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*ORGANIZATION OF THE ROYAL ENGINEERS IN AN INFANTRY DIVISION.**

By Bt.-Lieut.-Colonel A. W. Roper, R.E.

In our service we seldom use Army Corps and the Infantry Division becomes the largest unit. The Army Corps despatched to South Africa in 1899 was never used as such, and the various Divisions acted independently or in concert with each other as circumstances directed.

It would appear, therefore, that the Infantry Division should be complete in itself. This is not the case under existing regulations so far as Engineers are concerned. The Engineers in an Infantry Division consist of Regimental Staff and one Field Company; but no Telegraph or Balloon Sections are included.

The Regimental Staff comprises a C.R.E., his Assistant, an Engineer Clerk and batmen. The Field Company numbers 212 officers and men, of whom 54 are mounted and 158 dismounted. It is divided into three Sections in addition to the Headquarter Section, which consists mainly of the Company Staff.

Each of the three Working Sections of the Company should be complete in itself, so as to be thoroughly efficient when detached with a Column. This, however, is not at present the case. For instance, there is only one "Forge, double bellows" with a Company, so that a detached Section has none; yet it is a most necessary article of equipment.

The mounted men are not tradesmen, but are used as officers' servants and as Drivers of the technical vehicles. The Sappers, who are artisans and form the bulk of the Company, are all dismounted and consequently have to march like infantry. They cannot therefore be made full use of on the line of march, as there is no way of carrying them quickly to any place required. Again, on arrival in camp after a long march, they are often too tired to properly carry out their technical work.

There are at present no R.E. in an Infantry Brigade. Yet there is much work which Brigadiers would like done, but for which they have to ask through the Divisional Generals. In action and on Field Days, the latter often appear to have so much else to think about that the Field Company gets overlooked. It seems probable that this would not be the case if Engineers were allotted to each Brigade.

* Since the above was written a revised War Establishment for a Field Company R.E. has been published. It does not however materially affect the principles advocated.

As regards what is called the Regimental Staff, it is very desirable that the C.R.E. should be recognised as one of the Divisional Staff. This is really essential if the Engineers are to be efficient in forwarding the execution of the General's plans, as it is only through the C.R.E. that the R.E. officers learn what is to be done.

On active service, there are never enough Sappers to carry out the work required of them.

The shortcomings of the present organization may thus be summarised as follows :—

1. The Infantry Division is not complete in itself.

2. The Sections of the Field Company, R.E., are not sufficiently independent.

3. The Company is not sufficiently mobile.

4. There are no Engineers permanently allotted to Infantry Brigades.

5. The C.R.E. does not form part of the Divisional Staff.

Moreover, on active service there are never enough Sappers to carry out all the work required of the Engineer.

The following organization is therefore suggested as one that would be more suitable and more likely to produce the best results:—

1. The Divisional Troops should include a Telegraph Section, a Balloon Section and a Field Park.

2. On the Staff of the Division there should be a C.R.E. with an Assistant and a Clerk.

3. Each Brigade should have a small Field Company of its own, commanded by a Major and consisting of about 120 of all ranks. It should be divided into two Sections, each of which should be complete, so as to be thoroughly efficient when detached.

4. Every individual should be either mounted or carried in wagons. Probably the latter method would be the better; on arrival in camp the Drivers would look after the horses and the Sappers would be available for their legitimate work. Tools could be carried in the seats.

It would be necessary to guard against the danger of the Sappers degenerating into Pioneers; and every effort should be made to keep up a high standard of trade qualifications.

5. The R.E. Divisional Troops, for purposes of discipline and interior economy, should form one unit under a Major; but they should be under the orders of the C.R.E. for their employment.

The Field Park would carry a small reserve of stores for the use of the Brigade Field Companies; it should also have some bridging equipment and a good deal of water-supply equipment. The Sappers belonging to it would have to do any work required by the Headquarter Staff and Divisional Troops. The Field Park should be about 100 strong and might be commanded by a Captain. The men should be carried as in the Brigade Field Companies.

*THE SCIENTIFIC STUDY OF MILITARY HISTORY.**

By LIEUT.-COLONEL F. N. MAUDE, *p.s.c.*, LATE R.E. (O.C. 1st HANTS R.E. VOLS.).

WHEN a little more than thirty years ago I joined the R.M. Academy, France and Germany were just emerging from a war which differed very materially in its conditions from any which had occurred in previous history, and all military Europe was busy trying to find the solution of the many and apparently startling phenomena the struggle had disclosed.

The method in which the different nations approached these problems differed materially according to their several standpoints. Whilst we in England had to rely almost exclusively on hearsay evidence, often of a most unsatisfactory character, the French and Germans at least knew on the testimony of eyewitnesses the actual facts which had to be dealt with. But all were practically alike in this, that the number of men in any army capable, by personal experience, of drawing conclusions between the new phenomena and the old was most surprisingly small; because during the long peace from 1815 to 1870 the continuity of warlike tradition had been almost completely broken, and, except in America, there had been nothing in the interval approaching a real "struggle for existence" between two well-matched nations.

It happened to me, whilst still a cadet at the R.M.A., to be put on the track of a solution of the many conflicting theories, though I must confess that it took me quite twenty years to discover the full significance of the knowledge of which I had then become possessed.

I was staying with some German friends at Constance, where I had previously been at school; finding the young Englishman very keen to pick up information, they were good enough to tell me many of their personal experiences, which did not at all tally with the impressions I had received from newspapers or books. One day an experienced soldier, many years my senior, found me reading one of the numerous pamphlets to which the war had given rise—Boguslawski or Tellenbach, I think it was—whilst waiting in his study; he went to his bookshelf and took down Clausewitz's *Vom Kriege*, and giving it to me with one hand whilst with the other he removed the pamphlet, he said: "There, if you want to learn what War really is, study that; don't waste time over those others." I took his advice; and though it

* Lecture delivered at the Royal Engineers Institute on 13th Oct., 1904.

was long before I began to understand the book, constant reflection, aided by the help I by degrees derived from others, set me on the track of a line of thought which brought me to the investigations I am now able to put before you.

Time is altogether too short to attempt a summary of this extraordinary work, but there are a few points to which it is necessary to draw your particular attention. Clausewitz himself was a man who had not only enjoyed an almost unequalled experience of war but had seen the destruction of an old and time-honoured system and the resurrection of a new one; he had been trained in the "school of defeat," and witnessed the gradual evolution of the spirit of victory; and had prepared his intellect, naturally a remarkably clear one, by the highest training the educational system of Prussia could give him, to deal with the phenomena his opportunities had presented. He had seen all the old empirical rules for securing military successes swept away by the board, and had realised the necessity of substituting some more scientific method of investigation than any previously in force, in order to fulfil his duties as head of the Prussian "Kriegs Akademie." His work remained incomplete at his death, but as far as it went it represented the last word on the subject that the methods of thought of those days could reveal, and, though weapons and other means employed in the making of war have changed, no one has been able ever since to add essentially to his book.

He lays down no pedantic rules for observance, but investigates the forces which encounter one another in war and the materials these forces employ, shewing the variations of strength to which each is liable and their interdependence one upon the other. Like an engineer, he asks, "What is it I am asked to do?" "What are the forces I have either to employ or overcome?" "What materials are available for my purpose?" Transfer the analogy to the building of a bridge, and the idea will be clearer.

Your task is to construct a bridge across a given river, to carry certain loads. The forces against you are gravitation, which is known, the power of the stream, with its influence on the banks, etc., of wind and its pressure on your girders and so forth, and the combinations of other natural forces which condition the reliability of your foundations, all of which may or may not be known within reasonable limits of variation. The materials at your disposal are steel, iron or wood, as the case may be, whose strength can be estimated within very reasonable limits. The *Art* of the engineer consists in putting the materials at hand to the best practicable use for the attainment of his object; and he is guided in the exercise of this Art by his knowledge of the sciences, which explain the strength of materials, their fashioning, action under different strains and stresses, and so forth. The final success of the bridge will be in accordance with the soundness of his knowledge of all these matters, *e.g.*, if he thinks that wrought iron

is the same as best steel, he will be exceedingly likely to find all his bridge some fine morning in the river bed.

Years after Clausewitz's death von Moltke, being asked to define the Art of War, said: "The Art of War is the Art of making the best practical use of the means at hand to the attainment of the object in view." I think it was the discovery of this phrase and the realisation of all that it meant, which came home to me like a flash one day when standing by the engineer of the Sutlej Bridge, at Ferozepoor, then under construction and in momentary danger of being swept away by a tremendous flood coming down the river, that led me to the second step of my investigations. The history of the bridge had been as follows:—Its construction had been recommended years before, and project after project made, but the difficulty was that time was the essence of the situation; the only time available was from the end of the rains to the *chota bursat*, during which the river bed was practically dry, and no engineer would undertake the responsibility of attempting to erect the girders on a temporary staging in the dry river bed, with the chance of a flood coming down and destroying the whole plant. Hence all the designs contemplated "building out," and were immensely expensive in consequence. Then at last Colonel Conway-Gordon, R.E., and Mr. James Bell, C.E., foregathered, and determined to take the risk. The bridge was duly designed and erected in England, and then sent out in pieces to be put together, each one of course duly labelled so that no time should be lost in sorting them out. But the best-laid plans often break down; the cargoes arrived successively all in confusion; and to crown everything the floods came on a few weeks sooner than observation had led them to be expected, and in the end it was a matter of minutes literally whether the last bolt could be got into place or not. At last it was fixed, and ten minutes later not a vestige of the staging remained; it was all swept away down stream; but the bridge stood, and that was the one consideration.

It seemed to me, as I thought it all over afterwards, that here was the nearest imaginable approach to the conditions of warfare; and I set to work to see how what I knew of engineering might be worked in to help me in constructing, for my own guidance, a theory of the "conduct of war." Foundations, organisation, design, all found their places easily enough, but the ultimate reason why the bridge stood was the knowledge of the strength of materials possessed by its designer; and here my analogy broke down completely.

The General's materials are battalions, squadrons, batteries; but military history, and that collection of empirical rules for conduct which we in England always call "strategy," invariably treat these units as known factors of constant value, whereas experience shews that they are susceptible of almost infinite variation. It seemed to me therefore that an investigation into the strength of our materials and the

best methods of forging, welding and tempering them should form, at any rate, the preliminary portion of my proposed inquiry.

Endurance under fire being the prime condition on which a leader bases his plans, it became necessary to tabulate such figures as were available, and see what data could be derived from their study.

The broad results arrived at are shewn in the diagrams.

No. I. shews the nature of the stress, measured in bullets per minute per yard of front, to which the troops have been subjected. Here I want to point out this curious fact, that, in spite of all variations and improvements in weapons, the actual number of bullets discharged per minute per yard of front has remained nearly constant;* because the advantages of holding as wide a front as possible have always been so obvious that every improvement in rapidity of fire has been immediately seized upon in practice to economise men in the fighting line, so that the test, as regards frontal fire only, has remained much the same, though duration of exposure and degree of convergence, both dependent on the length of range, points to which I shall recur hereafter, have varied very largely.

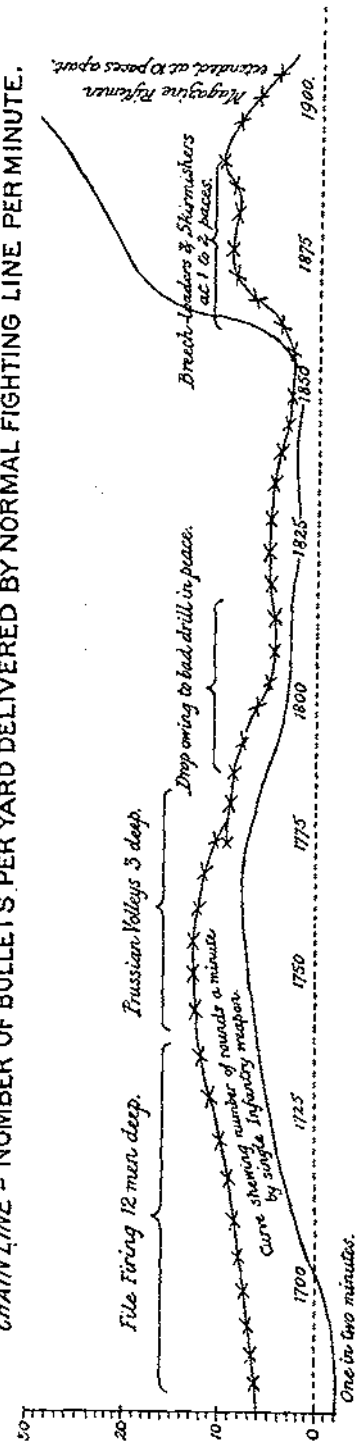
No. II. shews the variation in the incidence of losses, tabulated in percentages per hour, which is obviously a better criterion of the intensity of strain than percentages per battle, for 40 per cent. in three days' fighting means actually less strain on the troops engaged than 10 per cent. in one hour.

No. III. is simply a rough chronological chart to assist the elucidation of No. II., and one's military reading generally.

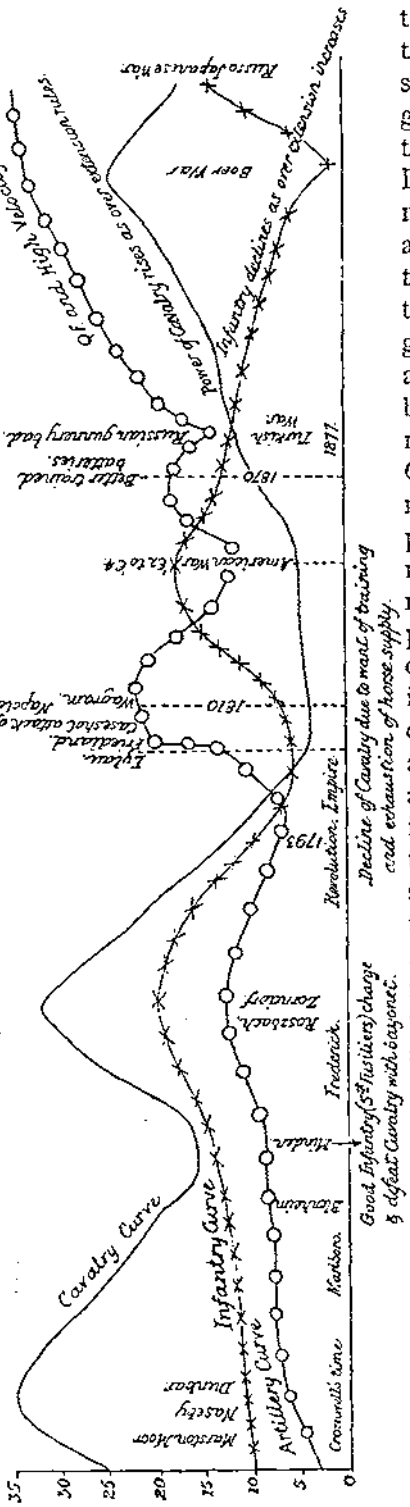
Of course these are only rough approximations. To compile accurate curves would entail the labour of a whole historical section of an efficiently equipped General Staff for years; but they suffice to establish limits of error, between which one can, as information is added, gradually approximate more and more closely to the absolute truth. This is simply the "scientific" as opposed to the "logical" method of investigation which has hitherto been exclusively applied to military research. The "logical" method, which is practically that of the law courts, is useful for determining actual matters of fact; but military problems are in their nature most frequently "indeterminate," and the most one can hope to do is, by collecting a sufficient amount of data, to establish a generalisation which will approximate as closely as possible to the ultimate truth.

Returning to diagram No. II. Whereas at least nine-tenths of the writers who endeavour to educate public opinion are evidently under the impression that the constant improvement in weapons must lead

* I do not claim priority of discovery in this matter. Colonel Hime, R.A., in his *Stray Military Papers* brings it out with equal force; but since he was good enough to say that he derived the idea from me, though I cannot trace it myself, I think it may be considered a case of simultaneous discovery.


I. DIAGRAM SHEWING, FULL LINE, RATE OF FIRE OF WEAPONS INDIVIDUALLY.
CHAIN LINE - NUMBER OF BULLETS PER YARD DELIVERED BY NORMAL FIGHTING LINE PER MINUTE.
File Firing 12 men deep.
Prussian Volleys 3 deep.
Drop owing to bad drill in peace.
Curve shewing number of rounds a minute by single Infantry weapon.
Breech-loaders & Skirmishers at 1 to 2 paces.
Magazine Rifle mean estimated at 10 paces apart.
One in two minutes.
50
20
10
0
1700
1725
1750
1775
1800
1825
1850
1875
1900.

II. CURVE OF LOSSES PER HOUR AT VARIOUS PERIODS FROM TYPICAL INFANTRY BATTLES.
12.5 percent.
Marston Moor.
10 percent.
Marlboro's Wars.
Seven Years War.
Revolution.
1 percent. 4 percent.
Empire.
Bohemia.
2 p.c. 4 p.c. 3.5 p.c.
France.
Flevrus.
Modder River, etc.
½ percent.
12
11
10
9
8
7
6
5
4
3
2
1
0



III. DIAGRAM SHEWING RELATIVE POWER OF THE THREE ARMS.

to such unprecedented slaughter that War will become impossible, the actual facts when grouped together shew that the exact converse is the case. Battles are certainly less bloody now than they were 150 years ago. But a further reference to the table shews that the variations in slaughter were actually greater in the days when the armament was a constant on both sides than it has been since new arms have been introduced. On the other hand, I can find no evidence whatever to support the assertion—very freely made—that men are less brave nowadays than they were in the past. As far as a single man can collect and collate the facts, individual heroism is quite as common and fully as admirable as in the past; hence, as there are only three possible variants in question—arms, men and training—, and two have been shewn not to affect the issue, the third (the collective training, *i.e.*, drills and tactics) must be responsible for the change. And now let us see how history supports this conclusion.

I need not take you back to Marston Moor; there cold steel still played the decisive part, and the obstinacy of the combatants, drawn both essentially from the same race, will sufficiently account for the result. The times of Marlborough and Frederic, when fire power had already established its supremacy and steel—to quote the saying of the latter—was "*peu de chose*," will amply suffice for our

present purposes. The infantry had already become a highly mobile manœuvring body, equally well armed, raised and disciplined substantially on similar lines. The guns were still in a state of chaos; and though the idea of artillery preparation was in the air, want of mobility in the weapons themselves and of discipline in their drivers reduced their power to very little indeed, except in defence, where, arranged in big batteries of the old siege type, 18 feet from centre to centre, the grape and case from 24, 18 and 12 prs. (the usual calibres) formed a terrible stumbling block to the attacking infantry.

Marlborough's Wars were fought out mainly in the Netherlands, a cramped and confined district which hampered mobility and never gave time for one side or the other to entrench itself; and a glance at the numerous battle and campaign plans of the period (see Müller's *Fortification*, 1716, the first textbook in use at the R.M.A.) will shew how ready they were to avail themselves of these opportunities. Lines grew up 50, 60 and more miles in length of ditch and parapet, defended by every conceivable obstacle, a real "physical impediment to assault," not merely "cover from fire"; and since the rate of infantry fire was still relatively slow, these lines were broken into salients and re-entrants, bastions, etc., till the assaulting columns had often to face a threefold cross fire before closing; and though the pointblank range of the musket was short, only about 200 yards, the bullets even then carried sufficient remaining velocity up to 800 and 900 yards to inflict serious and shattering wounds.*

With practically no artillery available to prepare the way, assaults became so terribly bloody that practically War came to a deadlock, and positions could at length only be captured by stratagem; and it is worthy of note that it was at this time that the word "strategy" made its first appearance in the sense of the employment of stratagems—a meaning which still attaches to it in this country, though it has long since been extinct in all others. Marlborough's capture of the "*Ne Plus Ultra*" lines is the finest example of this particular type of leading, and will be found very fully narrated in Fortescue's *History of the British Army*, a book I cannot too warmly recommend.

During the years which followed the cessation of hostilities the Prussians were developing a new departure in infantry tactics, which, favoured by the nature of the country in which it was first employed, completely upset the existing relation between attack and defence. By the most incessant and accurate drill, and by the adoption of the simple expedient of a heavy cylindrical iron ramrod, they brought up the rate of individual fire to five and six rounds a minute against two, the normal in other armies. The

* See the many tables and data collected by Max Jähns in his *Geschichte der Kriegswissenschaften.*

relative advantage this conferred on them was far more than the mere numbers suggest; for, assuming the first volley on each side fired simultaneously and with equal effect, the second Prussian one would catch the enemy whilst still loading, and by the confusion it created delay the process, so that a third and fourth might go crashing in before the enemy could pour in a second fire. But at short ranges two or three *good* volleys usually did the work—the enemy seldom waited for more. A further advantage accrued to the Prussians from this ceaseless effort, which perhaps carried them further even than their fire. The discipline they acquired incidentally made them more mobile and staunch than their enemy, and losses which would have stopped the latter proved quite inadequate to check them. Their mobility, helped by the nature of the country, deprived the enemy of the opportunity of entrenching, or enabled the Prussians to march round such entrenchments as were made; and their superior discipline enabled them to dispense with the preparatory action of artillery, so that the relative advantage of attack and defence were reversed and for a time the former had a decided ascendency.

These duels between infantry on the one side against infantry and artillery, both generally more or less entrenched, proved terribly costly to the former. Hence, as the war went on and the numbers of his enemies constantly grew, Frederic had to reduce the number of his men to the yard to oppose an equal front; as these men were no longer of the same skill or training as their predecessors, so again the defence overtook the attack, and the deadlock which had existed in Marlborough's time again arose.

The chief point to notice in the tactical methods of these days is that they were deliberately adopted by one of the greatest generals in history as ultimately the most economical to the State; and if they were expensive in life to the army, that was because the conditions of the time left him no alternative. His battles were uniformly designed to ensure that the maximum possible number of men should find useful employment. His casualty lists were not unnecessarily swollen by chance hits amongst crowds of reserves, for the discipline of his men allowed him to reduce these to a minimum. He strove to crush his enemy by a single blow, not to reduce him by attrition (see Malachowski's *Scharfe ü Revue Taktik;* Berlin, 1890).

In the early wars of the French Revolution, though the weapons remained the same and also the tactics, for all nations had copied the Prussian model on paper, an entirely new factor made its appearance, which owed its existence to the social upheaval the French nation was undergoing. For them it was no longer possible to find and pay men for the two years' drill which was necessary to acquire the standard of rapidity in firing demanded by the tactics of the line. They had to raise men and compel them to fight as best they could, and though

they tried to make them fight in line, the experiment broke down on the battlefield. Their men had not the cohesion to advance closing their files as the casualties increased; but the bravest went to the front, whilst the less brave straggled behind and were rallied and led forward in "clumps" by the older war-seasoned veterans who still remained from the ranks of the old Royal Army. Ultimately this system or want of system was fused into the framework of the light infantry school, which, though it had existed more or less all over Europe since the beginning of time, had been developed and perfected by the French and ourselves in America and Canada; but whereas in these wars the nature of the ground and experience had turned the disciplined soldier into the skilled skirmisher, the early French levies were neither disciplined nor skilled, but fought by the simple light of nature in long orderless lines (like a "lot of beaters," as an old French general declared), advancing and retreating but never closing, until their numbers gradually overlapped the enemy's flanks and compelled him to retreat without being either broken or defeated. Numbers played for the French the same part that mobility played for the Boers in South Africa, and the war took a very similar course.

The French, living on the country and having no supplies to guard, swarmed all over the district, whilst the allies, having by tradition to pay for everything they wanted—even hire for the camps and houses in which they lodged their soldiers—were hampered by their provision trains and the necessity of guarding their depôts. If they were victorious they could not pursue, for the French ran away too fast and left no supplies behind them, whilst, if beaten, the French found all the supplies they needed in the captured position or camp.

The war resolved itself into a series of small column and detachment operations, armies of 30,000 men fighting in groups over a front of thirty miles with no decisive results; and whilst, as the curve shews, the percentage of loss per hour was insignificant, the aggregate loss to the nation was very heavy indeed.

In the process the French, unhampered by tradition and aristocratic prejudice, evolved a system admirably suited to their national proclivities; and when Napoleon appeared on the scene, he found ready to his hand a war-seasoned, supple army and subordinates ready to obey unhesitatingly, without making difficulties, but equally ready to assume responsibility when their trained judgment shewed the necessity.

His first great successes were achieved by purely strategical methods. He massed numbers against the decisive point and left his subordinates to do the rest. It is noticeable that up to 1806 the fighting fell mainly on his infantry; he never possessed a cavalry really fit for the battlefield, and his artillery he had not yet learnt to use. Battalion guns had indeed been abandoned and his batteries had made great progress in mobility; but though in a sense everyone

realised the importance of masses of artillery, the way to form those masses had not yet become part of the flesh and blood of the arm itself.

The idea only took shape after Eylau and Heilsberg, where, against the stubborn Russian infantry, all efforts of the attacking infantry had failed. It was first successfully employed at Friedland by Senarmont at the head of the Guard Artillery, who, galloping up in advance of the columns of attack, simply blew a hole out of the Russian line with case fire; and ever afterwards the same manœuvre was employed, till it became conventional in every Continental army, with consequences to be referred to in the sequel.

But now the deterioration in the French infantry began, the drain on the country had been enormous and the service was becoming intensely unpopular. The conscripts no longer went into action with the same spirit and could not be induced to advance except in heavy columns, which, of course, drew a convergent fire. All other armies, too, except the British, had had to be re-cast to meet the hosts the French continued to bring against them, and since there was no longer any time to train the men for the line they, too, had to fight in column; and thus step by step the density of the opposing forces, which in Frederic's time had been from about 10,000 to 15,000 men to the mile, went up to 40,000 and even 50,000, the consequence being that more men being exposed more men were hit, quite irrespective of whether they were doing useful work in the fighting line or looking on as spectators in rear. This accounts for the rise in the curve on the diagram; but it will be noticed that, whilst the percentages are still only half those of Frederic's time, the totals at Wagram and Borodino began to exceed the worst of the old Seven Years' battles.

The British army came late on the scene, having evolved in years of experience all over the world a perfect system of skirmishers for introductory fighting, whilst retaining the line as the true decision-compelling weapon in the hands of the leader. But it was numerically so small, and foreigners were so entirely absorbed in their own affairs, that its victories and the tactical teaching they involve passed unnoticed across the Channel, where, after the final victory of Waterloo—in which, being on our part a defensive action, the line was not seen at its best—all Europe settled down to a sleep of exhaustion, and tactical study ceased for a full forty years.

Everyone went on where Napoleon had left them, and when at length the long peace was broken and the Prussians marched into Bohemia, and four years later into France, they went into action practically with the same formations and distances as at Waterloo. They were victorious, and Europe jumped to the conclusion that the same foresight that had provided their infantry twenty years before the rest of the armies of the Continent with breechloaders had also supplied the tactics best fitted for their utilisation. In this we

were all totally mistaken. The Germans really owed their victories to the organisation which had provided, and the strategical skill which directed, superior numbers upon the decisive point.

The Prussians themselves fell into no such error; they knew only too well the haphazard nature of their tactical leading, and realised keenly by how very narrow a margin they had escaped defeat. But though they commenced investigation almost before the war was over, so great had been the break in continuity of tradition and so complete the absence of scientific method in their inquiries that it was a good ten years before they began to collect the evidence a proper solution of the new problems demanded, and officially the promulgation of their conclusions is wanting yet.

Probably this slowness can be accounted for by the absence of a sufficiently formidable resistance to the dominant trend of opinion. "They had been victorious, therefore they were heroes," as Dragomiroff, the great Russian writer, the first almost in Europe to remind his readers that the dominant factor in victory is a psychological, not a technical one, pointed out; and when once each writer had promulgated his contention that all was for the best in the best possible of worlds, he was content to leave his research at that point and settle down to the enjoyment of a more or less well-earned notoriety.

Only the cavalry, who had not come well out of the war in their own opinion, insisted on further information. They wanted to know why either men or horses should be more afraid of a bullet because it was loaded at one end of the barrel rather than the other. They did not raise the question of the actual numbers of the bullets to be encountered or their distribution in space, but contented themselves with pointing out that the danger on a battlefield where ten men fell in an hour must have been considerably greater than on one where 4 per cent. (Mars la Tour) seemed an outside possibility in the way of risks. This led to a digging up of the old Frederician material in their archives, from the results of which I have borrowed the bulk of my data in the first part of this paper; and then a number of questions began to obtrude themselves which clamoured for immediate reply.

The men of Frederic's army were recruited mainly from the lowest class, and certainly did not fight from any exalted feeling of patriotism, but chiefly from a very real and lively fear of the stick. Yet they excelled all records in the heroism with which they faced punishment in the field. There were veterans amongst them certainly, but after 1870 belief in the veteran had rather died out. Could it be that there was something wrong with the modern system of recruiting by compulsory service which for so long had been the pride and glory of the Fatherland? The idea was not a pleasant one, but it undoubtedly bore fruit in the increased intensity with which the drilling of the

recruit was henceforward carried out. They then turned to the alternative horn of their dilemma and began to ask whether, after all, the last word in the conflict between line and column—small columns and skirmishers—had been pronounced. In this inquiry Meckel and von Malachowski took the lead, and von Scherff followed with proposals which logically could only lead to the same result. Hoenig, whilst giving ample evidence in support of these views, refrained, to the best of my knowledge, in formulating any definite conclusions. All saw the hopeless unwieldiness of the continuous line under certain conditions, and equally the practical impossibility of imparting a simultaneous forward movement to a body consisting of innumerable small units, each led by the independent initiative of its commander; but whilst all more or less combined to condemn their existing regulations (Scherff, indeed, going as far as to say that, if logically adhered to, the German infantry could only hope for success if it had the good fortune to encounter an enemy whose regulations were even worse than their own), they all alike ignored the changes in the relative power of artillery and infantry, which, as between armies equally well-found in weapons, give to the attacking general the power to create conditions to suit his materials.

This is the point on which I now desire to focus your attention. Turning back to the diagrams and what I have said in explanation of them, it will be seen that in Marlborough's time it was the defender who created the tactical conditions to suit himself. In Frederic's era increased mobility robbed the defender in great part of this power; but owing to the low degree of manœuvring skill in the artillery, the ultimate decision had to be fought out between the two infantries; and further, owing to the short range of the weapons, they had to settle the matter on more or less equal fronts, the degree of convergency attainable being too small to exercise much influence. Hence the obstinacy and bloodiness of their struggles.

In the early days of the French Revolution the material on the French side was too heterogeneous to allow of combined direction under a single will, and battles became a tedious conglomeration of insignificant skirmishes; and it was only when Napoleon and his artillery officers, Drouet and Senarmont, lit up the idea of massed batteries at case-shot ranges that it became possible for the commander to suit the task he set them to the staying power of the attacking troops.

Then presently the balance between the arms was completely upset by the introduction of the long-ranging and relatively accurate muzzle-loading rifle, which effectually prevented the opposing artillery from unlimbering at case-shot ranges; and in the American Civil War, local conditions favouring the construction of entrenchments, the defence re-asserted its power, and the struggle between the contending infantries became locally as bloody as they had been in the past; but

it will be noted that the fighting was spread over a much longer period of time.

In the Franco-German War mobility, conditioned mainly by the number of good roads, again very generally robbed the defenders of the opportunity of entrenching, the common shell of the guns being a far less effective man-killing projectile than case at 300 yards, the commander no longer had it in his power to ensure with rapidity and certainty the destruction of the defender's power of resistance; and the fighting again reached a high degree of intensity, though still falling far short of what it had been in Frederic's day.

In the Russo-Turkish War mobility again sank very low, bad roads and a clayey soil making rapid turning movements of large bodies almost an impossibility; hence, again, the defenders had leisure for entrenching, and as there was a great want of tactical skill on the part of the attacking artillery, the two infantries, as before, were left to fight the matter out between themselves; but though the power of the weapons had been greatly increased since 1870, the slaughter was no worse, hardly as bad (except in the special case of the second battle of Plevna, the figures for which are quite unusual).

The Boer War was conducted under such abnormal conditions of mobility on the two sides that its results need scarcely be taken into account. Superior mobility enabled the Boers not only to select their positions, but also gave them time to entrench; and their power of rapid withdrawal when threatened with actual assault introduced a factor hitherto unheard of in war. Thanks to this power, they could hold enormous fronts with a small number of men, because their power of evasion guaranteed them against the usual consequences of having their front penetrated.

In the war now raging in Manchuria we are back on more familiar ground, and find as a consequence of the increased power of preparation due to shrapnel shell, which at 3,000 yards has the same effect as case of equal calibre at 300, that the attack has regained almost, if not quite, the relative advantage it held at the end of the Napoleonic period; but again we note that the slaughter per hour is not so great or the result of defeat so disastrous, probably owing to the absence of a cavalry good enough to reap the harvest of success.

Now the one relation which seems to hold good throughout these periods appears to me to be this. The greater the range of the weapons in use, the less rapid the loss; and the explanation of this relation leads to other conclusions of a somewhat remarkable nature.

In the days when 200 to 300 yards was a medium fighting range it is evident that the power of convergence on any chosen point of attack was very limited indeed as compared with what it has since become with infantry ranges of 1,500 and artillery of 5,000—10,000; a glance at the diagram makes this clearer than much explanation. It is also evident that for equal numbers on the arcs the chance of the

individual shot on the defender's side attaining any human billet is immensely reduced, even assuming equal accuracy for the two weapons.

But the power of arranging a convergence of fire in advance is the special attribute of the attack, and it is as much easier to arrange when the ranges are a mile and upwards as it is easier to approach a black buck to the same distance than to get within pointblank range. The opportunities for concealment increase with the area; and whereas in the old days attempts to overlap a flank were always dangerous until the defender's cavalry had been thoroughly beaten, nowadays cavalry, with 1,000 yards of open to cross and fresh troops at the end of it, has practically no prospect of success at all.

As between two parallel fronts, the rate of fire with equal arms matters nothing; it is only the difference in accuracy which decides, and this should be initially on the side of the defender, particularly in a prepared position. But convergence eliminates the errors of direction, whilst divergence increases them, and hence the greater the range of the weapons the greater the advantage derived by the attack.

Moreover, and this is a point which I submit has hitherto been most unaccountably overlooked, the effect of unsteadiness of hands and nerves reduces the chances of unaimed fire hitting anything in a very remarkable degree. Thus, if we assume two lines of infantry, one armed with the Lee-Metford, the other with Brown Bess—and both reduced by the excitement of action to such a condition of unsteadiness that at the moment of discharge their barrels point at random anywhere between 30° elevation and 3° depression—then all the bullets of the latter line would reach the ground somewhere within 1,000 yards, whilst those of the former would be disseminated over a surface not less than 5,000 yards in depth and would attain an altitude roughly of 5,000 feet. Imagine at any given instant of time, in each case, the whole of the atmosphere frozen solid and the bullets suspended in space at the points they at that moment occupied; then now move your line of infantry through the shot-filled space and note the difference of the random hits they would receive in the two cases. There being fewer bullets per cubic unit in the larger space than in the former, the chances of a man and bullet coinciding in their endeavour to occupy the same spot would be materially less.

It will perhaps be said that battles are won by *aimed* fire, not by chance hits, but the evidence available seems to me to point to a different conclusion. The chance of hitting a particular mark must vary as the product of all the disturbing causes. The apparent size of the target varies inversely as the square of the distance and the difficulties of judging distance, effect of wind, light, etc., error in any one of which will carry the bullet off the target. Theoretically I see no means of arriving at a satisfactory formula, but it seems to me that a ratio might be obtained by practical experiment up to extreme ranges at a constant rate of fire. What conceals the issue in ordinary

practice is the neglect of the time factor altogether; the further the range the longer a man requires to get his aim, and in peace the bigger the bull's-eye at which he fires.

Eliminate these disturbances and the results would, I think, be surprising; for, taking the average of many registers, I find that a man will make about the same percentage of hits at 200 as at 500, firing in the same position, but the number of square inches in the bull's-eye are 113·1 and 452·4 respectively. Taking all factors into consideration, I think it would be found that the difficulty of hitting a particular target varies inversely nearly as the cube of the range; and I submit the suggestion here in the hope that it may attract the attention of some of the mathematicians of the Corps infinitely better qualified than myself to undertake the investigation.

Assuming, however, that I am substantially correct in my solution, when we come to investigate the number of bullets required in practice to put a man out of action at different ranges, we find that it follows no such law. Thus the best figures attainable shew that, whereas in the days of Brown Bess (average range being about 200 yards) the average expenditure of bullets per casualty was 200, in the Franco-German War (average range 400) it was about 800, in South Africa (decisive range 800) about 10,000; three figures which have no apparent mathematical ratio to one another, but which, plotted on a diagram, fall far within a curve of cubes; the inference seems to me that it is quantity of fire, not quality, which mainly decides in a general action.

Having taken the collective figures for a number of battles, the next step should be to determine them for each stage in a particular typical battle; but here the data are almost altogether wanting. The only approximate facts I can ascertain are these. The expenditure of ammunition at Omdurman has been calculated at 60 rounds per Mahdist (all due allowance having been made for artillery practice), the mean range being 500 yards and the target quite unusually favourable. Since in this case our troops were quite unshaken by artillery fire and were probably superior to any in Europe at the present day, I think this may safely be taken as the worst which troops can be called on to face, if prematurely committed to an assault against an unshaken defender; and whatever their gallantry the result would be annihilation, just as it always has been against unshaken infantry all the world over, the sole difference lying in the distance at which the assailants have been stopped.

At the other extreme of the scale come cases from the latter half of the Franco-German War, where it took 100,000 rounds and upwards to disable a single assailant; worse shooting than this, I take it, one is never likely to encounter anywhere. But the point I am endeavouring to make is this. Every increase in the power and range of weapons by lengthening the arc of convergence, and every additional

rifle or gun brought into action, increases the prospect of reducing your enemy's fire to this lowest limit; but if, to increase the difficulty of hitting each single man, you adopt widely extended formations, you diminish the causes at work which produce inaccurate fire on his part. Men at 20 paces apart are practically powerless against men at 1 pace only, for their fire can do next to nothing to unsteady the enemy's aim against them.

As against European infantry, therefore, with no ponies at hand to secure their evasion, you are deliberately throwing away one of your main factors of safety if you omit to oppose your enemy from the outset with as many rifles to the yard of front as he can oppose to you;* and, further, you must arrange to keep your first line at its full strength, so that the storm of aim-disturbing causes should not for a moment be diminished.

Undoubtedly by so doing you increase the number of men exposed; but in proportion as you succeed in reducing your enemy's fire to the lowest limit, the influence of the target in drawing aimed fire diminishes, till, when the bullets are falling simply like rain on the just and unjust alike, it does not signify in what order you group your men at all, and only the duration of exposure and total area of the target conditions the hits.

It would be easy to shew, by calculation, that by too great extension you can eliminate all the advantages the increased power of convergence confers; and then, since the power of preparation would fall to a minimum, the enemy's accuracy of reply would approximate to its maximum. Your advance would be indefinitely protracted, and ultimately you would lose a larger number of men out of your whole army than by the bolder method I have advocated.

I am speaking of decisive attacks only—attacks meant to shift the enemy bodily, not merely to reconnoitre his position. For these latter the old rules of the famous Light Division still hold good, distances only requiring to be adjusted to suit the new conditions of range. But the essence of the matter is this. These preliminary operations, which are meant only to fix in detail the enemy's positions, should not be confused with the attack proper, which is intended to crush him absolutely. In the former, an approach in such order as will attract the enemy's attention as little as possible is the chief point be to considered; for, his exact position not having been as yet revealed, adequate artillery preparation has not yet been possible, and you are advancing against an unshaken defender, whose fire power is still sufficient to destroy you many times over.

But once the limits of the position are fixed and your general point of attack determined on, you possess nowadays, in convergence of fire

* This is the fundamental principle for the attack laid down in the Japanese regulations.

due to long ranges, the means of accumulating on that chosen point such a hail of projectiles that aimed fire becomes an impossibility, if only because the dust struck up by the bullets and the smoke of the bursting shells conceal the target from the defender's vision.

When that condition is reached nothing you can do in the way of formations can affect your losses; it is simply a case of the longer you are out in the rain the wetter you will get.

In conclusion I must apologise for the many imperfections of my lecture. I can only plead in extenuation that it is exceedingly difficult to compress the result of 30 years of reflection into the space of only 60 minutes reading.

A CELESTIAL CLOCK.

By LIEUT. F. C. MOLESWORTH, R.E.

THE accompanying method of finding the time by the stars (without the aid of instruments) was suggested by Major-General Rice (late Indian Army). It has proved very useful to me and to all to whom I have shown it; and will, I hope, prove equally so to readers of the *R.E. Journal*. It has never before been published.

In the following description of the method employed, the apparent motion of the stars is referred to as if it were real, and not (as of course it is) referable to the motion of the earth round its axis. No allowance is made for any difference in the apparent positions of the stars due to refraction or to any other such, comparatively speaking, unimportant cause. For the calculation is of necessity a very rough one, taken by the eye and without instruments; and it is useless to attempt to introduce into it an element, which, while it would add much to the difficulty of the observation, would not make a difference of sufficient moment to materially influence a computation so inherently wanting in extreme accuracy. Nor is any allowance made for the fact that the Pole of the heavens is not situated exactly at the Pole Star, but is (at present) distant some $1\frac{1}{4}^{\circ}$ from it.

The stars used are the Pole Star and the two stars in the constellation of the Great Bear, called the "Pointers," or, to speak more accurately, that star of the "Pointers" which is nearer to the Pole Star (α Ursæ Majoris), henceforward called "A."

The Pole Star is the centre of the clock; the circle described by A in its revolution round the Pole Star is the face of the clock, and a straight line joining A and the Pole Star is the hour hand. Thus in *Fig.* 1, P is the Pole Star, A the Pointer used, U W L E the face of the clock, and the dotted line P A the hour hand.

Speaking roughly, A revolves round P once in 24 hours; it therefore reaches W 6 hours after it leaves U (the point of upper transit), L 12 hours after, and so forth. If for example it is known that A is at U at (say) 5 p.m., it is at once apparent that it reaches W 6 hours later, viz., at 11 p.m., L at 5 a.m., and E at 11 a.m., though of course for some part of the time, *i.e.*, during the day, it would not be visible.

Knowing that A travels from U to W in 6 hours, it is easy to calculate how long it takes to travel over any fraction of this distance. If, therefore, A were always at U at the same time on

every day of the year, and that time were known, there would be nothing easier than to calculate the time at any hour of the night.

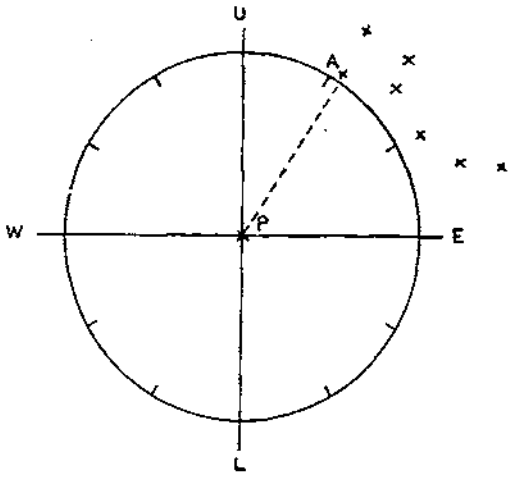


Fig. 1.

But this is not the case. A takes slightly less than 24 hours to complete its revolution round the Pole Star, becoming earlier and earlier every day, making in fact 366 revolutions in a year of 365 days.

Every year on June 21 A is at U at 5 p.m. This gives us a starting-off point; June 21, being the longest day of the year, is an easy date to remember.

One month later, on July 21, A would reach U two hours earlier, *i.e.*, at 3 p.m. On August 21 it would be there at 1 p.m., and so throughout the year. The difference for one month being 2 hours, it follows that the difference for each day is approximately 4 minutes. Hence for any day in the year we can calculate at what time A will be at U. For December 6 which is 21−6, or 15 days before December 21, it will be there at 5 a.m. + 15 × 4 minutes, or 6 a.m. On February 27 it will be there at 1 a.m. − 6 × 4 minutes, or 12.36 a.m.

To take a general instance, suppose that on the night of 29 July A is in the position noted in *Fig.* 2, estimated at rather more than $\frac{1}{3}$ of the way from W to L (point of lower transit). Starting as usual with the datum of A being at U at 5 p.m. on June 21, we find that on July 21 it would be there at 3 p.m., and on July 29, 8 × 4 = 32 minutes earlier, *i.e.*, at 2.28 p.m. It would therefore be at W at 8.28 p.m. We estimate A as being rather more than 2 hours, say 2 hours 20 minutes in advance of W, and we find the time to be 10.48 p.m.

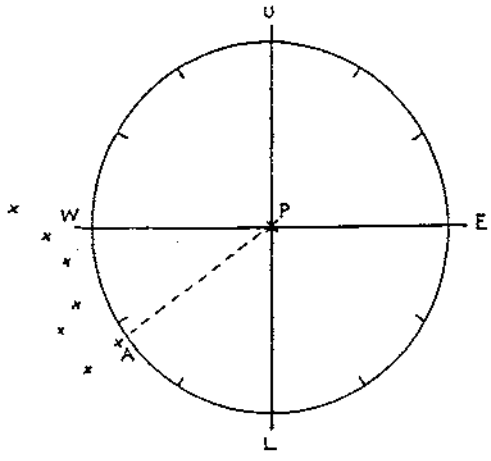


Fig. 2.

In practice the chief difficulty is to tell with sufficient accuracy, without instruments, the position which A actually occupies on the face of the clock.

The best method for ordinary occasions is to hold a swagger cane or riding switch about $\frac{2}{3}$ of the way from its head, letting the head hang down perpendicularly so that the side of the cane nearer to A just appears to cut the Pole Star (*Fig.* 3). As the cane hangs perpendicularly it gives U and L; and if a pencil be placed perpendicular to the cane, so that the Pole Star is just visible in the angle so formed, the position A occupies can be judged with a fair amount of accuracy.

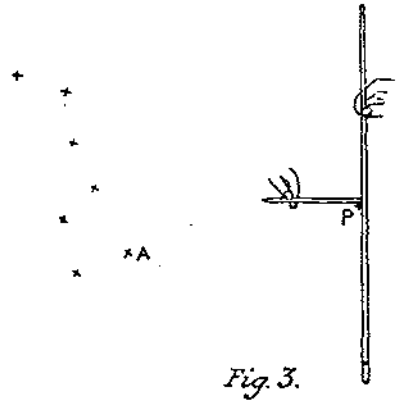


Fig. 3.

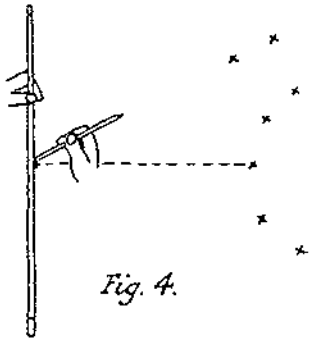


Fig. 4.

For greater accuracy it is sometimes useful to notice some star in the prolongation of the pencil, and, moving the pencil, divide with it the distance between the star and the cane (*Fig.* 4).

A small circle of cardboard, with projections dividing the circumference into 12 parts and a hole in the centre through which to look, held up by a piece of string so as to hang correctly, will give a very close approximation to the real position of A. The officers of the Guides made small eight-pointed brass stars, which could be carried in the pocket. These however might almost be called instruments.

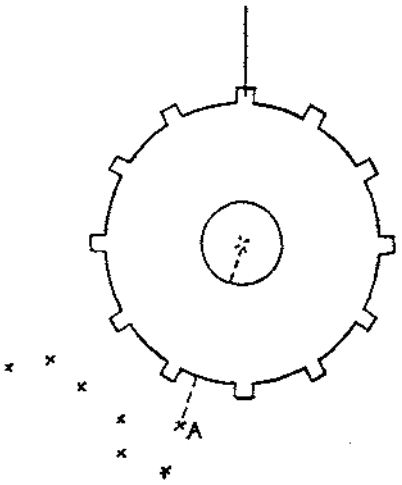


Fig. 5.

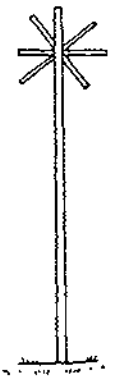


Fig. 6.

But there are other ways; *e.g.*, in stationary positions, as on picquets and outposts, a pole stuck perpendicularly in the ground, with 3 pieces of stick fixed across it (*Fig.* 6); or even, for very rough guessing, one hand held up perpendicularly and the other held up at right angles to it. The side of a house, or even the straight and upright trunk of a tree may often be useful for discovering the positions of U and L.

The rules given above may be summarized as follows:—

1. A is at U at 5 p.m. on June 21.
2. Each month after this date A reaches U two hours earlier, and each fraction of a month 4 minutes earlier for each day of that fraction.

   (These two rules fix the time at which A is at U on any day of the year).
3. In every 24 hours A travels round the circle, traversing each quarter of it in 6 hours, and each fraction of a quarter in a like fraction of that time.

The stars used are of course only visible in the Northern hemisphere. In low latitudes A is often invisible at some portion of the night, rising and setting like most of the other stars.

When this is the case, I use another star. There is a constellation nearly opposite the Great Bear, on the other side of the Pole Star and about the same distance from it as the Great Bear, called Cassiopeia (*Fig.* 7).

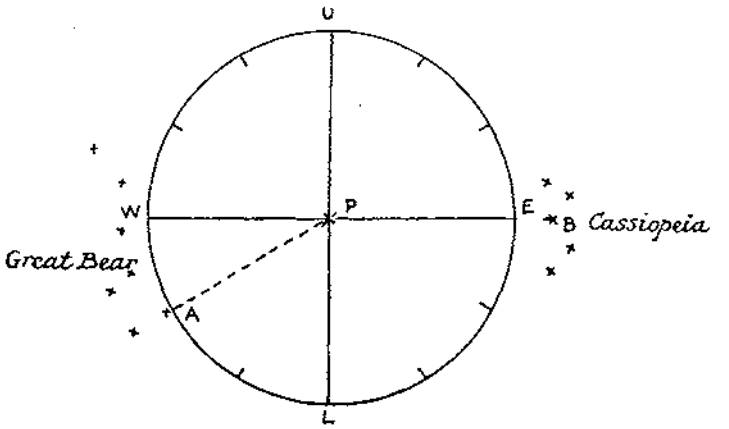


Fig. 7.

It contains 5 bright stars, situated so as to resemble the 5 points of a W. The middle one of these (γ Cassiopeiae), henceforward called B, is the one to use. It is sufficiently correct to say that this star is 10 hours in advance of A; therefore, all that is necessary, when using this star, is to calculate the time by it exactly as if it were A, and to deduct 10 hours from the time so found.

For example, on August 21, A not being visible, I look for B and find it as in *Fig.* 8, which I estimate to be $\frac{1}{3}$ of the way from U to E.

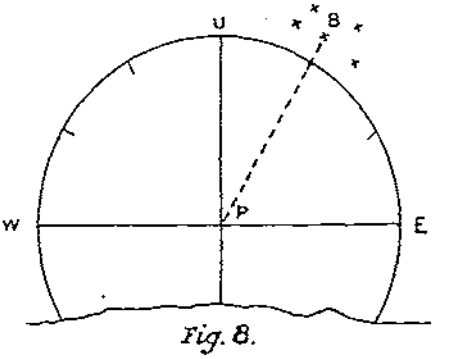


Fig. 8.

By rules 1 and 2 I find that on that day A was at U at 1 p.m.; if therefore it were where B is, the time by rule 3 would be 11 a.m.; deducting the difference between A and B, we find the time is just 1 a.m.

Hence for low latitudes it becomes necessary to add a fourth rule :—

4. When A is not visible, observe B as if it were A and deduct 10 hours from the time found.

When both A and B are visible, it is not a bad plan to estimate the time from the position of both, and to take the mean of the results.

No allowance has been made for the fact that A and B revolve, not round the Pole Star, but round the true Pole, distant some $1\frac{1}{4}^{\circ}$ from it. The effect of this is to make the time obtained from "A" observations some 6 minutes slow (an amount which may practically be neglected). There is no appreciable difference in the B observations, as the R.A.s of B and the Pole Star are very nearly equal.

But there is one more correction that may have to be made. Many places do not keep local time, but take their time from some other place (as Greenwich); so that for every degree of longitude East of the time-giving station 4 minutes must be subtracted, and for every degree West 4 minutes must be added. At Home, except in the extreme west of England and Scotland, this difference may be disregarded. In India a large number of stations employ "railway" (*i.e.*, Madras) time, and in such cases, unless the place is comparatively close to the meridian of Madras, the necessary correction will have to be made. The longitude of Madras is 80° 17′ E. of Greenwich.

For example, the longitude of Rawal Pindi is 72° 7′ E., being a difference of 8° 10′ from that of Madras. The difference in time is therefore 32 minutes 40 seconds (say half an hour), and this must be added, as Pindi is W. of Madras.

Thus for such places we must add a fifth rule :—

5. In places where time is obtained from another place on another meridian, and which are distant some 3° or 4° or more of longitude from that meridian, 4 minutes must be added or subtracted for each degree of longitude West or East of the time-giving place.

By frequent practice it will be found that these methods give fairly accurate results. The error is generally not more than a few minutes, and rarely exceeds a quarter of an hour.

THE FUTURE OF LONDON.

By COLONEL H. P. KNIGHT, LATE R.E.

IN the *Royal Engineers Journal* for January last there appeared an article, entitled *The Future of London*, which dealt with the proposal for the construction of a barrage across the Thames at Gravesend as a solution of the Port of London question. This article so ably presents, in a condensed form, the advantages of the scheme as to lead to a conviction not only that they greatly outweigh any possible disadvantages, but also that the scheme itself is the only one worthy of consideration.

It is however admitted that this scheme has been rejected by the London County Council; and it might have been added that it lacks the support of eminent harbour engineers, and that so far the Government has refused to have its merits enquired into.

In view of the enormous advantages claimed for the Barrage scheme, which, with few exceptions, would doubtless accrue on its completion, and which, were it not for necessarily attendant disadvantages, would justify a far larger expenditure than its estimated cost, it appears to be worth while to enquire into the reasons for its rejection.

Before, however, entering into a consideration of these, it may be well to make some allusion to the proposals contained in the Bill about to be introduced by the London County Council, and thereby prevent certain misconceptions with regard to it that might arise from a perusal of the article under review.

The statement that the proposal to purchase the docks is in opposition to the wishes of Dock Companies is not borne out by their action in connection with the Bill that was introduced last Session. The mention of the estimated cost of the London County Council scheme, and later on of that of the Barrage scheme, suggests a comparison between them which is altogether misleading, more than four-fifths of the former being an investment which will presumably bear a fair rate of interest immediately, whereas the whole of the latter represents expenditure which will only become indirectly remunerative in the dim future, if ever.

The amount of dredging contemplated in the Bill is that required to provide a channel, 30 feet deep at low water spring tides and of a width varying from 1,000 feet to 300 feet, from the Nore to the

entrance to the Royal Albert Docks, and of as great depth as practicable above that dock as far as the old Thames Tunnel.

It is not claimed that this amount of dredging will provide anything like the same facilities for navigation above Gravesend as would result from the Barrage scheme when completed; but in the opinion of His Majesty's Commissioners, based on the evidence of the greatest experts, when these and the other works provided for in the Bill have been accomplished, "the river will bear the same relation to the dimensions of the largest modern ships as it bore fifty years ago to those of the largest ships then existing."

They estimate the cost of this dredging, including suggested moorings and subsidiary works, at 2½ millions of pounds; and state that the proposed deepening of the river as far as the Royal Albert Docks presents no engineering difficulty, and can be executed without risk to the riparian properties, although above that point the question of the safety of property adjoining the river will affect the precise dimensions of the width and depth to be adopted.

The disadvantages of the Barrage scheme may now be considered; and here it is only right to say that they have not escaped notice in the article under review, although the formidable nature of some of them at least is not appreciated.

They may be summed up as follows:—

(1). Interference with the natural means of drainage, including the fouling of the river with sewage.
(2). The insufficient strength of the existing river-walls for a permanent reservoir.
(3). The danger of forming a large obstruction in the river during the construction of the Barrage, the effects of which no one can certainly predict.
(4). Obstruction to navigation, both during the construction of the Barrage and when it is completed.

The existing admitted inefficiency of the natural drainage of the Thames Valley will be greatly accentuated by the permanent raising of the level of the river, and the cost of installing works for the artificial drainage of the adjacent low-lying lands correspondingly enhanced.

With regard to the existing river walls the question of their efficiency as permanent reservoir walls has not received the serious consideration it merits. Surely this is a question equal in importance to that of the design of the Barrage itself; and any such uncertainty with regard to it, as is indicated, is totally inadmissible. Any engineer who witnessed the effect on these river-walls of the exceptionally high tides of November, 1897, and the manner in which the breaches in them were repaired, will pause before guaranteeing their efficiency for the part they would be called on to

play in the Barrage scheme. At the present time the vegetation that covers them above the level of high water neap tides is a considerable protection from scour, and this would probably disappear if the level of the water were permanently raised to that of Trinity high water mark as proposed. It would indeed be an appalling disaster if the proposed Barrage proved a second Assuan dam so far as the Thames Valley is concerned.

The process of construction of the Barrage will involve the formation from the start of a permanent obstruction in the form of a coffer dam, which will reduce the sectional area of the river at Gravesend by about one-third. Can anyone predict what will be the effect of this on the rise and fall and rapidity of the tidal flow at and above the site of the Barrage? It is safe to say that it will seriously affect all these; and that the resulting impediments, and danger to navigation with the up and down traffic converging at this point, will drive shipping to other ports, possibly never to return. The danger of interfering with nature's means of keeping the waterways open in a river, where even the shifting of a buoy's mooring has been known to cause the extension of a sandbank, must not be lightly incurred. Those who know most about the action of tides and storms upon the submerged delta in the estuary of the Thames fully recognize this danger, and point out that it would be of little use to provide a channel over 30 feet deep above Gravesend at the risk of the formation of a continuous bar across the channel below the Nore.

The objections to the Barrage scheme so far dealt with are small in comparison with that of the obstruction to navigation resulting from the necessity of passing all the traffic through the locks of the Barrage. The average number of vessels that arrive at Gravesend in 24 hours, going up and down river, is between 600 and 700. It requires no very vivid imagination to picture the inevitable rush of vessels to secure a good billet for passing the locks and the resulting collisions and possible sinkings. For vessels arriving singly or in small numbers in fine weather the circumstances are sufficiently awkward; but mark what will happen on the occurrence of a thick fog of even 24 hours' duration; such fogs are not uncommon, and those of 3 days' duration, during which no large vessel has got under way, are not unknown.

Imagine a fog and from 200 to 300 vessels in the river below Gravesend. The fog suddenly clears and these vessels get under way and make for the Barrage. The tide is at flood and the vessels must swing before entering the locks. The whole width of the river (about 2,000 feet at this point) is full of shipping, and the manœuvre of safely swinging a modern vessel, 400 to 700 feet long, in this narrow channel congested with traffic is inconceivable. A similar situation obtains with regard to the vessels approaching the Barrage from up river. Meanwhile vessels are constantly arriving; these cannot be

dealt with till those detained by the fog have been got out of the way, and a deadlock eventually occurs. This is no dream of a disordered brain, but the anticipation of those most competent to form a sound opinion as to the probable effects on navigation in the river of a Barrage at Gravesend.

It is admitted that there is no precedent of the dockization of a tidal river of sufficient magnitude to form a guide as to the practicability of dealing with the Thames, and as to how it would affect navigation, tides, river banks, channels, etc. It appears very unlikely that the future of the Port of London will be handed over to the advocates of a scheme which involves so much that is little better than guesswork, more particularly as the scheme has no support from those in the best position to judge of its probable effects.

It remains to consider the Barrage scheme from the Military point of view, and its bearing on the question of possible forms of attack upon the Port and shipping.

The Port of London is not recognized as a Naval base, except possibly in connection with vessels of the torpedo boat and destroyer class; and the defences of the Thames are not armed like those of Portsmouth and Plymouth to meet the organized attack of an enemy's fleet of battleships. It is considered that the established superiority at sea that would enable an enemy to make such an attack would render other measures preferable to risking his battleships in such narrow waters. Furthermore, no British Admiral would contemplate the use of a basin closed by a barrage as a harbour of refuge for a crippled fleet, as the facilities for bottling it up would certainly be taken advantage of by an enterprising enemy. With regard to this Port Arthur is an object lesson.

Accordingly the object of the Thames defences is primarily the protection of shipping in the river, and the keeping open of the trade route for the supply of London. Any obstruction to the free passage of vessels carrying supplies to the Metropolis in time of war will make itself keenly felt in the form of privation and possible famine.

The mere threat of raids by fast lightly-armed vessels upon shipping in the river would no doubt have some effect upon trade; and although there is good reason to hope that we shall maintain our supremacy at sea, the possibility of such raids being undertaken must be provided for.

The Thames defences are designed to deal with such raids; and it is of the very essence of their strength that they should not be concentrated at one point, but extend for some distance along the river, so that hostile vessels may be kept under fire for a prolonged period in case of need and not allowed to run the gauntlet too easily. It is further essential that, when an attack is anticipated (*i.e.*, always on a threat of, and during, hostilities), the whole river area covered by the guns of the fortress should be kept clear of vessels moored or lying at

anchor ; and that, both for the efficiency of the service of the guns and the effective carrying out of the Traffic Regulations, friendly vessels should be passed as rapidly as possible through the defended zone.

It is obvious that a Barrage, constructed in the position proposed, must cause an accumulation of shipping which is incompatible with the efficient working of existing defences, and therefore be most objectionable from a Military point of view. It is not difficult to imagine an enemy's torpedo boats approaching unseen under the shelter of vessels at anchor below the Barrage, and making an attack resulting in the destruction of dock gates and the obstruction of their approaches by means of sunken vessels.

CAMP TRAINING OF THE OUDH AND ROHILKHAND RAILWAY VOLUNTEERS.

By Capt. A. Gardiner, R.E.

An account of the doings in camp of the Oudh and Rohilkhand Railway Volunteers may be of sufficient interest to those of us who are, or have been, connected with the Indian Railway Volunteers to find a corner in our *Journal*. Although such Corps are not at present styled Engineers, the duties which presumably would be theirs in war approximate much more closely to those of Sappers than to those of Riflemen.

The 27th January having been fixed for the annual inspection by the Inspector-General of Volunteers in India, it was decided to concentrate as many members as possible and to form a small camp in Lucknow. This was joined on the morning of the 25th by some 60 men from outstations, making the strength available for the Inspection Parade up to 5 officers (including the Adjutant) and 162 men.

Two parades were held daily on the 25th and 26th. The first three were devoted to drilling the outstationers who, thanks to the good work of the Sergeant Instructors among their little batches of 6 or 7 men here and there along the Railway, quickly dropped into working together; and to practising the "attack" by Companies with ball ammunition on the rifle range.

For the fourth parade practice was carried out with the "armoured train" under the following ideas :—

I. The regular garrison of Lucknow having been mostly withdrawn to the frontier, the country has shown signs of unrest. A large number of former Railway coolies have deserted, and the line has been picqueted by the remaining Regulars and the non-railway Volunteers.

II. Picquets report that 3 rail lengths have been removed from the main line beyond the Bibiapur crossing (about 4 miles from Lucknow). The O.C., O.R.R.V.R., will repair the damage.

The necessary rails of the heaviest section in use on the line, with the full number of sleepers, etc., had previously been loaded into what was doing duty as the "armoured train." Two working parties, each of 16 men and a sergeant, were detailed for the repair, the rest of the battalion forming a train guard and covering party. As there was only a sprinkling of engineers present the working parties had to

be composed chiefly of Loco. and Traffic men without previous experience of platelaying; no coolies were allowed. The train proceeded to the site of the damage, and the 3 rail lengths were laid parallel to the existing main line and then dismantled and reloaded in readiness for the next day's work.

On the morning of the 27th the Corps proceeded to the rifle ranges for inspection. After the Inspecting Officer had examined each Section minutely on the parts and mechanism of the rifle, the battalion carried out the "attack"; the advance was well executed and the shooting as a whole was good.

In the afternoon the "armoured train" practice was repeated; the style of the laying was a great improvement on that of the day before, the 90 feet of track being laid, straightened and roughly packed in 36 minutes from the time the order was given to drop the flaps of the construction trucks. On this occasion a party was despatched in advance in *tikka garris* to carry out an attack, but failed to get to close quarters until after the "damage" had been repaired.

This is believed to have been the first occasion on which Railway Volunteers have actually laid permanent way in this country. The work was keenly and enthusiastically carried out, and was doubtless a valuable lesson in more than one quarter.

LANDSCAPE DRAWING FROM A MILITARY POINT OF VIEW.

By Capt. C. E. Vickers, R.E.

We all know that it is useful to be able to draw, and most of us have a foggy sort of notion that on Service a sketch of what a landscape looks like might sometimes be called for to elucidate some particular point. But few of us I think have more than a hazy idea at best of how a sketch of this kind would be utilised. As a matter of fact I do not suppose we ever think of it. Of course it is remunerative to send sketches to the illustrated papers, and a pleasant way of earning pocket money; but that is not exactly a military use for the art of landscape drawing, even if it affords an opportunity of recording the most wonderful (even apocryphal) events.

A sketch of a foreign fortress (to show what the exterior of it looks like, where the guns are, and what the vulnerable points) should be of undoubted value, probably one of the most useful forms which Intelligence about such a place can take; but I should imagine this is not a task to be postponed until War is actually in progress. How then are we to employ our drawing talents so as to be of most service to our country?

I am sure many brother officers have theories on the subject. It seems a very suitable matter for discussion in our Journal; and I would humbly suggest that any officers who have views to state should take an opportunity of putting them into print for the benefit of others.

Arising out of this question, information as to the best methods of reproducing drawings in the field would be most useful.

TRANSLATIONS.

FORTRESS WARFARE AS ILLUSTRATED BY THE FIGHTING ROUND PORT ARTHUR.*

(*By* Lieut.-Colonel Frobenius *in the* Militär-Wochenblatt, 13*th and* 15*th October*, 1904).

I.—The Rôle of Fortresses and their Garrisons.

The science of fortress warfare does not derive much benefit from the blessings of long-continued peace. The lessons deducible from peace training being of very small value, its only progress is dependent on theoretical investigations and literary discussions. It is handicapped more than other military sciences, as these derive instruction from the organisation and the employment of living beings, from the records of technical improvements and of practical trials. On the other hand it is rarely possible, owing to the expense entailed, to endow inert fortifications with life and colour by means of fortress exercises; and when such are undertaken, it is usually on so small a scale and in so hurried a manner that wrong impressions are conveyed and wrong deductions too easily drawn.

As fortress warfare will undoubtedly play an important part in a future European War, the extremely instructive conflict of two modern armies for the fortress of Port Arthur affords a welcome example. We need not hesitate to use it for testing our previous theoretical views and for modifying our ideas. It is true that our information is still too sketchy to apply it to details, both as to tactical and technical matters; such investigation must stand over until a later period. This is, however, not the principal question for the Army at large, but merely a speciality for some of its branches. We are already in a position to review *on broad lines* the doings of both the attacker and the defender; we can judge of the character and the general progress of events, of the assistance afforded by fortifications prepared and located in peace time, and also of the importance of the fortress as such to friend and foe in their respective plans of campaign and in the progress of the war. This seems to me a sufficient basis for amending our views concerning the value of fortifications, their powers of resistance against modern weapons, and the method of their employment.

The second Japanese Army, after landing at Takushan and Pitsevo, turned in May towards the South of Liaotung and toward the Kwantung

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Peninsula. The opinion was then freely expressed that this army would make a great mistake if it allowed itself to be attracted by Port Arthur, and if it laid siege to that fortress. It was a principle derived from 1870 to take the field army past fortresses in order to obtain a decisive result with concentrated forces against the hostile armies. Entirely isolated, it was thought that Port Arthur would fall an easy victim. This view, backed by many influential authorities in the army, had much to recommend it; it was based on the conviction that the Japanese Fleet had secured the mastery at sea, and was free from further aggression by the enemy. I am not sure whether our comrades in the navy were of the same opinion.

The importance of Port Arthur was first of all due to its being a fortified harbour and, for the Russian fleet in the theatre of war, the only base which, owing to freedom from ice, was available all the year round. Men-of-war shut up there were not rendered entirely innocuous; their offensive power could not by any means be thus ignored; and the Japanese Fleet by itself was not powerful enough to divide its forces and to cripple this adversary, while at the same time fulfilling all its other tasks, such as affording protection against the fleet at Vladivostok. It must not be forgotten that Japan was engaged in a transmarine campaign, that any doubt about her supremacy at sea was equivalent to danger to a most sensitive line of communication and to risking the very existence and liberty of action of the entire field army. At that time too the army's base of operations on the mainland was a very precarious one. The nature of the southern coast of Liaotung and of the western coast of Korea makes the landing of large bodies of troops and of war material as difficult and slow an operation as transport along the Russian single-line railway. Taking the lack of roads in that part of the country also into consideration, it cannot be disputed that bases situated in those districts were very risky. Only two bases could be considered satisfactory, viz. :—Dalny and Newchwang (or rather its port Ying-tse).

In order to safeguard all operations against interference from Port Arthur, it would only have been necessary to cut off the Kwantung Peninsula, for which purpose the neck at Kin-chou afforded ideal opportunities. A strongly fortified position on the hill at Nanshan could have been held by a comparatively small force, and this line of action was advocated by those who considered the siege of Port Arthur to be a mistake. But this hill was occupied by the Russians, it had first to be captured by a desperate fight, after which Dalny fell into Japanese hands without further effort. The subsequent employment of Dalny as a base was so much to the latter's advantage that they could not well help grasping the opportunity and taking steps to safeguard it. Such steps could only consist either in extensive defences of the port against Russian aggression, or in an attack on Port Arthur itself. They should not be blamed for their choice of the latter alternative, especially as the capture of the fortress would destroy all Russian hopes of the fleet contained therein, after having been refitted and reinforced from home, again threatening Japanese supremacy at sea and thus endangering the issue of the war. That this fortress would be able to offer such dogged resistance,

that its siege would engage so large a proportion of their forces, was certainly never expected by the Japanese who had their experience of 1894 as precedent.

Probably politics and ambition were also factors in determining them to attack the fortress. Port Arthur, next to Korea, was the chief objective of the war; the possession of the harbour, as important for Japan as for Russia, will infallibly be demanded as a prize of victory; and it was excusable for the Japanese to consider it a point of honour to take this fortress, which they were deprived of by foreign interference when they captured it before. It would nevertheless have been a mistake, for such reasons, to dangerously weaken their field army before an issue had been reached in the field, unless the reasons previously mentioned had been imperative. To the Japanese, however, it did not seem so serious a matter to detach a siege army as it did to their European critics, for they knew very well that they had at least twice as many troops as was supposed by Russia. This may have rendered the decision more easy; and their calculations promised that, even after detaching several Divisions, they would continually be able to reinforce their army faster than the enemy could his, and that they would thus be able to retain numerical superiority for a long time to come. Facts have borne out this calculation.

It was considered sound in Germany, as recently as 10 years ago, to deduce from the experience of 1870-1 that an invading army could only be compelled to capture such fortresses as lay directly along its lines of operation and which could thus cut off and endanger its communications, while more distant fortresses were not worthy of attention. Port Arthur has furnished a contrary example, to the effect that there may often be other weighty reasons for attacking a fortress than merely its immediate influence on the lines of communication of the field Army.

Port Arthur had two duties to perform. Its fortifications were intended to enable it to act as a base whence the fleet could undertake offensive operations. To effect this, hostile ships must be kept at such a distance off a harbour entrance, and away from its outer anchorage, that its own ships can issue and form up in the open without danger or molestation, and that they can escape pursuit when forced to retire. If this object is attained a port and its equipment are *ipso facto* safe from bombardment. Fortifications must also close and protect the entrance against a raid. The coast defences of Port Arthur perfectly fulfilled all these requirements. The inability of the Japanese fleet to vanquish them unaided, or even to permanently restrict the liberty of action of the enclosed war vessels, has been decisively proved. This fleet was restricted to a blockade, to the task of protecting the transport of troops, arms and stores for the besieging army, to securing the army's shore flanks, to preventing supplies and information reaching the fortress, and to stopping the interned fleet from acting at sea.

The capture of the fortress—even of its coast defences—therefore entailed an attack by land, and such attack has to be resisted by the main army, unless the latter are relieved of this duty by defences on the land front. Besides protecting a port from inland bombardment, land

defences are relied upon to relieve the field army of the care for this point of strategic importance, to attract as many hostile forces as possible, and thus to withdraw them from decisive action in the field. This is an old, a well-known principle; but its correctness depends on the faith that the fortress will be able to repulse, unaided, all hostile attacks.

In this connection it is imperative first to settle the question whether up-to-date means of attack are able to overcome in a comparatively short time the resistance of an efficient garrison holding a modern fortress fully equipped with all accessories. If any doubt were justified, the responsibility for such a fortress would form a constant source of pre-occupation to the Commander-in-Chief, and it might thus unfavourably influence the operations of the Army. *The value of a fortress thus depends on the confidence in its efficiency.* As this cannot be founded on theoretical reasoning, on calculations, or on examples from ancient history, but only on up-to-date instances of successful resistance, the facts of the fight for Port Arthur, pursued on both sides with unequalled energy, endurance and sacrifice, become of primary importance in rightly estimating the value of fortresses. The justification for their existence is established, a right which would have been very doubtful had there not been clear proof of their power of affording lasting resistance.

The vital question of fortresses thus favourably answered, the progress of the attack and the defence affords further valuable lessons for elucidating a number of important questions for fortress warfare in a far more convincing manner than can be done by theoretical reasoning.

1. *The employment of the general reserve in the distant forefront.* Ever since the adoption of the principle of considerably strengthening the defensive garrison of a large fortress by the addition of a large body of troops, similar in composition to detachments of the field army, to act as a general reserve, proposals have been formulated for the employment of this body in front of the fortress. Two opposite views have appeared in this connection. One of these is defined in the French Regulations, entitled *Instruction générale sur la guerre de siège* (1899), and recommends the extension of the offensive enterprises by the general reserve—even augmented by positions of the defensive garrison—to such an extent that the attacker be met, his advanced guards assailed and his flanks threatened, in fact, that he be made to suffer as much as possible by aggressive action. The other view, chiefly represented in Germany and Austria, deprecates the employment of shock tactics under all circumstances; but wishes the general reserve always to adopt fire tactics, while confining its activity, when far out, to the occupation of such positions as must be assaulted by the attacker and cannot be evaded in his effort to reach the main line of outer forts with a siege train. Even in such positions obstinate resistance should be avoided, and retreat should be effected as soon as it is obvious that the enemy has developed sufficient forces to ensure his early success. Under all circumstances the delay of the attack should only be aimed at, while large losses, inseparable from offensive action or an obstinate defence, should be avoided.

It is interesting to note that the Russian General Kasbek, in his guide for the attack and defence of fortresses, writes in favour of the first-mentioned view of shock tactics:—"With a view to delaying the investment by an adversary, all the garrison, with the exception of troops absolutely essential for repelling a surprise assault, should be sent out to meet the enemy in the open, where it should endeavour, both by manœuvring and by fighting, to beat his advanced troops and to threaten his flanks, taking care however not to expose itself to any risk of being cut off from the fortress." Which measure did General Stoessel adopt? and how did it turn out?

The garrison of Port Arthur consisted, as far as we know, of the 4th and 7th Divisions of East Siberian Rifles (24 battalions), with their Brigades of Artillery of unknown strength, three Battalions of Fortress Artillery, and one Company of each of the following, viz.:—Fortress Sappers, Miners, and Telegraphists; a total force amounting to about 40,000 men. It is reported that amongst the killed, left behind on the Nansan Hill on the 26th May, men belonging to seven different regiments were found, from which fact it would appear that Stoessel had detailed troops from each of his eight infantry regiments to form the general reserve, a disruption of units for which there may have been special reasons. It may certainly be assumed that at least seven battalions occupied the position referred to, and it is indeed probable that there were no less than twelve. The position was about 27 miles from the forts of Port Arthur, but this space could be bridged by the connecting railway, and trains were kept in readiness at the station of Nansan-shi-li-pu for the transport of troops in case of need. The position had been prepared a long time beforehand; shelter trenches had been constructed, with numerous bomb-proof covers, and in several lines in tiers behind one another, in front of which obstacles and mines had been arranged. Special assistance was afforded by a number of old, but useful, Chinese fortress guns of small and medium bores (numbering 68 according to Japanese accounts), besides some machine guns. Field Artillery does not appear to have been strongly represented, only two batteries being mentioned.

With both flanks resting on the seashore, the position was about 2 miles long (the Talienwan Peninsula being excepted) and about 525 feet above sea level. The position could not be avoided by land, but it was possible to outflank it on both sides by utilising the shallow foreshore, which at low water was high and dry in parts. In order to make this position practically impregnable it would have been necessary for the fleet to act in support on both wings. Such support could however no longer be counted upon in view of the loss of the command of the sea, and it must be considered a stroke of luck that a Russian gunboat and two destroyers succeeded in evading the Japanese cruisers and reaching the Bay of Talienwan, where, despite hostile artillery fire, they managed to take an active part in the battle. Probably it is their assistance that caused the failure of the attack of the 3rd Japanese Division against the Russian right. Similarly it was the employment of the Bay of Kin-chou by the Japanese Fleet that enabled the Russian left to be outflanked, the

enfilade fire of the ships' guns making the position absolutely untenable; in this case three gunboats and an armoured coast defence vessel (with guns corresponding to two 8·4″, two 6″, eight 4·8″, one 3″ and five 1·85″) were employed as far as the depth of water and their respective draught permitted; it was fatal to the Russians that, just in the evening, the rising flood enabled these ships to again approach after having been compelled to withdraw in the middle of the day, their assistance thus coinciding with the last enveloping attack of the 4th Japanese Division.

The position at Kin-chou was an instance, which is rarely likely to recur, of providing means for closing the enemy's only avenue of approach to the fortress. Its distance, rather more than one day's march from the defences, was not of sufficient importance to prevent its being made use of for delaying the hostile advance. The Commander of Port Arthur had to reckon with the possibility of the Japanese landing at Pitsevo, a coast line, which, though rather unfavourable, they were well acquainted with from 1894; thence they would have been able to advance across the peninsula, cutting the railway while approaching Port Arthur. This they might have done, not so much with a view to attacking the fortress as to preventing its garrison from interfering with their operations. The Japanese could most easily have effected this by occupying the position at Kin-chou. The shores of Liaotung were watched by small detachments of the field army, who seem to have been supported by somewhat stronger forces on the heights behind them. Takushan (2,400 feet), 4 miles to the east of Kin-chou, was thus occupied. General Stoessel was therefore able to join his mobile forces with this detachment and to make an offensive advance, in accordance with General Kasbek's instructions, against the enemy's flanks, whether advancing in a westerly direction on Port Adams or along the eastern coast on Talienwan. To effect this, it was possible that a successful action would first have to be fought. Such success would not, however, have been of any considerable importance, as the main body of the field army was too distant to turn it to good account; while Stoessel could only have secured it at a loss, which could not have been replaced, at the same time exposing himself to the risk, if not successful, of being cut off from the fortress as he was dependent on a defile for his communications. It would therefore have been a mistake to do the work of the field army, while relegating the functions of the fortress and its garrison to a secondary position.

It has sometimes been assumed that the battle of Takushan on the 17th of May was fought by parts of the garrison. This seems to me impossible, as the Russians engaged here retired towards the north. Should it, however, prove to have been the case, the issue of this battle would merely prove such employment of the garrison to have been mistaken, as the troops engaged were actually cut off from the fortress. By confining himself to the defence of the Nanshan position, by sending forward his firing resistance—even the employment of spare fortress guns being in this case justified—Stoessel achieved more, he attained everything that was feasible under the circumstances; he compelled his adversary to capture at an enormous sacrifice the position, which was an indispensable one, and he probably delayed the advance and the commencement of the

siege very considerably. As he managed to retire in good time, his own losses were not excessive in view of the result obtained. Nevertheless so extensive an advance of the general reserve must not be laid down as a type for the future. Circumstances required it in this case, but such circumstances are not likely to recur. The defence of Kin-chou must therefore be considered to be an exceptional case. The normal employment of the general reserve did not commence till the 26th May.

II.—Defence of the Foreground.

The peninsula of Kwan-tung has in front of the railway station of Nansan-shi-li-pu, upon which General Stoessel had retired, a position affording protection to Victoria Bay and to Dalny. But the right wing would have had to extend as far as Point Robinson, as the narrow bay to the north of this (Junk Bay) is so shallow that it could not be relied upon as a point of support for the flank. The General had just had experience that shallow sea waters afforded no protection; he could scarcely rely any longer on the support of his own fleet; he had rather to fear that Japanese ships would threaten in rear and in flank the peninsula ending at Point Robinson, and thus make the position untenable. Situated at a distance of 21 miles from the outer forts, and exposing him to the danger of being forced off the railway running along the north shore and of being cut off from the fortress, this position was too risky a one, and Stoessel therefore gave up the idea of holding it; his forces would probably hardly have sufficed for its occupation. He retired as far as the Lung-wang-ho which flows into the sea about 6 miles from the forts. The breadth of the peninsula at this point, as far as Ingentsi Bay, is about 10 miles, and it would seem that the formidable Mount Trible (Jupilatsu) situated some distance from the north coast, as well as the heights on both sides of the Lung-wang-ho, afford a good position.

We are almost entirely without news as to what happened between the 26th May and the 26th June, on which latter date the advance of the Japanese against this position started. We do not know whether there was any fighting whatsoever in the broad tracts they had to traverse after the 26th May. It appears, however, that they contented themselves with the occupation of Dalny, protecting themselves in this position just in front of the railway. They devoted all their energies to getting the harbour of Dalny into working order and to preparing means for carrying on a siege. In the subsequent fighting they had heavy guns at their disposal, whereas at the attack on the Nansan position they had not even field howitzers. During this period also the army of Oku was probably relieved by the divisions of General Nogi; but we are not fully informed as to when and how the general relief was effected. General Stoessel estimates the strength of the Japanese at the battles on the Lung-wang-ho as being five divisions. It is fairly safe to assume that at any rate by the beginning of August the 5th, 6th, 9th and 11th Divisions, besides the 5th and 11th Reserve Brigades, also possibly the 6th and 9th, were in front of Port Arthur; in September the 8th Division is said to have been added to these.

It is certain that at the end of June the Russians were forced to retire from the left to the right bank of the Lung-wang-ho on account of their left wing having been outflanked, but they recaptured the left bank in the first week of July and retained it until the end of the month. The Japanese were compelled to bring heavy (6-inch) guns to bear upon this position, besides calling in the fleet to their aid. After heavy artillery preparation the attack was commenced on the 26th July, and was continued uninterrupted for three days, but without success. The Russian cruisers and gunboats also took part in the battle and with good success, the Japanese, owing to the danger from mines, no longer employing their modern ships in the vicinity of the coast. At the same time an attack on the position of the Jupilatsu was carried out with equal lack of success. The situation remained unchanged until the 30th July, when the Japanese succeeded, by employing their whole blockading fleet, in preventing the Russian Navy from taking part in the battle. By means of a combined attack of five divisions, supported by siege guns and by four battleships, four large and ten small cruisers, and 48 torpedo boats, Stoessel was finally forced to evacuate his position and to withdraw into another one immediately in rear, which extended along the declivity of the Takhe and rested to the north on Wolf Hill. As this position undoubtedly extended as far as Louisa Bay, its total length was about 10 miles and it exceeded the powers of the garrison to occupy it with sufficient strength throughout. Thus it appears that as early as 30th July Wolf Hill had to be evacuated on the approach of the enemy.

The capture of Wolf Hill constituted a considerable success for the attacker, because he thereby captured the principal artillery positions necessary for fighting the forts. Its distance from the north front of the line of forts (Kikwan and Rikwan) is about 3 miles and from the port itself 6 miles, so that it was possible to reach the latter, including the war vessels therein, with the long 6-inch gun. It is reported that on the 6th August 20 heavy guns were placed in position here, and the statement that both the town and the harbour were being hit removes all doubt about these guns having been made use of. The subsequent fights (often inaccurately described in newspaper accounts as assaults on the line of forts) aimed at driving back the defenders from the advanced positions which it was necessary to take for artillery purposes. Therefore the position on the Takhe (Takushan and Shakushan), in front of the eastern forts, became the first objective. Takushan, captured on the 8th August and recaptured by the Russians on the 9th, appears to have been obstinately defended until the 14th. Similarly (on the 15th and 16th) determined attacks were made on High Hill and Division Hill in the neighbourhood of Louisa Bay, and according to Stoessel's account these attacks were repulsed. Subsequent fights between the 17th and 20th of August appear to have placed the Japanese in possession of foreground to a sufficient extent to enable them to occupy artillery positions enveloping the north front and the northern portion of the east front. If even after this date the Russians had not entirely relinquished the foreground, it may nevertheless be considered that at this period the fights for the foreground ended.

These eight weeks of obstinate fighting on the part of the general reserve, which we have estimated as being only equal to a division, against vastly superior forces, have provided us with a proof of the possibility of defending the foreground, a matter which has often been considered doubtful. They tend to show that the best method does not consist in delivering a number of independent offensive blows, but in gradually retreating from one carefully prepared position to another. They have proved that an attacker, even when having at his disposal such fanatical and reckless troops as General Nogi, will find it impossible to run through an efficient garrison holding a carefully entrenched position. It will on the contrary require much time and trouble to prepare sufficiently powerful measures to compel the defender to retire. It required, as it would appear, the preparation of complete positions on the opposite side to obtain a secure base for the attack, and the defender's fire effect was such that these positions had to be constructed during the night. On the other hand the weaknesses of defensive positions in the foreground are also shown up. They consist chiefly in the fact that they do not surround the fortress in a continuous ring and that equally favourable conditions of ground are not to be found everywhere. The conditions in the case of Port Arthur appear exceptionally favourable, because only a portion of the circumference could be utilised either by friend or by foe, the major portion being sea bound and secure against operations on land. But even this segment of a circle compelled the defence to occupy broken positions, which, split up by intervals, made control difficult and offered many vulnerable points in the numerous exposed flanks. The positions when outflanked had always to be evacuated. Therefore the rule applies to these positions as it did to that at Kinchou, that they should never be held to the last, but should be evacuated as soon as the attacker has been compelled to bring up sufficiently powerful means for their capture. That this alone means a good gain is proved by the fights round Por Arthur. The duty performed by the heavy artillery is merely an accessory one; the main duty devolves on the infantry, which has to handle the spade as well as the rifle.

III.—The Fight for the Line of Forts.

The view has often been held that infantry must certainly solve the problem of driving back the defender from the foreground so that heavy artillery can be brought into play; but that at this point its duty ends, as everything else could be confidently entrusted to the heavy arm, which would quickly gain a preponderance over the artillery in the fortress. This was generally, but without cause, imagined to consist in the complete destruction of the fortress artillery; and it was thought that the guns would then drive the defenders out of their defences by shattering their nerves, so that the infantry, after such careful preparation, would merely be required to pluck the ripe fruit without any trouble. As soon as the heavy artillery opened fire, it was expected that the infantry would have a period of spectatorship, probably of short duration, while the success of the artillery action was being awaited. "When the

artillery of the defender is in the main part silenced, when his infantry has retired behind the line of forts, and when pickets and reconnoitring parties sent out from the artillery position are little interfered with by the defenders, then the time for an infantry attack has come." (*Feldtaschenbuch fur officiere des Geniestabes und der Pioniertruppe*, published in 1902).

Others go further than this and think that a short but extremely sharp bombardment, concentrated solely on the forts as pivots of the position, would suffice to overcome the garrison and would enable an advance in large masses to be made against the line of forts with every chance of this line being broken through. The example of Kars, given by the Russians, proves that a successful piercing of the line can lead to the fortress being captured, if the latter is without an inner line of defence and if the troops driven back from the line of forts have no opportunity of finding cover for renewing the resistance. Port Arthur as far as we know lacked a town parapet. The ground is not suited to one, and it would only be a question of defending the hill between the old and the new cities. The occupation of this hill would not prevent the attacker from placing the town and port under concentrated direct fire from the surrounding hills, which afford so excellent a position for the line of forts. The fate of the fortress and of the fleet would therefore probably be settled as soon as the line of forts was pierced.

Whether the main line of defence at the forts satisfied all modern requirements of defensive works is uncertain, but it appears open to doubt in more than one respect. We have only certain information about the Chinese fortifications built as a temporary measure and captured by the Japanese in 1894. The Eastern portion stretched from Cape Laolishui to the gorge of the Lunche Valley, along the heights of the Drakonnowji hills, a distance of about 5 miles, having in front of it the broad open valley of the Takhe. Of the three main forts one was situated on the east front, Kikwanshan on the short north front, and Erhlungshan on the junction of the north and east fronts; nine smaller independent forts, besides connecting lines, completed the position. This line was no doubt kept by the Russians, though it was probably improved and a large number of additional works appear to have been constructed. To the west of the Lunche the Chinese had fortified the Isusan Group, which is somewhat to the rear of the eastern portion of the north front; and here we have the Itseshan fort and several subsidiary works. This group is commanded by the surrounding heights, and it is due to this that the entry of the Japanese at this point was favoured in 1894. The information appears correct that the Russians pushed forward a new position on to these commanding heights and connected it with the western line extending along the heights of Sanshan to White Wolf Hill, where they reach the coast. In order to remedy the lack of drinking water they constructed reservoirs and wells south of the village of the Shui-shi-jin and they led the water thence into the town. To protect these waterworks, which extend well beyond the main line of forts, a fort (Kuropatkin) is said to have been constructed, which was probably south of this village on the rising ground to the west of Palitshwang. The total length of the whole defensive position would be about 12 miles.

As to the nature of the fortifications all information is wanting, as the Russians maintained absolute silence on that point and the reconnaissance of Russian fortresses by Europeans is well known to meet with insurmountable obstacles. The Japanese were probably better informed owing to their excellent intelligence system. From statements made it would appear that the Russians, true to the principles they have followed in other fortifications, made somewhat different arrangements from those we are accustomed to find with other European nations. A thorough separation of the positions prepared for distant fighting and for close fighting does not appear to have been carried out; that is to say, the artillery was not restricted to occupying the intervals and the ground outside, but was also introduced into the forts. Protection in this exposed position by means of armoured towers, which we consider essential for retaining permanent fighting power for our artillery, was not provided; however, it is not improbable that the same object was effected by providing disappearing carriages and perhaps also by fitting gun shields. It is also not impossible that a conventional preference for bayonet fighting and for counter-attack by the internal reserve caused too little stress to be laid upon the provision of a permanent, assault-proof, thoroughly-flanked obstacle; and that, instead of it, frontal fire on to ditches filled with field obstacles was arranged, with a view to facilitating such counter-attack.

If we may therefore doubt the Russian works, as regards their power of resistance, being fully up to requirements, it is perhaps also questionable whether the preparation for the artillery defence reached even approximately the perfection aimed at with us. As regards the construction of a circular road and the necessary communications with the town, nothing is known; the considerable differences of level, and the intersected nature of the ground make such constructions very difficult. The well-known preference for developing the construction of Dalny probably caused Port Arthur to be stinted of the necessary funds; and to make up for lost time during the war itself was impossible owing to lack of men. Whether the material necessary for narrow gauge railways was at hand is very doubtful. Whether means were provided to construct artillery buildings in the intervals between the forts, besides those constructed in the forts themselves, is also open to doubt. It may therefore be assumed that Port Arthur was not qualified to produce the highest results possible, and consequently our great forts ought at least to be able to render as good an account of themselves, assuming the commander of the garrison to be equally good.

How did the Japanese proceed in the method of their attack? Do their successes justify the views expressed above? The impatient nature of the Japanese, the importance which they attributed to the speedy capture of this fortress and to the destruction of the Russian fleet, led one to expect that they would carefully prepare the attack as they do their field battles, and that they would not unduly hurry themselves in doing so, but that afterwards they would not await the success of the artillery fight with infantry inactive. It was therefore not surprising that a violent attack immediately succeeded the period of fights for the artillery

positions. On the 6th August the first heavy batteries had been got into position on Wolf Hill; until the 20th fights took place for the artillery positions, and on the very same day commenced a period of practically uninterrupted violent attacks and attempts at penetration. It may be supposed that the batteries first constructed had already operated for some considerable time on the northern forts and that the Japanese counted on these being shattered. The tremendous fights lasting for ten days, the losses numbering many thousands, the co-operation between a powerful artillery and greatly superior numbers of fanatical troops filled with a wild hate and a contempt of death, effected no more than to prove the great power of resistance possessed by a fortified position prepared in peace time, a power which has so often been disputed. The Japanese, who had effected an entry into the defensive line more than once, had to retire, and they could only retain one point in the vicinity (Pulingshing). When some final attempts in the last days of September had also failed, the attacker resigned himself to the necessity of letting the artillery play for a prolonged period prior to his making a repetition of these violent assaults.

From some newspaper articles, however, it would appear that the Japanese infantry did not remain idle. From the investing position, situated about 2½ miles from the line of forts, the infantry advanced with the aid of earth works, and it is even reported that they attempted to approach the forts by means of mining, in order to blow the forts up. They discontinued this, however, probably because the technical troops had been insufficiently trained for such work and were not able to overcome the difficulties due to the rocky nature of the ground. The situation of their investing position would seem to confirm my view that the danger from the fire of fortress artillery should not be exaggerated, and it is therefore not necessary to remain at a very great distance from the works.

While the attack was making progress, the artillery is said to have been reinforced by mortars. It is, however, doubtful whether a weapon of the nature of our 21 cm. (about 8¼-inch) rifled mortar is meant thereby, for I have it on good authority that the Japanese did not receive steel blocks for the manufacture of such mortars from Krupp, and it is well known that they purchased all the raw materials for their siege artillery from this factory. The employment of such mortars would therefore only be imaginable if they had succeeded in manufacturing them entirely in Japan, but in that case I should be inclined to doubt their efficiency. The artillery action is said to have been weakly pushed by the attacker, and is even said to have been interrupted during long periods, which seems to point to a lack of ammunition. This assumption must not be considered far fetched, because the transport from Dalny had to be carried out over a country road about 18 miles in length, and these roads are stated to be hardly practicable during periods of rain. The railway could not serve this purpose, as the Russians had succeeded in securing all rolling stock. It was not until the capture of Liaojang that railway trucks fell into Japanese hands; and even these, owing to a lack of locomotives, had to be propelled by manual labour. As these trucks were no doubt principally used for the field army, the transport of ammunition for the guns in

front of Port Arthur was probably a more serious matter even than ours before Paris.

A second period of assaults, which opened with a heavy bombardment on the 15th September, is said to have commenced on the 16th, and to have led to the capture on the 21st of some important forts, Kuropatkin and Itshwan; but the report has not been confirmed. On the contrary it is now reported that an order has been issued from Tokio to the besieging army to abstain for the present from further assaults. This would mean that the attacker realises the necessity of proceeding with a leisurely and deliberate siege. A greater triumph could not be celebrated by the fortress.

Nevertheless the fortress will not be able to maintain itself when its forces and resources become exhausted, and it does not seem improbable that after sufficient preparation a violent assault undertaken from closer proximity will end the situation before that period. As soon as the Japanese succeed in capturing a portion of the line of forts, then will Port Arthur, owing to its lack of a second and interior defensive position, be unable to offer further resistance. But it has nobly done its duty, and it has proved the power of resistance of a modern fortress. Great credit is due to the Commander, who knew how to dispose of his forces in so efficient and thorough a manner, and how to imbue his troops with such enthusiasm that they offered this heroic resistance in fights of unexampled fury and of enormous strain.

Since the Turkish war no fortress has been attacked with such fury, and so regardless of the heaviest losses in men. Never has a fortress been tested as to its power of resistance by such a series of almost uninterrupted assaults. If this fortress, the value of which is open to doubt in more than one respect, could, in the hands of a courageous and efficient commander, withstand such an attack so long and so successfully, we may place the greatest confidence in our fortresses which are better equipped; we may rest assured of their power of doing all that is required of them, and of offering a long-continued resistance against any weapon of offence.

IV.—Mines.

When in 1889 our pioneer troops were organised as pioneers pure and simple (in fact hardly as more than pontoon troops) the miner vanished from the German Army, and with him naturally vanished all interest in the further development of mining and the sciences connected therewith. In other countries this science has made considerable progress, which has been practically ignored by us. The Russian Army especially has developed this service considerably. It was therefore to be expected that the employment of mines would be noticed in the war in the Far East, though it seems unlikely that Port Arthur had already been provided with a regular system of mines like other Russian fortresses. General Stoessel ordered the construction of mines in front of the position on the Nanshan Hill as obstacles, that is to say of so-called trip mines, which generally are not considered of much value, owing to the usual experience of their not going off at the right moment, so that their actual success did

not justify the fear with which they were viewed. The effect in the most favourable circumstances was a moral effect. Their reputation was not increased by the experiences which the French had in 1870 at Paris with their mines in front of the fortress, and which so often failed to act. It need not therefore be considered exceptionally lucky for the Japanese to have discovered on the 26th May, before the ignition of the mines, the connecting wires in front of the Nanshan position, when they were able, by disconnecting them, to avert all danger.

In front of Port Arthur, however, such mines seem to have played a more important part. They are said to have rendered the occupation of the Wolf Hills most difficult. On the 26th and 27th August they are supposed to have inflicted considerable losses on the Japanese in their assaults on the subsidiary defences, and on the 3rd September they are even supposed to have stopped an attack altogether. And as General Stoessel himself, in a report of the 2nd of September, lays stress on the effect of automatic mines on a hostile column, it would appear that the report emanating from the opposite side was not without foundation; the report stated that the Russians constructed mines in the valley between Long Hill and Division Hill before they evacuated that portion of the country, mines extending over a distance of nearly a mile and concealed by means of rocks and earth. It is stated that when, during the night of the 3rd September, an advancing column was discovered in this valley by means of search lights, the garrison fired these mines electrically; and the explosion, which actually threw stones into the Russian positions, almost annihilated the hostile column. Even if this report is considerably exaggerated, there would still appear to be sufficient justification for paying greater attention to the employment of automatic and of observation mines, and it is not unlikely that the Russians succeeded in getting much more value out of them than had ever previously been possible.

Whereas the defenders were enabled to make considerable use of, and to derive considerable advantage from, their peace training in the science of mining, and to make the attacker fear these mines so much that he wished to employ similar mines himself, the Japanese evidently could not carry out this intention as their technical troops were trained entirely according to the Prussian example and were therefore unable to carry out the technical works required. Here is a lesson which should be well considered, that it is undesirable to neglect entirely a branch of technical training which may possibly at some future time be of great value to us against our western neighbour.

REVIEWS.

THE CROSSBOW.

Its Construction, History and Management, with a Treatise on the Balista and Catapult of the Antients.

(Continued from March Number).

A review of Sir R. Payne-Gallwey's colossal work would not be complete without a reference to the mechanism, range and sporting use of the weapons so fully described. The influence of the mechanism on the flight in relation to the ranges obtained, the results of some hundreds of years of experiments as bearing on present-day projectiles, is instructive to all who are at present engaged in thinking out possible secret improvements to existing armaments.

As already described, the longbow was the cherished weapon of the English people in the 14th and 15th centuries, whilst the crossbow held a similar position in France, Germany, Italy and Spain.

The longbow was but a hewn stick of foreign yew, bent to shape and of little intrinsic value; but the crossbow gave the artist, the engraver, the inlayer and the mechanic great chances of exercising their talents. Many of the mediæval crossbows still to be seen in foreign museums are beautifully constructed weapons, and in nicety of finish compare favourably with a costly modern fowling piece.

The mechanism of the primitive crossbow was very simple; a straight piece of wood, rectangular in section, formed the stock, the arrow bolt resting in a groove on the upper side of the stock. The near end of the groove was fitted with a catch, over which the cord, or bowstring, was stretched. At right angles to the stock was the bent bow. To stretch the string the whole power of a man was required; standing with his two feet on the bow, one foot on each side of the stock, whilst at the same time grasping the cord with his hands, he slowly bent it back over the catch. A stirrup of iron fixed to the middle of the bow, to place one foot in whilst stretching the string, formed the next modification. But this primitive form of weapon was soon in turn superseded by a bow, which, instead of being made from a single solid piece of wood, was compositely built up of horn, whalebone, yew and tendon, thus helping to prevent the warping or setting to which the solid bow was liable.

The composite form of bow is said to have been introduced into Europe during the stirring times of the Crusades by the Saracens from

the East, that useful article, best town-made glue, appearing for the first time in recorded history. This built-up form of bow survived in Northern Europe till about 1460, although in France, Spain and Italy a superior crossbow, consisting of a thick steel bow and windlass, had already been in use for nearly one hundred years.

The composite bow was attached to its stock by means of a bridle made of sinews, acting as a spring buffer in lessening the jar to the stock caused by the rebound of the bow after a discharge; indeed, in crossbows now 300 years old, with sinew bridles, it has been found impossible in experiment to knock the bows from out the stocks, even by the use of a heavy hammer, without first cutting through the bridle, so firm and hard had the sinew become through the action of dryness and age.

The mechanism connected with the releasing catch, over which the bowstring was stretched in mediæval crossbows, consisted of a trigger, actuating a detent, a spring, a revolving nut and lock. In the earlier crossbows the lock-pins were riveted in by a hammer, but after the 15th century we find that steel screw pins with split heads were used for the purpose.

The next advance in construction is the use of steel bows, the ends of the bow being slightly canted up from the centre in order to relieve the grooved edge of the stock from being unduly pressed by the bowstring, thus lessening friction.

In order to draw the bowstring of a powerful steel bow to the nut or catch, a windlass or, as it was called later on in the 16th century by the French, a cranequin, was now introduced; this was detachable, fitting on to the stock. By the aid of two revolving windlass arms and a pulley the cord, or string, was gradually drawn back to the catch; this method supplanted the older one of drawing back the bowstring by hand or by means of a metal claw hanging from the belt surcingling the jerkin of the man-at-arms, who at the same time held an arrow bolt between his clenched teeth ready to place in the groove of the stock when his bow was bent with tautened bowstring up to the catch.

The arranging of the arrow bolt, or quarrel, as it was termed, had to be made with great care, so as to reduce friction to a minimum and secure accuracy of flight; the usual length of the bolt was 12½ inches, head 3 inches, the butt of the shaft being tapered, with flattened sides of elliptical section; the weight of the metal head was 1½ oz., shaft 1 oz., the head being of greater width than height, so as not to touch the groove of the stock when in flight. Great niceties of adjustment were required with regard to the position of the three feathers on the arrow shaft, the inclination of the head of bolt, and the position of the releasing nut's face, in order to secure uniformity of range and accuracy of aim.

In some cases the feathers were inserted spirally on the arrow bolt, whilst in other cases grooved flanges were cut longitudinally out of the shaft, taking the place of feathers, and were found to be very effective in causing the arrows to fly with greater accuracy and force.

By the first quarter of the 16th century barrels of metal, doubtless suggested by the hand-gun, or arquebus, were fixed to the stocks of the crossbows, the barrel having to be cut away to allow the bowstring to

slide along the stock. Crossbows fitted with barrels were termed slur-bows; they discharged bolts, and not bullets. Amongst the weapons stored in the armouries about that time are mentioned "fire arrows for slur-bows" and "slur-bow bolts."

The slur-bow was a weapon chiefly used for military purposes, its steel bow being bent by the cranequin, or improved winding apparatus.

By the end of the 15th century we find the mechanism of the crossbow exhibiting a considerable ingenuity of design. The windlass was fitted with cords wound round by movable pulleys; these pulleys had protecting guards to keep the pulley cords in position, and, although not differential pulleys, were capable of exerting a great strain in pulling back the bowstring to the nut or catch. Every working part had been elaborated—the bow, the winding, the arrow bolt and the bowstring; so much so that when, at the commencement of the 16th century, the sporting crossbow, a much lighter implement, jumped into favour everything was ready for further development.

Our neighbours, the French, were the first people to move in this direction, introducing the ratchet-winder cranequin as simpler and more portable than the mediæval windlass, no cords or pulleys being used. The underlying principle of this new winding apparatus was the same as that of the old-fashioned lifting jack as used in timber yards.

The pictures of these light sporting crossbows show them to have been lavishly decorated, at once stamping them as being the treasured property of sportsmen and not of the stern followers of Mars. These more modern weapons of the chase had two triggers, of which one was a safety trigger; the other, a short one, was protected by a guard similar to that of the modern fowling piece. A backsight with a notched cross-bar, when aligned with the upper edge of the head of the arrow bolt, gave the sportsman his aiming line. The bolt was laid on the stock without the customary groove, the head of the bolt being supported by a small ivory notch.

The sporting crossbow was preferred by sportsmen and foresters for more than a century after the hand-gun or arquebus had made its appearance, chiefly, no doubt, for the silence of the discharge and for the fact that, owing to the frequent misfires and inaccuracy of hits and the variable powder, the hand-gun was not at that time a reliable weapon.

The earlier hand-guns or arquebus were wont to suffer much from windage; the bullet wobbled and rattled loosely down the barrel, until it was found that by using a crossbow arrow bolt, minus the feathers, exactly fitting the bore, penetration and accuracy of aim were much improved. That this was so is amply proved by the chroniclers of old, who state that bolts fired by the arquebus hit the bulwarks of ships, and indeed pierced them from side to side.

The more powerful cranequin crossbow for killing large deer, boar and wolves was discarded for a still lighter form about 1625. This lighter form was regularly used by hunters of game-birds, chamois, roebuck, hares and rabbits until 1730. Many of these beautifully constructed light crossbows with cranequins may still be seen in Continental museums, being largely made for the use of the chief foresters and

keepers of royal domains so recently as the end of the first quarter of the 18th century.

But the desire to obtain a very light portable sporting crossbow soon led to the use of a very light arrow, which in Spain was of the poisoned variety, and which by merely penetrating the skin of a deer sufficed to kill.

A great Spanish hunter, Del Espinar, writing in 1644 quaintly describes its use:—"Both large and small game were readily killed by the weapon, except when on the wing or when offering a shot where rapid firing was required; in which case the arquebus or hand-gun made all easy for the would-be sportsman or common gunner." At that time all who were not of the truly finished sportsman type or "Crossbowmen" were termed "Hunters."

When speaking of those who were genuine exponents of the true art, "even if they be princes, it is usual to say 'the king is a great crossbowman'; hence much honour follows those who practice with the crossbow." He who earned this title had to be a general sportsman, acquainted with the habits and characteristics of all animals and game birds, and not a mere "Bird catcher" using snares, decoys, nets and other cunning devices. He who had an arquebus or hand-gun for killing large birds, rabbits or hares, or who used wire snares, was only a "Hunter." The term "Hunter" included also all those who "hunted partridges with a tame decoy bird or who laid snares of cord which they call 'Perchas.'"

They also who hunt at night with a dark lantern, which drives the birds into a net, are mere "Hunters." Those also are "Hunters" who use ferrets and nets and a pointer dog.

A picture by Olina of date 1622 is reproduced, showing *Le sport à la mode* in Spain. In it is depicted a grandee of Spain, accompanied by his wife, who is attired in classical garb, wearing a muff; the retainers are busily engaged attending to the *cuisine*; one of them is toasting larks, spitted on a revolving skewer worked by a windlass handle, over the licking flames of a field kitchen apparatus. In the vicinity is the state van, or family coach, drawn by six horses, with one postillion on the near hind. The "Crossbowman," who is arrayed in picture hat and plumes, shooting cape and knee breeches, is armed with a light stonebow. In the foreground in a rocky recess is spread out a sumptuous repast consisting of cakes or dough-nuts, in the midst of other dainties, embellished by the presence of two large carboys of wine. The surrounding trees are depicted as bristling with long spikes, impaling at their extremities diminutive birds, thrushes, larks and blackbirds, which have been caught by twigs smeared over with bird-lime, as carefully arranged for beforehand. The whole picture is representative of a style of luxurious shooting strikingly suggestive of a variety of modern sport under equally comfortable circumstances.

Another reproduction of a picture by the same artist illustrates a night attack on pigeons at roost, and their accompanying suite of smaller birds in attendance on the headquarter tree; four general sportsmen with crossbows are stealthily advancing from the four points of the compass; two huge bloodhounds or mastiffs, in an expectant attitude, are following at

their heels; whilst two retainers, armed with big night lanterns in their left hands, are projecting fixed beams on to the slumbering birds; abnormally long-handled square-headed bats with nets are carried in their right hands, with which the pigeons are to be enmeshed. Another retainer is sitting down replenishing the oil in a troublesome night lantern; an oval-headed racket bat with net is reclining at his side.

A reference to the sporting illustrations in Sir R. Payne-Gallwey's voluminous record would be incomplete without allusion to the quaint drawings illustrating the MS. of Gaston Phœbus, a great writer on the chase in the 12th century. These drawings are descriptive of the cross-bow shooting of the wild boar, the ibex and deer.

Stradanus, a Flemish historical painter, who delighted in portraying all kinds of sport, such as shooting, hunting, fishing and coursing, is also reproduced in most realistic fashion. One of his pictures depicts an attack on a rabbit warren by crossbowmen. Five sportsmen armed with crossbows and daggers are advancing through a wood on the warren, and are ensconced behind the friendly shelter afforded by the trunks of antient oaks; the rabbits are being evicted from their burrows by fire and smoke. Purse nets and stop nets close the main entrances to the burrows; three rough-haired bull-nosed terrier dogs are engaged pursuing and mauling retreating rabbits. Two attendants, one armed with a lance pointed at one end, are picking up and despatching the wounded. In the middle distance with head and ears erect, peering from out their crannies, are those rabbits not yet engaged, interested spectators who are anxiously awaiting the development of the attack.

These accurately delineated pictures enable the reader to enter into the spirit of sport as indulged in in the mediæval days, when no opportunity was apparently lost of using every means which stratagem or cunning could devise in order to secure the biggest bag obtainable. That very little compassion was shown to the hunted animal may be partly attributable to the fact that the crossbow was nearly useless against a moving or a vanishing target; but on the other hand birds and beasts had not learnt to be so wary as they afterwards became when confronted with the noise made by the discharge of the arquebus or hand-gun.

As an example of stratagem in sport of the 14th century one of the pictures illustrates the method adopted for killing partridges as they feed by means of a stalking horse, in reality a man disguised as a cow with a bell round his neck, who under cover of a blanket steals up to the unsuspecting prey; he is accompanied by the sportsman with crossbow and hunting knife, who cowers under the near flank of the cow, thus disarming all suspicion on the part of the unsuspecting birds.

Another picture, suggestive of unwary and misplaced confidence on the part of the animals of the time, reveals a doe and her attendant stag tamely advancing in review order to be killed; each is marked down as legitimate booty by two crossbowmen, whilst another sportsman craftily concealed in reserve, is tautening up his bowstring in case of need. Although the pictures all show that the sportsman did not waste his skill by attempting too much at long ranges, being desirous of utilizing to the full the fire potential of his weapon at decisive or short ranges only, still,

as is recorded by many an enthusiastic chronicler, the range capable of attainment, although always a varying quantity, was by no means a short one. Our gallant author, Sir Ralph Payne-Gallwey, has himself verified by personal experiment the ranges which mediæval crossbows can attain even after the lapse of so long a period of time as five centuries. Quoting from his results, it would appear that the range of a 15th century military crossbow with a thick steel bow, if elevated 45°, would average about 370 yards, the so-called point blank range about 65 yards. (It is noteworthy in this connection that very few of our crack modern archers are able to achieve a range of 300 yards). The average length of flight of the light sporting crossbow was about 350 yards but from the heavier military bow, weight 15½ lbs., a greater penetration and range was to be expected.

Although our ancestors were so supremely skilful with the longbow, it is doubtful whether the heavy-headed war arrow as used at Crécy or at Agincourt attained a greater distance than 250 yards, that is during the halcyon days of the longbow, when every jocund Englishman or callow youth, rich or poor, who could bend a bow was constant in his attendance at archery practice, voluntarily so, and if not by statutory power. But a range of 250 yards was found to be quite sufficient when put to the eminently practical test of stern warfare. Cool courage and accuracy of aim, coupled with rapidity of fire, were required and apparently obtained.

Nearly five centuries after Crécy our armies were fighting at Waterloo with the improved weapons of the day; but our author, in illustration of the slow progress in the improvement of arms, gives his deliberate opinion that:—"If a hundred marksmen armed with the Brown Bess (or Brown Arquebus) as used at Waterloo and 100 of the best archers at Crécy and Agincourt could be opposed to one another in line at 120 yards, the archers would gain an easy victory." He considers that the archers could discharge at least six arrows to every bullet fired by their foes, and that they would probably be more accurately aimed, and being barbed have greater effect.

Extra long ranges with the bow have however been shown to be possible with specially constructed implements unsuitable for war or even for target practice. The Turks excelled in these long-range practices, but they used a particular form of miniature flighting arrow for the purpose. In 1795, before the Toxophilite Society in London, the Secretary to the then Turkish Ambassador is said to have shot such an arrow a distance of 482 yards, but being out of practice at the time the shot was considered merely as a sample of what any Turk could do. These long-distance arrows were very light, made chiefly of bamboo with a light steel or ivory cap for a head; a little piece of hard wood formed the notch, the feathers being formed of two strips of thin paper, varnished, to keep them hard and upright. To the wrist of the archer's bow arm was buckled a flat strip of grooved horn to hold the head of the arrow; by this means the archer turned himself into a gigantic animated crossbow; drawing the arrow head full stretch a considerable distance back beyond the bow head, he attained an immense range thereby.

The Ottoman emperors were expert both in the theory and practice of

archery. Every emperor was supposed by tradition to be the master of some manual trade, and indeed to be capable of earning his living in that way. Many of them, instead of learning an art or profession, preferred to devote themselves to the art of making bows and arrows, with which they afterwards performed prodigies in shooting. Some of their records are carved deep on the columns in the Place of Arrows in the suburbs of Constantinople. Amongst the record flights are those of Pashaw Oglee Mehmed, 762 yards; the grand admiral, Hussein Pashaw, 764 yards carry; but against these triumphs is the record of the reigning emperor, Sultan Selim, who shot two arrows in succession into the air, the arrows lodging in the ground at the extreme distance of 838 yards and thus beating all subordinate records.

One late development of the crossbow, sometimes to be met with in the gun-rooms of old country houses near rookeries, is the weapon known as the bullet-shooting crossbow, popular about the years 1800—1840. It was a more powerful edition of the 16th century stonebow, was intended to kill rooks and rabbits, and was contemporary with the improved air gun with a hollow stock that superseded the air gun, invented in 1560 by Guter of Nuremberg, which held the compressed air in a metal ball below its barrel.

After the introduction of rook rifles about 1840 the old-fashioned bullet crossbows and air guns were laid aside for serious work, except for poachers' use for killing pheasants at roost, the discharge being a silent one. One German regiment of infantry was still armed with Guter's air gun at the commencement of the 18th century.

The enclyclopædian treatise which Sir Ralph Payne-Gallwey presents to his country takes us along with it away down the years from the time of Archimedes to Waterloo. Many of the changes it describes strike us of being of very slow growth, and of not so revolutionary a character as might have been expected even after the discovery of the new propellant in the form of gunpowder. It took quite a few years to replace the crossbow and pike by the rifle and bayonet, many of the old-time methods having been curiously re-invented at different times in the course of our national history.

The modern re-arming of cavalry with a shooting weapon in addition to their personal body weapon would appear to be but a retroversion to the tactics pursued by the Spanish mounted crossbowmen of the 14th century, the long sword and the dagger being mere adjuncts of the crossbow or shooting weapon. Shock tactics and the use of *l'arme blanche* were not the exclusive *rôle* of the Spanish mounted crossbowmen as they were of the Roman mounted scouts before them, who invaded Caledonia in A.D. 149 and who carried no shooting weapon. Archimedes, by employing original mechanical devices during the siege of Syracuse, gave a fresh impetus to the value of secret weapons, but these secrets, probably owing to their simplicity, did not remain for long the sole property of the Greeks. After the discovery of gunpowder the English people were apathetically slow in discarding their cherished longbow, until forced to do so by the unrelenting progress of events.

Repeating or magazine weapons, although used by the Chinese from

time immemorial, were not required by this country until quite a recent date. And why should it be otherwise in the case of an insular nation accustomed for ages to rely on its bulwarks of ships, and on the manliness of character and endurance of its inhabitants, in the absence of any striking development in secret weapons on the part of their probable adversaries? The various improvements both in the engine, the propellant, and the projectile have been very gradually evolved during the period dealt with in the great work under review. But what is so ineffably pleasing and instructive in the reflections conveyed to the mind of the reader by a careful study of Sir R. Payne-Gallwey's work is that, the part which the military mechanical engineer has played in the evolution of weapons has been mainly responsible for all those improved and any secret weapons which we may now possess; and that the first great advance was initiated by that grand old mechanical engineer, Archimedes, during the siege of a fortress, an operation which may in the future demand the concentrated strength of the greater part of the engineer force, and which will most assuredly give full scope and occupation for all the mechanical talent and ingenuity which may be possessed by the members of the various branches of our versatile corps.

O. E. RUCK.

NOTICES OF MAGAZINES.

Kriegstechnische Zeitung.

Year VII.—No. 1.

The Technical Military Academy.—Opened on 1st October, 1903, for the dissemination of technical knowledge in the Army. Officers of the Communication Troops and of the Departments of the Army, as well as those who wish to prepare themselves for transfer to the Engineer Corps, are to be given such opportunities, as Military exigencies will permit, to receive instruction of a theoretical and technical nature.

Hitherto it has only been officers of Pioneers who were able to prepare themselves for the Engineer Corps by studying at the Artillery and Engineer School, but now every officer can have a chance of preparing himself for transfer to the Engineers in the New Academy.

The School of Engineering now only exists in name, for although Pioneer officers are able to put in a 12-months' course there, Engineer officers are not fully trained there. The Engineer Corps is now in a transition stage, and its completion and organization are still in the womb of the future.

The Academy is under the Inspector-General of Military Education and Instruction; the Inspector-General is the official Chief of the Academy, which is in communication with all other heads of technical branches and arms of the service, so that the training may be carried out in harmony with their respective requirements. On the other hand the War Academy, which, in many respects, is similar to the one under review, is under the Chief of the General Staff of the Army.

The Director of the T.M. Academy holds the rank of Brigadier-General. He commands the Academy in all respects. Associated with him is a staff officer as Assistant Director, who carries out the discipline and interior economy according to the Director's orders. Under him come the officers attending the courses and certain rank and file, with regard to whom he has the same powers of punishment as a battalion commander in garrison.

The Instructional establishment consists of military and civilian instructors, supplemented by honorary instructors paid from the Academy funds.

To help the Director in the arrangement of courses there is a Commission of Studies, presided over by him, consisting of staff officers or captains of (*a*) The General Staff, (*b*) Engineer Corps, (*c*) Communication troops, (*d*) Military Artificers, (*e*) Commission of Inspection of

Arms, (*f*) Artillery Experimental Commission. With these are associated several experts whose number varies with circumstances.

This Commission settles the programme of studies for the year, and tells off the instructors to their respective classes. It also arranges for certain specified instructors to issue the papers for the entrance examination.

For the present the test only consists of mathematics and physics. The Inspector-General will determine how long this is to continue. The papers are done by the officers in their garrisons, three of mathematics and two of physics, of which at least two and one respectively must be done, two hours being allowed for each. On conclusion the examinee has to sign a certificate that he has done his paper without anybody's assistance. Books may be used for reference, but their names must be reported.

The Commission of Studies has to mark these papers. It has also to settle the scope of intermediate examinations, check the syllabus of subjects, set the papers for the final examinations of each year, and look after scientific compilations.

The military members of the Commission have besides to be present at certain branches of the instruction, specified by the Director, to take note of the talents and capacity of the students; they have also to be present at the examinations.

The Academy course comprises three terms in three years, from 1st October to 30th September. The 3rd term concludes the course for the 3rd termers, and also for those of the 2nd and 1st terms who are not considered fit for further instruction. Fifty officers at most are told off to the 1st term and these pass on according to their merits to the 2nd and 3rd terms.

The students are Lieutenants or First Lieutenants, with a minimum of 3 years and a maximum, as a rule, of 9 years service. Besides possessing the qualifications tested by examination, with a disposition and talent for learning and technical knowledge, they should have distinguished themselves in some manner with their units, have obtained a character for solidity and good education, be financially unembarrassed, and pass the doctor.

Foreign officers are not admitted.

Individual officers and military Medical officers may be permitted, on application by their C.O.'s, to attend lectures and demonstrations in the laboratories. The advantages of this are obvious.

A narrow military training is avoided since some of the lectures are delivered at the technical High School of Berlin. To illustrate the lectures personal visits are made to workshops and factories; and it is hoped that the large works of private industry will not be left out, so that branches of science not dealt with in Military Establishments may be studied.

In the interval between the terms the officers of the 1st and 2nd terms are generally sent to a unit of some other arm than their own, or occasionally to Technical Institutes. This part of the order appears to require some modification, for it is to be hoped that officers training for

the Engineer Corps may be sent to some fortification or other new work, and those for Communication Troops to railways, telegraphs, etc.

The duration of these recesses is settled by the Director. The theoretical studies for all three terms closes on 30th June. The 1st termers now go on detachment to the Artillery or Infantry as the case may be. The 2nd termers do practical reconnaissance till 21st July and then go to duty with a Cavalry or Infantry regiment as the case may be. The 3rd termers begin their final training journey (which I take to be a sort of Staff Ride) which ends on 21st July. For these duties the officers receive travelling expenses going and returning, so long as they go to an unit of their own Army Corps; if they wish to go to another Army Corps they must forego this allowance; the reason for this is not clear. Throughout their course they also receive extra pay of 36 marks per mensem, a privilege, so the author says, not extended to the students of the War Academy for some unaccountable reason.

At the conclusion of their course, the officers are granted a Leaving Certificate which specifies their attainments. In certain cases it is stated whether an officer should be sent to a Technical Institute, Inspection of Arms or Artillery Experimental Commission, or whether he appears suitable for the Instructional Staff. Especial merit leads to special consideration of the individual or even to recognition by the highest power in the Annual Gazette.

No reports on the merits of officers are sent by the Director to the C.O.'s of units before the completion of the 3rd term, so that special consideration may be avoided.

Leave during the course is only granted under pressing circumstances by the Director or Inspector-General. Applications for leave, which, if granted, would interfere with the applicants being attached to another Arm or Institute are only permissible under very special circumstances.

Disciplinary measures are exercised in the first instance through the Commandant of Berlin. Appeals are dealt with by the Governor of Berlin.

In questions regarding honour the officers are under the jurisdiction of their own units; all the same, a Court of Honour has been formed in the Academy to which officers can refer without the necessity of recourse to Corps in Berlin garrison.

On 1st November of each year the Director lays before the Inspector-General an opening report for the year just beginning and a yearly report for the year just concluded. The last must be so conceived as to be presentable to the highest power.

The 1st and 2nd Classes of the Academy are each divided into 3 sections, viz., Arms, Engineering and Communications. In the 3rd Class, from the Arms section are formed two sub-sections, viz., Construction and Ballistics, so that the 3rd Class is divided into 4 sections.

In addition to the lectures which are obligatory, voluntary classes for French, English and Russian are formed, provided the numbers for a class are made up. Once begun they must be gone through.

Instruction in purely scientific and technical branches is imparted by teachers of the High School and when possible at the High School itself.

In the 1st Class all three sections are taught mathematics, mechanics, physics and the rudiments of experimental chemistry. In the Arms Section are taught the knowledge of arms, ballistics and drawing of details of construction of arms.

In Engineering comes the technical details of fort building, drawing of fortifications and knowledge of weapons. In Communications come bridge construction theory and working drawings.

The following subjects are dealt with subsequently in the 2nd and 3rd Classes, viz. :—Thermodynamics, electrodynamics, military technical chemistry, ballistics, elements of machine design, metallurgy and iron-founding, estimating, the art of fortification, tactics in the field, machinery, railway traction, use of railways in war, principles of campaigning, armour-plating, strength of materials, photography, explosives, communications in war, fortress warfare, railway traffic management, telegraphy, telephony, gas engines, automobiles, theory of airships.

The author concludes by expressing a pious hope that, when they have absorbed all this knowledge, the officers concerned will have reached a pinnacle of technical knowledge worthy of an army so important as that of Germany.

THE SIBERIAN RAILWAY AT THE OPENING OF THE RUSSO-JAPANESE WAR (*conclusion*).—This was built at the cost of the Russo-Chinese bank, under whose control it remains in a measure.

The work had to be pushed on as quickly as possible to bring up material for the 1,100-k.m. stretch in Western Manchuria, which is almost destitute of timber, and again for portions in Eastern Manchuria towards Ussuriland, where for hundreds of kilomètres no building stone is to be found. Moreover, it was necessary to bring labour from Chifu and Tientsin, etc., and to furnish supplies in this almost desert country.

When the disturbances arose in 1900 it would have been impossible to forward and victual the troops without a continuous line of rails of some sort. So all obstacles were run round, temporary wooden bridges put up, and diversions laid that admitted of earthworks being deferred. Meanwhile the formation level was being carried out according to design, and as it advanced the rails were laid in the proper manner and were used to supplement the rough line. Where hills had to be crossed, winding inclines were put up to begin with. The maximum incline was put up at $1\frac{1}{2}$ per cent. on the straight. As a rule, curves were never sharper than 425 m. radius, though there are exceptional ones of 256 m. On the flat, maxima and minima are represented by ·8 per cent. and ·6 per cent. for a length of 640 m.

As works of art are to be mentioned 14 bridges over 200 m. long and those over 640 m. long crossing the Nonni, the Ssungari (2) and the Hung-ho. The Ssungari bridge at Charbin (950 m.) is 60 m. longer than the Jenissei bridge, and is only exceeded in length in Russia by those over the Volga and Amu Darya. Drainage openings are set at 9 m. per kilomètre. All the large bridges have masonry piers and abutments and iron superstructure.

The Chingan mountain tunnel, 4 k.m. long, is worthy of mention. While it was being pierced a 20-k.m. diversion, with heavy gradients and two reversing stations, was opened and worked. The tunnel has now been in use for some time. The finished embankment is well made; it is 5·55 m. in the crown, well above flood level and the sides well sloped. The permanent way is of rails 33·2 k.g. to the metre and well ballasted (nature of sleepers not mentioned).

There are no difficulties about water. There are plenty of pumps where gravitation supply has not been completed. The machine shops and repairing shops are on a permanent footing.

Dwelling houses, churches, schools, libraries and hospitals have been liberally provided. Apart from the offices and other public buildings, 48,230 sq. m. of dwellings = 191 sq. m. per kilomètre, had to be provided, of which the greater part are for railway officials. These work out at about $\frac{1}{3}$ the usual allowance for Russian railways, but they are declared to suffice for the requirements of the case. These buildings had to be put up of anything that came handy at first—clay, wood, earth, and such like, and many of these are still in use. The new buildings are mostly of freestone or brick; timber and frame houses in wooded districts.

Whatever may be said against this railway, it at any rate had the same carrying capacity as the Trans-Baikal line at the beginning of the war. The trains are of 44 wagons. The wagon park, which was very defective last year (1902), has been increased by many newly purchased engines and carriages of the very best description for working in the excessive heat of summer and bitter cold of winter. The carriages turned out by the Rigaer wagon works are highly spoken of. Altogether the Manchuria railway is not to be despised, and its rapid construction reflects great credit on Russian enterprise, considering that it was completed in time of war; and on account of the uncertainty of the political situation it has remained throughout on a war footing.

The Russian line of communications from Moscow works out at about 8,500 k.m., thus:—

	K.M.
Moscow to Tschelfabinsk	2,200
West and Middle (officially East) Siberian section up to Lake Baikal	3,320
Circum-Baikal line	260
Trans-Baikal line from Myssowaja to Kaidalowo, and from there to the Chinese border (station Mandshurija)	1,200
Manchuria Railway from the border to Mukden, about	1,480
	8,460

The Siberian railways are State Railways, and the Manchurian line, as an undertaking of the Russo-Chinese Bank through the Finance Minister, is directly dependent on the State.

Nevertheless, the chain of responsibility is complicated enough, and the following will show that this is not without influence on the working of the whole line.

The Ministry of Communications, Finance Ministry and Controller General of the Empire are all interested in railways. While the last mentioned has to oversee the projects, the Finance has an influential voice in voting the funds, and in the case of the Manchurian railway has had to mix itself up in decisions that trench on the duties of the Communications Ministry. The last, again, is the highest executive organ for construction and management, and is to a certain extent subordinated to the Standing Committee for Siberian Railways, which has been working for the last ten years under the Emperor as president.

The local management of the lines (West and East Siberian and Trans-Baikal) is under the General Manager, who is supported by a standing Council composed of representatives from the three ministerial districts concerned and his departmental Chief. In the Great General Staff at St. Petersburg the 1st section, the "Management of Military Communications," is concerned with the study of communications in general, railways in particular, and waterways of the Empire, the organization of transport in peace, and certain personal and managerial matters.

Meanwhile the 2nd section, "Mobilization," deals with mobilization transport, war and mobilization traffic, management of the railways, organization of *étappen* management, post and telegraph services in the theatre of war, preparations for the disposal of sick, wounded and prisoners, and finally the arrangement of hospital trains.

In military districts there are railway staff officers subordinate to the Director of Military Communications.

Moreover, the special needs of the war have called into being a working "Committee for the organization of railway transport to the Far East," under the Chief of Military Communications in the Great General Staff. Its duties consist in co-ordinating all war railway transport to Siberia and the Far East, including the Red Cross Society private institutes and persons; also in taking measures to secure and maintain an unbroken traffic to the Far East, and to ensure its safety and punctuality. The decrees of the Committee are binding, but must be carried out through the agency of the Ministers concerned.

In addition to all this, conformably to the recent general order on the organization of the Army in the field, there is a special section of the General Staff of the Commander-in-Chief in the field which deals with the general scheme of communications by rail and river. These are the Trans-Baikal and Manchurian railways (except the portion Charbin-Pogrunitschnaja), and the rivers Schelka, Amur and Ssungari. It is only the extreme length of the line of communications that prevents the influence of this section of the local staff from reaching as far as the European border, added to the circumstance that the Circum-Baikal, Trans-Baikal and uncompleted portions of the Siberian railway demand the intervention of the Minister of Communications, so that in a measure a compromise between peace and war working has proved itself necessary.

For protection of the line it has been found necessary to put the whole, as far back as the Ural Mountains, under martial law. The measure is justified by the fact that Chinese and Japanese workmen have engaged themselves in the railway works, and, as many detected cases of foul play testify, are capable of undertaking all sorts of mischief. The inhabitants of the country along the line are held responsible for its safety. The portion on the other side of Lake Baikal, in which the bridges and other works of art are numerous, demands extra special supervision by the military. As a means of protecting the line, the remarkable proposition for the troops to get out of one train and march along the line till the next coming train could be emptied and pick them up is an example of what extraordinary fancies can be evolved by the brains of civilian strategists.

Even in peace time the Manchuria section demanded careful watching by troops, to protect it against the raids of the Chunchuses. The Border Guard, which consists of 55 sotnias, 55 companies and 6 batteries, total 25,000 men, has nothing really to do with the border, but is distributed over various fortified posts and patrols the line. Besides these there are detachments 60 versts distant on either side of the line, and these are in constant conflict with the Chunchuses. That the Border Guard will be able eventually to take on this duty is a matter of doubt, for the Chunchuses, it appears, have been organized by Japanese officers for cutting communications.

The Chinese authorities have issued stringent regulations forbidding the carrying of arms by unauthorized persons and urging instant co-operation of the inhabitants with the Border Guard.

The employment of Chinese on the line is forbidden, and civilians are only admitted under careful supervision; moreover the opening of windows on bridges and in tunnels is forbidden under threat of severe punishment. So far serious damage has been prevented, and even the attempts of patrols of disguised Japanese frustrated. The only serious loss was the burning of 850 tons of coal and 88,000 c. metres of wood in April and May.

The *personnel*, which was quite insufficient for increased working, has been supplemented by men from the South-West railways and Orenburg-Taschkent line. In the theatre of war the Trans-Amur Railway Brigade of 4 battalions is at work on the line.

The traffic was 4 military and 2 other trains daily. The rolling stock has since been augmented from the reserve of the Government, and some 200 locomotives have been transferred from other lines.

One of the difficulties to be met was the cleaning of the wagons and carriages; so halts are made after 3 to 4 days' journey for 1 day, the troops are turned out, and the trains cleaned. Some of the halting places, notably those in European Russia, are not well provided with accommodation, which takes the form of old market stalls, a few special buildings and lined buildings of sorts. Across the border in Asiatic Russia the stations Ob, Krasno-jarsk and Inokentjewskaja are provided with new double-storied barracks, the first two each for 500 men, the last for 4,000 men, besides stabling. Each story has lavatories and baths, with water

laid on, and kitchens, etc. There are also disinfecting establishments. The officers are provided with quarters and mess room. Although the trains are cleaned thoroughly during the halts, nothing of the sort can be done for the barracks, and latest reports describe these as in a filthy state.

The supply arrangements provide for a warm meal to all hands once in 24 hours. Each supply station has cooking appliances for 1,000 or 2,000 men, and dining halls for 500, and the necessary accommodation for *personnel*. Some even have bakeries. The troops can also draw their rations raw and cook them in their travelling kitchens.

It is calculated that under favourable circumstances the number of trains run has been :—

From 1/14 February to 1/14 May 4 military trains daily, and from the latter date this has been increased to 6.

Out of the 4 trains for the 100 "train" days before 1/14 May probably 2 and at least 1 daily has been for war material and supplies.

Judging by the fact that the halting points only provided for 500 men daily, it may be concluded that the 35 wagons per train have not been fully utilized. However, from the figures above we deduce that the trains run have been something between 246 as a minimum and 346 as a maximum ; and these at 500 men per day put the reinforcements delivered at the front between 125,000 and 175,000 men.

As regards speed, authorities are at variance. But assuming 20 k.m. per hour as far as Lake Baikal and 15 for the remainder of the line, we get :—

To Lake Baikal $\frac{5500}{20 \cdot 24} = 11\frac{1}{2} + 3$ rest days	$= 14\frac{1}{2}$ days.
Crossing the lake	$\frac{1}{2}$
Lake Baikal to Mukden $\frac{2680}{15 \cdot 24} = 7\frac{1}{2} + 1$	$= 8\frac{1}{2}$
	$23\frac{1}{2}$

If we put this at 30 days from Moscow to the front we shall be not far wrong.

The rest of the article comprises calculations as to what troops were present with General Kuropatkin in July and up to the date of the article (not given).

The author concludes that this report will convince the readers of the want of veracity of the American and English reports, which very much understate the capacity of the line. But it is the slowness of the arrival of reinforcements and the fact that the capacity of the line is now stretched to its utmost elastic limit that most probably contribute to the passive attitude adopted by General Kuropatkin.

Year VIII.—No 1.

"LIGHT TELEPHONY" AND ITS USE FOR MILITARY PURPOSES.—By Oberleutnant Von Hoffschlaeger, 4th Engineer Inspection.—With 12 plates.—Proposes the use of wireless telephones to supplement or replace wireless telegraphs in the field.

Briefly, the author proposes to reproduce the inflections of the voice in an arc light and to transmit these by means of an ordinary parabolic projector to the receiving station. This latter consists of a similar projector with a selenium cell fixed in its focus. The selenium is acted on by the variations in the intensity of the rays from the transmitter, and so undergoes variations in conductivity that are reproduced in a telephone connected up with it.

ARTS AND TRADES AT THE SERVICE OF THE RUSSIAN WAR OFFICE.—By Captain von Toepfer, Instructor in the War School, Dantzig.—Industry is only prepared to produce in war what she has been accustomed to do in peace. It is only a highly developed industry that, in a military technical sense, can render a country independent and ensure it against the hostile efforts of a country more advanced in its industrial development. Contemplating Russia from this standpoint, we must confess she has made enormous strides in the last few years.

She is almost independent of foreign sources in steel work, *e.g.*, guns, projectiles, armour plates, etc. To Professor D. K. Tschornoff is due much credit for his experiments and discoveries in tempering steels; and when Krupp's armour-plating secret was purchased, it was found to be no secret, but a process based on the identical principles enunciated by the Professor for gun making in the Obuchoff Factory.

Since the Harvey process was discovered the Russians have succeeded in hardening plates to resist Lyddite shells, as proved by the war in progress. They have now purchased the process for producing double curved steel plates, so that ere long foreign orders will cease to be necessary. So all steel work, with the exception of the plates which the Ishora and Obuchoff Works are unable to undertake, is from Russian sources.

The building of ironclads is not up to the standard required, so that many new ships must come from abroad. The Admiralty, Baltic and Nikolaus Works can undertake liners and cruisers. The Newa Works build protected cruisers, the Admiralty, Baltic, Newa, Putiloff and Crayton can manage torpedo boats, and ships' fittings come from the Baltic and Franco-Russian Works.

Guns of all classes, except the revolver cannon from England (probably "Colt" guns), are home products. The Obuchoff Works turn out the ships' guns of heavy and medium calibre; the remainder come from Perm. The Government Factory in St. Petersburg produces castings, and the mounting of the three-inch (76 m.m.) guns is going on at Putiloff Factory.

The remainder of the article is best reproduced in the form of a catalogue.

Briansk.—Projectiles, large calibre; carriages, limbers, wheels, harness and fittings.

Isheff.—Sword steel, barrels, axles, naves, rifles, instrument steel.

Ishora.—Metal cartridges, sea service.

Kasan.—Smokeless powder, S.S.

Kijeff.—Carriages, limbers, wheels, harness and fittings.

Lugansk.—Cartridges, S.A., sulphuric and nitric acids, and æther.

Obuchoff.—Projectiles, large calibre; gun carriages and mountings, S.S.

Ochta.—Percussion caps, smokeless powder, S.S.; melinite, sulphuric and nitric acids and æther.

"Open Market."—Projectiles, small calibre; L.S. carriages, limbers, harness wheels and fittings; gun mountings, S.S.; metal cartridges, L. and S.S.

Perm.—Projectiles, large calibre and L.S.

St. Petersburg.—Projectiles, large calibre; carriages, limbers, wheels, harness, fittings, cartridges, S.A.; brass and "maillechort."

Putiloff.—Projectiles, large calibre.

Schastka.—Smokeless powder, S.S.; sulphuric and nitric acids, and æther.

Schusselburg.—Smokeless powder, S.S.

Slatoust.—Projectiles, L.S., and *armes blanches.*

Ssjestrorjäzk.—Lances, rifles.

Tula.—Rifles and revolvers, cartridge cases, S.S.

Matériel for technical troops, railway gear, engines, bridges, fortification work, pontoon and trestle wagons, and telegraphs are all home products. Telephones are imported; so are, with a few exceptions, all the elements of ballooning. Electrotechnic is not up to the mark, so that much apparatus has to be imported. The same remark applies to instruments of precision. Besides the above, large quantities of coal for the fleet, lead, copper, tin, zinc, and medical and surgical appliances have to be brought from abroad.

Great efforts are being made to push the use of petroleum on warships, and the Dresel motor is being utilized by the Nobel firm for generating electrical power, so that the large supplies of petroleum at command of the Empire may be adequately utilized.

ELECTRIC MOVING TARGETS.—With 3 plates.—Describes the apparatus now in course of adoption for moving targets. A complete train consists of:—

2 Fowler traction engines, complete with dynamos, 1,250 rev, 230 v., 10 kilowatt.

2 battery wagons, each of 60 elements of 75 ampère hours.

2 drum wagons and cables, each of 5 drums, holding 2,500 m. of 5-mm. diam. steel rope.

1 water cart.

The whole train is taken in tow by one of the traction engines.

The train can be either assembled or arranged in two groups for working one large set of targets or two smaller sets.

One drum wagon can deliver either 4 Infantry targets, "Quick" or "Double," or 2 Cavalry targets at "Gallop." If the Cavalry are required to go faster than 400 m. to the minute, the dynamo must be switched on to help the accumulators. If 4 Cavalry targets are wanted from 1 drum wagon, you turn on both batteries and switch in one dynamo if necessary.

The author does not describe the targets.

THE MIKROPHOTOSCOPE, THE NEW GENERAL STAFF MAP MAGNIFIER.—An ingenious little instrument with eyepiece and lens, 13½ linear, in which is inserted a reduction of the map required on a scale of 1:100,000 in an area of 4 to 5 centimètres square (say 2″×2″). The eyepiece is movable and commands a field of about 175 square kilomètres. For night work an electric glow lamp is provided. The secret lies in the "diapositive" reproduction of the maps, for which a special secret emulsion is requisite. The whole thing is carried in a portable case, said to measure in all 8 c.c.m. (?). Anyhow, it is very portable, and seems worthy of trial. Apparatus complete with spare battery and 6 diapositive maps 25 marks (25s.); each new diapositive 90 pfg. (about 10½d.), each new battery 30 pfg. (say 4d.).

A certain amount of practice is required in using the lens, which must be accurately focused. Spectacles, eyeglasses, etc., should be removed, and the author recommends the owner never to lend his instrument once he has got it to suit him. To be obtained from Herr Dr. Otto H. F. Vollbehr Halensee, Berlin, 130, Kurfürstendamm.

J. A. FERRIER.

NATURE.

MOUNT EVEREST.—In 1848 trigonometrical surveyors commenced to build a line of survey stations along the plains of Oudh and Bengal, and to determine the position of these stations in latitude and longitude. Sir George Everest had intended to carry the series among the mountains, but abandoned his design in consequence of the refusal of the Nepalese Government to allow the surveyors to enter their territories. At almost every station the snow peaks of Nepal were visible, and Sir Andrew Waugh ordered that the true direction of every visible peak and the angular elevation of every summit above the horizon should be determined from every observing station.

From the observed angle of elevation and from the calculated distance of the peak from each station the height of the peak was deduced. If the several values of height were accordant, the identification of the peak was accepted.

Numerous peaks were found to have been observed only once or twice, and could not be identified; but in 1852 the chief computer found that a peak designated as XV., which had been observed from six different stations, had been found to be higher than any other peak in the world, though on no occasion had the observer suspected that he was viewing through his telescope the highest point of the earth. The mean height of the six observations was 29,002·3 feet; and so accurately had the angles of elevation been taken, at an average distance of 111 miles, that the minimum divergence from the mean was only 12 feet and the maximum 24. When the possible errors due to refraction, changes in temperature and atmospheric pressure, and personal equation are considered, the accuracy of the result is extraordinary.

Sir Andrew Waugh had always adhered to the rule of assigning to

every geographical object its true local or native name, but here was a mountain, the highest in the world, without any known name. He determined, therefore, to call it Mount Everest, after Sir George Everest, his former chief, the great Indian geodesist. Mr. Hodgson, however, who had been political officer in Nepal, said that Sir Andrew Waugh had been mistaken, and that the mountain had a local name, viz., Devadhunga All subsequent information goes to show that there is no *peak* in Nepal called Devadhunga, which is merely a mythological term for the whole snowy range, and in 1854 Schlazenweit saw the mountain so called by Mr. Hodgson, identified it as Mount Everest, and certified that the local name of the peak was Gaurisankar, and not as stated by Mr. Hodgson.

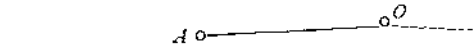
In 1903 Capt. Wood visited Kanka by order of Lord Curzon, and found that Gaurisankar and Everest were different peaks 36 miles apart, and that Everest, the highest of the two by 5,562 feet, was not a conspicuous peak, being almost obscured from view by intervening ranges. Everest and Gaurisankar are separated by a wide interval and a deep valley, and are not spires of a single pile; the latter is remarkable in Nepal for the pre-eminence of its grandeur, the former, screened from the gaze of man, is known only as the highest point of the earth.

After fifty years of discussion the Hindu and Nepalese names have been proved to be inapplicable by Captain Wood, an experienced British surveyor, equipped with instruments and with full permission to use them; and it is to be hoped that Continental geographers, who have hitherto attached the name of Gaurisankar to the famous peak that we call Everest, will, in the interests of scientific harmony, now accept the name that has always been accepted in India, and suffer the English name to rest on our maps in peace.

THE RECENT DEVELOPMENT OF PHYSICAL SCIENCE.—By Whetham.—The author has sought to express the results of recent physical science investigations in a form which might prove useful to students of science in general, and "also appeal to those who, with little definite scientific training, are interested in the more important conclusions of scientific thought." Foremost among these problems must be placed the structure of matter, the mutation of energy, and the nature of comets and nebulæ. Suggestions have recently been made by Lord Kelvin and Professor J. J. Thompson that the internal motion of the atom, be it that of a vortex ring or of a moving electron, may perhaps be drawn upon to supply the energy that is liberated from the hidden storehouse by the radio-active element. Mr. Whetham devotes two chapters to the liquefaction of gases and the phenomena of fusion and solidification. He shows that even a brittle, metal-like antimony can be made at ordinary temperatures to flow like a liquid.

The final chapter contains an account of the more recent results of spectroscopic investigations of the sun and stars. The pressure due to radiation is considered and applied to the explanation of the curious phenomena of comets' tails, whilst the mutual repulsion of radiating particles is suggested as a possible explanation of the permanence of Saturn's rings.

MATHEMATICS OF BILLIARDS.—Mr. Hemming, K.C., in his treatise on this subject, discusses the comparative advantages of fine and through strokes, with regard to the margin of error permissible in the respective cases.



If A is the player's ball, O the object ball, then the stroke is to make A, after striking O, pass within a distance of the point P, depending on the nature of the stroke, namely, for a cannon a distance equal to the diameter of a ball, for a losing hazard the necessary distance from the centre of the pocket. Mr. Hemming calls the angle AOP, $\pi - \Delta$, and finds that the margin of error is the same for the through as for the fine stroke when $\sin \Delta = 0.320$. For smaller values of Δ the through stroke has the advantage, for larger values of Δ the fine stroke until a certain maximum is reached.

W. E. WARRAND.

REVUE D'ARTILLERIE.

October—December, 1904.

WIRE-DRAWN STEEL INGOTS.—Said to be an improvement on Whitworth's compressed steel, and to possess many advantages as regards the quality of steel turned out, reduction of waste and cheapness of working, owing to diminution of the forging required. The process is known as the Procédé Harmet. The article is fairly long and is illustrated by several plates. A certain knowledge of the subject is requisite for its comprehension.

NOTE ON RANGE-FINDERS.—An interesting study of the subject, which lucidly explains the difficulties encountered in designing an instrument sufficiently simple to be of use in the field of battle. The guiding principles of the generality of range-finders are described, and calculations given shewing their limits of error. The article is summarized in a short essay debating the actual value of range-finders in the field, and the conclusion arrived at is that they seldom can be used, although the author admits that well-trained infantry who shoot well feel a necessity for a range-finder, while well-trained gunners can very well dispense with it.

The Germans stick to the "Minostatic" range-finder, of which there are many patterns—Gautier, Le Cyre, Christie (Greenwich Observatory), Souchier,—but something much simpler and less costly is required. Full value can only be reaped from such instruments by having plenty of them and making a practice at every halt, whether in peace or in war, of each squad taking the range of noticeable points, so that every soldier when the fight begins may have one or more approximate ranges fixed in his mind. Put thus, the problem does not appear insoluble, but the men concerned are the best qualified to pass a sound judgment on an instrument of this nature. There is one criterion that never fails. If the men make use of an instrument of their own accord, well and good. If they have to be ordered to use it, most probably it will prove a failure.

January, 1905.

A RUSSIAN MACHINE-GUN COMPANY AT THE BATTLE OF LIAO-YANG.—A letter from the officer in command, who begins by complaining that nobody seems to know or to understand what machine guns are for. The description of his experiences is graphic and confirms, by practice, a good number of the theories propounded as to the conditions under which machine-gun units can be used or abused.

He comes under artillery fire to begin with and finds himself paralysed, as far as useful action is concerned, for 15 hours. He is then sent off to a flank at night and takes up a position under cover on the edge of a village. Here he is able to be of some use, and catches a mountain battery in column of route at 1,200 paces and wipes it out.

Then after two hours' quiet he gets bothered by sharpshooters; these he clears out, with the result that an organized attack of skirmishers is directed on his village. This he is able to keep at bay, thanks to the millet having been cut in front of him.

But night is the dangerous time for machine guns, which are then powerless, and at dawn the snipers have come too close for him to be able to clear them out with the machine guns, for the exposure of a hand was enough to bring down a hail of bullets. So these snipers, some 25, had to be cleared out with the bayonet, and so on.

The conclusions drawn are:—

(i.). Impossible to face artillery in action.

(ii.). At about 1,000 m. troops on the line of march can almost be wiped out, provided progressive (*i.e.*, increasing elevations) and sweeping fire be adopted.

(iii.). Beyond 700 m. machine guns have displayed superiority over skirmishers.

(iv.). Beyond 2,000 m. fire should not be attempted.

There are 8 Maxim guns, 7·6 m.m., 5 officers, 90 N.C.O.'s and men, 56 horses, in a Russian machine-gun company.

J. A. FERRIER.

REVUE MILITAIRE DES ARMÉES ÉTRANGÈRES.

November, 1904.

MILITARY BALLOONS AT PORT ARTHUR.—The balloon equipment despatched to Port Arthur was captured by the Japanese on board the steamer *Mandchouria*, which they seized during the first few days after the opening of hostilities; and it was impossible to replace it before communications were cut off.

Nevertheless, Lieut. Lavrov, who had been through the course of instruction at the Balloon Depôt and was appointed to command the balloon detachment detailed for the fortress, had arrived during February, and was able to remedy in some measure the absence of the equipment.

He constructed one balloon from silk found in the city, purchasing the whole stock, and another by utilizing bed sheeting. For varnish he used plain linseed oil; and the required hydrogen was produced by the action of sulphuric acid (which the Navy had) on iron. He was thus enabled to effect several ascents.

TRANSPORT AND RAILROAD GAZETTE.

February 3, 1905.

TELEPHONES FOR TRAIN DESPATCHING (BALTIMORE AND OHIO).—After a conference of operating officers, this line has authorised its Superintendents to use telephonic orders for directing train movement wherever possible. A very complete system of telephones is installed, and one can understand that (under suitable rules, and presuming adequate arrangements for protecting traffic, *i.e.*, provided a Block or Absolute Timetable system exists) no undue element of danger need be introduced; but the note goes on to say that "the telephone is used exclusively for single-track blocking." This seems to imply that the element of safety obtained in arranging Meetings by duly recorded Orders is to be foregone. If so, this sounds like sacrificing safety to smart handling. From our point of view it is interesting to see that a telephonic system *can* be worked. Telephone or Phonophore might be of great use in arranging train movements on service, when it may happen that the telegraph line is blocked with urgent messages.

February 10, 1905.

RATE REGULATION AND RAILWAY CONTROL IN THE UNITED STATES.—The functions which are to be performed by the Interstate Commerce Commission in the future have come in for a good deal of discussion of late. The Commission, at the present time, has powers somewhat resembling our Board of Trade towards the Railways, but hardly so extensive, and can neither issue definite orders as to the system of working nor fix a limit of Rates. The tendency now seems to be towards conferring such powers, the underlying idea being the same as that which seeks to limit the power of the Trusts. Meanwhile, however, the writer of this article expresses the opinion:—(1). That legalisation of Pools will shortly be an accomplished fact; hitherto it has been maintained as a constitutional principle that competition should be unrestricted. (2). That further unification of the Railway systems must come about. If so, there is a great danger that the power thus gained by the parties in financial control of these big systems might be misused, and that eventually the result would be (3) Government ownership, with all its possibilities of political manipulation and illegitimate influence on the labour market. We must remember that the system of American Government makes it distinctly undesirable that such Government should embark on such commercial undertakings.

February 17, 1905.

EMPLOYMENT OF FIREMEN.—By E. W. Pratt, C. & N.W. Railway.—Mr. Pratt urges the desirability of a proper system of registering men for employment on the principle "in time of peace prepare for war," so that there may be no difficulty in obtaining suitable men when the serious rush of traffic comes. He considers it important that the taking on of men should be concentrated at Divisional headquarters, and not simply left to local officials to do the best they can with what men they can get on the spot.

It is a little striking to read of men going through a "Correspondence course in combustion and Loco. firing" as a preliminary to entering the trade; and it shews how different some American methods of education are from ours. The author thinks it advantageous that men when taken on should at once get some acquaintance with shop and running shed work, and then learn the rudiments of firing on shunting engines, etc, so that they may be available to go out on the road on emergency.

He suggests that, when it is necessary to reduce strength, a "lay-off" list should be kept, the younger men being discharged first but given promise of re-employment. The C. & N.W. line has a regular scheme of first, second and third-year mechanical examinations, so that men may be encouraged to improve themselves technically. These courses have been found valuable to the Railway in reducing the number of burnt-out grates and such other failures as are caused by ignorance.

The writer does not, however, expect to get a really good class of man till mechanical Stokers are generally introduced, so that the fireman may be something more than a "Coalheaver."

C. E. VICKERS.

REVUE D'HISTOIRE.

February, 1905.

THE CAMPAIGNS OF MARSHAL SAXE, 1745.—The disposition of the two armies for the battle of Fontenoy is fully described, and is illustrated by a good map which does not, however, agree in all points with the text. The numbers of the two armies are said to have been nearly equal; French 47,000 present under arms, and Allies 51,000. But this does not take account of the French reinforcements (fully 5,000) which came up in the course of the battle; and it overrates the effective strength of the Allies. According to Ligonier, they had 46 battalions and 79 squadrons; and three weeks before, he had reckoned the battalions at 650 and the squadrons at 150, which gives a total of 42,000. The Austrian commander, Königsegz, reported the units as 48 battalions and 85 squadrons, perhaps including those which were left to guard the camp. In any case the superiority of numbers seems to have been on the French side. The story of the battle is begun, but not finished.

THE CAMPAIGN OF 1794.—*Army of the North.*—This section deals with the Engineer organisation. The amalgamation of the French Artillery and Engineers, adopted in 1755, had been abandoned three years afterwards. There were many advocates of it in the first years of the Revolution, but the decision arrived at was that the two corps should be kept distinct, the Engineers being a corps of officers only, and the sappers and miners forming part of the Artillery. This was in 1790, but war experience soon showed the importance of giving special troops to the Engineers. The sappers and miners were transferred to them in 1793, and twelve new battalions of sappers were formed.

THE CAMPAIGN OF 1800 IN GERMANY.—The writer continues his discussion of the plans of operation, and shows that Bonaparte quite agreed with Moreau that Germany, not Italy, was the important theatre of war. He wished to go to Moreau's headquarters and direct the operations, though (as First Consul) he was excluded from the nominal command. Moreau, however, intimated that he should resign in that case; and he also refused to carry out any plan but his own. Bonaparte gave way, as he could not afford just then to quarrel with Moreau and make him a rallying point for malcontents; but he turned his whole attention to Italy. He could do as he pleased there with the more complaisant Berthier, and he drew off so many men in that direction that the campaign in Germany became subordinate.

SIDI-BRAHIM.—The effects of this disaster are shown, and the movements of the various French columns are described up to the junction of Cavaignac and Lamoricière, a fortnight afterwards.

E. M. LLOYD.

RECENT PUBLICATIONS.

A Modern Campaign (War and Wireless Telegraphy in the Far East), by David Fraser, Special Correspondent to *The Times*. (6s. Methuen).

The Yellow War, by O. ($7\frac{3}{4} \times 5$. 6s. Blackwood).

God and our Soldiers, by Paul B. Bull, Chaplain to Cavalry Brigade in S. Africa. (6s. Methuen).

The Crisis of the Confederacy. A History of Gettysburg and the Wilderness, by Capt. Cecil Battine, 15th Hussars. ($9\frac{1}{4} \times 6$. 16s. Longmans).

Feldhandbuch für Truppenoffiziere, by H. Hoernes, Captain in the Austrian Infantry. (2.50 krs. Feichtingers Erben, Linz, 1904). (Pocket book on tactics for regimental officers in the field).

Marschtafel der deutschen Heeresteile, 1870–71, by v. Bornemann, Lieutenant in the German Infantry. (Gerhard Stalling, Oldenburg, 1905). (Consists of 4 pages tabulating movements of troops during the war).

Kriegsgeschichtliche Uebersicht der wichtigsten Feldzüge in Europa zeit 1792, by A. v. Horsetzky, Commanding 1st Austrian Army Corps. (20 mks. Seidel & Sohn, Vienna, 1905). (Condensed *résumé* of military history since 1792).

Die letzte Operation der Nord-Armee, 1866, by an Officer of the Austrian General Staff. (10 mks. Seidel & Sohn, Vienna, 1905). (Of historical value, describing the retreat in 1866, based on official records).

Wie studiert man Kriegsgeschichte? by Hoppenstedt, Major and Instructor at the Staff College, Potsdam. (1 25 mks. Mittler & Sohn, Berlin, 1905). (Interesting study of the battle of Elandslaagte, 1899).

Entwurf zu kampftechnischen Vorschriften für die Infanterie, by v. Schmid, Captain in the German Infantry. (1.20 mks. Bath, Berlin). (Suggestions on the vexed question of the Infantry Attack).

"*Seydlitz, den deutschen Reitern zugeeignet*," by Buxbaum, Colonel, Bavarian Cavalry. (Max Babenzien, Rathenow). (Fascinating sketch of the personality and exploits of Seydlitz, who is declared to be the "beau ideal" of a Cavalry leader).

Mémoires sur la Campagne de 1794 *en Italie.* (Publiés sous la direction de la section historique de l'état-major de l'armée), par Capt. Fabry. (5 frs. Chapelot, Paris).

Die letzte Operation der Nord Armee, 1866, *vom* 15 *Juli bis zum Eintritt der Waffenruhe*, bearbeitet von einem General staboffizier. (12½ mks. Seidel & Sohn, Vienna).

Le Blocus de Plevna; d'après les archives historiques, par Colonel Martinov, traduit du Russe par E. Cazalas. (Paris).

Stratagem, by Major C. G. Morton, U.S.A. (Hudson-Kimberley Publishing Co., Kansas).

Coast Defence. Handbook for Use of Electricians in Operation and Care of Electrical Machinery and Apparatus of U.S. Seacoast Defences. 2nd edition. (Washington).

Waffenlehre (Schiesswesen, Handfeuerwaffen, Gebirgsgeschütze, Feldkanonen). (19 mks. Seidel & Sohn, Vienna).

Observations sur la Guerre dans les Colonies, by Lieut.-Colonel Ditte. (École Supérieure de guerre, Paris).

La guerre et le droit. Les Conventions Militaires dans la guerre continentale, by Emanuel. (4 frs. Lahure, Paris).

Instruction sur les travaux de Campagne à l'usage de l'Infanterie. (A. Fortification de Campagne. B. Travaux de Campement). (Offic. Suisse).

Wellington, Soldier and Statesman, by W. O'Connor Morris. (5s. Putnam's Sons).

Architecture East and West, by R. Phené Spiers. ($9\frac{1}{2} \times 6\frac{1}{2}$. 12s. 6d. Batsford).

The Timbers of Commerce and their Identification, by Herbert Stone. (7s. 6d Rider & Son).

Cements, Mortars and Concretes; their Physical Properties, by M. S. Falk. ($2\frac{1}{2}$ dols. M. C. Clark, New York).

The Metallurgy of Steel, by F. W. Harbord. (C. Griffin & Co.).

Fire Protection in Central Europe (Notes of Special Commission formed by the British Fire Prevention Committee), by E. O. Sachs, H. S. Folker and E. Marsland. ($11\frac{1}{4} \times 8\frac{1}{2}$. 5s. British Fire Prevention Committee).

Der Suezkanal; Seine Geschichte, seine Bau und seine Militärische Bedeutung. von Hauptmann Ungard. (5 mks. Hartleben, Vienna).

Leçons sur la topométrie et la curvature des terrasses (Professées à l'école des ponts et chaussées) par d'Ocagne. ($7\frac{1}{2}$ frs. Gauthier-Villars, Paris).

Earthquakes in the Light of the New Seismology, by Major C. E. Dutton, U.S. Army. (6s. Murray).

Cryptographie pratique, par de Grandpré. (3 frs. Boyveau, Paris).

Cities of India, by G. W. Forrest, C.I.E. ($8\frac{3}{4} \times 5\frac{1}{2}$. 5s. Constable).

Indian Life in Town and Country, by Herbert Compton. (3s. 6d. Newnes).

Adventures in Tibet, by Sven Hedin. (10s. 6d. Hurst & Blackett).

Le Trans-Sibérien (Railway), par A. M. de Koulomzine, traduit du Russe par Jules Legras. (5s. 8d. Hachette, Paris).

The East African Protectorate, by Sir Charles Elliot, K.C.M.G., late H.M. Commissioner for the Protectorate. (15s. Edw. Arnold).

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

Great Zimbabwe, Mashonaland, Rhodesia, by R. N. Hall. (9×6. 21s. Methuen).

Sur la route du Congo; Lettres d'Afrique, Maroc et Sahara Occidental, par Lahure. ($3\frac{1}{2}$ frs. Lamberty, Brussels).

La grande route du Tchad, par Lenfant. (12 frs. Hachette, Paris).

Le Niger; Voie Ouverte à notre Empire Africain, par Lenfant. (Hachette, Paris).

The XXth Century Book on the Horse, by S. Galvayne. ($10\frac{1}{2} \times 8\frac{1}{4}$. Atkinson).

Mit der Schutztruppe durch Deutsch-Afrika, by "Simplex Africanus," etc. (1.75 mks. Köhler, Minden i. W.). (Illustrated description of German Colonies in Africa).

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The main object of the Army School is the preparation of boys from the age of twelve years for Woolwich and Sandhurst—just as pupils are prepared at the Royal Naval College, Osborne, for the Royal Navy. Boys are placed in one of the Army Classes (limited to eight boys in number) the moment they enter the School, whereas at many of our Public Schools they often waste two or three years before they are considered eligible for the Army Class. At the Army School all the advantages of Public School Life—college, chapel, games, gymnastics, drill, *esprit de corps*—are combined with individual tuition and attention; while the disadvantages of large class teaching is done away with owing to the fact that the proportion of masters to pupils is always six to one.

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G. T. SAVAGE. Passed out of Sandhurst. Gazetted to A.S.C.
G. C. SLACKE. Passed out of Sandhurst. Corporal, Rugby XV. Indian Army.
H. MULLALY. Passed out of Sandhurst. First Prize in Gymnastics. Indian Army.
J. WATSON. Passed out of Woolwich. Obtaining Royal Engineers. Corporal.
C. MULLALY. Passed out of Sandhurst. Corporal, Rugby XV. Indian Army.

N.B.—Special attention is drawn to the following facts, as evidenced by the above statistics:—

(*a*). The education at Trinity College is such that the pupils, when they *have* passed in, are not worn out or rendered limp by the effects of cramming; but nearly one and all show at Woolwich or Sandhurst a continued all-round proficiency.

(*b*). Equal attention is paid to the clever and backward pupil.

The Army School is to be inspected for the purpose of Leaving Certificates—which will soon become almost indispensable for Army Candidates.

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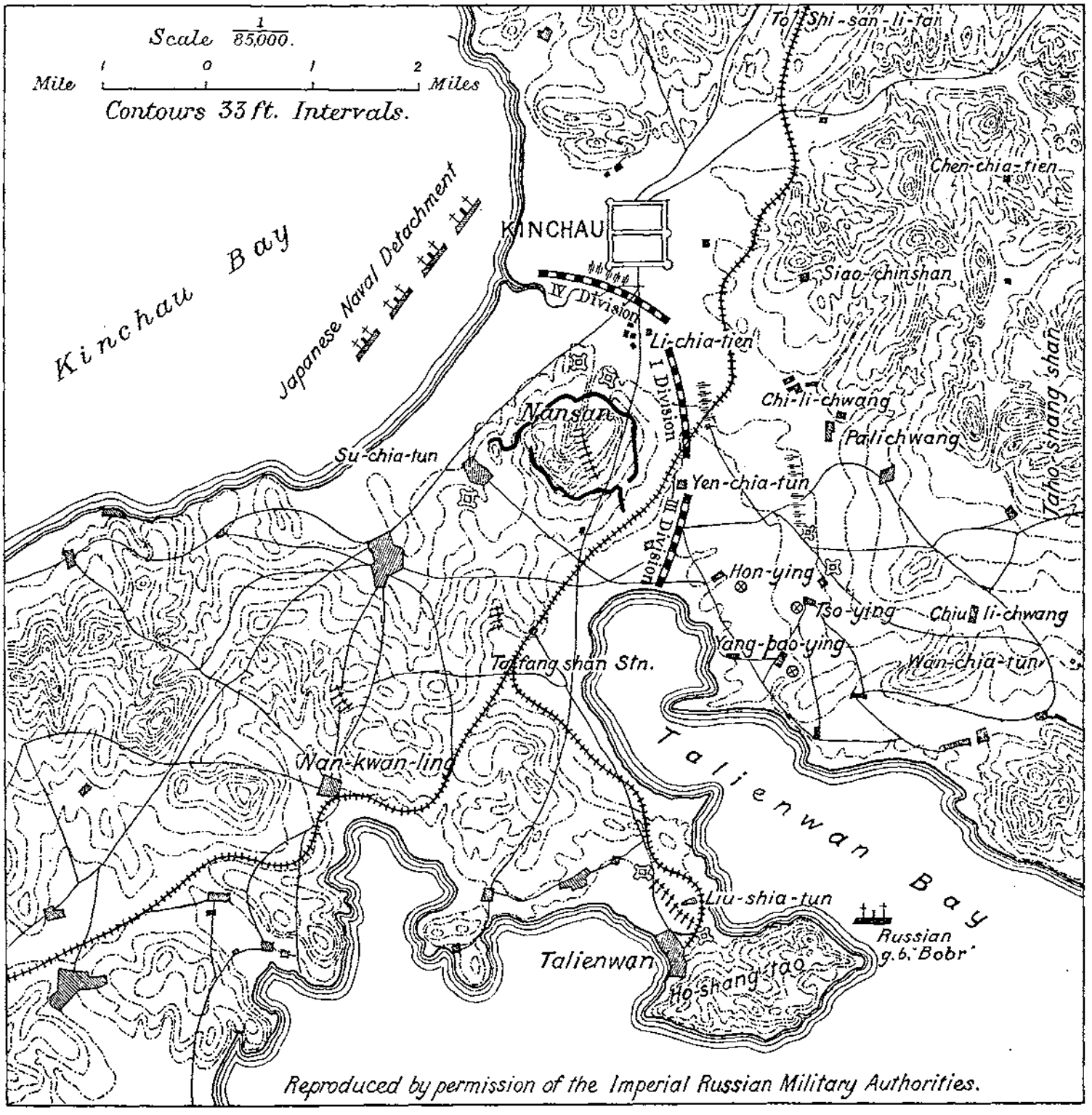
THE BATTLE OF NANSAN.

Positions at 12 noon on 26th May, 1904.



REFERENCES.

Russians — *Entrenchments* ▬▬ *Guns* †††† *Search Lights* ⊗

Japanese — *Troops* ▬▬ *Guns* ††††

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RIVER NIGER TO LAKE CHAD.

as defined by the Convention of Paris 1898.

From Surveys by the

BRITISH BOUNDARY COMMISSION.

Scale of Miles.

10 0 10 20 40 60 80 100

Nat. Scale 1 : 3,000,000 or 47·34 miles = 1 inch.

Scale of Miles.

50 0 50 100 200

Nat. Scale 1: 10,000,000 or 158 miles = 1 inch.

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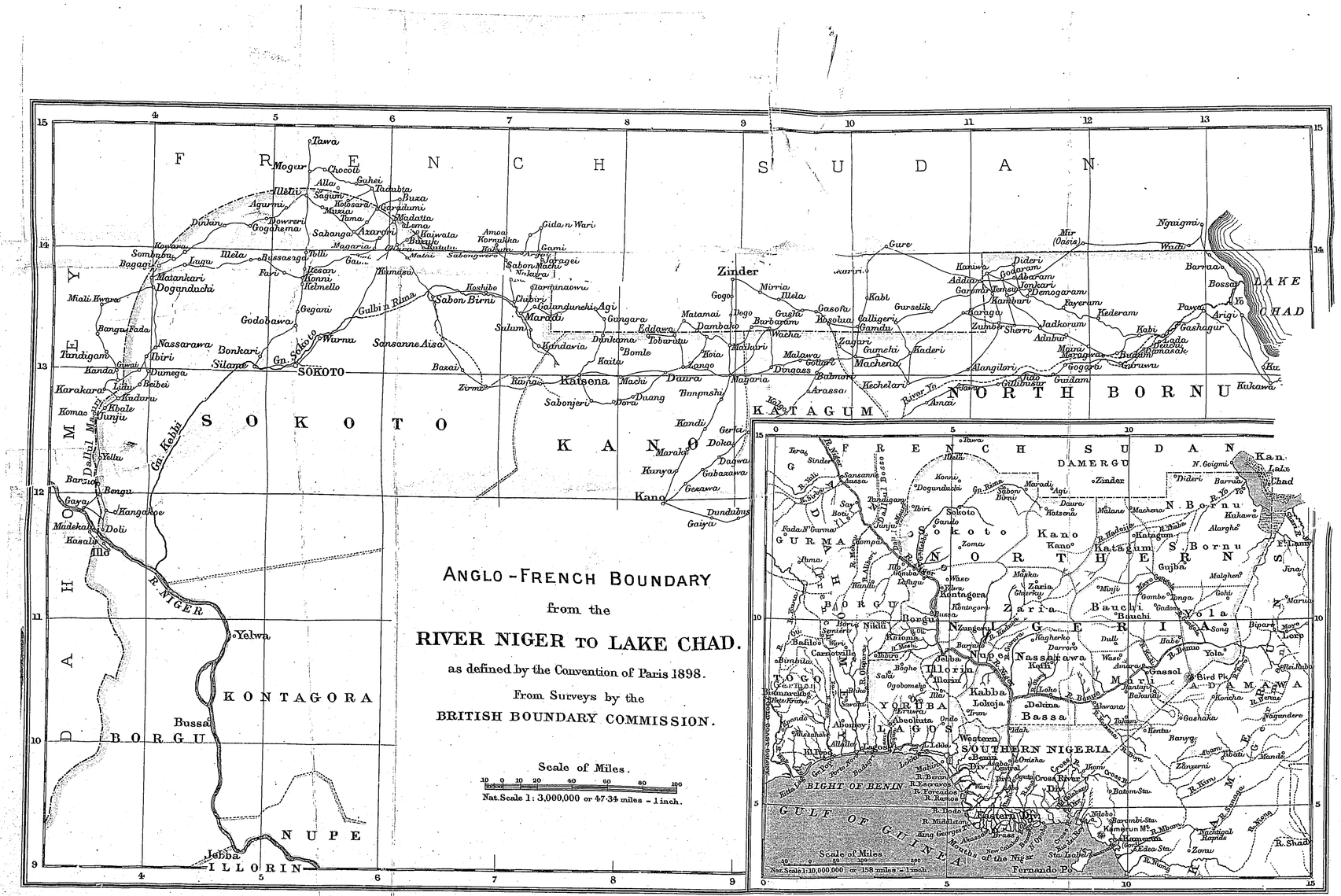

ANGLO-FRENCH BOUNDARY

from the

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