THE NEW TEN INCH WIRE WOUND, SEGMENTAL GUN FOR THE UNITED STATES ARMY.

The Ordnance Department has taken in hand the construction for experimental purposes of an altogether new type of gun, which is likely to show an efficiency far in advance of the hooped gun which is the standard type for the United States army and navy to-day. The new weapon, of 10 inch caliber and 30 tons weight, will be known as a Brown segmental, wire-wound gun, and will be the second of its type to be built; the first, a 5 inch gun, having been built four years ago by the inventor, Mr. J. H. Brown, and tested by the government at the United States proving grounds, Sandy Hook, in December, 1893, and again in May, 1896. The tests consisted of 200 rounds, fired with both brown and smokeless powder, when the gun was subjected to excessive powder pressures, the maximum reaching 65,600 pounds to the square inch, and developed the high muzzle velocity of 3,235 feet ... out showing any signs of failure.

Although the principles upon which the wire-wound gun is constructed are thoroughly scientific, they are simple and easily understood. If the modern gun were made in one piece, as were the old cast iron guns, the enormous pressure of the powder gases would stretch the metal lying nearest the bore of the gun beyond its elastic limit before the overlying metal nearer the circumference could come into play and assist in taking the strain.

To correct this fault guns are built up in a series of overlying cylindrical rings, each ring being shrunk on over the others, with the result that the innermost tube is thrown into a state of initial compression. It is evident that upon firing such a gun the shock of discharge will be instantly felt and resisted by every one of the cylinders or "hoops," as they are called, and every particle of metal, from the bore to the circumference of the gun, will be doing useful work. The strength of a built-up gun will depend upon the amount of initial compression and tension which the inner tube and the outer layers can respectively be made to carry, and this in turn depends, of course, on the elastic strength of the metal employed. Many years ago it occurred to a Mr. Longridge, in England, that if, instead of shrinking on hoops, a high grade of steel wire were wound onto the inner core of the gun at a high tension, a much higher compression of the inner tube could be obtained and greater powder pressures and velocities would be possible. He built an experimental gun which verified his theories, but failed because sufficient provision had not been made for longitudinal strength. The system was ultimately taken up by Mr. Armstrong in England, who overcame the difficulties of longitudinal weakness and produced a wire-wound gun, which has been adopted as the standard weapon for the whole British navy.

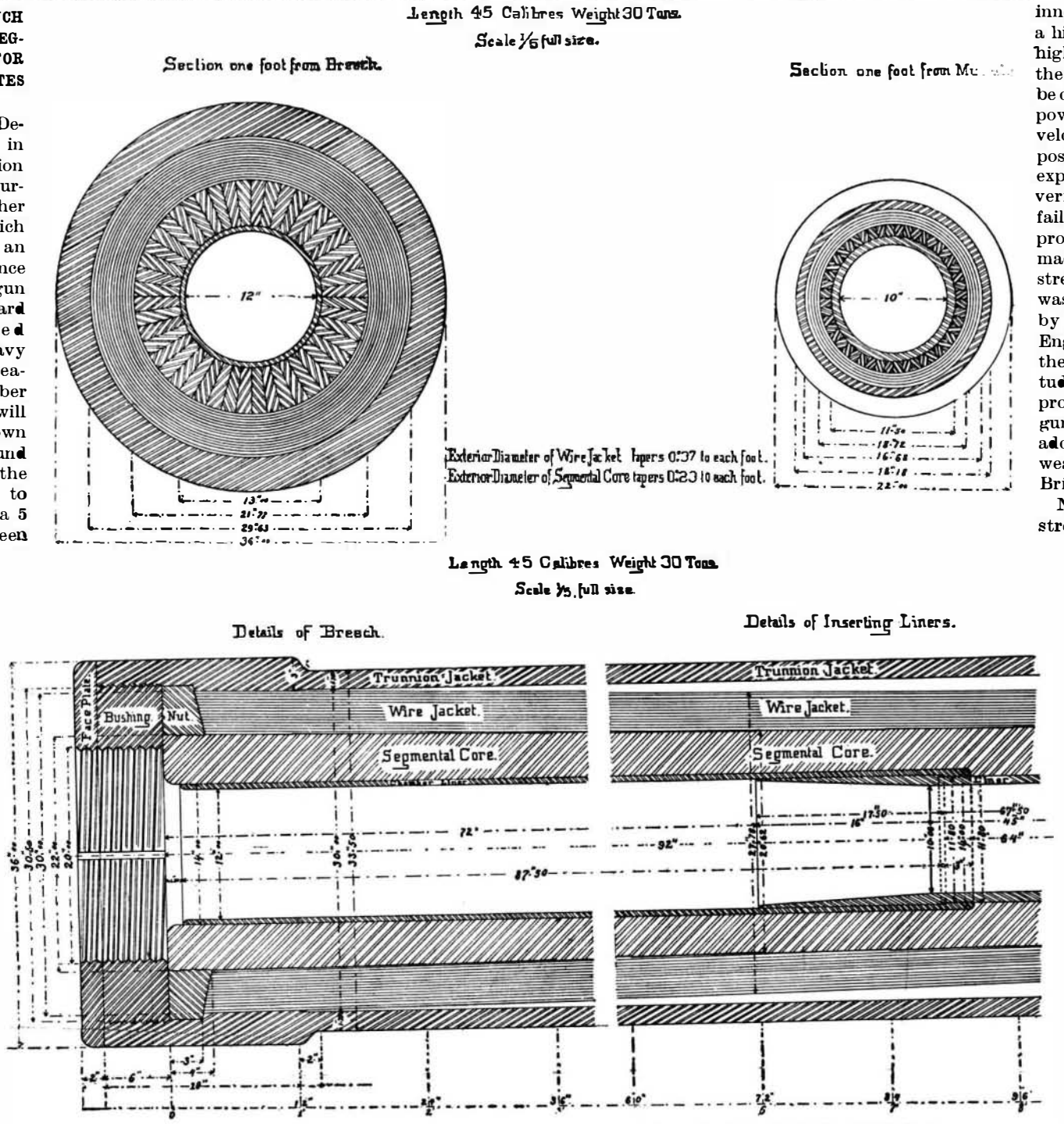
Now, the limit of strength of the ordinary wire-wound gun will be the elastic strength of the inner core of the gun (for it is evident that the metal must not be compressed beyond its elastic limit), and the elastic limit will be dependent upon the possibilities of manufacture.

Mr. Brown conceived the idea of building up the internal tube with a number of longitudinal steel bars or staves and wrapping them together under the tension of the steel wire. By this means he was able to secure a core having a much higher elastic limit than was obtainable in an ordinary tube.

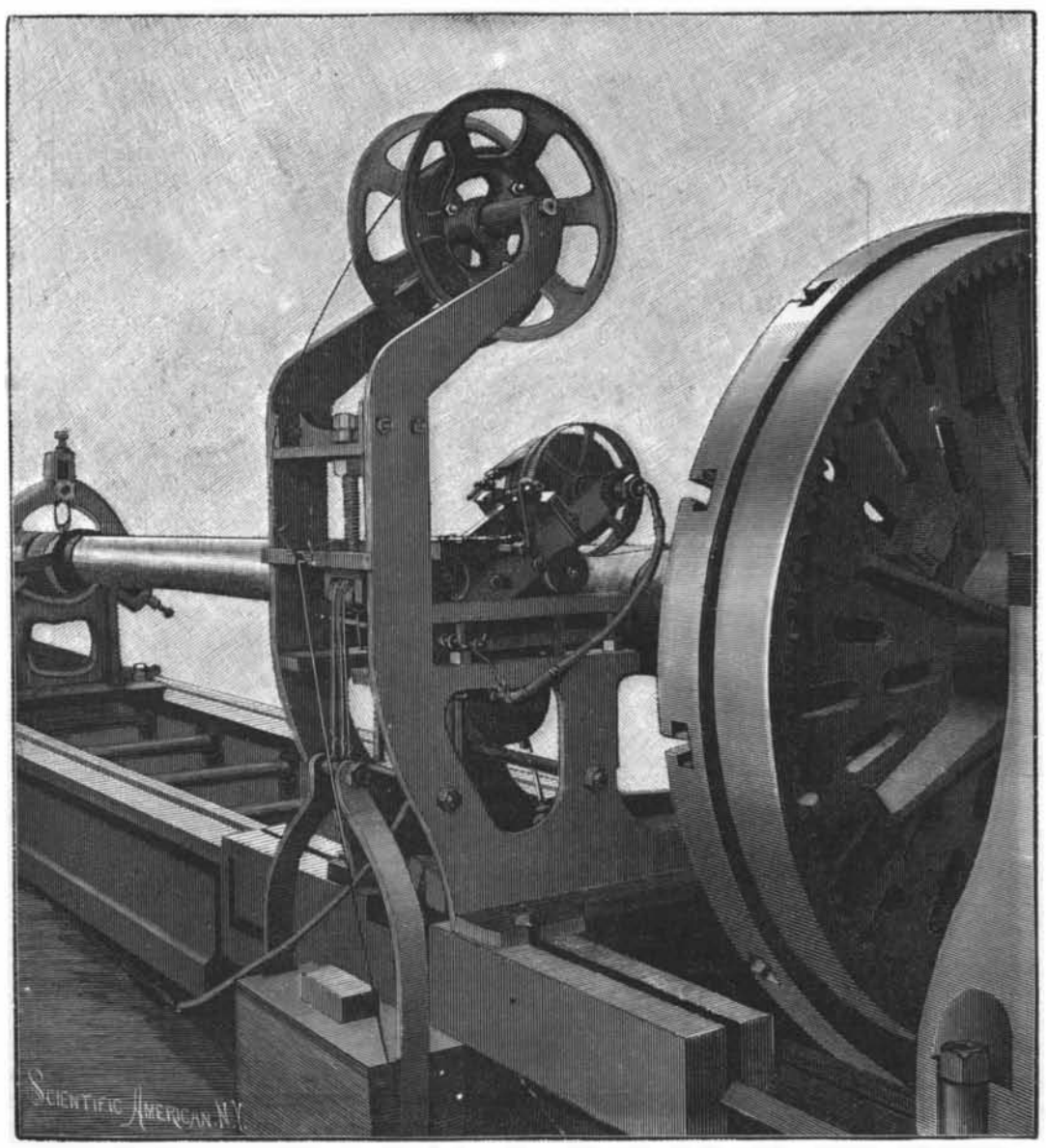
The advantages of this system of making the core are thus stated by Lieut. G. N. Whistler in his admirable theoretical discussion of the Brown segmental system:

1.—In consequence of the small weight of each of the component parts of the gun, crucible steel can be used economically. 2.—The small size of the segments, and the ingot from which they are rolled, admit of being carefully cast and uniformly forged, so as to insure uniformity of metal and of being thoroughly annealed. 3.—As they can be readily rolled into shape, the method of construction is exceedingly economical. 4.—They can be thoroughly and conveniently inspected. 5.—The size and thinness of each segment insures a thorough and uniform tempering and annealing, if temper be considered desirable. 6.—The size of the segments admits of readily setting up conditions of special elasticity by cold work.

This latter feature is by far the most important one in this system of construction, as it renders it possible to use a character of steel far beyond anything heretofore employed in the core of a gun. The core of such a gun whose bars or shoes have been hardened, annealed and cold drawn could readily be wound so



LONGITUDINAL AND CROSS SECTIONS SHOWING CONSTRUCTION OF THE TEN INCH BROWN SEGMENTAL WIRE GUN.



WINDING THE THIRTY-SEVEN MILES OF WIRE ON THE FIVE INCH BROWN SEGMENTAL WIRE GUN.

as to produce a compression between the segments of 112,000 pounds to the square inch without exceeding the elastic limit of the weapon.

In the manufacture of the 10 inch Brown gun the production of the segmental core is the most novel feature. The segments, which are made from open hearth steel, are cold drawn and are tapered and beveled in the working. This is done so accurately that no machining is necessary. They are assembled vertically, with the large end down, in much the same way as a cooper assembles a barrel, and are temporarily held together with three-part clamps placed one foot apart. The core is then put in a lathe, the two ends are machined, and the breech and muzzle nuts are shrunk on. The lathe is then set at the taper of the finished gun, and the outside of the core is turned down from nothing at the breech nut to a depth equal to the thickness of the wire, at twelve inches from said nut. Here the operation is again repeated for another twelve inches, and so on until the muzzle nut is reached. The steel wire is ⅛ of an inch square in section, with a sectional area of $\frac{1}{75}$ of an inch. The end of the wire is keyed into the gun at the breech nut and it is wound on at the required tension by means of the automatic winding machine shown in the accompanying cut. When the wire reaches the shoulder it is tightly wedged in against it, turned over, and keyed into the gun. The next layer is started at the second shoulder, 24 inches from the breech nut, and wound back to the breech. The third starts at the breech and runs to the third shoulder, the successive layers running in contrary directions until the necessary amount of wire is laid on. The gun is then bored out, heated internally by gas, and shrunk onto a thin steel liner. The chase jacket is shrunk on in two foot sections. The trunnion jacket is interlocked at the breech end by shrinking on, and fits with a slip joint over the chase. The breech closure is screwed into the projecting end of the jacket, and the trunnion ring is screwed on over the front end of the same jacket, as shown, so that the recoil of the gun is taken up directly by the jacket and transferred by the trunnions to the gun carriage. The longitudinal stress is taken in part by the longitudinal segments. In addition to this, the method of cross wrapping the wire in itself imparts considerable longitudinal strength to the gun.

The winding of the wire at a constant tension is done by the ingenious machine shown in the engraving. It consists of a stout frame, bolted to the lathe carriage, which is provided with a large overhead spool to carry the wire, and a small car which runs on a track at right angles to the axis of the gun. Upon the car are journaled two sets of adjustable steel rollers, between which the wire passes and by means of which the necessary tension is given to the wire as it passes to the gun. The pressure between the rollers is regulated by means of coil springs, controlled by thumbscrews. The two sets of rollers are geared to two brake wheels, which are seen above and below the car. The upper brake wheel has a fixed brake. The lower brake is automatic in its action and is controlled by the position of the car. From the rear of the car a set of wires passes over the pulley which is seen suspended between the vertical frames, and down to a bracket which carries a certain amount of dead weight. The winding is started with the weight resting on the floor. The handwheel on the brake is then turned until the weight is raised, when the tension in the wire equals the weight. As the car travels toward the gun, the brake wheel is released by an automatic gear and the car soon finds a position of equilibrium. The brakes are kept cool by the water pipes shown in the engraving.

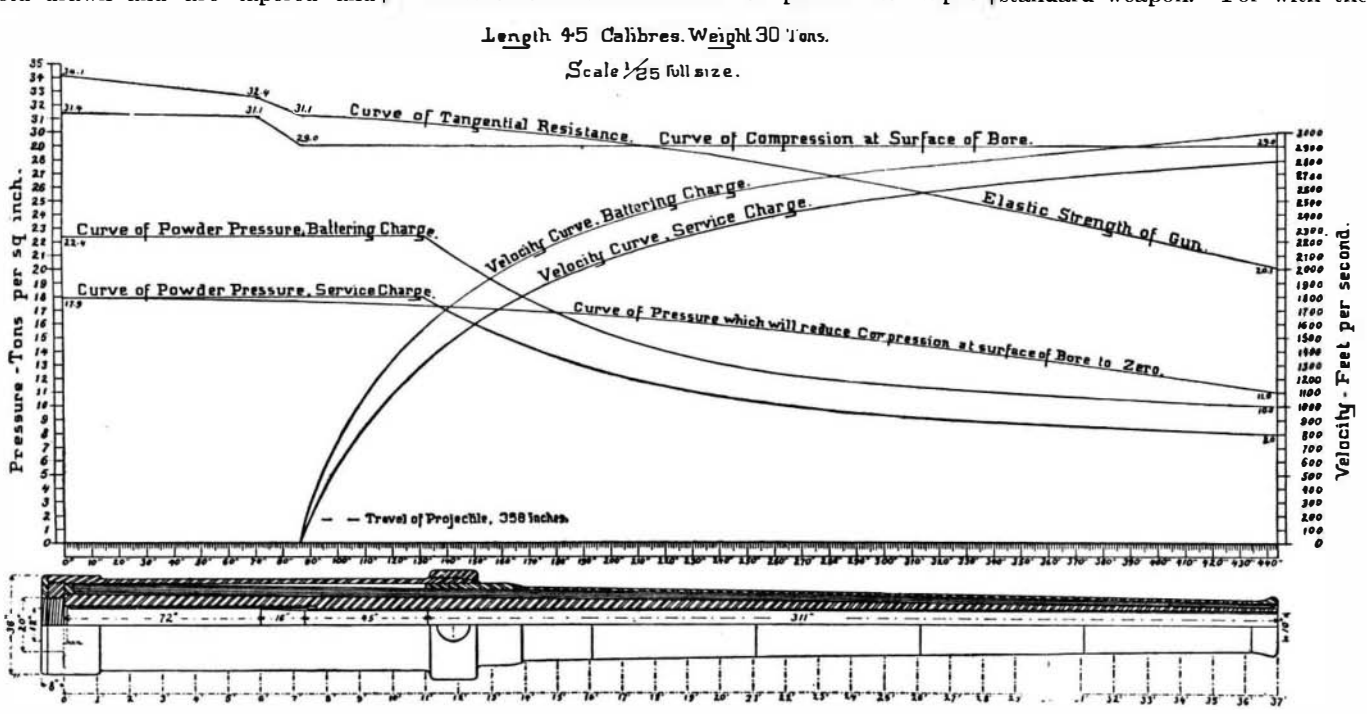


DIAGRAM SHOWING CURVES OF PRESSURE, VELOCITY AND RESISTANCE OF THE TEN INCH BROWN SEGMENTAL WIRE GUN.

The wire used in the construction of the 10 inch gun will have a total length of 75 miles.

The high quality of steel which it is possible to use in the segmental wire gun is evident from the official tests of the metal put into the 5 inch gun of this pattern. The segments showed an elastic limit [illegible] pounds per square inch and an ultimate strength of 176,000 pounds per square inch; the wire shows an elastic limit of 230,000 pounds and an ultimate strength of 262,000 pounds per square inch.

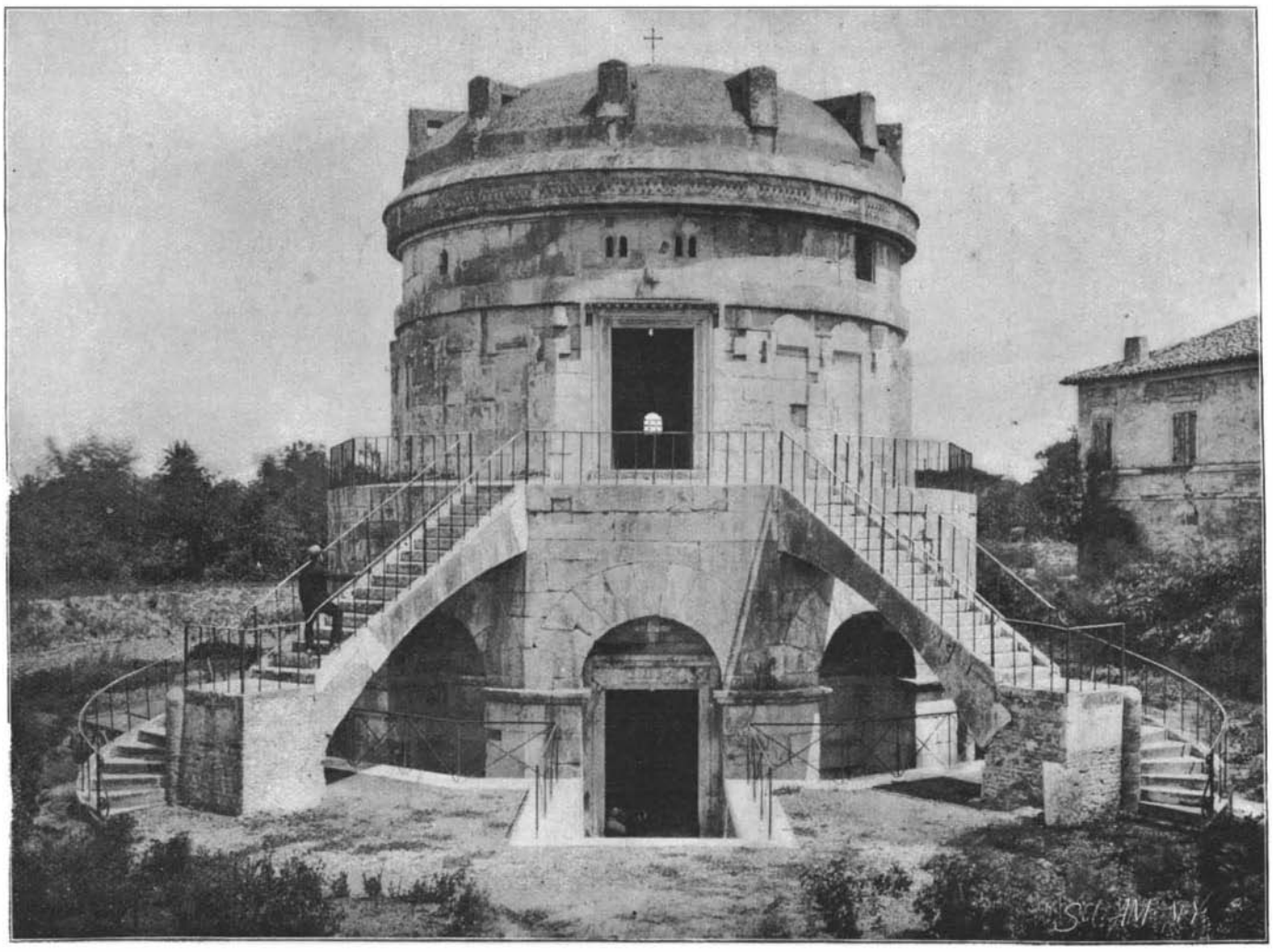
We would direct our readers' attention, bearing these figures in mind, to the accompanying diagram showing the curves of velocity, pressure, and resistance, from which it will be seen that, when using the battering charge, which gives the enormous velocity of 3,000 feet per second, the curve of powder pressure is never beyond 60 per cent of the elastic strength of the gun. If the segmental wire gun has the necessary endurance, and the army trials at Sandy Hook demonstrate that it has, its superiority over the hooped system of construction is obvious, and explains why the English navy has adopted the Armstrong wire gun as its standard weapon. For with the higher velocities of which the wire-wound gun is capable, the energy of the projectile per ton weight of the gun is enormously increased, with the result that of two ships of equal size, carrying the same total weight of guns, the ship armed with the segmental wire gun will have an enormous superiority of fire. For the same weight it can carry more weapons of equal power, or the same number of weapons of greater power.

This can best be shown by a comparison of the naval 10 inch gun, Mark II, of 28 tons weight, and the Brown 10 inch gun of 30 tons weight which is now being built. The hooped navy gun has a muzzle energy of 15,285 foot tons, whereas the Brown gun, which is only 2 tons heavier, will have 37,800 foot tons energy, which, be it said, is over 4,000 foot tons greater than the energy of the 13 inch hooped gun now in service.

Limits of space prevent any further discussion of this very live question. Enough has been said to show that the government is fully justified in its determination to build a gun of large caliber and give it a thorough test. It is not enough to say that our hooped guns are the best of their *kind*; we must have the best of any kind, and if the performance of the segmental wire gun is as good in the large as it has [illegible] as the service weapon for both army and navy.

THE TOMB OF THEODORIC AT RAVENNA.

There are few places which impress one with the idea of age more than Ravenna, the old Gothic city by the Adriatic. Even Rome itself with its modern improvements seems vastly nearer in time than the city of Theodoric and the Exarchs. Ravenna is enshrouded in an atmosphere of history and romance. Here was the seat of the later Roman emperors, and the center of the elaborate machinery of the state. Here Odoacer obtained his decisive victory, and where he was himself defeated and afterward assassinated by Theodoric the Ostrogoth; and afterward Ravenna became the governing center of the Byzantine dominion in Italy. Later memories are linked with the battle of Ravenna, when the flower of chivalry, Gaston de Foix, was killed, and here Garibaldi sought refuge. Ravenna has more peaceful memories, for here the exiled Dante wandered in the Pinetum, that glorious pine grove, extolled by the poet himself, and by Boccaccio, Dryden and Byron; and in Ravenna Dante lies buried, while in far away Florence the descendants



THE TOMB OF THEODORIC THE GREAT AT RAVENNA.