loading at the breech connected with absence of recoil, in a way that no roughness of manufacture can conceal. The principle of non-recoil was frequently, of course, embodied in wall pieces on tripod stands. We did not learn breech-loading from the Spanish Armada, for in Fig. 2 will be seen a similar gun, I/8, which looks better made; but it apparently has not been subjected to the same influences of weather—indeed, the Armada gun looks as if it had laid under water for a long time, which reminds us, by the way, that there is a breech-loader taken up out of the wreck of the Mary Rose, sunk in 1545, on which the action of sea water for three hundred years has indeed played havoc. This gun, in Fig. 2, No. —/8, is of the time of Edward IV.—A.D. 1461 to 1483. It is made of longitudinal bars of iron hooped with iron rings. The chamber with lifting handle is complete. The vent is well preserved. Length of gun, 3 feet; caliber, 2·5 in.; weight, 1 cwt. 13 pounds.* The breech end in this gun fits on over the barrel below the trunnions. The curious square-shaped projection behind the trunnions appears to be a sort of rough key piece holding the two parts of the gun together. The bolt hole for securing the chamber may be seen in the side. Other chambers with handles may be seen in this cut. If we learned nothing in breech-loading from the Spanish Armada, we might apparently at a subsequent date have taken something from the Dutch, judging from No. II/160, Fig. 2, which is dated 1650. It is a brass breech-loader, a very handsome gun. The bore is continued through the cascable, being closed at the breech after loading by a wedge (*vide* cut) moving horizontally, being on the same general idea as that of Krupp. This gun was found by Captain—now Admiral—Selwyn, R. N., in a deserted Dutch fort near the mouth of Gambia River about 1851. The actual wrought iron wedge is modern. The gun IX/1, Fig. 2, is another remarkable one—also classed I/21; it is of wrought iron, beautifully finished, and bears the date of 1619. It is inlaid with gold and silver, and bears the cipher of Louis XIII., with initials M. and R., etc. The bore is continued from end to end. It has a vertical slot and a vent piece, in which is a vent with the first portion vertical and last portion horizontal, like that of the first Armstrong system. Fig. 3 shows the breech open. It will be seen that the breech piece is worked from a lever below, reminding one somewhat of the Martini lever, though it has not much in common with it, having comparatively an awkward motion. The lever, B, brought down the block, A, to open the breech. In closing the cap, C, had a catch, which holds into the breech end of the entire gun. The hinge, D, is broken; there may have been some special piece there suited to the descent of A in a straight line.

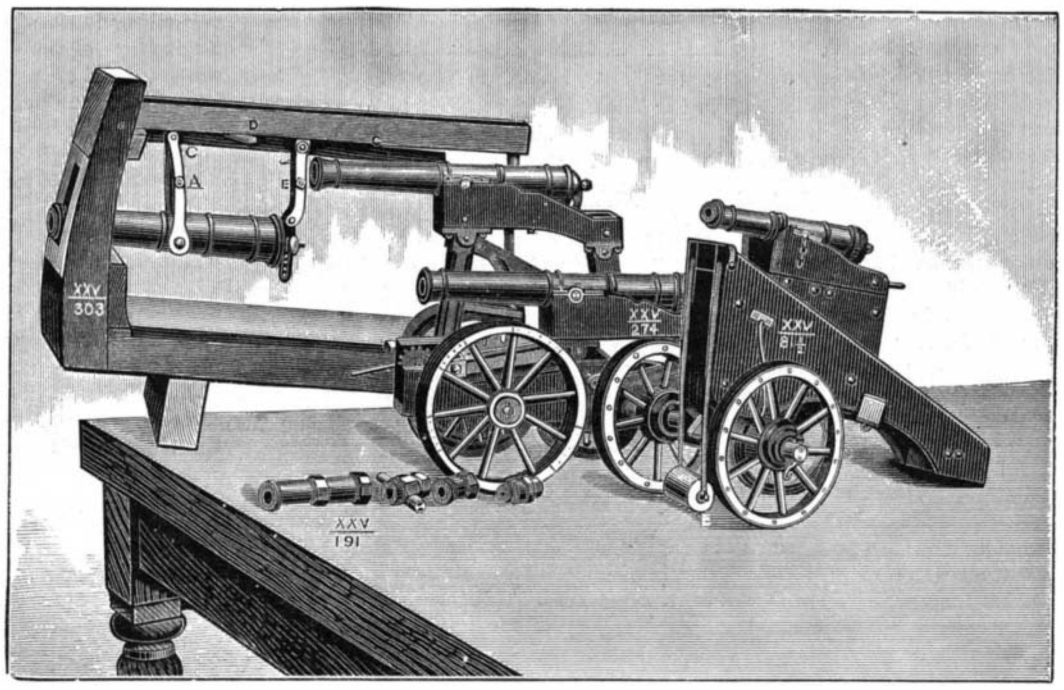


Fig. 5.--GROUP OF DESIGNS FOR CHECKING AND STORING UP FORCE OF RECOIL.

The French wall piece X/1, Fig. 2, is an ingenious double barreled one, loading at the breech. The date is about 1690. The barrels are rifled, being grooved with twelve rectangular grooves. Caliber, 1·45 inches; length of rifled portions of the barrels, 7 feet 8·8 inches; length of unrifled portion—for the charge cylinders, 9·25 inches; total length of piece, 8 feet 8 inches. The breech bolt carries the motto of Louis XIV. The year 1690 is an early date for a rifle; but there is an earlier specimen, namely, a barrel taken from Hungarian insurgents in 1848, with a date of manufacture on it of 1547.

The grooving is not visible at the muzzle, having been obliterated; but on removing the breech plug, six fine grooves, with a twist of 1 in 26, were discovered. It is thought improbable that a specimen of rifle of an earlier date than this can be found in any collection, Danner, of Nuremberg, having been commonly said to have perfected the rifle about 1552 A.D.

Our object, however, is to select the special features that have come in in modern times as new, and we would call attention to the group depicted in Fig. 4. The musket IX/9 is a breech-loader. The invention is ascribed to Marshal Vauban. Mr. Hewitt has shown from an English example in the Tower that this combination of flint lock and breech-loading was known in England in the time of James II. The feature we wish to point out is the interrupted screw, which forms so characteristic a point in the new

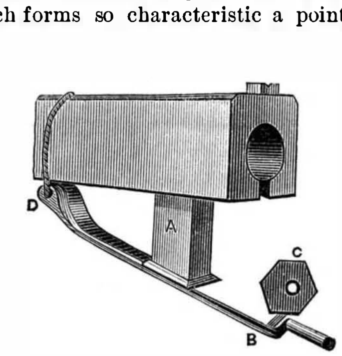


Fig. 3

French breech-loading guns and those adopted in our service during the last three years. The interrupted screw was on the front end of the breech block turned up. The corresponding interrupted thread was in the enlarged breech end of the barrel, A.

The barrel, B, with a portion of the stock, C, attached, was free to slip forward and backward through the collar, D, attached to the main portion of the stock, E.

To close the breech, the breech block is turned down, the barrel slid home on it, when turned round in the proper position for the interrupted threads to pass through the openings cut away. Then the barrel was turned so far round that the threads engaged and locked, the wood parts of the stock in that position coming fairly together.

This, then, was a very good, business-like breech action, in our opinion far better than many that competed about 1866. That date, however, naturally suggests to us the well-known Snider system of conversion. Now, we will ask our readers who are familiar with the Snider to look at IX/5, attributed to the time of Henry VIII., when we think they cannot fail to be struck with the identity in general idea of this breech-loader with the Snider.

The Snider offered the advantage of adaptation of hammer and lock to firing a central-fire cartridge, and of application of shoe containing breech block to barrel by tapping and screwing without any operation involving the heating of the barrel. These, as well as the sliding extractor, do not belong to this piece. Nevertheless, the resemblance of the general idea is remarkable.

Small-arm No. VIII/1, whose barrel is seen in cut, C, is comparatively a modern piece, having been proposed by Sergeant-Major Moore, R. A., in 1839. The arm is dated 1843. It is remarkable as having the hexagonal system of rifling recommended subsequently by Sir J. Whitworth. The twist is almost identical, being one turn in 29·5 inches, the caliber being 0·71 inch. This amounts to a spiral of one turn in forty-one calibers. The Whitworth rifle pattern, 1862, had a twist of one in 20 inches, with a diameter across angles of 0·49 inch, which amounts to a spiral of one turn in nearly 41 calibers. The combination of hexagonal rifling and spiral is, then, almost identical with that afterward proposed by Whitworth; but we have no sort of reason to question the originality of the latter.

If these two last are striking, what will be said of V/27, which is a six-chambered revolver pistol of the 17th century, with wheel lock? A casual observer might almost pass it as a Colt's revolver; diameter of bore, 0·35 inch; length of barrel, 14 inches. Among the small arms there are found examples of rifled arms, breech-loaders, and a six-chambered revolver. Can we complete the series by anything like the piece that is now finding its way into the equipments of nations—that is, a magazine arm? Such an arm is found in IX/22, which is seen in Fig. 4. It is a crude affair, the charges being inserted in succession in the magazine, B, probably with tight wads between them. Each charge occupies a given space with its own touch hole. The flint lock is made to slide along a guide bar. It is worked by a trigger in the stock; it is moved forward to fire the front charge, and drawn along to stops in positions fixed to enable it to fire the other charges, probably in rapid succession if everything went right, but this we should think seldom

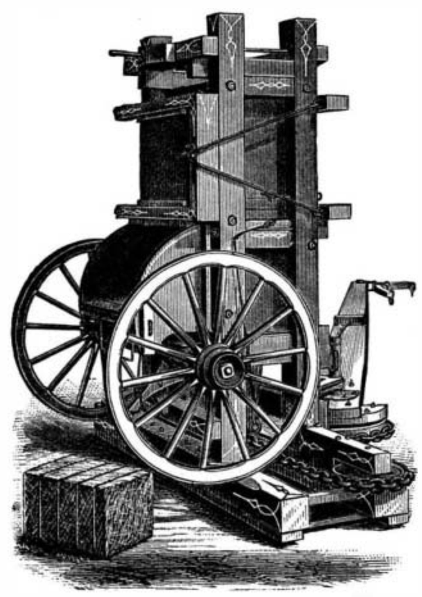
(*Continued on next page.*)

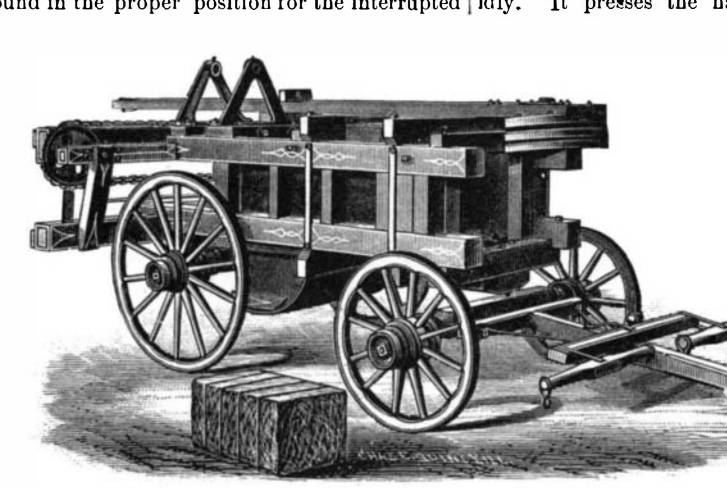
* "Mons Meg" in Edinburgh Castle belongs to this period. It is said to have been made in Mons, in Flanders, in the beginning of the fifteenth century. It was employed in the siege of Dumbarton Castle in 1489, and last fired in 1682, when it was injured.

PORTABLE HAY AND MOSS PRESS.

The engraving represents a new portable hay and moss press manufactured by the patentee, Mr. George Ertel, of Quincy, Ill. This press is of entirely new design, and is much lighter than other presses for the same purpose. It is small, compact, and works easily, turning out from five to seven tons of hay per day, one horse doing the work.

Being a double acting machine, it operates very rapidly. It presses the hay upward in separate charges, insuring freedom from dirt and gravel. The hay in the bale lies lengthwise and is bound up crosswise.





ERTEL'S PORTABLE HAY AND MOSS PRESS.

The average weight of bales turned out by this machine is 100 pounds, a convenient size easily handled. This press is mounted on four wheels, and arriving at the hay the sweep is taken down from the press, the nut on the king bolt taken off, and then the press is set up, swinging on the hind wheels, and as soon as sweep is placed it is ready for work. Two men and one boy, with one horse, can operate the press successfully.

The press is operated by an ingenious arrangement of toggle links acted on by a chain connected with a drum moved by the sweep to which the horse is hitched. The machine works both ways, so that whenever it moves it is doing its work. We understand that a number of these presses have been sold, all of them giving excellent satisfaction.

ANCIENT COUNTERPARTS TO MODERN INVENTIONS.

(*Continued from page* 403.)

happened. Other magazines were provided to replace the first when exhausted. In this arm, then, crude as it is, we have the idea of a magazine fairly carried out, though struggling with difficulties in mechanism.

Leaving arms, we will pass on to the question of mounting and working guns. Can we find an ancient inventor corresponding to Moncrieff? or can we find the hydraulic buffers, muzzle pivoting, or overbank arrangements that have latterly come into the service? or, again, guns carried in pieces and united by screwing together in lengths? Now we confess we can find no sign of hydraulics being known, but we can find the remaining ideas fairly represented. In Fig. 5 will be seen a design of Sir William Congreve's, $\frac{XXV}{303}$. The object is to deaden recoil and facilitate working. The gun is suspended on a system of jointed bars, A and B, attaching it to a directing bar, C C, which is pivoted nearly over the muzzle of the gun, traversing along the curved arc, whose end is seen at D. This offered the advantages of deadening recoil, of good direction, the gun coming back to the position in which it was last fired, and of a very narrow port. We admit that we wonder Sir William, having got so far, did not make his gun a breech-loader. It is to be observed that the weight of the gun would oppose a gradually increasing resistance to the recoil, on much the same principles as that of the Moncrieff counterweight. So ingenious is this design that we think it is quite open to question whether as a breech-loader it might not be made to succeed at the present day. The gun is not here brought under cover, nor is the work of recoil stored up; but these elements are found in $\frac{XXV}{81\frac{1}{2}}$, Fig. 5. Here a gun is made to descend a steep incline by recoil, in its descent lifting a counterweight, E, suspended in front of the carriage by ropes running over pulleys, which, if sufficiently heavy, would run up the gun when required into the firing position. It was intended evidently for siege train work, the lower carriage being a traveling one, and having wheels, of which the hinder pair are removed in the figure.

No. $\frac{XXV}{274}$ is a design for a pair of overbank carriages, the guns traveling on low carriages, but being raised by a jointed frame of bars to fire over a high parapet when required, and lower under cover after ceasing firing. No. $\frac{XXV}{191}$ is a gun made to be unscrewed into six pieces. We cannot furnish the date of the design. Probably it is older than any one's memory would take them, but not so old as the guns made to unscrew by the Turks in the middle ages.

We will not tire our readers by describing other things good and bad, such as a naval piece discharging seven barrels simultaneously, which is a very poor attempt at a machine gun, if it is one at all; a leather and copper gun, wound round with hempen cord, said to have belonged to Gustavus Adolphus; and "infernal machines" so called, which are awkward forms of machine guns. These things are generally better understood by actual inspection of the arms than by any description. The Rotunda Museum is a Government one, thrown open to the public free of charge. It is visited as a popular museum by many, but if Woolwich were not out of the way, it might be better known to scientific visitors. It certainly contains very interesting designs in war material. In the case of models, of course, we should bear in mind that we have before us only a model, and not necessarily a design that would answer its purpose when worked out, but this does not apply to the case of the arms themselves. We think that it is easy to satisfy ourselves in such a collection that men were as ingenious in designing destructive implements some centuries ago as at the present time. Progress, however, was, as we have said, mainly hampered by the imperfect development of machinery and difficulty of reproduction.—*The Engineer.*

Chemical Tests for Portland Cement.

With reference to tests for Portland cement, it is recommended that, in addition to the usual trials of strength, weight, and fineness, a chemical test for common adulterations should be made. In order to discern whether cement has been adulterated with blast furnace slag, 5 grammes of the suspected material are put into a glass vessel containing 50 grammes of dilute muriatic acid containing 1 part of pure acid to 4 parts of water. The mixture should be well stirred with a glass rod. Pure cement is not rendered turbid by this treatment, but imparts a yellowish color to the solution. If, on the contrary, the liquid turns milky, from the presence of sulphur in suspension, while at the same time the yellowish tinge disappears and a strong smell of sulphureted hydrogen becomes perceptible, this is an indication that cinders have been added. The presence of ground limestone or chalk may be detected in a similar manner by the occurrence of ebullition at the time when the liquid acid is added to the cement. The quantity of added material may be approximately found by the degree of ebullition. Pure Portland cement does not effervesce upon the addition of acid, because it does not contain carbonate of lime, but is chiefly composed of lime, silicia, alumina, oxide of iron, magnesia, sulphuric acid, and water. The proportions of these ingredients vary in samples from different localities; but lime is always about 60 per cent of the whole, the remainder occurring in the order stated above. Sulphate of lime should not exceed 1 per cent; but the greatest value is attached, especially in Germany, to the presence of magnesia. English or French cements seldom contain 1 per cent of this substance; but the proportion rises to 3 per cent in some German cements. Perhaps the most essential points to be regarded in the manufacture of cement, apart from the question of chemical composition, are uniformity of mixing and burning and fine grinding, without which the material is valueless.

Straight Tread Car Wheels.

The Griffin Car Wheel Company, of Detroit, Mich., have been for the past three months turning out 150 wheels per day, of all kinds and diameters, with straight or coneless tread, on orders from railway companies, so that their economy and practicability is in a fair way to be tested. All the wheels of these patterns are cast so as to measure when cast the full size by which they are designated; that is, a 33-inch wheel measures exactly 33 inches in diameter on the tread line. It is a fact not generally known, that most 33-inch wheels are so only in name, ranging from 32 inches upward in diameter; other sizes in the same proportion. All of these new pattern wheels are made especially heavy with a view to meeting the increased demand for strength consequent on the heavy loading of freight cars. The outside inch of the edge of the tread is beveled or coned off one-eighth inch in the chill, so as to prevent the chipping off of the tread when passing over frogs, etc. This has been partially done heretofore on some makers' wheels in rounding off the corner of the tread, also in casting the outer edge of the tread in sand. The latter idea, however, is objectionable from the fact that the sand is liable to allow lumps and swells to form in the very place where it is most necessary to avoid them. In the coneless wheels referred to, the chill in which the wheels are cast is turned out so as to produce the bevel on the outer edge of the tread, in the chill, thus presenting a smooth, even finish, and absolutely preventing anything in the shape of a swelling or lump on the tread. The total output of the Griffin Car Wheel Company, and the Griffin & Wells Foundry Company, of Chicago, is 450 wheels daily, the greater part of which is being disposed of to railway companies for their monthly requirements. They are increasing this output, as it is not sufficient to keep pace with their orders.

How Some Old Walls in Rome Were Made.

On the west side of the Piazza Vittorio Emmanuele, where large houses are being built by Signor Marotti & Co., a peculiar wall has been found. It gave us some two hundred pieces of marble bodies. As far as I can judge, they belong to four statues, but a great many fragments have not yet been classified. One of the statues, of colossal size, seems to represent an athlete of the Greek-Roman school brought to such perfection under Hadrian. Another represents a female figure, perhaps a Faustina. There are, besides, lovely busts of Hadrian, of Antinous, and others. It is difficult to state at what period these works of art were turned into building materials. Perhaps they met their fate in the Middle Ages, although I should not wonder if such things had happened before the fall of the Empire. Here is an example of statues walled up under Aurelian: A new gate is being bored through the walls of the city to afford a direct communication between the Esquiline and Saint Lorenzo fuori le Muri. Between the third and the fourth tower south of the old gate, the walls, ten feet thick, are patched up in the following way: the outside face is of brickwork of the time of Aurelian; the inside face belongs to an earlier building, of which Aurelian took advantage, as it fell exactly on the line of his projected ramparts. It is an inclosure or foundation-wall of a garden, handsomely ornamented with a rustic kind of mosaic made of shells, colored stones, and pieces of enamel, such as are often seen in Roman nymphæa and fountains. The wall had rows of nitches for statues. Three niches have been found in cutting the new gate, and in front of each one the corresponding statue lay imbedded in the nucleus of the wall. One represents a sitting Venus, of no artistic value; the second and the third represent fighting fauns, bright and spirited in their attitude, well chiseled, and beautifully preserved.—*The Athenæum.*

Typhoid Fever and Malarial Waves and Their Relation.

In a recent monthly report, the Secretary of the State Board of Health of Connecticut gives statistics showing an increase in typhoid fever, and comments upon its relation to malaria as follows:

"This return of typhoid fever to prominence, and its steady increase in frequency for the last three years, is apparently a part of an extensive and comprehensive movement. As the epidemic of malaria was ushered in by a decrease, and in places almost, if not quite, a total disappearance of typhoid, this return of typhoid fever to its former importance and relative frequency is an intimation of the decrease and disappearance of malaria. The tendency toward typhoid fever commenced several years ago, and has steadily grown stronger each year, as shown by the increased prevalence, tendency to unusual frequency and severity, and the increase each year of deaths from this cause. As the decrease in the frequency of typhoid preceded the malarial wave, so its increase precedes the entire disappearance of malaria, or at least gives us some ground for hope that such a disappearance will take place. This disappearance of epidemics of malarial fever on a large scale has often been followed by an unusual prevalence of typhoid fever or an extensive epidemic. The epidemics of malarial fever of 1807 and 1824, which are stated to have extended over all Europe, were followed by typhoid fever." The writer thinks that the spread of malarial fevers over Connecticut, Massachusetts, and Rhode Island has ceased.

Tests for Lubricating Oils.

It is stated that a good test for lubricating oils is to place single drops of the different kinds to be compared in line across the end of a piece of plate glass about twenty-four inches long, one end being six or eight inches higher than the other, to form an inclined plane. The drops of oil run down this smooth plane in a race with each other. The quality of the oils for lubricating purposes is shown by the distances traveled and the trace left by the drops. Thus, on the first day sperm oil will be found in the rear; but it will in time overtake the rest, and retain its power of motion after most other oils have dried up. A light-bodied oil flows quickly, like water, but also dries quickly, whereas what is needed is a good body combined with a limpid flow. Many oils have a good body, but have a tendency to gum; and this will be distinctly shown upon the glass. It is scarcely necessary to remark that the test slip should be covered from dust while the experiment is being made. The above method will show the physical qualities of different descriptions of oil; but if the presence of acid is to be detected, another simple device may be adopted. In a sheet of bright copper a number of shallow pits are made by the blow of a round-faced hammer. Samples of oil left some days in these dishes on a shelf in the engine-room will show, by the formation of verdigris, where acid is present. The existence of a blue tinge of fluorescence in a glass phial of oil is frequently assumed to indicate the presence of mineral oil; but this is an illusory test, since the same effect is frequently observed in the purest and freshest vegetable oils.

Pure Carbon for the Electric Light.

The manufacture of carbons free from ash can be accomplished, according to Jacquelain in *Comptes Rendus* (xciv. 837), by passing dry chlorine gas over pulverized coal or coke heated to bright redness. All of the silica, alumina, and magnesia, as well as alkalies and metallic oxides, would be converted into volatile chlorides and expelled; even the hydrogen is driven off as hydrochloric acid.

The easiest method of carrying out the process on a large scale is to allow the dry chlorine gas to act upon gas carbon (from the retorts) cut into thin prisms for thirty hours, and then raise the temperature to a bright white heat. This makes the carbon porous, and in order to convert into a dense, heavy carbon which is a good conductor and not easily combustible, the vapors of heavy tar oils (dead oil?) are passed slowly over these pieces of glowing carbon, when a deposition of carbon will take place within the pores of the coke.

If the carbon rods are treated with fused sodic hydrate (caustic soda), the silica and alumina will be dissolved as sodic silicate and aluminate, and can be removed by washing with hot water. Oxide of iron and other constituents of the ash are removed with hydrochloric acid followed by pure water.

The simplest process recommended by Jacquelain is to leave them for two or four days in dilute hydrofluoric acid, at ordinary temperature, then wash well and expose for a few hours to a slow current of tar vapors at a high temperature.

Fastest Two Miles ever Trotted.

Two years ago the brown mare Manetta, hooked double to road wagon with the running horse Longman, brother in blood to the great Longfellow, trotted two miles on Mr. Bonner's three-quarter track in 4:35—the first mile in 2:20 and the second in 2:15. Saturday, November 11, hooked to the same wagon (which weighs 155 pounds and has a high dashboard to oppose the wind), she trotted, with Longman as running mate and John Murphy driving, two miles in the extraordinary time of 4:27¼—the first mile in 2:14½ and the second in 2:12¾. The mare did not wear breeching, and therefore, outside of his taking the major part of the weight, she received no assistance from Longman. The track was a trifle dull and slippery. As the two miles are the fastest ever trotted, we give the fractional time:

First Mile.	Second Mile.	Aggregate.
0:34¼	0:34¼	2:48¾
1:07¾	1:08	3:22½
1:41½	1:40	3:47½
2:14½	2:12¾	4:27¼

The first quarter of the second mile, it will be observed, was trotted in 0:34¼, the second quarter in 0:33¼, the third quarter in 0:32, and the fourth quarter in 0:32¾. The last half mile was done in 1:04¾. The pace increased as the distance lengthened. Manetta is ten years old, and by Woodford Bambrino out of Malmaison, by Alexander's Abdallah, sire of Goldsmith Maid. She has trotted a mile to sulky in 1:16¾.—*Turf, Field, and Farm.*

The "Plateway."

The Liverpool correspondent of the London *Times* gives the following account of a new engineering project, designated "The Lancashire Plateway," which aims at nothing less than the complete revolutionizing of the inland transit of merchandise. The introductory step is to raise a fund of £75,000 for surveys, preliminary expenses, and parliamentary charges; and more than half this amount is said already to have been subscribed. Broadly, the proposal is to lay out a series of roadways, radiating from Liverpool to the centers of manufacturing industry in South Lancashire, to carry along these roadways a double set of iron plates, corresponding in breadth with the wheels of ordinary lorries or wagons, to set the loaded wagons on this smooth plateway, and draw them by steam traction engines to their appointed destination. Passenger traffic is excluded from the scope of the scheme; it is confined entirely to goods, and the anticipation is that it will be possible to carry these at a much lower rate than is now charged by the railway companies. The movement has its origin and motive in the burdensome charges now levied.

The common impression is that railways have both cheapened and accelerated traffic; but such has not been the experience on the main route of South Lancashire. It may appear to be rather a startling fact, yet it is distinctly affirmed that the present cost of sending a bale of cotton from Liverpool to Manchester, by railway, is actually greater than was charged before railways were constructed, and when the conveyance was by canal, or by horse haulage along the highway. Nor is the speed materially quickened. In the old days the journey was completed over night, so that goods dispatched in the evening were delivered early next day; and the railways now do nothing better than this. The loss of time occurs in the handling of the goods at either terminus, and the frequent transshipment they must undergo before being delivered. In the same way, a very large proportion of the expense of railway transit arises from the "terminal" charges—that is, the labor and trouble of loading and unloading the wagons, and marshaling the trains ready for dispatch at the one end and for delivery at the other. The plateway proposes to supersede these terminal charges altogether, and to dispense with the intermediate handling of the goods, as well as to reduce haulage cost to a point far below anything that the railways can compete with. To understand the character of the change, it may be well to explain the railway system as it now exists, and then to compare it with the plateway system as intended to be established. Take the progress of a bale of cotton from the ship to the mill, as an illustration of the prevailing practice. It is lifted out of the ship's hold, deposited on the quay, again lifted on to a cart, and taken either to a warehouse or the railway station. Arrived at the station, it is once more unloaded from the cart, accumulated in convenient piles in the depot, and finally placed on the railway truck, which, after a long succession of shuntings, is marshaled into its proper train, and is then ready to begin its journey to Manchester. At that end an almost similar process has to be gone through.

The process of the plateway will be infinitely simpler, and, therefore, proportionately cheaper. The bale will be loaded on to the appointed wagon at the ship's side or at the warehouse door, the wagon will be drawn by horses to the nearest station of the Plateway Company, it will be linked on to a long train of other similar wagons, a steam traction engine will be placed at the head of the train, and it will haul the whole train of vehicles along the smooth plateway to the appointed destination. At the further end of the plateway, the traction engine will be disconnected, horses will be yoked to the wagons, and they will at once be drawn to the mill yard. By this treatment all the labor and expense of transshipments will be obviated. The same vehicle that receives the cotton at the Liverpool dock or warehouse will deliver it into the mill without any intermediate handling. This will be a palpable economy. In the case of manufactured goods it will also be a great advantage in the avoidance of the damage now inseparable from rough usage on the railway. But the dispensing with frequent handling is not the sole element of economy. It is proposed to carry the plateway into the outskirts of all the principal manufacturing towns of South Lancashire; at each there will be a stud of horses to take up the work, and thus the plateway wagons will be drawn into each mill yard without loss of time or cumulative charges.

Having now explained the theory of the plateway, it is necessary to see how it is to be applied in practice. Its fundamental principle is that the goods shall never be unloaded or shifted from the wagons in which they are placed from the beginning of the journey until they reach their final destination. If a bale of cotton is loaded at Liverpool, it shall remain in the same condition until it is delivered into the mill at Oldham or Blackburn; if a bale of manufactured goods is sent from these towns for shipment abroad, it shall remain similarly undisturbed until lifted into the ship's hold in Liverpool. This result is to be attained by a very simple process. The wagons or lorries will be similar in construction to those now universally used in Lancashire; the only difference will be in their wheels. The front and rear axles will be of identical width, and of the same gauge as the plate way, but in all other respects the vehicles will be suitable to ordinary roadwork. The plateway will consist of two parallel rows of metals running along the prepared highway. The metals or plates will be about five inches in depth, and along the smooth surface the wagon wheels will run with ease and freedom. On the outer edge of the plates will be a raised flange, strong enough and high enough to prevent the train from leaving the track. In fact, the accustomed railway track is simply reversed. There the rail is flat, and the retaining flange is placed on the wheel; in the plateway the rail or plate carries the flange, and the wheel is flat. The original idea of the promoters was to utilize the ordinary highways for this system of goods traffic, but insuperable difficulties presented themselves, and it is now proposed to acquire land and lay down a special track for the plateway, similar in all respects to the ordinary railways. There will be no necessity, however, to make the permanent way of so substantial construction, or to have the levels so exact as in the case of railways. Although the estimates are still in a very crude form, it is calculated that the plateway can be constructed and equipped at an average cost of £35,000 per mile; if so, the capital will be insignificant in comparison with that embarked on the railways in the same district. This greater cheapness will allow of lower charges, and another substantial gain will be in the smaller working charges. As there will be no passenger traffic, and as the rate of speed for the trains will be comparatively slow, there will be little or no expense in signaling, and the road staff will be slight. The enormous expense of establishing stations in the center of all the large towns (as in the case of railways) will also be avoided, because the depot may be located in the outskirts. This arrangement will only necessitate the haulage of horses for a little greater distance, and will constitute no appreciable addition to the expense of working.

The scheme, as mapped out by the projectors, covers a large portion of the busiest manufacturing districts of Lancashire. The present proposal is to lay down 133½ miles of plateway, at a rough estimate costing about four and a half millions of money. There are two main routes, one starting from the south end of Liverpool, and running to Oldham *via* Warrington, touching the south side of Manchester, and taking in Ashton and Staleybridge. The other route starts from the north end of Liverpool, touching St. Helen's, Ashton-in-Makerfield, Bolton, Bury, Heywood, and Rochdale and, like the other line, terminating at Oldham. There will also be subsidiary lines leaving the main road at convenient points, and branching off to Burnley in one direction and Preston in another. It will thus be seen that some of the principal manufacturing centers of Lancashire are tapped by the plateway, and brought into direct communication with Liverpool. As regards the traffic that now passes between these several points, it is almost impossible to obtain trustworthy statistics. But some idea of the magnitude of the goods traffic of the district may be formed from the fact that every day about 35,000 tons of goods pass through Liverpool; and, unquestionably, a very considerable proportion of it originates with the districts proposed to be served by the plateway. Those who have taken up the subject are confident not only that the scheme is practicable as an engineering work, but hopeful of success as a commercial adventure. This confidence certainly displays itself in a practical form when the preliminary surveys have been completed, a bill drawn for introduction into Parliament next session, and a large guarantee fund already subscribed, not by a speculating syndicate, but by men of the highest repute in the commercial world. The originator of the project is Mr. Alfred Holt, of Liverpool, who, besides being a large owner of steamers trading to India and China, is also a trained civil engineer. He has been working at the project assiduously for two years.

Through the St. Gothard Tunnel by Locomotive.

A correspondent of the *Engineer* writes as follows:

At 10 A.M. we steamed out of the station at Göschenen; at 10 hours 2 minutes we passed under the arch of the tunnel, and at 10 hours 28 minutes we emerged from the corresponding arch into the daylight at Airolo. We were thus twenty-six minutes in traversing the tunnel, and as the length is about nine and a quarter miles, this gives an average speed of about twenty-one miles an hour. As a matter of fact, however, the first part of our journey was performed at a considerably higher and the latter at a considerably lower speed, and that for a somewhat curious reason. It was due to the particular state of ventilation of the tunnel at that particular time. My readers will probably remember the immense difficulties which were encountered in maintaining proper ventilation in the tunnel during its construction, and the many prophecies of equal difficulty to be experienced whenever it became the channel of any considerable traffic. So much did these fears weigh even on the managers of the undertaking, that schemes were mooted for carrying bags of oxygen to supply the driver's with the means of respiration, and designs for working by electric locomotives were seriously entertained. When, however, the matter was put to the test, the difficulty vanished. It was found that at all times there is a difference in the height of the barometer at one side and the other of the great chain of the Alps; the corresponding difference in pressure forms a head of air always acting on one end or other of the great tunnel, and there is therefore a continual current of air through it in one direction or the other, exactly as there would always be a current of water through a pipe connecting two reservoirs with unequal head. This natural ventilation is found more than sufficient for the present traffic of between twenty and thirty trains per day, and there seems no fear that it will ever need to be supplemented. On the particular occasion of my visit the barometer apparently stood higher at the north, or Swiss, portal, by which we entered. Consequently, we were bringing, as it were, the fresh air with us; and certainly for the first half of our journey it was to us on the engine not perceptibly fouler, though somewhat warmer, than the damp and chilly atmosphere of a wet morning at Göschenen. Those in the train had, of course, the benefit of the smoke and gases from our engine, but this was not so bad but that windows could be kept open without special annoyance. The tunnel is guarded by means of brilliant lamps placed at each kilometer, and signaling white for safety and green for danger; and during this first half of the journey I was able, after passing each of them, not only to see the next, but also the next but one, shining like a star of the sixth magnitude just above one of the first. It is obvious that if a light can be seen at 2,200 yards distance, the atmosphere must be more than moderately clear. But after we had reached the summit level, and began to descend toward Airolo, things became different. The atmosphere got thicker and thicker, and soon assumed the character of a white mist, which was vaguely lighted up by the head lamp, and through which the signal lights only became visible when some 200 yards away. At the same time it must be observed that the air, though warm and heavy, was in no appreciable degree sulphurous or choking. In fact, to a Londoner, accustomed to face without shrinking the passage of the "Underground" from Westminster to the City, or from King's Cross to Paddington, the idea of any unpleasantness in the St. Gothard tunnel would have rather the appearance of a joke. The thickness of the mist is, however, somewhat more serious, and it seems open to question whether some species of audible signal might not be substituted with advantage for the lamp. As it was, our driver shut off steam, screwed the brakes on slightly, and went cautiously down the gentle incline at about ten miles an hour. It was as well that he did so, for one of the lamps, when at last we did see it, proved to show green; the brakes were applied and the train nearly pulled up, and we crept at a foot's pace past a gang of laborers engaged apparently in plate-laying. It is in this way that the mean speed of twenty-one miles an hour, at which we traversed the tunnel, is accounted for. If a different system of signaling could be devised, there seems no reason why the speed should not be at least thirty miles an hour, and the transit would then occupy from fifteen to twenty minutes only.

Tungsten Bronzes.

In the arts, tungsten bronzes of different colors are used, namely, golden-yellow, reddish-yellow, purple-red, and blue. The first two crystallize in forms resembling cubes, while the third is obtained partially in cubes and partially in amorphous pieces, and the last named forms prismatic crystals. Other circumstances being equal, the yellow bronze is obtained from mixtures poor in acid, the other two from those containing more acid. But the color is dependent not merely on the composition of the tungstate of soda salt, but also on the amount of tin and on the duration of the fusion, so that when much tin is used and the fusion long prolonged a yellow bronze is obtained from a very acid mixture, and, on the contrary, a salt that is but slightly acid, when fused only a short time and with very little tin, may yield a red or even a blue bronze.

A mixture of two molecules of tungstate of soda and one of anhydrous tungstic acid, with tinfoil slowly added, and kept melted for one or two hours, will yield cubes one half centimeter long (one fifth inch) when 100 grammes (about 4 ounces) are melted, and they will produce a yellow or reddish-yellow bronze, the powder of which seems light brown, and when stirred up with water it imparts to the liquid the property of appearing of a fine blue color by transmitted light.

The red bronze obtained from 10 parts of carbonate of soda, 70 parts of tungstate of soda, and 20 parts of tinfoil yields, on pulverization, a powder that, stirred up in water, transmits green light.

According to J. Philipp, a blue bronze is always obtained if the fused mixture contains more than three molecules of tungstic acid to one molecule of soda; if the fused product is boiled alternately with muriatic acid and with carbonate of soda, the result will be a considerable quantity of fine blue prismatic crystals, with which there are intermixed, in most cases, single red and yellow cubes.

Moreover, all the tungsten bronzes obtained by fusion with tin can also be prepared by electrolysis of fused acid tungstates, but the yield is so small that it is unprofitable.—*Ind. Zeitung.*

The First Telephone.

At a recent meeting of the London Physical Society, Prof. Thomson exhibited an early Reis's telephone made by Phillip Reis, in 1861, at Frankfort, and designed to transmit speech. It was modeled on the human ear, one form of transmitter being a rudely carved wooden ear with a tympan, having a platinum wire behind hard pressed against a platinum-tipped adjustable spring. Prof. Thomson showed by various proofs that words were actually sent by that and similar apparatus.

A Large Refrigerator.

The Quincy Market Cold Storage Company, of Boston, are said to have the largest refrigerating building in the world. It is of stone and brick, 160 by 80 feet in size, and 70 feet in height. The capacity is 800 000 cubic feet, the cost $200,000, and the ice chamber holds 600,000 tons of ice. It will be used for storing dressed beef and mutton. The Chicago refrigerating cars unload at the door.