ON THE PRINCIPAL CONSTRUCTIONS OF BREECH-LOADING MECHANISM FOR SMALL ARMS, AND THEIR RELATIVE MECHANICAL ADVANTAGES.

BY MR. WILLIAM P. MARSHALL.

(Adjourned Discussion.)

Mr. A. HENRY, of Edinburgh, whose rifle was one of those described in the paper, expressed (through the President) his regret at being unable to be present on this occasion, and wished to draw attention to the advantages of the principle of the vertical sliding block for closing the breech, which he considered the best mechanical arrangement, the force of the recoil being resisted by surfaces bearing at right angles to the line of strain. This mode of closing the breech allowed a straight passage into the cartridge chamber for loading, and also afforded an unobstructed view through the barrel to admit of inspection and cleaning. The mechanism by which the sliding breech-block was actuated was of very simple description, and the same lever that opened the breech also ejected the empty cartridge-case and cocked the hammer at the same time, allowing of great rapidity of firing. The hammer and the whole of the lock action were enclosed within the lock, and were thus completely protected from wet or dirt.

Mr. W. SOPER, of Reading, pointed out that an important difference in his own from other rifles was that the breech lever was situated conveniently at the side of the lock, so as to be readily worked without shifting the hand from the trigger guard. Practically he had found this was a better position for the lever than any other, and it enabled the lever to be worked much more rapidly, so that as many as thirty rounds in a minute could easily be fired from the shoulder, taking aim, and in public trials as many as sixty rounds in a minute had been fired from a rest. To this advantage of rapidity of firing was also added another of the greatest importance, namely

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perfect safety to the firer; for in the event of firing a defective cartridge, the breech-block effectually prevented any escape of gas backwards into the firer's face. With the Prussian needle-gun it was often necessary to fire from the hip, on account of the danger from the gas escaping backwards at the breech; and for arms of precision, to be fired from the shoulder, it was requisite that any escape of gas should be driven in the opposite direction, away from the firer's face, as was effected by the breech-block in his own rifle. There was also free access to the breech chamber of the rifle, so that the barrel could always be cleaned from the breech end, and a clear sight could be obtained through the barrel; in rifles that had to be cleaned from the muzzle it was found that after frequent cleaning the muzzle became so much worn that the accuracy of the shooting was interfered with; whereas the same amount of wear occurring at the breech end was of no consequence, and the rifle when cleaned entirely from the breech remained an effective gun for a much longer time. The action of the spring, hammer, and trigger, was exactly the same as in the Enfield rifle, and the hammer could be set at half cock or full cock in the same way. The striker was perfectly in line with the axis of the barrel, and the hammer struck its blow precisely in the same line. The extractor slide was worked entirely by the breech-lever, without any spring being employed to move it; and the power exerted at the first moment to start it was four times that applied to the lever, while at the end of its motion its speed was eight times that of the lever, by which means a very powerful and rapid extracting action was obtained. The breech-block working at right angles with the axis of the bore offered the most secure resistance to the strain of firing. The stock of the rifle was in one piece throughout its entire length, the lock-box being let into it. The number of separate parts in the lock and breech action was only twenty-three in all.

The PRESIDENT enquired how far this rifle would bear exposure to wet or dirt.

Mr. W. SOPER replied that he had had one of these rifles placed under water for a fortnight, and then laid out in the open air for another fortnight, and at the end of the month it had been fired in

its dirty state, without being even wiped, and no mishap of any kind had occurred with it; it was fired just as rapidly as on any other occasion, without the slightest difficulty. It had also been publicly tried by pouring a quantity of sand into the breech-box, and then working the action backwards and forwards for several minutes, after which it was fired with perfect facility; in actual service however no rifle would ever be subjected to such rough usage. With regard to the soundness of the breech action, many of the rifles had been fired with as much as 210 grains of powder, when finished and in the stock, without sustaining any injury whatever in any instance; and as regarded the durability of the mechanism, many hundreds of rounds had been fired continuously without producing the slightest interference with the action.

The PRESIDENT remarked that the subject of the paper was not only one of particular interest in its mechanical aspect, but also one of national importance; and although he knew nothing of the different rifles described, except as regarded their mechanical construction, he should not hesitate to express his opinion upon some of the mechanical questions involved in the subject, feeling that it was one which called for the fullest discussion at the present time.

With regard to the use of a spiral spring in place of the ordinary flat mainspring, there appeared to be no reason why the spiral spring should not work well, when employed under suitable conditions; and he presumed it had been found from the experience of its working in the Prussian and Chassepot needle-guns that its performance was reasonably satisfactory. But the conditions of its use in these two guns were very different from those under which it had now been applied in the rifle selected as the national weapon for this country; in this case the spring was an exceedingly short one, and the strain upon it must necessarily be correspondingly great in order to do the required work; and moreover the spring itself was very difficult to be got at. On these accounts the rifle now selected appeared to him eminently unsatisfactory as a piece of mechanical construction. The great difficulty resulting from the use of this short spiral spring was that the pressure upon the trigger nose was so excessive as to render the pull-off impracticable without the aid

of some supplementary contrivance for relieving the pressure in the act of firing. Although the contrivance adopted for this purpose was exceedingly ingenious, it was at the same time in his opinion almost as unsatisfactory as the action of the spring itself. So much depended upon the original accurate fitting of the rubbing surfaces in this trigger action, and upon their state of cleanliness and degree of lubrication, that the pull-off must be very variable indeed, and calculated to mislead the person handling the rifle.

Another serious objection to the same rifle was that the breech-lever raising the breech-block had very small bearing surfaces against the block, and these bearing surfaces were very near the fulcrum of the block; there was therefore a comparatively heavy pressure upon them, which would increase their liability to wear, and under these circumstances he considered nothing but very superior workmanship and exceedingly hard bearing surfaces would secure a reasonably satisfactory action for any length of time. If the principle of the falling block was considered good enough to be adopted at all, it was at any rate carried out in a much more satisfactory manner in the Westley Richards rifle, which appeared to him to be exceedingly simple, and to possess several advantages in mechanical construction.

The rifle exhibited by Mr. Soper was certainly a most ingenious piece of mechanism, and in rapidity of firing it stood before all the other rifles. There appeared to be considerable force in the advantage attributed to this rifle, in respect to the security of the firer from escape of gas backwards; how far the objection of the gas blowing out backwards applied to the falling block of the Peabody rifle, which was really the origin of the Martini, he was unable to say; but it appeared to be effectually obviated in the Soper rifle by the employment of the transverse breech-block. Another advantage in this rifle was that the striking pin and the blow of the hammer were exactly in the direct line of the axis of the barrel. These were all excellent mechanical points, which would go far to secure the success of the rifle embodying them; and there were also points about nearly all of the rifles now exhibited which were exceedingly ingenious.

Reverting to the rifle which had been selected as the national weapon, he wished to take the opportunity of putting upon record his own opinion that it was not likely to give the satisfaction which was expected from it. This opinion was based upon purely mechanical considerations, and looking at the subject from that point of view he had no hesitation in saying that this construction of breech mechanism appeared to him to be most unsatisfactory, and not likely to answer well for any lengthened period of working.

The Meeting then terminated.