A Great Steel Forging.

The steel forging for the fighting tower of the Italian armorclad Lepanto is 10 feet in outside diameter, 7 feet 11 inches inside diameter, 12½ inches thick, and 4 feet 9 inches high, and is intended to protect the captain of the ship in battle.

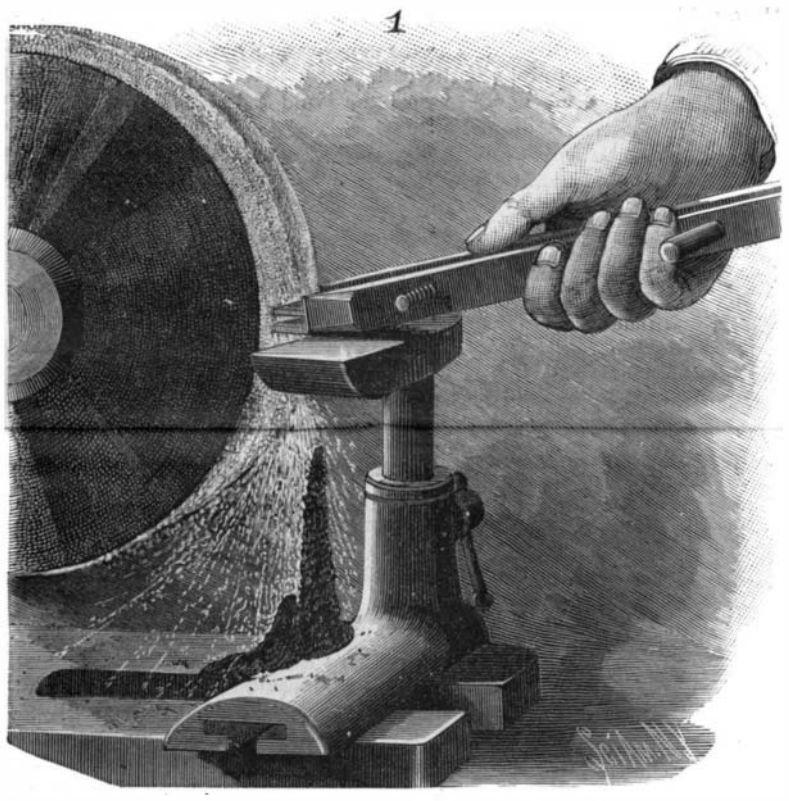
The weight of this huge block of steel is 30 tons, and the rough ingot from which it was forged was 65 tons. It was produced by the firm of Schneider & Cie., of Le Creusot, France. The ingot was worked to a diameter of about 6½ feet, then bored, and then worked by forging on a mandrel to the dimensions given above. It is the first fighting tower that has ever been made in one single piece.

CURIOUS ACCRETION OF EMERY WHEEL DUST.

The particles of material removed from solid bodies by the abrasive action of dry emery wheels are always more or less heated. Dust from metals is often fused, and sometimes dissipated altogether. Fused globules of metal are frequently found in emery wheel dust, but the stalagmitic formation consisting of particles welded together, as shown in our engraving, is not common.

These curious growths are formed almost hourly by a wheel 14 inches in diameter, revolving at the rate of 900 revolutions per minute, employed in shaping some of the steel parts of a sewing machine. The position of the stalagmite relative to the work and the wheel is shown in Fig. 1. Under the microscope the particles do not appear to have been entirely fused, but only sufficiently softened to cause them to stick together.

The mass of the aggregation is quite solid and strong. Except in color, it more nearly resembles a spire of coral than anything else.



CURIOUS STALAGMITIC FORMATION OF EMERY WHEEL DUST.

NEW ELECTRIC ORGAN MOVEMENT.

The introduction of the pneumatic movement for organs was one of the great steps in the development of this instrument. By it the strain of directly opening the pipe valves was removed from the fingers of the performer, and a light acting manual, as easily played upon as a piano keyboard, was placed at his command. In the illustrations accompanying this article we show another improvement, that is as distinct a step in advance as the one just mentioned. By it electricity is called into play, and the pneumatic movement is controlled by the electric current.

In Fig. 1 a section of the mechanism is shown. The details of the pneumatic movement will be at once recognized by those familiar with it. It is controlled by the electric attachment, that forms the subject of this article. Within a wind chest a hollow cored electro-magnet, indicated by B, is mounted in a vertical position. A cylindrical armature, A, plays up and down below it. The armature and core are made of soft iron. The armature fits loosely in a cylindrical chamber directly below the magnet. Its top and bottom are covered with disks of leather.

Below the armature a nozzle communicates with the open air. Thus, when the armature rises, the opening in the magnet core is closed. When it falls, it closes the opening of the nozzle, C. The wind chest is in constant communication with the organ bellows, so that the air within it is maintained at a pressure above that of the atmosphere. Within it is a bellows that is held open normally by a spring. It will be seen that when the armature has fallen the bellows is filled with air from the wind chest. The pressure is carried down through the hollow core and space surrounding the armature and through the passage, W. The bellows, under the circumstances, remains distended and closes the valve, K, and keeps the valve, L, open. This leaves the outer bellows free to remain open or shut. The tracker attached to the arm at M, acted on by the pipe valve, pulls it shut, and no air is admitted to the pipe.

When it is desired to sound the pipe a current of electricity is passed through the wire. This draws up the armature, and closes the opening in the magnetic core, and at the same time opens the nozzle, C. The bellows in the wind chest, having its interior put in communication with the outer air, at once closes under the effect of the air pressure within the box. This opens the valve, K, and closes the valve, L, so that the outer bellows is forced open by the pressure from the wind chest. The tracker is caused thereby to open the pipe valve, and the pipe begins to speak. In Figs. 2, 3, and 4 different modifications of the magnets and armatures are shown.

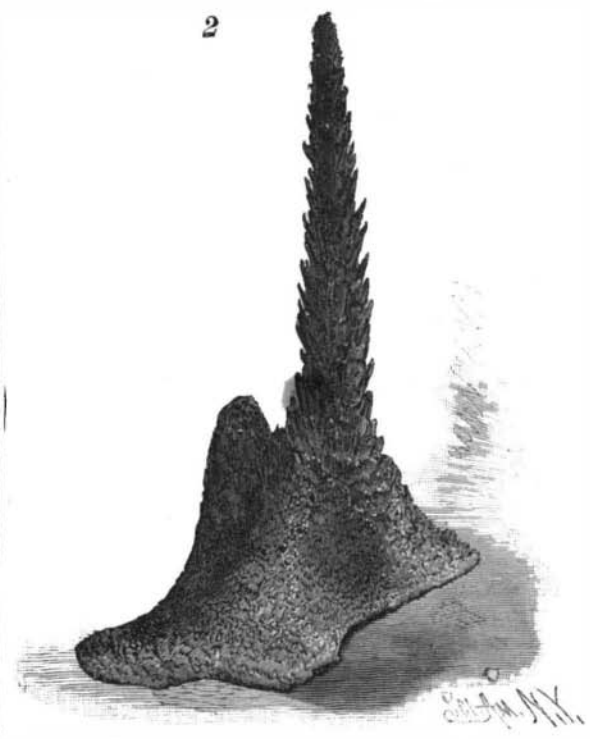
All this is done so quickly that a sensitive pipe can be made to speak six hundred times a minute.

These are the pipe movements, and one such magnet and attachments are supplied for each key in the manual and for each pedal key. For the draw stops a somewhat different apparatus is provided.

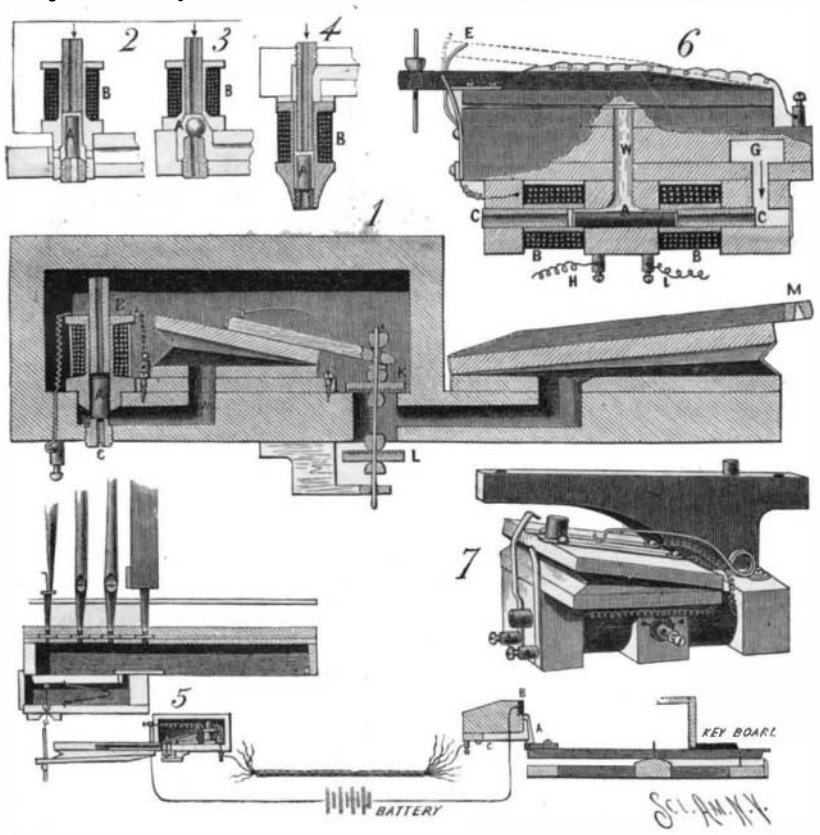
It is clear that what has been described would answer for them, but with the attendant disadvantage that electricity would have to be supplied as long as the stop was kept open. In Figs. 6 and 7 a section and elevation of the draw stop mechanism are given, by which arrangement this difficulty is avoided completely. Referring to the section, two magnets, BB, wound in the same way are shown arranged horizontally, and supplied with a horizontal cylindrical armature, which is permanently magnetized. It is attracted to one or the other of the magnets, according to the one the current is caused to pass through. Air pressure from the organ bellows comes through the passage, G. When the armature, A, is attracted toward the left, as a current passes through the left hand magnet, this air pressure raises the bellows and opens the stop. As the bellows rises, the spring, F, breaks contact with the piece, D. This cuts off the left hand magnet from the line, but the polarization or magnetization of the armature causes it to retain its place. Hence the bellows stays open. But in rising by means of the spring, E, and another contact piece corresponding to it, it throws the right hand magnet into its own circuit. Then, when another pulse of electricity is sent by the opposite movement of the stop handle, it passes through the other magnet, and draws the armature to the right. The bellows under the influence of the spring shown in Fig. 7 collapses, closes the draw stop, and at the same time cuts off the current of electricity. A separate wire is provided for each magnet going from the draw stop handle, but a single return wire acts for both. The horizontal position of the magnets in conjunction with the polarized armature are the distinguishing features of this mechanism. The bellows acts by a tracker directly on the stop valve.

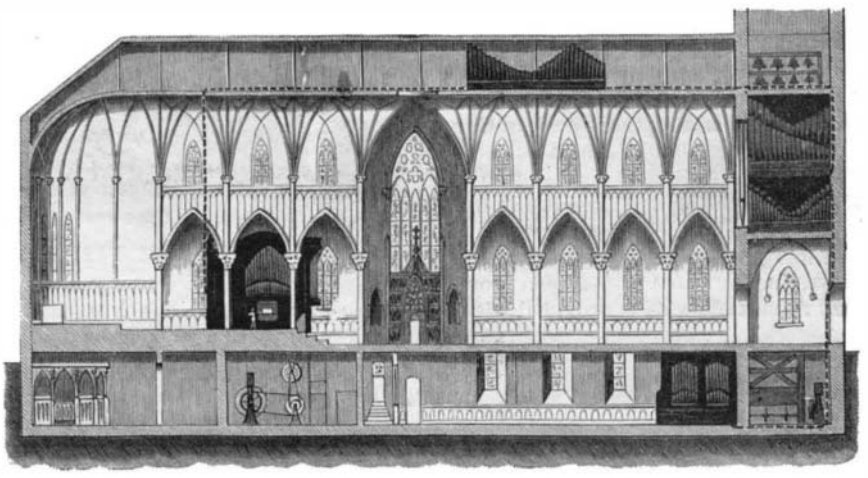
One of these movements is supplied for each stop, and thus the whole range is controlled by electricity. Very little current is required, as the draw stops are worked by a current of a second's duration. The manual consumes but little.

To give some idea of the connection between manual and soundboard, the section shown in Fig. 5 has been given. To the right is a key in its normal position. When depressed by the finger, it makes an electrical connection between the oscillating piece, A, and the contact piece, B. All the magnets connect at one terminal with a single wire, running from them to the contact piece, B, and including in its course the battery. Each of the other terminals of the magnets has its own wire which runs to the manual, each wire being connected by the binding screw and spring, C, to its own key. Hence, when a key is depressed it actuates the magnet connected with it, and makes the corresponding pipe give its note. On the left of the draw-



STALAGMITIC ACCRETION OF EMERY WHEEL DUST.





WACKER'S IMPROVEMENTS IN ELECTRIC ORGANS AS APPLIED IN THE CATHEDRAL, GARDEN CITY.

ing will be recognized in section the electric valve movement just described. A variation is here introduced by placing the outer bellows below, instead of above, the supporting board. The cable containing the individual wires, insulated from each other, is shown between the keyboard and movement, while above the movement is shown the soundboard, a pipe valve, and a row of pipes.

This arrangement leaves the manual perfectly free from strain. The keys, by being weighted, or by the use of springs, are made to work as easily or stiffly as desired.

What this invention effects is to render possible the playing of any number of organs from the one manual and by one organist, whatever be the distance of the soundboards from the performer. It is the invention of Mr. George Wacker, of 168th Street and Franklin Avenue, New York city, an organ builder of long experience, and, as this invention shows, a competent electrician. The complications and difficulties that beset the simple organ movement have to be allowed for, and here the skill of the organ builder is necessary. An electrician would not be able to cope with these difficulties any more than a mere organist could solve the electrical problems. A combination of the two was required in the solution of the problem.

The Stewart Memorial Cathedral, in Garden City, on Long Island, furnishes a good illustration of the practical application of this invention to the second largest organ in the world. There an organ with two hundred and forty keys in the manual, thirty pedal keys, one hundred and fifteen stops, and seven thousand pipes, is provided with this instrument. A sectional view of the cathedral accompanies this article.

The organ is divided into five parts. The main organ is in the chancel, immediately back of the manual. In the crypt under the front entrance is what is known as the "chapel organ." High up in the tower are the "tower" and "solo" organs, the latter unprovided as yet with its pipes. Then over the stone ceiling, between it and the roof beams, is the "echo organ." The bellows for the chancel organ are driven by a steam engine under it. A second engine and bellows supply the other four divisions. A small magneto-electric machine, run by a sewing machine belt, generates the electric current. At will the organist plays on one or the other of these organs, producing the most beautiful distance and echo effects.

In the processional hymn with which the service commences, the system is brought into play most effectively. The choir forms in the chapel, and is accompanied by the chapel organ. As they come up into the body of the church, the tower organ is brought into action. Then, as they approach or reach the chancel, the current being shifted from the tower, the chancel organ may take up the strain.

Each of the different divisions has its own manual for the convenience of the tuner. When the chapel organ is played from the chancel manual, the keys of its independent keyboard, the church's length from the organist, move up and down as the notes are sounded, producing a most peculiar effect, as if some invisible performer were seated in front of it, and moving the keys.

In the entire organ there are about four hundred of these magnets. Having no springs and no adjustments, when once in place, they are set forever. The great wind valves, sometimes of fourteen inches area, open and close with absolute certainty. The most beautiful effects of this great organ are due to and depend upon electricity, and it never yet has failed.

As an illustration of the size and range of the organ, it is of interest to note the largest and smallest pipes. The largest is 19 in. by 23 in. in area and 32 ft. long, giving 16½ vibrations per second (sub-contra C or C_2); the smallest, rather less than half an inch long, gives 16,896 per second, corresponding to the upper C (C^7)—a range of ten octaves, and practically covering the musical capacity of the human ear, though Preyer has claimed that from 16 to 41,000 vibrations per second, or an octave and a fraction higher, can be heard by some ears.

Tetanus Treated by Rest.

Dr. De Renzi states, in the *Rivista Clinica*, that by treating patients with traumatic tetanus by means of perfect rest, he has been able to restore four out of five to health; whereas, when treated in other ways, these patients usually die in two or three days. He places the case in a special room, where absolute silence reigns. Even in the passages leading to it and in the neighboring wards care is taken to lay down carpets, so that no sound shall penetrate the tetanus ward. The door of the latter is of course well oiled, so as to open and shut noiselessly, and the patient's ears are stuffed with cotton wool, he himself being strictly enjoined not to make the slightest noise. He must, of course, be fed. This has generally been considered impossible, the teeth being clinched and the spasmodic contraction being increased by attempts to masticate. The obstacle may, however, be easily overcome by parting the jaws and introducing liquid food through a curved sound; swallowing is accomplished without difficulty. This method of treating traumatic tetanus has been tried with success by several Italian practitioners—Drs. Pisani, Maragliano, Ria, etc. The only disadvantage is that the affection is sometimes prolonged for two months. It seems to increase in duration as it diminishes in force.

IMPROVED PIPE WRENCH.

This wrench is strong, durable, and very simple in construction, and not liable to get out of order. It is preferably made of cast steel, the serrated block being made of the best tool steel. For its gripping power it does not rely upon the spring, which is applied to hold the block in place when working the wrench in an inverted or overhead position. The gripping power is obtained by placing the serrated block eccentrically in relation to the hook-shaped jaw. To operate the wrench the block is simply closed on the pipe, and to remove it the handle is pushed backward, when the peculiar curve in the jaw will allow the wrench to easily leave the pipe. When using an adjustable wrench, fitting

THE FATKIN PIPE WRENCH.

pipes of various sizes, the pipe is liable to be crushed; but with a wrench such as this, three-fourths of the circumference of the pipe is covered, and that danger is obviated. It is claimed that the several sizes of this wrench can be furnished for the same amount that is now paid for one adjustable wrench.

Further particulars regarding this wrench, which has been patented, can be obtained from Mr. T. O. M. Davis, of Winifrede, W. Va.

Corundum and Its Uses.

Corundum in its pure state is composed of the oxide of aluminum, having the formula Al_2O_3, *i. e.*, it contains two atoms of oxygen in each molecule. It is an exceedingly tough, compact mineral, occurring in a great variety of colors—blue, red, yellow, to nearly white. The pure crystals are translucent, and used as gems. It is one of the hardest known minerals, being placed in the scale of hardness next to the diamond. This quality is the source of its greatest value in the arts. The species is divided into three varieties—sapphire, corundum, and emery.

Sapphire includes the purer kinds of fine colors, transparent or translucent. These stones are used as gems, and are known by names indicating their color. The following well known jewels are forms of this mineral: Ruby, sapphire, oriental emerald, oriental topaz, and oriental amethyst. These gems are found chiefly in the beds of rivers in Ceylon, though some rubies are brought from Syria. The value of these stones was well known to the ancients, who used them under various names now obsolete. The stone called sapphire by Pliny is now known to lapidarists as lapis lazuli.

The oriental emerald is perhaps the rarest gem known. A few specimens have been found among the gold sands of the Missouri River near Benton. But few of these jewels are in existence, and these are in the great collections of Europe.

Corundum generally means the dull, untransparent occurrences of the mineral. They vary in color—blue, gray, or brown—but are never clear or capable of being cut; it usually occurs in large, rough crystals, or in massive cleavages.

Emery is granular corundum. It is black or grayish-black in color, and mixed with grains of magnetite. Emery has very much the appearance of fine-grained iron ore, and for a long time was considered to be such. The texture is variable, some specimens being composed of almost impalpable grains, while others are made up of large, rough fragments of crystals.

Until recently the only source of emery was the far East, the island of Naxos, in the Grecian Archipelago, containing the chief mines. The emery was shipped from the port of Smyrna, and was known to commerce as Smyrna emery. Between the years 1835 and 1846 the entire business was in the hands of an English capitalist, who had a monopoly obtained from the Greek Government. In 1847 Dr. J. Lawrence Smith, an eminent American scientist employed by the Turkish Government to explore the dominion for valuable mineral deposits, discovered two large deposits of emery, one at Smyrna and the other on the site of ancient Ephesus in Asia Minor. These deposits have since then been worked by companies paying a royalty to Turkey.

Emery and corundum are chiefly used in the arts as abrading and polishing materials. The mineral is ground, and separated by passing through sieves into classes of various dimensions, which are then further prepared in different ways adapted to the purposes for which they are to be used. For the use of jewelers and opticians, the fine emery is poured into water containing gum, and the coarser particles allowed to settle; the fine, impalpable dust remaining suspended in the liquid is then collected and used in polishing fine lenses, spectacles, and similar articles. The largest amount of emery is used by the manufacturers of plate glass, though great quantities come upon the market prepared in a great many different shapes to suit special purposes. One of the largest of these industries is the manufacture of emery wheels; these are prepared by mixing the powder with glue or cement, and subjecting the paste to great pressure. Mixed with paper pulp and rolled into sheets, it is sold in the form of patent razor strops and knife sharpeners. Spread out on paper and cloth, it forms an excellent substitute for sand paper. Recently it has been discovered that crystallized corundum, when ground, forms a better abrading material than emery, owing to the fact that it breaks into sharp edged fragments, while emery has rather a rounded form. This discovery was followed by the discovery of large deposits of corundum and emery in Massachusetts, North Carolina, and Georgia. All of these localities are being actively worked, and large quantities of American material are being put on the market.

In the near future it is probable that corundum will assume a far more prominent place among the useful minerals as the source of the metal aluminum. The cheap production of this metal has long been the object of experiment to metallurgists; and corundum, furnishing the purest source from which it can be obtained, will probably be the most valuable ore. Even at present a good deposit of corundum is as valuable a "find" as one could desire to have on his property, there being a steady and regular demand for it. Corundum is generally found associated with crystalline rocks, such as granular limestone, gneiss, granite, or slate. The emery of Asia Minor is associated with granular limestone. The characteristic by which it is most readily distinguished by the prospector is its extreme hardness. A fragment of corundum will scratch any of the constituents of the rocks in which it is found.—*The Milling World.*

A Shying Horse.

To the inquiry, Why does a horse shy? the *National Live Stock Journal* replies: Because he sees something which he does not understand, and is filled with a greater or less degree of fear, something as the boy feels when he shies at the burying ground, and goes around to keep clear of it. It may be some new or unusual object that the horse sees, or it may be an imperfect view of it. Even a familiar object, if it comes to view suddenly and unexpectedly, will cause a horse to shy or jump, just as an unexpected object or sound causes a nervous person to start. When a person is so startled, how much would it improve the matter to be scolded at or given a cut with a whip? Just as much as the same treatment would in the case of the horse. Harshness only aggravates the matter.

The more the horse is scolded and whipped, the more nervous he gets; and every time he passes the place where the fright and whipping occurred, he will recollect the unpleasant affair, and he will begin to prick up his ears and fidget, ready for another jump. Give him the lines, and he will go by in a hurry. The proper way is never to strike or scold a horse that is startled or frightened. Speak to him coolly, calmly, and kindly; give him time to see and collect his scattered senses, and make him feel that you are his friend and protector. When he sees that all is right, there is an end to all further trouble. We have seen a horse refuse to cross an unsafe-looking bridge; but when the driver took him by the bits and walked ahead, the horse cautiously followed. Next time he required no coaxing or urging to cross the bridge. He might have been whipped into it at first, but was not the milder course, although a little trouble, the better one? The horse showed his confidence in the driver ever afterward.

Photometry.

A neat method of indicating the precise rate of consumption of candles, used in photometrical work, has been carried out in Germany. The candle holder is hung in an unequal arm balance, the beam of which has a long pointer hanging down from the fulcrum, for marking the position of the balance on a vernier scale. At the two opposite ends of the scale there are two metallic pins, while a movable pin, in electrical connection with a battery and a bell, is arranged in the middle of the scale. The candles are lighted and weighed until the pointer just swings clear of one stud of the vernier, when a certain weight is placed in a pan provided for the purpose underneath the candles, a clock being started at the same moment. When, owing to the consumption of the candles, the weight placed in the pan is lifted by the weight in the opposite pan, the pointer swings back and touches the pin, which completes the circuit and so rings the bell. By noting the time the candles were burning, the precise rate of consumption of the candles can be easily determined.