The Pressure of Confined Gunpowder when Fired.

We quoted last week from Prof. Treadwell's paper on the practicability of large cannon of very long range. We now present another quotation from the same, which, with the added facts, may be of much interest to many of our readers :—

"The expansive force of gunpowder, which must be resisted by the strength of the cannon, depends almost entirely upon the circumstances under which it is fired. Count Rumford has shown, by his experiments made about sixty years ago, that if the powder be placed in a closed cavity, and the cavity be two-thirds filled, the force will exceed 10,000 atmospheres, or 150,000 pounds upon the square inch; and he estimates that if the cavity be entirely filled with the grained powder, and restrained to those dimensions, the force will rise to 50,000 atmospheres. My own experience, made in bursting wrought iron cannon, the strength of which was known to me, leads me to believe that he has not overestimated its power, although I am aware that it is generally considered as excessive. If, following an opposite course to that herein described, the powder be at liberty to expand upon any side the force thrown in the other directions is very small. Thus, if a charge be placed loose in a gun, without shot or wad, the force upon the walls of the gun is very trifling—no more than is produced by the restraint of the inertia of the charge itself, or the fluid formed from it.

If we could divest a charge of this property of inertia, and fire it in a constantly maintained vacuum, it would not rend walls made of cartridge paper, if a single end were left open for its escape. From the preceding statement it will be seen that gunpowder will take any force, from perhaps 50,000 atmospheres, when confined to a close cavity, down to zero, if it be deprived of inertia and fired in a vacuum constantly maintained.

In artillery practice, the restraining power which causes the powder to act against the walls of the cannon, is derived principally from the inertia of the shot. This is so much greater than the inertia of the powder itself, that the latter may be neglected in the considerations that are to follow. Now, bearing in mind what has been already said, let us compare the difference of the force of powder as exerted upon a small and large gun respectively. It is perfectly well known that, if we have a pipe or hollow cylinder of say two inches in diameter, with walls an inch thick, and if this cylinder will bear a pressure from within of 1,000 pounds per inch, another cylinder of the same material, of ten inches in diameter, will bear the same number of pounds to the inch if we increase the walls in the same proportion, or make them five inches thick. A cross-section of these cylinders will present an area proportional to the squares of their diameters, and if the pressure be produced by the weight of plungers or pistons, as in the hydrostatic press, the weight required in the pistons will be as the squares of the diameters, or as 4 to 100."

Fifty thousand atmospheres is equal to a pressure of 750,000 pounds per square inch. Prof. Treadwell speaks of his own experience, and we have always a very high respect for any conclusions arrived at by an intelligent man from actual observation; but the figures found by Count Rumford, have, we think, been since sufficiently proved to be too high.

In October 1844, several stout guns were tested by the hydraulic press, at the expense of the U. S. Government. The first burst with 9,000 lbs. pressure; the second "sprung aleak" in several places under a pressure of 9,500 lbs., and soon vented the water too fast through its pores to keep up the pressure; the third burst with 9,860 lbs.; and a fourth with 12,400 lbs. There was certainly no reason to suppose that the guns wouldhave withstood any more strain if applied suddenly by burning powder. But the strain on a gun is, of course greatest near the breech, dying away as the charge expands; and guns are made thicker at the breech to provide for this.

The principles on which to estimate the strength of cannons, water pipes, etc., were not well understood until a comparatively late period, and it is probable that the extravagant results attained by the early experiments are due to that fact. Count Rumford, for example, who has been quoted as authority even by Prof. T. above, based his calculations on the bursting strength of a small eprouvette, which there are reasons for believeing did not actually possess more than one-tenth the resistance to a sudden force from within which he assigned to it.

Dr. Wm. E. Woodbridge and Major Alfred Mordecai made experiments at the arsenal at Washington in 1854-'5, in which the pressure of the powder was ascertained directly by a delicate piezometer, in which accurate means were employed for measuring by the compression of oil. A very thick and strong gun was employed, and the piezometer, very strongly and nicely constructed of steel, was introduced in a hole in the side, so that the full force of the powder might be felt on a small piston, and thus transmitted to the oil. With a ball weighing 6 1-2 lbs. and a charge of 1 1-2 lbs. of Dupont's cannon powder, a pressure of about 20,000 lbs. was produced. At one foot from the breech it was only 8,000 lbs., at three feet 6,000, and at four feet 5,900 lbs. per square inch. These facts, although important, do not bear on the main question —the pressure of powder when absolutely confined—but another experiment made under the same auspices does. A quantity of Hazard's rifle powder was fired in a cavity, from which there was no possible escape. A hollow cylinder of cast steel. 1 1-2 inch outside, with a bore of 1-4 inch, was filled up close with Hazard's Kentucky rifle powder, but without shaking or crowding, and was then confined very effectually, and fired by a flash of powder penetrating through a valve opening inward. To be sure that the valve or other parts did not leak some of the gas, the cylinder was placed under water. The pressure was undoubtedly very great, but was insufficient to burst the box, which box, from calculations made on its thickness, etc., would have been ruptured by any force exceeding about 93,000 lbs. per square inch. This is very different from the 750,000 lbs. of Count Rumford; but it is very probable that the gases from larger quantities of powder being less cooled by presenting proportionably less surface to the cold metal, would display a somewhat greater pressure.

The experiments of Woodbridge and Mordecai here quoted, if they do not show the absolute pressure of powder confined, give results of very great importance in showing how the pressure diminishes from the breech toward the muzzle, in an ordinary cannon. It may be presumed that the pressure in a musket or rifle diminishes with equal rapidity, and that the breech of small arms should, in order to be of a truly scientific form, be made with even more thickness in proportion to the muzzle than is now usually adopted.

Turbine and Overshot Wheels.

A recent number of the Paterson (N. J.) *Guardian* contains a communication from L. Holmes, giving a statement of the work accomplished by a turbine and an overshot wheel, the former in the Phenix mill, and the latter in the Passaic mill No. 1, in Paterson. Both mills manufacture cotton duck, and use the same kind of machinery. They are situated on the same raceway, within five hundred feet of each other. The overshot wheel of the Passaic mill is 19 1-2 feet in diameter, and it is stated to be in excellent working order; the water is gaged by a four foot gage, (576 inches area,) properly placed on a level with the bottom of the race; it takes most of that water to operate their machinery, running two thousand spindles with weaving and other machinery in proportion. The quantity of work done by a certain number of spindles correspond with the work done by a like number in the Phenix mill. Mr. H. says :—

"The machinery of this latter mill is operated by a Jonval Turbine wheel, five feet in diameter. The amount of water belonging to this company is five feet, or an opening of 720 inches area, gaged in the same manner and under the same restrictions as the Passaic No. 1, but only 480 in. area of water is used. This runs 3000 throstle spindles and 2500 mule spindles with weaving, twisting machinery, &c." Mr. Holmes says, in reference to such results, "throwing the 2,500 mules entirely out of the question, the comparative result would be :—

Passaic No. 1,	576 inches water,	2000 spindles	
"	or, 288 "	1000 "	
Phenix Mill,	480 "	3000 "	
"	or, 160 "	1000 "	

A result *exactly* 80 per cent. greater that is obtained from the wheel of the Passaic No. 1. said to be of superior construction.

This immense increase of power in favor of the Turbine wheel, as constructed for the Phenix Company does not by any means prove that the Turbine wheel has this overpowering superiority in *all* cases; although from 15 to 25 per cent. increase will always be guaranteed. It only goes to show—and pretty conclusively — that overshot water wheels *are* sometimes, if not frequently, constructed according to the mysterious "rule of thumb," and that the most cautious manufacturer *may* get a very poor result, sometimes, even from this well tried and ancient motor, when he vainly supposes that he has got all the value of his water."

The article does not state who put up the turbine in the Phenix mill, but we have been informed that its makers are Messrs. Collins & Gilbert, of Troy, N. Y. We had no conception that there was a single overshot wheel running in our country, and doing such a small amount of work in proportion to the water power, as that of the Passaic mill, and Mr. Holmes' irony we hope will not be thrown away on our millwrights and manufacturers.

But we have made a visit to the mills and gaged the water. Making allowance for the difference of head under which the two gages are working, the quantity of water used by the two mills are practically alike, the Passaic using about 55, and the Phenix 56 cubic feet per second. Strictly speaking, the latter uses 2 per cent. more water, and by the peculiar circumstances, has the advantage, practically, of two feet more head, so that instead of less, it would, with a precisely similar wheel, etc, develope *more* power. Mr. Holmes is probably correct in his other points, which we had not time to investigate.

Electric Printing on Glass.

A process for printing designs on glass by electricity has been discovered by W. R. Grove, of London, inventor of the galvanic battery which bears his name, and he has given an account of his experiments in the *Philosophical Magazine*. Two plates of window-glass, about three inches square, were dipped in nitric acid, then washed, and dried with a clean silk handkerchief, and coated on the outside with pieces of tinfoil a little smaller than the glass. A piece of a printed hand-bill was laid between the plates thus prepared; the tinfoil coatings were connected with the secondary terminals of a Ruhmkorff's coil, and removed after a few minutes' electrization. Now, "the interior surface of the glass when breathed on, showed with great beauty the printed words which had been opposite it, these appearing as though etched on the glass, or having a frosted appearance; even the fibres of the paper were beautifully brought out by the breath, but nothing beyond the margin of the tinfoil." These impressions were fixed by holding them over hydrofluoric acid—powdered fluor spar and sulphuric acid slightly warmed in a leaden dish.

Mr. Grove cut out of thin white letter-paper the word Volta, and placed it between the plates of glass. They were submitted to electrization as before, and the interior surface of one of them, without the paper letters, was subsequently exposed in the hydrofluoric acid vapor; the previously invisible figures came out perfectly, and formed a permanent and accurate etching of the word Volta, as complete as if it had been done in the usual mode by an etching ground. This, of course, could be washed and rubbed to any extent without alteration. The results obtained give every promise for those who may pursue this as an art, of producing very beautiful effects, enabling even fine engravings to be copied on glass, &c.

A plate of glass on which a slightly visible image was impressed, was immersed in a bath of nitrate of silver, in the usual manner as for a photograph. It was then held opposite a window for a few seconds, and taken into a darkened room; and on pouring over it a solution of pyrogallic acid, the word Volta, and the border of the glass beyond the limits of the tinfoil were darkened, and came out with perfect distinctness, the other parts of the glass having been as it were protected by electrization from the action of light. The figures were permanently fixed by a strong solution of hyposulphate of soda.

Lightning Conductors.

This subject, so interesting to such a large number of our readers, has recently been brought before the Royal Scottish Society of Arts, by William Hepburn, who read a paper on it, advocating the use of balls instead of points on the upper ends of the rods. He stated that he had been led to doubt the efficiency of the conductors usually adopted, terminating in points, which was contrary to the plan found to be necessary in the management of artificial electricity, in which, while the fluid is gradually collected from the excited cylinder by a row of pointed wires attached to the prime conductor, its transmission from the conductor to the battery itself is always effected by balls. Mr. Hepburn believes that the conductor ought to terminate in one or more pear-shaped balls having a surface sufficient to absorb at least as much of the fluid as the descending rod is capable of carrying to the earth.

It is hardly necessary to say that we consider Mr. H. entirely wrong. Points universally receive and transmit the fluid withless resistance, and consequently tend to make a lightning rod more efficient, but the reception or discharge of the same is accomplished with less shock, in consequence of its being performed more gradually. Prime conductors in electrical machines are rounded for a purpose the opposite of that for which conductors on buildings are designed. The first are to retain and prevent, the second to *aid* the flow of the fluid. Good conductors on buildings produce effects by silently and gradually promoting an equilibrium between the electrical condition of the atmosphere and that of the earth

Meerschaum Pipes.

The clay of which these are made is procured chiefly in Asia Minor, but also in Spain, Greece, and Moravia. The manufacture of pipes from the clay is carried on with especial care at Vienna and Pesth. The meerschaum is soaked in a liquefied composition of wax, oil, and fat, the absorption of which occasions the colors assumed by the pipe after smoking. Occasionally the bowls are artificially stained, by dipping them in a solution of copperas and other substances, before the application of the wax composition. The carving of the bowls is often difficult work, owing to the occurrence of a kind of clay mixed up with and harder than the meerschaum. The large quantity of parings left in roughing out the bowls would entail considerable loss unless some process had been devised for using them This has been done; the parings are employed in making the kind of meerschaum bowls called *massa-bowls*. The parings are ground to a fine powder, boiled in water, and molded into blocks, with or without the addition of clay. The blocks are allowed to dry, and then a pipe-bowl is fashioned from each.—These bowls are distinguished from the real meerschaum chiefly by being rather heavier.

Meerschaum bowls have been produced so large and so elaborately carved as to be valued at $500 each.

Railroad Expenses.

The working expenses of the Great Western Railroad in England, amounts to about 40 per cent. per annum, of the gross receipts. The working expenses of our railroads amounts to about 60 per cent. It costs more to keep our railroads in repair; they are not so solidly built as the English ones.

Correction.

The residence of Mr. R. Hurd, inventor of the seed planter illustrated in No. 24, present Volume of the SCIENTIFIC AMERICAN, is at Springhill, Whiteside co., Ill., instead of Moline, as there stated.