

minute, but requires more frequent reliefs at the crank than the smaller calibres.

RESULTS AT 150 YARDS.

In this instance the Gatling gun, if the firing had been continued with the same ratio of hits up to one minute thirty four seconds, the time occupied in firing six rounds from the Napoleon, would have put 633 shots through the target; and it would moreover, have been by far the most effective weapon of the two against troops on account of the greatly superior penetration attained with it, the canister balls passing through but three thicknesses of one inch yellow pine boards, while, the shots from the Gatling gun penetrated six thicknesses. The killing and disabling effects of a projectile in a column of troops is, within cer-

tain undefined limits, proportional to its penetrating power.

The canister projectiles (from Gatling gun here used, although giving a large number of hits in a brief time, are not considered effective, on account of the smallness of the balls and their slight penetration.

The maximum penetration for direct hits is scarcely one 1-inch yellow pine board. It will be seen below that at 200 yards, (a suitable range for canister,) the penetration is less than half an inch. The disabling effects of these projectiles against any kind of troops would be insignificant in comparison with those produced by the solid shot from the 0.42 inch or 0.45 inch calibre Gatling gun, or even by the special canister from the 12-pounder Napoleon gun or the 8 inch siege howitzer, at the same range.

strikingly shown by the record. At 200 yds. it gave but 52 hits, as against 312 hits with the largest lead canister, and 560 hits with the smallest; four rounds being fired in each case.

The service canister for the 24-pounder flank defence howitzer contains the same number of iron balls (48) as the 8-inch service canister; but as the balls are much smaller in the former than in the latter, being, indeed, only a little more than one-third as heavy, their range, penetration, and general effectiveness would be proportionally less; giving 4 rounds at 200 yards probably not more than 25 or 30 disabling hits.

But if filled with lead balls, 0.75 inch diameter, the 24-pounder howitzer canister, retaining the prescribed weight of the finished projectile, would contain about 170, and would doubtless be quite as effective, in proportion to the number of lead balls fired, as the special 8 inch canister, delivering, in four single rounds at 200 yards, upwards of 200 disabling hits in a target of the dimensions used. A number of explosive bullets were fired from the 1 inch Gatling gun into the penetration target, at a distance of 200 yds. They usually penetrated three or four boards and then burst, splintering the target considerably. The shattering effect, however, appeared to be greatly diminished by the intervals between the boards, and would doubtless have been much greater in solid wood.

PENETRATION AT 150 150 YARDS.

Into 1-inch yellow-pine boards, separated by 1-inch intervals.

	Maximum.	Minimum.	General.
0.42-inch-calibre Gatling gun.....			6 to 7 boards
1.00-inch-calibre Gatling round canister, 0.45 inches diameter.....			1 board.
12-pounder Napoleon lead, canister, 0.75 inch diameter.....	3 boards, full.....	2 boards.....	3 boards.
8-inch howitzer canister, 0.75 in. diameter,.....	3 boards.....	1 board.....	2 boards.
8-inch howitzer canister, 0.97 in. diameter,.....	3 boards, full.....	2 boards.....	3 boards.

PENETRATION AT 200 YARDS INTO 1-INCH YELLOW-PINE BOARDS, SEPARATED BY 1-INCH INTERVAL.

	Maximum.	Minimum.	Average.
0.42 inch Gatling gun.....			6 boards = 6 inch.
1.00-inch Gatling gun round canister, 0.45 inch diameter.....	0.70 board = 0.70 inch	0.23 board = 0.23 inch	0.45 board = 0.45 in.
1.00-inch Gatling gun slugs, 0.45 inch diameter.....			Much less than round canister.
12-pounder Napoleon lead canister, 0.75 inch diameter.....	3 boards.....	2 boards.....	Scant 3 boards
8-inch howitzer lead canister, 0.75 inch diameter.....	3 boards.....	1 board.....	3 boards.
8-inch howitzer lead canister, 0.97 inch diameter.....	3 boards.....	1 board.....	2 boards.

Upon the results of the foregoing competitive trials at ranges of 150 and 200 yards, reference being also had to the diagrams of the targets, it may be remarked as follows, viz:

First. At 150 yards the 12 pounder Napoleon gun, firing double special canister, and the 0.42 inch-calibre Gatling, used with the oscillator so as to cover the target laterally, are about equal in number of hits. The 12-pounder, however, made the best target for want of sufficient dispersion vertically in the Gatling.

On the other hand this deficiency is perhaps more than compensated by the superior penetration of the latter.

Second. At both 150 and 200 yards the 1.00 inch calibre Gatling, firing canister containing either slugs or round balls, cannot be deemed an effective arm, unless the penetration can be increased, for many of the shots would be stopped by the clothing worn by the soldiers, and many others would fail to inflict disabling wounds.

The canister ammunition used by the board contained only coarse grained powder adopted for previous trials, when the case was made of thin metal. As the thickness and strength of the case has been greatly increased, a fine grain quick powder is admissible, and much better results can reasonably be expected from it.

It is the intention of the company to use fine grained musket powder for all canister ammunition prepared hereafter for the 1-inch gun.

Third. Forty Springfield rifles, served with average skill, are equal to one 0.42 inch calibre Gatling gun in the number of shots delivered in a given time; but at 150 yards the latter gave 38 per cent. more hits than the former; and at 200 yards 79 per cent. more. The forty rifles, however, covered the targets better than the Gatling, and for an equal number of hits would have been more effective against a deep column of troops on account of their greater dispersion vertically.

Reckoned simply by the number of hits in the target, one 0.42 inch calibre Gatling, using the oscillator, is equal to seventy Springfield rifles firing against time, and fifty two rifles firing deliberately. Without the oscillator every shot from the Gatling should strike the target.

Fourth. At 200 yards the 8 inch howitzer, firing double special canister, gave more hits than the 0.42-inch calibre Gatling, used with the oscillator, in the proportion of 1,463 to 574, (average.)

At 200 yards, and probably at 250 yards, one 8-inch howitzer firing this canister would therefore be superior in number of hits to two 0.42-inch calibre Gatling fired with the oscillator; but this superiority, if it exist at all, in delivering disabling hits against troops, is probably restricted to ranges not exceeding 200 yards, bearing in mind the great difference in the penetration recorded above. The howitzer covers the target vertically much better than the Gatling.

Fifth. The great inferiority of the 8-inch service canister containing 48 iron balls is

RESULTS AT 500 YARDS.

The record shows in a striking manner the vast superiority of the Gatling gun against troops at ranges beyond effective reach of canister, or say beyond 250 yards, for the projectiles in competition with it whether case shot or shell, are subject to a variety of disadvantageous conditions, more or less beyond control, among which may be enumerated the inaccuracy common to smooth bore guns; the varying effects of the wind, due to changes in either force or direction, or to both; the eccentricity of the projectiles, and the imperfection of fuses, the latter having been, during the trials of the board, a conspicuous and fruitful cause of the very poor results obtained.

At 500 yards 1 Gatling, fired with oscillator, gave 58 per cent. more hits than two 12 pounder Napoleons and one 8-inch howitzer together, each firing 1 minute 30 seconds.

At 800 yards the proportions of hits were very largely increased in favor of the Gatling, there being an average of 320 hits for 1 Gatling against an aggregate of only 38 hits for 2 Napoleons and 1 howitzer.

Some of the shells did not explode at all, while others burst either too soon or too late to be effective.

In some cases the fuse blew out without bursting the shell. There were only a few bad line shots, and it was not considered that the pieces were unskillfully served. Neither was the wind unusually high while firing with shell and case shot. Indeed, no abnormal condition prevailed in any marked degree, and the failure to achieve good results was due directly to characteristic defects in the kind of ammunition used, not under certain and uniform control of existing knowledge or skill on this subject. The ammunition had been prepared with great care by Major Baylor, and in average excellence was not regarded as inferior in quality.

RESULTS AT 1,000 TO 1,150 YARDS.

Targets representing a column of infantry. Guns on trial: 0.42 inch calibre Gatling gun; 4.50 inch calibre siege rifle; 8-inch siege howitzer.

The firing at the ranges from 1,000 to 1,150 yards was made at a series of targets repre-