the cylinder again in passing through the second valve arranged for the purpose.

A hydraulic gauge, placed at the side of the cylinder, permits of regulating the pressure by acting upon the spring of the exhaust valve. The compression is effected within three distinct periods: in the first, the upper compressor acts alone; in the second, the lower one rises until the pressure is equal upon both surfaces; in the third, when the limit of pressure is reached, the piston continues its motion in the hydraulic cylinder until the dead center of the crank is passed.

The moulds are emptied upon a tilting table or endless belt, or even directly upon the floor in cases where carts can be driven into the works.

The table carries from 12 to 14 moulds, which are so arranged as to give the bricks a form such that their height and breadth are half their length. They can then be piled up crosswise, so that four of them form a perfect cube and waste no space. There are four styles of double compression presses that yield bricks of 1, 2, 5, and 10 kilogrammes, and manufacture, respectively, 18, 50, 90, and 150 tons of bricks per day.

This system of double compression presents numerous advantages, the most important of which is the greater degree of homogeneousness, and consequently greater solidity, obtained. In the old machines, the density of the bricks, as a consequence of the friction of the coal against the moulds, continued to diminish from the surface in contact with the compressing cylinder to the one most distant from it. With double compression, the least dense part is found in the center; the edges are entire and sharp, and waste is, through this fact, notably diminished.

The paste for manufacturing the bricks was formerly prepared by means of a steam pug mill; but this is now replaced by a special furnace that heats directly and has a revolving sole. The apparatus may be seen in the center of Fig. 2. The paste consists of a mixture of coal and pitch, that must be as intimate as possible in order that its agglomeration may be afterward effected in the press.

The furnace is circular in shape, and consists of a revolving cast iron platform whose motion is dependent upon that of the agglomerating machine. This platform is surrounded with masonry, which is inclosed within an iron plate jacket, and which supports a spherical dome that is traversed in its center by a cylinder that carries an axle provided with paddles. It is into this cylinder that is emptied the mixture to be prepared. A lateral fireplace, with two opposite doors, permits of obtaining the heat necessary for the elimination of the water, for heating the coal, and for melting the pitch. The flames, after licking the upper surface of the mixture, heat the dome (which reflects them), pass beneath the sole, opposite the fireplace, and from thence, through a flue, to the chimney. In the circumference of the furnace jacket there are six apertures. The first four of these serve for the introduction of scrapers that turn over the material, and mix it up, so as to permit it to become heated uniformly and to present all its parts to the flames and the sole. Opposite the fifth aperture there are two bars, one fixed and the other movable, which, through the aid of hinged partitions that may be inclined more or less, gradually carry the material from the center to the circumference, while at the same time turning it over and stirring it up just as the scrapers do. Another object of this arrangement is to regulate the thickness of the layer, and, consequently, the time during which the mixture remains upon the sole.

Another scraper, maneuvered by means of a rod exterior to the furnace, acts upon the material in the center, moves it to the zone of action of the preceding ones, and regulates the delivery. The sixth aperture serves for the exit of the properly heated paste.

The furnace, as a whole, is built upon masonry that contains an opening for the passage of the shaft and for the gearings that actuate the sole.

The revolving sole furnace operates continuously, as does the agglomerating press. The coal is well dried therein, an essential condition for obtaining a good product; and the temperature to which it is submitted softens it a little and increases its agglutinative properties, this being followed by a considerable saving in pitch.

The engraving that gives a general view permits one to obtain an exact idea of the mode of manufacture. The refuse and pitch, coming in on the right, pass through the breaking and proportioning apparatus, and the coal is then carried by chain and buckets to the sole of the furnace, to be dried, and the pitch to an endless screw, where it mixes with the dry and heated coal. The mixture thus begun in the endless screw becomes more intimate in the pug mill stationed above the press. The bricks, upon coming from the latter, are piled up, or are loaded on carts and carried away.—*La Nature.*

IN small blasts, 1 pound of powder will loosen about $4\frac{1}{2}$ tons; in large blasts, 1 pound of powder will loosen about $2\frac{3}{4}$ tons. One man can bore, with a bit 1 inch in diameter, from 50 inches to 100 inches per day of 10 hours in granite, or 300 inches to 400 inches per day in limestone.

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IMPROVED METHODS.

So wedded are workmen, generally, to familiar methods that even a demonstration of a better way of doing a job is not always convincing. A sub-contractor in a machine shop took certain parts of the work on machine tools to do by the job. He was a stickler for old methods, and did not "take stock" in the kindly meant suggestions of the superintendent, who was disposed to aid him. At last, however, he yielded so far as to allow the superintendent to "fit up" for one job, with the understanding that if the output did not promise to pay, the contractor should bear no expense. The job was the finishing of "ball nuts," so called, nuts to be turned up by hand, and consisting of a central boss for the thread and two short arms ending in balls. The contractor's method was to center each end, drill centers, and turn and finish each ball in the lathe. Then the nut was chucked, and the central cylindrical portion was drilled and tapped. A threaded arbor was then fitted and mounted on centers, and properly dogged on the table of a crank planer or pillar shaper; and so the two sides of the nut and the arms were dressed by the reciprocating motion of the cutter. The arbor was then swung in a lathe, and the ends of the cylindrical threaded portion and the edges of the arms squared up. It will be seen that this was a roundabout way to complete a simple job; indeed, the machine work on the crank planer was slower than hand filing would have been.

The superintendent improved on these methods very sensibly. He chucked the piece, drilled the center hole, and tapped it. Before removing it from the chuck he finished, by turning, the face of the central portion and the edges of the arms. Then he screwed it in a threaded arbor, reversed ends, either in the same lathe or another, and repeated the turning for the other face. While still on the arbor, it was placed on centers on a milling machine, and passed under a gang of milling tools adapted to the profile of the cylindrical portion and the arms; the work was half revolved on the centers, and the job repeated. Nothing now was left to be done but finishing the balls. This was done in a peculiar way. On the two ends of a polishing spindle were mounted hollowed out emery wheels with rests in front. The piece was held, first one end or ball, and then the other, inside the concavity, and slowly turned. The ball was cleaned, scoured, and shaped in the wheel of coarse emery on one end of the spindle, and then was finished and polished in the finer wheel at the other end. In all this work there has been no centering, no lathe turning, no slow planing on the pillar shaper, and the amount of handling was greatly reduced from the old method. But the crucial test was the economic result: a saving of two-thirds of the time, and even more, for five completed pieces were turned out within the time required by the old method to complete three pieces. The contractor was convinced, and bought the plant.

This single specimen of improvement in methods might be supplemented by instances in the recollection, if not in the practice, of many mechanics. It pays to use wit and judgment, as well as skill and handy manipulation, in the conduct of work.

DROPPING AND STRIKING UP.

There has been great improvement on the old style machines for cutting and heading tacks and nails and forming rivets; the heading machine has been adapted to forging purposes with great advantage. But the limit of the machine is not great; a requisite to accurate work, unless with the result of great strain to the machine, and its final disabling, is that the amount of material fed in for working should be accurately measured. All the blows of the heading machine are absolute as to force and exact as to distance; they are made by means of a crank or an eccentric acting directly on the hammer, or by similar means acting on a knuckle or "toggle" joint; in either case there is no provision for yielding in the event of a superabundance of material to work upon; the material must give, or "get," or the machine must stop or break. So it is necessary that the feed of the heading machine shall be exact as well as accurate; it must not "bite off more than it can chew."

But the drop has plenty of leeway, limited only by the accommodation of the dies, and they are made so as to allow plenty of room for sprues, or overplus of metal. The force of the blow of the drop is graduated by the weight of the hammer and the distance through which it falls, the latter element being changed at will. The limit of the blow is simply the resistance of the material to be worked to the impact of the falling weight. This force varies in effect by the condition of the material; if soft and plastic, at nearly a white heat, it yields as readily as soft putty; if only dull red, it resists impact, and works hard. So, also, the quality of the material adapts itself to the blow of the drop.

From the above it is easy to see that the drop has a much larger range of useful work before it than the heading machine; the latter may work faster and be more exact in its first results; but the drop can be adapted to a much more varied list of articles. At all events, the heading machine can never usurp its place.

An Incident of the Late Philadelphia Exhibition.

A rather good practical joke was played on one of the exhibitors of the Philadelphia Electrical Exhibition by a representative of the SCIENTIFIC AMERICAN, who was making some sketches for publication. While this gentleman was putting the finishing touches on one of his drawings, his attention was directed to a crowd of sightseers, who were collected about one of the hand electrical machines where shocks were administered to the curious. Three or four would join hands, and after the "end men" had taken the poles of the battery in their hands, the operator would rotate the wheel and administer shocks of gradually increasing severity.

Occasionally curiosity would be excited in the breast of some innocent, and as soon as he had given himself up to the influence, the operator would generate ahigh current, taking advantage of his inability to let go of the handles, and would very soon have him dancing to any tune he was inclined to whistle.

This sport was very amusing to the spectators, and especially so to the showman. Our artist, after watching several experiments of the nature described, became filled with sympathy, and determined, if possible, to turn the ridicule to the other side of the table.

He soon provided himself with a piece of copper wire, which he passed down his sleeves under his coat, and which he made of such length as to terminate in the palms of his hands. Thus equipped he strolled leisurely to the center of interest, where he found a new subject dancing a Highland fling without any specialinvitation from anybody. As soon as the unfortunate had been released, our friend stepped before the instrument, and, muttering something about his being very fond of electricity, took hold of the handles, taking good care, however, that the ends of the wires should be brought in close contact with the poles in each hand. Thus prepared, he bade the tormenter begin. The wheel began slowly to revolve, and a good current was very soon indicated, but our hero stood it like a Spartan, and showed no signs of discomposure. The greater the current, the more he seemed to like it. The spectators could hardly believe their eyes, and the operator's amazement and anger could only find vent on the poor wheel, now flying at its fullest speed and generating a current strong enough to kill any man. An occasional voluntary shake of the arms on the part of Mr. Artist further increased the deception. Finally the latter requested to be released, whereupon Mr. Showman stopped the wheel and accused him of holding insulators in his hand, which he quickly disproved by opening his palms and raising his arms, which latter act served to pull the wire out of sight under his sleeve. He then turned on his heel, and as he approached the gaping crowd was received with that absence of elbowing which might characterize the reception of an uninvited visitor from the nethermost world.

How Shot are Made.

Every person who has walked about the lower part of this city, says the New York *Tribune*, must have noticed a high round tower, as high as the roadway of the Bridge, which rears itself high above the surrounding buildings and has small windows at different places. This tower is in Center Street near Worth Street, and belongs to the Colwell Lead Company. There are several of these towers in this city. They are places built especially for the casting and manufacture of shot. The tower rises to a height of 176 feet, and is fifty feet in diameter at the base. It diminishes in diameter as it ascends, being about thirty feet across at the top. It is divided into several stories. A circular stairway made of iron extends to the summit, giving access to the several stories. Great height is essential for casting, as the lead must cool in the descent, and thus assume a spherical shape. If hot, it would flatten when it strikes the water into which it falls.

The first method is makingwhat is called "temper." This is a mixture of arsenic and lead. The mixture is melted in large kettles, and is constantly skimmed and stirred. It is cast in bars, the same as lead. When the temper is made it is carried to the top floor, where there are kettles and a furnace for melting it. The temper is mixed with the lead, as pure lead would assume various shapes in casting; but when mixed with the temper in the proportion of three tons of lead to one ton of temper, it takes the shape of globules when it is cast.

The casting pans are large colanders, round pans with holes perforated in the bottom. The casting is all done on the top floor, and the colander is suspended over an opening in the floor, which goes through the entire height of the building to the ground, where there is a well of water. The lead is melted in large kettles, and is dipped out and poured into the colander with ladles which have long handles. It oozes through the holes in the bottom of the colander, and falls through the opening to the ground floor into the well. The shot is taken out of the well by small buckets fastened to an endless belt, which runs over a wheel, which carries it from the well up to a long hot metal table. Here the shot is constantly stirred by men with long rakes, and the heat rapidly dispels the moisture, and the shot soon becomes perfectly dry.

It is taken from the "drying table" to the "screeners," a series of tables with narrow openings between them, the tables being set at a slight angle. If the shot is round and perfect, it rolls rapidly along these tables, skipping the openings, until it reaches a box at the extreme end, into which it falls. If it is imperfect, it cannot roll fast, and falls into the openings, under which boxes are placed.

The shot then goes to the "separators," which are a series of drawers, not unlike a bureau, which rocks backward and forward by machinery. The shot is poured into the upper drawer, which has an iron bottom perforated with holes of a certain size. The second drawer has holes of a smaller size, and so on down to the lowest drawer, the bottom of each drawer being perforated with holes of a size smaller than those in the drawer above it. The backward and forward motion throws the shot from side to side, letting all the shot the size of the holes or smaller pass through into the second drawer, while all larger than the holes remain in the drawer. The same is repeated down to the lowest drawer, so that each drawer contains a smaller size of shot than the one immediately above it.

The next process is "polishing." The shot is put into irregular shaped iron boxes, which continually revolve. When the box is nearly full, powdered black lead is put in. The irregular motion of the box throws the shot from side to side, and the black lead is so ground into it that it cannot be rubbed off. And it is this that gives it the beautiful shiny appearance.

Bolton Flagging.

Sixteen miles east of Hartford, Conn., in the town of Bolton, is a quarry of remarkable stone, not duplicated in its qualities by any other in this country. The stone is a micaceous slate, but is so thoroughly filled with mica that the slaty matrix is barely discernible by the eye. The best qualities of this stone are not affected by moisture and frosts, are not corroded by acids nor stained by oils, and a slab of it will bend perceptibly before it breaks. As a pavement, its durable quality is also remarkable; there are flags of it on a busy street in Hartford that have been trodden for more than fifty years, and are in good condition now. This stone is in great demand for floors and tables for chemical factories and laboratories, for hospitals, and in public buildings where constant cleanliness is a requisite. The area of these flags is limited; very seldom is one quarried with a superficies of two hundred square feet.

The quarries are in the mountains known locally as the "Bolton Range," and forming the eastern boundary of the Connecticut River valley. They are at an elevation of about 1,000 feet above the level of the Connecticut River, and are of considerable antiquity, having been worked continuously for more than sixty years. In 1820, flags of this stone were sent to Washington, Philadelphia, Baltimore, and to New Orleans. At the first, the quarrying was largely done by means of gunpowder; but this destroyed more than was gotten out in a marketable condition. Now gunpowder is used only to remove the superincumbent rock to make the ledge bare; all the slabs are taken out by the use of crowbar and wedge. The ledge has been traced for more than six miles, but much of it is valueless because of the cost of getting out the stone, the layers being at an angle, so that the surface rock may be reached in one place at a depth of less than six feet, but within one hundred feet surface distance it will be sixty feet below the soil. The rock is split into slabs only where natural divisions occur; some slabs may be only half an inch thick, while others are five inches, and as they are they must remain, for no chiseling can effect another division. Indeed, the only means of dressing the stone is by hammering, the edges being dressed in this way; the surfaces remain in their natural state, smooth and glistening. These natural divisions may be traced by the eye, sometimes entirely around a block, and where the minute crack appears, rows of thin iron wedges are inserted and gently forced in by hammers until one lamina can be lifted from the rest like the well-baked upper crust of a pie.

Compressed Air in Birmingham.

A very remarkable kind of public meeting was lately held in Birmingham—a meeting which seems at first glance to be without precedent. It was called by the promoters of the Birmingham Compressed Air Power Company, who have obtained an act of Parliament for the distribution, for manufacturing purposes, over a considerable area of the town of Birmingham, of air strongly compressed at a central station. The Town Council have accorded their moral support to the scheme, after receiving favorable reports from Sir F. J. Bramwell and Mr. Henry J. T. Piercy; and the object of calling the recent meeting was, says the *Journal of Gas Lighting*, to explain fully the nature and extent of the proposed undertaking to such of the inhabitants of the borough as might be interested in the scheme, either as future consumers or as investors.

The meeting seems to have been very successful in every way. Several experts spoke simply and practically in support of the scheme; and if an intelligent audience of power users—thoroughly alive to everything that might improve their pecuniary interests—cannot be got together in Birmingham, it is very difficult to imagine where such an assembly could be collected. Judging from the report of the proceedings, the scheme was thoroughly examined from every point of view, and unanimously approved of on grounds of economy, safety, and cleanliness. All that now remains, therefore, is for the company to get to work and prove that they can earn a dividend. This they are confident of being able to secure; and if their anticipations should be realized, there is no possible reason why the consequential public benefits which they promise to the town should not be forthcoming. It is a most interesting experiment, and will attract a great deal of attention from other manufacturing communities.

In New York and some other cities we distribute hot steam from a central station, the circulating pipes extending in the aggregate for many miles underground. There is no reason why compressed air should not be so conveyed, and thus furnish power to run elevators and engines, large and small.

Fireless Tramway Engines.

The system of tramway haulage by fireless locomotives has been tried on a very considerable scale in Batavia, and has given so much satisfaction that it is contemplated to extend it. The Batavia Steam Tramway Company, says *Engineering*, owns a line divided into two portions: the first, from Batavia to Kramat, having a length of 8 kilometers (5 miles) laid with a double track of Demerbe grooved rails, and the second from Kramat to Muster Cornelis, having a length of 4½ kilometers of single track of Vignolles rails. The first piece is almost level, with the exception of short inclines of 1 in 32 over bridges; there are two long curves and a number of short ones of 30 meters radius. The second section has a continuous gradient of 1 in 450. The haulage is effected by 21 fireless Lamm Francq locomotives and five stationary boilers, the whole of which were manufactured by the Hohenzollern Locomotive Works, Dusseldorf. Two of the boilers are situated at Batavia, and three at Kramat, but one only is in work at each station at a time, the remainder being in reserve.

They are worked 12 hours a day, and fill an engine every 1½ minutes during about three hours in the day, and every 10 minutes at other times. An engine charged to a pressure of 12 atmospheres (180 lb. per sq. inch) will draw two or three passenger cars from Batavia to Kramat, and from Kramat to Cornelis, up and down again to Kramat. Part of the line was opened in July, 1883, and from the last annual report it appears that the cost of haulage amounted last year to 23 cents per kilometer (7·4*d.* per mile), composed of the following items:

	Cents.
Driving engines	4·7
Heating boilers	2·3
Coals	14·0
Packing, lubricating, etc.	2·0
Total	23·0

(5 cents equal 1 penny.)

More recently the cost of haulage has been only 17 cents per kilo (5·24*d.* per mile), the price of coal being 2*l.* per ton. The consumption of fuel was at first 6 kilogrammes per kilometer (21·3 lb. per mile), but recently it has fallen to two-thirds of that amount. Repairs of boilers and engines have cost 2 cents per kilometer, and have consisted chiefly in returning the wheel tires and renewing the felt on the boilers. Since the road has been completed, the receipts per month have amounted to 22,800 florins, and the total expenditure to 12,800 florins, leaving a net monthly profit of 10,000 florins (800*l.*). The fare is 2½*d.* for a four mile run, or any part of it. The engines give every satis faction. They are in native hands, and run constantly, with little attention and no breakdowns. Two more have been ordered, and will be shipped from Amsterdam this month. It is believed that with a better road the expenses might be reduced to 50 per cent.

Professor William Wagner.

The founder of the Wagner Free Institute of Science in Philadelphia died at his home in the latter city Jan. 17, at the great age of 96 years. He was an apprentice of Stephen Girard, but in 1835 retired from business with an ample fortune, and turned his attention to scientific subjects, founding the institution which has since borne his name. In October last we called attention to the work that Prof. Wagner was doing for the promotion of the education of young people, and at that time it was thought that his gifts to the institute had amounted to $600,000, while his will now leaves all his property thereto. Prof. Wagner retained his faculties to the last, his death not being attributed to any special disease, but to the gradual wearing out of the vital powers.

RECENT excavations at Worms, Germany, brought to light about 1,300 feet of Roman pavement and a large number of objects of great interest, including some which afford a hint to manufacturers, namely, pieces for playing a game such as draughts, made of glass.