

human dwellings. Neither manager nor contractor consider it a duty or necessity to erect a roof to protect their workmen, so that they sleep in the open air in pleasant seasons, exposed to the damp dew; while in winter they sleep in the foul atmosphere in the mine itself, exposed to the dangers of being buried alive. In cases of sickness, the unfortunates have no assistance, and the families of those who die, or are killed, are exposed to the greatest misery. As regards education and moral instruction, the working classes are entirely neglected; there are no schools, savings banks, or associations for mutual aid. The consequence is that the society which grows up about the sulphur mines is in every respect an abandoned class, ripe for crime. The mines are a refuge for evil doers from the whole island.

The sulphur is prepared throughout Sicily by melting the stone in *calcaroni*, where the combustion of a portion of the sulphur furnishes the necessary heat to fuse the remainder. The liquid sulphur drips down to the bottom, and flows out into molds intended for its reception. In building a *calcarone*, a spot is selected at the side of a hill, and a cylindrical furnace built, from 20 to 40 feet in diameter, and a few yards in height. The walls are supported in the rear by the earth, and in front project in a semi-circular form. The hearth of the furnace has a double inclination, from the hill toward the front and from the sides toward the middle, so that the liquid sulphur collects in one place, and through a perforation in the inner wall it reaches the outlet. The bottom is pounded down hard like a threshing floor. The interior is filled with sulphur ore, the larger pieces being thrown in just as they are, and the smaller ones are formed into cakes, so that the melted sulphur will flow down through it more readily. When the cylinder has been filled, the pieces of sulphur ore are heaped up in a cone above the mason work, and covered with the burned pieces from a previous operation.

A *calcarone* will hold from 175 to 1,750 tons. In charging the furnace, several vertical flues are left open, which serve in part for kindling the fire, and in part to keep up the combustion at the beginning of the operation. The pile is ignited by throwing burning wood or bundles of straw down these openings. When the whole mass gets to burning, all the openings are closed; and the operation, which lasts from two to four weeks, according to size, is attentively watched, and the combustion controlled by the cover on the heap. The temperature is kept at a proper height, above 240° Fah., since sulphur melts at 240°, and remains a thin fluid up to a temperature of 320°. The melted sulphur is drawn off through a hole a foot wide and two feet high, in the front of the furnace, which is previously stopped with clay. The sulphur is run into wooden molds, the bottom and sides of which are moistened so that the sulphur cake will not adhere so tightly.

This method of obtaining sulphur is attended with a great deal of loss; experience shows that the highest yield of a *calcarone* is 70 per cent, although it does not usually exceed 50 per cent of the total amount of sulphur. The crude sulphur is worth from \$1 80 to \$2 per 225 lbs., so that the fuel consumed is worth at least twice as much as English coal would cost in Italy.

In producing sulphur in Sicily, only those resources to be found on the spot are made use of: no wood for framing, no machinery for raising the ore and water, no coal for smelting. Any one who would attempt to introduce any improvement in mining or reducing the sulphur would encounter great difficulty, arising chiefly from relations of proprietorship, and in the social status of the country. Legislation is the only help. Notwithstanding the immense store of natural sulphur on the island, it will be seriously impaired, by the progress in other countries which now make oil of vitriol from pyrites, unless some change is effected in the state of affairs.

#### THE FAIR OF THE AMERICAN INSTITUTE.

The American Institute Fair is proving remarkably successful, if we may judge from the large crowds which constantly throng the building. The display is unquestionably the best that has been made for many years; and since it includes a number of industrial processes carried on in presence of the visitors, it calls forth a much more lively interest than it would were it restricted to mere exhibition of completed products. At one portion of the hall, ivory turners are at work, making billiard balls and carving ornaments; at another a newspaper office is shown in full operation, from the editor vainly endeavoring to seize vagrant ideas—a difficult task, and one we should unhesitatingly decline under the circumstances, for we doubt if we could work with a bevy of bright-eyed damsels staring at us—to the finished sheets deftly piled by the swift-running press. There are tailors cutting out garments by machinery, brush makers manufacturing brushes of all kinds, scroll saws cutting out wooden ornaments and trinkets, engravers making illustrations similar to those in our pages, confectioners cooking candy, and even an old gentleman who cuts your profile likeness in black paper, and does it admirably too, in half a minute, for a small consideration. Up in the Art Department are large volumes, each leaf of which shows an application of one of the numerous tints imprinted on a well known chromo. By studying the pages the visitor can learn in a very short time just how the very handsome works of art which Mr. Prang exhibits are made, and how laborious the task must be.

There are a number of interesting shoemaking and leather-working machines in the main hall, and a superb display of leather. Hides tanned by the best American processes are brought in direct competition with those imported from Europe, and the special medals which are offered for excel-

lence have tended to heighten popular interest in the exhibition, apart from that excited by its partaking of the nature of an international contest. A new object of curiosity has been recently added in the shape of the winning boat of the Columbia crew at the Saratoga Regatta, last summer. It lays across the hall, gaily decorated with blue and white ribbons. The youngsters seem to be especially pleased with a variety of miniature steam machinery exhibited in operation. There is a steam fire engine which throws a needle-like stream for several yards, steam propellers which travel quite rapidly about a tank of water, and a small machine shop, including lathes, saws, etc., the tools all run by a tiny boiler. Mr. Hawkins, the Superintendent of Machinery, also aims at popularity among the children, for he has lately devoted his ingenious button mold machine to the manufacture of some queer games, which are very interesting, and beside has produced skipping ropes of a remarkable and hitherto unknown pattern.

The Fair as a whole is admirable, and the exhibitors have fairly outdone themselves in the elaborate and tasteful plans adopted in showing their contributions. The management is open to improvement, particularly with reference to allowing the woodworking people to howl their wares like country showmen, to the individual with the perfumery who squirts cold spray into peoples' ears or eyes, and in regard to that ugly drapery on the roof; and there are ridiculous advertisements which talk about "enormous fish" in that little fountain; but generally, however, we find a great deal to praise and very little to condemn.

A recent stroll through the Machinery Department has filled our note book with descriptions of a score or more novelties, some of which below described will doubtless prove interesting.

#### THE MACHINE TOOLS

of the New York Steam Engine Company are well worth critical examination. Many of them are in actual operation thus affording excellent opportunities for the mechanic to watch their practical employment. There is a chucking and turning lathe, by which a hole can be bored or chucked 20 inches in diameter; and by means of a new slide turning rest, a pulley can be turned, having a diameter of from 8 to 30 inches. This machine has a gap bed. In the upright drills there is a steel drilling spindle attached to a gibbed head which moves up and down with the spindle, giving the latter a very long bearing at every point. A number of machines which have been illustrated in our volumes are exhibited, notably a hand crank drill, a slotting machine, and a gear-molding machine. The shapers have their cutting bars placed on edge in adjustable guides. The vibration or spring of the tool is prevented by placing the widest section of the bars directly opposite the cut. The box-boring machine is arranged so that either of two bars may be used independently. A side rest is provided for each bar, and four boxes in each rest may be simultaneously operated upon. The 9 inch bending rolls exhibited are so constructed as to be kept in constant contact with the plate, and their springing at the centers is prevented. There are a number of other machines of which our limited space necessitates omitting mention.

#### THE BOILERS,

employed to supply steam to the main engines, are of the Howard safety type. Five tiers of tubes which incline upward to the rear are connected to vertical sections by boring small holes in the extremities of the tubes and allowing the cast metal of the sections to flow in, forming a perfectly solid joint. The parts of the vertical sections are bound together by stay rods passing through and set up with brass nuts; and the caps opposite the parts where the tubes enter are similarly attached by rods passing lengthwise through the tubes. Above the second tier is a fire brick diaphragm, in rear of which the heat passes and then encounters another diaphragm, above the third tier. The products of combustion are then conducted to the front of the boiler, whence they return to the uptake. The three lower tiers of tubes are for water and the upper ones for steam, the latter, through the disposition of the heat, becoming highly heated. There are three

#### CURIOSITIES IN THE MACHINE DEPARTMENT.

The first is a large tank provided with windows and filled with water. In this the Myers rotary engine is soon to rotate a good sized propeller, and brilliant lights are to be placed so as to shine down and through the water. This is an ingenious way of loading the engine and, besides, showing its adaptability to marine purposes. The tank, however, looks somewhat fragile; extra riveting might improve it.

Another application of the diamond to industrial use is found in the second of our trio of curiosities. It is

#### THE DIAMOND BAND SAW.

There is little in the construction of this machine, save perhaps its extra heaviness, differing from that of the ordinary woodworking tool. The blade, however, instead of being a single strip of metal, is a band covered with small straps of steel, the latter strung on the former, like beads. In certain straps the diamonds—borts or carbons—are secured so that three straps containing diamonds may come together, and then an interval to the next set occurs of some eight inches. There are of course other ways of arranging the diamonds, which need not here be described. The machine cuts a curve or scroll in stone as easily as the ordinary hand saw goes through wood. A certificate published by the inventor, Mr. Herbert Cottrell, of Newark, N. J., says that the blade cut through Newark brown stone, measuring 3 feet 2½ inches one way and 3 feet 3 inches the other, making a superficial surface of 1,501½ square inches, in 22 minutes time.

#### THE ICE CREAM MACHINE

of Messrs. Dixon and Tonstill is the last odd invention of the three. The prepared materials are dropped into a can arranged above like the oil reservoir of a bolt cutter. They flow through a tube into a horizontal cylinder which is placed in a tub and covered with ice and salt. Inside the cylinder is a helicoidal knife, which scrapes the edges and also forces out the frozen material through one end. Both cylinder and knife are rotated by simple gearing. It is quite curious to watch the material enter one part of the machine, and quickly emerge in a frozen condition from another, in the shape of excellent ice cream.

There are two

#### PIPE CUTTING AND THREADING MACHINES

which deserve notice. One is that of the Chase Manufacturing Company, illustrated on page 131 of our last volume. In this the pipe is held stationary in the vise, and passes through the center of a gear, the rotary motion of which is imparted to the die in the die box by means of guides, upon which the die box freely slides forward as the die passes upon the pipe. When cutting pipe, the tool post, with the cutter, has an automatic feed.

The manufacturers of the other machine are N. W. Frost & Co., of Cohoes N. Y. The apparatus is in three pieces, readily taken apart and put together. One portion forms an excellent vise; another is inserted above and carries the handle and a pinion; and the third is the gear wheel, in which the pinion engages, and which turns the dies and operates the feed. The machine does excellent and rapid work, and is very simple and strong in construction.

#### THE MAXIM AUTOMATIC PUMPING ENGINE

is a novelty recently added. It consists of a little steam boiler heated by gas, which warms and regulates its own feed and controls the fire. It runs a little pump, placed above, which is said to be capable of forcing from ten to twelve barrels per hour to a distance of one hundred feet, at a cost not over 6 cents.

#### New Camera Lucida for Drawing.

It is known that the construction of the *camera lucida* is founded upon the simultaneous perception of two images—that of the object and that of the pencil. Various means have been employed to arrive at this result. In that of Sömmering, it is a metallic mirror smaller than the pupil; that of Amici is constructed on the principle of reflection on a plate with parallel faces; that of Wollaston, at present most in use, consists in a prism, of which the edge, dividing the pupil in two parts, permits the object to be seen by the upper half, and simultaneously the pencil by the lower portion. In all these systems the fusion of the images is somewhat difficult to seize, especially for certain points of the reflected image. Govi, Professor of Physics at the Royal University at Rome, proposes to cover with a thin layer of gold the reflecting surface of a prism, and to apply upon this, with Canada balsam, a second prism with like angles. Although this layer of gold is sufficiently transparent to allow the luminous rays to pass, its power of reflection is considerable, and it gives images of great brightness. We have thus a perfect means of superimposing, without fatigue to the eye, two different images—the one direct, and the other reflected. The principle is the application of that property of thin plates—metallic or otherwise—to transmit simultaneously direct rays, and to reflect rays which arrive obliquely from another source.

Dr. Robertson, of Georgetown, Mass., thinks that the popular idea that hot or cold drinks are apt to crack the enamel of the teeth is incorrect. He has ascertained by experiment that it requires a change of temperature of 160° Fah. to crack the enamel of an ordinary tooth. The teeth are never subjected to such a great change as this in the use of hot or cold liquids.

The first passenger train making the complete circuit of St. Louis lately passed over the bridge and through the tunnel. The regular locomotive being exchanged for one of the smoke-consuming engines used by the tunnel company, the train passed as comfortably as though traveling in the open air.

THE SAW CONTEST AT CINCINNATI.—In our account of the saw premium contest at the Cincinnati Exposition, the 16 good boards, 10 x 20, sawn in two minutes and forty-four seconds, should be described as 16 x 20, making a still greater result than we reported.

THE Canadian way of measuring a tree is said to be as certain as it is grotesque. You walk from the tree, looking at it from time to time between your knees. When you are able to see the top of a tree in this way, your distance from the root of the tree equals its height.

A LAWYER'S ADVICE TO A PUPIL.—"When the facts are in your favor, but the law opposed to you, come out strong on the facts; but when the law is in your favor, and the facts opposed to you, come out strong on the law." "But," inquired the student, "when the law and the facts are both against me, what shall I do?" "Why, then," said the lawyer, "talk around them."

LEATHER PULP.—A process of pulping leather in engines, similar to those used for beating rags in a paper mill, is now in use in Massachusetts. By rolling it into sheets under considerable pressure, a product of great tenacity, homogeneity, and closeness of texture is obtained, which is, moreover, perfectly waterproof.