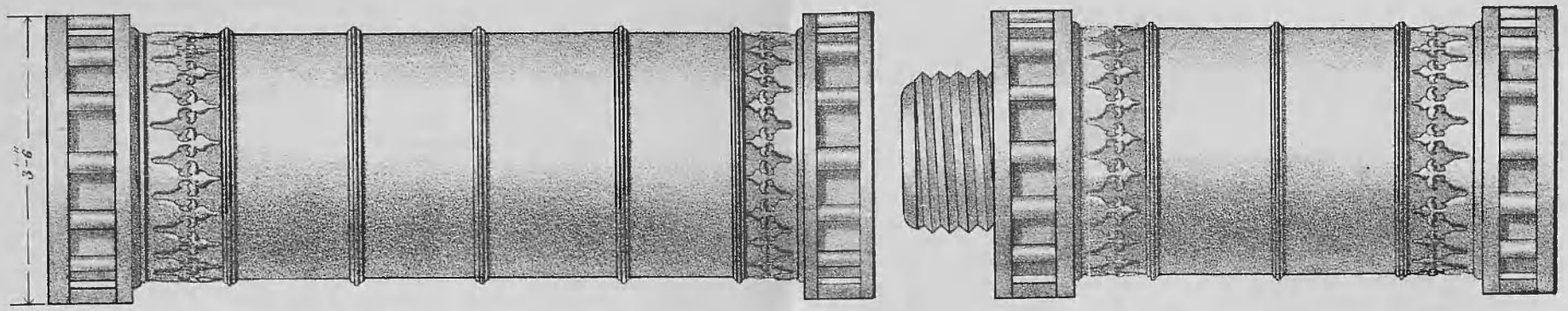
CANNON OF MUHAMMAD II, *cast AH 868 (A.D. 1464.)*

PRESENTED TO

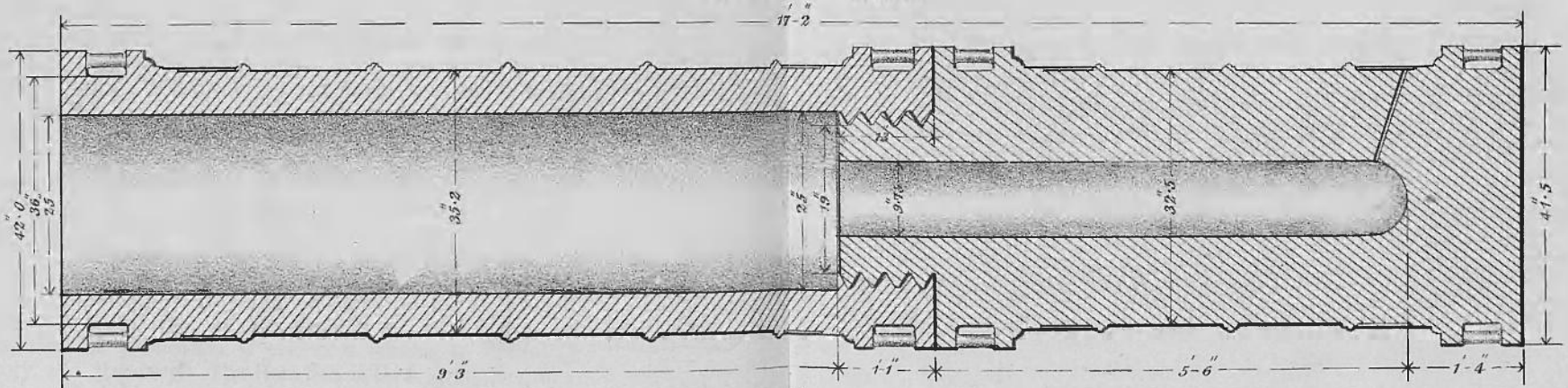
HER MAJESTY BY THE SULTAN ABDUL AZIZ KHAN, 1866.

NOW IN THE MUSEUM OF ARTILLERY, WOOLWICH.



Scale $\frac{1}{24}^{th}$

LONGITUDINAL SECTION.



Lithographed at the Royal Artillery Institution

The Archaeological Journal.

DECEMBER, 1868.

THE GREAT CANNON OF MUHAMMAD II. (A.D. 1464.)

RECENTLY PRESENTED TO THE BRITISH GOVERNMENT BY THE SULTAN, AND NOW IN THE MUSEUM OF ARTILLERY, WOOLWICH.[1]

By Major-General J. H. LEFROY, R.A., F.R.S.

THE great cannon of the Dardanelles have been a subject of wonder to travellers and of interest to artillerymen from the earliest period. There are no other examples of guns which have remained in use for four centuries, and are still, in a very real sense, effective pieces of ordnance. They testify to the former energy and power of the Ottoman race, as no other military monument does, and remind us of an event which has had a greater influence on the politics of Europe than almost any other within the same period—the fall of Constantinople. Monuments of the military genius of Muhammad II., they remind us also of "the splendour and the havoc of the East" by their prodigious size, and cost and power. They form a class apart, and although there is reason to think that they are referable to a Flemish original, they bear the stamp of a national character and of an epoch of conquest of which European history presents scarce any other example. These cannon were formerly very numerous. M. Thevenot (1655) did not land at the Dardanelles, but as he passed he could "privately discern, with a Perspective glass (on the European side) about twenty Port-holes level with the water, in which there are guns of such prodigious bore, that besides what I could observe by my glass, I was assured that a man might easily creep into them." The other castle (on the Asiatic side) he remarked, "hath not

[1] Substance of a memoir read before the Archæological Institute, June 3, 1868. See p. 249, *ante*. It was subsequently published in the Proceedings of the Royal Artillery Institution, Woolwich (vol. vi. p. 203), with notices of other great Oriental Cannon. These, it is hoped, may, by the author's kindness, be given hereafter in this Journal.

so many gun holes." Bishop Pococke, writing about 1740, reckons about 42, viz., on the north side of the Dardanelles 22, on the south 20. His description of them is the more interesting as there can be no doubt that the gun, in two parts, which, like the other, is adorned with the *fleurs-de-luce*, is the identical gun that we have lately acquired. It is as follows :—

"There are fourteen large brass cannon without carriages on the sea shore; they are always loaded with stone ball, ready to sink any ship that would offer to pass without coming to anchor, in order to be searched; they fire likewise with ball in answer to any ship that salutes the castle, as this does much damage where they fall, so the lands directly opposite commonly pay no rent. There are eight other cannon towards the south; I saw among them two very fine ones, one is 25 ft. long, and adorned with *fleurs-de-luce*, which they say was a decoration anciently used by the Emperors of the East before the French took those arms, and I have seen them in many parts; the other cannon is of brass, 20 ft. long, but in two parts, after the old way of making cannon of iron of several pieces; the bore of this is about 2 ft., so that a man may very well sit in it; two quintals and a half of powder are required to load it, and it carries a ball of stone of 14 quintals.[2] The other castle, called Rumeli Eskihissar (the old castle of Romelia), has in it twenty large brass cannon, one of which is of great size, but not so large as that on the other side."

A more recent Prussian traveller, Major von Molke (1829), says that there are "63 kamerliks or guns which throw stone balls, some of which weigh 1570 lbs. weight." "These gigantic guns," he adds, "are some of them 28 inches in diameter, and a man may creep into them up to the breech. They lie on ground on sleepers of oak, instead of gun carriages, and their butts against strong walls, so as to prevent recoil, as it would be impossible to run them forward in action. Some of them are loaded with as much as 1 cwt. of powder."[3] 1570 Turkish chekies are equivalent to about

[2] A quintal is 110 *rotoli* of 144 drams, or 1·00 lb. avoirdupois, according to some authorities. Tate makes the *Rotolo* 180 drams or 1·27 lb. (Modern Cambist.) Von Hammer says, "Moi meme j'en ai vu un aux Dardanelles: sa bouche était si vaste, que peu de temps avant mon arrivee, un tailleur poursuivi pour dettes s'y était blotti et v resté cache pendant plusieurs jours!" Liv. ii. p. 514.

[3] Quoted by Mallet.

1050 lbs. avoirdupois, a stone shot of this weight would have a diameter of 31·7 in.; as the largest calibre mentioned by this officer, 28 Prussian inches, is equivalent to only 28·8 English inches, it is possible that the stone shot of 1570 (Turkish) lbs. were intended for a gun not seen by him; but the discrepancy is not greater than may arise from the vagueness of the original unit, the kantar, when applied to stone shot. Of the primitive mode of mounting which he describes we have many examples.

At the present time there are only 18 of these guns left, including the one recently presented to Her Majesty, and I am indebted to Mr. Wrench, H.M. Vice-Consul at the Dardanelles, for being enabled to give a list of them; it includes also three that have been recently broken up.[4] See Table I., on the next page.

Mr. Redhouse has supplied the following translation of the four inscriptions on Nos. 8, 9, 12, and 21 (date A. Heg. 928, or A.D. 1521-22). The first line is in Persianized Arabic, Persian, and Turkish, the last two in Arabic, the engraved inscription in modern Turkish.

"The work of Mustafa son of Murad, Chief Gunner."—"And in the time of Sulayman Shah the just."—"I made the guns for the destruction of forts."—"The chronicler said of the great gun,—'This is one of the houses, judge thou then as to the palaces.'

"The last line," he adds, "is an allusive quotation. The letters added together in their numeral values should give the date, but do not in any way I can see. The quartet is a chronogram, but a false one. There are several mistakes made by the moulder or the copier, which I have indicated; all the long inscriptions are verbatim copies of this."

This difficulty as to the chronogram has given a great amount of trouble. There seems to be certainly a mistake in the work; Mr. Wrench wrote thus in May last:—"The inscription which has been puzzling me in common with the scribes here for so long a time is not even yet satisfactorily deciphered. I went some little time ago with one of the

[4] In Table I., N signifies that the gun was, in January. 1868, in the Fort Kilit Bahar on the European side of the Dardanelles Straits. S that it was in the Sultanieh Fort of Chanak Callessi. on the Asiatic side of the Dardanelles Straits. Many of the guns have the weight of shot marked in kantars only; I have reduced these to okes, at 44 okes = 1 kantar. In others it is marked in okes, not in kantars.

TABLE I.—LIST OF GREAT TURKISH GUNS EXTANT IN 1868.

No.	Place	Date. A.H.	Date. A.D	Designation in kantars.	Dimensions. Cal.	Diam. of chamber.	Length.	Modern Turkish charge. Powder okes.	Shot. Kantars.	Shot. Okes	In English measures. Charge of powder.	Weight of one shot.	Remarks.
					in.		ft. in.				lbs.	lbs.	
1	N	—	—	10	29·5	—	14 5	25	10	440	70·7	1245	
2	N	—	—	10	29·0	—	14 2·5	25	10	440	70.7	1245	
3	N	—	—	8·5	27·5	—	13 10	20	8½	374	56·6	1058	
4	N	—	—	8	27·0	—	14 1·5	20	8	352	56·6	996	
5	N	—	—	8	26·7	—	12 4·5	20	8	352	56 6	996	
6	N	—	—	7	26·5	—	13 10	20	7	308	56·6	871	
7	N	—	—	5·5	26·0	—	14 0	16	5½	242	45·3	685	
8	S	928	1521	5	25·5	9·5	15 6	17·5	—	240	49·5	670	The work of Ahmet, son of Abdul, the chief gunner.
9	S	928	1521	5	25·0	9·5	15 7	17·5	—	240	49·5	670	
10	S	868	1464	5	25·0	10·0	16 7	17·5	—	240	49·5	670	The work of Munir Ali.
11	S	—	—	5	25·0	9·5	14 0	17·5	—	240	49·5	670	
12	S	928	1521	4·6	23·5	9·7	14 0	16	—	220	45·3	620	The work of Mustapha, son of Murad, the chief gunner.
13	S	—	—	4·5	22·5	—	16 0	16	4¼	198	45·3	—	
14	S	—	—	4·2	22·5	8·1	12 9·5	15	—	200	42·5	564	
15	S	863	1458	3·7	23·2	8·5	12 8	13	—	176	37·7	498	The work of Khoder.
16	N	—	—	3·5	20·5	—	13 11	12	3½	156	34·0	—	
17	N	—	—	3·5	20·7	—	11 11	12	3½	156	34·0	—	
18	S	—	—	3·2	21·2	8.7	10 7	12	—	154	34 0	436	
19	S	—	—	3·2	21·0	8·7	11 4	12	—	154	34·0	436	
20	S	—	—	3·2	20·0	7·0	12 7	12	—	154	34·0	436	
21	N	928	1521	2·5	19·5	—	11 2·5	10	2½	110	28·3	—	The work of Mustapha, son of Murad.
22	—	1109	1697	1·0	13·5	—	10 11	—	—	—	—	—	See note, p. 280.

No. 5. By a clerical error the bore is returned at 20·7 inches, for a shot of 8 kantars.—No. 8. *This gun is still constantly fired.* It is marked by 11 shot. It bears a second date A.H. 1126 = A.D. 1714, the epoch of preparations for war with Venice, when its weight, length, and weight of shot were inscribed.—No. 9 bears the marks of having been struck by 6 shot; and No. 10 gun is marked by one shot.

Nos. 12, 14, and 15 have been recently broken up; and Nos. 18 and 19 stand sentenced to be broken up.

No. 10 is the gun lately presented to our Government. There are only two guns of the list which date from the reign of Muhammad II., and one of them is already broken up. We possess the other. There are four of the same date, A.D. 1521, one year before the conquest of Rhodes, and possibly among those which were cast on the Island for its subjection before the siege of the Fortress, which fell December 22, 1522. These four guns, Nos. 8, 9, 12, and 21, bear the same inscription, which has been deciphered by Mr. Redhouse, a task of which the difficulty can only be fully appreciated by Oriental scholars; having seen educated natives entirely baffled by them, I may venture to call the attention of artillerymen to the obligation we are under to this eminent scholar for having on many occasions brought his great learning to bear on so apparently trivial a subject as the inscription on a gun, at the cost of not a little time and research.

most learned men here, and we copied the inscription, as I thought exactly, as it was on the gun; this copy I sent to Mr. Hughes, our Oriental Secretary at the Embassy, and at a meeting I had with Mr. Hughes and a learned friend of his, it was shown that my copy could not possibly be correct, as the date in figures did not correspond with that in characters. They advised me to send a rubbing of the inscription, and I am in a day or two going to take one, when I trust that a satisfactory result will be obtained."

Only two of these guns are referable to the period of Muhammad II. (A.D. 1451-1481), and, although we have none exactly contemporaneous with the fall of the Byzantine Empire, one of those that have been lately broken up (No. 15) carries us to within seven years of that epoch. The interest attaching to them has been very much enhanced by the discovery at Constantinople, within these few years, of a work in MS. by a contemporary writer named Kritoboulos, in which he describes the actual fabrication of the first of Muhammad's great cannon. A part of this MS. has been translated into French by Dr. Dethier, Director of the Austrian College at that place; through the kindness of Mr. Newton, of the British Museum, I have had access to this work, and can present a translation from it. It bears date 1467, and the portion published by the learned doctor commences thus :—

"After having distributed his troops around the walls of Constantinople (1451), Muhammad II. summoned the makers of his ordnance and discoursed with them on the guns, and on the defences, and what manner of cannon he needed the better to beat down the walls. The gunners replied that it would be easy to make a breach if they could make on the spot out of the guns they then possessed others large enough to overturn and demolish the rampart; but that to cast such pieces a considerable outlay was necessary, and above all a large supply of bronze. Muhammad commanded at once that they should have everything they required, and on their part they made the machine (cannon), a thing terrible to look upon, and not to be believed by the hearer. But I will now explain the mode of fabrication, and the form and the use of it. They take a quantity of very fat clay, the purest and lightest possible, which they make plastic by kneading it for several days. The mass is knit together and pre-

vented from breaking by the intermixture of linen, hemp, and other shreds, and the whole well worked up and well mixed in such a manner as to make one tough and compact mass. Then they make a round cylinder, *en forme de flute*, very long, to be the mandril or core of the shape. It was forty palms in length, the front portion of gun proper was twelve palms in circumference. The rear portion, that is to say the chamber intended for the reception of the powder (*l'herbe*), was four palms, or a little over, in circumference, according to the rule of proportion to the rest of the gun, that is to say, one-third.

"Another exterior shape, to receive the first, was next made ready, hollow and if as intended for a sheath to the first; but, be it observed, larger, and not alone to receive the other, but such as to leave a void space between the two. This space or this interval all round between the surfaces, which is uniform, is a palm or a little more. It is the space intended to receive the bronze pouring into it from the furnace to take the form of a cannon. This exterior is made of the same description of clay, but entirely surrounded and fortified with iron, timber, earth and stones, built up round it, and intended to prevent the immense weight of the bronze from fracturing it and spoiling the cannon. Then they erected two furnaces, one on either side and close by for the foundry. These towers were very strong and fortified internally with bricks and a very fat well worked clay, and on the outside surrounded with large cut stones and cement, and everything suitable for adding to their strength. And they cast into the foundry a mass of bronze and tin, about 1500 talents. Thereupon they threw in charcoal and wood, and so disposed it that the metal was covered above and below and on all sides, and the very furnaces hidden except their outlets. Round about this were the bellows which worked without rest or intermission when the mass was once lighted, and this for three days and three nights, until the whole of the bronze, melted down and liquid, became as water. Then the outlets having been opened the bronze poured through earthen pipes into the mould until it was filled and the interior cylinder covered, and the metal one pic in depth above it. The cannon was then cast.[5]

[5] A Turkish pic is equal to 27·9 in. If we may trust Baron de Tott, they continued to cast their guns hollow till the middle of the last century. "All the

"When the bronze had contracted and cooled down the exterior and interior moulds were taken away, and the metal which was scraped and polished glittered on all sides. So much for the fabrication and form of the cannon.

"Now I will explain to you how it was made use of. First they put into it that which is called the powder, filling the chamber behind completely up to the mouth of the enlarged part of the bore which is intended for the stone shot. Then they introduced a great stopper (*bouchon*), a lid (*couvercle*) of wood, and very strong, which they batter down with iron rammers so that it shall closely confine the powder after such sort that nothing can dislodge it if it be not the force of the inflamed powder; then they placed the stone upon it, ramming it down with force so as to make it enter into the wooden stopper and make a round cavity.[6] After this, having turned the cannon towards the object intended to be struck, and given it an angle of inclination according to the rules of their art and of like cases, they brought great beams of wood which they laid under it, and on top and on all sides so that it might not be disturbed and strike wide of the mark by the effect of the shock and the recoil. After all this, they applied the fire to the little orifice behind, making a train of the powder. This lighted quicker than thought; first ensued a terrible muttering and a shaking of the very ground beneath and around and a strange noise, then with a lightning flash, a horrifying uproar, and a flame scorching and blackening all around, the stopper borne on by the strong hot breath thrust the stone forcibly forth and issued from the gun. Borne by an irresistible force and energy this latter struck upon the wall and instantaneously broke it, knocked it over, shattered it and crumbled it into a thousand fragments. By sending pieces in all directions it scattered death all over the neighbourhood; sometimes it knocked down all one section of the wall, sometimes half of it; sometimes more or less of one of the towers, or the

work was done in common furnaces, and the bronze burnt by the action of the bellows, and then cooled at the bottom of the basons, reached the moulds in a state of paste, their defective nature adding to the imperfection of the piece produced. I proposed to establish a reverberatory furnace, and a boring machine. The idea of casting without bellows, of casting solid, and then boring, provoked the laughter of the Turkish founders."—De Tott's *Memoires*, about 1790, pt. III., p. 98.

[6] This proves that the wad was raised at the edges, and concave.

great wall between two towers, or the battlements. There was nothing so hard, or so mighty, or so heavy, even in the strongest wall, as to be able to resist a shock like this, or ward off such a missile.[7] Thus inconceivable and incredible is the nature of this machine. The ancient princes and generals did not possess and had no knowledge of such a thing; for if they had had it, no city could ever have resisted their attack, and they would not have had such trouble to breach and destroy their walls, and the very strongest would have been no obstacle to them. They were obliged to raise mounds against them, to gird them with trenches and lines of circumvallation, to dig mines and galleries to get below the walls, and to do many like things all to make themselves masters of cities or fortresses. With cannon all this would have been done quicker than thought; they would have easily battered and overturned the walls; but they had them not. It is a new invention of the Germans, or of the Kelts, made about 150 years ago or a little more.[8] It is an ingenious and happy discovery, especially the powder, which is a composition made of the element most hot and most dry—of saltpetre, of sulphur, of charcoal, and of herbs, from the which composition is generated a dry hot gas, which being inclosed in the narrow rigid and unyielding body of bronze, with no other means of escape than the one left it, opens this by its internal pressure and gives such velocity to the stone that sometimes the very bronze is ruptured. For the rest, our old language has no word to designate this machine unless you choose to call it, ἑλιπολος, taker of cities, or ἀφέτεριον, the bolt-compelling. In current language now-a-days all the world give it the name of σκεύη, machine, bagage. So much for the description of this cannon, as we have been able to learn, seeking the information among those who make a profession of artillery."

Dr. Dethier, the translator of the unpublished MS., pro-

[7] A French writer quoted by the Emperor of the French, in the "Études sur le passe et l'avenir de l'Artillerie," II. p. 95, and who was present (he does not name him), describes the defences of Constantinople as follows:—"Les murs devant le Turc sont tres gros et hauts, et dessus y a barbacanes et machicoulis, et en dehors faux murs et fossés, et sont hauts les murs principaux de 20-22 brassees et larges, en eaux (haut), en aucun lieu 6 et aucuns lieux 8 brassées. Les faux murs en dehors ont le terrain haut de 12 brassées, le mur dessus haut de 14 brassées et gros de 3 brassees. Les fossés sont larges de 26 brassées et profonds de 10."

[8] This early author therefore gives 1317, or a little earlier, as the date of the invention of gunpowder.

ceeds to draw a comparison between the gun of Muhammad and the American 20-in. Rodman gun, which is of no great interest; but he subjoins a further extract from the same MS. in support of the claim of Muhammad II. to the first employment of vertical fire. "After having given," he says, "an interesting account of the attack on the chain and vessels which defended the entrance of the Port of the Golden Horn, and the necessity the Turkish Admiral Baltoglou was under to retire without any result," the author proceeds:—"But the Emperor Muhammad, beholding the repulse of this attack, turned his attention to the invention of another machine. He called together those who made his guns and demanded of them if it were not possible to fire upon the ships anchored at the entrance to the port, so as to sink them to the bottom. They made answer, that there were no cannon capable of producing such an effect; adding that the walls of Galata hindered them on all sides. The Emperor then proposed to them a different mode of proceeding, and a totally new description of gun, of which the form should be a little modified so as to enable it to throw its shot to a great height that in falling it might strike the vessel in the middle and sink her. He explained to them in what manner, by certain proportions calculated and based on analogy, such a machine would act against the shipping. And these on reflection saw the possibility of the thing; and they made a species of cannon after the outline which the Emperor had made for them. Having next considered the ground, they placed it a little below the Galata Point on a ridge which rose a little opposite the ships. Having placed it well, and pointed it in the air according to the proper calculations, they applied the match, and the mortar threw its stone to a great height, then falling it missed the ships the first time and pitched very near them into the sea; then they changed the direction of the mortar a little, and threw a second stone; this, after rising to an immense height, fell with a great noise and violence and struck a vessel midships, shattered it, sunk it to the bottom, killed some of the sailors and drowned the rest, only a few saved themselves by swimming to the other ships and nearer galleys."

Kritoboulos affirms that the order to make the mortar was given four or five days before the Latin fleet arrived,

that is to say, about the 17th April; and we learn from Nicholas Barbaro[9] that a Genoese ship was sunken by a bombard on the 5th May, leaving only eighteen days for the manufacture of the piece, a period that seems hardly sufficient, even allowing for the terrible stimulus which must have been given by the chastisement of the Admiral Baltoglou to all who had the orders of Muhammad to execute.

The Turkish habit of casting great ordnance on the spot where they were wanted shows an extraordinary energy and readiness. In the first siege of Rhodes, 1480, Muhammad caused sixteen great pieces to be cast, called basilisks or double cannon, 18 ft. long, and carrying a ball of 2 or 3 ft. diameter;[1] and here also we are told that their mortars "threw stones of a prodigious size, which, flying through the air by the force of powder, fell into the city, and lighting upon houses, broke through the roofs, made their way through the several stories, and crushed to pieces all that they fell upon; nobody was safe from them, and it was this kind of attack that gave the greatest terror to the Rhodians."

There is some little difficulty in determining the actual size of the gun cast by Urban, nor is it clear whether our description relates to that gun or to another. Gibbon states that the great cannon was flanked by two fellows of almost equal magnitude, one of which is described by a contemporary writer, Leonardus Chiensis, as throwing a stone ball of eleven palms (104·5 in.) in circumference; he measured the shot,—"Lapidem, qui palmis undecim ex meis ambibat in gyro." This would give a diameter of about 33·2. But it is further stated by all authorities that the great cannon was cast in Adrianople, whereas our account seems to refer to one cast in front of Constantinople. "At the end of three months Urban," says Gibbon, "produced a piece of brass ordnance of stupendous and almost incredible magnitude; a measure of twelve palms is assigned to the bore, and the stone bullet weighed about 600 lbs." He adds "that it took two months to transport it from Adrianople to Constantinople, a distance of 150 miles." Here again Phranzas steps in with a correc-

[9] See Von Hammer.

[1] Relation de Merry de Dupuy, quoted by Vertot, "Hist. of Knights of Malta," i. 373.

tion, and says the shot weighed 1200 lbs., "Lapide in eâ estimatione mille ducentarum librarum," and mentions as an eye witness that it was drawn by 50 oxen to Constantinople. It is probable therefore that the statements relate to different guns. Assuming, however, that one of the guns fired stone shot of 1200 lbs., we have still to enquire what the pound was. The most reasonable supposition is that it was the weight now known as the *chekie*, which is nearly the Roman pound; if so, the shot of 1200 chekies weighed about 804 lbs. avoirdupois, corresponding to a diameter of 25·6 in. The piece would, in fact, have been a piece of seven kantars.

In regard to its weight, Muhammad, as we are told, delivered 1500 talents of bronze to the founders, but we are met by the same difficulty of determining what the talent was, or rather which of its many values to select. If the Roman talent was carried to Byzantium, as seems probable, and remained in use to the fifteenth century, we may assume that it equalled 57·6 lbs. avoirdupois, and this agrees with the statement of Leonardus Chiensis quoted by Gibbon,[2] that the talent equalled 60 minæ, or nearly 60 avoirdupois pounds; on the other hand, it is expressly stated by Von Hammer that "le talent pèse cent vingt cinq livres," or in fact was the same as the kantar.[3]

For purposes of rough calculation we may assume the talent intended as equivalent to our half-hundred weight, when the quantity comes to 37·5 tons; some allowance must be made for dead-head and unavoidable waste, and we cannot expect from this quantity a gun weighing more than 32 tons, which is perfectly irreconcileable with a bore 12 palms or 34·5 in. in circumference. Such a gun, if made of the other dimensions stated, would in fact weigh over 100 tons, a bulk beyond the bounds of credibility, and we must be content to know that the Turks had in the fifteenth century guns discharging stone shot of more than 33 in. diameter, the authority of contemporary writers being supported by the existence of two guns of a size not much inferior to this

[2] See Mr. Mallet, in "Engineer" of Aug. 21, 1868. "The attic talent weighed about 60 minæ or avoirdupois pounds (see Hooper on ancient weights and measures): but, among the modern Greeks, that classic appellation was extended to a weight of 100 or 125 pounds (Ducange, *τάλεντον*.)" Milman's Gibbon, 1839, xii. 192. Ducange gives examples of Talentum pro centum libris; pro 50 libris: pro *libra* et marca: but not for 125 lbs.

[3] Von Hammer, liv. xxii., N. v.

day, namely, 29 in. and 29·5 in.; the other particulars of their length and weight are open to question.

It is evident that our gun was cast on its face, the dead-head being left at the breech end and hewn off with axes, probably while the metal was hot. The axe-marks are plain; similar marks may be observed on other early guns which have the breech cut off square, for example, No. 201 of the Catalogue of the Museum of Artillery, in the Rotunda, Woolwich, which is dated A.H. 937, or A.D. 1530.[4]

I have referred to the singularity of guns three or four centuries old taking part in modern engagements. The most memorable instance of this was afforded in the passage of the Dardanelles by Sir John Duckworth's squadron in March, 1807, when the following vessels were struck:—"Canopus.' Wheel carried away: hull much damaged; 3 seamen wounded.—"Repulse." 10 killed and 10 wounded by one stone shot from the Asiatic side.—"Royal George" (Sir J. Duckworth.) A stone shot stuck fast in her cutwater. It is not stated what damage was due to this projectile, but she lost 3 killed and 27 wounded.—"Windsor Castle." Mainmast nearly cut in two by a stone shot of 800 lbs. She lost 3 killed and 13 wounded.—"Standard." Struck by a stone shot from Sestos of 770 lbs., 26 in. in diameter, which killed 4 men and led to a succession of disasters by which 4 more lost their lives, and 49 were wounded.—"Active." Was struck by a granite shot 78 in. in circumference, and said to have weighed 800 lbs., but no one was hurt. It was this shot that made so large a hole in the side that the Captain, looking over to see what was the matter, saw two of his crew thrusting their heads through it at the same moment: there is an exaggeration, however, about the weight of it, perhaps the boatswain put his foot in the scale; a ball 78 in. in circumference will be rather under 25 in. in diameter, and not weigh more than 760 lbs. There are two of these stone shot preserved at the Tower, one of them, 24·5 in. in diameter, weighs 744 lbs.; the other, 19·7 in. in diameter, weighs 586 lbs.[5] The shot which accompanied the gun to be described, average 75·7 in. in

[4] Official Catalogue, p. 29.

[5] Several of these shot, as we are informed by Mr. C. Tucker, are still remaining on the piers of the entrance gates at Wear near Exeter, the seat of Sir J. T. B. Duckworth, Bart. One or more some years since were mischievously dislodged and thrown into the river Exe.

circumference, or 24·1 in. in diameter, and weigh 672 lbs. very uniformly; their material is granite.

One of the most interesting documents that has come down to us is an account, given in one of the notes to Von Hammer's History, of the pieces of ordnance placed in battery against Scutari in Albania, in 1478. There are no less than 11 guns enumerated,[6] throwing stone shot increasing in weight from 3 to 13 kantars; the kantar is a well-known weight equivalent to 44 okes, each oke 2·83 lbs. avoirdupois, consequently the kantar is equal to 124·5 lbs. avoirdupois. Upon this datum I have constructed the following Table. It will be observed that there are only two guns exceeding in size those actually known to us, and that the calibres follow pretty closely the scale afforded by the guns now extant, as given in Table I.

TABLE II.—GUNS PLACED IN BATTERY AGAINST SCUTARI, IN ALBANIA, BY MUHAMMAD II., A.D. 1478.

Cannon shooting a stone shot of kantars.	No.	When ready, 1478.	Computed diameter of stone shot.	Probable diameter of gun.	Computed weight of shot.
					lbs.
3		22 June	19·8	20·8	373
4	2	22 „ / 26 „	21·8	22·8	498
6	2	6 July / 8 „	24·9	25·9	747
6½	1	26 June	25·6	26·6	810
7	1	7 July	26·3	27·3	871
9½	1	11 „	29·0	30·0	1182
12	5	6 „ / 7 „	31·4	32·4	1494
13	1	8 „	32·4	33·4	1640

Confined as they were to the use of stone for their projectiles, in the impossibility of casting large spheres of iron, the Turks, whether they knew it or no, acted in accordance with sound principles, in preferring very large masses of that material, launched with low velocities, to smaller masses launched with such velocities as they might have obtained: the former performed their work and transmitted their whole force to the object struck; the latter would have probably broken up and great part of it been lost.

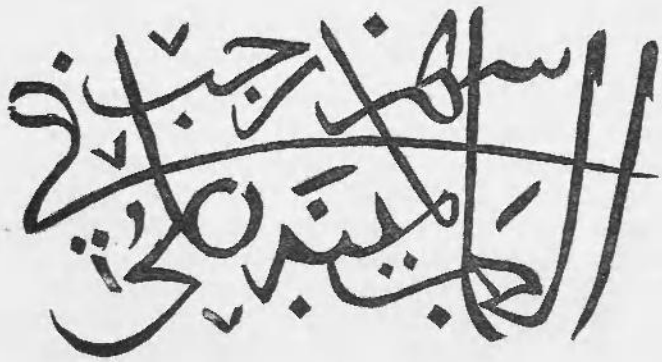
[6] Von Hammer, iii. p. 42. He quotes Barletius.

We are furnished by the same document with a return of the number of shots fired each day, which I subjoin :—

Date 1478.	Guns in battery.	Fired shots.	Date 1478.	Guns in battery.	Fired shots.	Date 1478.	Guns in battery.	Fired shots.
June 22	2	7	July 2	4	35	July 12	11	187
„ 23	2	9	„ 3	4	44	„ 13	11	183
„ 24	2	8	„ 4	4	47	„ 14	11	168
„ 25	2	7	„ 5	4	4	„ 15	11	187
„ 26	4	29	„ 6	6	42	„ 16	11	182
„ 27	4	28	„ 7	8	57	„ 17	11	194
„ 28	—	—	„ 8	10	42	„ 18	11	131
„ 29	4	1	„ 9	10	76	„ 19	11	193
„ 30	4	34	„ 10	10	104	„ 20	11	148
July 1	4	36	„ 11	11	178	„ 21	11	173
							Total ...	2534

Thus it appears that towards the end of the siege these great cannon discharged 16 shots a day each, a number which indicates a very tolerable degree of manageability. At the risk of being tedious, I cannot but remark on two other points. First, the immense supply of gunpowder required, and its sources. We are not precisely informed of the charges, nor is the precise constitution of Turkish gunpowder at this period known, but we know the proportions of European gunpowder a little later; it consisted of—saltpetre, 4 parts, sulphur, 1 part, and charcoal, 1 part; and I take the charge at one-fourth the weight of the shot: on this estimate nearly 250 tons of gunpowder must have been consumed, requiring for its manufacture about 167 tons of saltpetre. Montecuculi, speaking of the Turk as he knew him about 1660, remarks, "He works incessantly at the production of gunpowder in every place on the frontier. He gets it from Cairo and Egypt; he buys it of the Christian, and he has such an abundance of it that he consumes more in useless firing and display than we do in necessary services. When he is conducting a siege, or in a campaign, they cry every evening during the hour of public prayer, *Halla, Halla* (Allah), and after this cry they fire a general salvo of what ordnance is to be found in the trenches, in the lines of approach, and in other parts of the camp. This occurs every day. It is easy to see what a consumption there must be of ammunition. For the rest, their powder is excellent,

(1) Help, O God. The Sultan Muhammad Khan, Son of Murad.



(2) The work of Munir Ali in the Month Rejeb.

(3) In the date of the year eight hundred sixty eight (A.D. 1464).

Inscriptions on the Cannon of Muhammad II. (A.D. 1464), presented to H.M. Queen Victoria by the Sultan. Preserved in the Museum of Artillery, Rotunda, Woolwich.

as appears by the noise of the report, the force, and the reach of the shot (*longueur des coups*)."[7] A similar barbaric abundance, and doubtless waste, must have characterized their employment of gunpowder from the very first. I imagine that this supply must have been obtained, as the Turks have obtained it at later periods of their history, by levying a tax to be paid in saltpetre over whole provinces. Nitrate of potash is produced in an impure state pretty extensively in warm climates, and the production may be augmented by artificial means. It would be interesting to discover how the receivers discriminated between this salt and others very like it.

The other observation that I have to make relates to the provision of stone shot. Upon the supposition that the guns all fired alike, and in total proportion to the number of days they were in battery, the expenditure will be about as follows :—

Shot of	19·8	inches or	373	lbs.	310	Shot of	26·3	inches or	871	lbs.	190
„	21·8	„	498	„	580	„	29·0	„	1182	„	190
„	24·9	„	747	„	420	„	31·4	„	1494	„	400
„	25·6	„	810	„	230	„	32·4	„	1640	„	214

Total, 2534.

The whole weighing about 1000 tons; now the transportation of 1000 tons of stone shot with the army is out of the question. They must have been cut on the spot, and one is lost in astonishment at the prodigious labour of quarrying the blocks and cutting them into a spherical form. A single shot of 24 in. offers $12\frac{1}{2}$ square feet of surface to be dressed, and they are generally extremely well cut. The misery of the wretched slaves condemned to this labour must form a heavy item in the huge aggregate of human suffering which lies to the charge of Muhammad the Conqueror.

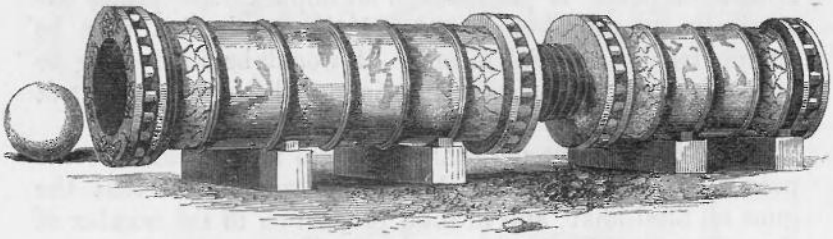
The gun recently received at Woolwich bears three ancient inscriptions, of which representations are given.

The extremely intricate character of Turkish caligraphy introduces some uncertainty in regard to the proper name. Mr. Redhouse, who at first read Muner, was then inclined to prefer Minbir, a word which signifies Pulpit. His excellency Halil Pasha, Grand Master of Artillery, read Munir, and

[7] Memoires, &c., Montecuculi, I. Bk. II. Ch. ii.

Efflatoun Pasha, on recently examining the gun, was equally positive that the name cannot be so read, but may be Mener.

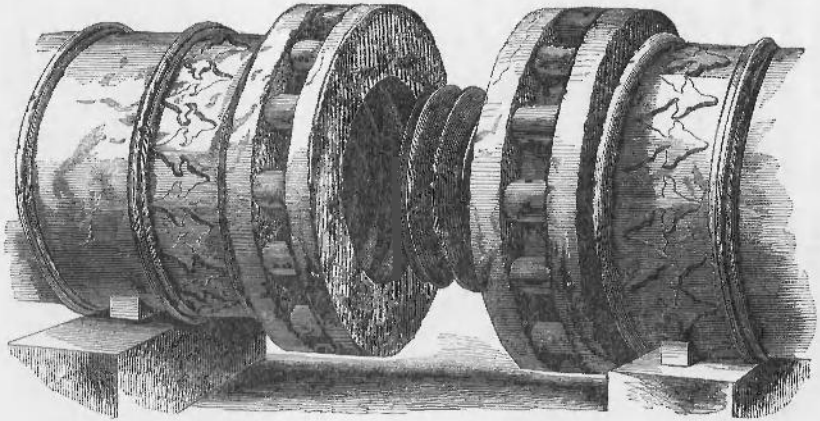
The gun is made in two parts, which screw together, each weighs 8 or 9 tons; no description can do justice to the massive character, the grand simplicity which belongs to this great piece of ordnance. The external form is a cylinder,



Cannon of Muhammad II. (A.D. 1464) presented to H.M. Queen Victoria by the Sultan. Museum of Artillery, Woolwich.

the muzzle being as large as the breech; but either half is relieved by a boldly projecting moulding at each end, which is divided transversely by 16 cross bars into as many recesses. Considered only as ornaments, these have the happiest effect, but they were made with a design. They answered beyond doubt the purpose of the holes in a capstan head, and were used to give a purchase to the levers employed in screwing the two parts together. A precisely similar provision of capstan holes in Mons Meg and in the great bombard at Ghent has often puzzled observers. I have no doubt that those pieces also are made in two parts, and screwed together; and, although the oxidation of the iron might make it more difficult to unscrew the former than it was found to be to unscrew Muhammad's gun, it might be done. There is nothing new in the fact of the gun being screwed together, similar examples are referred to by General Favé,[8] and engraved by St. Remy; but a very considerable degree of mechanical skill and precision was required to cast two screws of 23 in. diameter, which should fit one another, and so to unite such ponderous masses. There is no appearance of tool-work; in fact, a tool could only smooth away minor inequalities of surface, and could not

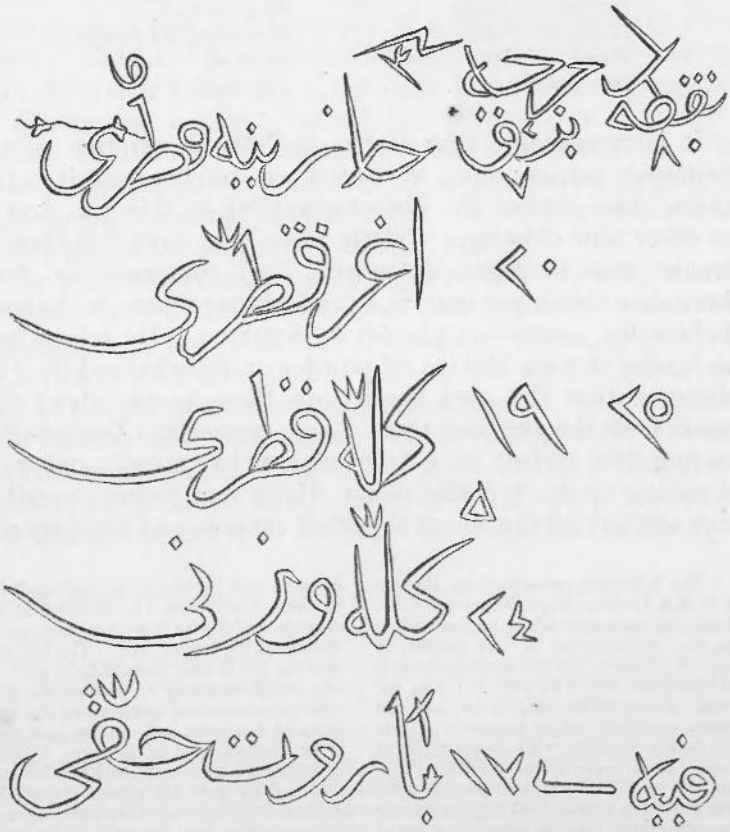
[8] Artillerie, tom. iii. p. 168.



The Great Cannon of Muhammad II., A.D. 1464. Museum of Artillery, Woolwich.

alter the distance or pitch of the threads, on which the fit depends. We can only suppose that moulding-pieces were first cut in wood and nicely fitted, and then applied to the clay moulds. We have a palpable application of moulding-pieces in the ornamentation, called by Dr Pococke "*fleurs-de-luce,*" which will be noticed at each end ; the marks where the moulds joined are still to be seen. The only other ornament attempted is the subdivision of the cylindrical part by bold rings or mouldings about 14 inches apart.

There is a modern inscription of considerable interest in the neighbourhood of the vent, for a translation of which I am indebted to the distinguished Orientalist, Mr. Redhouse.



We have here the practical rules for the employment of the gun in the situation which it occupied for three or four

centuries at the mouth of the Dardanelles. Their modern origin is proved by the small charge of powder laid down, for the chamber was made to hold about 150 lbs. of the powder of the period; but the greater strength of the powder of modern times has made it necessary to reduce the quantity to 49½ lbs. I think it probable that the inscription was cut by the European, I believe a Prussian officer, who some forty years ago was employed to mount the guns at the Dardanelles on modern carriages. Each of the cannon enumerated in Table I. has an inscription of the same nature.[9]

	3 degrees.
Diameter, chamber	7 inches, 80 points,
Diameter, muzzle	20 inches,
Diameter of shot.	19 inches, 25 points,
Weight of shot	240 okes,
Due powder	17½ okes,

It is remarkable that Baron de Tott's description of the "enorme perrier dont le boulet en marbre pesait 1100 livres," like that of Dr. Pococke, applies to this gun, and to no other now existing. "Cette pièce," he says, "fondue en bronze sous le regne d'Amurat, était composée de deux morceaux réunis par une vis, à l'endroit que sépare la chambre de la volée, comme un pistolet à l'Anglaise." He relates how he loaded it with 330 lbs. of powder and discharged it. He observed that the shot break into three pieces about 600 yards from the gun, and these pieces crossed the Dardanelles, leaving the surface in a foam where they struck, and went bounding up the opposite shore. He is very vague, or rather says almost nothing, about the other cannon, and his authority

[9] The following extracts from the log of H.M.S. Terrible, Capt. Commerel, C.B., detail the measures taken by that officer for the embarkation of this ponderous piece of artillery, and the manner in which he unscrewed the two parts. "Jan. 10, 1868. Commenced rigging a pair of sheers outwards, which consisted of two two-decker topsails, with topping lifts of stream chain over lower mast-head and into the main deck port on opposite side. The same day commenced rigging similar sheers on those topping lifts, two parts of an eight-inch hawser, set taut to the stream anchor, backed with timber, &c. Jan. 16. Hoisted out 6½ ton gun, and landed it in paddle-box boat. Jan. 17. Hoisted out 12-ton gun, and landed it in same boat. Jan. 18. Hoisted in the shorter half of the large gun, and in the afternoon the longer half. The fall used was 6½, the blocks, threefold, 24 each. It was found necessary to unscrew the gun; this was performed by means of the lever jacks of ten tons, and capstan bars made to fit the holes cast in the gun; a power of nearly 40 tons was used for this purpose. The gear all closed remarkably well, not a rope yarn strained or spar sprung. The gear lay on the open beach at Chanak, and was very exposed to the prevailing winds. Three days would have sufficed for the operation if weather had permitted."

for the date of this one cannot be accepted. Amurath, or Murad II., was the father of Muhammad; he was the first to employ artillery, but it is impossible to transfer to him the credit which history assigns to the son for the invention of these gigantic pieces. In short, Baron de Tott cannot be implicitly relied on for the age or the size of the gun he refers to, which was beyond a doubt the one we now possess, or for the charge he employed with it. The chamber does not hold half the quantity.

I have observed that Muhammad's cannon were probably copied from a Flemish original. This will appear on comparing our gun with the great bombard of Ghent, the Dulle Griete, *Maryuerite enragée*, which I have been enabled to do with great precision, by the aid of a drawing made by Professor Pole in 1864. The dimensions, allowing for the necessary difference between wrought-iron and bronze, correspond so closely that I cannot believe the resemblance to be accidental, and it extends to the method of construction. In both pieces the powder-chamber is in a separate forging or casting, and screwed to the body. Mons Meg presents us with a similar example on a smaller scale.[1]

On a future occasion I propose to resume this subject, and to place before the members of the Institute a detailed notice both of the celebrated bombard at Ghent, to which it is believed that allusion has been made by Froissart, and also of certain oriental and other bombards of very remarkable fashion and dimensions. These notices may, I hope, prove acceptable as a sequel to my account of the great cannon, the "*Michellettes*," the relics of English warfare in the fifteenth century, at the Mont St. Michel in Normandy.[2]

CHEMICAL COMPOSITION OF THE GREAT CANNON OF MUHAMMAD II.

Specimens of the alloy composing the great cannon, lately presented to the British Government by the Sultan Abdul Aziz Khan, having been detached from the mouldings at either end of each part of the piece, accurate analysis was made by Mr. F. A. Abel, War Department Chemist. An abstract of his report is subjoined. (See Chemical News, Sept. 4, 1868.)

The metal was found to be more or less thickly coated with suboxide of copper, which had passed into carbonate here and there. In some parts, where the porosity of the metal had been considerable, the oxidation had proceeded to depths varying from 0·2 to 0·5 of an inch, and

[1] See a Memoir by Mr. Hewitt, Arch. Journ., vol. x. p. 25.

[2] See Arch. Journ., vol. xxii. p. 137.

even upwards. The alloy was found to vary greatly in hardness; the specimens differed also considerably in color, some presenting the usual appearance of gun-metal of good quality, whilst in their immediate vicinity were patches of white alloy rich in tin, such as are observed in bronze castings in which the mixture of metals has been imperfect, or which have been allowed to cool very slowly. Again, other portions more nearly resembled pure copper in color, and were comparatively soft. The proportions of copper and tin in the several samples analysed varied from 89·58 per cent. of copper, and 10·15 per cent. of tin; the maximum of copper being, in one of the samples, 95·20; this was from the moulding at the muzzle. In three instances the proportions of copper were higher than have been found in any other specimens of ancient gun-metal. The large Bhurtpoor gun at Woolwich, cast in 1677, contains from 60·5 per cent of copper in different parts of the gun; a large bronze gun also at Woolwich, cast at Florence in 1750, contains 89 per cent. of copper, and about 10 per cent. of tin. The Malik-i-Mydan, or great gun of Beejapore, cast in 1648, is stated to contain only 80·42 per cent. of copper, and 19·5 per cent. of tin. It is interesting to note, that in seven specimens from the great gun of Muhammad II., traces only of other metals were discovered. Lead and iron were detected in minute quantities, also antimony and arsenic; but a careful examination for gold, silver, and zinc failed to furnish any indication of the presence of those metals.

Note to Table I., p. 264; *Gun*, No. 22.—This piece has been introduced from its connection with Sir J. Duckworth, by whom it was brought to England in 1807; it is, however, strictly speaking not a Bombard, but a comparatively modern Turkish naval gun for throwing stone shot. It is mounted as a trophy at Plymouth, and bears inscriptions, thus translated by Mr. Redhouse.—1. At the muzzle:—The Sultan, the champion of the faith—Mustapha Khan, son of the champion of the faith Muhammad Khan.—2. Near the breach:—The work of Hasan, chief founder of the imperial capital. A.H. 1109 (A.D. 1697-8).—3. Near the trunnions:—Weight of piece, 74 canters, 13 oggas (76 cwt); length, 14½ spans; calibre (by weight), 44 oggas (about 115 lbs.). A.H. 1126 (A.D. 1714).

The Institute is indebted to the kindness of the author for the whole of the Illustrations of the foregoing Memoir.