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Royal United Services Institution. Journal

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/rusi19>

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Published online: 11 Sep 2009.

To cite this article: Captain C. [Agrave] Court (1888) The Russian Artillery in 1888, Royal United Services Institution. Journal, 32:143, 219-304, DOI: [10.1080/03071848809416465](https://doi.org/10.1080/03071848809416465)

To link to this article: <http://dx.doi.org/10.1080/03071848809416465>

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THE RUSSIAN ARTILLERY IN 1888.¹

By Captain C. A COURT, Rifle Brigade.

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¹ For further information see the "Armed Strength of Russia," 1886; the *Revue Militaire de l'Étranger*, 1880-1887; *Die Organisation der Russische Artillerie*, Schultz; *Revue d'Artillerie*, 1878-1887; Russian Artillery Journal; Ministerial Orders and Regulations; Hazenkampf's Administrative Course at the Staff Academy; *Deutsche Heeres Zeitung*, 1884; *Archiv für die Artillerie und Ingenieur-Offiziere*, 1884-1887; Pamphlets and Essays, by Generals Engelhardt and Fersmann, and Colonel Chiklarévitch; Colonel Löbel's *Jahresberichte über die Veränderungen und Fortschritte im Militär-Wesen*, 1875-1887; *Zeitschrift für die Schweizerische Artillerie*, 1880; *Die Land- und Seemacht Russlands*, v. Schneher, 1887; *Militär-Wochenblatt*, 1880-1887; *Rivista Militare Italiana*.

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No arm of the Russian service has undergone more serious reforms within the last few years than the artillery: none has done better credit to the reformers. If we look back some fifteen years or more, and trace the various improvements which have been effected in this arm, whether in organization, in numbers, or in material, we must in justice allow that the subject has been handled in a wise and enlightened manner, and that no effort has been spared to render very real the support of Russian guns to Russian infantry. Thus in 1870, when only half the present number of infantry Divisions existed, there were only three batteries to each Division; by 1872 these were increased to four, and the 5th and 6th batteries ordered to be ready within three years; in 1875 the horse artillery was reorganized and distributed among the cavalry Divisions: in 1876 the mitrailleuse batteries were abolished and replaced by light batteries, while that most important service, the fortress artillery, was given renewed vitality by a sensible scheme of reorganization: from 1877 to 1879 the new material for field guns, together with a new and excellent

equipment, were tried, adopted, and issued to batteries with a most commendable promptitude. In the latter year mountain batteries received a separate existence : lastly, in 1885 *sortie* and *dépôt* batteries were formed, and the field parks placed on a level with the requirements of modern war.

The Russian artillery, like the rest of the Army, has been for many years in a transition state, but this period is now over for the one as for the other : the great work of reorganization, carried on for so many years with exemplary zeal and activity, is now accomplished, and although it must be always true that a good military system is never at rest, but always seeks for improvement under whatever name, still the bases of the work are so far established that no great radical change is very probable, at all events in organization, for some time to come.

I. COMMAND.

At the head of the artillery arm in Russia there is a "Grand Master" with the grade of General of Artillery, who is also *ex-officio* chief of the General artillery direction at the War Ministry as well as President of the artillery commission. His authority is supreme over all personnel and matériel, while the ultimate decision on all questions of armament and instruction rest with him as well : his powers of discipline over those officials and agents forming part of the direction itself are equivalent to those of the commander of a Military District. The office of the Grand Master is thus the great centralizing machine for all the services of the artillery, but the vast distances which deny to Russia the uniformity of an ideal organization make it necessary to subdivide this command just in the same way as that of other arms and services is subdivided. In addition therefore to the general direction and the services directly controlled by it, the various artillery corps were formerly regulated to pass under the chiefs of Military Districts in respect to all questions of general service, recruiting, discipline, and mobilization, and to a certain extent are still subordinate to these regional offices. The Grand Master retains the chief share of what may be called the patronage of the arm, that is to say, he selects Officers for the command of corps, and nominates candidates for high commands and employment, while his permission is required for the transfer of soldiers or officials from the territory of one Military District to another. On the other hand, transfer of Officers from one artillery brigade to another, or from field to fortress or *dépôt* artillery, requires the sanction of the Emperor. The Grand Master inspects, either personally or by deputy, all troops and establishments under his command, but there is not always the same method and usefulness in these inspections as is the case in Germany : the principle of inspection is indeed admitted in all its force, but between theory and practice there is a great gulf fixed, and inspections of all kinds are too often carried out with such regard for appearances as to detract greatly from their value. The post of Grand Master is usually given to a member of the Imperial family, and in this case an Assistant Grand Master is appointed : the staff of the Grand Master consists of two Generals and four Aides-de-camp, his assistant has one Aide-de-camp.

All motive power emanates from this general direction at headquarters, and the personal character of the Assistant Grand Master makes for much in the future of the arm : the orders issued are addressed to the subordinates on the next lower rung of the hierarchic ladder, namely, the chief of Military Districts, whose offices form a kind of regional ministry with a composition analogous to that of the central administration, although on a smaller scale. The chief of the District forwards these orders and instructions, in so far as they concern the field artillery, to the chiefs of Army Corps, and as regards the fortress artillery, to the commanders of fortresses. Certain services, factories, arsenals, and establishments are placed directly under the

orders either of the Ministry or of the District staff. The general direction of the artillery at the War Ministry has seven sections, a cabinet, a service of military law, and a record office, while in addition certain services are directly governed by it. The seven sections deal with personnel, arsenals, fortresses, armament, powder mills, accounts, and reports respectively. The services directly governed or controlled by the general direction include the artillery committee, the inspections of fortress artillery and technical establishments, powder mills and factories, together with the Artillery School and Academy, and the office of the Artillery Journal.

In each Military District there is a Lieutenant-General in command of the artillery, whose authority formerly extended not only over the depôts and establishments of the artillery of the District, with the exception of a few which referred to the general direction, but also over the fortress troops and the corps of field artillery forming part of the Army Corps localized in his district. He was further charged with the instruction of Officers and men, their inspection and supply with the necessary material. A conflict of powers frequently arose as a natural consequence between these Officers and others at the head of the artillery of the Army Corps, who found their domain invaded at every point by an Officer not directly responsible, with all his power, for the efficiency of the arm in the field.

In 1882, however, the Emperor, "anxious to realize in a more precise manner the object aimed at by the creation of Army Corps in 1874," decided :—

(1.) That the corps of field artillery forming part of the Army Corps should be taken from the authority of the commandant of the artillery of the District and placed under the chief of the Army Corps, through the artillery commandant of the Corps.

(2.) That the artillery commandants of the Districts should be deprived of all their rights and duties in matters of military instruction and technical training of troops forming part of the Army Corps, but that they should retain their authority over the polygons and their administration. Since this change the chiefs of the artillery of each Army Corps have been responsible to their Corps commander alone, and the useless and often harmful intermediary at the District office exists no longer. Very great advantages have been derived from this step, which harmonized with the needs of the service, and promised a far better and more suitable control, since it replaced the old system by another which laid down that the leaders of the arm should be the same in peace and war, a principle of command far too often and too lightly neglected.

Simultaneously with this reform the horse artillery batteries were taken from the command of the cavalry Divisions and also placed under the artillery commandant of the Corps, since it had been found that cavalry Generals, not feeling qualified to interfere with technical details, cared little about the service of their batteries, and busied themselves mainly with their regiments : and that horse batteries often deteriorated in consequence of this neglect, and of their comparative isolation from the rest of the service.

Artillery is now as directly under the artillery commandant of the Corps as the infantry and cavalry are under their own Divisional chiefs. The artillery commandant is responsible that all batteries are up to their full peace strength, that the effectives are equalized in brigades, that vacancies are at once filled up, and no men detached from their proper duties unnecessarily ; he inspects the monthly returns, and inquires into any case where it appears that the sick rate is exceptionally high. He decides whether volunteers who wish to serve at their own expense may be admitted in excess of the establishment, and forwards requests for readmission to active service of retired Officers and officials. Each year he has the unpleasant duty of sending up a list of

Officers who are coming on for promotion but are considered unfitted for the honour: it is also his duty to strike men off the lists after an unexplained absence of a year, if their place of residence cannot be ascertained.

He generally supervises the accommodation prepared and makes propositions for improvements. In his office all routes are made out, and the number of wagons and amount of baggage allowed on the march regulated. He corresponds with the intendants, directing the civil authorities, local military authorities, railway and steamboat administrations, during the transfer of any body of troops under him from one station to another. When the troops are in camp or cantonment near a railway he fixes, by the authority of the chief of the Army Corps, the number of tickets which have to be obligatorily issued as a free pass to soldiers for travelling on the line.

The military and technical training of the arm takes place under his guidance: he is recommended to strain every nerve to improve efficiency in every detail conformably with the exigencies of the service. He draws up the annual course of drills which cannot be regulated on any one single programme for the Empire owing to the great variety of local and climatic conditions. He is generally responsible that all orders and instructions are strictly adhered to, and he is required to aid in the general spread of scientific knowledge throughout the service. In administrative affairs his duty is to certify that all troops receive their just dues both as regards quantity and quality, that the equipment is regularly replaced at the specified periods, that the material and ammunition are in good order, in proper quantity, and ready for use. He may inspect all corps more than once yearly, as well as prisons and hospitals, the chief of the Corps being informed of any irregularities. Lastly, he is authorized to unite batteries and brigades in close cantonments for field manoeuvres for fifteen days.

The personnel of the artillery direction at the District is variable: the commandant has usually one or two assistants, while other Officers are often attached for inspection, instruction, administration and technical duties, but the tendency is to reduce this staff to a minimum.

A Field Officer of the artillery usually acts as secretary to the direction, and supervises the routine of business and administrative affairs generally. Secretary, draftsmen, printers, and orderlies complete this personnel. The numbers employed in the various duties range from 14 Officers, 15 officials, and 78 men in the Caucasus to 2 Officers, 2 officials, and 9 men at Orenburg. The territory of the Don Cossacks has a special staff, and is divided into two sections for the recruiting and general service of artillery, with headquarters at Novo-Tcherkask and Oust-Medveditskaia: at each the staff consists of four Officers.

For the Army Corps the artillery staff consists of 1 Lieutenant-General and 2 other Officers, 4 secretaries, &c. Owing to the absence of Corps artillery in Russia, the functions of this Officer are less than in other great military States, but the tendency is to throw more power and authority into his hands, and make him the really responsible Officer in all matters respecting drill, military education, and troop leading.

All the fighting field artillery in the Army Corps is distributed among the Divisions of infantry and cavalry. The field batteries are generally grouped by brigades of six batteries each, and are divided among the 48 infantry Divisions at the rate of one brigade of artillery to an infantry Division. The horse artillery batteries are not brigaded together, except those which are attached to the Guard cavalry, six in number, one being furnished by the Don Cossacks.

All brigades of artillery have a Major-General for commandant, a brigade Adjutant, paymaster and quartermaster, two surgeons, one veterinary, and 23—24 clerks and orderlies: two 4-horsed wagons are added as the train.

The reserve brigades assume these proportions only on the outbreak of war, while the depot brigades possess neither train nor horses in peace. The commander of a brigade has the same powers as a regimental chief. If the brigade forms part of an Army Corps he is directly under the artillery chief of the Corps; when attached to an independent division (very rarely the case), he is under the infantry Divisional chief as regards duty, discipline, and training, but in technical matters refers to the artillery chief of the district. This closes the list of commands proper in the artillery. It may be noticed, however, that there is an additional and very important command in war, namely, that of the artillery of the Army; the staff of this command consists of 12 Officers, 4 officials, 8 clerks, and 26 orderlies, &c. The staff of the ammunition park includes a commandant, 2 other Officers, and 16 agents, clerks and soldier servants. Lastly, the communication between the armies and the territory in rear is assured by the "Director of Military Communications of the Army of Operations," whose functions are sufficiently explained by the title.

II. ORGANIZATION.¹

A.—Peace.

The artillery of the field troops is divided into field artillery, horse artillery, and field parks: each of the two first subdivisions includes a certain number of mountain batteries.

In the regular Army of European Russia, the field batteries are grouped, as a rule, by brigades of six batteries each, and these brigades are attached to the infantry Divisions in the proportion of one brigade to each Division, as already noticed.

The three brigades of the Guard are numbered from 1 to 3. The four brigades attached to the grenadiers are similarly numbered, but the 4th is known as the Artillery Brigade of the Grenadiers of the Caucasus, and has the Grand Duke Michael for its honorary chief. The remaining brigades are numbered from 1 to 41. Of these 48 brigades, 41 belong to the Army of European Russia and 7 to the Caucasus. Forty-two of these 48 brigades have an identical composition, the two first batteries of each of them are *heavy*, that is to say, armed with 4.2-inch guns, 1877 pattern, while the four last are *light*, that is, armed with 3.42-inch guns. In the Caucasus the Grenadier brigade is the only one similarly formed; the remaining 6 have 2 heavy, 2 light, and 2 mountain batteries apiece. To these must be added 3 mountain batteries formed at Kiev in 1885, which do not belong to any brigade; they are no doubt designed, after their war expansion, for use at need against the rampart of the Carpathians.

In peace all field batteries in Europe have only four guns horsed; in Asia and the Caucasus the batteries are as a rule practically on a war footing. Reserving the details for a tabular statement it may be noticed that, as a rule, the batteries in the Caucasus have 8 guns and 2 ammunition wagons horsed in peace, those in Turkestan and W. Siberia, 8 guns, 8 ammunition wagons, and 2 spare gun-carriages, while the 1st and 2nd light batteries of E. Siberia have each 4 light guns and 4 mountain guns horsed, and 19 pack animals for ammunition and spare carriage.

The reserve artillery was first organized in 1876, and underwent modification in 1879 and 1885; at present it consists of 5 brigades each of 6 batteries.

¹ The tables and general plan of this part of the paper are based upon two articles in the *Revue Militaire de l'Étranger* for 1887.

As these brigades give birth to very complicated formations in war it is necessary to tabulate their composition in order to make clear how fresh units are formed on mobilization.

Reserve Brigade. Peace Units.

	Station.	Heavy batteries, 4 guns.	Light batteries, 4 guns.	Light batteries, 2 guns.	Light batteries, with 2 field and 2 H.A. guns.	Light batteries, with 2 field and 2 moun- tain guns.	Total.
1st Brigade..	Muraviev .. (Novgorod)	1	1	3	1	..	6
2nd Brigade.	Serpakhov..	1	2	2	1	..	6
3rd Brigade.	Smolensk...	1	1	3	1	..	6
4th Brigade.	Kursk	1	2	1	1	1	6
5th Brigade.	Taganrog ..	1	1	2	1	1	6

Up to a recent date the old bronze 9- and 4-prs. were still in the hands of these batteries; this old material is now, however, being replaced by the 1877 pattern guns.

Every battery of reserve artillery keeps up all material, harness, and stores required for the mobilization of the units which it forms on mobilization.

The artillery of the depôt troops was also reorganized in 1885: at present it only includes two light batteries stationed at Düna-burg. The formations designed in this depôt artillery on mobilization are important, and will be presently described. The horse artillery batteries are not brigaded together with the exception of those of the Guard, six in number, including a Don Cossack battery; all the remainder are distributed among the cavalry Divisions, at the rate of 2 batteries to each Division of 24 squadrons.

As already noticed there are 5 regular horse artillery batteries of the Guard and 23 of the line, while 8 Don Cossack, 2 Terek, and 2 Kuban batteries also share in this divisional distribution.

Thus forty horse artillery batteries are permanently attached to the cavalry Divisions in peace; outside this organization six batteries remain over for new formations, namely, the 5th Kuban battery, the 3 Orenburg, and 2 Transbaikalian batteries.

The 28 Guard and line batteries have each six 3·42-inch guns organized in three divisions in peace and war. During peace the 18 batteries with the cavalry on the western frontiers (3rd Guard, 3rd to 13th and 18th to 23rd) have 2 ammunition wagons horsed; the remainder have only their guns horsed and the number of draught horses reduced to 40.

The so-called "irregular" artillery includes 20 horse artillery batteries in peace and 40 in war. The following table shows the composition of these:—

The batteries in each Cossack territory are united in brigades except in the Don *voisko*. The brigade does not correspond, however, to any analogous tactical unit in other arms, like the cavalry Division; the grouping has been adopted merely to better centralize affairs connected with the artillery of the *voisko*. The brigade commandant is directly under the Sub-Ataman of the territory, who is himself under the chief of the District. Cossack batteries forming part of cavalry Divisions come under the staff of these Division tactically, but in technical matters refer to their Corps artillery chief. Lastly, there is the arm peculiar to Russia, namely, horse mountain artillery: of this service there is one battery in Turkestan and another in W. Siberia. These batteries are being rearmed with the 1883 pattern 2.5-inch guns, adapted, like Baranovski guns of the same calibre, or the older 3-prs., to pack transport or use on wheels: in peace the Turkestan battery is practically on a war footing, but that of W. Siberia has only 2 guns and 2 wagons.

The question of field parks marching with the army, of reserve depôts to feed these, and generally of the supply of ammunition by a practical organization determined in advance, has been most carefully studied in Russia, and is worthy of notice.

There existed, up to the reorganization of 1886, 48 flying Divisional parks, corresponding to the number of infantry Divisions of the Guard and the line. Each park had 5 sections, 3 for artillery and 2 for infantry ammunition; 23 sections of cavalry flying parks and 7 for the rifles also existed. The

Field Artillery. Peace Units.

	Brigades.	Batteries.				Total.
		Heavy.	Light.	Horse.	Mountain.	
<i>Field Artillery.</i>						
Artillery of the Guard	3	6	12	..	..	18
" " Grenadiers..	4	8	16	..	..	24
" " line.....	41	82	152	..	12 ¹	246
" of Turkestan.....	1	2	3	..	2 ¹	7
" " W. Siberia.....	1	..	3	..	1 ¹	4
" " E. Siberia.....	1	..	2	..	2 ¹	4
Kiev batteries	..	..	..	..	3	3
	51	98	188	..	20	306
<i>Horse Artillery.</i>						
Artillery of the Guard	1	..	..	6 ⁵	..	6
" " line	..	..	..	23	..	23
" " Don Cossacks ..	..	..	..	7	..	7
" of Kuban.....	..	..	..	5	..	5
" " Terck	..	..	..	2	..	2
" " Orenburg.....	..	..	..	3	..	3
" " Transbaikal	..	..	..	2	..	2
" " Turkestan	..	..	..	..	1	1
" " E. Siberia.....	..	..	..	..	1	1
	1	..	..	48	2	50

second category, or mobile parks, were 14 in number, each of 4 sections or 56 in all. Communication between these various parks and the permanent establishments of the artillery was effected either directly or by means of reserve depôts established only on the outbreak of war.

An order of the 6th June, 1886, modified this system considerably. Each infantry Division, with its artillery brigade, has now a flying park in time of peace. The material of this park is so organized that it can form in war two infantry ammunition parks of 24 wagons each and two parks of artillery ammunition each of 48 wagons. Thus the flying park of the peace footing becomes in war a flying brigade of parks.

The sections of flying parks for cavalry and rifles were abolished by the same order.

The mobile parks number 56 fractions as before, but no longer retain the name of "sections," nor are they now divided into 14 parks. They are now simply called mobile parks and numbered from 1 to 56. These are distributed as follows :—

¹ 6th and 6th batteries of the 13th, 19th, 20th, 21st, 38th, and 39th brigades.

² 6th and 7th batteries. ³ 3rd battery.

⁴ 3rd and 4th battery.

⁵ Including one Don Cossack battery.

- 4 at St. Petersburg.
- 4 at Dünaburg.
- 12 at Bobruisk.
- 4 at Brest-Litovsk.
- 8 at Kiev.
- 8 at Krementchoug.
- 4 at Kursk
- 8 at Moscow.
- 4 at Tiflis.

These parks have a double duty in war. Part are intended for the active troops and serve to replenish the flying parks in war and to form the connecting link between these and the depôts established in rear of the active army; the remainder are told off to the reserve infantry Divisions which they supply in the same way as the flying parks do the active Divisions. In order to fulfil this double duty the mobile parks are given to the Army Corps in the proportion of one park to two Divisions. Since, however, several Corps have three Divisions, this organization is somewhat deficient of uniformity. In the formations of reserve the infantry Divisions formed from elements of the first line, that is, with the reserves of the active army, have two mobile parks, while those composed of elements from the second line have only one. The personnel belonging to these parks is kept up at the artillery depôts of the military districts, and are called sections of mobile parks of the Military District.

Besides these flying and mobile parks, 76 local artillery parks are maintained in Europe and 8 in the Caucasus, numbered from 1 to 84, but no cadres are maintained for these in peace, although the necessary material is kept in store. In war these parks are detailed at the rate of one to every two infantry Divisions, their duty being to fill up the mobile parks from the nearest field ammunition depôts.

Both flying and mobile parks are recruited from the annual contingent, in the same way as other corps and branches of the Service. In war they will probably be completed by men of the cavalry and field artillery reserve according to the scheme drawn up by the Headquarter Staff. All the cadres for the flying parks are placed under the chief of artillery of the Military District; they look after all material and stores necessary for mobilization; the commander keeps a plan of mobilization always ready, the Officers required for each park of the brigade being detailed in peace and acquainted with the plan of mobilization; for the mobile artillery parks only a small number of storemen are kept up in peace.

This completes the list of the artillery of the field army and the services directly connected with it.

Summing up the various data which have been given, it appears that *the Russian Field Army on a peace footing has 395 batteries, namely 103, heavy, 221 light, 49 horse, and 22 mountain batteries, with a total of 1,610 horsed guns.*

Lastly, there is the fortress artillery, a perfectly distinct and separately organized body. This arm has undergone perpetual reforms during the last few years, and at present numbers 50 battalions of 4 companies each, with the exception of two battalions, which have 5 companies each, and two which have 3 companies. These battalions bear the name of the fortress where they are located, and are numbered separately for each fortress: in war the siege train would be manned by detachments from these batteries. The distribution of the battalions is as follows:—

Fortress Artillery Distribution.

Fortress.	No. of battalions.	Fortress.	No. of battalions.
Cronstadt.....	6	Brest-Litovsk	4
Viborg.....	2	Kiev and Dubno	2
Sreaborg.....	2	Bender	1
Dünabünde.....	1	Otchakov.....	1 (5 companies)
Dünaburg.....	2	Sebastopol.....	1 (5 "
Kovno.....	2	Kertch	2
Ossowetz (Goniondz)....	2	Mikhailovsk and Poti..	1½
Novo Georgiysk.....	6	Alexandropol.....	1
Warsaw.....	6	Kars	2½
Irangorod.....	4	Terck-Daghestan	1

In 1876 the fortress artillery underwent a partial transformation. It was desired to endow this service with a more suitable organization; to do away with certain very glaring defects, and to place it, if practicable, on a level with field artillery as regards its special characteristics and technical training. Before this date the effectives were quite insufficient for the duties incumbent upon the service, nor were they at all determined by the armament of the fortresses, since the guns of these were worked partly by artillerymen and partly by infantry—a method which answered well enough in the old days of smooth-bores, but was found quite unsuitable when the heavy and complicated mechanism of rifled guns came into use, requiring considerable skill and scientific handling in order to produce their full effect. The peace effectives were barely enough for the needs of current service and the care of material, the time occupied in these duties leaving scant leisure for instruction in artillery drill. Again, the proportion of Officers to men was only half that admitted as the due quantity in the field artillery. In 1861 an effort had indeed been made to improve the status of the fortress artillery, and Captains of field artillery, before receiving the command of their batteries, had been regularly placed at the head of fortress companies. But the result was the contrary of what was anticipated: these Officers proved out of touch with the Service, and were pupils instead of instructors: they were strangers to their men, the system was in fact a pernicious one, since the changes in command were perpetual and most prejudicial to the interests of the Service. The appointments were so transitory that Officers took little trouble with the men and their training. As regards the first of these many defects, the organic laws of 1874 greatly improved matters by radically altering the status of the fortress infantry and substituting skilled artillerymen for unskilled infantry. Again, the numbers of men required for each fortress were calculated on exact instead of empirical data; the number of servants for each gun of the armament was reckoned up as well as the numbers required for other duties of the garrison. It will be useful to notice the principles upon which these numbers were ascertained, so that in case the armament of a place be known, the number of fortress artillerymen can be guessed at, and *vice versa*. For a land or continental fortress, as it is termed in Russia, the guns are classed in three categories, namely, those for permanent use against the batteries of the attack, next those for special service, including guard armament, guns for interior retrenchments and sortie purposes, and lastly reserve guns. Taking the all-round armament, 1 non-commissioned officer and 5 men are allowed per gun: for those in the first category, namely, guns for

permanent use, 15 men per gun are allotted to insure reliefs and repose : for guns of the second category only 5 men per gun are allowed. Each gun in the armament of a fortress requires 10·2 men for regular service.

For the landward defences of a coast fortress the same principles are followed out, but for each gun on the sea fronts only 7 men and 1 non-commissioned officer are allowed, it being considered that the action of these guns will be only short and intermittent, being provoked by the approach and attack of a hostile fleet. For all other duties 3 men per gun are allowed : each piece of a maritime stronghold will require, as a rule, 10·9 men.

The next step was to fix the total number of combatants required. It was evident that the needs of the Service must be satisfied in peace and war, that a cadre must be formed of sufficient strength to expand quickly to a war footing, while a sufficient reserve was no less essential. Taking all these requirements as a basis for calculation, it was reckoned that 81,000 combatant fortress artillerymen were required for the various fortresses which were only projected at the time of the reforms, but are now fairly complete ; this number, it must be remembered, corresponded with the simultaneous preparation of the whole of the strong places. Such a case actually took place during the Crimean War, but it would be very exceptional : no country has attempted to take such a vast deployment as a means for calculating its defenders. In order to obtain a more certain basis for calculation, the hypothesis of several wars and alliances was discussed, and in each case the number and nature of the strong places to be kept up at full strength and at a reduced establishment was studied. This fresh calculation produced the number 54,000, but since it was felt that the limits of the theatre of war might at times extend beyond all anticipation, it was determined to organize so as to obtain 60,000 men in readiness for war. Since, again, active service meant at this time four years' liability, 20,000 men had to be kept on foot in peace, or treble the number under the old organization.

Officers being no less a difficulty in this Service than in others, it was not found feasible to increase the proportion of these to the men above 1 to 60 : the number of non-commissioned officers was fixed in the proportion of 1 to 12 men. On the other hand, a great advance was made by permanently dividing the field from the fortress artillery—a step necessitated, beyond a shadow of a doubt, owing to the special and very extensive knowledge required in each branch, only to be learnt by permanent duty in one or the other. As regards the particular formation by battalions, not much need be said : it appeared suitable from an administrative standpoint ; it also fell in with the company system which seemed advisable for duties in certain sections of defence, and there appeared no great advantage in adopting the regimental organization which would add to the expense without increasing efficiency.

There are three siege parks in the Empire, two in European Russia and one in the Caucasus, permanently formed as regards material, although always liable to alteration. In each European park¹ there are 424 pieces of ordnance, namely :—

- 60 6" heavy rifled B.L. steel guns.
- 144 6" light rifled B.L. bronze guns.
- 116 4·2" rifled steel B.L. field guns.
- 12 8" screw rifled B.L. guns.
- 40 8" rifled B.L. howitzers.
- 40 6" " " "
- 12 9" screw R.B.L. howitzers.

¹ The composition of these parks was changed in 1887. Compare "The Armed Strength of Russia," p. 424.

The Caucasus siege park is on a smaller scale and consists of only 230 pieces, namely, 126 guns and 104 howitzers.

The two European parks have each 12 and the Caucasus park 10 sections; ammunition being carried, according to the regulations, at the rate of 1,000 rounds for every gun and howitzer: in all 1,088 tons of powder are supposed to be taken into the field by a European siege park.

During peace these three parks are located as follows:—

No. 1, 5 sections at Novo-Georgievsk, 5 at Brest-Litovski, and 2 at Düna-burg.

No. 2 at Kiev.

No. 3 at Alexandropol.

Speaking generally, No. 1 is for use against Germany's north-eastern frontier, No. 2 for Galicia and the Austro-Roumanian frontier generally, No. 3 for Asiatic Turkey, Persia, or Afghanistan.

In peace the material only of these parks is kept up: 5 Officers and 10 storemen form the peace cadre: all the siege park ordnance is kept distinct from that of the fortress where the section may chance to be located. In war, besides the personnel of the direction, the material, park, laboratory, &c., there are six battalions of fortress artillery attached. It has been objected that this duty will unduly weaken the particular fortress whence these troops are drawn, but in reality there is no danger, for the siege train would only come into play in an offensive campaign when there would be no necessity for maintaining all the strong places at a full complement.

It must be repeated that the number, category, and calibre of guns forming the normal siege train, as well as the number of projectiles, can only be given as a rough guide: they are liable to change with the necessities of each case, the armament of the hostile works, the season, and other causes: they are decided by agreement between the general direction of artillery and engineers. For each park a certain number of carriages and sets of harness are kept ready: in general it may be noticed that sections 1 and 2 of the parks are destined to aid the first operations of investment, and in certain cases to proceed with bombardment; the eight following sections are for the operations of a regular siege, and the two last for reserve to replace losses. In the Caucasus the first four sections are on the lighter principle, that is to say, organized mainly for investing and the earlier operations of a siege; sections 5 to 8, inclusive, are for the regular duties of a siege, and 9 to 10 the reserve.

In each war the General commanding has the duty of deciding upon the distribution of guns in the sections, the proportion of projectiles for each gun, the quantity of powder, wagons, horses, wall guns, repository machines and accessories, tools, &c., so that the normal distribution of calibres in these sections can only be taken as a guide.

At Alexandropol the pieces are under the charge of one of the commandants of the fortress artillery battalions at Alexandropol, whose battalion then forms the normal peace cadre for the service of the siege artillery of the 3rd or Caucasus park.

The whole service of fortress artillery is controlled and regulated by inspectors who are responsible for efficiency.

In addition to the fortress artillery battalions, there are seven independent fortress artillery companies: 1 two at St. Petersburg, and the remaining five in Asia at Vladivostock, Perovsk, Tashkent, Samarcand, and Vernoe; while, lastly, there are three detachments at Odessa, Ashkhabad, and at Nikolaievsk at the mouth of the Amur.

¹ A company is to be formed at Bobruisk this year.

Heavy and Light Batteries. Peace Strength.

	Heavy batteries.				Light batteries.			
	Grenadiers and line.		Turkestan.		Grenadiers and line.		Turkestan.	
	Guard.	Brigades.	1st Battery.	2nd Battery.	Guard.	4th Battery.	38th & 39th Brigades.	Batteries, 1-2.
Officers'	6	6	6	6	6	6	6	6
Combatants	195	195	237	237	167	167	167	212
Non-combatants	13	13	22	22	13	13	13	22
Officers' chargers	5	5	5	5	5	5	5	5
Horses Troop	12	11	17	17	12	18	17	17
Horses Draught	27	27	115	115	27	71	66	120
Horses Train	6	6	8	6	6	18	6	8
Guns	4	4	8	4	4	8	8	8
Wagons	..	..	8	..	..	8	2	4

The 1st and 2nd Batteries of the Field Brigades of Guard and Army have one Captain in addition for batteries formed on mobilization.

In 1865 five field-fortress or "sortie" batteries were raised and are now stationed at Warsaw, Novo Georgievsk, Brest-Litovski, Ivangorod, and Kovno.

Those who require to know the detail of ranks, &c., in the batteries will find full data in the work of the Intelligence Department on "The Armed Strength of Russia." In the following tables many of these details have been purposely omitted in order to direct attention more to the general question of organization.

The table on p. 232 shows the effectives of heavy and light batteries:—

Thus all heavy batteries have the same effectives, and all have only 4 horsed guns: the 4 heavy batteries of the 38th and 39th Brigade, stationed in the Tiflis Government, are an exception and have 8 guns and 2 wagons.

All batteries in Turkestan are practically on a war footing, but the 1st heavy battery has 8 guns, 8 wagons, 1 spare carriage, and 1 train wagon, while the 2nd has 4 guns only.

All light batteries are similarly composed, except the 4 batteries of the 38th and 39th Brigades, which have 8 guns and 2 wagons, like their heavy batteries.

The 19th Brigade, stationed at Armavir in the Kuban territory, has one of its batteries, the 4th, detached in the Transcaspien province: this battery has 8 guns, 1 spare gun carriage, and the battery train at war strength. The 3 Turkestan and 3 W. Siberian batteries have all 8 guns apiece; the 2 E. Siberian batteries 4 light and 4 mountain guns each.

The table on p. 234 shows the effectives of the horse artillery batteries:—

The horse artillery batteries are usually of 6 guns in peace and war, but they do not all possess the same number of carriages. Thus of the 5 regular batteries of the Guard only 1 has 2 wagons, while the 4 others have their guns only. Similarly in the 23 line batteries 14 have only 2 wagons, and the 9 others have none.

The Kuban and Terek Cossack batteries have 4 guns and 2 wagons, as also have those of the Transbaikal Cossacks. As an exception the 4th battery of the Kuban horse artillery brigade employed in Transcaspia has 6 guns and 6 wagons horsed. The Orenburg batteries have 6 guns if stationed in Turkestan, and 4 if in Europe: in each case they have 2 wagons horsed.

The table on p. 235 shows the effectives of the mountain batteries:—

Thus only three of all these batteries have at present the new steel gun,¹ the remainder have the old pattern bronze. All the mountain batteries carry their material on horseback, except the 6th battery of the Turkestan brigade, the so-called "steppe battery," which has its material on wheels.

It has been noticed that only the flying parks and the sections of mobile parks have a peace cadre; for the former these include 3 Officers, 67 combatants, 9 non-combatants, and 6 train horses. The sections of mobile parks have different numerical strengths, but average 2 to 3 Officers, and 30 to 90 men.

Collecting together the preceding data, the whole of the elements which constitute the field artillery in peace can now be tabulated.

¹ The manufacture of the new 2.5" steel mountain guns is, however, so far advanced that all batteries could probably be quickly armed with the new weapon.

Horse Artillery Batteries. Peace Strength.

	Guard.		Line.				Don Cossack batteries.			Kuban and Terck Cossacks.		Orenburg Cossacks.		Batteries of Transbaikalsk Cossacks.
	With wagons.	Without wagons.	Nos. 1, 3, 5, 7, 9, 11, 13, 15, 16, 17, 18, 19, 20, 21.	Nos. 2, 4, 6, 8, 10, 12, 14, 22, 23.	With wagons.	Without wagons.	Guard.	With wagons.	Without wagons.	Even numbers.	Odd numbers.	In Kazan district.	In Turkistan.	
Officers.....	5	5	5	5	Effectives are the same as batteries 1, 3, 5-21, or batteries 2, 4-23.	4	4	5	7	5	5	10	10	6
Officials.....	..	..	2	..	..	..	..	..	..	..	2	1	..	2
Combatants	170	170	168	167	..	..	167	180	180	132	132	180	127	133
Non-combatants.....	15	15	18	15	..	..	19	30	30	20	25	29	16	15
Officers' chargers	4	4	..	..	..	..	5	7	7	5	5	11	11	7
Troop saddle	98	98	No. of horses and wagons is the same as for the 14 batteries with wagons or the 9 without	..	98	98	89	96	96	71	71	98	65	67
Artillery draught	53	40	..	..	53	40	40	53	40	40	40	53	36	40
Train.....	6	6	..	..	6	6	6	6	6	4	4	6	6	6
Guns	6	6	..	..	6	6	6	6	6	4	4	6	4	4
Wagons.....	2	..	..	..	2	..	..	2	..	2	2	2	2	2

Mountain Batteries. Peace Strength.

[illegible]

Peace Units and Effectives. Russian Field Artillery.

	Officers.		Officials.	3	Non-combatants.	4	Total of columns 3 and 4.	Horses.					Carriages.	
	1	2						Officers' chargers.	7	Draught, artillery or pack.	9	Train.	Total of columns 6 to 9.	Guns.
<i>Guard.</i>														
6 Heavy batteries	36	..	..	1,170	78	1,248	30	72	162	36	300	24	..	..
12 Light batteries	72	..	..	2,004	156	2,160	60	144	324	72	600	48	..	..
5 Horse artillery batteries	25	..	..	850	75	925	20	490	213	30	753	30	2	..
1 Don Cossack battery	5	..	..	167	19	186	5	88	40	6	139	6	..	..
	138	..	..	4,191	328	4,519	115	794	739	144	1,792	108	2	..
<i>Line.</i>														
86 Heavy batteries	516	..	..	16,770	1,118	17,888	430	916	2,322	516	4,214	344	..	..
4 Batteries (38th and 39th brigades)	24	..	..	780	52	832	20	68	264	24	376	32	8	..
163 Light batteries	978	..	..	27,221	2,119	29,340	815	1,793	4,401	978	7,987	652	..	..
1 Battery (19th brigade)	6	..	..	167	13	180	5	18	71	18	112	8	..	..
4 Batteries (38th and 39th brigades)	24	..	..	663	52	720	20	68	264	24	376	32	8	..
	1,548	..	..	45,606	3,354	48,960	1,290	2,863	7,322	1,560	13,065	1,068	16	..

Peace Units and Effectives. Russian Field Artillery—continued.

	Officers.					Officials.	3	Combatants.	4	Total of columns 3 and 4.	Horses.					Carriages.	
	1	2	3	4	5						Officers' chargers.	Troop horses.	Draught, artillery or pack.	Train.	Total of columns 6 to 9.	Guns.	Wagons.
<i>Line—(continued).</i>																	
23 Horse artillery batteries	115	28	3,855	287	4,242	92	2,254	1,102	138	3,586	22	30	475	149	729	138	28
16 Mountain batteries	90	..	2,253	195	2,448	75	30	475	149	729	75	30	475	149	729	80	..
<i>Cossack Artillery.</i>																	
7 Don horse artillery batteries	49	..	1,200	210	1,470	49	672	319	42	1,081	42	6	20	20	600	42	6
5 Kuban	25	6	660	115	775	25	355	200	20	600	20	10	14	14	401	20	10
3 Orenburg	30	1	434	61	495	33	228	125	18	401	18	6	8	8	240	8	6
2 Transbaikal	12	2	266	30	296	14	134	80	16	240	16	4	4	4	240	4	4
Terek	10	2	264	45	309	10	142	80	8	240	8	4	4	4	240	8	4
	126	11	2,884	461	3,345	131	1,531	804	100	2,566	92	30	92	92	2,566	92	30

Peace Units and Effectives. Russian Field Artillery—continued.

	Officers.	Officials.	Combatants.	Non-combatants.	Total of columns 3 and 4.	Horses.					Carriages.	
	1	2	3	4	5	Officers' chargers.	Troop horses.	Draught, artillery or pack.	Train.	Total of columns 6 to 9.	Guns	Wagons.
<i>Turkestan Artillery.</i>												
2 Heavy batteries	12	..	474	44	518	10	34	142	14	200	12	8
3 Light batteries	18	..	615	66	681	15	51	315	24	435	24	24
1 Horse mountain battery	18	..	519	60	579	15	80	150	18	263	22	..
2 Mountain batteries	48	..	1,608	170	1,778	40	165	637	56	893	58	32
<i>Artillery of W. Siberia.</i>												
3 Light batteries	18	..	636	66	702	15	51	323	30	419	24	20
2 Mountain batteries	12	..	282	20	302	10	26	86	14	136	10	..
	30	..	918	86	1,004	25	77	409	44	555	34	20

Peace Units and Effectives. Russian Field Artillery—continued.

¹ At St. Petersburg, Dänaburg, Dänaburg, and Tiflis. ² At Dobruisk. ³ At Moscow, Kiev, and Kremmentchug.

The effectives of the batteries of reserve artillery vary with the type on the peace footing: these effectives were laid down in the order of 1885, which reorganized this service. Without going into these in detail, it will be necessary to note the general total of these batteries on a peace footing.

Peace Strength. Reserve Artillery.

	Horses.				Carriages.						
	Officers.	Combatants.	Non-combatants.	Total of columns 2 and 3.	Officers' chargers.	Troop horses.	Artillery, draught and pack.	Train.	Total.	Guns.	Wagons.
	1	2	3	4	5	6	7	8	9	10	11
5 Heavy batteries	55	935	105	1,100	50	55	135	39	270	20	..
7 Light batteries, 4 guns	77	1,197	147	1,344	70	77	189	42	378	28	..
11 Light batteries, 2 guns	121	1,881	231	2,112	110	121	154	66	451	22	..
5 Batteries with 2 guns, horse artillery	55	915	105	1,020	50	100	130	30	370	20	..
2 Batteries with 2 moun- tain guns	22	342	42	384	20	22	48	12	102	8	4
30 Batteries	330	5,330	630	5,960	300	435	656	180	1,571	98	4

	Officers.	Officials.	Combatants.	Non-combatants.	Total of columns 3 and 4.	Horses.					Carriages.	
						Officers' chargers.	Troop horses.	Artillery draught.	Train.	Total of columns 6 to 9.	Guns.	Wagons.
2 dépôt batteries.....	22	..	354	42	396	20	43	40	12	115	6	..
5 sortie batteries.....	55	..	560	70	630	50	40	70	20	180	10	..
44 4-company fortress battalions.....	572	..	19,712	176	19,888	..	..	..	..	..	..	..
4 5 " ".....	64	..	2,210	20	2,260	..	..	..	..	..	..	..
2 3 " ".....	20	..	672	6	678	..	..	..	..	..	..	..
2 St. Petersburg companies.....	10	..	554	4	558	..	..	..	..	..	..	..
2 companies, Tashkent and Samarcand.....	10	..	444	4	448	..	..	..	..	..	..	..
2 " Vernoo and Perovsk.....	10	..	332	4	336	..	..	..	..	..	..	..
1 Vladivostok company.....	5	..	334	2	334	..	..	..	..	..	..	..
Detachments { Odessa.....	3	1	99	1	100	..	..	..	..	..	..	..
{ Nikolaievsk.....	3	1	99	1	100	..	..	..	..	..	..	..
{ Ashkhabad.....	3	1	102	8	110	..	..	..	..	..	..	..
2 instruction batteries.....	11	..	333	13	336	9	109	90	..	208	12	..
Total local and instruction troops.....	766	3	25,499	309	25,778	59	149	160	20	388	22	..

Peace Strength of the Russian Artillery.

	1 Officers.	2 Officials.	3 Combatants.	4 Non-combatants.	5 Total of columns 3 and 4.	Horses.					Carriages.	
						6 Officers' chargers.	7 Troop horses.	8 Pack or artillery draught.	9 Train.	10 Total of columns 6 to 9.	11 Guns.	12 Wagons.
Active troops.....	2,387	39	68,335	5,539	73,874	1,788	7,782	11,684	2,535	23,789	1,610	144
Reserve troops.....	330	..	5,330	630	5,960	300	435	656	180	1,571	98	4
Depôt troops	22	..	560	70	630	50	40	70	20	180	10	..
Local and instruction troops..	766	3	25,499	309	25,808	59	149	160	20	388	22	..
General total	3,505	42	99,724	6,548	106,272	2,197	8,406	12,570	2,755	25,928	1,740	148

The two *dépôt* batteries are not similarly formed; one has only 2 guns; the other 4 (2 field and 2 horse artillery).

The five fortress sortie batteries have each 2 guns in peace; their effective is uniform, namely, 11 Officers, 112 combatants, 14 non-combatants, 10 Officers' chargers, 8 troop horses, 14 artillery draught, and 4 train horses.

The effective of the companies of the fortress artillery battalions is 3 Officers, 112 combatants, and 1 non-combatant: the battalion staff has only a single Officer, a Colonel or Lieutenant-Colonel.

The effectives of the independent companies are relatively much stronger than those of the battalions.

Thus each company of the two at St. Petersburg have 250 men; those in Asia are always on a war footing, and number 300 at Vladivostock, 200 each at Tashkent and Samarcand, and 150 each at Perovsk and Vernoe.

Lastly, there are two instruction batteries, one a field battery, the other a horse artillery battery; both are much above the usual peace strength, particularly in horses.

The effectives of all these various categories appear in the table on p. 241.

If now the totals of the preceding tables are added up the sum will give the peace strength of the Russian artillery corps in all its various services and departments. (See p. 242.)

In War.

Of all arms which engage in modern warfare, artillery is the one which has the most complicated operation to undertake on mobilization. Infantry regiments have merely the men to look after, and these after all are animate beings, and assist in the great task to the extent of their ability, not only by appearing when called out, but by assisting in arming, clothing, and equipping both themselves and their comrades. Cavalry again is now maintained so nearly upon the war footing in peace, partly owing to the pressing need for instant action by quick moving bodies, partly owing to the general distrust of reserve cavalry men who have been vegetating in civil life for some time, that it has far fewer stages of preparation to traverse than any other arm.

But artillery in general, and Russian artillery in particular, owing to the very numerous transformations and additions which are designed to take effect only in war, has a peculiarly complicated task set it, a task not indeed above the powers of an arm that in all countries and in all time has been distinguished as much by its devotion to duty as to science, but one that will tax to the utmost limits the power of the arm, with all its science and devotion, to overcome. The Russian artillery, as will presently be shown, has to increase its corps of Officers by one-third in order to satisfy the needs of mobilization; it has further to recall 7 men from the reserve to every 4 in the ranks, to collect 6 horses for every 1 present in peace with the batteries, to equip some 2,300 additional guns, 15,000 wagons, and a vast number of train carriages, and all this in a very short period of time, and without neglecting the manifold other duties with which the corps in all armies has been burdened and oppressed from time immemorial.

In so far as the active or field troops are concerned, the passage to a war footing does not affect the number of light and heavy batteries which have merely to complete their individual effectives. The same remark applies to the mountain and horse artillery with certain exceptions; for instance, the three batteries at Kiev double their number on mobilization, while as for the horse artillery a considerable augmentation at once takes place by the aid of the Cossack *voiskos*. The Don supplies seven 2nd line and seven 3rd line bat-

teries, which are numbered from 8 to 21; Orenburg gives three and Transbaikal one.

The artillery parks, whose organization has been already discussed, have a more difficult task set them.

According to the Imperial Order (No. 131), of June, 1886, each flying Divisional park becomes on mobilization a "flying brigade of artillery parks," composed of four flying parks; two of these with 24 wagons apiece carrying the infantry ammunition, and two with 48 wagons each the artillery ammunition. Thus these flying brigades number 48; they have the same number and designation as the brigade of artillery with which they march; in consequence of this organization there are 192 flying parks, numbered "1st or 2nd, &c., flying parks of the — flying brigade of parks." Nos. 1 and 2 contain the infantry ammunition; each flying park is further subdivided into 2 half parks, 4 quarter parks, and 8 sections.

This is the first and most important means for replenishing ammunition expended by the infantry and artillery of the active army in the field, but the service is increased by the mobile parks which form the 2nd Echelon. There are 56 of these, numbered consecutively, and distributed among the Army Corps, as already mentioned, at the rate of 1 to 2 Divisions. At first sight it would appear as if this organization must be amply sufficient, but a little consideration shows that this is not quite the case, while it serves to demonstrate the vast extension required by modern war in the accessory services in rear of a field army.

In the normal "order of battle" of the Russian Army there are 10 Army Corps with 2 Divisions; these, therefore, absorb 10 mobile parks. The remaining 9 Army Corps, which have 3 Divisions of infantry, are given 1 or 2 mobile parks, according to the decision of the Minister of War and the Commander-in-Chief. But besides these first necessary duties, the mobile parks have to act as flying parks for the reserve Divisions of infantry, allowing 2 parks to each Division. There are 24 of these reserve Divisions, and 12 of them are formed from elements of the 1st line; the latter will alone absorb 24; the remainder or Divisions of reserve formed with 2nd line elements are allowed 1 apiece. Hence the requirements of the army may be stated as follows, as far as the mobile parks are concerned:—

10 Army Corps of 2 Divisions each	10	mobile parks
9 " 3 " " "	9—18	"
24th Infantry Division (Finland)...	1	"
12 1st line reserve Divisions.....	24	"
12 2nd " " " " "	12	"

56—65

The *Revue Militaire de l'Étranger*¹ in its admirable summary of this question seems to have been led to a false conclusion about the employment of these parks, since it argues that the reserve Divisions will first receive their allowance, and that "only 10 will remain for the 9 Army Corps, each of 3 Divisions, and for the 24th Division."

It is evident that the minimum number of mobile parks, 56, was found by allowing one to each Army Corps, irrespective of the number of its Divisions, and further by adding two mobile parks for each infantry reserve Division of 1st line, and one for each of the 2nd line; it is also evident that the logical outcome of this would be to increase the mobile parks to 65, in order to endow the stronger Army Corps with the necessary means of action without disturbing the general plan. This step is in fact a necessity

for the harmonious organization of the system of gun and small-arm supply, but it is not reasonable to suppose that the reserve Divisions will be given their parks first and the Army Corps afterwards. It seems far more probable that the fighting troops in the first line will be first supplied, and that the reserve Divisions will be the losers; either, in fact, that nine of the twelve 1st line reserve Divisions will have a single mobile park to act as flying park, instead of two as laid down, or else that these will each receive two, and the remaining four will be handed over to such of the reserve Divisions of 2nd line as have succeeded in effecting their formation.

The local parks, 84 in number, whose material alone exists in peace, are distributed at the rate of one to two Divisions for the army in the field; 64 are told off for the active troops, and 20 the reserve troops. They are forwarded to the theatre of war on demand of the chief of the artillery of the army, and their duties are to fill up the mobile parks from the nearest field ammunition depôts. It is evident that if Russia can succeed in mobilizing these parks, she will be able to make up to some extent for the deficiencies existing in the 2nd line of parks, and to retain a surplus of 41 parks for the projected deployment of *opoltschenic*. Thus it appears that in this highly important service, a service which in this country up to a recent date was conspicuous by its absence, Russia has given proof of forethought and sagacity; if the 1st line organization is a little wanting in levelness, the means of action are on the whole very extensive, and prove, as does nearly every detail of Russian military organization, that if failure ensues in war it will at all events not be due to the want of preliminary care bestowed upon every portion of the organization.

It has been noticed that the artillery reserve troops give birth in war to very extensive formations, and it has been seen that these troops consist in peace of 30 batteries, distributed in groups of 6 among 5 brigades. On a principle similar to that which rules in the reserve infantry the developments assumed on mobilization are to the peace strength in the proportion of 4 to 1, and the reserve artillery is increased from 30 to 120 batteries.

This is effected as follows. In the first three brigades the 1st battery includes 4 heavy guns, and expands to 4 heavy batteries; the 2nd, 3rd, 4th, and 5th batteries expand to 16 light batteries, while the 6th battery, which has 2 field and 2 horse artillery guns, expands to 4 light batteries, one of them being a 2-gun horse artillery "battery." Thus in each of the first three brigades 20 light and 4 heavy batteries are formed, excluding the 2 horse artillery guns in each. In the 4th and 5th brigades, 24 batteries are produced on the same general plan, but owing to the slightly different composition of these brigades in peace, 4 heavy and 19 light batteries are formed in war (the latter including 2 horse artillery guns), as well as 1 mountain battery in each brigade, which is made up by each of the 5th batteries of these two brigades, thanks to the 2 mountain artillery guns they each possess in peace.

In all, therefore, 20 heavy, 98 light, and 2 mountain batteries of reserve artillery are so formed. Of this number, all the heavy and 60 of the light batteries constitute the artillery of the 24 reserve infantry Divisions, and are distributed in 20 brigades of 4 batteries each; 40 batteries remain over for another organization yet to be described. In a very similar fashion the 2 depôt batteries each become 4 batteries in war: the 40 batteries remaining over from the expansion of the reserve brigades are also now called depôt batteries, and are divided into 5 brigades of 8 batteries each; 8 batteries remain over and above this organization. In all, therefore, the 48 depôt batteries consist of 40 light field batteries, 6 light batteries, each including 2 horse artillery guns and 2 mountain batteries.

The horse artillery divisions, or "sections," as they are called in Russia,

go to form dépôts of horse artillery, and to these may be added the artillery of the Cossack troops, namely, 1 dépôt 4-gun battery, supplied by the Don *voisko* from its available 2nd line elements, and 1 battery of Orenburg Cossacks. In a similar way the mountain batteries constitute the dépôts for their service.

No country in the world has attempted such an expansive or extensive artillery dépôt system as Russia, none certainly have made arrangements for such a "waste," whether in men or in material, during a campaign. Over 30,000 men, with 50 batteries of 404 guns ! This is a whole army of artillery, and yet it is designedly intended, not for overpowering a foe at the outset, for which purpose indeed it is not available owing to its chrysalis condition in peace, but for gradually filling up the gaps caused by campaigning, *more particularly in material*. No country but Russia has really faced the fact that there is a strong probability of great loss of guns, ammunition, and wagons in the next great war, partly because the opposing artilleries will be more evenly matched than has been the case since the days of Napoleon, partly because all artilleries have adopted those forward "tactics" of which Prince Hohenlohe is the great exponent, and intend to throw themselves into the thick of the fight like the other arms regardless of loss. These tendencies and theories are very praiseworthy and excellent, but it is necessary to be prepared for the logical result of them, and this result Russia is prepared for by the wise organization of her dépôt artillery. Only it will be noticed that Russia has not attempted to create a large reserve of horse artillery ; in this she has been wise, for no one can doubt that the thorough efficiency and dash required in this branch of the artillery are incompatible with the humdrum life in a skeleton dépôt.

To complete the picture of the war formations it only remains to discuss the development given to the sortie batteries and fortress troops. The 5 sortie batteries expand to 16 in war ; the 1st expands to 4 which are destined for the fortress of Warsaw ; the 2nd also to 4 for Novo-Georgievsk ; the 3rd to 3 for Brest-Litovsk ; the 4th to 2 for Ivangorod ; and the 5th to 3 for Kovno. Attention may be called to the fact that all these are intended for Poland, a proof that defensive action here is contemplated in advance, and for this region in particular, as we do not find sortie batteries in the fortresses opposite Galicia.

The fortress troops, as well as the two instruction batteries, merely complete their effectives from the reserve on mobilization, and do not form any additional units.

The following table (p. 247) shows the result of mobilization as regards the numbers of batteries throughout the Empire.

All heavy batteries in Europe and the Caucasus have the same effectives at a war strength, and the differences which exist in peace disappear. Each heavy battery has 6 Officers, 237 combatants, 22 non-combatants, 5 Officers' chargers, 18 troop saddle horses, 163 artillery draught horses, and 20 train horses, including 2 spare. The material includes 8 guns, 16 wagons, and 1 spare gun-carriage. The train 8 carriages, namely, 5 for the artillery train and 3 for the intendants.

The 2 heavy batteries in Turkestan have a similar composition, except that each raises a 2-gun dépôt on mobilization which increases their strength by 46 combatants. There is no regulation train for any of the artillery units in Turkestan or the two Siberias. All light batteries of the Guard, grenadiers, and line have at war strength 6 Officers, 205 combatants, and 22 non-combatants, with 5 Officers' chargers, 18 troop saddle horses, 137 artillery draught horses, and 20 train horses, including 2 spare. The material is 8 guns, 12 wagons, and 1 spare gun-carriage. The train is the same as for the heavy batteries.

War Units. Russian Artillery.

	Brigades.	Batteries.				Total.	Increase from peace strength.
		Heavy.	Light.	How.	Mountain.		
Field artillery:—							Batteries.
Guard	3	6	12	..	..	18	..
Grenadiers	4	8	16	..	..	24	..
Line	41	82	152	..	12	246	..
Turkestan	1	2	3	..	2	7	..
W. Siberia	1	..	3	..	1	4	..
E. Siberia	1	..	2	..	2	4	..
Kiev batteries	..	..	..	..	6	6	3
Total	..	98	188	..	23	309	3
Horse artillery:—							
Guard	1	..	..	6	..	6	..
Line	..	..	..	23	..	23	..
Don Cossacks	..	..	..	21	..	21	14
Kuban	..	..	..	5	..	5	..
Terek	..	..	..	2	..	2	..
Orenburg	..	..	..	6	..	6	3
Transbaikal	..	..	..	3	..	3	1
Turkestan	..	..	..	..	1	1	..
W. Siberia	..	..	..	..	1	1	..
Total	..	..	..	66	2	68	18
Reserve artillery	20	20	60	..	..	80	50
Depôt artillery:—							
Batteries from reserve brigades	5	..	38	..	2	40	40
Batteries from two depôt batteries	..	..	8	..	..	8	6
Don Cossacks	..	..	..	1	..	1	1
Orenburg	..	..	..	1	..	1	1
Total	..	..	46	2	2	50	48
Fortress artillery:—							
Sortie batteries	..	..	16	..	..	16	11
Instruction artillery ...	..	..	1	1	..	2	..
General total	..	118	311	69	27	525	130

The light batteries of Turkestan and the two Siberias have a slightly different composition. In Turkestan there is a 2-gun depôt with 38 men, in W. Siberia, the 1st, 2nd, and 4th batteries have 211 combatants, the 1st and 2nd batteries also raise a 2-gun depôt with 38 men in war. The two light

batteries in E. Siberia, having 4 light and 4 mountain guns apiece, also vary in their composition. These have 6 Officers, 211 combatants, 22 non-combatants, 5 Officers' horses, 17 troop saddle horses, and 67 artillery draught horses; 8 guns, 16 wagons, and 1 spare gun-carriage.

In a similar way all horse artillery batteries have a practically identical composition, but there are here also variations, unimportant in themselves, but which have to be noticed in order to arrive at the real appointed strength of the arm in war.

Thus the Guard batteries have 5 Officers, 183 combatants, 28 non-combatants, 4 Officers' chargers, 99 troop saddle horses, 123 artillery draught horses, and 27 train horses, including 2 spare. The material includes 6 guns, 12 wagons, and 1 spare gun-carriage, the train 11 carriages, 5 for the artillery train and 6 for the intendants. In the line the only variation is the diminution of the combatants by 3, and a corresponding increase in non-combatants in 14 of these batteries, which also number a doctor and veterinary, while in the other 9 batteries the only change is the reduction of 3 combatants.

All batteries of Don Cossacks, whether of 1st, 2nd, or 3rd line, have a similar composition, namely; 6 Officers, 238 combatants, 33 non-combatants, 6 Officers' chargers, 142 troop saddle horses, 120 artillery draught, and 27 train, including 2 spare; the material is on a similar scale to the regular batteries; 44 of the combatants belong to a 2-gun *dépôt* created in war. The Guard Cossack battery has a slightly different organization, as will appear from the "General Total" Table. All Kuban, Terek, Transbaikal, and Orenburg batteries have an identical composition in each separate *voisko*; from whatever "line" their elements are taken. The details appear in the table.

It will be noticed that there is considerable variety in the composition of the mountain batteries, owing to the different composition of their material.

The flying parks are divided into infantry ammunition parks and artillery ammunition parks. The first have 3 Officers, 163 combatants, and 16 non-combatants; there are 4 Officers' chargers, 7 troop saddle horses, 156 artillery draught, including 8 spare and 9 for the train. The carriages number 29, namely, 24 ammunition wagons with 6 horses each, 1 workshop-wagon with 4 horses and 4 2-horse train carts. The artillery ammunition flying parks have each 4 Officers, 300 combatants, 24 non-combatants, 6 Officers' chargers, 7 troop saddle horses, 311 draught, including 15 spare and 15 train. The mobile parks have an almost identical composition to these latter; the local parks have 50 combatants and 4 non-combatants in war, and are commanded by a Captain and Lieutenant.

Counting the spare gun-carriages, as described, under the head of train carriages, and leaving out of consideration the regimental train of Turkestan, the two Siberias, and the mountain batteries, the following is therefore the total effective strength in men, horses, guns, and wagons of the elements belonging to the artillery of the active troops. (See Table.)

In round numbers the batteries with the field troops are commanded by 2,200 Officers and served by 91,000 men. The batteries require 75,500 horses, and are armed with 2,882 guns supplied from 4,876 ammunition wagons which march with the batteries, and 9,600 with the parks. In all, 22,417 horsed carriages are required, 10,069 for the 595 batteries and 11,448 for the parks.

Under the head of reserve troops of the artillery there must be included on mobilization only 80 of the 120 batteries; the remainder coming under the category of *dépôt* artillery.

The sum total of these 20 heavy and 60 light batteries amounts to 480 Officers, 17,040 combatants, 1,760 non-combatants, 400 Officers' chargers, 1,440 troop saddle horses, 11,480 artillery draught and pack, and 1,600 train.

War Strength. Russian Artillery (Active Army).

						Horses.					Carriages.			Increase from peace strength.			
	Officers. 1	Officials. 2	Combatants. 3	Non-combatants. 4	Total of columns 3 and 4. 5	Officers. 6	Troop saddle. 7	Artillery draught. 8	Train. 9	Total of columns 6 to 9. 10	Guns. 11	Wagons. 12	Train. 13	Men. 14	Guns. 15	Horses. 16	Carriages. 17
<i>Field Artillery.</i>																	
96 Heavy batteries	576	..	22,752	2,112	24,864	480	1,728	15,648	1,920	19,776	768	1,536	864	4,896	368	14,886	2,392
2 Turkestan heavy batteries	12	..	566	44	610	10	36	326	..	372	16	32	2	92	4	172	26
180 Light batteries	1,080	..	36,900	3,960	40,860	900	3,240	24,660	3,600	32,400	1,440	2,160	1,620	8,460	700	23,325	3,772
3 Light Turkestan batteries	18	..	729	66	795	15	54	411	..	480	24	36	3	114	12	55	..
3 Light W. Siberian batteries	18	..	709	66	775	15	54	411	..	480	24	36	3	73	12	61	..
2 Light E. Siberian batteries	12	..	422	44	466	10	34	134	..	178	16	32	2	(- 2)	..	56	..
	1,716	..	62,078	6,292	68,370	1,430	5,146	41,590	5,520	53,686	2,288	3,832	2,494	13,633	1,096	38,555	6,190
<i>Mountain Batteries.</i>																	
13 3-pr. bronze batteries	78	..	3,029	871	3,900	65	39	1,482	..	1,586	104	182	13	..	..	..	..
3 2½" steel	18	..	699	201	900	15	9	399	..	423	24	48	3	..	..	..	..
1 Turkestan Steppe battery	6	..	155	57	212	5	3	55	..	63	8	12	1	..	..	..	..
6 Kiev batteries	36	..	1,338	342	1,680	30	18	768	..	816	48	96	6	..	..	..	..
	138	..	5,221	1,471	6,692	115	69	2,704	..	2,888	184	338	23	3,333	72	1,760	361
<i>Regular Horse Artillery.</i>																	
5 Guard batteries	25	..	915	140	1,055	20	495	615	135	1,265	30	60	60	130	..	512	118
14 Line batteries	70	28	2,531	434	2,965	56	1,386	1,722	378	3,542	84	168	168	598	..	2,433	414
9 Line batteries	45	..	1,620	252	1,872	36	891	1,107	243	2,277	54	108	108		..	..	..
	140	28	5,069	826	5,895	112	2,772	3,444	756	7,084	168	336	336	728	..	2,945	532
<i>Cossack Horse Artillery.</i>																	
1 Guard battery, Don Cossack	5	..	210	31	241	5	129	133	27	294	6	12	12	55	..	155	24
21 Don Cossack batteries	126	..	4,998	693	5,691	126	2,982	2,520	567	6,195	126	252	252	4,221	84	5,114	498
4 Uneven Kuban and Terek batteries	20	8	1,016	160	1,176	28	636	572	108	1,344	24	48	48		..	..	..
3 Even Kuban and Terek batteries	15	..	762	108	870	15	465	429	81	990	18	36	36	4,346	96	4,902	376
6 Orenburg batteries	30	6	1,404	192	1,596	36	852	720	162	1,770	36	72	72		..	..	..
3 Transbaikalian batteries	15	3	714	93	807	18	426	360	81	885	18	36	36	4,346	96	4,902	376
1 Turkestan battery	5	..	137	64	201	4	82	57	..	143	6	6	1		..	..	..
1 W. Siberian battery	7	..	208	51	259	6	110	84	..	200	8	8	1		..	..	..
	223	17	9,449	1,392	10,841	238	5,682	4,875	1,026	11,821	242	470	458	8,622	180	10,171	898
Total of batteries	2,217	45	81,817	9,981	91,798	1,895	13,669	52,613	7,302	75,479	2,882	4,976	3,311	26,346	1,348	53,431	7,981
<i>Parks.</i>																	
96 Infantry flying parks	288	..	15,648	736	13,384	384	672	14,976	864	16,896	..	2,304	480	43,840	..	49,056	7,968
96 Artillery flying parks	384	..	28,800	2,304	31,104	480	672	29,856	1,440	32,448	..	4,608	864		..	18,928	3,192
56 Mobile parks	224	..	16,800	1,232	18,032	280	392	17,416	840	18,928	..	2,688	504	14,960	..	..	..
Total of parks	896	..	61,248	4,272	65,520	1,144	1,736	62,248	3,144	68,272	..	9,600	1,848	58,800	..	67,984	11,160
General total	3,113	45	143,065	14,253	157,318	3,039	15,405	114,861	10,446	143,751	2,882	14,576	5,159	85,146	1,348	121,415	19,141

The material includes 640 guns, 1,040 ammunition wagons, and 720 train carriages. This amounts to an increase above the peace strength of the 30 reserve batteries of 150 Officers, 11,710 combatants, 1,130 non-combatants, 100 Officers' chargers, 1,005 troop saddle horses, 10,824 artillery draught and pack animals, and 1,420 train, with 542 guns, 1,036 ammunition wagons, and 720 train carriages.

It is unnecessary to again discuss the elements which go to compose the dépôt artillery, and it will be sufficient to tabulate the war effectives and notice what expansion takes place in order to gain some idea of the strain upon the service on mobilization.

The dépôt artillery consists then in war of the following elements (p. 250).

It has been noticed that the 40 light batteries come from a development of the reserve artillery; for the rest of the above formations the only peace cadre consists of the 2 dépôt batteries; practically then the whole of the men, horses, and material existing in peace have to be quadrupled on mobilization by both reserve and dépôt artillery.

Thus the general design for artillery organization in Russia appears clearly. In the field troops one man is recalled from the reserve to every three or four with the batteries, the number of guns horsed in peace has to be doubled in war, except by the regular horse artillery, which does not need an increase; two horses have to be requisitioned for every one in the ranks, and a train has to be created *ab ovo*. This is for the field troops only. For the 2nd line troops 32 peace batteries expand into 130 batteries; the field troops may indeed be able to complete their guns in good time under ordinary conditions, but the same result will be achieved in the 2nd line formations with difficulty.

To complete the picture it only remains to give a glance at the war effectives of what some writers include under the general head of "local" artillery, under which heading are included sortie and instruction batteries, companies and detachments.

The 16 sortie batteries have 8 guns and 2 ammunition wagons in war, each of 6 Officers, 128 men, and 73 horses. The companies of fortress artillery have their cadres increased from 3 to 5 Officers and their combatants to 327. The independent companies in Asia (Vladivostok, &c.) retain their peace strength: the two St. Petersburg companies expand to 442 men each; the Odessa, Nikolaïevsk, and Askhabad detachments are unchanged. The war strength becomes as shown in table on p. 251.

In the case of the local artillery, therefore, the men in the batteries and battalions are to the reserve recalled on mobilization in the proportion of 3 to 5, which appears reasonable, given the advanced system for fortresses for which these troops are intended; on the other hand, the number of horsed guns to those not horsed is in the proportion of 1 to 3, which appears altogether insufficient, given the pressing calls there will be for horses from services which will have a prior claim to these "local" or garrison troops.

The war effectives of the whole artillery service can now be summed up in a table which requires no comment (p. 252).

From these tables and statements it results that *the Russian artillery requires on mobilization the addition of 1,820 Officers and officials, 171,918 men, 137,019 horses, while the extra material required amounts to 2,328 guns, 15,531 ammunition wagons, and 5,800 carriages.*

Details of the various establishments of batteries, together with a description of clothing, armament, and equipment of the men are given in great detail in "The Armed Strength of Russia," and these matters will not be referred to at length.

War Strength. Depot Artillery.

	Officers.	Officials.	Combatants.	Non-combatants.	Total of columns 3 and 4.	Horses.					Carriages.		
						Officers.	Troop saddle.	Artillery draught.	Train.	Total of columns 6 to 9.	Guns.	Wagons.	Carriages.
40 Light batteries	400	..	23,880	520	24,400	360	240	1,040	80	1,720	320	80	..
6 Light batteries with 2 horse artillery guns	84	..	5,106	108	5,214	78	354	276	18	726	60	18	..
2 Mountain batteries .	20	..	1,194	26	1,220	18	6	44	4	72	16	8	..
1 Don horse artillery battery	6	2	88	12	100	6	46	32	..	84	4	1	..
1 Orenburg horse ar- tillery battery	3	..	48	3	51	3	44	26	..	73	4	..	..
	513	2	30,316	669	30,985	465	630	1,418	102	2,075	404	107	..

War Strength. Local Artillery.

	Officers.	Officials.	Combatants.	Non-combatants.	Total of columns 3 and 4.	Horses.				Carrriages.		
						Officers' charges.	Troop saddle.	Artillery draught.	Train.	Total of columns 6 to 9.	Guns.	Ammunition wagons.
	1	2	3	4	5	6	7	8	9	10	11	12
16 Sortie batteries	96	..	1,952	128	2,080	80	128	396	64	1,168	128	32
2 Instruction batteries	5	..	180	28	208	4	99	123	27	253	6	12
44 Battalions, 4 companies each.	924	..	205	22	227	5	18	137	20	180	8	12
4 " 5 "	104	..	57,552	176	57,728	..	..	..	..	..	..	..
2 " 3 "	32	..	6,540	20	6,560	..	..	..	..	..	..	..
2 St. Petersburg companies	10	..	1,962	6	1,968	..	..	..	..	..	..	..
2 Tashkent and Samarcand companies ..	10	..	894	4	898	..	..	..	..	..	..	..
2 Vernoo and Perovsk companies	10	..	444	4	448	..	..	..	..	..	..	..
1 Vladivostock company	5	..	332	4	336	..	..	..	..	..	..	..
Detachments { Odessa	3	1	332	2	334	..	..	..	..	..	..	..
{ Nikolaievsk	3	1	99	1	100	..	..	..	..	..	..	..
{ Ashkhabnd	3	1	102	8	110	..	..	..	..	..	..	..
Increase from peace strength	1,211	3	70,683	404	71,087	89	245	656	111	1,601	142	56
	467	..	45,538	117	45,675	30	96	496	91	1,213	120	34

* Moved here from Tchinar in 1881.

War Strength of the Russian Artillery.

	Horses.					Carrriages.							
	1 Officers.	2 Officials.	3 Combatants.	4 Non-combatants.	5 Total of columns 3 and 4.	6 Officers' chargers.	7 Troop saddle.	8 Artillery draught.	9 Train.	10 Total of columns 6 to 9.	11 Guns.	12 Wagons.	13 Carrriages.
Active troops .	3,113	45	143,065	14,253	157,318	3,039	15,405	114,861	10,416	143,751	2,882	14,476	5,059
Reserve.....	480	..	17,010	1,760	18,800	400	1,410	11,810	1,000	14,920	610	1,010	720
Depôt	513	2	30,316	669	30,985	465	690	1,418	102	2,675	404	107	..
Local	1,211	3	70,683	404	71,087	80	215	1,150	111	1,001	142	56	21
	5,317	50	261,104	17,086	278,190	3,993	17,780	122,275	12,259	162,947	4,068	15,679	5,800

A Russian battery is an administrative as well as a tactical unit, and the duties of its commander are considerable. He has all the rights and duties of a regimental commander in questions relating to instruction, barracks, and mobilization; he is directly responsible for the careful administration of the unit under his command. The artillery commandant of the Army Corps is his immediate superior, through the brigade chief, in all matters concerning material, ammunition, horses, harness, clothing and equipment, and other technical affairs.

In the matter of clothing, a reference to the system pursued by the infantry regiments will be the best guide to the general plan. The State furnishes arms, head-dress, cloth, lining material, and buttons. All clothing, equipment, and harness is made up in the battery shops, and the commander of each unit receives for this purpose a certain sum based upon the effectives of his corps and the time that the materials are calculated to wear.

All other necessities, except flour and oats, are also supplied in cash, that is to say, in paper money, and the battery makes the best of its local markets.

The brigade chief is supposed to exercise a general supervision over these operations; the accounts, made up at the end of the year, are passed by him. Practically, as in the other arms, there is an uncontrolled manipulation of certain funds by those in charge of certain units above and including the battery. While it is probable that the stories of peculation by Russian Officers—as distinct from officials and agents of the intendant—are grossly exaggerated, there is no doubt that in our own Army, so long as the system was pursued, it gave rise to frequent abuses, and there is no reason to suppose that in this matter Russia is greatly in advance of the England of 50 years ago.

All ranks in the Russian batteries are armed with the dragoon sword and with a revolver slung on the waistbelt and secured by a cord round the neck. In peace only 40 revolvers per battery are issued; 120 are kept in store for each dépôt and reserve battery; in the parks the dismounted men have rifles.

The entrenching tools carried by a field battery include 32 spades, 24 axes, and 4 picks, besides saws, mattocks, and crow-bars; a mountain battery has a smaller proportion of tools and a dépôt battery a smaller quantity again. In the fortress artillery men have Berdan rifles as well as revolvers.

Forage is issued twice a month. The allowance for the line artillery daily is 9 lbs. 5 ozs. of oats, 9 lbs. 1 ozs. hay, and 3 lbs. 10 ozs. of straw, a ration much below what we consider the minimum. After the summer drills all horses are turned out to grass for a month, and hence in October and November are quite unready for campaigning. In the artillery of the Guard this practice is not the rule, while the horses receive a ration of oats more than 3 lbs. in excess of that given to the line. Barley is very frequently substituted for oats in all branches of the Service.

III. MATERIAL.¹

If the question be asked, When did the fact first become prominent that Russia was able to compete successfully in the artillery market with foreign rivals? the answer will probably carry us back to 1873, the year of the great Vienna Exhibition. No one who visited that world's fair can fail to have been struck with the brave show made by the military division of the Russian or XVth Section.

¹ I am much indebted to Captain G. V. Kemball, R.A., for carefully revising this part of the work.

This period also is coincident with an epoch when the reign of force was firmly established in Europe, and when the expansive force and vitality of a State began to reckon, not by its light and leading in peaceful arts, sciences, and industries, but in its power and ability to create the most complete, approved, and deadly engines of war for the future annihilation of its neighbours.

Regarded by scientific Europe as more or less outer barbarians, the Russians suddenly disclosed that if the Slav race is distinguished by its imitative faculties, these are at all events of a high order, and aid the people at arriving at exactly the same result as that attained by Western Powers—thanks to the many gifts known among the latter by the various names of “culture,” “science,” and “creative genius.”

Very soon after the last war the old 9- and 4-pounder bronze guns, with flat Krupp wedge, were condemned, since they were deficient in range, accuracy, penetration, and had a very low initial velocity: they failed, in short, in nearly every characteristic demanded from a good model field-gun. Batteries of these guns are still retained by some dépôt and reserve corps, but they are rapidly being replaced, and will, in all probability, never see active service again. It is useless, in consequence, to waste time over their description.

Russian artillerymen were well aware of the defects of their armament, and even before the Russo-Turkish War there arose a question of adopting Colonel Lavrov's bronze system. At the time of the declaration of war a new heavy gun was undergoing a series of trials, but by April, 1877, the arsenals were only forward with some 150 guns of the new pattern.

The lessons of the war brought home most forcibly to the Government the folly of a short-sighted economy: an instant transformation of the armament was decided on, but the Government, unable immediately to supply its wants at home, was forced to apply to the foreign market.

After a great number of trials the special commission appointed for the purpose of selecting the gun of the future decided on a Krupp steel field-piece not at all unlike the German field-gun of the 1873 pattern, and a supply of these pieces was in consequence ordered from Essen.

But Russia had no intention of permanently paying toll to Krupp and being at the mercy of foreign enterprise in such an important matter, and active measures were at once taken so that the home arsenals might find themselves in a position to complete the renovation of the material within a period of three years.

Artillery Officers of scientific attainments and engineers skilled in metallurgy were sent abroad to study and report on the installation and machinery of great foreign metallurgic establishments. By the light of the experience so gained the Obukhov works were transformed and enlarged, so that within eighteen months this single arsenal was in a position to complete the required order, and then, gaining confidence from its strength, it obtained the sanction of the Grand Master to a new design on a very similar system of construction, but differing somewhat in detail from the original type selected from Essen.

This latter weapon (Pl. A, Figs. 1, 3, and 4 (vol. Plate 4)), known in Russia as the “field-gun, pattern 1877,” consists of a steel tube or body and a single coil or jacket which carries the trunnions and the slot of the wedge. The jacket is expanded by heat and placed over the tube: after cooling it contracts and grips the tube firmly, while a catch formed by two half-rings prevents it from shifting.

The guns (Pl. A, Figs. 2 and 5) designed and made at the Obukhov works and generally known as the “field-gun, 1879 pattern,” are composed similarly of an inner tube and an outer jacket, but in the newer type this jacket is con-

tinued right up to the muzzle of the gun instead of ending a little in front of the trunnions as in the original type selected. The trunnions are carried by a trunnion hoop retained in its position by a ring, composed of two half-rings and covered by a hoop. The tube is of Martin-Siemens steel compressed by hydraulic machinery on the Whitworth system at a pressure of 90 atmospheres.¹ The jacket is constructed of puddled steel cast in a crucible, but not subjected to pressure; it carries the slot of the wedge block. The trunnion hoop is of compressed steel, and is heated before it is placed over the jacket. The tube is fitted into the jacket when cold under a pressure of about 30 atmospheres by the help of a special apparatus whose motive power is derived from a hydraulic press worked by two men. The tube is rifled before this operation takes place, and is entirely finished, as also is the jacket over which the trunnion coil has to be fitted.

Since the rearward edge of the tube has to end on a level with the front edge of the slot of the wedge, there is screwed into the jacket in the rear of the slot and in the prolongation of the tube a second small steel tube to compensate for the difference of diameter which is indispensable in order that the large tube may be fitted into the jacket: another screw prevents this from shifting.

The same machinery enables the tube to be withdrawn when cold if it is necessary to repair it or replace it by another. Both these operations are perfectly feasible provided that the surfaces of the two portions have been properly prepared and conveniently adjusted.

This idea of constructing guns with movable tubes was proposed and tried for heavy ordnance so far back as 1876, and is due to General Mousseliuss and Captain Kolokoltzov, the former being director of technical works at the Obukhov foundry, while the latter is chief of the administrative service at the same institution.

The advantages claimed for this system are that not only can worn-out or damaged tubes be replaced with ease, but also that alterations and improvements can readily be made in the tube and interior arrangements generally, thus keeping on a level with advances in gunnery science, without entailing as a necessary consequence the condemnation of a whole system of ordnance while still in a perfectly serviceable condition.

The breech mechanism (Pl. A, Figs. 7, 8, 9, and 10) of the field-guns, pattern 1877, is identically similar to that of the German field-guns: as far as general principles are concerned it has for Russians the advantage of being on the same lines as for the old bronze guns: the same remark applies equally to the 1879 pattern, although there is a slight and unimportant difference in the latter type. In each pattern the non-modified steel Broadwell ring is used. The bore and interior arrangements are identically the same in each pattern: there is a cylindrical cartridge chamber and lodgment for the obturator in rear of it, the neck of the chamber, the cylindrical projectile chamber, and the bore proper.

The grooves are twenty-four in number for all field calibres, and have the same breadth and depth, the twist being from left to right: these are continued into the projectile chamber with a less depth and only cease at the beginning of the rear neck of the chamber, although in the German guns these terminate at the front neck.

In their exterior appearance the 1877 guns are very similar to those adopted by Germany, and do not show an increasing thickness towards the breech: on the other hand, the 1879 guns finish off with a strengthening hoop rather

¹ The unit of measurement for fluid pressures abroad is the weight of one atmosphere, or 14.7 lbs. per square inch. We use the more complicated expression of "lbs. or tons per sq. inch."

larger in dimensions than the breech end : it is square in section and projects from the jacket : on its upper surface is engraved a line parallel to the axis of the piece and intended for the clinometer. The exterior of all field-guns was originally bronzed, but the rule now is to cover the whole with a coating of black varnish.

The sights (Pl. A, Fig. 6) resemble those of the Austrian service, pattern 1875. The tangent scale is in two parts. It consists of a brass bar or stem, which slides in a brass outer case ; the latter works in a wrought-iron bush which is let into the strengthening hoop on the breech of the gun. The tangent scale is cylindrical in section, but a plane face is cut on the rear portion of its surface, and on this face is engraved the scale of distances in *sagènes*.¹

For ranges up to 800 *sagènes* it is not necessary to use the stem of the tangent scale, but to obtain the elevation for longer ranges the stem must be raised and clamped. By this telescopic arrangement one tangent scale serves both for short and long ranges without necessitating the use of a tangent scale of excessive length.

The head of the tangent scale is formed of a graduated horizontal tube : in this tube works a steel traversing screw with a milled head : along it also moves a nut which forms the deflection leaf, and contains the notch of the backsight. The steel foresight is conical in shape and fixed to the upper side of the shoulder of the left hand trunnion : it is painted black to facilitate laying.

The light gun and the horse artillery gun have the same calibre and practically the same range : they also make use of the same ammunition : the cavalry gun is, however, 16 inches shorter and 180 lbs. lighter than what is sometimes called the "infantry" light gun. This advantage is gained at the sacrifice of a certain amount of initial velocity (1,350' : 1,450') : further, the horse gun has a more curved trajectory, and at practice gives a less satisfactory probable rectangle or cube of mean deviation. As for the heavy or battery gun, an inspection of the tables in the Appendix will show that this weapon is essentially a low-velocity gun in which everything has been sacrificed to weight of metal. The details of the heavy projectiles afford very instructive reading.

Coming now to the consideration of the ammunition (Pl. B) used by both the 1877 and 1879 patterns, we find as regards projectiles the three usual natures, shell, shrapnel, and case : these, however, differ in a number of details from those used in our Service, and are worth attention. Both shells and shrapnel have two copper rings on their exterior circumference in order to properly centre the projectile and prevent windage. The front ring is rounded in shape, but that in rear is cylindrical and has two cannelures filled with grease. In order to give the exact shape to the projectile the outer surface of the rings and the cylindrical portion of the shell or shrapnel are turned to the proper measurements.

The shells (Pl. B, Fig. 2) are 2·5 calibres long, and are of the kind so much in use abroad, but deliberately rejected by our Service, namely, annular segmental or ring shells as they are more commonly called—very effective projectiles against troops behind slight cover : those of the earlier pattern are similar to the Uchatius shells of the Austrian field artillery and to the German shells (pattern 1876). The light shell breaks up into about 140 fragments each of a mean weight of about 3½ ozs.

In 1880 a new light shell (Pl. B, Fig. 3) was designed by M. Babouchkine, the chief feature of these being the teeth of the different rings which were made so as to break joint and thus obviate the danger of the metal breaking

¹ 1 *sagène* = 7 feet.

up into strips along the lines of weakness and losing a great part of its effect ; this shell breaks up into much more regular fragments. It is difficult to resist the impression that the Russians have acted wisely in giving their field artillery shell considerable man-killing properties. We, on the other hand, in our latest equipment appear to rely solely for this effect upon shrapnel, a projectile notoriously requiring for effective use a number of favouring conditions which one cannot always expect from the fickle goddess.

With shrapnel (Pl. B, Figs. 4 and 5) the bursting charge is placed at the base of the projectile : it is separated from the leaden bullets by an iron diaphragm and communicates with the fuze by the usual primitive central cast-iron tube filled with powder.

There are two types of shrapnel : the first (Fig. 4) is cast in a single piece, and the second (Fig. 4a) has two parts, namely, the body and the ogival head which fit into one another and are clinched by screws ; it is the latter type that is of most importance, since it will probably be chiefly used in the future. There is, however, a third (Fig. 5), which has numerous advocates and is peculiar in its construction. It has a bronze head screwed on to the body of the projectile and is provided with an opening for the introduction of the bullets. After these are inserted, the opening is plugged by a leaden stopper ; in this pattern the central tube is of wrought iron. The interior surface of the projectile has a number of spiral grooves, and it is alleged that fire effect is much more considerable with this projectile. In all patterns of shrapnel the bullets are of hardened lead, viz., four parts of lead to one of antimony, they are half an inch in diameter, and are coated with olive oil.

The case shot (Pl. B, Fig. 1) has an increased diameter at the base, which regulates the loading ; the envelope is a sheet of tin, the ends being rivetted and soldered together ; three sheets of zinc placed inside form a second envelope giving rigidity to the outer case. If this interior and uncontinuous envelope, so suitable for resisting pressure from outside without interfering with the break up of the case shot after leaving the muzzle, were abolished, the outer covering would have to be greatly strengthened, or the shot would break up in the gun. If, on the other hand, it received sufficient strength to resist this, the shot would not break up when required. Both envelope and base are of copper ; the latter has a handle of leather to allow the case shot to be extracted if not required after loading. These case shot projectiles are filled with zinc bullets, without sulphur, sand, or molten resin.

Many interesting experiments have taken place with a view to determine the best construction for the envelope, the diameter for the bullets, and the proper rules for the conduct of case fire ; these have been given by Colonel Chiklarevitch in the "Russian Artillery Journal."

The question of fuzes has been no less difficult in Russia than elsewhere ; indifferent skill in manufacture and in design, faults in the material, deterioration due to extremes of weather, careless handling, and other causes have contributed to make the selection of a good serviceable fuze a matter of much difficulty.

The frequent failure of the ancient types used in the last war is too well known to require remark. With the new material in 1877, a fair 10-sec. time fuze (Pl. C, Fig. 1) was brought out and satisfied the consciences of Russian gunners for some six or seven years. When the rearmament of the artillery was, however, completed, the inventive faculties of various ingenious Officers were called into use for the designing of a time and percussion fuze that should not only replace the 10-sec. fuze, but be in advance of the most perfect existing elsewhere.

After a great number of experiments with fuzes analogous to the Budin and Kreutz types, a fuze invented by Colonel Filimonov was selected for percussion use (Pl. C, Fig. 4), together with a base fuze (Pl. C, Fig. 3), due

to the same inventor and employed with the 9-inch mortar. At the same time the 10-sec. time fuze, to which had been added a 12-sec. fuze on exactly the same principle, was replaced by another 12-sec. fuze, while lastly a 16-sec. fuze was given to the siege artillery.

The 10-sec. time fuze, 1877 pattern (Pl. C, Fig. 1), is on the principle of the morable collar and circular powder channel. It will soon be out of date, and it is unnecessary to give a detailed description of its action. It may be said generally that, as usual in these fuzes, strokes and numbers, corresponding to the periods of combustion of the composition, are engraved plainly on the exterior circumference of the collar. In the 10-sec. fuze the figures show single seconds, the intermediate strokes allowing the fuze to be set at intervals of one-fifth of a second. All these fuzes are regulated at 0·4 of a second in the transport, so that in case shrapnel is suddenly required for close firing or to replace case, no preparation is needed. The chief faults of this fuze consist in the insufficient flame given by the cap composition, while the striker in many cases fails to sharply sever the suspending wire by which it is secured. The present 12-sec. time fuze, 1884 pattern (Pl. C, Fig. 2), differs mainly by the increased weight of the striker and the rounded form of the head, which prolongs the ogival-shaped head of the projectile, and is better adapted to overcome the resistance of the air. The general construction will be understood by reference to the Plate. The maximum time possible to allow for burst, namely, 12 seconds, corresponds to a range of 3,826 yards for the light gun, 3,608 yards for the horse artillery gun, and 3,498 yards for the heavy gun: beyond these ranges shrapnel cannot be employed by Russian guns, nor indeed could the effect be observed under ordinary conditions. The new fuze, it may be noticed, proved unsuitable to the new mountain gun; the shrapnel practice was most uncertain. A smaller 10-sec. fuze was therefore designed for it, allowing a maximum shrapnel range of 3,280 yards. As for the 16-sec. fuze for heavy ordnance, this only differs by its size and time of combustion. All the new fuzes are set at 0·3 sec. in peace; this corresponds to a burst at 109 yards in the case of 12- and 16-sec. fuzes and at 87 yards for the 10-sec. fuze.

The percussion fuze (Pl. C, Fig. 4), 1884 pattern, consists of a body, A, two screw-plugs, B B', closing the fuze at top and bottom, the hammer C, needle D, safety pin E, cap piece F, and spring G soldered to the upper part of the cap piece, the lead washer, and safety pin I. The interior has three separate compartments, that in the centre being truncated and the others cylindrical; two notches in the head take the branches of the screw-key. The channel of the bottom screw-plug is closed by a tin washer (a). The needle grip b, is screwed into the hammer and supports the ends of the branches of the spring. The striker is of bronze. On firing the hammer drops into the central compartment, where the branches of the springs prevent it from flying forward. The cap containing the fulminate is screwed into the cap-holder, which is soldered to the end of the spring G. Before firing, the safety pin is pulled out. In peace the fuzes are not kept in the projectiles, but in special cases. The base fuze (Pl. C, Fig. 3) already mentioned consists of a body a, striker b, hammer c, a claw spring g, and cap e. The latter has four openings, k, through which the flash reaches the bursting charge.

The charges of all guns are made up with large-grained powders, a mechanical mixture in the same proportions as that in use in England, namely, 75 parts saltpetre, 15 charcoal, and 10 sulphur. The density of this powder is from 1·66 to 1·70, and the size of the grains varies from 0·25 inch to 0·39 inch.

The ballistic properties of this large-grained powder are defined by the results of trials with the light gun, the pressure being calculated by an

American apparatus known as the Rodman indicator, placed in position for this purpose in front of the breech-block. Under ordinary service conditions, the initial velocity, measured by a Boulengé chronograph, should be from 1,430 to 1,469 feet a second; the mean pressure should not exceed 1,700 atmospheres,¹ and no single one 1,950. These muzzle velocities are low according to our ideas, since the new 12-pounders give 1,700—2,000 feet initial velocity per second.

Up to a recent date the old 1866 friction tube has been in general use in the Russian artillery; with enlarged powder chambers and new charges and powders, it was found to give insufficient flame, and the one employed is a curved tube invented by Generals Mine and Platsov.

This instrument is in two parts, namely, the exterior tube and the friction arrangement. The tube is of copper: the friction arrangement is introduced, and the interval between the sides of the tube and the roughened thread inserted filled with mastic. Two small gutters prevent the upper part from expanding by the action of the gases, and the small tube of the friction arrangement from being driven forcibly back towards the gun detachment. The outer tube is filled with compressed powder, and closed by a washer of mastic (35 parts asphalt, 35 wax, and 30 turpentine).

The friction arrangement is made up of a small tube of bent brass, which contains the fulminating composition, the roughened ends, the paper washer, and the gutta-percha washer. The fulminating composition consists of 60 parts Berthollet salts, 10 parts sulphur, and 30 of antimony.

While on the subject of Russian fuzes, a most ingenious contrivance called the Berdan mechanical time-fuze may be noticed, in which the inventor has striven to utilize the rotatory movement of the projectile in order to secure an accurate burst, and thus obviate the well-known inconveniences which undoubtedly arise even with the best fuze compositions. A very slight inspection of this toy shows, however, that it is far too delicate and complicated an instrument for war purposes, the probability of the required precision being gained is slight, while the setting of the fuze takes long, and is dangerous in inexperienced hands.

The definite adoption of heavy field-guns of a very superior stamp brought up the question of the desirability of change in the field equipment and material generally. It is a generally accepted fact, that the selection of a suitable equipment for any given new field-gun offers great difficulties, and takes more time than the choice of the gun itself. In Russia, where automatic decisions have their value, the question was solved with a rapidity and success that afford a very instructive example. After careful and complete trials the gun-carriage, limber, and wagon proposed by General, then Colonel, Engelhardt, were definitely adopted in 1878, and the only important variation since that time has been the substitution, at a more recent date, of a lighter limber and wagon for the horse artillery gun. The general system adopted (Pl. D) includes a carriage entirely of steel and iron, wood being only employed in the wheels. In the Engelhardt system the most remarkable point is the extensive substitution of gutta-percha for cork, and the various elastic parts of the carriage. The cheeks of the gun-carriage are of $\frac{1}{2}$ -inch boiler plate iron strengthened with angle iron, and their prolongation forms the trail; the cheeks are fastened to an iron axle, and to each other by three bolts placed at intervals along the trail and by the trail plate; in lieu of a trail eye there is a circular hole in the trail plate through which a strong pintle is passed. The trunnion beds and plates are of the usual form. The elevating arrangement is known as the double or Russian screw. This consists of an inner right-handed screw working in an outer

¹ 11 tons per square inch.

left-handed screw, the latter working in a gun-metal socket and acting on a lever, one end of which is fastened to a bolt connecting the cheeks, and the other supporting the breech of the gun. The trail (Fig. 4) is arranged so that by ploughing up the ground it may lessen the recoil, and is made particularly strong for this purpose. The elastic buffer (Figs. 2 and 3) is formed of two rectangular plates of gutta-percha, *a*, with a central hollow of the same shape. On the short sides there are two semi-circular lodgments for the passage of the bolts, *b*. Between the two plates there is a sheet-iron diaphragm with rivetted washers on each face, which fit exactly over the central hollow of the plates. The cap-squares have a similar washer; all this arrangement of washers and nuts is designed to retain the gutta-percha plates in position, and prevent their being displaced by the jolts and shocks they are always liable to. This employment of gutta-percha, a material hitherto regarded as one that stiffens in low temperatures and rapidly loses its elastic properties, is distinctly a point scored by Russian gunners. The secret of the Engelhardt system consists in the employment of a perfectly pure material, which is made to undergo a suitable preliminary vulcanization; a perfectly homogeneous and elastic gutta-percha is obtained in this way, and its properties are not affected even by a temperature ranging to 25° below zero. Gutta-percha washers are also placed at *m* (Fig. 2) to lessen the lateral shocks produced in movement.

Formerly cork springs supported the seats of the carriage; these have been replaced by gutta-percha springs made of a simple hollow cylinder, fitted at each end with a bronze collar and traversed by the nut *e*, which carries the sheet iron of the seat *d*, and passes freely in the collars and in the support *f*.

The framework of the limber is made up of two futchels which unite in rear, and of the fixed splinter-bar which forms the front. The connection is further insured by cross-pieces; all these are of strong angle iron. The union is strengthened by elbows, and in order to avoid bending the projecting portion of the splinter-bar, the latter is united to the futchels a little in advance of the front cross-pieces by short tensile stays (Fig. 8).

The rear ends of the futchels are united by two plates rivetted above and below into which the pintle is fixed. A similar axle serves for limber and ammunition wagons; this has two wings secured by a transversal rivet at right angles, and destined to unite the axle and the suspending springs. The gun-carriage rests therefore indirectly upon the axle, but by the agency of the springs placed below the latter. This disposition has the tendency to lessen shocks and movements which take place on the march, and to reduce the wear and tear which these causes so rapidly produce.

Without going into very elaborate details it may be noticed that the suspension of the carriage is so contrived that the weight of the frame, body, and load bear on the head of the springs, and are thence transmitted to the axle, so that all shocks and movements first place the elasticity of the springs in action, and all vibrations that might be dangerous are replaced by less violent vertical oscillations of the body of the carriage towards the axle.

The limber has a large single metal ammunition box secured to the cross-pieces and futchels by rivets so that it is not removable.

The ammunition box is of sheet iron, only $\frac{1}{16}$ of an inch thick; it has a low hand-rail in rear and at the sides. It is divided into two half-boxes (Pl. D, Figs. 5 and 7), and each of these, as shown by the sketches, into six cases, each holding one case of projectiles or cartridges.

The six lower cases are each intended for a case of projectiles, the upper shelves receive the cartridges, contained in leather cases, and provided with as many cylindrical frames as they are intended to hold cartridges. In front of this ammunition box is a second smaller wooden box attached

to the futchels by ratchets. The inclined upper surface of the latter, which also serves as footboard, opens and shuts with a swivel and hasp. It contains battery tools and spare pieces, that of the gun limber has in particular the sights, clinometer, quadrant, &c.

The pintle or iron post, 18 inches long, projects some 2 feet behind the axle of the limber. It is a very convenient method for limbering up, but it does not appear to present any other advantage over the more usual system. It causes a perpetual change of balance of the pole, the front end of which is sometimes up in the air and sometimes at the horses' knees. The limber ammunition box is placed somewhat in front of its axle, in order to counter-balance the pressure of the trail when attached; but since the amount of forage and ammunition carried is far from being invariable the adjustment of the weights is seldom satisfactory.

The leaders of the teams, instead of being directly harnessed to the traces of the wheelers, are attached to a sling splinter-bar at the end of the pole. To enable the wheelers to back the carriage the end of the pole has a large ring (Pl. E, Fig. 4) in which are two smaller rings each provided with a hook; from these to the collars there passes a strong chain. The swingle-trees are of iron, the traces and couplings absurdly long, making a distance of 5 feet between the horses; this, combined with the frequent proximity of the pole to the ground, gives rise to the danger of entangling the horses' legs in the traces.

Turning now to the ammunition wagon, it will be evident from the sketch (Pl. E, Figs. 1, 2, 3, and 5) that in its essential parts it is similar in construction to the limber, the framework having two futchels joined by three cross-pieces, of which the central piece is a little in rear of the axle. This carriage can turn through an angle of 80°. The ammunition box is of similar construction to that already described, but it has a double interior capacity with a centre of gravity placed considerably in front of the axle; it is fixed at the sides by bent ratchets, and also by rivets to the framework of the carriage, on which it is supported by wooden brackets. The front and rear of this box have a single door opening downwards on hinges, and kept closed by three hasps. The projectile cases both for wagons and limbers are made of open work sheet iron, in order to facilitate loading and unloading, and preserve the projectiles in transport. Each case is in two half-cases, and the whole is strengthened by the arrangements shown in the sketch. (Pl. E, Fig. 6.)

The later pattern of horse artillery limber and ammunition wagon designed by General Engelhardt mainly aims at increased lightness of construction, in order to afford greater mobility to the guns acting with cavalry. The pintle is still adhered to, but its connection with the trail-eye has been altered and improved since it was found that with the other system the connection between gun and limber was occasionally severed when going fast over rough ground. In the new pattern there is an oblong ring at the end of the chain, which fits over the end of the pintle, made of the same form, and is then given a turn through half a circle.

A circular axle is joined to the branches of the framework by an arrangement of twin plates turning on a pivot: a combination of steel bolts, iron discs, and gutta-percha springs makes the whole less liable to damage by jolting, tie-pieces connect the centre of the axletree with the futchels of the frame and pass through small gutta-percha springs, held firmly between an iron disc and a disc of phosphorized bronze. A plate is rivetted both to the disc and to the branch of the frame; thanks to these arrangements lateral oscillations are very much reduced. The pole is similar to that in use by field batteries, but each horse artillery battery has six spare shafts each in two parts.

The ammunition box is in six compartments, the upper and lower compart-

ments being separated by a layer of sheet-iron. Each lower compartment has three case divisions, that at the top has three compartments in all. The floor of the box has a number of small holes to allow rain water to pass through in case it may have penetrated in spite of all precautions. One would think that powder would rapidly deteriorate by being exposed to the air in this fashion.

On the six gun limbers there are carried six sacks of oats and various spades, picks, and axes; each of the twelve ammunition wagon limbers has also to carry a sack of oats and a variety of battery tools; twelve iron bands to repair broken poles, as well as three spare pintles are distributed among the limber boxes of the battery.

The body of the new ammunition wagon has a similar system of springs; the projectile cases do not materially differ. The differences, generally speaking, are slight and unimportant.

Ammunition is carried by batteries in war as follows:—

		Shells.	Shrapnel.	Case.	Total.	Cartridges.	Friction tubes.
Horse artillery battery (6 guns).	Gun limber.....	7	10	3	20	23	23
	Wagon limber	12	10	3	25	25	70
	Wagon body	15	15	..	30	30	..
	Total per gun.....	61	60	9	130	133	165
	Total per battery	366	360	54	780	798	990
Light battery (8 guns).	Gun limber.....	13	15	2	30	30	38
	Wagon limber	13	15	2	30	30	102
	Wagon body Nos. 1 to 8...	25	25	..	50	53	..
	Wagon body Nos. 9 to 12..	25	25	..	50	50	..
	Total per gun.....	70	75	6	150	153	191
	Total per battery	560	600	40	1,200	1,224	1,528
Heavy battery (8 guns).	Gun limber.....	7	9	2	18	18	21
	Wagon limber	7	9	2	18	18	59
	Wagon body Nos. 1 to 8...	12	15	..	27	30	..
	Wagon body Nos. 9 to 16..	15	12	..	27	27	..
	Total per gun.....	48	51	6	103	111	139
	Total per battery	384	432	48	864	888	1,112

The fortress field batteries with 8 guns and 2 wagons have each a supply of 600 rounds a gun, but only one-twelfth of this is carried with the batteries in action, as follows:—

	Shells.	Shrapnel.	Case.	Total.
Gun or wagon limber	15	15	2	32
Wagon body.....	25	25	..	50
Total per gun	25	25	2	50
Total per battery.....	180	200	20	400

In the question of mountain material the Russian Army has long been in a transition state, but this period may now be considered at an end. In 1884 a steel mountain gun, called the 2·5-inch pattern, 1853, was adopted, and is replacing both the 3-pr. bronze guns which so long formed the armament of the service as well as the more recent 2·5-inch Baranovski guns.

The 2·5-inch Baranovski gun has a screw bolt breech mechanism, and the cartridge is contained in a tin case attached to the projectile; the later pattern has the more common cylindro-prismatic breech mechanism and the ordinary detached silk cartridge.

If it be considered for a moment that *mobilization produces 25 batteries of mountain artillery with 200 guns*, and further that Russia in Europe has no mountains, it becomes sufficiently obvious against what Power this very considerable deployment has been projected. If, as regards quality of field material, our new guns are certainly superior to the Russian, except in weight of metal, can the same thing be said for our mountain material? To answer this question it is only necessary to compare the tables given in the Appendix with the performances of our own guns.

There is one other point of importance: it has not been considered advisable or necessary to give Lieutenant-Colonel Scott's telescopic sights to our mountain artillery; but within the last year practically identical sights have been adopted for the Russian mountain guns, giving them a new advantage which it may perhaps be not too late to retrieve.

The new mountain gun (Pl. E, Figs. 1 and 2) is of steel, and has a long carriage giving great stability when in action: the carriage is heavy and is in two parts connected by a hinge-joint, and secured by bolts. The cheeks of the carriage consist of iron plates with edges bent outward, the trunnion plates are rivetted inside the cheeks of the carriage. When fired where there is no room for recoil, ropes are attached to the hook at *q* and the naves of the wheels.

The gun can be used on wheels or carried by pack transport. The ammunition case holds six cartridges and six projectiles; a horse carries two cases, each gun is supposed to have eight horses for ammunition or ninety-six projectiles per gun.

The projectiles (Pl. B, Figs. 7 and 8) used with the new gun can be very shortly described. The shell varies little in its characteristics from that in use by the field artillery. The shrapnel has a steel body A and a brass head F attached to the body by four screws. The bursting charge is in the base of the shell, and is covered by the steel cup B. The central tube is of iron and fits into the cup at one end and the plate G at the other, which is screwed into the fuze-hole. The bullets are of the same material as used by the rest of the service, namely, four parts lead to one of antimony; they are 100 in number for the shrapnel in question, and are retained against the walls of the projectile by an iron tube D. This projectile has two rings to centre the action and prevent wobble; the whole weighs 8 lbs. 12 ozs.

This gun has a special carriage, and that used with the now discarded Baranovski gun is, it seems, to be employed with machine-guns.

As a rule the material of the foot mountain batteries is carried on the backs of horses, while that of horse mountain batteries is on wheels, the men of the battery all being mounted. For short marches and changes of position, however, the foot batteries keep their material on wheels.

This completes the account of the field material in the hands of Russian troops. Glancing back at the material as a whole, it is impossible not to be struck with the great progress made in this technical branch of the service since the last war, when it may be said that all was for the worst, in the worst of all possible artillery worlds. Admitting that the Russian artillery was much behind the age in 1877, that it was armed with bad guns, with a low

muzzle velocity, third rate man-killing projectiles, and fuzes whose action was chiefly conspicuous by its absence, it must in justice be allowed that quite another state of things now rules, and without any desire to over-estimate the value of science in unscientific hands, it must be conceded that this fact has much importance. It has been shown that the Russian artillery is now armed with a gun which, as regards practical fire effect in the field, is second to none but our own and the French, and superior to several foreign weapons, that the rearmament is complete, and that future wants can be met entirely in the home markets; that the arsenals and foundries bear favourable comparison with many of the best in Western Europe, and have enabled Russia to produce a peculiarly economical type of gun; that in every technical detail which has been examined progress is the rule; that inventions in all the paths of technical science are many, frequent, and valuable; that the difficult details of shrapnel, sights, and fuzes have been solved satisfactorily; that the equipments of batteries have been decided once and for all, in a manner to satisfy the requirements of the arm; that the manufacture of carriages for guns discloses a number of remarkable inventions and improvements, and that the supply of ammunition is calculated on a scale of wise liberality; that, in short, so far as a mere technical enquiry into material can carry one the Russian artillery is a formidable arm. On the other hand, in certain details there are defects, but of not sufficient importance to counter-balance the good points noticed. Of these defects the clumsy compiling of the terms has been already mentioned, together with the insecurity of the pintle attachment in the 1877 carriages, and the want of care displayed in the proper adjustment of weights. One or two minor points remain to be noticed. It has been observed that the sheet iron of the ammunition boxes is only $\frac{1}{16}$ of an inch in thickness, and that the cartridges are all carried in the upper part of the ammunition boxes; it would appear, therefore, that since the brown powder invented in Germany, with its peculiar properties of not exploding by the force of a blow, has not been adopted,¹ and that the ordinary large-grained black powders are in use, that these limbers and ammunition boxes may be exploded if struck by an infantry bullet, a point of the very greatest importance. Nor will it have escaped the attention of artillerymen that Russia has not succeeded in inventing a base fuze except for mortar fire, and further that the majority of the shrapnel employed have the same absurd central tube, taking up much valuable space, as that from whence we are slowly emancipating our service. Lastly, no good combined time and percussion fuze has been introduced; in all other artilleries such a fuze is now considered indispensable.

Turning now to the heavier natures of ordnance, the various types may be most conveniently considered under the separate headings of siege, fortress, and coast material, although certain calibres are indiscriminately used for one service or the other.

All questions relating to the heavier natures of guns have been studied profoundly in Russia since the Crimean War, when Russia saw her coasts insulted by the "amphibious strength" of a powerful fleet. In 1858 Colonel Gadolin analyzed and determined the conditions of resistance of the bores of guns, and by 1861 he was able to demonstrate the possibility of increasing the resistance to explosions by more methodical manufacture of heavy ordnance. While Gadolin's theory served as the basis for the construction of the famous Krupp guns, it is equally true that the formulae made use of in Gadolin's two mémoires published by the Russian Artil-

¹ The Okhta powder mills claim that they have discovered the secret of this powder, and are now manufacturing large quantities of it.

lery Journal in 1863, were originally due to MM. Lamé and Clapeyron, and had been published so far back as 1833. Russian industry was not in any position to make use of Gadolin's new application of old discoveries, and the first experiment took place at Essen. Russia, nevertheless, contributed largely towards the creation of the hooped steel system, which subsequently became the recognized method of construction for heavy ordnance.

The siege guns are intended to form part of the siege parks and to be used on the offensive: the fortress guns are, as their name implies, intended for the defence of strong places in Continental Russia; the third and most powerful type is destined to oppose the equally or perhaps still more powerful batteries of an ironclad fleet. In the following description of Russian heavy ordnance, only a few points of importance will be touched on in the text, so that the general character of the heavy artillery may not be lost sight of under a mass of details. All these details, ranges, penetration into earth and iron, weights, &c., are fully set out in the Appendix for all the most important types of guns, in order to make the whole account as complete as possible.

The SIEGE ARTILLERY includes the following guns:—

(1.) *4·2-inch R.B.L. guns* (Pl. F, Fig. 1), for dismounting the enemy's guns, and for fire effect generally at medium ranges. This gun has a steel tube and steel hoops; the breech mechanism is on the cylindro-prismatic wedge principle; there are two cylindrical chambers, one for the cartridge the other for the projectile, connected by a neck where the rifling begins; a second shorter neck joins the projectile chamber with the bore proper.

(2.) *6-inch light steel R.B.L. gun of 120 puds*, for every description of fire at middle and long distances against troops and moderately strong obstacles, firing shells, shrapnel, and case. The gun is entirely of steel, with cylindro-prismatic wedge; it is one of the latest additions to the siege train.

(3.) *6-inch long steel R.B.L. gun of 190 puds* (Fig. 2, Pl. F), for distant bombardment. This weapon has an inner steel tube and steel hoops enveloping the breech from the front extremity of the wedge; one of these hoops carries the trunnions. The breech mechanism is the same as in the last gun, and the arrangement of the chamber very similar to that of the 4·2-inch gun.

(4.) *8-inch screw steel R.B.L. gun* (Fig. 3, Pl. F)—a peculiarity of the Russian siege artillery—for firing against earthworks with shells containing a large bursting charge. This gun has also two essential parts, the inner tube and the body of the gun proper. The tube is a solidly cast single piece, and forms both the chamber and the rifled portion of the bore. The body of the gun is also in two parts, namely, the breech and the chase. The latter, for a portion of its length, has a series of cylindrical hoops in steps; these hoops are continued over the breech, while round the portion which corresponds to the rear end of the cartridge chamber is a thicker hoop forming a salient. The breech has a cylindro-prismatic wedge, and the rifling is increasing. In putting this gun together after a journey, the breech is first placed on the carriage and the chase then raised to the same level, fitted to the breech, and then attached by a turning movement being given to the connecting screw. Into the body of the gun so put together, the inner tube is inserted, and the whole carefully connected by an arrangement of clamping screws; it takes twenty men three hours to put this gun together, and great results are expected from its portability and power. It was used at Rustchuk in 1877, and gave every satisfaction.

(5.) *3·4-inch R.R.L. steel howitzer*, for vertical fire against troops at short distances.

(6.) *8-inch steel R.B.L. howitzer* (Fig. 4, Pl. F), for vertical fire against casemates at medium ranges. This mortar has a row of hoops like the

8-inch gun, and the chamber is on the same principle as the 4.2-inch gun; the rifling is increasing.

(7.) 9-inch screw R.B.L. howitzer (Fig. 5, Pl. F), for vertical fire against casemates when a very heavy projectile and destructive effect is required. This weapon is built upon the same principle as the 8-inch screw gun; it is a very cumbersome piece of ordnance, and in travelling the breech cannot be transported on the carriage, as in the case of the 8-inch screw gun, for the breech itself weighs over 3 tons, and the carriage 2½ tons. The breech is, therefore, transported on a special carriage; the putting together of this gun is managed on the same principle as the 8-inch screw gun.

As a rule, it may be said that during the process of rearmament which, as regards heavy ordnance, is never ending, the principle is in Russia to give the newest and best guns to the siege parks and coast batteries, and to scatter the more ancient weapons among the Continental fortresses, the most indifferent types being given to the least important places.

Fortress guns include six different types; each of these has again a certain number of varieties.

(a.) Bronze 4- and 9-pr. R.B.L. field guns, formerly in the hands of the field troops, for use against hostile troops in the open.

(b.) 4.2-inch R.B.L. guns (Fig. 1, Pl. F), for dismounting the enemy's guns at short and middle distances. These have been already described.

(c.) 12- and 24-pr. long and short R.B.L. guns in bronze and cast iron. A great variety of these guns exist.

(1.) 12-pr. cast-iron double wedge R.B.L. gun. There are two patterns of this gun, which differ only in their exterior shape. The first has a cylindrical breech; to right and left are two lateral cylindrical appendages with a common axis which meets and is perpendicular to the axis of the piece. These two appendages form the lodgment of the double wedge; they are terminated by planes perpendicular to the axis of the trunnions; the shoulders of the trunnions are cylindrical. The second pattern has a breech with the form of a parallelepiped with squared edges; it has the same lateral appendages as the pattern just described. The breech finishes off with a large cylindrical ring concentric with the bore of the piece; the shoulders of the trunnions are square. The breech end and chase are similar in each pattern; these form two truncated cones with their major bases towards the rear.

(2.) 12-pr. cast-iron R.B.L. gun. The breech mechanism has a cylindro-prismatic wedge. The chase and breech take the form of truncated cones; the chase ends in a cylindrical rim. The breech is a cylinder, cut on the left side by a plane face perpendicular to the axis of the trunnions; it is terminated by a rim, also cylindrical, on the upper portion of which is cut a slight groove or recess, on which the clinometer is placed. The trunnions and their shoulders are cylindrical.

(3.) 12-pr. cast-iron R.B.L. gun, with cylindro-prismatic wedge. This weapon has a truncated chase and breech end; the chase finishes with a cylindrical rim. The breech is a cylinder, cut on the left side by a plane face perpendicular to the axis of the trunnions; it finishes off with a cylindrical rim, on the upper part of which a groove is cut to receive the clinometer. The trunnions and their shoulders are cylindrical; the interior shape is the same as the 12-pr. double wedge guns.

(4.) There are a few 12-pr. steel R.B.L. guns with cylindro-prismatic wedge like the German guns of the 1873 pattern, but the manufacture is discontinued.

(5.) Long cast-iron 24-pr. R.B.L. guns, 1867 pattern, with double wedge. These are of the same shape and make as the corresponding 12-prs.

(6.) The long cast-iron 24-pr. R.B.L. gun (Fig. 1, Pl. G (Vol. Pl. 5)), with cylindro-prismatic wedge, is similar to the corresponding 12-pr.; and the

(7.) 24-pr. long bronze R.B.L. gun, pattern 1867, is also built exactly on the same line as the corresponding 12-pr.

(8.) The 24-pr. short cast-iron R.B.L. gun, pattern 1871 (Fig. 2, Pl. G), was designed to emulate the performances of the German 15 c. gun which took so important a part in breaching the Strasburg lunettes; it is on the same principle as this gun throughout.

(9.) The 24-pr. short cast-iron R.B.L. gun, pattern 1872, is of bronze, and resembles in its general forms the 1867 long 24-pr. gun. Both these short 24-prs. are intended more particularly for enfilade fire, and dismounting the enemy's guns.

(10 and 11.) Only a small number of long and short 24-pr. steel guns (Fig. 3, Pl. G) exist. The first type is a great improvement on No. 7; it is 10 feet 8½ inches long, and has an initial velocity of 1,053 feet a second.

(d.) *The 6-inch light and heavy R.B.L. guns*, for direct fire at long distances, have been already noticed. One of the varieties of this gun, namely, the 6-inch or long 24-pr. R.B.L. gun with steel hoops, is particularly reserved for the fortress armament. This gun has a steel tube with a row of steel hoops shrunk over it, reaching from the front end of the breech-closing wedge. The breech mechanism is cylindro-prismatic. There are two chambers, one for the cartridge and one for the projectile, connected by the usual truncated necks; the twist of the rifling is uniform. This gun fires a lead-coated projectile; it has 24 grooves, weighs over 3 tons, and has the high initial velocity of 1,560 feet a second.

(e.) *Light 8-inch steel R.B.L. guns*, for direct fire against obstacles at long ranges.

(1.) Of these, the 8-inch light steel R.B.L. gun of the old pattern has a steel tube and three hoops (Fig. 4, Pl. G), one of which carries the trunnions. Cylindro-prismatic wedge; weight 5 tons; initial velocity 1,050 feet a second.

(2.) The 1877 pattern light 8-inch steel R.B.L. gun, weighs about 5½ tons, has forty-six grooves with an increasing twist in the rifling. The initial velocity is 1,312 feet a second.

(f.) *6-inch and 8-inch bronze, cast-iron, and steel howitzers*, for vertical fire against blindages and troops at medium and long ranges.

(1.) 6-inch bronze R.B.L. howitzer. This weapon has a breech of cylindrical form, cut by four planes parallel to the axis of the bore. The lower plane has a swallow-tailed shaped slot, into which gears the end of a toothed elevating arc. The chase is truncated; the trunnions strengthened by square shoulders; the axis of this meets that of the howitzer, whose centre of gravity is at the intersection of these two axes. The breech has the cylindro-prismatic mechanism, and the wedge is of steel. Two screw hooks, fixed on the edge of the breech, receive the shell carrier. The chamber is concentric with the bore; the vent channel is perpendicular to the axis of the piece, and the vent itself is placed in position by the side. The twist of the grooves is uniform. This gun has twenty-four grooves, and weighs 31 cwt.

(2.) The 8-inch bronze R.B.L. howitzer differs very little in construction from the above. It has a prismatic wedge and Broadwell ring.

(3.) The 8-inch steel R.B.L. howitzer, 1870 pattern, has a single row of hoops, the cylindro-prismatic wedge, and uniform twist in the rifling. It has thirty grooves, and weighs nearly 4 tons.

(4.) The 8-inch cast-iron R.B.L. howitzer, pattern 1873, is built on the same general lines, with a few modifications due to change in the material.

(5.) The 8-inch steel R.B.L. howitzer (Fig. 4, Pl. F), pattern 1877, has been already described.

This completes the list of the weapons in use by the fortress artillery, and

in the Continental strongholds of Russia. It only remains to briefly enumerate the larger types of guns in use in the sea batteries.

Coast guns include the following ordnance (Pl. II) :—

(1.) *6·03-inch steel R.B.L. guns.*—These have a similar external appearance to the 4- and 9-pr. guns; they are, in fact, the old 24-pr. steel muzzle-loaders converted. They have twenty-four grooves, and weigh nearly 4 tons.

(2.) *8-inch cast-iron and steel R.B.L. guns.*—Four varieties of these exist :—

(a.) *8-inch steel R.B.L. gun without hoops,* with a similar appearance to the 4- and 9-pr. guns (Pl. II, Fig. 7); it has a vent perpendicular to the axis of the piece, and a prismatic wedge.

It may be conveniently noticed here that when the principle of breech-loading was adopted in Russia, only a small number of 8-inch muzzle-loaders were completed; others were in course of preparation, some being turned and bored but not rifled; others only turned on their outer surfaces, and not bored to any definite calibre; others, again, were in the rough stage.

The guns already rifled were increased to a larger calibre, transformed into breech-loaders, and rifled afresh; these form the category of 8·5-inch guns which will be mentioned below. The other incomplete 8-inch guns were also transformed into three different types of steel non-hooped guns. The first of these consists of those muzzle-loaders which had been completed, but had not been rifled; the second of the material which had been partially prepared for muzzle-loading; and the third of ingots in their rough stage. The three are distinguished by their length, which increases from the first to the third type; the breech has also a different shape in each type.

In the two first patterns the cylindrical breech finishes off with a rounded edge, and is cut on its left side with a plane perpendicular to the axis of the trunnions; in the third pattern, the breech is thicker, and has these flat surfaces on each side. The latter has 30 grooves, weighs 8 tons, and has an initial velocity of 1,254 feet a second.

(b.) *The 8-inch steel-hooped R.B.L. gun (Fig. 6, Pl. II)* has an inner steel tube, and is strengthened by hoops extending from the fore end of the lodgment of the breech block to the beginning of the chase. One of these hoops carries the trunnions; it is wedged in its fore part by a ring in two pieces, which is bedded in a circular groove cut on the exterior surface of the steel tube, in order to guard against the hoops slipping to the front; the end hoop, placed over the point where the series of hoops begins near the breech, bears against a projection from the tube, and similarly prevents all chance of shifting from front to rear. The breech has the prismatic wedge, through which the vent is pierced axially. The chamber is eccentric, the grooves have a uniform twist. This gun weighs over 9 tons, has 30 grooves, and an initial velocity of 1,315 feet a second.

(c.) *The 8-inch cast-iron R.B.L. hooped gun (Fig. 1, Pl. II)* has a cast-iron inner tube and a steel jacket; very few of these exist.

(d.) *The 8-inch steel-hooped R.B.L. gun (Pl. II, Fig. 2)* with screw breech-closing mechanism. This gun has a steel tube and hoops of the same material. The peculiarities of construction appear on reference to the Plate. The last hoop but one has a series of grooves on its lower surface, into which fit annular excrescences which project from the outer circumference of the inner tube. Applied when at white heat like the rest, this hoop, on contracting when cold grips the tube firmly, and exercises a secure longitudinal and transversal pressure. The breech-closing arrangement is the screw of the French Navy. A good many of these guns exist, but their manufacture has been now discontinued.

(3.) *The 8·5-inch steel R.B.L. guns* have been already mentioned.

(4.) *9-inch cast-iron and steel R.B.L. guns.* Three varieties of these exist :—

(a.) *The 9-inch steel hooped R.B.L. gun of the old pattern (Pl. II, Fig. 8)*

has an inner steel tube; the breech and the breech-end are united by four successive steps of metal, the two last hoops of the first row resting against the steps; the hooping is in two portions, the first having a single row of three hoops, the second including two rows of hoops. One of the outer hoops carries the trunnions; it is kept in place by a ring which fits into the first row of hoops as in the 8-inch guns; the two last hoops of the second row project from the rest of the hooping and the breech end. The breech has the prismatic wedge; the chamber is eccentric and the vent axial. This gun weighs nearly 15 tons, has 32 grooves, and an initial velocity of 1,315 feet a second.

(b.) The 9-inch steel screw R.B.L. gun (Pl. II, Fig. 3). This gun has a peculiar arrangement of the hoops which will be best understood by reference to the Plate; the breech mechanism is on the French screw principle with an axial vent. The hand-wheel of the breech screw has at its upper extremity an iron lever whose point may be successively fitted into the notches of the upper portion of the circumference of the hoop over the breech end. This gun has two sights resting on two bronze supports fixed right and left of the breech. The gun weighs 16 tons, has 32 grooves, and an initial velocity of 1,315 feet a second. No guns of this kind have been made since 1877.

(c.) The 9-inch coast R.B.L. gun, pattern 1877, differs from (4) (a) by its different trace and dimensions; the exterior is very similar. In this weapon, as in all guns constructed at this particular period in Russia, there are the two chambers for cartridge and projectile; the vent is pierced axially; there are 52 grooves, the gun weighs 15 tons, and has an initial velocity of 1,360 feet a second.

(5.) 11-inch steel R.B.L. guns:—

(a.) 1877 pattern (Pl. II, Fig. 9), does not differ from the type proper to this period. Weight 27 tons; initial velocity 1,476 feet a second.

(b.) The more modern type of the gun, constructed at the Obukhov foundry, is hooped right up to the muzzle, the hoops toward the fore end of the chase being shrunk over graduated steps made for this purpose in the outer surface of the inner tube.

(c.) The 11-inch long steel R.B.L. gun (Fig. 4, Pl. II) weighs 43 tons. It may be remarked that Russia has been unable so far to produce good ammunition for her 11-inch guns, and is tributary to Krupp in this single instance.

(6.) 14-inch short steel R.B.L. gun, pattern 1877, only differs from the 11-inch, 1877 pattern, in dimensions; it weighs nearly 58 tons, and has 80 grooves.

(7.) 9-inch and 11-inch coast R.B.L. howitzers. Of these there are seven different types, as follows:—

(a.) 9-inch steel R.B.L. howitzer, with cylindro-prismatic wedge. This has a steel tube and a row of hoops; two half-rings make a support against which the first hoop rests; the twist of the rifling is uniform.

(b.) 9-inch steel screw R.B.L. howitzer, and (c.) 9-inch cast-iron R.B.L. howitzer do not differ materially in dimensions from (7) (a).

(d.) The 9-inch R.B.L. howitzer, 1877 pattern (Pl. II, Fig. 5), varies only in its interior trace: its weight is nearly 9 tons; it has 52 grooves.

(e.) The 9-inch screw R.B.L. howitzer has been mentioned among the siege guns.

(f.) The 11-inch steel R.B.L. howitzer, with cylindro-prismatic wedge, only varies in a few measurements from the old pattern 9-inch steel mortar.

(g.) The 11-inch cast-iron howitzer has a cast-iron tube with a single row of ten steel hoops up to the muzzle.

The carriages in use by the siege and fortress artillery are for the most

part of metal and are distinguished by their great variety of pattern. As a general rule it may be said that almost every gun and mortar has its own special and particular carriage. Distinguishing them by names, there are the Semenov carriages for 8-inch and 9-inch coast guns; the Gorlov, Chvede, and Chantz carriages also for the 8-inch guns; the "Artillery Committee" and Andriev carriages for 60-prs. and 3- and 6-inch guns. Among the wooden carriages there are the Venglovski and Nasvietevitch, while of the large types the majority are known by the calibre of the guns they are intended for. In the following description of the carriages of heavy ordnance details of construction have been omitted or relegated to the Appendix. It has been attempted to give a sketch and short account of the more important types so that the work may be of practical use if the need arises. The following types are those in most general use:—

- (1.) Iron field carriages for 4- and 9-pr. guns.
- (2.) Garrison carriages, 1865 pattern, for R.B.L. 24-pr. cast-iron, steel, and bronze guns; for 12-pr. R.B.L. cast-iron guns and S.B. cast-iron 24-prs. Many of these were modified in 1874 and succeeding years in order to enable a limber to be added so as to transport the 24-prs. from point to point, a process not practicable at the date given, owing to the diminutive size of the wheels. The weight of this type is about 22 cwt., and the height of the axis of the trunnions 4 feet 1 inch.
- (3.) Siege carriages, 1869 pattern (Pl. I, Fig. 1), for rifled bronze 24-prs. and middle weight cast-iron guns. In these the elevating arrangement is a simple bronze screw; it is of somewhat complicated construction, but can be used for travelling. Its weight is just under a ton with the wheels, and the height of the axis of the trunnions 4 feet 10 inches.
- (4.) Siege carriages, 1877 pattern (Fig. 1, Pl. I), for 24-pr. bronze guns and cast-iron middle weight guns, 4·2 inches and 6-inch light and steel R.B.L. guns. Owing to the importance of the latter guns this carriage is one of the best employed in the service. The weight of the gun on this carriage is thrown towards the rear so as to lessen the jar to the wheels, to increase the pressure on the trail, and to diminish the recoil. For short distances the gun can be carried in its firing trunnions; in its proper travelling position it rests on an iron cushion as shown by the dotted line in the Plate. The sighting arrangements in both these carriages are similar to the German *richtscale*. The height of the axis of the trunnions is 5 feet 11 inches, and the weight of the carriage 22 cwt. with the wheels. A maximum elevation of 26° can be given and a maximum depression of 8°.
- (5.) Siege carriages, 1878 pattern (Fig. 2, Pl. I), for 24-pr. R.B.L. hooped guns. These can also take the 6-inch guns of 190 pds, and all 12- and 24-prs., except the short bronze 24-prs. of the 1873 pattern. This carriage is very similar to that last described but is generally stronger; it allows the gun to fire over a 5 feet 11 inch parapet, and the total weight is 32 cwt.; an elevation of 40° and a depression of 8° can be given.
- (6.) Howitzer carriages for the 6-inch R.B.L. pieces (Figs. 3 and 4, Pl. I). These have a toothed elevating arc, fixed to the breech and fore part of the weapon, which steadies the piece when laid. Carriage, howitzer, and limber weigh 4 tons; elevation to 75° and depression to 5° can be given.
- (7.) Carriages for 8-inch rifled and 8-inch light howitzers (Figs. 1 and 2, Pl. K); these latter were originally intended for the 8-inch guns also, but the low parapet needed was found unsuitable; the 8-inch guns have now the 9-inch howitzer carriage. The weight of this carriage is over 2 tons.
- (8.) The 3·4-inch R.B.L. howitzer carriages are distinguished by an improved side elevating arrangement enabling an angle of 65° elevation and 10° depression to be given.

The question of carriages for the heavy guns in use by the coast batteries is

a matter which concerns more particularly a Naval Intelligence Department ; the same remark applies to the heavy armour-piercing projectiles, casemates, and platforms. Only a very summary description of these will therefore be given, certain diagrams being added to enable the heaviest and most modern types of guns to be at once identified in case of necessity. There are ten distinct natures of carriages for heavy ordnance in use by the Russian coast artillery.

1. The Artillery Committee carriage, now replaced by a later type.
2. The Andrieu carriage, more particularly used in casemates for the old 60-pr. guns. Maximum elevation 36°, and depression 6°.
3. The 8-inch gun coast carriage (Pl. I¹, Fig. 2), Gorlov pattern ; weight over 2 tons ; height of the axis of the trunnions 4 feet 6 inches ; maximum elevation 26°, and depression 9°.
4. Colonel Chivede's carriage (Pl. I¹, Fig. 3), for 8-inch guns firing through embrasures. Weight over 3 tons ; height of axis of the trunnions 4 feet 8 inches ; maximum elevation 10°, depression 5°.
5. Admiral Chantz's carriage (Pl. I¹, Fig. 4), designed originally for the old 60-prs., and now often employed for 8-inch R.B.L. guns. Weight over 2 tons ; height of the axis of the trunnions 4 feet 3 inches. Maximum elevation 16°, depression 6°.
6. Semenov's carriages (Pl. I¹, Fig. 5) for 8-inch and 9-inch R.B.L. guns. Employed either in open or casemated batteries. Weight over 2 tons for the 9-inch guns ; height of axis of trunnions 4 feet 6 inches. Maximum elevation 23°, and depression 7° ; for the 8-inch gun the weight is less and the angles of fire 25° and 8° respectively.
7. 9-inch howitzer coast carriage (Pl. I, Fig. 1) closely resembles the 9-inch gun coast carriage, but is stronger in make and has a different sighting arrangement ; this carriage has a shell-lifting machine.
8. 11-inch gun coast carriage (Pl. I, Fig. 2). This is an important addition, giving a horizontal field of fire of 90° ; its weight is over 3½ tons, maximum elevation 14° 30', depression 6°, and length of recoil 4 feet 8 inches to 5 feet.
9. 11-inch and 14-inch coast carriages (Pl. I, Fig. 3) with hydraulic brakes. These are of the 1877 pattern, and differ from the last by using glycerine in the cylinders. The total weight of carriage proper with traversing carriage, &c., exceeds 34 tons.
10. Turret carriage for 11-inch guns ; giving all-round fire ; a maximum elevation of 15°, and a depression of 3°. Seven men are required to work this gun, working three different handles.

Of the projectiles in use by siege, fortress, and coast artillery, there are none that offer any very striking characteristics or novelty of design. The penetration into iron plates being given in the general tables of the Appendix for the most important guns, no further details will be added. It may be noticed that all these projectiles may be divided broadly into two classes, namely, lead-coated projectiles, fired from guns designed before 1877, and secondly, projectiles with copper rotating rings, fired from later types of ordnance.

Von Schnecher¹ states that the complete armament of the whole of the Russian land and sea fortresses requires 7,422 guns and 2,230,000 projectiles.

IV. ARTILLERY ESTABLISHMENTS.

The artillery establishments of the Russian Government belong to three distinct categories : first, those concerned with the production and care of

¹ *Die Land und Seemacht Russlands.*

warlike stores, or of the service of material generally; secondly, the instructional establishments; and thirdly, the remount service. The various branches of this service can be conveniently considered under these three general headings.

A.—Service of Material.

Generally speaking, these establishments may be divided into two classes: one concerned with the production of guns, powder, &c., and the other with preservation and storage. In both of these classes repairs are executed, but the productive establishments make it the rule only to undertake larger jobs where a complicated machinery is needed.

The productive establishments include—

(1.) Three small-arm factories at Tula, Sestrorietsk, and Ijev, which turn out rifles complete with all accessories.

(2.) One cartridge factory at St. Petersburg, as well as a private firm (Gillenschmidt's) at Tula employed by the State.

(3.) Three powder mills at Okhta, Mikhailovsk-Shostka, and Kazan, supplying both Army and Navy.

(4.) Three local arsenals at St. Petersburg, Briansk, and Kiev, with foundries attached to the two first; guns are here constructed, and all other kinds of artillery material for land service are both constructed and repaired.

(5.) A rocket manufactory at Nikolaiev.

(6.) Two circle artillery workshops at Tiflis and Warsaw for the repair of material with the troops.

Various other establishments exist, such as the Zlatoust sword factory, but do not come under the artillery authorities.

In principle each establishment includes a certain number of sections, subdivided into workshops, magazines, depôts, hospitals, and sick-wards. When the establishment is situated in an open town, a local artillery detachment is charged with the maintenance of order and the escort of convoys. In the general routine of duty, three departments are distinguished, namely, the command, whose action extends over the whole service, and in particular over the personnel: secondly, the technical department, embracing the execution of works, testing objects constructed, care of machinery, &c.; and thirdly, the administrative department, whose duties entail the preparation and distribution of provisions, and the care of material other than that under the technical department. This administration is directed by a council or commission, with a cabinet or committee for its executive organ.

All productive works, with the exception of the Tiflis and Warsaw workshops and the rocket factory, are under the general direction of artillery for all matters connected with technical service, and are immediately supervised by inspectors. With regard to interior service generally, discipline, command of attached local artillery, and dealings with the intendants, they come under the authority of the District artillery commandants. There are three inspections over the local arsenals, powder mills, factories, &c., and a fourth has recently been created for supervising the material of State and private metallurgical industries. These inspections number from three to six offices, with officials, secretaries, &c. The greater part of the works are executed by civil and foreign mechanics, except at the Warsaw and Tiflis workshops, where only soldiers are employed, but the general direction and superintendence is everywhere given by Officers and agents of the artillery.

The method by which warlike stores are passed into the service is as follows:—In each small-arm factory the weapons when completed are handed over to be tested by a special commission, immediately under the orders of the General Direction, and composed partly of artillery Officers chosen by the Grand Master, and partly of Officers of infantry and cavalry

nominated by the chief of the Military District, within the limits of whose command the factory is situated. The president of this committee and the other Officers selected from the artillery retain their posts for three years, the other members for not less than one year; the assistant-director of the technical department of the factory becomes *ex officio* a consultative member of the body. Establishments other than those under Government are permitted, on payment, to have their produce tested in these State factories.

As regards personnel, Tula has 12 Officers and 29 officials, with a local artillery detachment of 4 Officers and 200 men; the other two small-arm factories are on the same scale. The annual output from these small-arm factories averages 65,000 complete rifles (Berdan No. 2), besides dragoon and Cossack rifles and rifle barrels. At a pinch, however, this can be greatly exceeded; thus in 1878, according to statistics published by the War Ministry, 480,455 arms were made, namely, 447,000 infantry rifles, and 33,455 Cossack rifles, in addition to 100,000 rifle barrels. Briefly stated, then, it may be said that Russia possesses the machinery for turning out unaided nearly half a million of rifles yearly, and this power is not without its importance.

At the cartridge factories mentioned all small-arm ammunition is prepared, only the powder coming from the mills given in (3). The receiving committee is on the same lines as in the case of the small-arm factories. The St. Petersburg factory is divided into six sections, which are subdivided into twenty workshops; a superior Officer directs each section, and a subaltern Officer each workshop. In the 1st and 2nd sections the manufacture of cartridge cases is carried on; in the 3rd that of the caps; in the 4th the bullets are cast and the cases filled; in the 5th all instruments and machines needed by the other sections are made; in the 6th percussion- and time-fuzes are manufactured. A Major-General is in charge of this factory, and the personnel includes 48 Officers, 15 artillery agents, besides non-commissioned officers, &c. In conjunction with Gilienschmidt's firm at Tula, about 100,000,000 cartridges are annually made, the latter factory turning out one-third of the whole; this does not, however, represent the full power available in case of need, for in 1878 the Government factory alone turned out 123,000,000 rounds.

The powder mills undertake the entire charge of everything relating to the manufacture and care of explosives, including the various chemical compounds required by certain services. Manufacture is always suspended during the winter, and the mills are only at work from April to September. Receiving committees exist here also. The personnel includes 11 to 15 Officers, 13 to 19 officials, 2 draughtsmen, and a local artillery detachment of 300 to 400 men at each powder mill.

The Ohta mills, which date from the year 1715, were considerably enlarged between the years 1869 and 1877; they are now capable of producing at need 2,455 tons a year. The steam machinery has 369 horse-power, and the hydraulic machinery 921 horse-power; 725 workmen are employed. This mill is divided into five sections: in the three first the preparation and mechanical mixture of primary materials take place; in the fourth this is made up in readiness for use; the fifth section contains the Officers' and workmen's houses. A sixth section for explosive materials of the nitro-glycerine class is in course of formation. So far as can be learnt there is at present no chance of a surprise in this quarter from Russia. It is true that articles have been written with wonderful tales of the devastation wrought by a compound called *tsilotvor*, literally "force-producer," or *silator*, as it has been more generally written in England. This compound is the invention of W. von Ruckteschell. It is very far from being the revolution-producing compound it is generally described. In reality it is nothing newer than nitro-

cellulose, the trinitro-product of wood fibre. General Feodorov having made a number of experiments at Ochta found the invention was of no value for practical purposes.

The average annual output of powder is now about 2,740 tons, but this can be doubled if required.

The local arsenals make the greater part of the bronze and cast-iron guns, and since 1883 have made the new steel field-guns as well. They also manufacture projectiles, gun-carriages, and ammunition wagons, and execute all repairs beyond the power of the district workshops.

The St. Petersburg and Briansk arsenals each include a gun foundry and workshop for the manufacture of the new breech mechanism. That at St. Petersburg is on a far larger scale than the one at Briansk, and numbers in its personnel 18 Officers, 23 officials, and 164 men. Judging by the average output at these establishments, and comparing them with the year 1878, it appears justifiable to conclude that some 300 field-guns and limbers could be turned out all complete within the year in case of need.

The Nikolaiev factory makes both signal and war rockets; only a small personnel is maintained. There exist no rocket batteries proper in Russia, but war rockets have been frequently used in Asia and the Caucasus, the batteries being provisionally furnished with the necessary material. An artillery detachment at the Nikolaiev factory serves to execute experiments, transport the manufactured articles, and instruct troops in their use. In 1878, 3,000 2-inch war rockets, 1,550 3-inch signal rockets, besides incendiary and life-saving rockets, were manufactured.

Lastly, the two circle artillery workshops are intended for both repair and construction of material and small-arms. The necessity for having a workshop of this kind in the centre of the Polish fortified region, and another in the Trans-Caucasus, very early forced itself upon the attention of the authorities, who have always aimed, not only at making Russia self-containing in herself, but also at enabling the defenders of these two frontier and outlying territories in particular to maintain themselves in case of temporary isolation: the personnel of artificers, &c., at each point numbers about 100.

This closes the list of the productive establishments. Of those concerned with the care and storage of material the Military District artillery depôts are by far the most important.

These are said to contain, for all arms, active, reserve, and local troops—

- (1.) A reserve of material and ammunition for the current needs of peace.
- (2.) A reserve war supply for mobilization, augmenting that in the hands of the troops.
- (3.) A reserve war supply to make good material lost or consumed during the course of military operations.
- (4.) An extraordinary reserve destined for the use of troops of new creation and for the militia, or serving to strengthen the armament of existing works, or to arm points newly fortified.

The artillery depôt of the District comes under the command of the District artillery direction. It has a Colonel in command, with a staff in three sections for artillery, small-arms, and ammunition. If stationed in an open town a detachment of local artillery is added. If in a fortress, only a small cadre for administrative purposes. An artillery workshop and a laboratory are attached to each depôt; only military workmen are here employed. A certain number of the depôts form in war mobile field workshops and mobile laboratories.

The depôts are as follows :—

Military District.	Artillery depôt.	Branch depôts.	Furnishing	
			Mobile workshop.	Mobile laboratory.
I. St. Petersburg.	St. Petersburg		No. 1	No. 1
II. Finland	Tavasthuus ..		..	..
III. Vilna.....	Dünaburg ...	Bobruisk	..	..
IV. Warsaw	Brest-Litovsk	{ Warsaw	..	..
		{ Novo-Georgiersk	No. 2	No. 2
V. Kiev	Kiev		No. 3	No. 3
VI. Odessa.....	Kremenichug	Rostov (Don) ...	No. 4	No. 4
VII. Kharkov.....	Kursk	{ Briansk	..	..
VIII. Moscow	Moscow.	{ Shostka	..	..
IX. Kazan	Kazan.....	{ Tula	..	..
		{ Orenburg	..	..
		{ Tjver	..	..
		{ Baku	..	..
X. Caucasus.....	{ Tiflis	{ Alexandropol ..	..	No. 5
	{ Georgiersk.	Petrovsk	..	..
	Batoum ...	Poti	..	..
XII. Omsk	Omsk		..	..
XIII. Irkutsk	Irkutsk.....		..	..
XIV. Pri-Amur	Khabarovka..		one	one

The Turkestan District (No. XI) remained apart from the depôt formations effected elsewhere between the years 1874 and 1880. An arsenal and laboratory at Tashkent are charged with the duties undertaken elsewhere by the depôts and workshops; the arsenal can turn out wheels and ammunition wagons, while the laboratory supplies all arms with ammunition; 165 Officers and men form the personnel. That of the depôt or arsenal detached section and workshops varies between 9 Officers, 35 officials and non-commissioned officers, 264 artificers, and 161 various at the capital to a dozen of all ranks at Irkutsk.

It will be noticed that nearly everything connected with the military service of these establishments in general falls to the duty of the local artillery, which has to supply either formed detachments or simple cadres. The duties of guard, escort, transport, and maintenance of order also fall upon this body. The composition of these detachments vary from 7 Officers and 450 men at Shostka, to 2 Officers and 100 men at Omsk. No other regular artillery troops are therefore required for these detached duties, and the instruction of the arm in field service is to this extent less hampered by unfavourable local conditions than that of infantry or cavalry.

B.—Educational Establishments.

These include all those which concern Officers, men, and special personnel of the arm of the artillery, as well as practice grounds and instruction camps. Of the establishments which concern Officers, the *Michael Artillery War School* and the *Michael Artillery Academy* are of chief importance.

The first of these is designed to act as a preparatory institution for the

academy, and to form young Officers of this important arm. Every year from sixty to eighty students are admitted: the course lasts three years, and the three divisions are known as upper, middle, and lower class. Of these the first is divided into a "front"¹ and a mathematical section. Competitors must be 16 years of age: soldiers serving with the colours or in the reserve, whether as conscripts or volunteers, are allowed to compete: in the case of conscripts these must have served the legal period according to their degree of instruction. Youths who have completed their course at the military gymnasia are admitted without examination to the lower class. Candidates who have followed the complete course at the secondary civil establishments, or who have already undergone an examination on the subjects taught at the military gymnasia, have only to pass in mathematics and physics. Cadets from other military schools are admitted without examination into the upper class. Youths who have passed the standard for nomination to the field artillery can also enter the "front" section of the upper class: those who have finished a course of physics and mathematics at the universities or other establishment of higher education, are permitted to join the upper class after qualifying in military subjects only.

The same General Officer superintends the Michael School and Academy: councils and special organs, together with the cabinet and part of the professorial staff, are also common to both establishments; both come directly under the Grand Master and the general direction of the artillery.

As a military body the school forms a half-battery: 8 Officers making up the commissioned ranks with the usual complement of men: 27 saddle and 27 draught horses are added: for practical work it is the custom to temporarily attach the men and material required. Each year the students join the camps of instruction, and are practically instructed in fortification, topography, manœuvres, care of horses, shoeing, &c. The theoretical course includes religion and sacred history, general and Russian history, analytical geometry, differential calculus and the elements of integral calculus, physics, chemistry, elementary mechanics, tactics, artillery, fortification, military topography, artillery administration, law, translations from foreign languages, landscape, and artillery drawing.

While at the school the students class as conditional volunteers, and are entitled cadets. An examination takes place yearly. After the final one the cadets are divided into three categories: the first class are nominated Sub-Lieutenants in the artillery with two years antedate, and with their commissions dated before those of students from war schools and corps of pages who received "excellent" certificates a year before: those with second-class certificates also get two years antedate, but rank below the last-named students: those in the third class join the infantry and cavalry as non-commissioned officers, and receive commissions in these arms after six months' service. Each year some forty to fifty Officers join the artillery of the regular army from this school and five or six the Cossack artillery.

The *Michael Academy* affords higher professional education to the artillery, and trains Officers for special technical branches. Thirty Officers are admitted yearly for a two-years' course: there is a senior and junior division in consequence each year: in addition there is a supplementary course for practical work.

Officers of all arms up to the rank of Second Captain in the line and Lieutenant in the Guard may compete for either division: these must have three

¹ The word "front" (*stroieroï*) has a particular meaning in Russian military language. It applies to all that concerns the *combatant* part of the service in particular. Thus "front" Officers, are combatant Officers of any arm, "front" horse charger or troop horse, "front" instruction field manœuvres, &c.

years' service, or two if coming from the Michael School, or again for those who have obtained the grade of candidate in the physico-mathematical faculty of the universities. Officers not belonging to the artillery arm must have passed through a military school with honours, or have followed higher courses at the universities. The entrance examination covers the ground of all the subjects taught at the Michael School, but adds one foreign language. The theoretical course includes principal and secondary subjects: the former deal chiefly with artillery and applied mechanics. The artillery course is grouped into history, organization and tactics of the arm, ballistics, technology, theory of construction of guns, material, and small-arms, and administration of technical establishments. Of the secondary subjects may be mentioned higher mathematics, mechanics, chemistry, and geometry.

During the course of the summer the Officers take part in the practical work at the technical establishments of the artillery and Navy, mines, and private factories: they also visit the most important fortresses. This academy possesses a good library, a chemical laboratory, and a collection of specimens and models. After the final examination Officers are divided into three classes: those in the first class receive a step in rank, except Second Captains, who receive one year's pay as a gratuity. Officers who particularly distinguish themselves receive the cross of the academical order.

Officers in the first class, after serving in technical establishments for a year, have the option of joining the Guard. Both the two first classes of Officers may also be sent direct to the Guard and be classed in it after a year: there are, however, only four yearly vacancies. The third class includes the Officers who have failed to satisfy the examiners and who rejoin their corps.

All Officers are permitted to follow the course at the academy if they choose to pay for it, subject of course to certain restrictions as to numbers. Most of the professors are Officers on the active list. A cabinet centralizes affairs, and a council directs the administration.

Six Officers of the artillery compete for two yearly vacancies in the *School of Mines*. This course includes mechanics, metallurgy, mineralogy, and analytical chemistry.

In principle all Officers of field and fortress artillery come from the Michael School or are promoted from the ranks; but it is not uncommon to find artillery Officers who have begun their career in other branches of the Service.

Before promotions take place from the ranks, candidates for commissions have to pass an examination at the artillery school. Volunteers have the right of competing if they have six months' service or have been non-commissioned officers three months. Men joining with the annual contingent are not given much inducement in this direction: they can only compete if non-commissioned officers, and if they have completed their normal period of service: in addition they must have held non-commissioned rank for at least two years if their liability is six years, or for one if it is four years.

In war-time non-commissioned officers are promoted for gallant service without any examination, but they are supposed to qualify subsequently.

Officers of other arms of the Service who have been through the military schools may be attached to the artillery for a year, at any time before they have completed their third year of service: if at the end of this period they pass a qualifying examination they are nominated Officers of artillery.

In principle promotion goes by seniority up to the rank of Lieutenant-Colonel: selection only takes place in lower grades than this owing to exceptional services performed. The grades of Colonel and Lieutenant-Colonel are given by selection. Promotion takes place on a separate list for horse artillery of the Guard and line respectively; for the field artillery of the Guard and line respectively; for the fortress artillery and for the horse artillery of each Cossack territory.

For the men there are two classes of schools. The first includes the *battery, park, and company schools*, and prepares men for the rank of bombardier, for the position of artificers to the batteries, and in particular for the duties of laying a gun—perhaps the most important and best neglected duty in the whole curriculum of artillery education.

Each school is directed by an Officer with one or two assistant non-commissioned officers who must have at least one year's service. The course begins within a month of the return from the camp of instruction, that is to say, in October as a rule, and lasts until a month before the return of this period of general field instruction, or about eight months in all. The course includes reading and writing, arithmetic, artillery, interior and field service, with religious instruction, and, lastly, gymnastics.

The second class of schools for men includes the *brigade and fortress artillery instructional detachments* whose duties are to form *feuerwerker* or sergeants in charge of sections: only those men are admitted who have passed the battalion and company schools successfully. Each unit sends to the instructional detachment a number of candidates equal to half its effective strength of non-commissioned officers; all these must have at least two years' service, and have taken part in one camp of exercise. The brigade fortress artillery commandants select the instructors at the rate of 10 per cent. from the candidates, and those selected remain with the instructional detachments for at least two years with increased pay. The course includes the elements of the Russian language; fortification (for fortress artillery only); care of horses and shoeing (for field artillery); the service of artillery, duties of non-commissioned officers, religion, gymnastics, and riding (for field artillery only). Batteries have to supply horses and material. In the fortress detachments the men are trained, as far as possible, with all the various types of guns, carriages, and hydraulic arrangements in service of the fortress artillery: a large covered shed contains types of most of the calibres for purposes of instruction in winter. If the men cannot be trained to the service of every type of gun it must be noticed that since fortress artillery are essentially localized troops as regards peace garrisons, they are always in a position to be trained with the guns in the armament of the particular fortress with the defence of which they are primarily concerned.

As regards the non-combatant personnel, there are four schools of some importance, namely, the *Technical and Pyrotechnical Schools* at St. Petersburg, with 100 students each, who are trained as foremen for the technical artillery, and the two *Armourers' Schools* at Tula and Ijev for 220 pupils in all. All the courses at these schools last four years, and youths are not admitted under sixteen at the technical schools, nor under seventeen at the armourers' schools.

The *artillery polygons*, which answer to Okehampton and Shoeburyness, were instituted in order to develop the practical knowledge of Officers and non-commissioned officers, as well as to serve for the execution of experiments. Each has a practice range and a government library. It is provided with all the service types of fortress, siege, and coast material, pioneer tools, &c. A Colonel is in command at each polygon under the Artillery Chief of the District. Practical work takes place during the summer, and certain corps and batteries are annually told off to take part in the practice; combined exercises of artillery and engineers are not infrequent. There are eight polygons, namely, Oust-Ijora (St. Petersburg district), Orany (Vilna), Warsaw, Kiev, Nikolaiev (Odessa), Tchougouniev (Kharkov), Moscow, and Tiflis (Caucasus). These are, it must be noticed, by no means the only land ranges in Russia, for the army has peculiar advantages in this respect over every other European artillery.

The last instructional establishment which calls for remark is perhaps

destined to be the most important of all, namely, the *Officers' School of Gunnery* established at St. Petersburg in 1893, replacing the field and horse artillery batteries of instruction, which performed a somewhat similar duty up to this date. The object of this school is to "complete the theoretical and practical instruction of senior Officers of artillery, to form skilful battery chiefs, to advance the science of gunnery, to spread correct notions on the duties of artillery in battle, and to insure uniformity of gunnery instruction in the field batteries." This school is directed by a member of the artillery committee,¹ but the thirty-five Officers admitted yearly—or about one Officer per ten batteries—come directly under the orders of a commandant. The Officers are chosen from those who expect shortly to be placed in command of batteries, and field and horse artillery batteries are attached to the school. The course lasts seven months, from the 12th February to the 12th September; it is divided into a theoretical and practical course. The first lasts till the end of May; the second till the middle of September. The programme during the first period is as follows:—

Artillery.—Solution of problems. Study of the ballistic properties of field and mountain guns and small-arms of different patterns. Use of range-finders. Foreign artilleries. Repair of material in the field.

Tactics.—General notions on the artillery fight. The three arms combined. Battles. Solution of tactical problems and the war game.

Veterinary.—Anatomy and care of horses; shoeing.

During the second period all kinds of fire are executed with the various types of field and mountain guns; tactical problems are solved on the ground, gun pits and emplacements for field artillery constructed. The Officers under instruction also visit the artillery establishments, assist at the experiments at the Ohlta polygon, and attend the musketry course of the regiments in the St. Petersburg district. Lastly, they go through a riding class, and are put through all the details of the administration and instruction of a battery.

From this brief enumeration of the instructional establishments, it is evident that the schoolmaster is hard at work training an arm which, without science, without technical skill and without efficient handling, is only an encumbrance to its friends prior to becoming a trophy to its enemies. Whether or not the efforts directed towards improvement have been successful must be reserved for consideration in the general question of artillery tactics and training.

C.—*Remount Depôts.*

The remount service of the artillery is carried on in much the same way as in the cavalry.

During peace the horses destined for the batteries are forwarded to some point in the District as ordered by the artillery commandant of the District. In time of invasion the depôts continue to send their horses to the corps or not according to orders received. If the ordinary routine is not abandoned, the horses are given to the reserve batteries or receive a special destination; if the service be stopped or the theatre of war be in a foreign country, the needs of the army are in principle met by requisitions. As in the cavalry, horses are supposed to be fit for service for nine years, which may be extended to eleven if recommended; but the number of these is not to exceed the number of annual remounts or one-ninth of the strength. The horses join their corps between the 15th September and the 15th October. Three days after their arrival they are inspected by the chiefs of batteries, then by the brigade chiefs, and lastly by a special commission. After this the corps are

¹ At present Lieut.-General Chiklarévitch.

responsible for the animals. For the artillery of the Guard horses must be from four to seven years old, and 14.3 to 15.1 hands; for the line they must be from three to six years for riding, and from 14.1 to 15.1 in height; for gun draught from four to seven years, and from 13.3½ to 15.1; for ammunition draught, already noticed to be excessive, from four to seven years, and from 13.3½ to 14.3; lastly, all horse artillery animals must be from 14.1 to 15 hands. One-third of the remounts may be mares, but entire horses and mares in foal are not allowed. The colour is kept the same in each battery and must be dark. For the purchase of horses for Guard artillery, a maximum of 207 roubles is allowed; for Guard ammunition wagon teams and line gun teams 125 roubles; for the line ammunition teams 100 roubles. In these sums are included the whole cost of purchase and keep of the animals up to their arrival with the unit for which they are intended. More than three quarters of the horses selected each year come from the Don district.

It is difficult to imagine a team of six 14.1 horses, worth 16*l.* each, dragging a heavy gun and limber of 41 cwt. It is even more difficult to conceive a team of six 13.3½ animals, which is approximately the standard for Indian polo ponies, and worth under 12*l.* each, getting through a few weeks' campaigning with a weight of 42 cwt. behind them. This question affects considerably, as will be seen, the question of artillery tactics.

V. ARTILLERY TRAINING AND TACTICS.

All the conditions which react so unfavourably upon the drill and training of infantry and cavalry exercise an equally prejudicial influence upon the annual march of instruction in the scientific arm. Among these primary causes for the comparatively low standard of military education in all branches of the Service may be mentioned, first and foremost, the long and gloomy winter during the whole of which period practical outdoor military training is dead, save for here and there a few experimental marches and manœuvres due to the initiative of some zealous subordinate commander. It is true that in principle theoretical instruction is given during this period, but theoretical instruction falls on very stony ground when an attempt is made to sow its seeds among illiterate peasants, and it is difficult to imagine a greater contrast than that presented by the programme of work in Russian barracks during the winter and that of Western nations more favoured by climate. The absurd number of holidays during the year also interferes greatly with the work of the Russian schoolmaster: there are 6 in November, when the "winter course" begins, 16 in December and January, 13 in February and March, and 14 in April, or 49 days in all absolutely wasted as regards military training during the winter: in addition the number of ceremonies and religious observances which have to be performed and observed by all arms, the celebration of anniversaries, birthdays, patron-saint days, and so forth, occupy not less than from ten to fifteen days; so that it may be said that one-third of the six winter months, or two months in all, are entirely wasted—always in a military sense of course, for according to the Russian saying, "The prayers made to God and the services rendered to the Tsar are never lost."

If we add to these lost months the amount of time wasted with semi-oriental indifference at other periods of the year: if we recall the fact that all horses in the artillery of the line are turned out to grass for a month in autumn, it will be found that fully three months out of the twelve must be deducted in order to arrive at the real period devoted to professional instruction in the artillery arm. This deduction is not as great as that which might be calculated as the average in the case of the infantry: the reasons for this are, first that, thanks to the development of railways, it has become the rule

for the batteries to be carried to and from the polygons and instruction camps by train for a great part of the journey, thereby economizing time ; secondly, that the winter furloughs, which are one of the most disturbing influences upon the training of the infantry, are much less extensively permitted in the scientific branches ; and lastly, that guard, orderly, and fatigue duties fall less severely upon them. All these causes, combined with a nominal six years' liability, naturally afford far greater facilities for training than in the case of any other branch of the Service. Again, the latitude left to the arm during the selection of recruits allows it to monopolize the better elements of society with the exception of the volunteers who are permitted to choose their corps : of this monopoly the arm freely avails itself, and in consequence the general standard of education, although very low, is not so bad as in the mass of the line. Next to the corps of Guards that of the artillery has always produced the larger proportion of intelligent Officers in Russia : it may even be questioned whether it has not almost a better general level of scientific knowledge, even if the greater facilities for education within reach of the higher ranks of the nobility produce finer intellectual exotics in the favoured corps. Perhaps this accounts for the fact that the artillery Officers have as a body been generally known for their liberal ideas. Conrad Rylejev, poet and rebel, the two Borisovs, Gorbatshevsky, Pestov, Kerejev, Colonels Borstel and Jentalzov, with many other Decembrists, and last, but not least, Michael Bakunin—all served in this branch of the Army.

If the proportion of admissions to the Nicholas Staff Academy be taken as a rough guide, it will be seen that in some years nearly half the successful candidates have belonged to the artillery, and four-fifths of these latter have been serving in the artillery of the line. Nor will it have escaped notice, in the description given of instructional establishments, that the schoolmaster is decidedly abroad in the Russian artillery, and that a really strenuous effort has been made to give a sound scientific education to the Officers and non-commissioned officers of an arm which, without this education, is valueless. It is not for a moment suggested that the Russian artillery is the equal of that of England in smartness and manœuvring power, of the German artillery in mobility and accurate shooting, or of the French in scientific acquirements and technical excellence, but, what does appear very strongly, and what may prove a most important factor in the highly complex problem of Russian power, is that the artillery, as an arm, is considerably in advance of the credit it possesses among foreign artilleries, due partly to the general ignorance of its composition and partly to the lessons of the last war in Bulgaria which seemed—and seemed rightly—to all observers to have proved a great absence of efficiency both in material and in leading.

That service is six years in the arm does not go for so very much when we deduct the allowance that has to be made for the peculiar conditions which attach in Russia to the profession of arms in general. If three months a year are thus struck off as time wasted, it is evident that six years' service in Russia would be the equivalent of $4\frac{1}{2}$ years under other conditions or in other countries.

Making a further allowance for the low standard of education of the annual contingents in comparison with that of other States, it will probably be true to say that, owing to a number of causes which militate against efficiency, just so much can be taught the ordinary gunner in his six years as would be the case in Germany in three or in Austria in $4\frac{1}{2}$ years. Even then it would be impossible to balance the solid advantage which must always be on the side of a nation with an inexhaustible fund of well-educated youths at its free disposal as rules in Germany. Nevertheless, in spite of the many unfavourable conditions of service which undoubtedly beset all instruction in Russia, the artillery now described, thanks to its enormous development,

which promises superiority in guns upon the battle-field ; to its dépôt system, which enables loss of men and guns to be made good ; to the fair standard of instruction of its corps of Officers, and to the completeness of its armament may, with good handling, prove distinctly a redoubtable arm. Even German critics, always chary of praise when any other service but their own is in question, are beginning to admit the fact. Thus a well-informed writer in the *Neue militärische Blätter*,¹ in a lengthy criticism on the Russian Army, states that in his opinion the artillery is the best instructed arm of the Service, and that it has made great strides in advance since the last war.

In the matter of drill, the programme of the annual course is generally divided into three periods : the first period lasting from the 1st October to 1st December, the second from this date to the 1st May, and the third including the time passed at, or on the march to and from the summer camps. In the first period the men selected for the battery school and brigade instructional detachments are examined, these detachments made up and trained to their work, drivers from men of one year's service selected, riding, gymnastics, gun and foot drill practised, young horses broken in, and theoretical instruction given. At the beginning of the second period the recruits make their appearance, and the early part of the time so given up to their instruction in rudimentary battery work. Drill with horsed guns begins in March or April, if possible, and in any case standing gun drill and instruction in laying guns is proceeded with in order to get the battery in serviceable order at the earliest moment for the polygons and summer camps. No regular course for the summer months is prescribed, although programmes have been issued for general guidance. As a rule batteries take it in turn to visit the practice grounds and complete their annual firing. The allowance of ammunition for each battery is 246 rounds a year, namely, 128 shell, 108 shrapnel, and 10 case : part is retained for inspection time when field-firing takes place. The time employed at practice may be taken at about six weeks yearly : the batteries are generally moved to the ranges in their own districts at varying dates between May 13 and the beginning of the camps. Some of these land ranges are not at all suitable for their purpose according to Russian ideas. At Kiev, for instance, the range consists of an undulating plain with a number of small hillocks covered with brushwood, rendering all shooting very difficult.

It has been noticed that the summer camps which afford almost the sole means for practically training the Russian Army in combined manœuvres and regular field exercises were only originated in the year 1872, and that they did not receive their full extension till some years later : it may be said, in short, that almost up to the period of the Russo-Turkish War, the artillery, as an arm, was not practised in the shifts and expedients of camp life, that it was not capable of long and rapid marches owing to its ignorance of the conditions of field service, and that the senior Officers had no skill in employing batteries in mass or in conjunction with other arms, since these things had either not been practised at all or had been practised on a limited scale and in quite an inadequate and perfunctory manner. But in the last ten years it has been quite a different story. Anyone who glances over the lists of the numbers of batteries which have taken part in these manœuvre-drills—taking a few years at random—will notice that in the year 1874, for instance, there were 118 guns present at the two camps formed ; in 1875 the troops were concentrated at thirty-five different points, and at fifteen all arms were represented, and 128 batteries took part in the manœuvres. In 1881 this number rose to 295 batteries, and in 1882 was 267. These numbers have been approximately maintained up to the present date. It is therefore evident that the facilities

¹ February 1887.

for self-education afforded to the senior Officers of the arm are far more extensive and far more valuable than formerly, and although the history of all war makes one doubtful whether senior Officers, as a body, allow their actions to be much shaped by new experiences, still a very great improvement in troop leading will probably be shown in the next campaign.

Where the Russian artillery may fail by comparison with German artillery is first in mobility, and secondly, in hitting power, and these two points of inferiority will go far to compensate for the prodigious deployment afforded by a powerful organization. "They seem to have strange notions in Russia," says a German critic, "on the regulation of fire, and the effect to be obtained from shrapnel." It is true that a great number of practice returns show a fair percentage of hits, and that the question of firing against and hitting troops behind cover has been met by the use of shrapnel with reduced charges, with a certain measure of success, but it would be unwise to take the lessons of the practice ground as sufficient. To begin with, the rate of firing at these exercises is far from attaining the necessary degree of rapidity; at the ordinary competitive practice a battery will take an hour or more to fire sixteen or twenty rounds, and this custom of slow shooting has become such a matter of habit that it serves as a basis for calculating the normal expenditure of ammunition. But even if a battery is able to fire 30, 60, or even 70 rounds an hour in practice, this rapidity of fire is still insufficient in a great many instances, particularly if the enemy is in possession of a numerous, formidable, and well-trained artillery. If we allow that a battery should, under ordinary service conditions, be able to fire three rounds a minute without prejudice to accurate shooting, this number will amount to 180 rounds an hour. The Germans allow 3 to 4 rounds a minute for ordinary cases, and from 6 to 8 rounds for rapid firing during a short space of time. Of course, very rapid firing would only be required for a comparatively short period under ordinary conditions, but it is just at this moment when the difference would be most marked between a slow- and a quick-firing battery; in the first case the battery commander would not be able to control his fire, which would become independent and comparatively useless.

Rapid fire is the decisive fire; to expect gun detachments to succeed in a matter in which they are not trained is only to prepare disappointments for oneself.

The importance of obtaining the mastery in the artillery duel which, under ordinary circumstances, precedes a great battle increases in direct ratio with the power, range, and accuracy of modern guns. Whatever opinions one may have on long-range and rapid fire as an infantry question, there can hardly be a doubt upon the subject from the artillery point of view. It is evident that given two opposing batteries with equally powerful guns and equally well-trained gunners, the battery which can succeed in firing 180 rounds in the hour will be three times as strong as the other which is only able to fire 60: that is to say, that one battery of six guns able to keep up its effective fire under the first conditions can engage on level terms three similar batteries firing sixty rounds an hour. The Russians have not paid sufficient attention to this matter: on the other hand, the text of the artillery field exercise and instruction hand-book has the advantage of being very general in its advice; it does not attempt to dogmatize or provide for meeting, theoretically, every possible contingency. Some few authorities think that so long as gunners are properly trained they can always rise to the level of the occasion, if a very rapid fire is demanded by circumstances. Artillery, it used to be said, has no nerves. But this was in the old smooth-bore days when artillery approached to within shouting distance of the enemy before it opened fire. Loading and firing was machine work, and whether the round shot bounded once twice or three times before reaching its mark mattered very little, and great accuracy

of laying was not indispensable. But the service of modern field artillery requires the greatest possible attention to every detail; if the distance is miscalculated by 50 yards in 2½ miles, if the shrapnel time fuze is set too long or too short, if the nerves are not steady when the sights are raised or depressed, or the movable collar of the percussion fuze turned, the round may be lost and the effect may be nil. All the operations of preparing fuzes, of laying and of firing, require the greatest nicety, and demand great accuracy. If modern science has endowed artillery with renewed vitality and power, it has detracted from the value of its gift by rendering gunners in their turn accessible to those impressions which have always influenced the behaviour of other arms.

Among other causes besides that already mentioned, which tend to reduce the hitting power of the Russian artillery, may be mentioned the *Le Boulengé* range-finder. This instrument was employed during the last war, and was adversely reported on, particularly so by the authorities in the Caucasus. Trials took place subsequently, but failed to substantiate the truth of the assertions made against it; in consequence a fresh and large supply was ordered,¹ with the curious result of forcing on the artillery a range-finder which had been proved bad in the field, simply because it had stood the tests of peace trials. The misuse of two things, the range-party and the range-finder, has for many years robbed the annual practice of more than one field artillery of half its value. Russian gunners are still trained by adventitious aids to ignore what has been long recognized and rigidly enforced in Germany, namely, that practice in peace under conditions unobtainable in war is worse than waste of ammunition, and that the gun can and must be made its own range-finder.

If the question of hitting must, after all, be decided on the battle-field alone, the other weak point of the service appears very strongly in the everyday life of a battery. The Russians are very proud of their heavy guns, and declare that this weapon, with a charge of over 4 lbs. of powder, and a shell or shrapnel weighing 27 lbs. 8½ ozs., has no equal in the world. But however much credit the artillery authorities may deserve for so rapidly designing and placing in the hands of batteries a good type of heavy gun together with its equipment, a matter which we have hitherto entirely failed to settle, it must be remarked that the result has been achieved at great sacrifice of mobility. Want of mobility, in fact, characterizes the whole of the artillery service, and more particularly the ammunition train. Taking our new 12-pr. guns for comparison, with a weight behind the teams of 37 cwt., which is quite the outside limit for use with horse artillery, even with English horses, it appears that this weapon is superior in every respect to the Russian light and horse artillery guns.

The Russian horse artillery gun has a weight behind the teams of over 32 cwt., that of the light gun is 36 cwt., and that of the heavy gun over 41 cwt.

As regards the first-named weapon, the outside limit of weight, 615 lbs. a horse, has been reached, compatible with the power of manœuvring with cavalry, and of draught by Russian horses. But the ammunition wagon has a weight behind teams of over 42 cwt., or 787 lbs. a horse, and nothing appears more clearly than the fact, that these wagons are incapable of following even field batteries across country roads with due rapidity, partly owing to the heavy weight of the wagons, partly to the low price, small height, and indifferent power of the horses, and in consequence, to expect their aid in an action of cavalry is to lean on a broken reed. Almost every German notice of manœuvres in Russia refers to the difficulty of keeping these wagons on a

¹ 814 in 1883.

level with their batteries, which naturally receive the pick of the remounts. As for the heavy guns, the weight behind teams is just as excessive as for the ammunition wagons, and in any future campaign the instances will probably not be rare of the Divisions being unable to bring their heavy guns into action. Russia has calculated the weight behind teams as if her guns were horsed like the pick of the English batteries, instead of by Russian horses, which after all cannot compensate for want of draught power by any amount of endurance. Nothing indeed is more striking in connection with the question of mobilization than this uselessness for military and particularly artillery purposes of the great mass of Russian horses. The fact is, that although the numbers of these are very great, since the unit of labour in Russia has from time immemorial consisted of a man, a woman, and a horse, the quality is very poor; the great mass of the horses belong to the peasants, and are quite incapable of doing duty in an artillery team; it will also be found that the supply of strong draught horses is a real difficulty. Hence the question of mobility assumes much importance, for if the absence of this invaluable quality is notorious in peace, when affairs work smoothly and full rations are always obtainable, how far will it affect efficiency during the stress of a bitterly contested campaign fought out under climatic conditions which must be taken as they come? If again the horse artillery batteries, growing weary of the dead weight which impedes the celerity of their movements, take heart of grace and leave their wagons behind them, they will have to engage with only 7 shell, 10 shrapnel, and 3 case per gun, and may be rendered harmless in half an hour's engagement. If the common saying is right that the speed of the squadron is the speed of the slowest horse, it is equally true that the mobility of a battery is the mobility of its ammunition wagon, since without projectiles a battery is only as useful as a steam engine without a tender. If this want of mobility still exists, it affords proof that the Russians are unable to improve, since it was pointed out most forcibly in the official reports which followed some partial essays of mobilization in 1881.

In the field the battery occupies normally 200 paces of front, but this may be reduced to 45; in action the limbers reverse and draw up with the leaders 20 paces in rear of the trail of the gun. The ammunition wagons are 50 paces in rear of the guns; this is the ordinary peace arrangement, and the Russian battery in action thus presents a mark 200 to 45 paces by 100: every projectile exploded in this rectangle is almost certain to produce some effect. It may be said this is only a drill formation, but in such a case everything useless is dangerous.

The employment of artillery in mass is perhaps the most difficult manœuvre of all for the command of the arm, but it is a characteristic of modern war that has to be provided for. This formation of masses of guns in a long single line, the choice of positions, and the proper direction of fire, demand a professional ability that experience on a grand scale alone can afford. General Gourkho, who is always zealous in the cause of improvement, prescribed in 1884 some manœuvres of this kind near Warsaw, which duly took place under the direction of General Pavlov. According to the *Militär-Wochenblatt*,¹ these were found "very highly instructive; all those who took part in them were convinced of the great difficulties of employment of artillery in mass, and more particularly of the due indication of the objective to such a large number of guns. Experiment alone is capable of deciding the rules necessary for this complex question; the handling of masses of guns must therefore be frequently practised, and all details of the employment of these great batteries

¹ No. 85. 1894.

must be seriously weighed and considered, since the result of success will be of immense importance."

General Gourkho, it may be incidentally mentioned, has always been the most rigorous critic of shortcomings in the artillery, since he is persuaded that if success can be achieved by this arm, or if it can duly support the excellent qualities of the infantry, Russia can laugh at her foes. It is almost the rule for the artillery to come in for hard words when they are passed in review by the authorities; thus, a few years ago, General Gourkho, at Krasnoe Seloe, and General Albedinski, at Vilna, spoke out strongly on the ignorance, the want of scientific knowledge, and the inaccuracy of the shooting displayed: "Only a well-reasoned method," said General Gourkho, "can give artillery fire a powerful effect in war. During my inspection, I have not noticed the application of such a method." This was in 1879; thanks to the initiative of a few able reformers, the progress in recent years has been considerable.

It may be said: "We have seen the Russian artillery campaigning; it proved itself a very indifferent auxiliary to the other arms; it was generally behindhand, it often fired very badly, and at Plevna its material effect was almost nil. We prefer to accept the lessons of that war to all the visionary lessons of peace training."

But one cannot dismiss the past twelve years in such a summary fashion, nor refuse to peace training that measure of progress which after all is its chief reason for existing. As for Plevna, field artillery is not intended for use against an army that goes to ground as Osman's did; it is intended for the *Massenschlacht*, or the shock of great field armies. If Osman and his troops fought gallantly and well, and by their spade-work rendered the numerous Russian guns harmless, they nevertheless prepared for themselves by their action the germs of strategic death, none the less certain because it was slow.

The Prussian artillery in the war of 1866, if it always did its duty, certainly failed to cover itself with glory, and although half the Prussian batteries were armed with rifled guns, the artillery as an arm was over-matched in every action by the numerous and formidable artillery of the Austrians. But the Prussian artillery laid the lesson to heart; under able guidance it rose to the level of the occasion, and in the next campaign certainly equalled and almost surpassed in energy and zeal, not to speak of material effect, the action of the other arms. With every respect for the precedent of 1877, it must be remembered that some time has passed since then; that even if Russians themselves had not reflected upon the meagre results gained by their artillery, there were plenty of unfriendly critics across the Vistula to bring the lesson home with all the superior cynicism that is the peculiar attribute of the German military critic.

The want of all rules for guidance of artillery chiefs in the war in Bulgaria was severely felt. Immediately after that campaign, the Grand Master called upon Major-General Gregoriev, who had acted as Chief of the Staff in the second phase of the war, to draw up at once a programme for future guidance. When this was done, a special commission, presided over by General Count Barantzov, examined it, and introduced a few alterations. General Count Milutin, Minister of War, rapidly passed the programme, and banded it over to chiefs of corps to be reported on. This method of drawing up a manual of field exercises appears sound. If a committee is appointed for the work the inevitable result is an invertebrate regulation, the result of a compromise between the conflicting opinions of the members of the assembled body; if, on the other hand, a single individual is given the task, without let or hindrance, the work is marked by his peculiar *cachet*, and the tenets he holds may be unsuitable to the Service in application. If, on the

other hand, one and the same hand draws up the general scheme, the advantage is gained of a single purpose running through the whole, and the idiosyncracies due to the personality of the author are toned down by the reporting commission. Lastly, chiefs of corps who have to practise the theory are the best practical judges of regulations, and every programme must take their opinion into consideration.

The general ideas which now govern the Russian artillery world are not greatly at variance with those accepted elsewhere.

The *sagène*¹ is usually adopted as the unit of measure in estimating ranges. Thus, 500 *sagènes* and below are called short distances, 500 to 1,000 *sagènes* middle distances, and over 1,000, long distances. Over 1,300 *sagènes*, it is considered that shells bury themselves into the ground owing to their considerable angle of descent, that the effect is hardly worth the ammunition; at 1,000 *sagènes*, and on hard ground, it is considered that the best effect can be gained. Shrapnel is used with effect up to 1,200 *sagènes*, and case from 50 to 150. As a rule, it is laid down that guns are not to open fire at over 1,300 *sagènes*, since at this range the observation of the burst is very difficult, ammunition is wasted, and the enemy gains confidence from the harmless display; fire at over 1,500 *sagènes* is only advised when it is required to demonstrate; the best effect is expected between 700 and 900 *sagènes*.

Since the light gun has a flatter trajectory and more accurate fire than the battery gun, it is recommended for use at the long ranges; at short distances, where rapid fire is required, and artillery has to follow closely the movements of the other arms, the light gun is also preferred, since it is more mobile, and has a greater number of rounds at its disposal. At middle distances, on the contrary, the powerful effect of the heavy projectile is expected to gain great results, while much is expected from it against entrenchments, troops in villages, and resisting cover generally.

The fire of an isolated battery is directed by its chief conformably with the orders received from the commander of the next higher unit. When a number of batteries are united under the orders of a single Officer, the fire is still regulated by batteries, while the general guidance and control belongs to the chief.

Fire is recommended to be slow early in the action, at a range of 1,200 *sagènes* or thereabouts; it increases in rapidity up to 700 or 900 *sagènes*, and at shorter distances becomes intense. In very rapid firing it is laid down that two rounds per gun every five minutes may be fired, less than half the rapidity of fire of a well-trained English battery under similar conditions. With this fire, it may be remarked, the entire ammunition of a heavy Russian battery would be expended in 5½ hours, that of a light battery in 7 hours, and of a horse artillery battery in 7½ hours.

A reconnaissance always precedes the choice and occupation of positions, and is conducted by the commandant of the arm on the field, or of the unit employed. It is recommended to come into action with loaded guns when it is required to open the action at once; the Russians seem scarcely alive to the fact that the necessity for rapidly firing the first round in an action has given place, under modern conditions, to the necessity for being able to cover long distances by rapid marches. Artillery actions now begin at such immense distances that batteries will, as a rule, be able to unlimber unperceived, and the usefulness of their fire will depend, not upon the favourite theatrical folly of letting off a round as quickly as possible, but by the careful calculation of distance and observation of the effect of the first few rounds.

The chiefs of the various units of artillery are, according to the regulations,

¹ 1 *sagène* = 7 feet.

the *auxiliaries* of the chiefs of troops under whose orders they are placed. They must, therefore, be kept fully informed of the projects of the latter, and for this purpose accompany them on reconnaissance; during a fight they keep up communication with them, and make the best arrangements possible for the successful action of their particular branch. Unity of action and concentration of fire are recommended, but the organization of the artillery often obliges the batteries to be distributed among brigades and even regiments of infantry. This is the radical fault in the tactical organization; the commander of the artillery brigade has to exercise supervision over six batteries of forty-eight guns, with all their ammunition trains and services. These, at the normal intervals, occupy a line of 1,320 paces, a front of action quite beyond the control of a single individual, quite apart from the question of the number of guns; the German *Abtheilung*, with just half this number of guns, is a far better and more handy tactical unit in the fight. When batteries are detached from the brigade, the commander of the latter ceases to exercise tactical supervision over the detached fractions, which, in their turn, only refer to him on technical artillery matters; it is the chiefs of troops, under whose orders the batteries are directly placed, who dispose of them upon the battle-field; the brigade chief can only intervene with the assent of these, or by virtue of superior orders.

By the same general rule the artillery commandants of Armies and Army Corps, not having a certain definite number of batteries directly under their control, have no orders to give the Divisional artillery except on technical subjects; they control the tactical handling of the arm only when the chief of the Army or Corps judges it expedient to mass a certain number of batteries under their direct orders at a given moment of the action and for some particular purpose. In fact it is everywhere most distinctly laid down and universally recognized that it is the chief of the troops with whom the artillery is acting who, throughout all fighting units from highest and lowest, has the right and the duty of controlling the action of his auxiliaries and the titular chief is unable to contravene this authority without special orders from higher authority.

The commander of the battery gives all directions to the fighting unit under his command; this unit consists in war of the battery guns, the first échelon of 4 ammunition wagons, 50 paces in rear, and a second or reserve échelon, 400 paces in rear, consisting of the remaining ammunition wagons and battery details; two spare teams only are kept in the close vicinity of the guns. The reserves of several batteries may be grouped together.¹ All these distances and dispositions may be modified in detail according to the requirements of the case.

When the brigade is united the commander directs the fire of the batteries; if the Division is acting independently, the flying Divisional park comes under his orders; otherwise it is under the chief of artillery of the Army Corps. This Officer selects its positions, makes it known to the troops concerned, and is generally responsible for the supply of ammunition. Some critics say that the only duty of his office is to scour the plain in search of projectiles for his batteries, but it seems probable that his actual command on the field will be made up of the batteries belonging to the infantry and cavalry reserves not employed in the early part of an action, which will probably be united with the guns of the infantry engaged near the position chosen for the massed batteries. The same remark applies to the functions of the artillery commandant of the Army, but it is very improbable that his influence will ever be directly noticeable on the field of battle.

¹ A certain class of Officers at the French *écoles de feu* support this idea, but it is too much like "all the eggs in one basket."

Generally speaking, the importance of deploying a formidable artillery at the outset of a fight is fully recognized, but part of the guns are usually held in reserve till the situation becomes clear. Lateral movement of batteries is generally deprecated, it being considered that the object can be better gained by the sudden onslaught of a large number of fresh batteries. In general, if an infantry Division is acting alone two light batteries are held in reserve at the beginning of the fight and with a cavalry Division one battery is held in reserve. This arrangement, which is carried out by all units, is in distinct opposition to the German principle of thrusting forward every available gun from the earliest moment in the action. From this fact a very curious situation results; in the German Army where Corps artillery exist, it is not used as reserve artillery at all, and in the Russian Army where there is no Corps artillery this reserve is artificially created on the battle-field. Apparently the Russians, not caring to further imitate their neighbours in organization, determined to create a Corps artillery under another name, with this result, that the dispositions made combine the double disadvantage of splitting up commands unnecessarily, and of forming of set design an echelon of batteries which is in fact nothing more than a return to the antiquated heresy of a *reserve* artillery.

For what purpose is this reserve? To guard against surprises, say the Russians, and to await the moment when the course of the action becomes clear. Then the advance of the fresh batteries at the critical time and place will be decisive of victory.

But this is an argument of smooth-bore days when, owing to the shortness of range, an artillery once thrown forward into the fight was lost to the command for employment elsewhere on the field, since, once in action, it was within a few hundred yards of the enemy's position and was materially influenced by all the varying vicissitudes of the combats of all arms. At this epoch the retention of artillery in reserve had a meaning and the employment of it at the right place and time was frequently decisive. But to-day this reasoning is true no longer; fire is opened at immense distances and artillery remains up to the last at the free disposal of the command, which can begin and break off an artillery action with far greater ease than formerly, and without compromising the other arms, since the latter, owing to the great range of modern guns, only come later into action.

The Germans, after the war of 1866, changed the designation of the "reserve" artillery to "corps" artillery. The philosopher might ask, What's in a name? but to soldiers the change of title was perfectly comprehensible, and the leading of the arm participated thenceforward in all the pushing forward, energetic action which had already characterized so notably the command of the infantry.

Without returning to the letter of the old system the Russians are infected with its spirit, and the result will scarcely prove advantageous to them. Let us imagine a contest with equal numbers of Germans and Russians on either side. The Germans will not only hold their guns well forward in the columns of route, but will seek at once to thrust them into action to form a solid framework for their order of battle; every available gun will be at once pushed up and an effort made to immediately establish a command over the hostile guns. On the Russian side these will be answered by the scattered batteries belonging to the infantry Divisions in first line; these, inferior in numbers and trained to a slower rate of firing, will begin the fight with all the chances against them. They will be reinforced by the batteries belonging to the infantry Divisions of the reserve; but reserve troops are generally some distance from the front line of battle; the roads—and it is merely euphonism to call the country tracks of Russia roads—will be filled with marching columns. The want of mobility already noticed will not fail

to exert an evil influence, and even if the batteries at length unlimber and open fire, they may be too late to save their comrades from defeat, when they, in their turn, would be exposed to the united and concentrated fire of the hostile guns. Such is the natural course of events from the opposite tendencies of these two artilleries; and it is not too much to affirm that the logical result of the Russian system has not been argued out, for it is admirably adapted for the destruction of Russian artillery in detail by an enterprising foe. The recommendation at the end of General Gregoriev's regulations for artillery to sacrifice itself at the critical moment regardless of loss seems therefore quite unnecessary.

Most of these regulations deal with the offensive combat; there is much less advice and fewer recommendations for the defensive battle. In general the advantages of the defence are merely pointed out, and a large number of batteries are held in reserve at the outset of a fight. One disposition lays down that the artillery duel is to be avoided if the hostile artillery is superior. But who shall say when this is the case? The only method for deciding this question is by this very duel which is to be avoided so carefully, and the disposition at once falls to the ground as impractical. Of other details may be noticed the paragraph which lays down that "it is advantageous, when the ground allows, to erect, parallel to the gun epaulment, but some 30 to 50 yards in advance, other works behind which there are no guns so as to deceive the enemy." Lastly, the Russians go in greatly for firing over the heads of their own troops. Some few years ago General Todleben executed a series of experiments, and subsequently it was laid down that during an attack on entrenchments, artillery was to go on firing up to the last moment, immediately preceding the final rush, and that its fire was not then to cease but to be directed over the heads of the attack upon the probable advance of the enemy's supports. To those who object that many accidents would happen in the field, the Russians reply that if this is allowed to interfere one might as well give up firing guns at practice in peace owing to the occasional bursting of a gun.

Such, then, are the general principles which govern the action of this important arm in Russia; they do not differ extensively from what is accepted elsewhere, but they are open to criticism on some points in conjunction with the many disadvantages from which all training suffers in the Empire.

But the training and employment of field batteries, although without doubt the most important duty which falls to the lot of the service, is far from being the whole duty of an efficient artillery corps under modern conditions.

A comparison of the effect obtained by the French artillery in the defence of Strassburg and in that of Belfort, the evidence of Colonel Denfert, who commanded at the latter fortress, as well as of a large number of German artillerymen who took an active part in the sieges and investments of the war of 1870-71, prove to demonstration that one of the chief causes for the bad defence of the greater number of French strongholds lay in the absolute want of Officers and men of a fortress artillery trained in peace to all the manifold duties of siege warfare.

In 1873, Lieutenant-General Fersmann and Colonel Chklarevitch laid down very clearly the principles which should guide the training of this service, and their programme, circulated unofficially, formed the basis upon which the future instruction of this branch of the artillery was framed.

The fortress artillery is intended in Russia both for the attack and for the defence of fortresses, hence its practical exercises include a general military instruction in accordance with these duties, and a special technical training with artillery material. The special course of fortress artillery includes siege and fortress artillery drill and practice; execution of secondary operations and armament of works of field and siege fortification; construction of

siege batteries and counter-approaches; preparation of mines; musketry; fortress manœuvres and polygon constructions. In addition, the fortress war game is recommended as a most useful and valuable means of instruction for Officers.

These exercises are of a varied nature, and the following rules are suggested in order to gain good results:—

(1.) Instruction must be simplified as much as possible, more particularly for the lower ranks; this simplicity is gained by a careful division of labour, and next by the strict definition of the duties of all ranks.

(2.) All the "open" season which can be devoted to practical exercises must be divided between the different duties already pointed out. The capital point is, however, *gun practice*, and all the rest only gains importance from its relative influence upon this first requirement.

(3.) In order to create a serviceable body of gunners, the German method of training is strongly recommended.

This method consists in handing over to each company for an entire year a single particular calibre of fortress ordnance (9 c., 12 c., or 15 c., long or short), and of training the whole of the company's recruits solely with this particular type of gun; only those men who remain longer than one year with the colours have the opportunity of becoming acquainted with the other types; in the practice shooting the company retains the same gun. The results obtained from this practice are most remarkable; a solid and rapid instruction is gained, which perhaps Germany may some day have cause to congratulate herself upon.

(4.) Regulations, instructions, and manuals are necessary for each of the practical exercises, and these must be kept on a level with scientific progress, and be continually improved or simplified.

With reference to gun practice, a great deal of valuable information is to be found in the regulations published on this subject in 1875, the result of an inquiry by a special commission, as well as in the "Manual of Gunnery" by Colonel Chklarevitch. It is considered useless to expect good results in this practice, unless Officers and gunners have received a sufficient preparatory education both in the theory and practice of their profession.

This education includes, for the gunners, heavy gun drill, use of the sights and range-tables, adjustment and care of the breech mechanism, setting of the time-fuze, and preparation of the percussion-fuze. During the annual course they are taught the effect of the gases from the powder upon the gun and breech mechanism and the effect of the various kinds of projectiles upon troops and cover.

A special body of men are told off for laying the guns, and these have to rapidly execute all the particular details of their duty; they have to learn the use of the quadrant, the manner of adjusting obturators, and in general the means for rectifying errors and obviating causes which prevent the regular action of the breech. During practice they are taught to observe the effect of fire and apply the necessary corrections. The non-commissioned officers in their preparatory course are taught how to direct the firing of a single piece, correct any errors made by men who lay the gun, make proper use of the range-tables, and alter the sights after the observation of each round. During a siege they may be called on to take command of a battery; for this purpose they are given the direction of a few guns at a time, and are taught to select the mode of laying most suitable in a given case, to solve questions relating to the object to be aimed at, the conduct of fire, &c. Officers are expected to know all the duties of their subordinates, and to be able to solve with rapidity and exactness, by means of the manual and range-tables, all questions relating to firing. During practice they are advised to try and perfect themselves in the conduct of fire, the secret of

which consists in knowing how to observe the effect of each round, and apply the necessary corrections.

It is the duty of the engineers to construct all siege batteries, together with their powder magazines, blindages, traverses, &c., as well as to prepare all material needed for the repair of the works.

Very little is therefore required from the fortress gunners, and the larger works of repair are more usually given over to infantry working parties under the guidance of an engineer cadre.

The pyrotechnical studies demanded are not very extensive, and are summarized in the "Practical Manual" issued by the artillery school press. Ever since the reorganization of 1876, the fortress gunners have been trained in elementary musketry as well as with the "rampart gun" of the 1876 pattern up to within a more recent period.

The German foot artillery after the war with France were given rifles, and taught their use by Officers and non-commissioned officers from the infantry; but, after all, the gun is the real arm of artillery, and the Russians are right in only awarding the rifle a secondary place in the training of their fortress troops.

Since the year 1861 a number of artillery polygons or land ranges have existed where fortress troops from the neighbouring strong places take their turn at big gun drill. In the ranges which are the common property of artillery and engineers, parallels, approaches, and batteries are constructed, and projectiles with service charges are fired against these, or experimental sections of escarps of a typical enceinte, and the profit derived from this system is very great.

The war of 1870-71 proved what advantage the Prussians had gained from their experiences of siege war at Neisse in 1865, and at Coblenz in 1868; these and the experiences of the war being followed up by the Graudenz siege manœuvres of 1873 (perhaps the most valuable of all), and those at Coblenz of 1875.

Fortress manœuvres are in one sense more valuable and more indispensable for infantry and artillery belonging to the garrison of a strong place than field manœuvres are for the rest of the army, since in the first case they take place on the very ground where the enemy will have to be encountered in war, and the actual conditions may with care be very closely realized.

One of Colonel v. Löbell's year books remarks on this subject: "The German foot artillery has gained an enormous advantage from the development which has been given in recent years to fortress manœuvres. When each company has executed the preparatory exercises on the ground the battalions are broken up into two parts, one being charged with the attack and another with the defence of the fortress which they aid in garrisoning. These exercises last fourteen days, and aim at giving the troops a practical and precise notion of siege warfare, just as the autumn manœuvres initiate them into field fighting. The expenditure both of money and materials allows these exercises to be given a distinctly practical character, and render them eminently useful for the war training of fortress troops."

Siege manœuvres have taken place at intervals in Russia ever since 1843, when the first was chronicled at Novo-Georgievsk, but these early efforts were somewhat wanting in realistic effect, since the approaches often only consisted of traced works, and the fortress fire of harmless blank charges. Again, the peace effectives of fortress troops were only sufficient for the daily routine of garrison work. But subsequent to the Franco-German War these experiences received a great development and became of real value, as for instance at Bobruisk in 1879, for by this time the reorganization of the fortress artillery permitted larger numbers to take part in the manœuvres. It is unnecessary to give details of these manœuvres, and it may be said generally, that while

faults are certainly committed, they are more often tactical faults due to a misappreciation of the general idea of the manœuvre than faults of training, since most reports agree in commending the energy, coolness, and knowledge displayed by the gunners, even when the sudden armament of a front of defence was ordered on a dark night without previous notice, as at Bobruisk in 1879. In 1884 the Tsar was present at an armament manœuvre at Novo-Georgievsk: forty-nine guns of a total weight of 512 tons had to be placed in battery by five battalions of fortress artillery; in an hour and a quarter from the signal, fire was opened from an 8-inch gun, and the entire armament was complete in two hours. At night some experimental fire was practised on batteries of the attack. The field of fire was lit up by a Mangin electric light with two Siemens engines, objects 2,500 yards distant being quite visible; a siege battery 2,400 yards distant was perfectly visible from the ramparts, and the percentage of hits was very high.

The foregoing description, together with the plates and tables, will enable technical and other readers to form their own conclusions upon the whole service of the Russian artillery. In this paper, which does not profess to be anything more than a compilation from sources within the reach of every one, all criticisms have been omitted except in those instances where they are necessary to enlarge or explain the particular points under discussion. The subject is one that is worth the attention of artillerymen. Very little in the foregoing pages has been gathered from English works, the collection of facts recorded may perhaps be of some value, if the Russian artillery is again called upon to take the field.

To complete the picture it would be necessary to give details concerning the recruiting, transport, and mobilization of the service, but these matters are so closely bound up with larger questions which affect the whole of the army, that to attempt their discussion in this paper would be to lengthen the subject beyond all measure.

Many of the details given are of a somewhat dry nature, but no military organization can be described except by the careful analysis of those details upon which the greater questions rest.

It is quite true that, regarded from an ideal standpoint, the Russian artillery does not bear comparison in some respects with what our advanced school considers indispensable. That the best of the Russian field-guns are inferior to our new 12-prs. is an undeniable fact, but against it may be put the equally true fact, that for the last ten years the Russian artillery has been in possession of guns and equipment superior in many points to our own, and that twice at least within that period we have been within a measurable distance of war.

In artillery matters it is or should be true that all that is last is best, and to suggest that the Russian field material only approaches a standard of respectable mediocrity, because we have just invented and armed a few batteries with a weapon giving some 300 feet a second greater initial velocity than the Russian guns of 1877-79, is to beg the whole question in its larger bearing.

In a certain sense the moment chosen for rearmament was perhaps not a fortunate one for Russia, since a really high velocity gun was soon afterwards produced in France; on the other hand, the material bears comparison with that of Austria and Germany, and it is by this standard, rather than by some fanciful ideal, that one should judge the productions of Russian arsenals. The Russian artillery is a remarkable service, from many points of view, but perhaps the most striking feature is the peculiarly comprehensive character of its organization. However much one may criticize certain points—and

what artilleries are not open to criticism?—one cannot say of the Russian artillery that one portion of the service has been nursed and pampered to the exclusion of another. The result is a particularly level organization in which heavy effectives, a respectable armament, and a fair practical training go far to promise a better measure of success in the next great war.

APPENDIX.

I. Details: Guns and Projectiles.

Data.		Field artillery.				
		Mountain guns.		Field guns.		
		2·5" Baranowski.	2·5" 1893 pattern.	H. A.	Light.	Heavy.
GUNS.						
Calibre	 in.	63·5	63·5	87	87	106·7
Length	Total	1·21	1·01	1·70	2·10	2·10
	of bore	1·07	0·853	1·465	1·865	1·830
	 cal.	16·8	13·4	16·8	21·4	17·2
	of rifled portion ...	0·778	0·549	1·067	1·492	1·430
Powder chamber	of line of sight	0·432	0·940	0·735	0·848	0·848
	 mm.	175	165	195	170	170
Grooves	Diameter..... mm.	66	67	98	98	118
	Number.....	20	20	24	24	24
Total weight.....	Depth	0·63	1·02	1·24	1·24	1·24
	Breadth..... mm.	8·13	8·13	8·41	8·41	10·49
Weight of breech mechanism.	kg.	97	98	365	460	625
Preponderance of breech.....	kg.	8·4	..	42	42	60
		7	25	63	61	61
PROJECTILES.						
Common shell	Length	225	216	226	228	277
	 cal.	3·55	3·4	2·6	2·6	2·6
	Weight loaded ..	4·150	4·000	6·860	6·860	12·5
	Bursting charge..	0·070	0·125	0·218	0·218	0·423
Shrapnel	Length	191	192	185	185	236
	 cal.	3	3	2·1	2·1	2·2
	Weight loaded ...	4·140	4·040	6·860	6·860	12·5
	Bursting charge..	0·030	0·030	0·060	0·060	0·110
Case	Number of bullets	88	132	165	165	340
	Weight of each ..	10·7	10·7	10·7	10·7	10·7
	Weight	..	3·275	6·550	6·550	11·7
	Number of bullets	..	96	102	102	171
	Weight of each	..	25·6	49	49	49

I. Details: Guns and Projectiles—continued.

Data.		Siege and fortress guns.								
		Guns.					Howitzers.			
		4".	6" light.	6" heavy.	8" light.	8" screw.	3.4".	8" cast iron.	8".	9" screw.
GUNS.										
Calibre.....	mm.	106.7	152.4	152.4	203	203	87	203	203	229
Length {	Total.....	3.73	3.25	3.36	3.40	3.40	0.61	1.83	2.20	2.07
	of bore.....	3.454	2.916	2.896	2.883	2.883	0.495	1.323	1.778	2.083
	of rifled portion..	32.4	19.1	19.0	14.2	14.2	5.7	6.5	9.8	9.1
	of line of sight..	2.784	2.386	2.052	2.219	2.219	0.300	0.771	1.171	1.228
Powder chamber {	Number.....	1.328	1.735	1.448	1.448	1.245	..	1.773	1.207	..
	Length.....	368	325	639	367	367	65	254	310	523
Grooves {	Diameter.....	127	159	159	211	211	91	211	211	237
	Depth.....	36	36	36	46	46	24	46	46	52
Total weight {	Depth.....	1.27	1.27	1.27	1.52	1.52	1.24	1.52	1.52	1.52
	Breadth.....	6.25	8.64	8.64	9.30	9.30	8.41	9.30	9.30	9.25
Weight of breech mechanism..		1,310	1,970	3,090	5,855	5,670	90	3,275	3,275	5,580
Preponderance of breech...		115	98	0	0	0	0	0	0	0
PROJECTILES.										
Common shell {	Length.....	361	381	381	508	508	226	508	508	572
	Weight loaded..	3.4	2.5	2.5	2.5	2.5	2.6	2.5	2.5	2.5
	Bursting charge..	16.3	33.3	33.3	78	78	6.860	78	78	111
Steel shell {	Length.....	0.610	1.540	1.540	3.5	3.5	0.218	3.5	3.5	5.0
	Weight loaded.....	432	351	351	469	469	..	..	..	..
Shrapnel {	Length.....	4	2.3	2.3	2.3	2.3	..	..	..	..
	Weight loaded.....	16.3	37.9	37.9	89	89	..	..	..	..
	Length.....	282	320	320	..	..	185	..	..	..
Weight of each. {	Weight loaded.....	2.6	2.1	2.1	..	..	2.1	..	..	..
	Bursting charge..	16.7	35.9	35.9	..	..	6.860	..	..	..
	Number of bullets..	0.117	0.203	0.203	..	..	0.060	..	..	..
Weight of each. g.		620	518	518	..	..	165	..	..	..
		10.7	21	21	..	..	10.7	..	..	..

I. Details: Guns and Projectiles—continued.

Data.		Coast guns.					4·2" mitrail- leuses.		
		Guns.			Howitzers.		10-barrel.	6-barrel.	
		9".	11".	14".	9".	11".			
GUNS.									
Calibre	mm.	229	280	353	229	280	10·7	10·7	
Length {	Total	m.	502	6·10	8·00	2·67	3·26	1·53	1·12
	of bore	m.	4·318	5·265	6·800	2·083	2·545	0·813	0·660
	of rifled portion ..	cal.	18·9	18·8	19·3	9·1	9·1	76	62
	of line of sight ..	m.	3·179	3·653	4·811	1·228	1·476	0·731	0·587
Powder chamber {	Length	mm.	812	1,201	1,470	523	660	..	..
	Diameter	mm.	237	290	367	237	290	..	..
Grooves {	Number		52	61	80	52	61	6	6
	Depth	mm.	1·52	1·78	2·00	1·52	1·78	0·28	0·28
	Breadth	mm.	9·25	9·14	9·45	9·25	9·14	3·90	3·00
Total weight	kg.	15,350	29,700	59,500	5,500	8,700	168	53	
Weight of breech mechanism	kg.	491	1,057	2,293	377	666	..	..	
Preponderance of breech ...	kg.	200	0	0	0	0	..	..	
PROJECTILES.									
Common shell {	Length	mm.	572	775	1,001	572	..	..	
	Weight loaded ..	kg.	111	217	432	111	..	..	
	Bursting charge ..	kg.	5·0	11·5	21·1	5·0	..	..	
Cast iron shell {	Length	mm.	572	781	1,000	572	..	..	
	Weight loaded	kg.	126	250	518	126	..	..	
Steel shell {	Length	mm.	556	721	518	556	..	..	
	Weight loaded	kg.	126	250	..	126	..	..	
Shrapnel {	Length	mm.	126	250	..	126	..	..	
	Weight loaded ..	kg.	..	..	..	..	0·039	0·039	
	Bursting charge ..	kg.	..	..	..	..	0·005	0·005	
	Number of bullets ...		..	..	..	..	1	1	
	Weight of each ..	g.	..	..	..	..	24	24	

II. Charges: Penetration, &c.

	Field guns.			Siege and fortress guns.								Coast guns.							
	Mountain guns.		Field guns.	Guns.				Howitzers.				Guns.							
	2-5" Para-norsk.	2-5" 1883.		H. A.	Light.	Heavy.	4-2".	6" light.	6" heavy.	8" light.	8" screw.	8" cast iron.	6".	9" screw.	9".	11".	14".	9" mortar.	
GUNNERY.																			
Maximum charge—	0.370	0.370	1.400	1.400	1.810	3.280	3.480	8.600	7.780	7.780	1.100	6.140	13.100	26.4	54.5	90	13.110		
Common shell kg.	"	"	"	"	"	"	"	9.000	"	"	"	"	"	29.3	52.4	98	12.700		
Proportion between weight of charge and of projectile kg.	11.2	10.9	4.9	4.9	6.7	5	9.6	4	10	10	19.1	12.7	8.4	4.2	3.9	4.8	8.4		
Extreme range on tables m.	3,200	..	6,400	6,400	5,340	8,750	7,250	8,970	7,040	704	3,910	5,710	7,420	7,470	8,510	7,470	7,420		
Initial velocity—																			
Common shell m.	290	284	411	442	373	426	332	458	321	321	214	272	315	457	457	396	316		
Penetration into earth—																			
At 1,050 m. m.	1.43	1.37	1.71	1.82	1.83	2.93	2.35	2.96	3.14	3.14	..	1.60	2.20	..	..	..	2.20		
At 2,100 m. m.	1.28	1.22	1.43	1.49	1.52	2.44	2.10	2.51	2.90	2.90	1.60	2.26	2.96	..	..	..	2.96		
Penetration into iron—																			
Point blank mm.	..	..	..	..	..	..	..	206	180	180	..	..	..	325	386	462	..		
At 1,050 m. mm.	..	..	..	..	..	..	..	160	165	165	..	..	..	285	351	425	..		
At 2,100 m. mm.	..	..	..	..	..	..	..	137	152	152	..	..	..	254	323	396	160		

III. Carriages.

	Mountain carriages.		Field carriages.			Siege and fortress carriages.						
	2.5" Creil system.	2.5" modified Creil system.	H. A.	Light.	Heavy.	1877 pattern for 4.2" and 6" light.	1877 pattern for 6" heavy.	Nastievitch for 6" heavy.	Howitzers.			
									3.4".	Old 8".	8" light and screw.	9" 1876 pattern.
Height of axis of the trunnions.....	0.643	0.690	1.151	1.151	1.103	1.829	1.829	1.245	0.305	1.321	1.521	1.524
Length of the carriage.....	2.40	2.17	2.69	2.69	2.90	3.31	3.35	2.16	0.66	2.44	2.75	2.75
Diameter of wheels.....	88	104	139.5	139.5	139.5	147	147	76	..	30.5	30.5	30.5
Weight without wheels.....	140	152	303	356	430	943	1,303	865	90	2,130	2,440	2,437
Weight of the two wheels....	52	63	147	147	147	291	291	249	..	..	..	..
Extreme { Of depression	12	15	10	10	3	6	8	6	10	5	5	5
{ Of elevation.....	25	30	17	18	20	40	40	25	65	75	75	65

NOTE.—All field, siege, and fortress carriages have the double screw, except the modified Creil, which has a lateral screw, and the howitzer carriages, which have single or double toothed arcs.

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		Coast carriages.				Mitrailleuse carriages.	
		9" Semenov.	11" Krupp, No. 1.	11" Krupp, No. 2.	14".	Howitzers.	
						9" 1877 pattern.	11".
Height of axis of trun-	m.	1.120	1.260	1.385	1.520	1.111	1.395
nions	m.	2.17	2.53	2.90	4.00	2.01	2.94
Length of carriage	m.	..	..	..	..	..	..
Diameter of wheels	cm.	double screw	2 toothed wheels	..	2 toothed wheels	2 toothed wheels	..
Elevating arrangement		2,115	..	4,603	..	2,023	about 7,400
Weight without wheels..	kg.	..	..	..	..	..	..
Weight of two wheels ..	kg.	..	..	..	..	..	..
Extraneous { Of depression	-	2	6	6	6	5	7
angles { Of elevation .	+	17	20	24	19	65	65

V. Ranges, Rectangles, &c.: *Field Guns.*

Guns.	Range.	Angle of fire.	Angle of fall.	Remaining velocity.	Time of flight.	Probable rectangles.		
						Length.	Breadth.	Height.
	m.	° ' "	° ' "	m.	sec.	m.	m.	m.
<i>II. A. Gun.</i>								
Weight of projectile 6·860 kg.	500	0 40	1 10	350	1·3	8	0·1	0·2
Weight of charge 1·400 kg.	1,000	1 40	2 40	312	2·9	8	0·4	0·4
Initial velocity 411 m.	2,000	4 25	6 35	207	6·3	11	1·1	1·3
	3,000	8 10	11 30	234	10·4	16	2·5	3·1
	4,000	12 40	17 45	208	15·0	21	4·7	6·7
	5,000	17 55	25 25	188	20·4	27	8·7	13·2
	6,000	23 25	31 35	176	26·6	34	16·4	24·1
<i>Light Gun.</i>								
Weight of projectile 6·860 kg.	500	0 25	0 40	374	1·2	8	0·1	0·1
Weight of charge 1·400 kg.	1,000	1 20	1 45	315	2·7	9	0·2	0·2
Initial velocity 412 m.	2,000	4 00	4 50	275	6·1	11	0·6	1·0
	3,000	7 30	9 40	240	10·0	13	1·5	2·2
	4,000	11 25	15 40	212	14·5	16	2·4	4·6
	5,000	15 40	23 15	192	19·8	22	3·4	10·8
	6,000	20 20	32 03	178	25·9	29	4·4	19·3
<i>Heavy Gun.</i>								
Weight of projectile 12·490 kg.	500	1 05	1 10	332	1·3	7	0·1	0·1
Weight of charge 1·810 kg.	1,000	2 20	2 40	304	2·9	7	0·2	0·3
Initial velocity 373 m.	2,000	6 35	6 50	266	6·6	10	0·8	1·2
	3,000	9 50	13 15	240	10·6	16	1·9	4·0
	4,000	15 35	22 00	216	15·0	26	3·4	10·0
	5,000	22 55	33 10	196	20·6	..	..	..

Guns.	Range. m.	Angle of fire. ° ' "	Angle of fall. ° ' "	Remaining velocity. m.	Time of flight. sec.	Probable rectangles.		
						Length. m.	Breadth. m.	Height. m.
4.2" Gun.	500	0 40	0 55	385	1.2	7	0.1	0.1
	1,000	1 35	2 00	352	2.6	7	0.2	0.2
	2,000	3 55	5 00	311	5.6	7	0.4	0.6
	3,000	6 40	8 45	281	9.2	8	0.9	1.2
	4,000	9 50	13 20	263	12.9	10	1.4	2.2
6" Light Gun.	5,000	13 35	18 55	249	17.1	13	2.2	4.5
	6,000	18 05	25 40	237	22.0	19	3.1	9.0
	500	1 15	1 20	311	1.5	4	0.1	0.1
	1,000	2 45	3 00	295	3.2	5	0.3	0.2
	2,000	5 55	6 45	270	6.9	6	0.7	0.6
6" Heavy Gun.	3,000	9 40	11 30	252	10.7	8	1.2	1.4
	4,000	13 55	17 05	243	14.9	10	1.9	3.0
	5,000	18 40	23 25	237	19.2	15	2.7	5.6
	6,000	24 05	30 00	233	24.7	24	3.7	13.7
	500	0 45	0 50	414	1.2	6	0.1	0.1
8" Gun.	1,000	1 35	1 45	373	2.4	7	0.1	0.3
	2,000	3 35	4 35	320	5.3	9	0.4	0.9
	3,000	6 05	8 20	289	8.8	12	0.8	1.9
	4,000	9 05	12 45	270	12.5	14	1.4	3.2
	5,000	12 30	17 45	260	16.5	16	2.3	5.0
8" Gun.	6,000	16 25	23 35	253	20.8	19	3.3	7.6
	500	1 25	1 30	307	1.6	5	0.1	0.1
	1,000	2 55	3 05	301	3.3	7	0.3	0.4
	2,000	6 10	6 40	292	6.7	9	0.6	1.1
	3,000	9 45	11 05	266	10.5	12	1.0	2.4
8" Gun.	4,000	13 45	16 15	254	14.7	16	1.1	4.6
	5,000	18 30	22 30	244	19.4	20	1.9	8.1
	6,000	24 25	30 10	237	24.9	24	2.4	14.1

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VII. Details of Fire. 8" Steel Howitzer, 1877 Pattern.

Charges.	Initial velocities.	Ranges.	Angles of fire.	Angles of fall.	Remaining velocity.	Time of flight.	Probable rectangles.	
							Length.	Breadth.
kg.	m.	m.	° ' "	° ' "	m.	sec.	m.	m.
6·140	272	4,100	20 30	23 40	220	18	12	3
		5,000	29 00	34 00	218	25	16	4
		5,700	43 00	49 20	217	35	20	6
		5,700	44 15	50 30	217	35	20	6
		5,000	58 45	64 10	225	43	19	8
		4,200	65 15	70 10	231	46	17	10
5·300	250	3,600	20 45	23 20	210	17	11	3
		4,000	24 30	27 50	208	20	13	3
		4,900	38 00	43 00	206	29	18	4
		4,900	50 00	55 30	207	36	19	6
		4,000	62 30	67 10	215	42	18	8
		3,700	64 45	69 10	218	43	17	9
3·700	200	2,500	21 00	22 40	182	14	9	2
		3,000	27 45	30 20	178	18	13	2
		3,500	41 30	45 00	175	26	17	3
		3,500	46 30	50 20	175	29	17	3
		3,000	60 30	64 10	180	34	15	5
		2,600	64 45	68 10	183	35	14	6
2·200	150	1,400	20 30	21 40	138	11	7	1
		2,000	37 30	39 40	134	18	14	1
		2,000	51 30	54 00	135	23	14	2
		1,500	65 45	68 00	140	27	11	3
1·200	100	600	21 45	22 10	98	8	6	0·3
		1,000	43 00	43 30	96	14	13	0·6
		1,000	44 00	44 30	96	14	13	0·6
		800	63 00	63 40	93	18	9	1·3

VIII. *Details of Fire. 9" Howitzer, 1877 Pattern.*

Charge.	Initial velocities.	Ranges.	Angles of fire.	Angles of fall.	Remaining velocities.	Time of flight.	Probable rectangles.	
							Length.	Breadth.
kg.	m.	m.	° /	° /	m.	m.	m.	m.
13·100	315	7,400	44 30	51 00	242	41	35	8
		7,000	53 00	58 10	250	46	31	9
		6,000	61 15	66 00	253	51	24	13
		5,400	64 45	69 40	255	53	21	15
12·100	300	6,800	48 00	53 20	239	41	32	8
		6,000	53 00	62 30	245	47	26	11
		5,000	65 00	69 00	248	52	20	14
9·300	250	5,100	49 00	52 50	212	36	26	6
		5,000	52 00	55 30	214	38	24	7
		4,000	63 30	66 50	216	44	17	11
		3,900	64 00	67 20	216	45	16	11
6·350	200	3,600	47 30	50 10	178	29	21	5
		3,000	60 45	63 10	182	35	15	8
		2,600	64 30	66 50	183	36	12	10
3·900	150	2,100	48 45	50 20	135	22	14	3
		2,000	52 30	54 00	135	23	13	3
		1,500	65 30	67 10	136	27	8	6
2·000	100	900	54 00	54 50	95	17	8	2
		800	62 00	63 00	96	19	7	3

TYPES OF GUNS. RUSSIAN FORTRESS ARTILLERY.

NOTE.—MEASUREMENTS IN MILLIMETRES: 1 MILLIMETRE = 0.0394 INCH
WEIGHTS IN KILOGRAMMES. 1 KILOGRAMME = 2.2046 LBS.

FIG. 1.—24-PR. LONG BRONZE R.B.L. GUN. PATTERN 1867.

FIG. 2.—24-PR. SHORT CAST IRON R.B.L. GUN. PATTERN 1871.

FIG. 3.—24-PR. SHORT STEEL HOOPED R.B.L. GUN.

FIG. 4.—8-INCH LIGHT R.B.L. FORTRESS GUN.

TYPES OF CARRIAGES: HEAVY GUNS AND HOWITZERS.

FIG. 1.

SIEGE CARRIAGE: 1877 PATTERN.

FIG. 2.

SIEGE CARRIAGE: 1878 PATTERN.

FIG. 3.

TYPES OF CARRIAGES.

FIG. 1.

24 PR. SIEGE CARRIAGE.

FIG. 2.

GORLOV CARRIAGE 8 INCH GUNS.

FIG. 5.

SEMENTOV CARRIAGE, 8 INCH GUNS.

FIG. 3.

CHVEDE CARRIAGE 8 INCH GUNS.

FIG. 4.

CHANTZ CARRIAGE, 8 INCH GUNS.

TYPES OF CARRIAGES: HEAVY GUNS AND MORTARS.

FIG. 1.

FIG. 2.

LIGHT 8-INCH R.B.L. GUN CARRIAGE.

FIG. 2.

8-INCH R.B.L. HOWITZER CARRIAGE.

TYPES OF GUNS IN RUSSIAN COAST BATTERIES.

FIG. 1.

8-INCH CAST IRON HOOPED R.B.L. GUN WITH CYLINDRO PRISMATIC WEDGE.

FIG. 2.

9-INCH STEEL HOOPED R.B.L. GUN WITH SCREW BREACH MECHANISM.

FIG. 3.

16-TON 9-INCH STEEL HOOPED R.B.L. HOWITZER WITH SCREW BREACH MECHANISM.

FIG. 4.

43-TON 11-INCH R.B.L. STEEL HOOPED GUN.

FIG. 6.

8-INCH R.B.L. COAST GUN.

FIG. 7.

9-INCH R.B.L. GUN.

FIG. 8.

9-INCH R.B.L. HOOPED COAST GUN.

FIG. 9.

11-INCH R.B.L. HOOPED COAST GUN.

FIG. 5.

9-TON 9-INCH STEEL HOWITZER.

NOTE: MEASUREMENTS IN MILLIMETRES
1 MILLIMETRE = 0.0394 INCH

TYPES OF CARRIAGES. RUSSIAN COAST ORDNANCE.

FIG. 2.

11-INCH COAST GUN

FIG. 1.

8-INCH COAST HOWITZER CARRIAGE.

HEAVY PROJECTILES. OLD TYPES

HEAVY PROJECTILES. LATER TYPES

11-INCH COAST GUN CARRIAGE WITH HYDRAULIC BRAKES.

FIG. 3.