeared to fill the boxes

almost to overflowing. Everything was orderly and methodical and apparently well taken care of.

The high wall surrounding these pawn shops has often an elevated platform a little below its summit, so that a watchman stationed there can see what is going on. In the occupation and defence of various villages these pawn shops are thus most important, as they are ready-made keeps forming the centre or nucleus of the defence. In our advance on Peking the Japanese had the advantage of the rest of the Allies in knowing the value of the pawn shops, both in respect of the contents and the arrangement of the buildings, and when a village was occupied the crafty little men always made for the pawn shop. After these buildings the next in importance are the temples, usually substantially built and roomy. They are frequently on the outskirts of the villages and come in usefully in the outer defensive line. Sometimes detached farms were suitably placed, and we utilised these also as outposts connected with the main line of the works.

THE FUTURE OF LONDON.

By Lieut.-Colonel J. Winn, late R.E.

In the *R.E. Journal* of November last we saw that the future of Egypt depended very largely on the construction of the necessary dams and collateral works for the control of the Nile. Looking nearer home it is interesting to see that the future of London (as a port) depends upon re-modelling the Thames, so that it may be accessible for large vessels; and the construction of a dam below London (at Gravesend) appears to be the cheapest, and in many ways the best, solution of a question which has already reached a very acute stage.

Of course there are objections to this scheme—as there are to all others—and it may be useful to consider the disadvantages as well as the advantages over other proposals.

By the Port of London Bill it is proposed to purchase the docks, in opposition to the dock companies' wishes, and to dredge the Thames to a depth required by modern steamships. This dredging is acknowledged to be practicably impossible, owing to the tunnels under the river and for other reasons, the chief of which is that dredging will alter the slope of the bed of the river and the dredged portion will be filled up by material from the foreshores, thus endangering the river banks and walls; and the scheme will cost £38,000,000. Yet the London County Council seems wedded to it, and has recently rejected an amendment by which the Thames Barrage Scheme was proposed as an alternative, as being practicable, better in itself, and costing far less than the huge sum with which the L.C.C. so lightly suggest burdening the ratepayers. To purchase the docks without dredging the channel will be of no use, and it is to be hoped that the scheme will be abandoned.

The Barrage Scheme, by which the river from Gravesend to Teddington will be converted into a lake with a very gentle current running through it, offers the following advantages:—

A permanent navigable depth of at least 30 ft. up to London Bridge (without the necessity of dredging); so that vessels of large draught can pass up or down at any hour of the day or night.

The dock gates can be left open continuously.

The river navigation will be safer.

There will be no flooding between Teddington and Gravesend.

Fixed piers, close to the shore, can be used for a paying steamboat service.

The river will be much purer, with no foul mud banks.

Ample water for the future supply of London can be provided without further capital outlay.

The dues and costs in rail and docks can be reduced by reason of greatly increased facilities and saving of the present time—losses in waiting tide, etc., etc.

All the river frontage lands can be brought into use with an immense increase of business.

There will be no need to purchase the docks, which can conduct a successful business if this scheme is carried out; and the upper docks will be rendered capable of full work again.

In addition to these advantages it is proposed to have a railway subway through the base of the barrage, which will connect up the railway systems on either side of the river, and also a roadway above it, thus forming a link between north and south which has for a long time been considered of the greatest necessity by the military authorities.

In view of the above a short description of what is proposed in the scheme originated by Mr. T. M. Barber, M.Inst.C.E., and Mr. James Casey, M.I.N.A., will be of interest.

In brief, it is a barrage, of mass concrete with granite facing, from Gravesend to Tilbury, with four locks in the centre. The provision of internal gates in addition to the outer ones will allow the locks to be worked in long or short lengths to suit the traffic; the lengths arranged in this way being 300 ft., 500 ft., 700 ft. and 1,000 ft., and the widths 80 ft. and 100 ft.

The barrage will be provided with the necessary sluices (much as in the Assuan dam) with a pilot tower in the centre.

The tunnel mentioned above will have a grade of 1 in 50, and pass through the centre of the foundations, which will be carried down to the chalk under the Thames ballast bed of the river. The height of the dam will be about 100 ft. from foundation.

As regards construction it is proposed to form a cofferdam round the site of the locks, and build them first; and when they are ready, to complete the weirs and sluices on either side to the shores.

The locks will be worked electrically from a power-house on the central pier of the locks, the power being obtained from dynamos operated by the fall of part of the water flowing over the dam. The sluices will also be worked electrically.

Such in a word is the scheme, the estimated cost of which is £3,658,000. A toll of ¾d. a ton on the shipping passing up and down will pay the interest on this sum; and will be amply compensated for by the reduction in river and dock dues, effected by savings in dredging, in operating dock gates, in time, in barging, in

management of the river, etc., estimated at over £800,000 per annum and costing over 6d. a ton to the 30,000,000 tons of shipping entering and leaving the port.

The first objection that suggests itself is the sewage question. But it has been firmly established that fresh water has the power of oxidizing sewage effluents better than salt, and there will be no tide to bring back the sewage as at the present time, when, as has been shewn, the sewage is kept in circulation in the Thames for 45 days.

The effluent at Barking and Crosshaven only contains seven grains per gallon, and there is no doubt that the lightly flowing river (always in the same direction) will absorb sufficient oxygen from the air to thoroughly oxidize this amount. At the worst period of the year there will be 560,000,000 gallons of fresh water entering this lake from Teddington to Gravesend; the sewage effluent amounts to 150,000,000 per diem; and as the river absorbs an immense amount of oxygen on its passage from London to Gravesend there will be an ample margin. In this connection Mr. Dibdin's book on the *Purification of Sewage and Water* should be studied.

But some special arrangements will have to be made to deal with the storm water of London, as many of the present outfalls are only effective at low water. If the level of the river is to be permanently raised, it will be necessary either to convey all the storm water to the outfalls at Barking and Crossness, which would probably cost some £3,000,000 as the drains would have to be large, or to have large reservoirs into which the storm water could pass, and from which it could be pumped into the river above high water. At present many low-lying districts are flooded after heavy rain, as the storm outfall can only act at low tide, and if the necessary pumping stations were installed London would be relieved of this nuisance for ever.

The barrage will prevent the flooding due to high tides.

However there will still remain some low-lying lands in Kent and Essex, which will have to be drained by means of pumping stations; but when these are once at work all the land, now useless, will be rendered valuable for factories, etc., with riverside frontages.

It has been suggested that many of the present river banks, though doing good service now, would not withstand a permanent high level of water without percolation into the districts they protect. This is open to question, and such banks would certainly be more liable to subsidence if the existing bed of the river were lowered by dredging, as is proposed in the Port of London Bill.

With regard to the effects *below* the barrage, it has been argued that when the tide is prevented from running up to Teddington it will rise higher at Gravesend; but this is a misconception, and the effect of the obstacle at Gravesend would be rather to lower the height of the tide there and also to silt up the bed to a certain extent.

It is proposed to overcome this latter drawback by scour sluices, provided in the dam, to be opened as occasion requires.

Another objection, which has been raised, is that delays will occur at the locks; but this will not be so great as those due to the necessity of waiting for the tide at Gravesend, and the amount of lock accommodation provided is based on the requirements of the known traffic, which could be considerably increased without exceeding the capabilities of the locks to deal with it.

The large number of barges now on the Thames depend upon the tides for their motive power, and their interests will be affected by the Barrage scheme. But in this connection it must be remembered that for 12 out of the 24 hours a very large number have to be idle whilst the tide is against them.

Towage will have to be resorted to. But as tugs can handle large fleets of barges, and towing is already being increasingly used, and in the dock-ised river barges will be able to approach any wharf, dock or vessel without waiting for tides, it is expected that the time thus saved—and time is money—will compensate for the loss of the tidal power to move the barges as at present, and that the new requirements of towage will soon adjust themselves.

Further criticisms of a minor character have been offered to the scheme, but its advantages seem to outweigh the claims of any other.

From a military point of view there are no objections, rather the reverse; from an engineering point there are no insuperable difficulties; from a commercial point it seems vital to London that something should be done—and that soon. Though a few minor interests may be affected, the proposal as a whole seems to meet the requirements of the case, so we may look forward at no very distant date to see the Great Thames Barrage.

THE CHOICE OF A SMALL MOTOR CAR.

By Lieut. O. G. Brandon, R.E.

In the *R.E. Journal* of November last the results of recent small car trials were given with a view to their being of assistance to anyone contemplating the purchase of a car. That these trials are excellent in many ways there is no doubt, but their results must not be taken too seriously by intending purchasers.

In the first place there is nothing to show that a car entered in these trials is the average turn-out of that particular make, nothing beyond the name and reputation of the manufacturers; and though one can almost with certainty say that a car of one particular make is an average car, it is equally open to doubt whether, in the case of a certain other make, more time and care has not been spent on the particular car exhibited than is given to the average car.

Then there is the question of "tuning up." Every car when first put on the road requires a certain amount of adjustment until the various parts get into good running order: the number and nature of these adjustments vary, they may be simple or the reverse, adjustable by almost a novice or requiring the skill of an expert. On this subject the trials referred to do not enlighten us, but it is of considerable interest to those who are trying to decide what car will suit them best.

Again, one car may do just as well as another in the trials, and yet from the materials used and the method of construction the life of the one may be only half that of the other.

We may assume that the intending purchaser will go round to all his friends who own cars and ask their advice. Unhappy man, for what a variety of opinions he will get, leaving him only the more bewildered.

What I would advise is this;—See if you have among your friends one who has a good knowledge of cars in general, especially of those of other makes than his own. If so, go to him; and having got his advice on perhaps two or three makes, go round to the makers and try their cars. All makers are only too pleased to take you for a trial run, and then you can judge for yourself the respective running merits of their cars.

If you cannot get more or less expert advice then I would say;—Buy a car of known good make and repute; you may pay a little more for it than for another car that you think might suit you, but at

any rate you have the satisfaction of knowing that you have got a good article.

Next we come to the question of second-hand cars; and here, to begin with, I would say "Do not think of this unless you know enough about a car to recognise anything radically wrong or inherently weak, and are prepared to wait several months before getting a car." If so, then having decided, as before, on the make you want, you should study the advertisements in various motor papers, and also call at one or two well-known agents; they may have something in stock to suit you, or, at any rate, will let you know if they do get anything.

One should bear in mind that, though great strides have been made in the last few years in the production of small cheap cars, yet the well-known manufacturers have made only minor alterations in the mechanism of their cars, and one of their 1903 cars is probably as good as one of 1904 or as the 1905 will be.

When you do find something that you think will suit you, then get expert advice, even if you have to pay for it; and insist on a good long trial run over a "give and take" road. There are bargains to be had occasionally, but remember they are few and far between, and small cars by good makers are not often on the market. To most people who invest in a small car, purchase means the outlay of capital representing hard-earned savings; and therefore the question of getting a good car is a very important one, and the trouble taken in selection should be proportionate.

As regards the all-important question of selection, the most I can do is to try and direct attention to various points.

First as to size, or H.P. The tyro is inclined to think that this is a question principally of initial outlay; but let me say at once that this is an absolutely wrong idea, and that he could entertain no greater fallacy. To determine the size of car that will suit you, you must decide what yearly expenditure you are prepared to incur. No very definite figures are yet available; but we may take it that, whereas a 6 H.P. car (costing from £125 to £200) will cost about £60 a year on upkeep including depreciation, a 10–12 H.P. will probably cost nearly double this amount.

As regards the initial outlay, to the prime cost of the car a liberal sum must be added for extras such as lamps, pump, jack, tools, rugs, etc., and a certain number of spare parts which have to be purchased at once. (Some of the accessories mentioned above are included in the price of certain makes of car).

Next we come to type and mechanical arrangement. In advertisements a great deal is often made of the fact that a car has three or four speeds. Now in a small car there is no great advantage in a number of speeds. With the latest improvements in throttling, etc., most of the work of a car is done on the top speed, and only in traffic

or on a steep hill is a lower gear resorted to, so that in a small car, like the 6 H.P., two speeds are quite sufficient. But in all cases a reverse is essential.

The chief points to be looked to in selecting a car are *simplicity of construction* and *accessibility of parts*. We must remember that an adjustment is often required on the roadside, perhaps in the rain; and when this is necessary to a part of the mechanism difficult of access, it becomes troublesome and often trying to the temper, and entails undue delay.

As regards tyres, if you intend to use your car in all weathers, some non-slipping device is imperative.

Now let us assume that the novice has actually bought a car. Of course he wants to get in and drive away at once; but while he is learning to drive I would advise him to put in some time in studying the mechanism of his car. It is not sufficient to know that the pulling of certain levers produces certain effects; the beginner should learn the reason of these effects, and what alteration is made in the arrangement of the mechanism. Besides this, I strongly advise him to learn practically how to take to pieces and put together again the various parts of the mechanism, and how to make the adjustments that will from time to time be necessary. It is not enough to know this theoretically; for on the roadside the novice will find that a good deal of theory goes a very little way, and a prolonged stoppage may result where only a few minutes would have sufficed had he possessed the requisite practice.

As I have said before, a new car requires certain adjustments and some of these will probably be done while the novice is learning to drive. For the rest he will find the value of the practical experience I have advocated.

The chief point to be attended to in "running-in" a car is *lubrication*. At first everything is stiff and tight; and unless care is taken that everything is thoroughly lubricated, it may mean considerable damage to the car through friction. At first the engine should be lubricated till the smoke of burnt oil is blown through the silencer, and the gear should be kept full of oil. Smoke and smell may be objectionable, but are better than running the risk of wearing away the walls of the piston chamber.

The oil must also be frequently run off, as particles of metal wear off and get into it; about every 25 miles should be sufficient. When this period of "running in" is ended, there is nothing left but the *care of the car*.

Here again lubrication is first in importance. The makers will say what they advise in this respect; and as we may assume that the novice intends to look after the car himself, he must make himself familiar with all the different bearings that require lubrication and must attend to them regularly.

Cleanliness is the next thing. To ensure continual good running, it is essential that the mechanism should be kept thoroughly clean, as in time there is always the probability that dirt will find its way into the bearings. In this connection, I would advise everyone to have an under-cover fitted to his car to keep out the dust and dirt. It is the only way to secure cleanliness, and is, I consider, an absolute necessity, and certainly the most important accessory. Do not start using the car and leave the matter of an under-cover for future consideration; you will only get dirt on to the mechanism, and it will be impossible to thoroughly remove it without partially dismantling the car. Many people consider that it is only necessary to wash mud off a car about once a week, though why dirt should be left on a car any more than on a carriage I can never understand; it looks bad and does not do the paint any good.

Almost the most important part of a car is the *brake*; this should always receive special attention. You can never tell when you may have to rely on its thorough efficiency, and your life or that of another may depend on it. It is not sufficient to know that the brake is acting fairly well; it should always be in the best possible working order.

The one question that remains is that of *insurance*, and I strongly advise every owner to take this precaution. In the present state of public feeling, the motor driver is always in the wrong, and there is the ever present danger of people or children walking across the road in front of a car. In insurance parlance this is called the "third party risk," and is one that should always be covered. There are various companies, such as the Car & General, General Accident, etc., which specialise in motor insurance, and their terms and respective advantages can easily be compared.

Finally, I would add one more piece of advice;—Always thoroughly overhaul your car before starting on a long run. There may be some nut loose, some split pin missing, or some trifling adjustment required, which, if not attended to, will lay the foundation of trouble on the road.

TRANSLATIONS.

DER WELTKRIEG.*

By AUGUST NIEMANN.—(Vobach & Co., Berlin—Leipzig).

Though the author's ideas of strategy and tactics are somewhat crude, this book is interesting as an illustration of views which appear to be entertained in some quarters on the Continent.

In his Preface the author recalls a conversation with a British Officer whom he met in India, in which the latter said that when he first served there as a subaltern the Russians were 1,500 miles from the frontier, when he returned as a captain 15 years later they were 500 miles away, and now they are actually at the passes leading to India.

He looks into the future and sees a war waged by the three allied powers—Germany, France and Russia—against their common enemy, England, with a new partition of the world as its result.

The scene opens with a conference of Russian statesmen at the Winter Palace in St. Petersburg, during which M. de Witte states that "It is the never-ending enmity of England which is responsible for the attack by Japan" and that it is necessary to put a stop to England's opposition to Russia's aims and interests. General Kuropatkin, called upon to unfold a plan of campaign says "There are three important passes leading from Afghanistan into India,—the Khaibar, the Bolan, and the Kurram,—and it suffices to say that we would find a way there. Habibullah Khan would join with 60,000 men as soon as we entered his country; he would indeed, be just as likely to join the British if they were first in the field, but nothing should prevent the Russians from being there soonest. I guarantee that within four weeks of the declaration of war a sufficiently strong army could be concentrated in the neighbourhood of Herat; this first army could, moreover, be followed by an unceasing stream of regiments and batteries; the reserves of the Russian Army are inexhaustible, and if necessary four million men and more than half a million horses could be brought into the field. I doubt, however, if the English would meet us in Afghanistan, and I consider they would be foolish to do so; for if they were defeated the Afghans would destroy them without mercy, whereas to us there would always be open a way of retreat through Turkestan. If the English Army were defeated, India would be lost to Great Britain; her power would be attacked on all sides by the Native

* A translation, by J. H. Freese, under the title *The Coming Conquest of England* has recently been published by Routledge.—EDR.

Princes, who have been so cruelly robbed of their independence, while we would be looked upon as deliverers. The Anglo-Indian Army is much stronger on paper than in reality. It numbers nominally 200,000 men; but only one-third is British, and it consists of four Army Corps scattered over the whole of India. The Field Army would have to be newly organized, and at most it could not number more than 60,000 men; for, owing to the disloyalty of the people, the country could not be denuded of troops. My opinion is that the war should be carried into India, and that victory would rest with the Russians."

The Minister for Foreign Affairs next speaks. "I agree with what General Kuropatkin has said, but point out that a war with Great Britain would not be confined to one quarter of the globe. Especially at sea is trouble to be expected. It is therefore necessary to ask the question as to what would be the attitude of the other great powers. Negotiations have been proceeding, through the Russian Ambassador in Paris, with Mons. Delcassé and the President of the French Republic." He proceeds to read a despatch received that day, the gist of which is that France would declare war upon England immediately the Russian Army was put in motion against India; in consideration for this France demands a free hand in Tonking and Cochin China, Russia's assistance to acquire Egypt, and her support to French policy in Tunis and the rest of Africa. M. Delcassé also impresses upon Russia the necessity of winning over the German Emperor as an ally, remarking that the question of Alsace-Lorraine might wait, and that nothing could be more disastrous for France than a misunderstanding with Germany.

Chapter 2 takes us to the camp of a British Cavalry Regiment at Chandigot in British India. The sun has just set; and while the soldiers are amusing themselves with playing games and singing, their officers are less innocently employed. A group of seniors are sitting outside the mess tent, smoking their short pipes and drinking whiskey and soda, while inside the younger officers are playing their usual, game of poker. Among the seniors is a guest, who is introduced as Mr. Heideck, a young German travelling for a Hamburg firm of indigo importers.

For some time the game of poker proceeds quietly, but eventually all the Officers except two, Captains Irwin and McGregor, lay down their cards. These two raise each other until the stake reaches a lakh of rupees, when the hands are laid on the table and it is seen that McGregor has won. Irwin, who is a comparatively poor man, then leaves the tent. Heideck proceeds to the Dak Bungalow, where he becomes immersed in sad thoughts of Mrs. Edith Irwin, a beautiful young English lady to whom he had recently been introduced. Soon afterwards a stranger arrives, who introduces himself as a Russian travelling in silks and bronzes and subsequently confesses that he is Prince Fédor Andrejewitch Tschadschawadse, captain in the Russian Guards; Heideck admits that he himself is a captain of the German General Staff. Both are in India in order to find out all they can about the Anglo-Indian Army, and the Prince announces that General Iwanov is already on the march against the Indian Frontier.

The next morning Heideck calls on the Maharajah of Chandigot in order to arrange a deal in indigo. He finds him looking rather annoyed, and full of complaints against the Government, which, he says, is becoming more tyrannical every day. He has just been ordered to supply 1,000 Infantry, 500 Cavalry, a battery of Artillery and 2,000 camels for service on the Frontier, and asks Heideck why troops are being concentrated there, remarking politely that as Heideck is not an Englishman he might possibly speak the truth. The latter, however, replies that he knows nothing.

Heideck subsequently has an interview with Col. Baird, O.C. Troops and Resident, who confides in him that the Russians are marching against Herat and that war would shortly be declared; and the former hastens to impart this confirmation of his intelligence to Prince Tschadschawadse, who decides to rejoin the Russian Army.

We now travel back to Europe and hear a conversation between the German Emperor and a Hamburg merchant, Herr Grubenhagen, who states that the whole of Germany is anxiously awaiting the moment for joining the Allies and prophesies, as one of the results of the war, the inclusion of Austria, Denmark, Norway and Sweden in the German Empire.

Back in India once more, we get a glimpse of the methods of British officials. Heideck is spending the evening with the Bairds. After dinner there arrive five ox-wagons with a small present of five lakhs of rupees from the Maharajah. Col. Baird thanks the messenger, the Rajah Tajahat, and says the five lakhs may be left pending instructions from the Viceroy as to their disposal. On the Rajah's departure the Colonel remarks to his guests that the money will be very useful in assisting to defray the expenses of preparing his command for war. He is doubtful whether he will make any report to the Viceroy about the incidents which have taken place; he thinks he would receive no thanks for doing so, as in the existing serious state of affairs the support of the native princes is very much required.

A few days later England declares war against Russia. France is evidently about to join, but the attitude of Germany is still doubtful.

Sir Bindon Blood, with the troops collected in the neighbourhood of Peshawar, was to advance at once up the Khaibar Pass on Kabul, while General Hunter was to move from Quetta on Kandahar. The Chandigot garrison had received orders to join the latter; but the day before the troops were to march an officer arrives on a motor car with a message from General Blood that the dispositions are all changed; the Russians had advanced over the Hindoo Khush and down the valley of the Indus* and General Blood was retiring southwards in order to avoid being cut off; all troops in Northern India, including General Hunter's Force, were now to concentrate at Multan.

The opening battle of the war takes place at Attock, and results in a success for the Russians. Owing to the inferior march discipline of the British troops there have been frequent halts, causing large gaps in the

* Officers, who know the country, will sympathize with Sir B. Blood's astonishment at being suddenly attacked by a large army from this direction.

stream of troops approaching the bridge over the Indus.* The Russian advance guard, crossing the Kabul River just above its junction with the Indus in the mist of the early morning, chances upon one of these gaps. The main body of the British Army continues its march southwards, while the troops cut off surrender after a short resistance; they consist of 2,000 British and 3,000 Native troops, and the latter at once transfer their allegiance to Russia.

The Russian General halts for a few days in the neighbourhood of Attock, to collect stragglers and to effect a junction with an Army Corps coming down the Khaibar Pass. He then proceeds southwards with an army of 70,000 men.

On receipt of the news of the reverse at Attock all the British forces, which had been ordered to concentrate at Multan, are diverted to Lahore; and the Anglo-Indian Army, which by this time is 100,000 strong (including 25,000 whites), occupies a position north of Lahore, with its left flank on the River Ravi. Heideck, who has marched with the Chandigot garrison, criticises the British very freely; the camping arrangements and commissariat were bad, and the tactical dispositions and manœuvres antiquated.

The Battle of Lahore ends, as usual, in a decisive victory for the Russians. (It is not worth describing in detail, as the account shows a grotesque ignorance of military matters, especially of the organization of the Anglo-Indian Army, and the character and composition of the Native troops). The battle formation of the British consists of two lines, the first made up entirely of Native troops, and the second of British ones to prevent the former running away. The Hindu regiments march along with the ends of their *puggaris* hanging loose and ashes sprinkled on their heads, in token of their despair, as it is known that the Mahommedans intend to turn on them when the battle begins. After a feint on the left, which draws the British troops to that flank, the Russians vigorously assault the centre. All is soon confusion on the British side, sepoys shooting their officers, and Hindus fighting Mahommedans. Finally whole regiments of Mahommedans begin to desert to the enemy, the first to go being the contingent furnished by our friend the Maharajah of Chandigot. The British regiments fight gallantly but are overpowered by numbers. Heideck stays long enough to see Colonel Baird and Captain Irwin killed, and then rides off to look after the ladies who are staying in Lahore. On the way to the citadel, Mrs. Baird and her children are all murdered; and subsequently Mrs. Irwin is carried off by retainers of the Maharajah.

The next day Heideck is tried by court-martial as a spy and sentenced to be shot. Fortunately, while on the way to the place of execution, he is recognized by Prince Tschadschawadse's page; and the Prince, arriving in the nick of time, takes him away and treats him as a guest. He informs Heideck that the first news he heard on reaching the Russian Army was that Germany had also joined in the war against England, Austria and Italy still remaining neutral. Germany had mobilized half

* Apparently all the fortifications discovered by the author at Attock, when collecting materials for the book, consisted of the Old Fort and the towers at each end of the bridge.

her Army and had occupied the Netherlands, while the French troops had entered Belgium; so that the whole coast opposite England was in the hands of the Allies, who were preparing for an invasion of that country.

The author now introduces us to a Cabinet Council in the Foreign Office in London. Despatches have been received from the Viceroy of India, describing the defeat at Lahore and stating that the Commander-in-Chief, with 5,000 men, has succeeded in reaching Delhi and will proceed to Cawnpur to collect a new Field Army, leaving the defence of Delhi to General Egerton.

The Minister for War remarks that no defeat in India or the Colonies can be a death-blow to the Empire, but the point to be considered is what steps are to be taken to protect the coast of England. The First Lord of the Admiralty says the Navy will do this. There are two Fleets in the Channel, one watching the French and one the Germans; while a third is in Copenhagen harbour to prevent the Russian Baltic Fleet uniting with the Allies. The Colonial Minister does not consider the dispositions satisfactory. The British Fleet should be united, and should compel the enemy to fight by attacking him in harbour and carrying out enterprises against the coast towns. This proposal is, however, overruled.

The question of land defences is next discussed. The War Minister states that 40,000 men have been despatched as reinforcements to India, and is of opinion that no more should be sent, as Great Britain is now denuded of troops. He wishes to enforce the Militia Ballot. But nothing is settled, and the meeting adjourns.

The scene again shifts to India. Prince Tschadschawadse has been detailed to command a detachment, which is to proceed to Simla in order to search the Government Offices for information. Heideck accepts an invitation to accompany him. The march is unopposed, and Simla is reached without any adventures except the rescue of Mrs. Irwin. The station is found to be deserted; but Heideck discovers Judge Advocate-General Kennedy, who agrees to take Mrs. Irwin and him to England. The Prince gives his permission; Bombay is reached without mishap; and the party embark on the P. & O. s s. *Caledonia*.

The voyage passes without incident until the Mediterranean is entered. About 24 hours out from Port Said, on the way to Brindisi, a strange vessel comes into view; this turns out to be a French cruiser, which is soon followed by three other fighting ships; the *Caledonia* heads first for Malta and then for Alexandria; an unsuccessful attempt to assist her is made by two British men-of-war, one of which is sunk and the other captured; she is then captured and a prize crew put aboard to take her to Toulon. The next night, however, a strong British fleet is encountered; the French Squadron is put to flight, and the *Caledonia* is escorted to Naples, where she deposits in the bank twenty million rupees brought home for the British Government.

Heideck now sets out to report himself in Berlin; and Mrs. Irwin, having with difficulty been persuaded that it is impossible for her to accompany the German troops, disguised as a soldier servant, decides to travel with the Kennedys to England.

The author now treats us to some naval warfare in the North Sea. Heideck, who has been promoted Major and appointed to the charge of the Intelligence Service on the coast of Holland, is standing on the deck of the German cruiser *Gesion*, lying in the mouth of the Scheldt, when he sees a fishing smack enter the river. On examining her he finds concealed on board a paper containing a list of questions regarding the dispositions of the German Naval and Military Forces in the vicinity of Antwerp. After threatening the skipper Brandelaar with trial as a spy, he obtains the names of his informers in Holland. On visiting one of them, Herr Amelungen of Antwerp, Heideck finds a letter in cipher, giving a list of the German ships lying in Kiel harbour (including a large number of merchant steamers, evidently intended to be used as Transports) and stating that there are 60,000 German troops in the neighbourhood of Kiel ready to embark. Heideck re-writes this letter so as to convey the impression that it is from Antwerp, and not from Kiel, that the invading Army is to start; and gives it, with his own answers to the questions found on the fishing boat, to Brandelaar to convey to the British Admiral at Dover. He also forwards a letter to Mrs. Irwin by the same agency.

When Brandelaar returns, Mrs. Irwin accompanies him. She brings with her a paper, which she has succeeded in getting from the British Admiral's secretary, and which turns out to be a copy of an order from the Admiralty for an attack on the German fleets at Kiel and Antwerp. Heideck is so disgusted with Mrs. Irwin's treachery to her country that he will have nothing more to do with her; she therefore bribes another fisherman to take her back to England, and during the voyage she falls overboard and is drowned.

Heideck takes the order to the German Admiral. The scheme is for the German Fleet, being the weakest of the three Allies, to be attacked first; the British Fleet at Copenhagen is to enter Kiel harbour and destroy or capture the ships lying there; while at the same time Rear-Admiral Sir Percy Domvile, with a portion of the Channel Fleet formed in two divisions, is to enter the Scheldt and force his way up to Antwerp. A Reserve Squadron, under Prince Louis of Battenberg, is to watch for any attempt by the French Fleet to come to the assistance of the Germans. The attack is to be delivered on the 14th of July.

In consequence of the above intelligence an urgent message is sent to the French Admiral, and the embarkation of the troops at Kiel is proceeded with. On the evening of the 14th the flotilla of transports in Kiel harbour gets under way, and enters the Kaiser-Wilhelm Canal to proceed to the North Sea. It is well on its way by the following morning, when the British Fleet from Copenhagen begins to bombard the forts at the entrance to the harbour. A north-westerly course is steered and the Firth of Forth is reached without meeting a single British man-of-war. No opposition being encountered, the two Army Corps are landed and proceed on their march towards the south.

While the flotilla of transports is making its way towards the north Sir Percy Domvile delivers his attack on the Scheldt. During the night of the 14th the German Admiral leaves his moorings in the harbour of

Antwerp, and anchors in the Eastern Scheldt to the north-east of the Island of Walcheren. On the morning of the 15th a few cruisers are despatched south-west to meet the British Fleet, with orders to retire before it up the Western Scheldt and thus convey the impression that the German Fleet is still at its anchorage in Antwerp harbour. As soon as the German Admiral receives intelligence that this manœuvre has been successfully carried out, he passes round the north of Walcheren Island with his battleships, sending his cruisers and torpedo boats back into the Western Scheldt. He is thus able to attack the British Fleet on its left flank, as it approaches the south-west corner of Walcheren; and when it turns to meet him, the cruisers and torpedo boats deliver their assault on its right rear. A long and bloody battle ensues; the French Fleet arriving at the critical moment, Sir Percy Domvile withdraws towards the mouth of the Thames; and the united French and German Fleets follow in pursuit.

Little more remains to be told. Immediately after the battle of the Scheldt a large French Army, with some regiments of Russian Guards, lands at Hastings; and the British troops, after a gallant resistance, are forced to give way before the superior leading of the French and Russian officers. The Russian, French and German allied forces are now in camp at Aldershot, with the headquarters at Hampton Court Palace; and Great Britain has sued for peace.

Preliminary negotiations are in progress regarding the settlement, and these are to be followed by a Conference of all nations at the Hague. It is not proposed to destroy Great Britain absolutely, but her power is to be considerably crippled. Russia is to take India, France Egypt, and Germany Walfisch Bay and other British possessions in South-West Africa. The fortifications of Gibraltar are to be dismantled and the place handed over to Spain It is probable that Belgium will join the French Republic, and the Netherlands become part of the German Empire.

F. W. BRUNNER.

EQUIPMENT FOR VISUAL SIGNALLING IN DULL WEATHER.

A recent Supplement to the *Militär Wochenblätt* contained the report of a lecture given in February of last year before the Military Society of Berlin by Capt. Gross, instructor in the Balloon Battalion.

The lecture dealt with all the most modern means of transmitting military messages; and the following extract may be of interest in showing how the Germans borrowed an idea from another army, thoroughly tested it and worked it out on their own lines, and incorporated it in their organization.

In dealing with visual signalling, the lecturer, after discussing its advantages and disadvantages, says:—

> It can therefore be easily understood that, though unreasonably, visual signalling came to be thought of little importance in our army after the introduction of the electric telegraph, and quite an exceptional occurrence was required to bring its military possibilities again into prominence.
>
> His Majesty the Emperor noticed the good services rendered by the English signalling staff in the autumn manœuvres of 1899, and the apparatus, which had proved itself serviceable in India and South Africa, was placed by the English Government at his disposal. Experiments were carried out by His Majesty's command, and our army was to be provided with an equipment after the utility of visual signals had been carefully considered.
>
> The result of nearly ten years' experiments proved that, of all signalling equipments tested, the English one was the best and most serviceable; but that even theirs was unable to ensure rapid and certain communication in our climate over long distances on cloudy days. Their portable helio proved itself exceptionally well suited for signalling, even in our latitudes, up to 100 kilomètres during sunshine; but their limelight on the other hand, when used by day with an overcast sky, was only visible up to 8 kilomètres. The successful use of signalling during the Boer war made it seem advisable to improve the apparatus by further trial and experiment so as to make it work successfully in our climate.
>
> The zeal and combined efforts of the Experimental Section of the Communication Troops, the 1st Battalion Telegraphs, and the Cavalry School of Telegraphs have at last produced a signalling apparatus which is of wider application than the English, and makes another step towards the perfection of the signalling service of our army. It is of course of the greatest use in directing an army, and especially

in keeping touch with cavalry scouts. The helio alone is unsuited to our climate, in which the sun often does not shine for days together. It must be accompanied by an artificial light, strong enough to allow of its use by day over the longest distances found necessary in practice.

The ordinary sources of artificial light known up to the present were either too weak or their operation and transport were such as to prohibit their use in the field. In the course of experiments in this direction, Dr. Knöfler, a chemist, found that a proper mixture of oxygen and acetylene gases gives a much hotter flame than the oxyhydrogen jet usually used for signalling purposes. Small plates of thorium can be brought to a white heat by it, and they are then capable of giving about a 500 standard candle power light. If all the rays proceeding from the plate are caught and concentrated by a system of lenses, as in a lighthouse, and emitted as a parallel beam, the intensity rises at once to 80,000 standard candles. In this way an artificial light of quite exceptional power is obtained.

It is on this principle that the new Field Service signal lamp, Mark C/1902, has been constructed. A removable head contains the lenses, the thorium plate and the burner. The gas is brought to the burner in rubber tubes; and the lamp, placed on a light tripod, can be turned in any required direction. A helio and telescope are so arranged that, firmly connected to the lamp, the optical axes of all three are parallel. By this means it is possible, while working with the helio, to change to lamp signals or *vice versâ* without interruption, as the sun goes in or comes out. Besides this it is easy to direct the lamp or helio on the other station, as either has only to be laid by the telescope.

The whole apparatus for making the gas is quite portable. The acetylene is made in a chamber from calcium carbide and water, just as in the ordinary acetylene cycle lamp. The oxygen is carried compressed in steel cylinders in the same way as hydrogen for the Balloon Section. One of these small cylinders can be attached to the saddle and holds enough oxygen for several hours' work.

With this apparatus signals can be read under favourable conditions up to 50 kilomètres, and occasionally at still longer distances. As, however, the selection of signal station points is determined for the most part by the progress of the operations, and it is not usually possible to select especially favourable positions, the average distance between stations on service has been laid down as from 12—15 kilomètres.

With a well-considered system and good instruction in peace time, successful results may confidently be expected in the following cases, as proved by experience during the grand manœuvres and by the Field signalling parties in China:—

(1). To connect troops separated by insurmountable obstacles, such as a big river, or during a siege.

(2). To connect a field army and a fleet acting together, when wireless telegraphy is not available.

(3). In scouting, to hasten the transmission of pressing reports from officers' patrols, contact squadrons, and the cavalry screen in general, which may be many miles in advance of Headquarters.

(4). Lastly, at times, to replace interrupted telegraphic or other means of communication in ordinary use.

Further technical improvement of the equipment is, generally speaking, impracticable; and it will be the duty of the troops entrusted with the service of this somewhat difficult apparatus to attain the maximum possible skill, after which a distinct organization and thorough training during peace time will be required.

T. T. BEHRENS.

NOTICES OF MAGAZINES.

NATURE.

GREAT GOLFERS AND THEIR METHODS.—This book by Mr. Beldam has a scientific value quite apart from the "science" and art of the game. Every golfer knows the value of steady and accurate putting, and how curiously variable is his "form" in this respect. Mr. Beldam's excellent photographs bring out the very familiar fact that stance and pose are of comparative insignificance. Professor Tait was the first to bring scientific principles to bear upon the mystery of the flight of a golf ball. His papers on the rotating spherical projectile virtually form a new chapter in the dynamics of rotation. In these papers he lays down clearly the conditions which must be fulfilled if a man is to drive a far and straight ball. Slicing, putting, topping, are all completely explained along the lines of Newton's note on the deflection of a tennis ball in air (which both Euler and Poisson rejected as of no account). Tait showed how the ball must be started if it is to finish aright. The difficulty the golfer experiences is to give the proper start, and the mode of solution is as varied as the temperament of the player. There must, however, be a best way for every individual, and in discovering this, he should be guided by scientific principles. Mr. Beldam gives accurate pictures of some of our best golfers, catching the player at the very instant the ball is struck or just before the impact takes place. Plate XXVIII., said to be taken in $\frac{1}{1000}$ of a second, has a blurred image of the club head, 4 inches broad, giving a velocity of about 370 feet per second for the club head *after* impact. This would mean fully 900 feet per second for the ball, about double of that which Professor Tait calculated for a well-driven ball on leaving the ground.

THE SIMPLON TUNNEL.—The length of the tunnel will be 12¼ miles, all of which has been penetrated (1st November, 1904) with the exception of about 260 yards near the middle. The work consists of two single-line tunnels 50 feet apart, axis to axis. The object of having two tunnels in place of one has been fully justified for the following reasons:—(*a*). The ventilation is much more efficient, one tunnel being used as an "intake" for fresh air, which is blown in by high-speed fans, working with a water-gauge of 9 inches, the other being the outlet. (*b*). In case of derailment of a train occurring, it cannot possibly run into a train in the opposite direction. (*c*). When repairs are required, one tunnel can be closed at a time, the traffic being conducted in the other; and finally (*d*) the crushing weight of the material overhead is much more easily dealt with than it would be in a double-line tunnel; the overlying rocks extending to a height of

7,005 feet. The tunnel is arched throughout, the pressure which has been encountered is so great, that in one place the arching of granite blocks is 2 mètres in thickness. The setting out is checked monthly; a small slit of light is thrown into the tunnel, which by the aid of theodolites is taken right up to the working face. It is anticipated that when the actual meeting of Switzerland and Italy takes place under Mount Leone, the error in direction will be under 18 inches.

The gradient rises from each end of the tunnel towards the middle so as to provide efficient drainage, a hot spring having been met with on the Swiss side, with a flow of 12,000 gallons per minute. The question arises from whence the great heat of the spring comes, for although borings in all parts of the world give an approximate rise of 1° F. in temperature for each 70 feet of vertical depth, this is insufficient to account for the great heat which has been encountered. A jet of cold water is played into the fissure from which the hot water is escaping; it is thus cooled down so as to enable the workmen to continue the drilling and blasting. It is expected that within three months of the piercement, trains will be running.

COLOUR PHOTOGRAPHY.—Messrs. Lumière use one screen only for the three-colour process. They sort out from potato starch granules from 0·015 to 0·02 mm. in diameter and colour separate lots of these, red, green, and violet respectively. When quite dry the coloured granules are mixed in such proportions that the mass appears grey, and a waxed glass is coated with them only one granule thick. To prevent the interstices from passing white light, they are filled up with a fine black powder and are then coated with a varnish of the same refractivity as the starch. By this means an irregular-grained triple-colour screen is obtained. It is then coated with a sensitised emulsion. The plate is exposed through the glass, developed, the silver image dissolved, and the remaining silver salt reduced to the metallic state to form the image. Thus is obtained the completed transparency. There must be many practical difficulties to surmount in the preparation of such compound plates, but the making of coloured transparencies must be much more simple than when three negatives and three prints have to be made.

SOLAR ECLIPSE.—Mr. Croker is to defray the cost of three expeditions of the Lick Observatory to observe the total solar eclipse of August 30th, 1905, one going to Labrador, another to Spain and the third to Egypt. At each of these stations the corona will be photographed with a camera of 5 inches aperture and 40 feet focus.

W. E. WARRAND.

BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS.

July, 1904.

AUTOMATIC COUPLERS.—A *résumé* of the state of affairs in England at present. No really satisfactory auto-coupler seems to have been devised yet, and the difficulties of the transition stage are great; moreover, the expense involved in the *process of changing* from non-automatic to auto-

matic would be considerable. Full experiments and trials are necessary before any definite steps towards bringing such couplings into general use can be made.

SLOW FREIGHT RATES.—By H. Smart (Sec., R.C.H.)—A most valuable summary of present conditions in England, shewing how the classification has been arrived at, and the general principles which determine the fixing of rates. English Law does not provide for raising a rate because it is unremunerative, or because the line is not paying reasonably. I think it is the case that certain American railways have raised their rates lately because working cost has gone up.

AMERICAN LOCOMOTIVE PRACTICE (see *R.E.J., July*, 1904).—This number contains particulars of the discussion and correspondence on Mr. Cowan's paper, of which some account has been given. A number of interesting points are brought out, of which it may be of interest to give some notion.

The author alludes to a type of engine known as the "four-cylinder Vauclain balanced Compound," differing from the type we are accustomed to associate with the name of Vauclain, as it has two cylinders inside the frame and two outside, instead of a high and a low pressure cylinder with a common crosshead on each side outside. The arrangement sounds very like that of the de Glehn compound, but the high and low pressure cylinders on each side are in one casting, in which is also a single piston valve controlling the steam distribution in both cylinders. All connecting rods work to the same axle, the cranks set at 90°, and the crank pins at 180° to their respective h.p. cranks. The h.p. pistons are sometimes filled with metal so as to equalise weights and effect a balance. In the pattern of Vauclain engines which have both piston-rods connected to the same crosshead there appears to be much risk of breaking the cylinders, by reason of the unequal amount of work done in them.

It appears to be very generally held in England that piston valves use more steam than flat valves, but some very good examples are quoted of economical working, and Mr. Churchward says that there is no reason to despair of getting tight piston valves before long. At any rate they are very commonly used in American practice.

The substance of the remarks made confirms the impression that real interchangeability, of which so much has been prated, is far from being attained at present in American loco. design. "When allowed a free hand, the locomotive builder did not trouble himself much about the interchangeability of the parts in the interest of the purchasing railway. He had a variety of drawings, and whenever possible parts in stock which had to perform a similar duty to those required were worked in." The builders had the trade in their own hands and railways only secured a measure of standardisation by getting successive orders from the same builders. Again, when each order is for a heavier type of engine arrival at a standard type is indefinitely postponed. One writer remarks as regards finish of working parts and so forth that the American engine is as much the commercial man's as the engineer's engine, probably because the builders have a freer hand than in England. The want of uniformity in details is considerably felt when engines come in for repairs in the

running shed, and such a thing as a broken spring, for example, cannot be replaced by taking from another of those in for repairs.

The author's opinion as to the disadvantage of training men for one job only is generally agreed in by those who remark on the paper; one or two instances are mentioned where men had a very poor idea of how to put right such things as twisted pieces sent them from the machine or forge (apparently this is by no means unknown). Again, surface finish has been found very valuable in detecting flaws in such things as axles. The American policy as to foundry work seems to be "make quickly and trust to luck for obtaining a fair proportion of good castings," but, on the other hand, many works take infinite pains over both chemical and physical tests of their metal.

There seems no doubt that the American engine is extravagant in fuel, and the enormous fire boxes now often fitted are more than one man can properly feed. More boiler power is allowed proportionally, but American engineers have been accustomed to build their engines with a wide range of power, that is, short laps, long leads, and ample clearances. Again, they reckon something like 10% higher mean effective pressure at the cylinders than English engineers do.

BIG WAGONS (GERMANY).—Some notes on recent experience.

It is apparently established (from experience with coal traffic mostly) that:—

(1). The ratio of paying load to tare is improved.
(2). Length of trains is decreased.
(3). Cost of haulage is reduced (but information is imperfect on this point).
(4). Time and labour are saved in unloading. Hence
(5). Wagons stand idle less time, and less rolling stock is required to do the work.
(6). Cost of maintenance relative to tonnage capacity is reduced.

November, 1904.

The greater part of this number is taken up with two reports, to be presented at the next session of the Railway Congress, on "Rails for lines with fast trains." The reporters are Mr. P. H. Dudley for America, and Mr. Van Bogaert (of the Belgian State Railway) for other countries.

The reports give an excellent general survey of the latest practice; and in fact resolve themselves into a general consideration of the best type of permanent way, for the rails cannot be satisfactorily considered without the sub-structure supporting them.

It is impossible to go into them in detail without exceeding due limits of space, and it must suffice to mention one or two prominent points. The articles will well repay perusal.

(1). The increased stiffness of permanent way, including sleepers and ballast as well as rails, has permitted much development of motive power and of rolling stock.

(2). The spacing and loading of the wheels have become the ruling factors in determining the nature of the depression, when the road passes from the unloaded to the loaded condition.

(3). The effect of using stiffer rails and stiffer joints is to increase the capacity to bear large bending moments and so bring on to the sleepers and ballast underneath a distributed instead of a concentrated load.

(4). When the track gives way little under the rolling load the pressure between wheels and head of rail is greater, consequently harder metal is needed for resistance.

It also appears advantageous to increase the width of the railhead and to make it flat instead of rounded, as one or two companies do now.

(5). With good rolling stock and well-balanced locomotives, however, the need for heavy rails is not so paramount.

(6). Rails rolled at a low temperature, and consequently of fine crystallisation only, wear best and are less liable to fracture.

C. E. VICKERS.

THE RAILWAY ENGINEER.

December, 1904.

LOW PRESSURE POWER SIGNALLING (L. & S.W.R.).—It is intended to equip the sections between Basingstoke and Woking, and some portions are already at work. The "normal safety" system is used; the train only puts the signals to "danger" to protect itself for a section's length behind. There is no overlap, to guard against trains over-running signals; usually elsewhere a certain distance is provided to ensure that before one train is allowed to enter the section the previous train must have wholly passed beyond it.

The general principle of the actuation is that a train entering the section, and so forming a connection between the rails, short circuits a track battery and so de-energises a magnet and drops its armature. This operates a valve which allows the air pressure to be released and so to put the signal "on." As the signal goes "on," it breaks the circuit to its distant signal, so that it goes "on" also. When the train goes out of section the magnet is re-energised; the valve then permits the air pressure to be applied again and so lowers the signal.

When the signals are operated from a signal box, there is automatic replacement; the valve operated by the magnet in the manner previously mentioned allows air to pass to a small piston attached to the lever slide, so as to replace it when the section is cleared. The lever being replaced, the cut-off valve is opened and allows the signal to return to its normal position.

It is somewhat difficult to attempt to explain the system clearly without the diagrams. Automatic signalling, however, deserves study, as, on account of the saving of labour it effects, it is bound to be extensively adopted.

C. E. VICKERS.

REVUE D'HISTOIRE.

November, 1904.

THE CAMPAIGNS OF MARSHAL SAXE.—*Campaign of* 1745.—The investment and siege of Tournai are described, down to the eve of the battle of Fontenoy. The officer commanding the artillery was not satisfied with the progress of the siege batteries. "The officers answered that the fire of the place hindered them from working; he asked them where were the dead and wounded. He placed them in arrest and reported it to M. de Saxe, who said this was not enough, they must be sent to Lille to be imprisoned, and their names must be sent to the Court that they might be cashiered."

THE CAMPAIGN OF 1800 IN GERMANY.—The successive reorganisations of the army of the Rhine, under Moreau, in the first three months of the year. Eventually it formed four Corps under the command of Lecourbe, St. Cyr, Sainte-Suzanne, and Moreau himself.

THE WAR OF 1870-1871.—*The 18th August in Lorraine.*—The account of the battle of Gravelotte is continued, and is carried up to the end of the day, so far as the northern part of the battlefield is concerned. Ladmirault, commanding the IVth Corps, held his ground at Amanvillers, and sent urgent messages to Bourbaki (commanding the Guard) to come and help him, that he might take the offensive. Bourbaki moved up to do so, but on getting clear of the woods he saw the stream of fugitives from Saint-Privat. "This is not well done," he said to Ladmirault's aide-de-camp. "You promised me a victory, and you are bringing me to take part in a rout." He gave the word "right-about turn" to his men, and marched them back to the position they had been holding before, in reserve. This retrograde movement added to the panic which had already begun in rear of the line of battle.

E. M. LLOYD.

MILITÄRISCHE BLÄTTER.

Nos. 21, 22, 23, 24.

The strategical importance of Egypt is treated in a series of articles which do not throw any particular additional light on the subject; they are, however, agreeable reading. The writer ascribes the fortifications of Suakim to Colonel Kitchener, but this is surely an error.

The autumn manœuvres in France are touched upon, and it is stated that much has been done in this year to give them more the appearance of war than has heretofore been the case. For example, battles were not always decided on the day on which they were commenced, it being recognized now that a combat may last for several days, and this is said to be an application of the knowledge gained from the War in progress; but the Boer War taught us this, without searching earlier history. Night attacks were not in favour, though the present war shows many instances where they have been attended with success, and surely there are no operations that armies require to be practised in more than in

these. They are very unpopular, as they may involve long marches and consequent fatigue and exhaustion to the troops, and artillery and cavalry are not utilized. A massing of guns for suitable purposes was often observed ; the theories on the subject suggested by the experiences of the Boer War appear to be now definitely put away. The usual final parade was this year dispensed with, which is highly approved of—this function leading often to many strategical absurdities, in order to get the rival forces in proximity to the place chosen for the march past.

Lessons from the present War are dealt with. The writer is well pleased with the aptitude which the German pupils have displayed, and that the fundamental principles of German prescriptions for the combat, adopted in their entirety by the Japanese, have shown themselves superior to the Russian of 1900, shock tactics and volley firing, recommended in the latter, having completely failed. The offensive, so dear to the modern German, is declared to have been most skilfully used by the Japanese, though it is recognized that the latter's successes have been due more to tactical training than to strategical leading ; their battles up to the present have only been half victory, and this must be looked upon as a consequence of deficient strategical ability. The success with which the Japanese have suppressed all information from their side is remarkable ; even their losses in the different battles are unknown to the public, and at sea only months after a catastrophe does it leak out that a ship has been lost. It is likely that in future wars all states will follow the lead given by the Japanese, and that the special correspondent will sink into insignificance. Many successful night marches have been carried out by the Japs, and in some cases the attacks consequent on them have been attended with success ; this was notably the case on the 27th July, when the 2nd Division attacked in the grey of the morning, after a long night march, the heights of Taotingling, and captured them in spite of a most vigorous resistance. Much praise is given to the Russian engineer for the skill he has shown in field fortification, although shelter trenches have at times been unfortunately placed ; but this may be due to bad execution on the part of the infantry. The Russian cavalry (mostly Cossacks) has hardly been engaged in battle ; at Wafungfoo it obtained some success ; in its principal duty (covering and discovering) it has singularly failed, and many checks in operations are ascribed to this cause. The handling of the artillery by the Japanese is quite in accordance with modern German ideas—massing of guns for an overpowering concentric fire on the decisive spot where the infantry attack is to be pushed home. On the Russian side scattering of guns has been the rule, at least in the earlier stages of the War, and they have suffered accordingly. The important *rôle* played by the 12-centimètre Japanese howitzers in the battle of the Yalu and other engagements is recognized, and steps are being taken in France to provide Army Corps with suitable howitzers. Heavy guns are not now attached to these.

The introduction of the two years' term of service is discussed in two articles, both worth reading. It is admitted that more trained men will be forthcoming ; but it is also recognized that great additional work will be thrown on the permanent cadres, and that the difficulty of providing

suitable N.C.O.'s in the future, already felt on account of increased prosperity in German trade and consequent openings in civil life, will increase by reason of this measure. The question also arises whether the officer class may not suffer by it, making the profession less sought after than it has hitherto been; indeed, for some years regimental service has not been so popular as it used to be, and the greatest difficulty is experienced in keeping officers with their regiments; and it is notorious that many regiments in out-of-the-way commands suffer much on this account, those officers who get employed on staff and colonial duties being as a rule the most influential and best in the regiment. According to the new law, the peace footing of the German Army, 495,500 rank and file, will be increased to 505,839; but adding to this the officers and under-officers, probably about 60,000 men, it will bring the peace strength up to about 560,000 men. As heretofore, the peace strength is represented by little less than 1 per cent. of the population, the proportion supplied by the different states of the Confederation being;—Prussia, 392,979, Bavaria, 55,424, Saxony, 37,711, and Würtemberg, 19,725; the strength by units being:—633 battalions of infantry, 510 squadrons, 574 batteries, 40 battalions of garrison artillery, 29 battalions of engineers, 12 battalions of communication troops and 23 battalions of train, the whole being distributed among the fortresses and 23 Army Corps. As Würtemberg, according to the new law, will not be able to furnish its contingent, in consequence of its population not keeping pace with the other states of the Empire, its deficiency of 256 recruits will be made good by Prussia, and in this way the per centage will be the same for all the states of the Empire. New cavalry regiments, infantry battalions, batteries and engineers will be formed.

Von Trotha continues his "History of War," and from his study of Liaoyan and Schaho, although recognizing the great absolute loss at these battles, concludes they cannot compare for a moment in losses per day with Zorndorf, Borodino, Mars la Tour or Gravelotte; but the marvellous is the astounding moral force displayed by both combatants in these battles of many days duration. The idea of "Buren Angriffs," which held its sway for some time, has been killed and buried in the East Asiatic battlefields. The supply of ammunition in these battles has apparently never failed; it is a proof of the good organization and fire discipline of both armies. The hand-to-hand combats with the bayonet speak volumes for the moral qualities of the combatants.

R. A. LIVESAY.

RECENT PUBLICATIONS.

A History of the Indian Mutiny, reviewed and illustrated from original documents by G. W. Forrest, C.I.E. (Size 9½ × 7. 38s. W. Blackwood & Sons).

The Navy as I have known it, by Admiral Sir E. R. Fremantle, K.C.M.G. (16s. Cassell & Co.).

Strategy illustrated by British Campaigns, by Capt. Macquoid, D.S.O. (9 × 6. 10s. 6d. Cassell & Co.).

The Sikhs, by General Sir John J. H. Gordon, K.C.B. (9½ × 7. 7s. 6d. W. Blackwood & Sons).

Tactics of Today, by Lieut.-Colonel C. E. Callwell, R.G.A. (2s. 6d. W. Blackwood & Sons).

Reminiscences of the Civil War, by General John B. Gordon, Confederate Army. (9 × 6. Constable).

Regulations for Intelligence Duties in the Field. War Office. (7 × 5. 2d. Eyre & Spottiswoode).

Report on the Medical Arrangements of the South African War, by Surgeon-General Sir W. D. Wilson, K.C.M.G. Official. (Folio. 7s. 6d. Eyre & Spottiswoode).

Report on Work of Telegraph Section, Somaliland Field Force. Official. (Folio).

The History of the Victoria Cross, by Philip A. Wilkins. (4to. 21s. Constable & Co.).

Story of the Campaign in Eastern Virginia, by Lieut.-Colonel H. M. E. Brunker. (7½ × 5. 7s. 6d. Foster, Groom & Co.).

My Service in the Indian Army and After, by General Sir J. L. Vaughan, K.C.B. (9 × 5½. Constable).

Glossary of Geographical and Technical Terms, by A. Knox. Supplementary Volume to Stanford's *Compendium of Geography and Travel*. (8 × 5½. 15s. E. Stanford).

The Electrical Transmission of Energy, a Manual for the designing of Electrical Circuits, by A. V. Abbott, C.E. (9 × 6. 30s. Crosby Lockwood).

Astronomical Discoveries, by H. H. Turner, F.R.S. (9 × 5¾. 10s. 6d. Arnold).

Maxwell's Theory and Wireless Telegraphy, by H. Poincaré and F. K. Vreeland. (8½ × 5½. 10s. 6d. Constable).

Linear Perspective Projection (Textbook for the Royal Military Academy, Woolwich), by Major E. H. Stafford, R.E. 2 vols., letterpress and plates. (6s. Eyre & Spottiswoode).

The White Man in Nigeria, by G. D. Hazzledine. (9×6. 10s. 6d. E. Arnold).

Through the Unknown Pamirs. The Second Danish Pamir Expedition, 1898-99, by O. Olufsen. (9×6. 15s. W. Heinemann).

On the Outskirts of Empire in Asia, by the Earl of Ronaldshay. ($9\frac{1}{2}$×7. 21s. W. Blackwood & Sons).

India, by Colonel Sir T. H. Holdich, K.C.M.G. (9×6. 7s. 6d. Oxford University Press).

Game, Shore and Water Birds of India, by Colonel A. Le Messurier, C.I.E., F.Z.S., F.G.S., late R.E. 4th edition. ($10\frac{1}{2}$×7. 21s. W. Thacker & Co.).

English Estate Forestry, by A. C. Forbes. (12s. 6d. Arnold).

The Governance of England, by Sidney Low, B.A. (7s. 6d. T. Fisher Unwin).

Hints on Horses, by Capt. M. C. Gonne, R.A. ($8 \times 8\frac{3}{4}$. 5s. Murray).

A Geometrical Political Economy. H. Cunynghame, C.B., M.A. ($7\frac{1}{2}$×5. 2s. 6d. Clarendon Press, Oxford).

The Cross Bow, by Sir Ralph Payne-Gallwey, Bt. (11×9. £3 3s. Longmans, Green & Co.).

Applications for Advertisement Space should be addressed to

THE SECRETARY, R.E. INSTITUTE, CHATHAM.

The terms, *prepaid*, will be as follows; no advertisements allowed on Cover, and no trade illustration blocks permitted :—

	3 insertions.	6 insertions.	12 insertions.
Whole Page - - -	£3 3 0	£4 15 6	£6 6 0
Half Page - - -	£1 12 6	£2 8 6	£3 5 0
Quarter Page - - -	£0 16 0	£1 4 0	£1 12 0

SOME PUBLICATIONS BY

THE ROYAL ENGINEERS INSTITUTE.

Title and Author.		Net Price to Non-Members.
		s. d.
R.E. Field Service Pocket-Book. 2nd Edition ....3″ × 5″	1902	5 0
The Destruction of Mosquitos, by Major W. M. Hodder, R.E.....	1904	2 6
Notes on Steel Concrete, by Major J. Winn, R.E., Assoc. Inst. C.E. 2nd Edition.....	1904	2 6
Notes for Officers Proceeding to India. Compiled by Major A. T. Moore, R.E.	1904	2 6
Detailed History of the Railways in the South African War, 1899—1902. 2 vols. .....Folio	1904	*In the Press.*
The Franco-German War, 1870—1871. Condensed from the German Official Account by Major J. Scheibert, German Army, and translated by Major J. A. Ferrier, D.S.O., R.E.....	1894	7 6
The Principles of Structural Design, by Major G. K. Scott-Moncrieff, R.E., Assoc. Inst. C.E. 2 vols.	1897	10 6
The Water Supply of Barracks and Cantonments, by Major G. K. Scott-Moncrieff, R.E., Assoc. Inst. C.E.	1896	10 6
Notes on Blacksmith's Work, by Major R. F. Sorsbie, R.E.	1903	4 6
Notes on the Manufacture and Distribution of Gas, by Lieut.-Col. E. C. S. Moore, R.E.	1894	6 6
History of the Corps of Royal Engineers, by Major-Gen. Whitworth Porter, R.E. 2 vols. .....9″ × 5½″	1889	5 6
Two Indian Campaigns in 1857—1858, by Col. Sir E. T. Thackeray, K.C.B., V.C., late R.E. (Bengal) .....8″ × 5″	1896	6 9
General Sir H. D. Harness, K.C.B., R.E., 1804—1883. Compiled by the late Major-Gen. T. B. Collinson, R.E., and Others. Edited by Major-Gen. C. E. Webber, C.B., late R.E.	1903	3 6
Professional Papers of the Corps of Royal Engineers. Occasional Papers Series. Vols. I. to XXX., 1877—1904. (Separate Papers at various prices) .....each volume		10 6

Except where otherwise stated, the books are octavo, measuring 8½″ × 5⅓″.

They may be obtained from Messrs. W. & J. Mackay & Co., Ltd., Chatham, or from any Bookseller.