WOUNDS CAUSED BY BLANK CARTRIDGES.

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Our interest in wounds produced by the discharge of blank cartridges has been aroused recently due to the admission of several patients suffering from such injuries. The fact that these wounds are comparable to ones produced by live rounds was not at first fully appreciated and it is wondered whether, in view of the wide use of blank ammunition in training schemes, the average rank and file understand the dangers attached to its discharge at close quarters.

As a preface to the experiment to be described let us consider what occurs on discharge of a live round in the firing chamber of a rifle. The principle involved is essentially the same in the case of a blank round. A charge of powder either black or smokeless is enclosed in a brass cylinder. The powder is ignited by the percussion of a fulminating mixture in the cap. The powder charge burns producing a quantity of gases at very high pressure and temperature. These gases swell the cartridge case outwards thus firmly sealing the firing chamber and releasing the hold on the bullet. The pressure then starts the base of the bullet moving forwards until it is mushroomed or "set up" as it is called by engaging in the grooves of the rifling of the barrel. This prevents the escape of gas in advance of the bullet. The pressure of the contained gases increases until in the case of the modern Service rifle it amounts to about 20 tons to the square inch. Due to this pressure the bullet passes out from the muzzle, the confined gases behind it give a backward thrust to the gun and the sudden expansion of released gas causes the report. As the bullet emerges it is accompanied by a blast of highly compressed hot gas, particles of unburnt powder, smoke, flame and fragments of wad. When the bullet leaves the weapon it is acted upon by a series of forces. The most important is the forward movement and the rate of this movement varies with the pressure of the gas within the barrel—e.g. the muzzle velocity of the Service rifle is about 3,000 feet per second. The next most important movement is spin due to the rifling of the barrel—in the Service rifle this amounts to one complete turn in every 10 inches—therefore the bullet has imparted to it a spin of about 3,000 revolutions per second. Other factors affecting the flight of the bullet, such as air resistance and gravity, will not be considered here.

When a missile strikes and becomes embedded in the body two forces are at play, namely the energy of the missile and the resistance of the body. The energy of a missile equals half its mass times the square of its velocity. Thus the velocity is of much greater importance than the mass. Piercing of objects however considerably reduces the velocity.

The resistance of the body depends on the type of tissue in the path of
the missile. But the pure hydrostatic effect must be considered—when a rapidly moving object strikes a fluid or semifluid medium, the force is distributed in all directions and this may result in extensive bursting of the particular part as well as damage to tissues and organs remote from its path. This cavitation and fragmentation is thought to be particularly accentuated by the spinning of the bullet at high speed when it enters the body. Of the tissues of the body, bone naturally produces the greatest resistance and fascia, aponeurosis and muscle follow next in that order. The differences in resistance provided by different tissues cause the course of the missile to deviate from a straight line.

The contents of a .303 inch blank cartridge, namely the wad and charge of powder, are shown in fig. 1. The wad consists of compressed cardboard about $\frac{1}{2}$ inch in diameter and 1/16 inch thick. The powder is composed of discs of a nitro-cellulose compound.

Three abbreviated case reports are presented to show the devastating effects produced by the discharge of .303 blank cartridges in Service rifles.

Private D. was participating in a unit scheme and was sent to reconnoitre a hedge. As he crept through the hedge an "enemy" lying on the other side of it fired a blank round at him at close quarters (exact distance not known). He died before medical aid was reached. Externally there was seen a small puncture wound of the skin below the right costal margin, while post-mortem examination revealed a shattered right lobe of the liver.

Private P. was also participating in a unit scheme when someone, accidentally fired a blank round at about 3 inches distance from his left buttock. On examination there was a skin wound of entrance about the size of a 6d. At operation it was found that this overlay a cavity the size of a small orange. The cavity was filled with blood clot, pieces of the wad, battledress, unburned flecks of powder and minced muscle. In depth it extended down to the sciatic nerve, though the nerve itself was not damaged.

Private L. was unaware of the blasting effect of a blank round so held the muzzle of his rifle lightly against his boot on the dorsum of his foot and pulled the trigger. External examination showed a small hole in the leather overlying a skin wound in the web between his third and fourth toes about the size of a 6d. X-ray examination revealed a comminuted fracture of the proximal phalanx of the fourth toe. At operation the wound cavity extended down between the third and fourth metatarsals to the skin on the plantar surface of the foot though the skin was not disrupted.

Amazed by the extent of these above-mentioned wounds, the following experiment was conducted. Moulds of fireclay about 5 by 5 by 5 inches were made to the consistency of putty as this was thought to resemble the consistency of the muscle mass of the thigh. On the open face of the mould a single sheet of white linen paper was placed in contact with the clay to represent the skin. Later a single thickness of battledress was tied over the open face of the mould at about $\frac{1}{2}$ inch distance from the paper so as to resemble the resistance of the normal clothing of a soldier. .303 blank cartridges were then fired from a Service rifle at the open or cloth-covered
faces of these moulds at varying measured short distances. The results may be seen photographed in figs. 1 and 2.

At 0 inch the mould was completely disintegrated and fragments were scattered for a distance of 3 feet.

In fig. 1 the moulds may be seen without and with battledress covering
fired at from inches distant corresponding with the numerals below. Of the two moulds without battledress covering, the cavity of that produced at 6 inches measures 3 by 3 by 2 inches, while that produced at 10 inches measures 2 by 2 by 1 inch. Of the moulds covered with battledress, those at 4 inches and 6 inches show a defect produced in the cloth while the others show flecks of unburnt powder and wad on the surface.

Fig. 2 shows primarily the extent of damage to the molds after firing through the battledress covering. At 4 inches the cavity measures 3 by 3 by 3 inches; at 6 inches it measures 2 by 2 by 1½ inches; at 8 inches it is 1½ by 1½ by 1½ inches; at 10 inches it lightly penetrates the paper and abraids the surface to the depth of ½ inch. In all cases the cavities contain fragments of the wad and battledress and flecks of unburnt powder.

The lower line of each figure from left to right shows a live .303 cartridge, a blank .303 cartridge, the casing of a blank round after firing, a blank round opened to show the contents, the compressed cardboard wad and the discs of smokeless powder from a blank round.

This presentation is put forward merely as a matter of interest and only two conclusions are suggested.

1) Wounds produced by the discharge of blank cartridges are of much greater extent than was heretofore imagined.

2) Wounds of varying degree will probably be produced by a .303 inch blank cartridge discharged from a Service rifle up to 10 to 12 inches from the target.

In conclusion I wish to express my appreciation to Colonel J. A. MacFarlane, Surgical Consultant, Canadian Army Overseas, my Commanding Officer, Colonel G. Earle Wight, and the Chief of the Surgical Division, Lieutenant-Colonel S. J. Martin, for permission to forward this article.

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EXFOLIATIVE DERMATITIS FOLLOWING PHENOBARBITONE ADMINISTRATION.

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The extensive use of phenobarbitone in medical practice makes it particularly important that attention should be called to the rare but nevertheless serious complication of exfoliative dermatitis which may arise in the course of its administration. Of twelve recorded cases, nine terminated fatally. Wile and Benson, who themselves reported two of these cases, state that