

### THE EFFECTS OF ICE AND SNOW ON ARTILLERY AND RIFLE FIRE.

We are indebted to the Austrian *Millhe- ilungen über gegenstände der Artillerie und Genie-Wesens* for the annexed details of experiments, which were carried out by the Austrian troops during the past two winters, for the purpose of ascertaining the effect of ice and snow on the fire of infantry and field-artillery.

The first series of experiments was made at the Polygon of Thalerhof, in the neighbourhood of Gratz, and commenced in February, 1873. The object of experiments was to determine the value of snow defence, and also to ascertain the effects of surfaces of ice and snow on the fire of the Werndl rifle, and of the Austrian 4 pounder and 3 pounder field guns.

A parapet of rammed snow was thrown up, thirty six feet in height. The minimum thickness of the parapet was thirty six feet at one extremity, tapering off to twelve feet at the other. It was formed with an exterior slope of one sixth of the height. The outer coating of snow was partially thawed by day and frozen hard each night, so that it acquired a considerable degree of consistency and hardness.

Shells, with percussion fuzes, were thrown against this parapet from the 4 pounder and 8 pounder field guns at 600 paces range, and penetrated to a mean depth of twelve feet before bursting. The 8 pounder shells, more especially, produce a remarkable effect; some of them, which lodged four feet below the superior slope of the parapet, produced a crater six feet in external diameter. The snow crumbled away very quickly round the holes thus formed. Only five per cent. of miss fires occurred. The conclusion arrived at was that snow defences could not withstand the continued fire of rifled field guns.

To test the effects of Werndl rifle fire, a parapet of the same dimensions as the above was thrown up, but the snow was not rammed so hard. The mean penetration of the bullets was found to be as follows:—At 10 paces, 3ft.; 300 paces, 3½ft.; 600 paces, 2½ feet.

The conclusion here arrived at was that a snow parapet, six feet high and of the requisite thickness, affords very efficient shelter against infantry fire, even at short ranges; but that, owing to the superior penetration of the projectiles in snow, the protection is not equal to that of an earthen parapet of lesser dimensions. Experiments, made in 1870, proved that at ranges between 100 and 300 paces, a Werndl bullet will penetrate to a mean depth of 5in. only in earth of average consistency freshly dug, and 7in. only in the same earth well rammed. In snow, the mean penetration is 42in. at a like range.

Other experiments were then made to ascertain the effect of snow and ice surfaces on the bursting of shells. For this purpose three plank screens, each 10 feet in width and 6 feet in height, were placed, one behind the other, at distances of 25ft. apart. In front of the foremost a bed of hardened snow was formed, extending 50 paces in the direction of the line of fire by 10 paces in width. In the first set of experiments there was no snow in front of the targets; in the second the snow was 1ft. in depth; in the last it was 2ft. deep.

Fire was opened on the targets with 4 pounder and 8 pounder field guns, at 600 paces. The proportion of hits on the targets was as follows:—4 pounder shells—Bursting on the bare ground, 23; on snow 1ft. deep, 40; on snow 2ft. deep, 13, 8 pounder

shells—Bursting on the bare ground, 107; on snow 1ft. deep, 60; on snow 2ft. deep, 12.

Although the 4 pounder shells gave results discordant with the rest of the experiments, the obvious conclusion was that troops with a surface of snow before them would be less exposed to injury from shell fire than if the ground were bare, and that the presence of snow might thus be turned into useful account. All the shells burst, the percussion fuzes acting admirably.

The experiments were resumed in January, 1874, at similar targets set up on the frozen surface of the Lake of Leopoldstadt, near Eisenerts. These experiments were of two kinds. In the first portion 8 pdr. shells were fired horizontally at 800 pace ranges; in the second a plunging fire was kept up with the same shells at 1500 pace ranges. Five trial shots were fired, and after each the thickness of the ice was measured at the point of impact. Two of the shells passed through the ice, which was 5½ in. and 6½ in. at the points of impact respectively; the other three struck where the ice was 6 inches thick and covered with 1½ in. to 2in. of snow, and ricocheted, leaving furrows 2in. deep in its surface. It was concluded that this was the maximum penetration, and the experiments proper then commenced.

The sights were aligned for 700 paces, giving a mean range of 784 paces. The four shells fired—two of which passed clean through 5½ in. and 6in. ice—burst at a mean distance of 11ft. beyond the first screen, making 14 holes and 7 indentions on the first screen, and 18 holes and 14 indentions on the two others. This showed that 35 to 50 per cent. of the total number of fragments into which the shell burst struck one or other of the screens, a result to be attributed to the low angle (about 3deg.) at which the shells rose after striking the ice. The fifth shell struck 30 paces in front of the foremost target, penetrated 5½ inches of ice, overlaid by 1½ in. of snow, ricocheted, passed through the first and second target, and burst ten paces in front of the third, which showed 24 holes and 6 grazes. The angle of ricochet after the first graze was so low that the shell passed through the first screen at 18in. above the ground, the same height at which it had been hit by the four preceding shots, which had struck only 10ft. in front of it.

To get hits on all the screens, half a dozen rounds were fired with the sights adjusted for 625 paces, which gave a mean range of 793 paces. The first shell passed through 5½ in. of ice at 815 paces distance. The other five, striking on snow covered ice 5½ in. or 6in. thick, merely left furrows 2in. deep. The first three shells burst at a mean distance of 24 paces from the point of impact; the others, the fifth, which never burst at all, excepted, at a mean distance of 67 paces.

Other experiments on thinner ice could not be carried out, as ice of the requisite dimensions could not be found.

The principal conclusions arrived at were that projectiles striking a surface of ice rise at a very low angle, which differs but little from the angle of incidence; that the shorter the range, the lower the angle of ricochet, and the less the penetration; that when the projectiles ricochet at very low angles, the bursting point of impact, and that it is, therefore, not of much use to fire shells at troops on the ice at ranges under 800 paces; that the results of the practice, as far as they could be ascertained from a like limited number of rounds, were superior to those on ordinary ground, the shells ricocheting

from the polished surface of the ice, and bursting with far greater uniformity; that, as a rule, ice of a less thickness than 6in., cannot be depended upon to withstand the shock of a horizontal fire of shell; that the striking shell imparts to the ice a strong oscillatory movement in the direction of the line of fire, producing numerous cracks, which, however, do not appear to compromise its stability; and that the mean effective penetration of a shell thus fired in ice does not appear to exceed 3in.

The second portion of the experiments was executed with a plunging fire of 8 pounder shells, at 1500 paces range.

Ice of superior thickness was sought, but could not be found, and all attempts to increase its dimensions by pouring water on it having failed, the experiments were carried out against screens similar to those used in the preceding experiments, and on ice of like thickness.

All the projectiles struck at angles of 15°, broke through the ice, mostly 7in. to 7½ in. thick, and much of it covered with a couple of inches of frozen snow, ricocheting, and bursting very regularly at 5 to 10 paces beyond the point of impact. The bursting effect were not satisfactory. The terminal velocity being much reduced, the bursting effects were disproportionately great, and the fragments were consequently spread over a large area.

The general conclusions arrived at after the second of the experiments were, that 8 pounder shells, striking down at an angle of 15°, will break through ice 7½ in. thick, laid with 2in. of frozen snow; that with ice 6in. thick they will penetrate to the surface of the water, after ricocheting and striking the ice a second time; also that, on account of the feeble impact and irregular dispersion of the shell fragments in a plunging fire, the latter should only be used when obstacles prevent the employment of horizontal fire, or when the enemy's troops present a sufficient depth to enable greater effect to be produced by firing into their midst.

### THE GREAT FUTURE.

It is reported of the First Napoleon that after his defeat at Waterloo, while contemplating the results to England of her great victory, he was heard to exclaim that England's future greatness would depend upon her ships, her colonies and her commerce. Many since that day have repeated the words of the fallen emperor, and in our own Provinces one of the ablest and most eloquent speeches ever delivered by the present Judge Wilmont on the floors of the House of Assembly, was upon this very theme, the ships, the colonies, and the commerce of the Mother Country. During the range and scope of his address, he pictured to his hearers the mighty power of Britain, the central sun of a glorious colonial system, which in its vastness and influence should outshine all others, and compared to which the Empire of Chloemagne or the might of Rome in her palmy days should be but a petty principality or utterly insignificant.

For years England held to the doctrine of ships and commerce, but never seemed to realize in regard to her colonies, especially these North American possessions, the full significance of the words of the conquered Emperor or the New Brunswick statesman. We find this illustrated so frequently during the past decade in the dealings of the British government towards Canada.—"Friends, your love is but a burden, loose the bonds and go!"—and when they withdrew their