THURSDAY, MAY 24, 1877

SCIENCE AND WAR

II.

AT no other time has there been so much want of unanimity among the Great Powers of Europe on the subject of Ordnance. There are to be found at the present moment cannon of a dozen different descriptions in the gun parks of European nations, differing from each other not only in respect to their construction, but in the metal of which they are made. So far as small arms are concerned, we know there is but one opinion; some nations prefer one breech-loader to another, but all agree in the employment of breech-loaders. In the case of cannon, however, it is different. Germany relies upon breech-loading ordnance, while Great Britain has forsaken the system and gone back to muzzle-loaders; Austria makes her guns of bronze, Germany of steel, Russia favours steel and brass, America cast iron, while England has cannon of steel encompassed with iron, and France weapons of iron girt with steel.

The balance of favour is beyond question with the breech-loader at the present moment. All the new artillery of the Russians and the Turks is of this kind, while the field-guns both of the Germans and Austrians are upon the same system. France has done nothing lately for the regeneration of its ordnance, and there remains but Great Britain and Italy to represent muzzle-loading artillery. But Italy, although she has adopted the British system for very heavy guns, is by no means a confirmed believer in it, and will doubtless hesitate before following our example very far, beset, as she is, with neighbours armed with breech-loaders.

Of all the Powers, it is, curiously enough, steady-going Austria, which has taken the boldest and most independent course in the matter of artillery. It was but at the end of 1875 that the Austrian War Office decided to adopt the Uchatius cannon for field artillery, and yet at this moment every artillery regiment of the vast Austro-Hungarian army is armed with the new weapon. Within eighteen months no less than 2,000 of these cannon have been cast and finished, and now the Vienna arsenal is engaged in the manufacture of heavy guns of the same character. Never was a more energetic step taken. A new cannon of some sort was held to be absolutely necessary to uphold the prestige of the army, and a Commission having been intrusted with the selection of an arm, pronounced without delay in favour of the scheme brought forward by Gen. von Uchatius. In October, 1874, the first round was fired from an Uchatius gun, and a twelvemonth afterwards the sweeping reform which was to introduce an entirely new artillery throughout the Austrian service was decided upon. Government sanctioned an expenditure of 1,800,000*l.* to be spent in two years, and Gen. von Uchatius was directed to give all the assistance in his power towards the fulfilment of the design.

The Uchatius gun is made of so-called steel-bronze. Chilled bronze would be a better name, since Uchatius casts his metal in a chilled, or metal mould, in the same manner, pretty well, as Sir William Palliser produces his famous chilled projectiles. Bronze, as everybody knows, has been a favourite metal with gun-founders from the earliest days, and in the East, especially, magnificent castings of this nature have been produced. About 90 per cent. of copper and 10 of tin is the mixture commonly employed in making ordinary bronze, but 8 per cent. of tin is the proportion preferred by Uchatius. The difficulty in casting bronze, as those who have any experience know full well, is that of securing homogeneity, soft particles of tin becoming isolated in the mass, and giving rise to the defect known as "tin-pitting." Whether we have lost the secret of bronze-casting, or whether in former times they were more skilful at the work, certain it is that founders of the present day are unable to secure so uniform an alloy as formerly. This was very apparent when some eight or ten years ago our own Government adopted, for a brief time, bronze artillery. The addition of a small percentage of phosphorus did not mend matters, and the highest authorities on the subject were at a loss to suggest an effective remedy. Our bronze guns, too, had another defect which could not be overcome. After firing the bore became affected, and the weapon, as it was termed, "drooped at the muzzle." These were the two defects indeed that led mainly to the abandonment of the bronze gun in this country, and they are, too, the difficulties which Gen. von Uchatius appears to have overcome. He has got rid of "tin-pitting" and his guns do not "droop at the muzzle."

Uchatius found that by subjecting the alloy in a liquid form to considerable pressure, he was enabled to secure a perfectly homogeneous mass, a result which was also furnished, he discovered when he had gone a step farther, if the molten metal was rapidly cooled. Steel-bronze is apparently made much in the same way as the toughened glass, of which we have heard so much lately. After being cast in a mould, the alloy is thrust into a reservoir of oil, heated to a high temperature, so that the metal suddenly cools, but only down to a certain point. Then the casting is withdrawn and allowed to get cold more gradually. A regular and crystalline structure is in this way produced, which has none of the defects of ordinary bronze. It is a moot point whether phosphorus enters into the composition at all. Chemists tell us they can find no trace of it, but this is no absolute proof that a small percentage of the element was not originally contained in the alloy, being burnt out after it had done its work of harmonising the two metals. The inventor is rather reticent on the point, but in any case, it is very certain that he produces a uniform and homogeneous alloy of a hard crystalline nature.

One other expedient Uchatius has recourse to in making his cannon. When he has cast his gun and chilled it, he proceeds to dilate the bore. Wedges of steel, shaped in the form of cones are forced into the tube of the gun one after another, until the calibre of the weapon has been increased by something like seven or eight per cent. This expansion or dilation of the tube has not only the effect of hardening or steeling the core, but also of rendering the gun more elastic and capable of resisting more effectually the strain put upon it at the moment of firing. The gun, after this process, is in a state of elastic tension, and it is said that there is a pressure from without, inwards, equal to that which was exerted to dilate the gun in the first instance; and that this is actually the case can scarcely

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be doubted, since it is a fact that a section of the gun before being quite severed, will tear itself loose with considerable violence, and will be found on separation to have partially returned to its former calibre.

So far as practical trials have been conducted with the weapon, the Austrian Government have every reason to be satisfied with the Uchatius gun, which compares favourably with the Krupp steel cannon in the matter of accuracy and durability; while as regards its cost, it is far cheaper than any other rifled ordnance. A steel field-piece costs upwards of 100*l.*, even when not protected with rings, while the iron-steel weapon manufactured in this country, costs about 70*l.* sterling; the steel bronze cannon of Gen. von Uchatius, on the other hand, are made for 35*l.* apiece.

In construction, the Austrian gun is so similar to that of Herr Krupp, of Essen, that the latter claimed compensation for an infringement of his patent when the manufacture of the Uchatius gun was first commenced. The Essen works, our readers may know, supply not only Germany with steel breech-loaders, but have provided the present belligerents with all their modern artillery. Russia has still many brass cannon on hand, and Turkey a goodly number of Armstrongs, but both powers mainly depend upon their steel Krupps. These stood the German army in such good stead during the last war that their reputation is firmly established. They are of crucible steel, and the breech, instead of being upon a hinge, or in the form of a block, moves round in a D-shaped socket, the escape of gas being further prevented by rings of phosphor-copper.

The manner in which the ordnance of this country is constructed is sufficiently familiar to our readers. A tube of steel is encompassed by jackets of wrought-iron, and in this way the toughness of the latter is combined with the hardness of the former. All our guns, as we have said, load at the muzzle, while those of Russia, Germany, Austro-Hungary, and Turkey, are breech-loaders. Italy, in the case of the 100-ton guns with which she intends to arm her two stupendous turret-vessels, the *Duilio* and *Dandolo*, has adopted our method of construction, except that she employs smooth, instead of studded, projectiles. With the employment of a gas-check at the base of the shot to prevent windage and so secure the full force of the exploding charge, the use of studs in a shot appears to be unnecessary, a sufficient spin being imparted to the projectile by the soft metal of the gas-check before-named, which causes the shot to rotate after the manner of a Snider bullet. So satisfactory, indeed, were the Italian trials of these projectiles last year that it is by no means improbable that we, too, may give up the use of studded shot.

As to the comparative value of breech-loaders and muzzle-loaders, we shall not offer an opinion. No doubt a muzzle-loader is the stronger weapon, because its breech is solid, but our cousins, the Germans, urge very justly that since their guns do not burst, they are quite strong enough. Advocates of the muzzle-loading system argue again that their weapon is more simple in construction and for this reason is to be preferred; but on the other hand the sponging and loading of a gun is more easy to effect, if it opens at the breech. Indeed, in the case of very heavy guns located in a casemate or on board ship, the Germans reproach us with the assertion that we must needs have recourse to all sorts of complicated and awkward machinery in loading, while in their case a simple pulley or crane is all that is necessary. Either, say they, we must expose our gunners through the open port when loading, or, as in the case of the *Thunderer*, rely blindly on hydraulic apparatus to work the guns for us. So stands the question; perhaps the present war will bring us a solution of it.

H. BADEN PRITCHARD

THE FORESTS OF PEGU

Preliminary Report on the Forest and other Vegetation of Pegu. By Sulpice Kurz, Curator of the Herbarium, and Librarian, Royal Botanical Gardens, Calcutta. (Calcutta: C. B. Lewis, 1875.)

INDIAN forest reports have of late years become as plentiful as the proverbial blackberries. The frequent appearance of them is a consequence that might be expected when we consider the wide range of country which comes under the supervision of the Forest Department of India. So far as bulk or quantity of printed matter is concerned, no one can say that these forests are not fairly represented in the Government papers which appear in the course of a year, but the quality of these reports is another question. They too often contain merely the dry details of work carried on during the year, and are interesting only to those immediately connected with the special department from which the reports emanate. Occasionally, however, a report is issued which in reality is something more, containing much valuable information on subjects connected with forest conservancy, and amongst such Mr. Kurz's may be classified. It is, in fact, rather a description of the vegetation of Pegu, to which are added appendices occupying quite two-thirds of the whole bulk of the volume. Taking the actual report itself, which, as indicated in the title, is of a preliminary character, the matter in which will be worked out in Mr. Kurz's forthcoming book, we find it divided into two parts, first, the "General Report," and second, the "Special Report." The general report is again divided into two sections—(A) A general aspect of the country, its geological and climatological features, in connection with the flora. (B) A botanical description of Pegu, with special reference to its forests. After a very brief topographical sketch of Pegu, Mr. Kurz considers the geological aspect of the country from a botanical point of view, which, unlike that of the true geologist, is not to consider the age of the rocks, &c., but simply their extent and quality, from which inferences may be drawn of the vegetation found growing upon each formation. The geology of Pegu is described as being very simple and uniform, the hills being composed solely of sandstone, skirted at their base by a strip of diluvium, "interrupted by a deeper or shallower alluvium wherever choungs come down from the hills, and succeeded by the vast alluvial plains, through which the Irrawaddy and Sittang flow." The laterite formation is described as being of the highest importance in the various floras of India. The term laterite, as generally used by foresters in Burmah, comprises several heterogeneous rocks and soils, all characterised by a more or less ferruginous appearance,

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