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Improved Tunneling Drill.

In the great engineering enterprises of the day, the operation of blasting is constantly gaining in importance. The vast resources, placed in the hands of engineers by the introduction of explosives of resistless power, have rendered the prosecution of a certain class of work so much more expeditious and cheap than it used to be, that the latter half of the nineteenth century witnesses the triumphant completion of mining and tunneling operations of unprecedented magnitude.

The Mont Cenis and the Hoosac tunnels are undoubtedly only the forerunners of many similar works, some of which may even eclipse in extent and difficulty these two, as yet, unrivaled feats of their kind.

With improvements in explosives has come the demand for improved means of drilling rocks. This has long been the most tedious and expensive operation in mining and tunneling; but, although there have been many attempts to supersede hand drilling by the use of machinery, it is only quite recently that really important successes have been achieved; and at the present time by far the greater part of rock drilling is done in the old way.

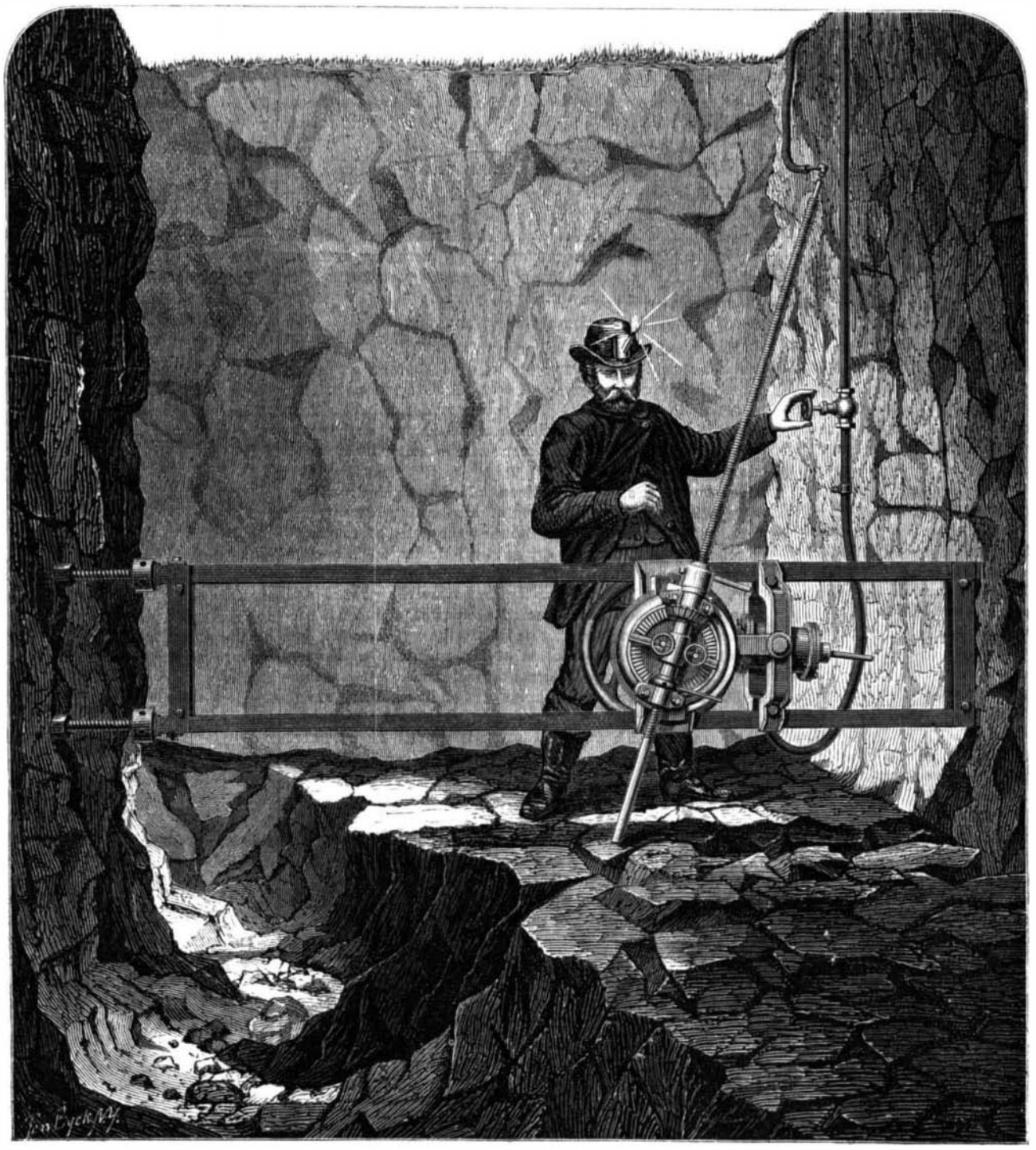
The first attempt at increasing the efficiency of drilling tools aimed at the improvement of the quality of the steel of which the points of hand drills are made, but latterly the mechanical world has become familiar with the black diamonds or borts, or—as they are sometimes tautologically called "carbon-diamonds," of which there is a plentiful supply. In hardness and abrasive power, these borts are rivaled by no other known substance.

The application of this substance to rock cutting has presented many difficulties. One after another these have been surmounted, until, at the present time, there is probably no material that will do as much stone cutting, in proportion to its cost, as these slate colored gems. Without brilliancy or beauty, they have proved to be of far more intrinsic value to mankind than their sparkling and more expensive congeners.

But though their extreme hardness gives them power to cut the hardest materials, they are too brittle to endure percussion. Their action is rather grinding than cutting; they may therefore be advantageously used, set as teeth in metal blades for saws, or to arm the extremities of metal cutting tools and drills, where they are not subjected to blows sufficient to crush them. Tools thus made now constitute a very important addition to the resources of the industrial arts.

For rock drilling, the principle adopted by Leschot, and first put in operation by him, has never been improved upon. His invention consists in the use of an annular ring armed with diamonds, or any other form of head similarly armed, attached to the end of a tube, through which water is forced to keep the drill cool, and to wash out the pulverized rock from the holes, by the regurgitation of the water up around the tube. The machinery employed by Leschot to propel his drill was very imperfect, and the method of fastening the diamonds has been greatly improved since the introduction of his invention into the United States. The patent for this country has passed from the possession of its first owners, and is now owned by the American Diamond Drill Company, of 61 Liberty street, New York, of which General Charles H. Tompkins is the President.

With the exception of the hollow tube and the diamond drill point, the diamond drilling machines employed by this company are purely American, and have been evolved from the fertile genius of Mr. John North, of this city, an engineer whose ability is well known to the mechanical fraternity.



THE AMERICAN DIAMOND DRILL COMPANY'S No. 2 TUNNELING DRILL.

As best illustrating these machines in their improved form, we place before our readers an engraving of what the company style their No. 2 tunneling drill, which is remarkable for its extreme simplicity and portability, as well as for the most ingenious mechanical movement, by which it is made to automatically adjust its feed, to the varying hardness of the rock to be drilled, while the drilling proceeds. In this movement lies the most interesting and important part of the machine, if we except the diamond cutters, and the hollow tube to which they are attached.

Let the reader take in his hand, or imagine, a plain bolt and its nut. If the nut be held from turning and advancing, the screw will, when turned, advance through the nut. If the screw be held from turning, and the nut be turned in an opposite direction, and still kept from advancing, the screw will be made to retreat. If the screw and the nut turn equally fast in the same direction, there will be neither advance nor retreat of the screw through the nut. If the screw makes one revolution more per minute in one direction than the nut makes in the same direction, then, at the end of the minute, the former will have advanced through the latter a distance equal to the pitch of the screw.

These principles enter into the feed movement of this machine. The screw sleeve, through which the drill rod or tube passes, and which turns with the latter, passes through a nut which can move neither up nor down, but can rotate freely with the screw when not held.

This nut has, on its outer surface, an adjustable friction brake, by which, when the pressure of the latter is adjusted, the revolution of the nut is retarded by a constant force, and this maintains a constant pressure upon the diamond cutter, whether it cuts fast through soft streaks, or slow through hard ones; for the moment the friction of the screw threads in the nut, caused by upward pressure of the drill, in the least exceeds the friction of the brake, the nut turns with the screw, the latter not advancing till the cutters relieve the pressure, and thus, lessening the friction in the nut, allow the brake to act. This action, however, must not be understood to be fitful or intermittent, for, as the cutters act constantly, they as constantly remove the resistance to the advance of the screw. The nut, therefore, keeps turning with the screw, but being less retarded by the action of the brake, the drill feeds down slower when hard streaks increase the upward pressure upon the nut.

It is thus rendered, so to speak, sensitive in its action, never crowding the drill shaft so as to endanger the carbon points, nor checking the revolution of the shaft. When it is desired to run up the drill, the gear which impels the screw sleeve by a spline and slot, is unclutched. The nut is then clutched to a gear which reverses its motion and, revolving it at high speed, quickly withdraws the drill from the hole in the rock.

The motive power may be either steam or compressed air, but for tunneling the latter is far preferable.

The machine illustrated and described has been running at the recent Fair of the American Institute with compressed air, supplied from a compressor, also on exhibition, and has formed a very interesting feature of this year's display.

We saw it cut an inch and a quarter hole through brown sandstone at the rate of 11 inches in 55 seconds.

A large machine (No. 1) cut through a very hard piece of blue limestone at the rate of 4 inches in 3 minutes, the diameter of the hole being about two inches, and the machine running below its proper speed. The framework of the No. 2 drill, as well as that of the other sizes, is adapted to work in headings, and is provided with screw supports, which hold it in any position required; and the drill works, equally well, pointed at any angle with the frame, above or below.

A No. 1 drill is now at work in one of the headings at Hallett's Point, having been purchased by General Newton for use in the extensive tunneling operations for removing the Hell Gate obstructions at that place.

General Newton states that the machine drills, with 60 lbs. air pressure, a total of twenty feet penetration in eight hours, and that it has more than fulfilled the conditions under which it was purchased. It is probable that others will be purchased and used on this work as the efficiency of the drill, in penetrating this excessive y hard rock, is more fully demonstrated.

It is stated that, at Pottsville, a machine of this kind made a perpendicular bore of 751 feet, and at Schuylkill, Pa., another made a horizontal penetration of 680 feet. The depth can be extended within any practical limit by simply joining on lengths of tubing.

We learn from an authentic source that the committee of the department in which this drill was exhibited, in the recent Fair of the American Institute, have made a highly favorable report in regard to its merits.

The above named company is, we understand, prepared not only to supply these machines, but to execute rock drilling and excavations under contract, and to employ their prospecting drills for obtaining test cores in the geological surveys of mineral lands.

ELECTRICITY AT THE AMERICAN INSTITUTE EXHIBITION.

The electrical apparatus of various kinds on exhibition at the Fair forms one of its most prominent and interesting features. It is much to be regretted, however, that instead of being classified in a group by themselves — a distinction which is certainly warranted by the present and prospective importance of electricity and its applications — the different entries of this class are scattered through half a dozen different departments, and placed in as many different parts of the exhibition, so that it is a matter of difficulty to find some of them at all. For instance, one electrical burglar alarm is placed in the Department of Intercommunication, and another, of precisely the same general character, is placed in the Department of the Dwelling. It would be difficult to imagine upon what principle such a classification as this is made. Other instances of a similar character might be mentioned. It is much to be desired that this defect may be remedied in future exhibitions.

MAMMOTH INDUCTION COIL.

The most interesting piece of electrical apparatus on exhibition this year is unquestionably the mammoth induction coil (miscalled Rhumkorff's), belonging to the Stevens Institute of Technology, of Hoboken, N. J., and which is the largest and most powerful apparatus of this kind which has ever been constructed. Its length is 40 inches, diameter 18½ inches, and it weighs 166½ pounds. The primary wire is 200 feet long, while the secondary is 234,100 feet, or about 44½ miles in length, of No. 34 wire. It is worked by a battery of fifteen pairs of zinc and carbon plates, 6 x 9 inches, which are lowered at pleasure, by means of a windlass, into three large glass jars containing a solution of bichromate of potash and sulphuric acid, made in the customary proportions.

With the above battery in good condition, the coil freely throws sparks through the air twenty-one inches in length by actual measurement, and a piece of glass is shown, three inches thick, which has been perforated by the spark, leaving an irregular crystalline looking track. This exceeds any performance of an induction coil on record.

This apparatus was constructed by Mr. E. S. Ritchie, of Boston, whose instruments and apparatus of this kind are confessedly superior to those of any other maker in the world. The SCIENTIFIC AMERICAN states that, a few years since, Professor M'Cullough carried a large coil of Ritchie's manufacture, belonging to Columbia College, to Paris, and showed it to Rhumkorff, who was so much astonished at its superiority over anything he had ever constructed himself, that he asked permission to dissect it. This permission was granted, and he found that Ritchie's insulation and mode of winding the wire was far superior to his own, and he has since adopted it in his own practice. The exhibition of these enormous sparks, and the beautiful coruscations of the Geissler tubes, connected with the apparatus, are highly suggestive of chain and sheet lightning, and never fail to attract a large crowd of astonished and delighted visitors.

Just back of this apparatus, near the entrance of the art gallery, may be seen a fine Thomson's reflecting galvanometer, such as is employed in working the ocean cables. This is also the property of the Stevens Institute.

MONSTER ELECTROMAGNET.

Down stairs, at the right of the entrance to the exhibition building, may be seen the monster electromagnet which was constructed by Mr. Wallace, of Ansonia, for Professor Henry Morton, of the Stevens Institute. It consists of eight metallic spools, twenty-one and a half inches in diameter by nine and a quarter inches long, surrounded by coils of copper wire insulated with kerite. It is wound in 272 convolutions around each spool — 2,176 in all. The spools are of metal, and are, of course, made hollow, to permit the passage of the cores. The latter are of the best Norway iron, thoroughly decarbonized, two in number, three feet three inches long, six inches in diameter, each weighing 183 pounds. They are suspended from a cross bar or back strap, whose cross section is that of said cores, being two feet four inches long, twelve inches wide, two inches thick, and weighing 180 pounds. The spools are slipped four upon each core, and held firmly in position by nuts upon the under side. The wire is wound separately upon each spool, and connected by binding screws passing through hard rubber insulating bands, fastened upon the flanges, so that the power of each spool can be developed separately, or the whole connected in series. The armature consists of a piece of soft iron, twenty-three inches long, five inches wide, and one and three quarter inches deep, and weighs fifty-four pounds. Through its centre passes a massive eye-bolt, to which can be attached the weight it is desired to lift. Its total weight is about 600 pounds. This is nearly twelve times as heavy as the celebrated magnet constructed by Professor Henry, of the Smithsonian Institute at Washington. Professor Mayer has estimated its lifting force at between thirty and fifty tuns! or nearly five times as powerful as that used by Professors Faraday and Tyndall in their famous researches and experiments.

Professor Mayer, of the Stevens Institute, exhibits some very fine photographs, showing the lines of magnetic force, which are of great interest to students of electrical and magnetic action.

ELECTROMAGNETIC LOCOMOTIVE.

Emile Prevost shows an electromagnetic locomotive, weighing about a pound, which continually travels around a miniature circular railway about three or four feet in diameter, the battery being connected with the rails. It is nothing more than an amusing toy, although the inventor makes the preposterous claim that, with similar but more powerful mechanism, he can develop two horse power from two cups of battery; an assertion entirely outrivalling anything we have yet had, even from our friends Paine, Highton and Reid.

NEW GALVANIC BATTERY.

Mr. Prevost also shows a new form of galvanic battery, in which the porous cell is formed of carbon. It is charged with dilute sulphuric acid in the outer cell, and with a new solution, invented by Victor Barjon, in the inner cell. This solution is the ordinary bichromate of potash and sulphuric acid, with the addition of some other chemical, which, it is claimed, increases its enduring properties very greatly. Tests which have been made with it show that, beyond question, it is a very superior form of battery, although how much of this superiority is owing to the arrangement of the elements, and how much to the peculiar solution used, has not, as far as we know, yet been definitely determined. Experiments are now being made with it.

NOVEL BURGLAR ALARM.

W. B. Guernsey, of Jersey City, N. J., shows a burglar alarm on a somewhat new principle, combining a closed main circuit with an open alarm circuit, the whole being so arranged that a break or short circuit in the main circuit will sound the alarm, so that the apparatus protects itself as well as the building in which it is placed.

ELECTRIC SEWING MACHINES.

E. Gaume, of New York, shows an elliptic sewing machine driven by an electromotor, consisting of six large, fixed electromagnets encircled by a revolving metallic ring carrying the armatures. The power is derived from four eight inch Bunsen cells, which seem to be amply sufficient to do the work, The arrangement of the motor itself shows no particular novelty.

Solomon Jones, of New Orleans, also has an electro-motor, for sewing machines, consisting of a vibrating bar carrying two armatures, and moving between the poles of two large electromagnets. This is driven by four large bichromate cells, and appears to move with considerable power. The arrangement of the mechanism is, however, awkward and unscientific, and a great part of the power produced is consumed in changing the motion of the heavy vibrating bar twice during every revolution of the main shaft. From a circular of a curiously illiterate character, which was presented to us, we learned that horse cars and machinery are to be driven by the new power, provided it turns out to answer the purpose, which we rather think it won't. As we heard an elderly countryman remark, when he saw it, "What would Ben. Franklin a' thunk o' this?"— *Telegrapher.*

TRIAL OF FIRE ARMS.

A military Board of Officers of the State of New York has lately had occasion to make a competitive test of various improved fire arms, with a view to the adoption of the best arms for the service of the state militia.

After careful examination and full explanation by the exhibitors of the various arms submitted, the Board selected from among them those which, in their opinion, were best adapted for use, and caused circulars to be sent to the owners, asking proposals to furnish the State with 15,000 new arms of their respective models, and to receive an equal number of the Springfield rifle muskets, calibre 58, now in the hands of the National Guard, at such price as might be deemed favorable, in part payment therefor.

Proposals were received from the owners or representatives of the following guns:

The Remington, the Springfield, the Ward-Burton, the Conroy, the Brown, the Whitney, the Joslyn-Tomes, the Peabody.

The proposals were as follows:

Gun	Cost of new arms.	Allowance for old arms.	Net cost.
Remington	$18 00	$5 50	$12 50
Springfield (Allin)	19 00	5 00	14 00
Conroy	19 00	3 00	16 00
Brown	21 25	5 00	16 25
Ward-Burton	18 75	2 10	16 65
Peabody	17 00	....	....
Whitney	21 00	3 00	18 00
Joslyn Tomes	24 00	1 00	23 00

The test of the guns took place during the latter part of September at Springfield, Mass. The salt water test was made in New York City.

The representatives of the arms tested were afforded every opportunity to display the merits of their respective systems, to point out the alleged defects of competing guns, and to demonstrate, by actual test, the superiority claimed for each in any particular.

The experiments resulted satisfactorily, and demonstrated that all the arms possess great merit in point of accuracy, durability and facility of manipulation. In fact, were the choice of an arm to be determined by the actual result of the experiments upon the arms themselves, the Board would have great difficulty in arriving at a decision, all the arms having undergone the various tests without injury, and unexceptionally to the satisfaction of the Board.

In arriving at the recommendation, embodied in this report, the Board considered, primarily, the relative merits of the various systems presented as regards strength, durability, accuracy, and simplicity of mechanism, and liability to accident in the hands of the troops who might be comparatively inexpert in the use of arms; secondarily, economy, rendered necessary by the limitation of the appropriation for their purchase, and, in view of the urgent necessity for the immediate procurement of breech loaders for the National Guard, the ability to furnish the requisite number within a short time.

The Board recommended, unanimously, the adoption of the Remington rifle musket, of the improved model manufactured for and submitted to this Board, (loading at assimilated half-cock, locking the breech piece in the loading, withdrawing the firing pin by a positive motion, and ejecting the shell on opening the breech), as the best arm, in all respects, for the use of the National Guard of the State of New York.

In order to make it conform to the calibre used by the United States Government, the Board commenced the adoption of the 50-100 calibre, although, but for this consideration, and as an independent proposition, they would prefer the 433-1000 calibre.

The Board consider the Springfield, Peabody and Ward-Burton guns especially worthy of attention and consideration. They all possess great merit, and are of undoubted excellence.

The Governor of New York having accepted the report, the militia will soon be supplied with the Remington gun. This will probably defeat the plans of the members of the notorious Ring of New York city, who had arranged a scheme for the robbery of the State treasury, by foisting an inferior arm upon the militia, at an exorbitant price.

It may be of interest to append the result of the tests with the accepted rifle. They were as follows:

REMINGTON—CALIBRE 50, WITH EXTRACTOR AND LOCKING DEVICE.

Rapidity of fire—First trial, 14 shots in one minute; second trial, 16 shots in one minute; third trial, 16 shots in one minute; (Berdan cartridges.)

EFFECTS OF SAND AND DUST.

After last sanding, the arm worked stiff for one or two shots, otherwise the gun worked well; no perceptible injury to breech mechanism.

EFFECTS OF DEFECTIVE AMMUNITION.

No discharge of gas until the sixth cartridge, was fired, which then was sufficient to slightly cloud a piece of white paper placed over the breech block during the firing; no perceptible injury to mechanism.

EFFECTS OF SALT WATER.

On attempting to fire the first cartridge, it was discovered that the firing was broken. A new pin was put in place, and the gun again placed in salt water and exposed in the open air the prescribed time. The piece was then fired, working rather stiff, and the extractor failed to throw out five or six shells.

SIMPLICITY OF CONSTRUCTION.

The piece was dismounted and found to be uninjured by the several tests. It was dismounted in fifteen seconds, and assembled in fifty-nine seconds.

Two other Remington guns were presented to the Board; one without locking device or extractor, cal. 43 (Spanish gun;) the other with locking device differing from the one first mentioned in the report. These arms were not subjected to all the tests, but such trial as was made of them proved that they withstood the tests equally well with the arm favorably reported.

The target record of the Remington, calibre 50, at 100 yards range, showed, the center of impact from center of target was 4·34 inches, with an absolute deviation of 4·58; at 300 yards, with the same arm, the center of impact was 12·53, absolute deviation 7·1; at 700 yards, the center of impact was 27·11, the balls carrying to the right. At 100 hundred yards with the Springfield B. I. R. model of 1868, calibre 50, at 100 yards, the center of impact was 5·96, most of the balls going to the right; at 300 yards, center of impact was 4·2; at 700 yards the center of impact was 55·46, all of the balls going to the extreme right of the target.

With the Ward-Burton with Springfield barrel, the center of impact was 10·66 at 100 yards, at 300 yards, 2·65, at 700 yards, 66·18.

With the Peabody, cal. 43, at 100 yards, the center of impact was 1·12, at 300 yards 11·04, at 700 yards 40·79. With the Winchester, at 100 yards, the center of impact was 6·54, nearly all the balls going up to the upper right portion of the target. With the Remington, cal. 42 at 100 yards, the center of impact was 14·8, all the balls being splendid line shots and placed in the lower portion of the target below the bull's eye. With the Remington, cal. 42, at 700 yards the center of impact was 17·55.

ONLY a few days before the great fire, the President of one of the largest of the English insurance companies (the Imperial, of London) was in Chicago, with a view of establishing an agency there; but he was so impressed with the precariousness of the situation that he declined to yield to the temptation. "I cannot do it," said he; "you have some fine buildings, but you have them surrounded by very bad ones. The first time circumstances combine against you, your whole city will burn up." This experienced underwriter had hardly time to get out of the country before his prediction was terribly verified.