SCIENCE OF WAR

II.

MACHINE GUNS

THE Machine Gun has for a good many years, in one form or another, excited the attention of the military authorities of Europe and America, and recent events have made it the subject of a great deal of popular interest. The best known guns of this class are the Gatling Battery and the Mitrailleur. The first (of which Figs. 1 and 2, taken from photographs of the original in the possession of the British Government, present a front and rear view) is an American invention, and did good service on many occasions during the late civil war. Three sizes of this gun are constructed. The smallest has ten steel rifled barrels, the calibre being suited to the musket cartridges

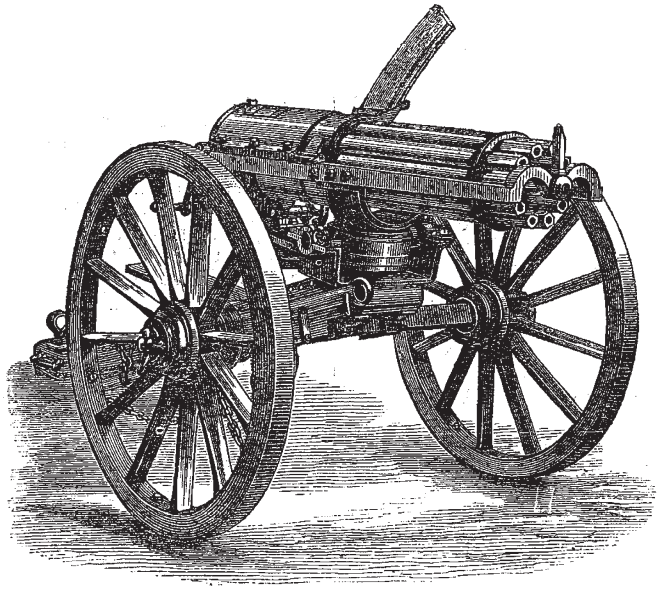

Fig. 1.

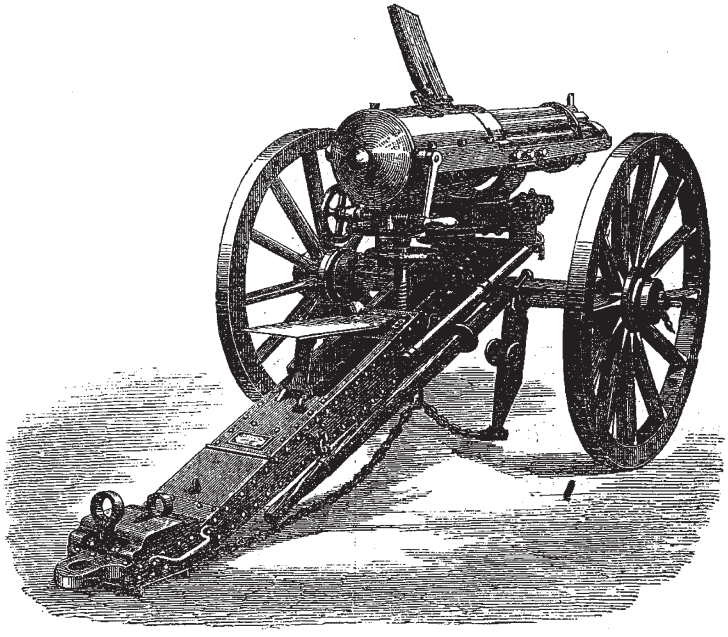

Fig. 2.

used by different Governments. The second-sized gun is constructed with the same number of barrels, but is invariably of three-fourths inch calibre, and discharges solid lead balls of $4\frac{1}{2}$ oz. in weight. The largest sized gun, which is of one inch calibre, has sometimes ten, but generally six barrels. It is provided with solid lead balls half-a-pound in weight, and can also use explosive projectiles. One of the main features of the gun is that it has as many locks as barrels, each barrel and its lock revolving together. Its success, therefore, as a whole, does not depend upon that of each of its parts, for if any of the barrels or their locks are injured, the remaining ones continue to work as well as ever. The weapon is supplied with cartridges by means of "feed-cases," through the hopper—the upward

projection rising at the end of the breech-covering nearest the barrels. When it is in operation the cartridges are placed in the rear ends of the barrels, and the breech is closed at the time of each discharge by a forward motion of the locks. A return movement extracts the shells when the cartridges have been fired. In the ten-barrelled gun five cartridges are being loaded and fired whilst as many shells are in different stages of being extracted. The locks are not attached to any part of the gun, and operate on a line with the axes of the barrels. Whilst the gun is revolving, "they play," to quote the words of the manufacturers, "back and forth in the cavities in which they work, like a weaver's shuttle, performing their functions of loading and firing by their impingement on stationary inclined planes or spiral projecting surfaces." The weapon can be loaded and fired only when the barrels, inner breech, locks, &c., are being revolved, all of which operations are set going by a man simply turning the crank. In the most recent guns the covering and back diaphragm in the outer casing are perforated, the apertures being closed by

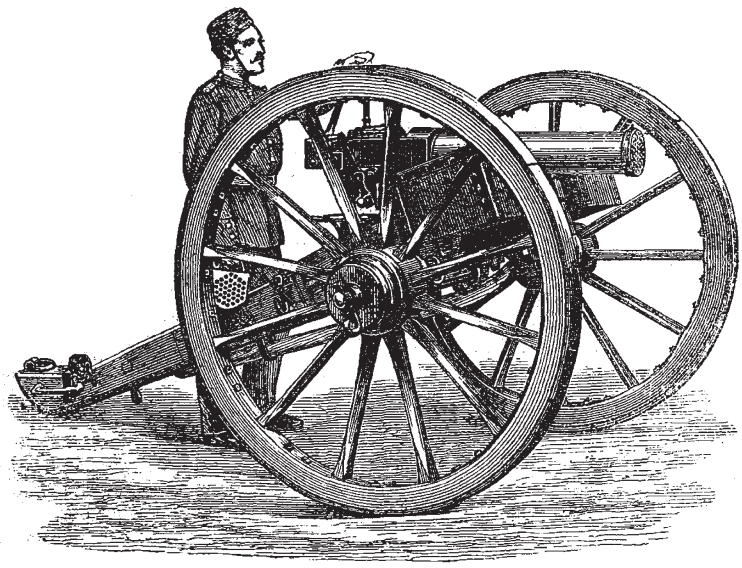

Fig. 3.

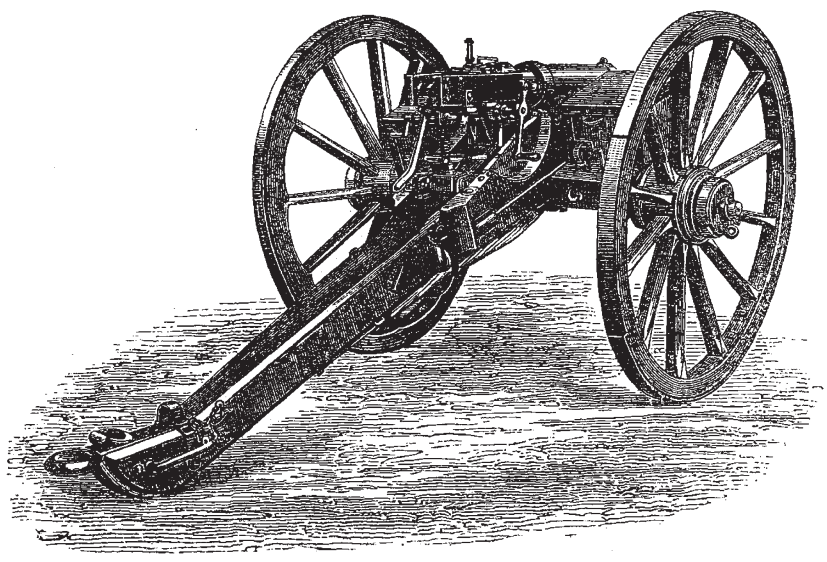

Fig. 4

means of a single removable plug. In this way the locks may be inserted and removed without taking off the caseable plate, obviously a great improvement, as it renders the inspection and repairing of the locks much simpler. The newest guns are also cocked by means of a knob placed at a point on the right side of the weapon. When turned, this knob permits the gun to be revolved without being snapped while not in use. If its position is reversed, the gun can be made to snap or fire at once. The carriage on which the gun is mounted is so constructed that the latter may receive, when being fired, a lateral motion, "so as to sweep the sector of a circle of more than twelve degrees, without moving the wheels or the trail of the carriage." Five hundred yards or more may thus be covered without the continuous fire of the gun being interrupted.

We turn now to the Mitrailleur Gun, of which there are two kinds, the French Mitrailleur and the Belgian, that of Montigny. The gun of which in Figs. 3 and 4 (also taken from photographs of the original) we present views

from different points, is that which is at present being made the subject of a great variety of experiments at Shoeburyness. It was constructed under the superintendence of Major Fosbery, and, although improved in detail, in all essential points resembles the Montigny gun. It is the latter that we shall describe in what follows, making free use of the careful report on the subject presented by Major Fosbery about two years ago to the Government.

Like the Gatling gun, the Montigny Mitrailleur is made of three sizes, the smallest containing nineteen guns and the largest thirty-seven. Major Fosbery's gun is of the latter size, is of ·534 inch calibre, and weighs 400 lbs. The barrels are planed exteriorly to an hexagonal form, those of Major Fosbery's gun being rifled on the Metford system. They are fitted and soldered together, and to the wrought-iron tube which surrounds them and forms the barrel of the weapon. To this barrel, it will be seen, are screwed at the breech end two broad plates of wrought-iron. They are placed vertically, and are connected together at the end nearest the barrel by the ring into which the latter is screwed, and near the other end by a transverse bar. These plates form what is called the breech attachment. Placed between them are the breech-block and the lever, of which the long arm forms a handle—in Fig. 3 raised, depressed in Fig. 4. Attached to the short arm of the lever is a cylindrical mass of gun metal, confined to a box or recess of similar shape, in which it can be played freely to and fro. Short tubes are bored in the metal of this cylinder, corresponding in number and position with the barrels of the gun, and in each of these are placed a spiral spring and a small steel piston. On the face of the cylinder a perforated steel plate is screwed, through which the pistons project. They also pass through corresponding holes at the bottom of the recess in which the cylinder moves. In a vacant space which now occurs slides a vertical steel plate or shutter, and beyond we come to a second plate, screwed to the face of the main breech-block, containing a small point or striker, corresponding with each barrel, and therefore with each spring and piston in the movable cylinder. The vertical plate or shutter by which the strikers and pistons are separated, is moved by a transverse axle by means of two ratchet wheels, which take into tooth racks placed on the back of the plate. The axle is kept in position by a coiled spring, and is provided with a handle, which may be seen in both Figs. 3 and 4, on the right of the gun.

Turning back to the lever, we find that it is secured to the breech attachment by trunnions working in brass bearings attached to the side plates, and forming its fulcra. Its short arm is connected with the breech-block by a link formed of two pieces, furnished with left-handed screws, and united by a screwed collar, by turning which the link can be lengthened so as to compensate for any wear and tear in the working parts. By raising the handle of the lever the breech-block is drawn back by means of the link, and by the same means it is pushed forward and forced against the rear end of the barrels when the handle is depressed. As the lever, when the handle is depressed, rests against the bar uniting the plates of the breech attachment, it is obvious that the breech-block could be removed from its place only by a force sufficient to fracture the bar or the trunnions of the lever. No force is ever applied to it greater than that which arises from the explosion of a single cartridge.

The only remaining part of the gun is the cartridge-holder. It is a steel plate about half an inch thick, in which holes are bored, corresponding in position with the strikers and barrels of the gun, and made to fit accurately the heads of the cartridges. On either side of the gun is an ammunition-box, plates being carried ready filled in one, and boxes of cartridges occupying the other. Flanges forming perpendicular grooves are attached to the face of the breech-block, and in these the cartridge holder and extractor is made to slide vertically.

If the gun is to be loaded the lever is raised, when the breech-block is withdrawn to its utmost limit, the lock springs are freed from compression, and the points of the pistons rest lightly against the steel shutter behind which they are placed. A full cartridge-plate is dropped into its place, the strikers being pushed back by its bevelled edges as it descends. Next, the lever is depressed, when the breech-block advances, the cartridges are forced into their barrels, all the springs are compressed, and the pistons are urged against the steel shutter in front of them. When the gun is to be fired the handle to the right is turned. The shutter which is connected with the axle to which the handle is attached at once begins to descend, and as a vacant space is thus left for the pistons, they shoot, one after the other, across it, and come into contact with the strikers. The latter communicate the blow to the cartridges, which are immediately fired. To avoid friction between it and the pistons, the upper edge of the steel shutter is bevelled, and it is so cut into steps that two contiguous barrels are never fired consecutively. The whole thirty-seven are fired by $1\frac{1}{4}$ turns of the handle. At any point the firing may be stopped, and the fired cartridges be replaced, or the whole may be fired by a rapid motion of the handle. When the cartridges are exhausted, the lever is raised, the breech-block is drawn back, and the plate containing the empty cases is taken away. A fresh loaded plate is substituted, when the breech is again closed and the firing renewed.

Neither in the Gatling nor Montigny do the barrels radiate, as is generally supposed; they are arranged perfectly parallel. That such must be the case is indeed evident on slight consideration. For were it desirable to render the tubes in any way divergent it would be necessary, in the first place, to fix upon a specific range at which the arm should be used, as upon the locality of the target would depend the degree of radiation; thus, if the charge were regulated to spread in the most advantageous manner at a hundred yards, its effect would be very insignificant at ten times that distance, by reason of its very scattered nature at a point so remote from the gun. On the other hand a sufficient separation of the bullets is always brought about by the unavoidable discrepancies inherent even to a well-finished arm with parallel barrels; for even if the tubes were all mathematically true—a condition practically impossible to fulfil—very slight variations in the powder charge of the cartridges would always prevent the whole series of projectiles from pursuing a perfectly parallel course and lodging in the target within the same limits as those whence they started. As a matter of experience we may mention that the shooting is considered to be exceedingly correct, when at a fair range the whole thirty-seven bullets from the Montigny are lodged in a target measuring twelve feet square.

We need not here enter into the disputed question how far machine guns are capable of competing with the ordinary field guns. There can be no doubt that if the former be well constructed, they ought to be much more easily worked in the field than the latter. It is in their favour, too, that the effect of their projectiles does not, as is largely the case with field guns, depend upon the proper action of a fuze; and the extraordinary rapidity of their fire (the Gatling gun may be fired, when well manned, from 400 to 500 times per minute, and the Mitrailleur 370 times, or more) is a decided advantage. The absence of recoil by which they are distinguished is also noteworthy. The weak point of the Mitrailleur is its comparatively small range. There is no evidence that it can be fired with effect much over 800 or 900 yards, so that it is comparatively useless at distances which a field gun commands with ease. Moreover, its trajectory at short distances is said to be

rather high, and hitherto the cartridges have manifested a tendency to stick after having been fired. These facts alone would be decisive against trusting solely to the Mitrailleur. But it does not follow, because it is not good for all purposes, that it may not be useful for some. There are obviously many positions in which it might inflict great damage on an enemy. Doubtless much light will be thrown on its capabilities by the tests to which it is being submitted at Shoeburyness, and by the manner in which it bears itself among the fearful scenes in which it is at present playing a prominent part on the Continent.

NOTES

DR. C. H. SCHAIBLE has published a little pamphlet of 16 pages, entitled "Self-help on the Battle-field" (*Selbsthilfe auf dem Schlachtfelde:* Trübner), for gratuitous distribution among the German troops, and solicits its reprint in Germany. In spite of the great care now bestowed upon wounded soldiers, it is practically impossible, in great engagements, for all to receive immediate attention; and immense suffering is caused by their lying as much as two days on the battle-field without being removed. In these cases the wounded soldier is thrown entirely on his own resources; presence of mind and quiet judgment are indispensable at such a moment; but both are the result of a knowledge of the proper remedies. This knowledge the author undertakes to teach in a concise and simple way, intelligible to every understanding. He first points out the articles required for immediate dressing, which might be carried by every soldier. He then explains the mode of arresting bleeding; the different steps in dressing the various kinds of wounds; the treatment of fractures; and concludes with some general rules. We earnestly hope it may afford some alleviation of the terrible sufferings caused by the present war.

NOTWITHSTANDING the announcement which was made to the contrary, the International Metric Commission met in Paris from the 8th to the 13th of August, for the purpose of some preliminary business, and then adjourned to a more favourable opportunity. Of the 25 foreign States which accepted the invitation of France, 20 were represented, viz, Austria, Chile, Colombia, Spain, the Roman States, the United States of N. America, Ecuador, Great Britain, Greece, Italy, Nicaragua, Peru, Portugal, Russia, San Salvador, Norway, Sweden, Switzerland, and Turkey. The bureau was constituted as follows:—President, M. Mathieu, of the Institute of France; Vice-presidents, M. Struve, of the Academy of Sciences of St. Petersburg; Prof. W. H. Miller, of the Royal Society of London; Prof. Henry, Secretary of the Smithsonian Institute of Washington; M. Herr, Prof. of Geodesy and Astronomy in the Polytechnic School of Vienna; and General Morin, of the Institute of France; Secretaries, M. Tresca, sub-director of the Conservatoire des Arts et Métiers; and M. Hirsch, director of the Observatory at Neufchâtel. The commission decided that the question to be proposed at a future time should be of two kinds, the first relating to the metre itself, the second to the kilogramme. A committee was appointed to carry out the needful arrangements in the interval before the next meeting, consisting of Prof. Airy assisted by Mr. Chisholm, Baron Wrède, and MM. Wild, Hirsch, Ibanez, Steinheil, Förster, Lang, and Hilgard.

WE regret to learn the death of Dr. Bolley, the celebrated professor of chemistry at the Polytechnic School, Zurich, which took place suddenly on the 3rd of August. He was a native of Heidelberg, where he was born in 1812, and had held positions as assistant and professor in the University of his native town, at the Cantonal School of Aargau, and the Federal Polytechnic School at Zurich. From 1859 to 1866 he was director of this school, and during that time the number of students increased greatly, being attracted from all the civilised countries of the world. He was a commissioner from the Federal Government to the London Exhibition of 1851 and 1862, and to that at Paris in 1867. The works by which he will be best known are his "Manual of Technico-Chemical Research," and his contributions to the most complete and valuable work on chemical technology. To his efforts is greatly due the foremost position which the Polytechnic School at Zurich enjoys among the technical schools of the Continent.

THE Dutch Scientific Society of Haarlem has proposed a series of questions to be answered by the 1st of January, 1872, among which the following are the most important:—1. To define, by anatomical and chemical researches, the mode of origin and the function of wax in living plants. 2. To explain, as much as possible by the aid of original researches, the history of the development of certain malformations and excrescences produced in the oak by different gall-making Hymenoptera. 3. To decide experimentally whether the roots of plants give rise to particular excretions, and in that case to establish the nature of the excreted matters. 4. To study the works of Huyghens, both with reference to the state of knowledge at his time, and with reference to its actual state. 5. The value of the constant of aberration, deduced by Delambre from the eclipse of the first satellite of Jupiter, and that which results from the more recent astronomical measurements, present a difference at present inexplicable. The observations respecting the eclipses of the first satellite of Jupiter are required to be collated, and a new determination of the constant of aberration to be deduced. 6. To make a new series of researches on the influence which the different colours of the spectrum exercise on the respiration of the green parts of plants. 7. To give a monograph of the flora of the sandhills of Holland. 8. To give a systematic description of the marine Phanerogamia.

WE have to announce that Dr. Debus, F.R.S., has been elected Lecturer on Chemistry in the medical school of Guy's Hospital; and that the practical classes of the institution will be under his direction.

DR. T. E. THORPE, of Owens College, Manchester, has been elected by the trustees of Anderson's University, Glasgow, professor of scientific chemistry in the room of the late Dr. Penny.

ON the 1st August severe shocks of earthquake were felt, about two in the morning, in several provinces of Greece, and were attended with disastrous results in the Parnasside and in Livadia. The town of Galaxidi and the villages of Khrusso and Arakhora suffered the most. The latter are nothing more than a mass of ruins; six of the people lost their lives, and all were more or less hurt. At Galaxidi all the houses were injured and some have crumbled to ruins; six children were crushed to death and about 150 adults were injured. Amphissa, the chief town of the province of the Parnasside, also suffered, but in a less degree. There seem to have been additional shocks the next day, but the dates are indistinct.

FROM official statements and from private letters received in London, we learn that Guatemala is suffering from the frequent occurrence and great destructiveness of earthquakes. The chief ravages are in the district of Cuajiniquilapa. The earthquakes have been daily from the 14th April to the last date, the 18th June, with the exception that after the 3rd May there was no shock for three days. The greatest shock was on the 12th June at 3 P.M. The motion was from S.E. to N.E., preceded by hollow rumbling. The church and chapel of the town were nearly destroyed. The principal parochial and municipal buildings, the prisons and custom-houses are in ruins. All the tiled private houses have suffered, especially those built of adobes or sunburnt