

THE VICTORY OF SHOT OVER ARMOR.

We present in this issue an excellent half-tone engraving of what may justly be called the most successful penetration of Harveyized armor plate on record, which was made by a Johnson solid shot at the naval proving ground, September 5. The penetration of 10 inches of nickel steel, face hardened, reformed plate by a 6 inch shot, as shown at the point marked No. 3 in the engraving, is in itself a phenomenal performance, and places the gun once more far in the lead. But when our readers learn that, after penetrating the plate, the shot passed through 12 inches of oak and three plates $\frac{1}{8}$ inch thick, and was finally found 8 feet back in the sand and practically uninjured, they will understand how complete is the superiority of the best type of shot over the best type of armor to-day.

It is a matter of history that, just at the time when armor plate makers were discouraged by the ease with which the gun makers were able to penetrate the toughest nickel steel, Mr. Harvey produced his brilliant invention for giving an intensely hard face to the plate, and succeeded in smashing up the projectiles at the moment of impact. Shots which theoretically should have passed clear through a Harveyized plate failed to do so, because their points could not hold together long enough to break in through the highly tempered face, which was made so hard that it could cut glass like a diamond point.

Subsequent to the appearance of Harveyized armor the makers of projectiles have been trying to produce a shot which should combine the necessary hardness and toughness to enable it to split open the hardened face and hold together until it had wedged its way through the body of the plate itself. A few of the best makers have met with partial success. The Holtzer in Europe and the Sterling-Wheeler in this country have succeeded in breaking up the face; but the effort has proved too much for the shell, which has usually collapsed before it could get entirely through the plate. This has been the case almost invariably when the improved reformed Harvey plate has been attacked. The result is shown very clearly in the case of shot No. 1 in the recent trials, when an 8 inch Holtzer shot, weighing 250 pounds, and fired with a velocity of 1,800 feet a second, entered the plate and broke up, leaving the point embedded.

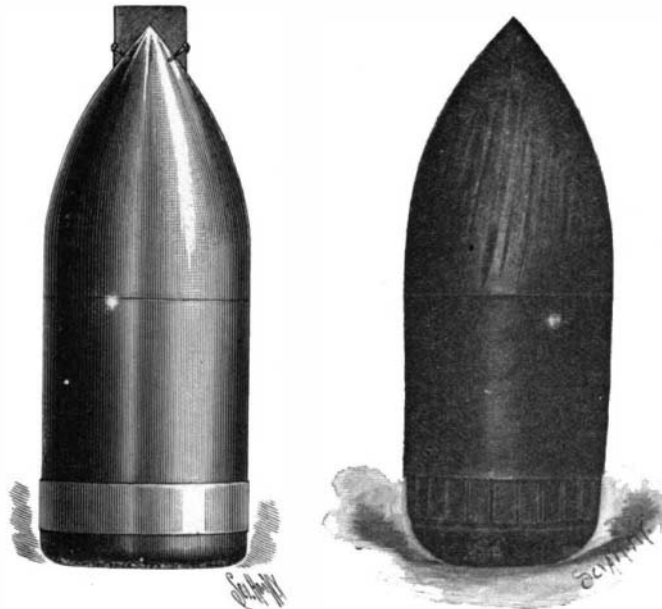
For many months the reformed Harveyized plate held its superiority, and it looked as though the final victory in the long contest between shot and armor was to rest with the armor. The next move on the part of the artillerist was of a very extraordinary, but very successful kind. He placed a cap of soft steel over the point of the shot to protect it, and, paradoxical as it may appear, the soft cap enabled the shot to get through.

The part played by the cap may best be explained by a simple experiment which can easily be tried by any of our readers. An ordinary sewing needle may be driven through a copper cent piece by thrusting it through a cork until the point is flush with the bottom of the cork, placing it upon the copper cent, preferably over an anvil, and giving the head of the needle a sharp tap with a light hammer. The copper will be cleanly perforated. The surrounding cork holds the body of the needle in the line of the blow, so that its whole force is concentrated at the point. The action of the cap is somewhat analogous. It preserves the integrity of the point of the shot at the moment of impact, holding the material together until penetration through the hard face is effected. Moreover, the cap becomes fused by the heat of concussion and lubricates the point as it enters. After the face is broken through, the Johnson shot holds together by virtue of its peculiarly hard and tough composition, which is obtained by a secret process of manufacture.

Referring again to the photograph of the plate, shot No. 2 represents a 6 inch 100 pound Johnson shot which was fired with brown powder at a velocity of 2,100 feet per second. It penetrated to a depth of 8 inches and communicated all of its theoretical capacity at that velocity, the rear portion of the shot breaking off and rebounding from the target. Mr. Johnson was confident that if the shot were given greater velocity, it would make a clean penetration, and accordingly a charge of 28 pounds of torpedo station smokeless powder was inserted for the next round. The shot, weighing 105.25 pounds, struck the target with a ve-

locity of 2,505 foot seconds and an energy of 4594.8 foot tons at a point 21.5 inches normally from the bottom, and 32 inches from the left edge of the plate. The work of the shot, which passed through the plate practically uninjured, can best be given in the words of the official report:

Action of Projectile.—Projectile penetrated plate, backing, boiler plates, and was recovered 8 feet back in the sand, entire, with the exception of one-half of base



A 6 INCH JOHNSON SOLID SHOT, SHOWING METHOD OF ATTACHING THE SOFT STEEL CAP.

A 6 INCH JOHNSON SOLID SHOT AFTER COMPLETELY PENETRATING A 10 INCH REFORMED HARVEY PLATE.

broken off diagonally to the bandscore. The remaining portion of the shell was in excellent condition, with the point whole, the head slightly scored, increased in diameter at the bourrelet 0.15 inch and in body 0.06 inch; length decreased 0.49 inch. Two small surface longitudinal cracks in the body 5.5 inches and 2 inches long, also two in the head 1.5 inch and 2.5 inches long respectively. Four fragments recovered; total weight, 95 pounds; weight of the shell proper, 85 pounds.

Effect on Plate.—Penetration complete; diameter of shot hole, $6\frac{1}{8}$ inches; interior for about 3.5 inches in rough, with fused metal, rest of hole smooth, all the interior being coated with copper, probably from the rifling band. Diameter of splash and flaking, 13 inches, $\frac{5}{8}$ inch deep. The boiler plate backing was star opened to a diameter of 16 inches.

A comparison of the two cuts showing the projectile before and after firing will show the wonderful endurance of the shot. The deep scorings on the conical head were produced by the jagged edges of the hardened armor face, and the twist imparted by the rifling is plainly discernible. The corrugated recess at the base is the seating for the copper rifling band, which, as the report states, was sheared off in the shot hole, together with diagonal fragments of the base. Altogether this is by far the most brilliant performance of any shot in any country, and the two photographs which are now presented to the public for the first time are well calculated to carry dismay into the camp of the armor plate makers. Messrs. Johnson & Company, of Spuyten Duyvil, New York, are to be congratulated on a success which has come as the result of many years of costly experiment; and the country at large will be pleased to think that, if Harvey's plates have been signally beaten, it is an American projectile that has done it.

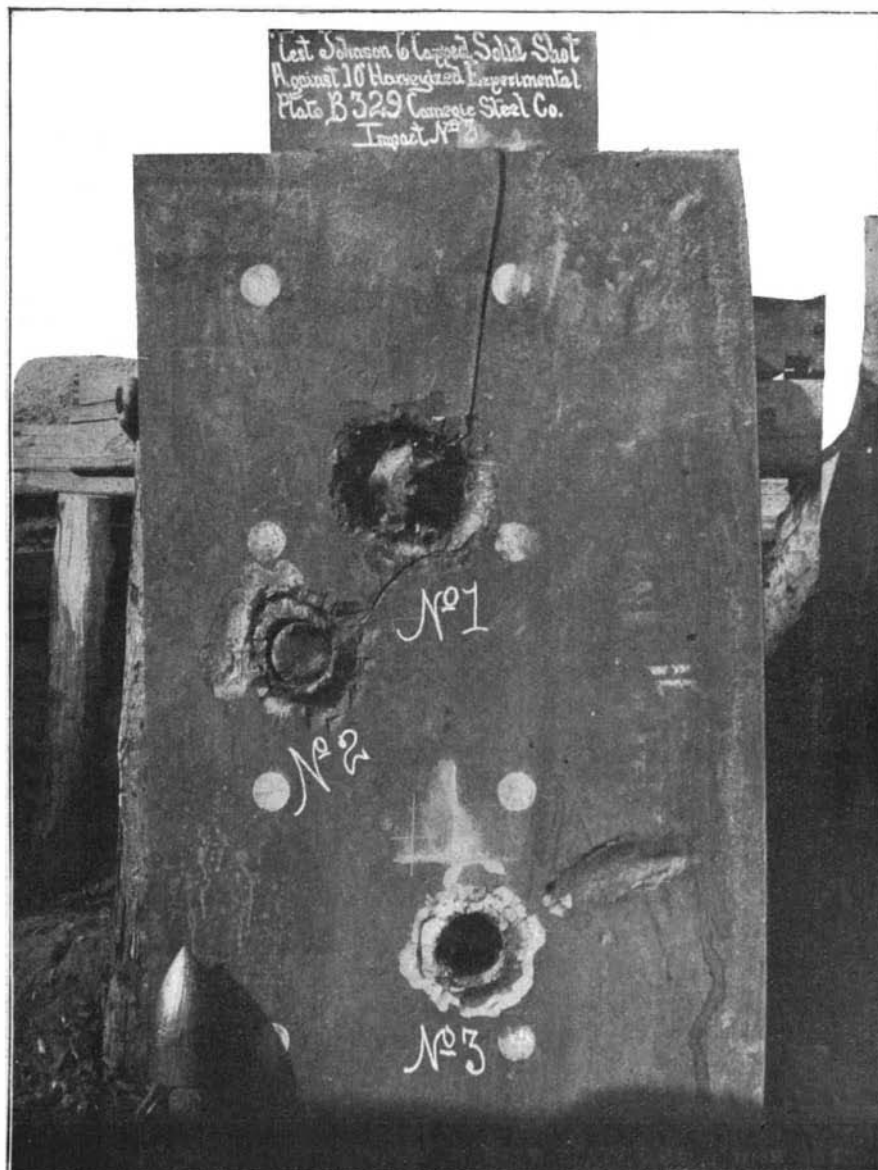
Incidentally it should be noted that the success of the second Johnson shot was only achieved by using a high velocity, considerably higher than the 2,000 feet per second which is obtained with the standard brown powder used for United States ordnance. Mr. Johnson is asking for 3,000 feet per second in order to develop the full potentiality of this solid shot; and it must certainly be admitted that the introduction of smokeless powder, with its higher velocities, would be an advance along the lines which are being universally followed by the gun makers of England and the Continent. The 10 inch Brown segmental wire gun now in course of construction by the government will have a maximum velocity with smokeless powder of 3,000 feet per second, and would seem to be the natural counterpart of the Johnson shot.

The St. Louis and the St. Paul are designed to carry a battery of 6 inch guns, and if these guns were to be of the wire wound pattern, and the ammunition included smokeless powder and a certain number of rounds of Johnson shot, these cruisers would have three-fourths of the armor plate now afloat at their mercy.

Water Curtains to Protect Sky Scrapers.

Firemen of the future will fight fire by simply draping buildings with water curtains, says the Home Journal. The water curtain is formed by throwing out continuous streams of water from the roof line, and merely allowing it to spread itself out and fall in a sheet. Several striking tests have already been made with this device in Boston. The results proved so satisfactory in every way that the attention of the fire boards and the insurance men has been attracted all over the country. The water curtain is a very inexpensive luxury. But, if it be adopted, fire risks will be reduced to a minimum. Besides, it can do no more damage to adjoining property than an ordinary hard shower of rain. The rapid growth of the modern sky scrapers and the conversion of streets into deep, narrow canyons have greatly increased fire risks. Modern fire apparatus has failed in some measure to keep pace with these changes, in spite of the extension tower, hose, and other devices. The danger has been only partially met by the construction of so-called fireproof buildings. The narrow streets, walled in by towering buildings, so confine the heat that a bad fire converts them into ovens. This drives the firemen out of them, and the next step is for the flame to arch over the street and spread at will. These conditions call for an entirely new departure in fire apparatus. The plan of the water curtain meets just this demand. It is necessary only to provide a source for this curious waterfall at the top of buildings, and let gravitation do the rest. A pipe is run up to the topmost cornice of the roof and connected with the water main. At the end of this hose or pipe a nozzle is so arranged that the water forced up is spread out in a thick spray. This first rises above the building for a few feet, then turns and falls to the ground in an unbroken sheet. The thickness of this curtain can readily be regulated by the size of the opening, while its texture depends upon the form of the nozzle.

PROF. RUCKER has shown that the Roentgen rays may be used to distinguish between various qualities of porcelain, those being more phosphatic being more opaque than those which are less so.



PHOTOGRAPH OF 10 INCH REFORMED HARVEY PLATE AND 6 INCH JOHNSON SOLID, CAPPED SHOT, AFTER COMPLETE PENETRATION. STRIKING VELOCITY, 2,502 FOOT-SECONDS. STRIKING ENERGY, 4,594.8 FOOT-TONS.