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THE FRENCH 120mm. FIELD HOWITZER.

By Major F. HOLZNER.

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BY a recent decision of the French Ministry of War, the armament of their Field Artillery is in future to consist mainly of a light Q.F. gun of small calibre,[1] with a flat trajectory; in addition to which field howitzers of heavier metal, and the larger calibre of 120 millimetres are to form part of the equipment of a certain number of regiments. In thus adopting special field howitzers, France has followed the lead of Russia with, however, this difference, that instead of forming separate bodies (regiments), the field howitzer batteries have been joined to existing units.[2]

It is obvious that the 120-millimetre field howitzer forms a very effective connecting link between the ordinary field-gun and the equipment of the French light siege trains discussed in an article which appeared in No. 4 of the *Mittheilungen* for the year 1894.

The construction of the new field gun is at present still veiled in mystery, but recently issued regulations[3] give fairly full particulars of the 120-millimetre field howitzer, especially of its construction, but information is scanty with regard to details of organisation, and as to ballistics, almost entirely wanting.

I.—ORGANISATION.

A 120-millimetre field howitzer battery consists of six guns, nine battery ammunition wagons, one store wagon, one forge wagon, and one forage wagon, with a proportion of supply and baggage vehicles. The complement of draught horses for a battery is made up of six for

[1] According to a statement in No. 114 of the *Militär-Wochenblatt*, dated 28th December, 1895, a 75-millimetre Q.F. gun, carrying a projectile of 6·5 kilogrammes, is to be adopted.

[2] Turkey, Bulgaria, and other Powers have also, as we know, already procured 12-centimetre field howitzers from Krupp.

[3] "Règlement sur le service du canon de 120 court, approuvé par le Ministre de la Guerre le 28 Mai, 1895." Librairie Berger-Levrault et Cie.

Additional sources of information used in this article are the *Militär-Wochenblatt*, No. 12, of February 3rd, 1896; and Girardon's "Organisation du matériel d'Artillerie, 1896."

each gun and battery ammunition wagon (average draught per horse, 349 kilogrammes); the same for the store wagon (average draught, 350 kilogrammes); four each for the forge and forage wagons; two for each of the other vehicles. The six guns with three ammunition wagons, forming three sections of two howitzers and one wagon each, constitute the fighting battery. Each section is commanded by an officer, and each gun by a non-commissioned officer. The issue of ammunition is controlled by a pyrotechnical non-commissioned officer, and three specially detailed corporals have charge of the wagons. The gun detachment consists of six men (four with the gun, two with the ammunition wagon of its section), reinforced, if rendered necessary on account of exceptionally heavy work or during a protracted period of rapid firing, by two additional men from the second-line wagons.

The guns are drawn up in the firing line at 13 metres interval, the three shrapnel ammunition wagons in rear and covering the second, fourth, and sixth guns. When specially ordered, an ammunition wagon containing shell is substituted for the centre shrapnel wagon. The drill of a 120-millimetre howitzer battery is the same as that laid down for the 80 and 90-millimetre field batteries. In a fighting position behind temporary shelter or regular fortifications the interval between howitzers is governed by the nature of such cover. The special training of the troops, who must first have been thoroughly drilled with field guns, is divided into training with the single gun battery drill (both dismounted and mounted, the latter on the parade ground and also in the field), the motions of firing (*tir simulé*), and finally in exercising the lieutenants in the leading of batteries, and the non-commissioned officers in the command of sections.

The battery has at its immediate disposal 288 shrapnel (double-action fuzes) and 240 elongated melinite shell (L/4) with percussion fuzes, equal to eighty-eight rounds per gun, and a corresponding number of cartridges. All the gun limbers and the even numbered ammunition wagons carry shrapnel, while the odd numbered ammunition wagons are filled with shell (sixteen rounds per limber, thirty-two rounds per hind wagon). Shrapnel is intended for use against living targets under cover, the melinite shell being designed for employment against resisting objects. Case shot is not used with field howitzers. When a battery is closely threatened it fires upon the approaching enemy with shrapnel timed to $\frac{1}{10}$-second, the gun being approximately laid horizontally. If, however, the guns are already loaded with shrapnel timed to longer periods, the muzzle is rapidly depressed so as to produce fire effect at about 20 metres in front of the attacking force. Shell already loaded in the guns is, under such conditions, immediately expended on the nearest target. The regulations are silent as to larger organisations, the tables of equipment, etc., referring only to the establishment of a group (corresponding to our former battery division).

An ammunition column for 120-millimetre field howitzers consists of five battery ammunition wagons, one forage wagon, one forge and ten

store wagons. Each column carries 368 shell and 432 rounds of shrapnel distributed as follows :—

Contents of	Shell.	Shrapnel.
First 3 Ammunition Wagons (48 each) ..	144	—
First 4 Store Wagons (56 each)	224	—
Remaining 2 Ammunition Wagons ..	—	96
Remaining 6 Store Wagons .. .	—	336
Total	368	432

The ammunition column also carries 800 cartridges, distributed in the same proportion as shown above for projectiles (forty-eight and fifty-six respectively per wagon), and 1,450 friction tubes, allotted at the rate of 90 and 100 respectively per wagon, besides certain reserve stores and a small quantity of entrenching tools. Its railway shipping plant includes six beams, fifty-one lashing ropes, the component parts of a movable ramp, with planking for railway crossings and bridge flooring. The proportion of columns to each group (division) is as yet unknown. The position of a column during an engagement is indicated in day time by a blue flag, and by a blue lantern at night.

The fire tactics of a battery distinguish between battery or section fire (by guns as ordered), and section or battery salvoes. The rate of firing after ranging is regulated by superior authority, otherwise by circumstances. Generally the distinctions are :—

a. Slow fire, when the battery delivers one shot per minute; section salvoes at intervals of two minutes.

b. When ranging, three shots are fired per minute in battery fire, an interval of 40 seconds being observed between section salvoes.

c. During brisk firing (*feu nourri*), six shots per minute is the rule. Section salvoes in this case following at intervals of 20 seconds.

The number of rounds per minute is ordered by the battery commander.

Besides the above rates, a very rapid fire may under circumstances be ordered by the command, "Rapid Fire—Rounds per Gun," or merely, "Rapid Fire," when the guns are quickly loaded, laid by the tangent scale, and fired, singly or in salvoes, on the command of section leaders, exact attention to deflection being sacrificed to speed.

The laying can be done quickly, as the recoil of the gun carriage is said to be entirely prevented, and the barrel, which alone moves backward and forward, resumes almost exactly its former position with respect to direction.

With regard to the regulations for gun practice and the rules as to ranging, I will refer the reader to a review, which will shortly appear in the *Mittheilungen*, of the new French Regulations[1] for Gun Practice of Field Artillery, which includes field howitzers. In this connection, I will only mention that it is, as a rule, the duty of section commanders to determine in the process of ranging the correct timing of fuzes, the shrapnel fuzes being graduated to seconds, as also the bursting elevation. The battery commander may, however, direct the correction of each shot singly by successive loading of guns, or verify the timing by battery salvoes. The responsibility of section commanders in ranging extends also to deflection. They must, furthermore, by range table, or in its absence by the aid of the sliding scale, give laying directions for each shot to No. 1 of guns, the battery commander merely indicating the nature of the projectile and the distance. The laying instruments not being graduated to distances, naturally augments the difficulties in the conduct of practice.

Regarding the general system of training in batteries equipped with the new gun, the Ministerial Decree of the 21st February, 1895, directs that the training of the young recruits of such batteries in the handling of field guns and howitzers is to proceed concurrently. The same rule to apply also to instructional sections (*pelotons d'instruction*). The men of other batteries in the same regiments are, however, not to receive instruction in the service of howitzers before their second year of service.

This decree justifies the conclusion that certain regiments only (for the present, it is said, only six corps artillery regiments) are to have a proportion of howitzer batteries. This view agrees with a statement by Muller in his well-known work, "Die Entwicklung der Feld-Artillerie," published in 1893, according to which certain French army-corps possess two field howitzer batteries[2] (representing a group or brigade division). There was present, coincidently, a group of two field howitzer batteries with the corps artillery of a body of twenty-two batteries massed at Châlons in 1894, for gun practice.

II.—MATÉRIEL.

A:—The Gun (Figs. 1 to 4).

The body of the 120-millimetre field howitzer consists of the barrel proper, the conductor socket *F*, and the hydro-pneumatic buffer. The former is built up to the core tube *K*, the jacket *M*, which extends back from the centre of the tube and is screwed on, and the breech coil *S* (all made of steel). The breech is closed by a screw, with "Bange" obturator *V*, as in the case of 80 and 90-millimetre field guns, with which we are already familiar).[3]

The breech screw has no safety arrangements against either premature discharge or hang-fire. This, together with the occurrence of

[1] Will be translated and appear in JOURNAL.

[2] According to other sources three batteries.

[3] See *Mittheilungen*, 1881, page 403.

after-flashes, and the necessity of constant supervision of the plastic obturation, counteracts the higher speed in firing which the construction of the gun would otherwise facilitate.

The tube has thirty-six parallel grooves, with a constant angular twist of 8°.

The buffer ring *R* on the fore-end carries on its upper surface the recoil index *Z*, and on its right side the "Broca" sight *B*. The object of the buffer ring, which has a rubber cap *u* on its rear face, is to weaken the shock in case of an abnormal rebound through the conductor socket *F*, and to prevent the further recoil of the barrel. The attention of the gunners is drawn to an abnormal recoil by the bending or breaking of the index *Z* on the nose *N* of the conductor socket. The jacket *M*, which is screwed on to the core tube, slides by means of lateral tongues fitting into corresponding grooves of the bronze conductor socket *F*.

The tangent socket *t* (Fig. 1) with brass lining, and the rest for the tangent case is situated on the right of the breech coil *S*, the bed of the detents on the left, and underneath the carrier ring *T'* of the buffer tube, which establishes connection between the barrel and the tube of the hydro-pneumatic buffer.

The bronze conductor socket *F* forms the intermediate connection between the barrel proper and the buffer on the one hand, and the carriage on the other. It envelops the barrel in its middle (Fig. 3), allowing slight room for play, and has on its fore-end a continuation reaching downwards and forming the buffer carrier *G*, into which the pneumatic cylinder *L* of the buffer tube is screwed. There is also connected with it a double shoulder *O*, with holes, through which a bolt is passed when preparing the gun for the march. The screw of the oil hole *a* is on the top.

Other parts requiring mention are: the quadrant bed *E*, and the trunnions and trunnion shoulders *P*, on the left one of which is the bed for the deflection sight. The guide grooves on the inside of the conductor socket *F* have already been mentioned.

The buffer tube (Figs. 3 and 4) consists of an oil and high-pressure air-pump, whose effects counterbalance each other. The forepart forms the bronze air chamber *L*, which is firmly screwed into its carrier *G*, on the conductor socket *F*, and is extended rearwards by a strong tube *R* (Fig. 4), upon which the steel buffer cylinder *B* slides. The rear-end of the buffer tube is closed by the piston *K*, fitted, as is also the cap *D*, with arrangements for re-filling the buffer in the manner shown in the sketch. The tube is perforated in several places close to the piston. The buffer cylinder *B* is firmly attached to the body of the gun-barrel by the carrier ring *T* on the breech coil. A pressure valve *V*, kept in balance by Belleville springs, is placed upon that end of the tube *R* which faces the air chamber *f* (Fig. 4), and in front of it is a movable sliding partition *W*, which separates the front space containing compressed air from the cavities in the rear portion, which are filled with mineral oil (petroleum?).

The buffer tube works in the following manner. The barrel recoils on discharge, sliding through the conductor socket and carrying with

it the buffer cylinder *B*. This has the effect of forcing the liquid round the hollow tube *R* inwards through the holes *O* at the piston. The pressure of the accumulating liquid then opens the valve *V*, and the liquid rushes forward and acts upon the movable partition *W*, which thereby still further compresses the air in its front in *f*. The force thus expended exhausts the power of recoil, until finally the highly-compressed air in *f* is able to again expand to its former condition, and in so doing pushes back the partition *W*. This causes the reflux of the fluid into the buffer tube *R* and through the holes in its base outwards into the hollow of the movable cylinder *B*, the automatic advance of which, accompanied by the gun-barrel above it, is simultaneously effected.

When the buffer is correctly filled and regulated it admits of a maximum recoil of 475 millimetres, which limit is not, however, allowed to be reached in the ordinary course. On attaining a stroke of 450 millimetres, steps must be taken to regulate the buffer. It appears that in spite of all preventive arrangements adopted in the construction, a certain loss of liquid gradually occurs during prolonged use. This decreases the efficiency of the buffer, increasing, on the one hand, the recoil of the barrel through the conductor socket, and resulting, on the other, in failure to bring the barrel back precisely to its original position. Immediately the brass index *Z* (Figs. 1 and 3) on the buffer ring *R* is bent on the nose *N* of the conductor socket *F*, the recoil has exceeded 450 millimetres, and reached the admissible limit for safety. It then becomes necessary to employ the next fire pause in replenishing the supply of liquid, which is done with a special pump, the manometer of which indicates 200 atmospheres. This process—not further touched on here—is carried out in peace-time in the arsenal at Bourges, and in war-time by a specially-trained soldier. It requires from 15 to 20 minutes. The forcing in of liquid is stopped as soon as the manometer indicates a pressure of 110 atmospheres. The re-charging of the buffer becomes necessary, as a rule, after 1,500 shots. An unserviceable buffer is replaced by a spare one (one per battery).

The barrel with breech block, buffer tube, and conductor socket, weighs 690 kilogrammes, the proportion due to the barrel proper being about 550 kilogrammes.

The carriage (Figs. 1 and 2) consists of the lower carriage (the wheel frame), and the upper carriage (the gun bed), which rests upon the former. The trail *a* of the lower carriage is composed of two side pieces of rivetted steel plates which converge rearwards, and are held together by several crossplates. It is fitted with the inverted steel crank axle (Fig. 5) mounting two wheels of special construction, the bracket brake, and other metal parts, as explained by the illustration. By the employment of the crank axle (made of forged and tempered gun steel), it becomes possible to combine a comparatively low carriage with wheels of large diameter.

A broad blade *sch*, resembling a ploughshare, fixed across the bottom of the trail, prevents the running back of the carriage after firing

by burying itself, if the soil is suitable. In gravelly or rocky ground a hole must be dug for the purpose. It is said that, when driving over uneven, cut-up ground, the edge of the blade, which when the gun is limbered up is only 37 centimetres above the ground, is apt to touch the surface and thus cause a check. Besides other defects noted during the artillery mass manœuvres at Châlons, in August, 1894, the spontaneous unlimbering of field howitzer carriages when driving across country was a special cause of complaint.

The traversing plane, with the pivot post on the front upper surface of the lower carriage, forms the bed for the gun-frame. The latter has the shape of a small carriage *b*, and is formed of two steel plate side pieces connected by cross plates and strengthened with angle bars. It rests upon the traversing plane of the lower carriage, and turns in front by the pivot eye, on the pivot post *p* (Fig. 1 bottom), the projecting end of which is closed by a nut. The rollers at the rear of the upper carriage run in the grooves of the guide piece *f* on the lower carriage (Fig. 1, top). The cap squares are attached to the trunnion plates by hinges in front, and are locked by spring bolts in rear.

On the march the upper carriage is secured to the traversing plane *R*, by means of a ring *r* (Fig. 2), on a traverse flap *tr*, which is hinged on to the rear transom *g* of the upper carriage. This ring *r* falls over a pin *pf* on the traversing plane, and is held down by a spring bolt. The barrel is further secured for the march by the joint *l* (Fig. 1), on the upper carriage, being connected with the shoulder *O* of the conductor socket, a spring bolt being passed through the eyes of both.

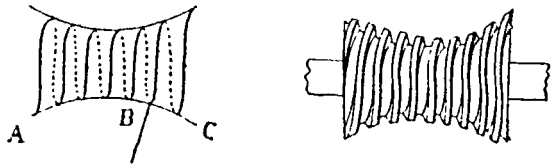
When preparing for action the latter connection, as also that on the lower carriage, is cast off, and the traverse flap *tr*, turned upwards and secured by a spring bolt at 2 (Fig. 2).

While the first lateral direction is roughly effected by shifting the trail, a special traversing arrangement attached to the upper carriage facilitates a more exact lateral adjustment of the latter within a field of 10°, during which operation it turns on the pivot post, already mentioned, of the lower carriage. This traversing gear consists of a horizontal worm *e*, in the rear transom *g* of the upper carriage (Fig. 2), which is provided with a hand-wheel *h* on both sides. The worm gears into a cogwheel *n* (Fig. 6), placed at the back of the traversing plane (of the lower carriage).

The elevating gear is attached to the right cheek of the carriage. It consists (Fig. 1) of an endless screw *oe* revolving in two sockets, which gears with a cog-piece keyed to the right trunnion. The construction of the endless screw, which is explained by the accompanying illustration, admits of several teeth being always in gear, thus preventing broken or missing teeth from interfering with the effective working of the elevating gear.

The aforesaid screw is set in motion by an overlapping double-cone wheel in connection with the lever (with handle and index) *u*. One turn of the lever corresponds to a difference of 4° in elevation. The stationary circular index plate is divided by brass studs into eight

divisions so as to facilitate alterations in elevation by the elevating screw direct. As soon as the desired elevation has been obtained the barrel is held firmly in position by pushing the stopper lever *hh* forward, which causes the nut of the stopper screw to hold the cog *k*. If the lever be reversed, the stopper is released.



As the breech mechanism can only be worked with angles of elevation up to 7°, which very seldom applies to howitzers, the barrel has to be brought back to the loading position after every shot fired, which is inconsistent with the character of a Q.F. gun.

The limits of elevation obtainable by the elevating gear upon level ground, with the blade embedded, are generally +44° and −12°; but, when firing at an elevation of over 40°, or with angles of depression, the wheels must rest upon an elastic bottom—upon sand-bags or fascines, brushwood or similar substances—so as to lessen the shock upon the axle. When firing at angles under 15° and up to 20°, the wheels of the carriage jump, and the carriage may also be caused to shift. With an elevation over 20° this displacement is practically *nil*. Two wheels of a special pattern, with steel tires, are mounted upon the steel axles *as*.

The carriage brake consists of a bracket brake with two arms, worked independently (Fig. 1), each of which is composed of the worm *I*, whose nut is situated in a carrier below the axle *as* and the lever *II*. The brake shafts *III* work the rubber brackets *V* by the right-angled jointed cranks *IV*. An eighth of a turn corresponds to a slight check, not seriously interfering with the draught power of the horses; a three-quarter turn causes a sharp check.

Other parts deserving mention are:—The trail eye, the trail handles for unlimbering and limbering up, the sockets for the traversing handspike (on the left), the hooks and rings for hanging the sponge, rammer and handspike, all on the lower carriage; and, further, the rest for the hand-axe, etc., on the upper carriage. The gun complete, unlimbered, weighs 1,475 kilogrammes, the proportion of the barrel and carriage being 690 and 785 kilogrammes respectively.

The limber (Fig. 7) is in its main features (following the limber hook system) similar to that of existing field guns,[1] but naturally of slightly heavier dimensions. The limber box, however, does not rest directly upon the cross-piece, but upon an intermediate strong frame *r*. The wheels are of the same pattern as the carriage wheels. The flap of the limber box is at the back and opens downwards on hinges, similar to that of the field limber M.77. This arrangement facilitates the withdrawal of projectiles and the preparation of cartridges. The limber

[1] See *Mittheilungen*, 1881, pp. 410 and 411.

has footboards for the gunners riding on both sides, and the back rest is movable between the side supports of the box. The gunners riding at the back are guarded against the danger of falling off by a breast-strap *br* (Fig. 8).

Each limber box contains, in sixteen compartments and four drawers, sixteen projectiles, both parts of sixteen cartridges, and thirty friction tubes. The projectiles are lying free in their compartments, base and head resting on strips of strong buffalo hide, and a cushion of hard rubber tightly encircles them close to the driving band. The point of the projectile fits into a spring counterpoise which keeps the base pressed against a rubber plate on the lid of the compartment. This lid turns on hinges, and is closed by a spring latch, the tongue of which snaps into a catch. In this manner a secure, and at the same time elastic, stowage of the projectiles is effected.

In order to withdraw a projectile, the man, after opening and lowering the flap of the box, unlocks and turns back the lid of the compartment, withdraws the projectile by hand or with the extractor, and then again closes the lid. During action the compartments are emptied in this manner, first the upper then the lower tier.

Each of the centre drawers (Nos. 2 and 3) contains eight cartridges, packed separately and fitting tightly into a square box, and in addition eight open pieces of cartoon, made up in fours, which are intended for use when firing with reduced charges in place of the portions of cartridges withheld. The right of the outer drawers contain thirty friction tubes in packets of ten; further, in separate rests the following spare parts, viz., obturator ring (plastic), breech-head, hand-saw, various screw and fuze keys, lanyard, vent bit, cartridge pricker. The left outer drawer contains one copy of Battery Regulations, one quadrant, M.88, one tangent sight for the 120-millimetre howitzer, one "fixed" quadrant, one deflection scale with two dioptres, one plummet, various spare breech parts, etc., all carefully wrapped in cloths.

When fully packed and equipped the limber weighs 890 kilogrammes of which ammunition forms 38 per cent., the projectiles alone 36 per cent. Consequently, the fully-packed and equipped howitzer represents a weight of 2,365 kilogrammes, *i.e.*, an average draught of 394 kilogrammes per horse, which exceeds in no trifling degree the limit of weight assigned by artillery experts to a serviceable field-piece.

The equipped and packed Russian 15-centimetre field mortar weighs 2,110 kilogrammes, giving an average draught of 350 kilogrammes per horse (slightly less than our battery ammunition wagon). The weight of the complete Swiss mortar of position is 2,210 kilogrammes, and of the Turkish 12-centimetre field howitzer (Krupp's) 2,100 kilogrammes. (See table at end.)

B.—VEHICLES.

The establishment of a 120-millimetre howitzer battery comprises ammunition, store, forge, forage, provision and baggage wagons. An ammunition column (section) for 120-millimetre batteries consists of ammunition, forage, forge, and store wagons.

The ammunition wagon (Figs. 10 and 11) consists of a limber and hind wagon, the former resembling the gun limber. The hind wagon is attached to the limber on the limber-hook system. Two limber boxes of the pattern already described are fixed upon its frame. The fore part of the joint lid serves as a seat for the gunners; the rear portion is fitted with a rail for the knapsacks of the dismounted men, and a small rack for a forage bag containing 65 kilogrammes of oats. The ammunition wagon is fitted with a bracket brake worked, as explained by Fig. 11, from the rear on the left-hand side. The boxes of the ammunition wagon (Fig. 12)—similar to the gun limber boxes—contain each sixteen projectiles, sixteen cartridges, and thirty friction tubes, which are stored, as already described, in the ammunition compartments and drawers. The left drawer of each first, fourth, and seventh wagon contains, in addition, one fixed quadrant, one deflection laying instrument, one dioptre sight, cleaning rags, etc. All right-hand drawers are packed with one obturator disc, thirty friction tubes, several fuze keys, etc. Various reserve parts, cleaning materials, friction tubes, a candle lantern, M. 91, etc., etc., are stored in the drawers and body of the wagon coffers.

The weight of a complete battery ammunition wagon is 2,360 kilogrammes, corresponding to an average draught of 393 kilogrammes per horse. The battery store wagon (wagon for requisites), M. 1,833, resembles that for field guns, M. 77, described and illustrated in the *Mittheilungen* for 1881 (page 501), but is fitted with suspension springs between the cross-tree of the bed and the hind wagon axle. The brake is similar to that of the ammunition wagon. The contents of the limber box are :—One pump for re-filling the buffer tube, twelve pouches for friction tubes and lanyards, twelve cartridge bags and pricks, five kilogramme-candles (twenty-four candles to a kilogramme), one reserve pane of lantern glass, four kilogrammes grease, etc. The interior of the wagon box is divided by two partitions into three compartments. It will suffice to mention only the principal items of their contents, viz., the battery telescope, M. 86 with stand, one telemeter, one reserve buffer tube, etc., etc. Two reserve wheels, two spare axles, etc., are secured to the outside of the wagon.

The weight of a fully-loaded store wagon is about 2,100 kilogrammes. The spring store wagons, M. 33, of ammunition columns are fitted for the carriage of howitzer ammunition by being provided with lengthened limber boxes, M. 40, and by means of movable partitions in the hind wagon. The forge wagon takes in the various tools and materials for horse shoeing and minor battery repairs (in iron and wood), besides a few reserve parts. It also carries a jack, M. 58, capable of raising 2,000 kilogrammes. It weighs, when fully loaded, 1,834 kilogrammes. The forage wagon serves for various purposes of battery transport, but principally for the carriage of forage, and belongs to the regimental train. Its load must not exceed 1,400 kilogrammes.

Of the various classes of two-horse carriages (*fourgons*), M. 74 or M. 74/79 are intended for the carriage of provisions, one or two spring carts, M. 87, per division, being alloted for officers' baggage, offices, reserve stock of boots, and veterinary supplies. These conveyances are

furnished by the transport department; they are driven from the box, and are provided with waterproof canvas covers. Their maximum load is 900 kilogrammes. One of the provision wagons of each division carries a box containing three lanterns with accessories and spare parts.

The rules for the transport by rail of the *matériel* of the field howitzer batteries are the same as those laid down for the 95-millimetre gun, but only one vehicle (two axles) is loaded upon each truck. If the number of available trucks is limited, some of the ammunition hind wagons are placed together in pairs, and space is found for their limbers with the *fourgons* and sutler's wagons. The trucks must have a minimum floor space of 5·45 millimetres in length, and 2·5 millimetres in width.

Each battery disposes of the following stock of entrenching tools:—

24 Cramps—2 and 1 fastened to each gun and wagon limber respectively, 1 on the store, and 2 on the forage wagon.
9 Spades and 27 shovels—in the proportion of 1 and 3 respectively per ammunition hind wagon.
6 Hand axes—1 to each gun carriage.
6 Felling axes—1 to each first line ammunition wagon.
21 Handspikes—2 and 1 per gun carriage and ammunition wagon respectively.
9 Lanterns, M. 91.
6 Hammers, M. 80, 6 hand-saws, M. 80—1 to each gun limber.
3 Crosscut saws on three of the ammunition wagons.
6 Billhooks in the forage wagons.

Each field howitzer battery also carries with it to the entraining station, distributed over the battery vehicles, four beams, fifty-four lashing ropes, and the component parts of a movable ramp with planking for railway crossings and bridge flooring. These articles are carried along to the detraining station and left there.

III.—AMMUNITION.

The 120-millimetre howitzer fires shell and shrapnel, M. 91. Besides these patterns of Service ammunition it may also in peace-time use ordinary 120-millimetre shell (in that case filled with melinite) and shrapnel of older pattern, both similar to the projectiles for long 120-millimetre guns, for which a special range table exists, differing from that for Service ammunition.

The older common shell is painted with a black tip; old-pattern shrapnel is similarly distinguished with red paint; modern shrapnel is painted all red, and melinite shell all yellow. The shell is 4 calibres in length, made of steel, and filled with a bursting charge of 6 kilogrammes melinite, which is ignited by the shell fuze inserted in the head. The construction of the pattern of fuze employed, M. 88, Type 22/31 R. (Robin), tends to make it more sensitive with small charges than that used for field gun ammunition. The fuze is screwed into a steel bush at the head of the projectile, which also contains a detonator and delay-action composition in the space below the fuze.

The projectile complete weighs 20·35 kilogrammes.

A description of the above-mentioned fuze not yet having appeared anywhere,[1] a sketch of it is given here. It has the same outer appearance as the field fuze, M. 84, described in Schubert's "Feld-Artillerien."

The body of the fuze *a* (Fig. 13) is closed by the screw *v* at the head, from which the jagged needle *z* projects downwards. There are three holes on the periphery of the screw filled with sporting powder, which is intended to enlarge the flash from the cap. The striker bolt *sb* has a projection, 1—1, 2—2, on each end as a holdback of the safety arrangements. The cap *p* is fixed in its head, and below it rests the charge of sporting powder *g* around the axial quickmatch *x*, a wax plug *w* forming the foundation. Three feathers project inwards from the cover *h*, which is turned over the bolt *sb*, and the mainspring *f* keeps cover and bolt apart. Before discharge, the bolt is kept in position by three feathers projecting from the guard *l*. The spiral spring *d* working in the thread of the bottom screw *bs* of the body of the fuze, and the bolt forms a third means of ensuring safety in transport and during the process of loading. On discharge, the cover *h* moves upon the bolt *sb*, the mainspring *f* becoming compressed, and the three upper feathers sliding over the rounded head of the bolt, and again springing inward under the notch 1—1, cover and bolt now forming one body. The funnel-shaped rim of the cover similarly moves the feathers *l* of the guard *l* aside, and out of gear at 2—2.

When the shell strikes, the feathers and the weak lower spiral spring are broken by the advancing heavy bolt, the cap now being free to fly against the needle, and to effect the explosion of the projectile by igniting the fuze charge.

The intended effect of howitzer shell is the destruction of earthworks against which the melinite shell of the 90-millimetre field-gun is considered to be of too little value. The demolition of an earth parapet 3 metres in thickness, and 2·3 metres high, requires, for instance, ten good hits per metre, with 90-millimetre shell[2], which would result in an enormous expenditure of ammunition against a fortified position. A fair hit with a 120-millimetre shell has the same effect, and it may be asserted that it always equals the effect of any 12 shell of the same calibre, filled with ordinary powder.

Against troops behind thin walls, or cover of similar kind, the shell acts, after penetration of the obstacle, by its scattering *débris*. Under such conditions, the fact of the air pressure produced by the exploding projectile being able to throw down living beings, and to cause them severe internal injuries, is also to be taken into account, together with the destructive agency of splinters. If the explosion occurs in a closed room, after penetration, all the occupants are killed, either by the flying pieces or by atmospheric pressure.

The 120-millimetre (base chamber) shrapnel, M. 91 (Fig. 14),

[1] Except in the "Regulations for the French Siege and Fortress Artillery," Part II. The same fuze also serves for the melinite shell of field guns.

[2] "Leçons d'Artillerie" (page 208), par le Capitaine E. Girardon, 1895.

consists of a steel casing with a groove and copper driving band; the head, which is screwed-on, has the double-action field fuze, M. 84, Type 30/38, screwed into its mouth.

A description of this fuze, which is graduated to 22 seconds, is found in Schubert's "Feld-Artillerien." The timing can be exactly regulated to $\frac{1}{10}$ second by boring the setting spiral according to the time of flight of the projectile. The chamber for the bursting charge at the base of the projectile holds 280 grains of rifle powder F_3. Over the powder a movable disk is placed, on which the bullets are deposited, 630 in number, and weighing 12 grains each.[1] The bullets are embedded in resin and covered with a mixture of wax. A second disk closes the top of the bullet chamber. It would appear that the head remains empty; at least, there is no information to the contrary (the head of Boxer's first shrapnel was, as we know, only filled with wood). But it is also possible that the empty space at the head is fitted with a second bursting charge for percussion action or with a smoke-producing preparation.

The communication tube is screwed into the lower disk; it widens at the top in the shape of a cup, and is closed, after inserting the bursting charge, with a gauze and two paper disks.

The adjusted shrapnel is painted red, and is of the same weight as the shell—20·35 kilogrammes, of which 7·56 kilogrammes (=37 % of the net weight) are taken up by the bullets. By French authorities the angle of the cone of dispersion for Service ammunition is given as 14°. The projectile acts as a case shrapnel, the steel casing, 6 to 10 millimetres thick, remaining intact on explosion.

Against standing obstacles, shrapnel acts by contact shock; against troops, by its bullets and splinters. As a result of experiments the normal height of burst (*hauteur-type*) with charges of 550, 330, and 220 grains, respectively, has been identified at 10, 20, and 30 thousandths, respectively, of the range; at 60 metres, for instance, with medium charge and range of 3,000 metres.

All bursting points of slight elevation are designated as "low," those above the normal as "high," and if more than double the normal height as "very high."

Corrections are made after the following rules:—

The burning time (timing) is increased by

0·8 second	after	2 very high bursts
0·6	,,	1 ,, 1 ,,
0·4	,,	2 ,,
0·2	,,	1 ,, 1 normal burst

[1] French artillerymen calculate the force required to disable men and horses at 4 and 19 metre-kilogrammes respectively, and require a striking velocity for hard lead bullets weighing 11 grains of 81 and 175 metres respectively, and of 77 and 166 for 15-grain bullets. The bullets of the 80 and 90-millimetre "Obus à mitraille" weigh 15 grains. The above (120 millimetres) shrapnels belong to the class of "Obus à balles" (Wille, "Waffenlehre," 1896).

The timing is decreased by

0·8	second after	2 grazes
0·6	,,	1 ,, and 1 low burst
0·4	,,	2 ,,
0·2	,,	1 ,, 1 normal burst

The cartridges consist of two parts, the normal charge of 550 grains of smokeless powder B.C. composed of two part-cartridges of 330 and 220 grains respectively, which separately form the medium and minimum charge. They are made up in differently coloured and suitably marked bags to facilitate identification. Each part-charge has a layer of 10 grains of gunpowder (Black Powder) C_1 in the bottom of its silk bag to ensure ready ignition of the cartridge. The finished cartridge has the shape of a four-sided prism, whose corners touch the walls of the bore. In closing the breech, the cartridge is slightly compressed lengthwise so that it cannot shift, and retains lateral air space.

When firing with reduced charges, the normal length of the cartridge is obtained by inserting a cylindrically rolled piece of cartoon in the lap of the cartridge bag in place of the portion withheld. This arrangement also makes it impossible to push the cartridge further into the chamber than required for prompt ignition and uniform burning.

In firing with B.C. powder, after-flashes may always be apprehended. This preparation has, like many other kinds of smokeless powder, the peculiarity of flashing after discharge, *i.e.*, a flame frequently shoots forth when the breech is opened immediately after firing. These after-flashes have already caused several accidents. The *Avenir Militaire* reports one case which occurred on the 15th June, 1895, on the range near Poitiers. On that occasion two cartridges and a shell (?) whilst being carried to the gun were exploded by after-flash, four men being wounded by the explosion.

The ignition of the cartridge is effected by the friction tube, M. 85, which is inserted into the vent bolt in the centre of the breech block.

The complement of ammunition of a battery is as follows:—

Carried in	Shell.	Shrapnel.
6 Gun Limbers (16 rounds each)	—	96
4 even-numbered Ammunition Wagons (48 rounds each)	—	192
5 odd-numbered Ammunition Wagons (48 rounds each)	240	—
Total	240	288
Total per Gun in the Battery	40	48
	88	

IV.—Laying Instruments.

Each 120-millimetre howitzer is equipped for indirect laying with a quadrant, a "fixed" quadrant (*niveau fixe*), a plummet, and a deflection sight (with dioptre), all packed away in the gun limber box. A tangent sight, in connection with the "Broca" sight on the buffer ring *R*, close to the muzzle, serves for direct laying. Three fixed quadrants and deflection sights are kept in reserve in ammunition wagons Nos. 1, 4, and 7, making nine of each per battery.

The quadrant, M. 88, was described in an article on French Fortress Artillery (*Mittheilungen*, 1895, page 296). It is used only when a fixed quadrant is not available.

The fixed quadrant (without Nonius) (Fig. 15) is so named because it remains during practice on the stationary conductor socket. It consists of the bronze case *a* with two feet *f*, within which there are two circular plates on a common axle, but movable independently. The latter are pressed together by a spiral spring *p*, and have on their inner side 72 teeth, so that their relative positions can be altered by multiples of 5°. One of these two plates serves as turning wheel *d*, and can be moved within angles of 10° by means of the worm *s*, which gears into the cog piece *o*, and receives its rotation from the stud *k*. The other wheel, the regulator *st*, has to follow the above turning movement by reason of the gearing. The level *l*, with furrowed ends *n*, is connected with the wheel by a pin passing through the quadrant case. By slightly drawing the level outwards, and with it the wheel, the latter comes out of gear with the turning wheel, and can then be freely moved independently. Upon relaxing the pressure both wheels are again put in gear by the action of the spring *p*. An index *x* (with a line scratched on it) projects upwards from the level box. A graduation from 0 to 60°, along which the above-mentioned index glides, is engraved on the mantle *g* of the upper sector of the quadrant case. The upper surface of the circular setting stud *k*, again, bears a division of minutes, which is wound past the line *i*, cut in the quadrant case. A watch spring *u* on the inside of the turning wheel causes the constant gearing of the cog piece *o* with the worm *s*, and the spiral spring *r* ensures similarly the movement of the worm in its sockets.

In setting the fixed quadrant, the box of the level is partly drawn out clear of the quadrant case with the thumb and fore-finger of the right hand in the manner before described, and moved until the index line coincides with the 5° line, nearest to that required. The regulating wheel is then allowed to spring back, and comes again into gear with the turning wheel, as already explained. The latter is then turned by means of the stud *k* until the index line coincides with the desired figure on the graduated scale. The turning of the stud is then continued until the given number of minutes coincides with the minute index *i*. For instance, to set the quadrant to 28° 8′, one first sets to 25°, then turns 3° further, and finally adjusts to the 8′.

One advantage of the French quadrant to modern guns of precision equipped with it is that the setting of a Nonius and the calculation of minute multiples are done away with, as the instrument can be accurately

set to a minute. This superiority is also possessed by our own laying instrument. Another advantage is that the fixed quadrant remains on the conductor socket throughout the whole duration of firing, being placed into its bed before commencing practice, and held in position by a locking pin. Corrections during ranging are made without shifting the quadrant, as alterations in elevation are nearly always made by its means.

This may, however, in exceptional cases, be done by means of the elevating gear or the tangent, when the following ratios apply :—

Relative Ratios.

Turns of the Lever of the Elevating Gear.	An Angle of	Tangent Elevation in mm.
$\frac{1}{8}$ turn equals	30′	13
$\frac{1}{4}$ „ „	1°	25
$\frac{1}{2}$ „ „	2°	51
1 „ „	4°	102

The deflection sight (Fig. 16) consists of the apparatus proper, and the dioptre scale. The former is composed of a base plate *g*, and the setting bracket *p*. The base plate is pushed into its bed on the left trunnion of the conductor socket, and is firmly held by a pin snapping into a catch, and a clip. The setting bracket turns on the hinge *s*, by which it is attached to the base plate, and the axis of which runs parallel to the axis of the bore. A spiral spring *f* presses the setting bracket away from the base. The movement of the former is effected by means of the milled-headed button *k*, which acts as a nut to the screw *b* jointed to the base plate.

The movable bronze block *o* is joined to the setting bracket by the pin *z*, and its turning power is arrested by the butterfly nut *u*. The block contains the bed *a* for the dioptre scale, and the box level *i* standing perpendicularly on its surface. The bubble of the level is adjusted by means of the screw *b*, *i.e.*, by turning the button *k*. By the use of the level, it is possible to counteract the effects of the wheels not being on the same level.

The steel dioptre scale *d* has an objective, consisting of a turn-down frame *r* with a vertical thread, and an ocular *v* with an eye-hole and a notch above it, which resembles the cross-arm of a tangent scale, and is held fast at the desired deflection point by a clamp *e*. The sight line of the dioptre scale when at zero is 320 millimetres long, *i.e.*, nearly one quarter of that of the tangent scale. The dividing lines on the cross-arm are 0·4 millimetre apart on the dioptre to 1·0 millimetre on the tangent scale, thus corresponding to $\frac{1}{800}$ and $\frac{1}{1300}$ of the respective lengths of sight line. Those on the dioptre cross-arm

reach from − 30 to + 80. Consequently, a correction by one dividing line on the dioptre corresponds practically, with sufficient exactness, to 1·5 millimetre (1·7 exactly) on the cross-arm of the tangent scale. When the dioptre cross-arm is at zero, the plane of sight is parallel to the symmetric plane of the bore. For each correction in deflection, the plane of sight, which remains vertical, forms, with the symmetric plane, the angle corresponding to such correction. The block remains in its first position so long as no considerable change is made in the elevation.

When more extensive corrections have to be made, such as are necessitated, for instance, by the wheels being on a steep slope, and the traversing plane much inclined, special precautions have to be taken with the apparatus on account of its sensitiveness. To use the deflection sight the clamp *e* is slackened, and the eyepiece *v* on the dioptre cross-arm shifted to the dividing line indicated, when the clamp is again tightened. The block *o* is placed in a constant position, so that the selected point, or the auxiliary point, is visible by both the ocular and the objective frame. The bubble of the level, *i.e.*, the effects of the wheels not being on the same level, must be compensated for. The auxiliary mark for the subsequent laying operations may be either in front or in rear of the gun. In the absence of marks in the ground, a pole, planted at least 500 metres distant, is made to serve the purpose. After completing the side-laying the dioptre rule is removed, the block remaining on the conductor socket.

When the laying is effected with the quadrant and the deflection sight, the elevation is taken first, then the exact deflection, and, finally, the fine elevation. For this purpose three men are required.

Any errors in deflection noticed during practice are corrected by shifting the eye-piece on the cross-arms towards the side to which it is desired to direct the projectile. Allowance is also made for wind crossing the range. When firing, for instance, at a range of 1,000 metres, the eye-piece is moved one, two, or three dividing lines further towards the side from which the wind is blowing, according to whether the force of the wind is light, medium, or strong.

One advantage of the deflection sight is that it possesses a shorter sight line, and commands a larger horizontal field of view than the tangent sight. It can, furthermore, be used with any elevation, and even during the process of loading, on account of its being situated at the side, and clear of the breech block.

The stem of the field howitzer tangent sight is similar to that of the field-guns, M. 77, and consists of a three-sided brass tube, which has on its left side a millimetre graduation up to 320 millimetres. The lower part of the cross-arm is toothed, and its motion sideways is effected by a small wheel (with stud attached) gearing into it. It is held fast by a clamp. The millimetre graduation on the cross-arm extends to 50 millimetres to the right, and 20 to the left.

The tangent scale is worked and fastened, when at the elevation ordered, by the setting screw. The case rests with its base plate on a rest at the breech coil, and a spring at the back of it prevents it from

accidentally sliding out. For rapid firing the use of the tangent sight, so far as its graduation allows, is obligatory. On account of the inaccuracy of the plummet, it is only to be used in the absence of any other laying implement.

V.—Ballistic Data.

In the absence of authentic French range tables for the field howitzer, the following ballistic data are supplied by the *Militär-Wochenblatt* (No. 12, of 1896):—

Charge *g.*	Muzzle Velocity.	Extreme Range.		Range with angle of descent of 30°
		Shell.	Shrapnel.	
	m.			
550	290	6,000	4,850	4,700
330	217	3,800	3,450	3,200
220	173	2,600		2,200

In view of these facts, the author of the *Militär-Wochenblatt* concludes that the French field howitzer can enter the fight already in the initial stage at long ranges, and he proceeds to say:—

"Although it has been hitherto believed that its principal *rôle* in the attack will be to work upon the intended point of assault, still, its high complement of shrapnel (55%) points to the intention that it is also to take part in the artillery fight proper.

"This, I think, certainly will be its main function in the defence, the more so, as firing at moving targets is to be the exception, according to the distinct wording of the regulations; and, on the other hand, targets for shell, such as prepared positions and obstacles, appear more generally on the side of the defence, and thus exist practically for the artillery of the attack only."

Fig. 1.
120 mm Field Howitzer.

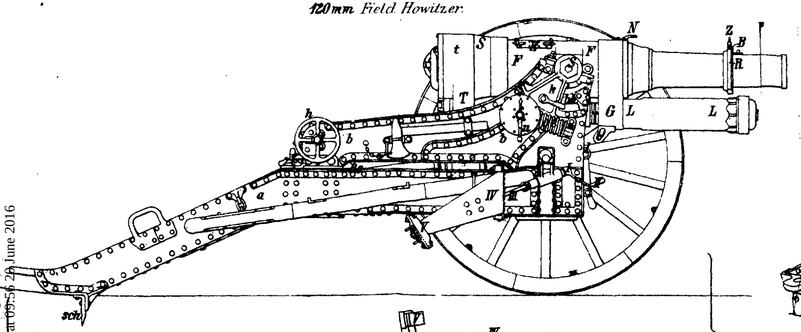


Fig. 2.
120 mm Field Howitzer

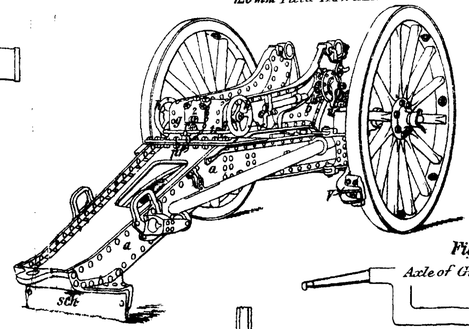


Fig. 3.
Barrel

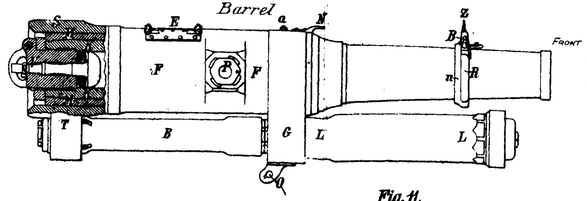


Fig. 4.
Buffer Tube

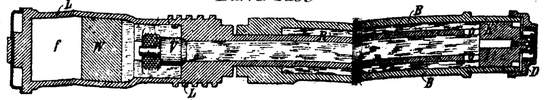
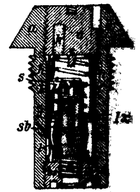


Fig. 13.
Shell Fuze



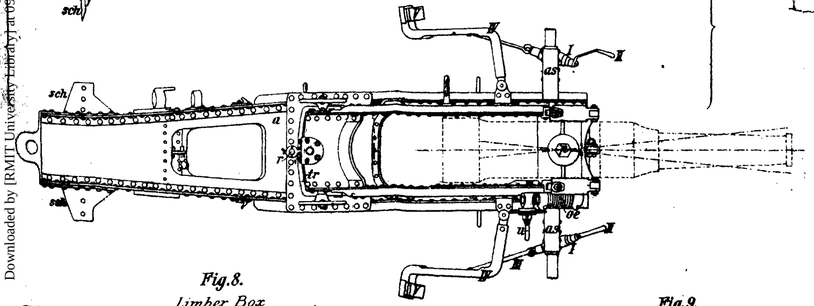


Fig. 5
Axle of Gun Carriage

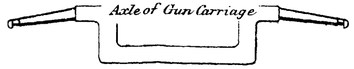


Fig. 11.
Frame of Hind Wagon

Fig. 12.
Box of Hind Ammunition Wagon

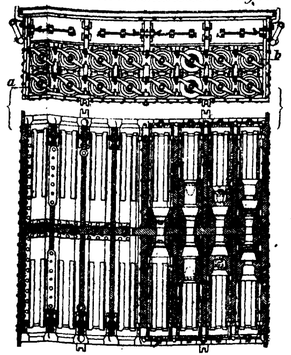


Fig. 15. Quadrant

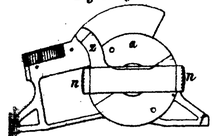


Fig. 7. *Limber*

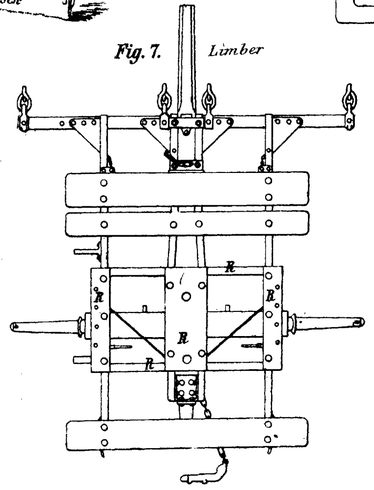
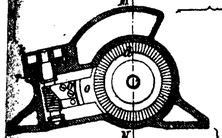
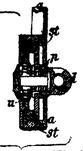


Fig. 6.
Traversing Gear

Section g h.



Section MN



Top View

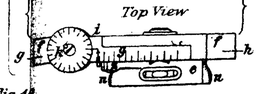
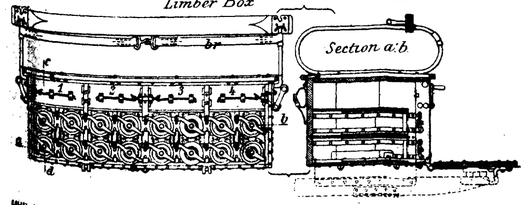


Fig. 14.
120 mm Shrapnel M. 91.

Fig. 8.
Limber Box



Section a b

Fig. 9.
Shell Compartments

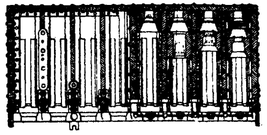


Fig. 10.
Ammunition Wagon

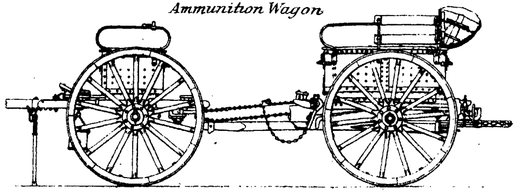
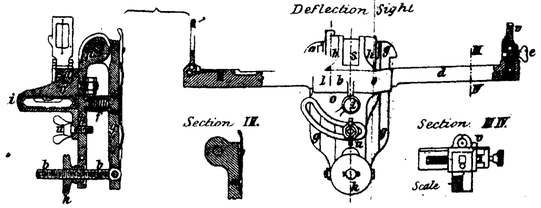


Fig. 16.
Deflection Sight



Section III.

Section IV.

Scale

Mittheilungen über Gegenstände des Artill.- u. Genie-Wesens. Jhrg. 1896.

J. el. Kellner & Co. Lith. London

Comparative Statistics of Various Systems of High-Angle Ordnance.

	Details.		French 120-mm.	Turkish (Krupp's) 12-cm.	Brazilian (Canet) 10-cm.	English Model "Armstrong" 12-cm.	German 15-cm. Howitzer.[4]	Austro-Hungary 15-cm. Mobile Battery Howitzer.[4]	Swiss 12-cm. (Position).	Spanish 12-cm. Model "Selgras."	Russian 6-inch.	Brazilian (Canet) 15-cm.	Krupp's 15-cm.
			FIELD HOWITZER.							FIELD MORTAR.			
BARREL.	Calibre	mm.	120	120	100	120	149·7	149	120	120	152·4	150	149·1
	Total Length of Barrel	mm.	1,700	1,400	1,300	1,596	1,700	2,000	1,500	858	1,372	1,200	1,250
		Calibres	14	11·6	13	13·3	11·4	12·1	12·5	7	9	8	8·4
	Length of the Rifled Portion	mm.	1,300	1,015			1,216	1,280		585		—	—
	Number of the Grooves	—	36	36	30	—	36	36	18	32	—	46	20
	Depth of the Grooves	mm.	0·75	1·5	—	—	1·3	1·5	1·5	1·5	—	—	1·5
	Length of Twist	Calibres	7	Final Twist 15	—	—	44·9 to 14·8	100 to 25	25	—	Final Twist 15	—	—
	Angle of Twist	Degrees	8	—	1°·030′ to 7°	—	4 to 12	1° 47′ 4″ to 7° 9′ 45″	—	4° 5′	—	1°·030′ to 7°	—
	Length of Sight Line (Tangent Scale)	mm.	1,360	570	475	—	660	1,000	920	—	—	450	—
CARRIAGE.	Weight of Barrel, including Breech	k.g.	with Conductor and Buffer Tube, 690	450	290	504	1,075	1,060	Bronze 631 Steel 534	285	460	390	450
	Height to Muzzle	m.	about 1·1.	0·91	1·04		1·08	1·4	1·11	—	1·1	1·12	—
	Greatest possible Elevation	Degrees	44	45	50	60	65	45	60	70	47	50	45
	Greatest possible Depression	Degrees	12	5	0	0	0	2	0	0	18	0	0
	Gauge of Wheels	m.	1·47	1·53	1·20	—	1·53	1·53	—	—	1·52	1·220	—
	Weight of Gun Complete Unlimbered	k.g.	1,475	1,115	885	1,230	2,188	2,410	Bronze 1,474 Steel 1,377 (including Bed (175 kg.))	565	1,260	1·255	1,093
	Weight of Gun Complete Limbered Up	k.g.	2,365	2,100	1,455	2,182	2,565	2,730	Bronze 2,209 Steel, 2,112 (including Bed (175 kg.))	With Bed (710) 1,855	2,100	2·100	2,086
	Draught per Horse (teams of 6 Horses, Gunners on foot		394	With 6 Horses 350 / With 8 Horses 263	242	364	428	455	Team of 4 Horses 550	310	350	350	345
AMMUNITION.	Length of Shell	Calibres	4	4	3.1	2·6	3.2	—	5	3	2.8	3	3·3	—	2·6	3·2	4·1	3·2
	Material of Shell	—	Steel.	Iron.		Steel.		—	Steel.		Iron.	Iron.		Steel.	Iron.	Steel.		Iron.
	Weight of Shell	k.g.	20·35	20		9·5		20·4	38·5	42·3	33	18	22	26	32		40	
	Composition of Bursting Charge	—	Melinite.	Black Powder.					Gun Cotton	Picric Acid.	Ecrasite.	White Powder.	Black Powder.	Black Powder. Melinite.	Black Powder.		—	
	Weight of Shell	k.g.	6	2·5	1	0·4	1·02	1·8—1·9			2·66	0·76 + 1·85 Paraffin.	1·1	4·98 7·4	1·36	3·42	—	
	Length of Shrapnel[1]	Calibres		2·5		2·2		—	Not yet adopted.		—	—	Undecided at present.	—	2·2		2·7	
	Weight of Shrapnel[1]	k.g.	20·35	20		9·5		—			36·9	18		31	32		40	
	Bursting Charge of Shrapnel[1]	g.	280	200		120		—			470	160		247	320		—	
	Number of Bullets	—	630	460		205		278			380	475		683	730		—	
	Single Weight of Bullets	g.	12	16		—		—			24	12·5		21·3	—		—	
	Maximum Powder Charge[2]	g.	550 *r*	1,500 *S* / 500 *r*		520 *r*		680 *r*	(850 *r*) / 750 *r*		750 *r*	300 *r*	? *S*	1,740 *S*	850 *r*		1,500 *S*	
	Medium Powder Charge[2]	g.	330 *r*	900 *S* / 300 *r*		—		—	400 *r* / 200 *r*		—	200 *r*	—	½ charge 870 *S*	—		900 *S*	
	Minimum Powder Charge[2]	g.	220 *r*	600 *S* / 200 *r*		—		—	100 *r* / 50 *r*		350 *r*	100 *r*	—	¼ charge 435 *S*	—		600 *S*	
RESULTS.	Muzzle Velocity with Charge. Maximum	m.	290	—		300		300	(276)		291 / 276	226	220	220	200		—	
	Muzzle Velocity with Charge. Medium	m.	217	—		—		—	—		—	175	—	½ + ¼ Charge 179	—		—	
	Muzzle Velocity with Charge. Minimum	m.	173	—		—		—			196 / 186	112	—	½ Charge 138	—		—	
	Extreme Range with Charge. Maximum	k.m.	6·6[3] / 4·85	5·8[3] / 5·4		—		—	(6·05)		6·6[3] / 5·0	4·0	4·0	3·4	—		—	
	Extreme Range with Charge. Medium	k.m.	3·8 / 3·45	3·5		—		—	—		—	2·6	—	½ + ¼ Charge Range = 2·13	—		—	
	Extreme Range with Charge. Minimum	k.m.	2·6	2.3		—		—	—		3·3 / 3·0	1·3	—	½ Charge Range = 1·7	—		—	

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[1] The Mobile 15-cm. Battery Howitzer of the Austrian Artillery carries also Case Shot of 27 kg., with 440 bullets weighing 43 g. each.

[2] *S* = Black Powder, *r* = Smokeless Powder.

[3] For Shell. / For Shrapnel.

[4] To be considered Guns of Position.