faculties and the animal propensities. He became capricious, fitful, irreverent, vacillating, impatient of restraint, a child in mind, an adult in physical system and passions. During his South American life he was a coachman, and underwent great hardship. It appears the man could see out of his left eye though the lid was not subject to his will. In summing up his paper Dr. Harlow presented these views:

1st, The recovery is attributed solely to the vis vitæ, vis conservatrix, or, if some like it, vis medicatrix naturæ. 2d, This case has been cited as one of recovery; physically the recovery was nearly or quite completed for the four years immediately succeeding the injury, but ultimately the patient succumbed to progressive disease of the brain. Mentally the recovery was only partial; there was no dementia; intellectual operations were perfect in kind, but not in degree or quantity. 3d, Though the case may seem improbable, yet the subject was the man for the case, as his will, physique, and capacity for endurance, could scarcely be equaled; the missile was smooth and pointed, dilating and wedging off rather than lacerating the tissues; the bolt did little injury until it entered the base of the brain, and that opening served as a drain for the blood and matter and other substances that might have caused death by compression; the part of the brain traversed was the part that could best stand such a shock with the least injury.

VEGETABLE COLORING MATTER.

Until within a recent period, most colors used in calico printing, paper staining, dyeing, etc., were chiefly obtained from vegetable sources. Mineral dyes, however, have been much in favor, and have the advantage, where they can be used, of being lasting and easily applied. Some of these thus used, and also as pigments, have been described in our previous pages; we shall, therefore, here chiefly direct attention to colors of a vegetable origin.

The natural colors of leaves and flowers are due to a peculiar principle which is subject to the action of heat, light, and chemical action, but which is lost on the death of the plant. It is there a vital principle only. Colors employed for dyeing, etc., are extracted from the plant after its vitality has ceased, and are resident in the leaves, stems, roots, and flowers. Red dyes are obtained from madder, or rubia tinctorum, safflower, or carthamus, Brazil wood, logwood, sapan wood, the cochineal insect, etc.; blue colors are afforded by indigo, archil, litmus, etc.; and yellow dyes are produced from fustic, turmeric, saffron, etc.

But all these colors *per se* are fugitive, and require a *mordant* to fix them in the fabrics to which they are applied. The action of a mordant is readily illustrated by that of iron and an infusion of logwood used in dyeing black. If a piece of cotton were simply dipped in the infusion of logwood, it would only acquire a dirty red-brown color; but if it be first soaked in a solution of sulphate of iron, the oxide of the metal attaches itself to the fibers of the material, and, on being introduced into the logwood infusion, a black and permanent color is produced. The mordants usually employed are salts of iron, alumina, and tin, others being used only to a limited extent.

Madder is chiefly employed in dyeing red. It is the root of a plant, and is imported into this country from the continent in a state of powder, having a dark red color. From it a peculiar principle, called *garancine* is produced by means of sulphuric acid. This preparation is superseding the use of the raw madder, because it is more economical, cleanly and effective. Other principles may be extracted from madder, such as *purpurine, alizarine, xanthine.* etc., of which the alizarine is the most important, because it is really the coloring principle of the rest, and is the chief constituent of the garancine of commerce. The celebrated Turkey-red dye, which withstands the action of most chemical substances, is obtained by means of madder.

Cochineal is properly an animal dye, but its coloring powers are due to the cactus, on which it feeds. With alumina, a decoction of the insect affords a rich red color, used in dyeing silk, and in producing "carmine." We have succeeded in producing some rich red precipitates from a cold infusion of the cactus flower and solutions of carbonate of soda and citric acid, employed in the manner we are about to describe in connection with safflower.

Safflower is a kind of saffron, and affords two coloring principles—a yellow and a red—the former being abundant and useless, while the latter is obtained only in small quantities, and is very valuable as a dye for silks, producing reds of the purest color and of every shade, from pink to deep poppy.

The safflower must be washed in cold water, until all the yellow color is removed. The residue of solid matter is then to be steeped in a solution of carbonate of soda, also cold; and, after some time, cotton wool is to be introduced so as to absorb the color. It will appear of a muddy red tint; but on the addition of a solution of citric acid, or lemon juice, a magnificent red color is afforded. By a repetition of this process the cotton may be filled with color, which can afterwards be removed by the same means as those just employed. The color is thus obtained isolated. A large quantity of the color is manufactured on the banks of the Lea, near London; and also near Paris. The winter months are chosen for the purpose, as the heat of summer spoils the tint. From the small quantity of color produced from the raw material, it is very expensive, and its use is chiefly confined to dyeing silks, and making "carmine saucers."

Decoctions made by boiling the chips of Japan, Brazil, and logwood, afford a red color, with tin and alum as a mordant; and a black with salts of iron. These substances are chiefly used for dyeing wool and cotton yarn. Each of them contains some tannic acid, as do sumac, gall nuts, oak bark, walnut peels. etc.; and such with iron, afford black dyes of various depths.

Yellow colors are produced by the action of alumina, as a mordant on infusions of turmeric, etc; but these colors are generally fugitive. Intermediate tints of brown, maroon, etc., are produced by successively dyeing the stuffs a yellow and red color, until the desired tint be arrived at.

Blue vegetable colors are obtained from some lichens, amongst which the *rocella tinctoria* is that most commonly used. All the lichens, however, afford colors of some kind and even those of a yellow and red tint. Archil, used in dyeing silk, is obtained from the *rocella* by means of ammonia, or more economically, urine, which has so far undergone decomposition as to afford ammonia. From these plants peculiar coloring principles, such as *orcine*, etc., may be obtained, which are analogous to garancine, alazarine, etc.

Indigo has, until the discovery of the production of aniline from coal-tar, been the chief source of the permanent blue of the dyer. The color from indigo is not obtained, as in most other cases, by infusion or decoction in water, but by means of the strongest sulphuric acid. The raw material, as imported. is in blue colored cakes; these are powdered, and to them the strongest sulphuric acid is added. By this, the real principle of indigo is dissolved out. The principle of dyeing with this substance is that of first deoxidizing it, which is done by means of the proto-sulphate of iron. This renders the indigo in a state fitted for absorption by the fabric, which, after being dipped into the solution, becomes of a deep blue color on exposure to the oxygen of the air, and the color then becomes permanent. In the process, the alkaline earth, lime, is used with the proto-salt of iron. And this introduces us to the production of aniline from a vegetable, as we have shown its production already from coal tar.

If indigo be acted upon by a hot solution of potassa and then distilled, analine is produced as a nearly colorless liquor. It is highly volatile, soluble in water, and on being oxidized by chromic acid, affords a rich purple tint. It matters not what it is produced from, for it is equally obtainable from indigo, nitro-benzole, and coal tar. And this is a matter of not only deep philosophical interest, but, in the uses to which it is applied, has become a most important article of commerce.

Into the varied treatment which this substance undergoes, we of course cannot enter; and we have made our remarks more extended on it than we should have done, solely because it affords an instance of a most remarkable practical application of purely scientific research, and which we are glad to say has been the means of enriching those to whose perseverance we have been indebted to its manufacture in quantities.

CUTLERY.---UNITED STATES INDUSTRY.

The Manufacturer, a London publication, has the following article on our cutlery manufactures, which is worth reading:

The manufacture of cutlery in the United States is of recent origin, comparatively. But a few years since the whole supply came through the hands of the importer from Europe; but the production of edge tools and cutlery was no sooner started than it took a rapid growth, and a foreigner, remarking upon branches of American industry, says—"The manufacturers of cutlery have far surpassed those of the Old World in the production of tools, and that not merely in the excellence of the metal used, but especially in the practical utility of the patterns, and in the remarkable degree of finish of their work." This is a just remark. The "high finish" of American work is applied only, however, where it has utility, not where it is a useless expense. This may be illustrated in watches and clocks. The English have highly polished works that add much to the expense but nothing to the service. In the American article this expense is saved. A peculiarity of American work is the readiness with which improvements are perceived by the intelligent worker, and immediately adopted and applied. This intelligence comes in some degree from the entire freedom of industry, and the absence of all trade "guilds," unions, or restrictions. The American who travels in Europe is struck with the, to him, ludicrous mystery with which every species of handicraft is surrounded. It would seem as if the proprietor of every petty workshop or factory was exclusively possessed of the philosopher's stone, which would be robbed from him by the prying gaze of every transient visitor. The apprentices are only taught the routine of centuries, and only so much as is necessary to fulfill the part of the labor required of them. The manufacture itself, whatever it may be, is divided into branches, each of which is in charge of persons who preserve their supposed secret from the other branches. Under these circumstances the apprentice succeeds with difficulty in becoming a master of his trade. When out of his time he must travel for three years, and when he returns to his native town he must have money and interest to be made a citizen, and then admitted as a member of the guild or trades' union before he can pursue, except as a journeyman, the trade he has learned. How different is all this in the United States! The boy enters a factory, or workshop, and is taught his especial work, and has within his reach every branch of information, scientific and practical, connected with the whole of it. His fellow workmen are experienced in all the branches and with the best modes in use in all countries. His employer is wedded to no system or rule, but is ever on the alert for improvement; always ready to suggest and hear suggestions, and to adopt feasible ones. It is no wonder that in such an atmosphere the arts should flourish, and that an observant foreigner should exclaim, as above, that hardly twenty years of experience in the New World should have surpassed the centuries of progress in the Old World. This branch of industry thrives mostly in individual workshops; it has not come within the sphere of corporate influences. There is a general and very perceptible adoption of American patterns not only in Europe, but in England, as being more practical, and it is stated that in American factories already there is more English steel used than in England itself. The American worker does not believe in using poor tools when good ones are to be had.

Steel is the material used, by reason of its hardness, for cutting edges of tools and cutlery. The backs are made of iron, as a cheaper material; so also are the handles or "tangs" to which the steel is welded. The steel is blistered as, or after, it is drawn down by tilt hammers into shear steel. This is used for table knives, scythes, etc. When a fine finish is required, or great hardness, the blistered steel is melted into cast steel, and the ingots are forged into bars. Simple articles, such as chisels, are made by hammering a bit of cast steel into the required shape. This being intended only for the edge, is made very thin, and upon it is welded a flat slip of iron which has been forged into the shape of a chisel, with a shoulder formed by driving it into a hole in the anvil. One side of the chisel is, therefore, iron, intended to be ground away, and the other steel. Scissors are made of various materials. Common ones are shear steel, with the blades hardened. Tailors' shears have the blades only steel; the remainder is iron. Formerly only the edge was steel. Some scissors are made of good cast iron, called run or virgin steel. Of these many are sold at seven cents a dozen. There are some, on the other hand, made with bows or shanks of gold, and sell for fifty dollars a pair. When made wholly of steel, the blade is hammered out at the end of a small bar; it is then cut off with enough to form the shank and bow. A hole is then punched, the instruments shaped, united by a screw, ground, filed, and burnished. The blades are slightly bowed in such a manner that they touch each other only at the point of cutting, and this point moves as the blades close in the act of cutting from the pivot to the point. This operation is seen by holding a pair of scissors, edgeways, to the light. This action gives smoothness to the cut.

The manufacture of table cutlery is of recent introduction in the United States; and it has made progress by reason of the American invention of a machine to form the blades, which invention has been adopted in Europe. In the old process the blade of a table or other large knife is hammered out on an anvil at the end of a bar of steel, and cut off. It is then welded on to the bar of wrought steel, about half an inch square, and enough of this is cut off to form the bolster or shoulder, or the tang. The blade is then heated and hammered, or, as it is called, smithed, which serves to condense the metal, and enable it to acquire a higher finish. The mark of the maker is then stamped upon it, and it is hardened by heating to redness, and plunging it into cold water. It is tempered to a blue color, and is then ready for grinding. The small blades of penknives are hammered entire out of the best cast steel. A temporary tang is drawn out to secure the blade while it is ground. A number of blades are heated together for tempering by being placed over the fire, upon a flat place, their backs downwards. When at the proper degree of redness, so as to take a brown or purple color, they are dipped into water up to the shoulder. For razors the best cast steel is selected, and when the blade is shaped upon the anvil, from a bar as thick as the back of a razor, and half an inch wide, it is well smithed to condense the metal. Only the best metal will bear the working down of the one part of the blade to the requisite thickness, while the other is left thick. The shape is further improved by grinding on a dry, coarse stone. The tempering is performed after the blade is drilled for the pin of the joint, and stamped. It is then ground and polished.

The grinding and polishing of cutlery are conducted mostly by wheels constructed for the purpose. There is a trough with a stone for grinding and a polisher driven by a pulley. The stones vary in diameter from four inches to two feet, according to the articles to be ground. The convex surface of the small wheels gives the concavity on the blade of the razor, and the other wheels suit the various sizes and shapes of the articles polished. Some are used dry and others are kept wet, in order that the heat engendered by dry grinding may not injure the temper of the articles ground. The dry grinding is more expeditious, but, unless the troughs are furnished with a ventilating fan and flue for carrying off the fine metallic particles and dust from the stones, the health of the worker suffers. This flue is constructed of tin, in the shape of a sort of cap, that comes over the back of the stone; the other end of the flue is in an adjoining room, and has the air partly exhausted from it by a fan in rapid motion. This creates a strong current, which, when the stone is in motion, carries the dust and filings from it into the flue. When the grinding is completed, lapping succeeds. This is done on a thin wooden wheel, faced with a tire of metal made of five parts of lead to one of tin, and cast upon the edge of the wheel. It is then turned true and indented, so as to hold a dressing of oiled emery of different degrees of fineness. The steel blades receive various degrees of polish by drawing them from end to end across the revolving lap, which is fed with emery of various sizes.

The handles of cutlery are made of a variety of substances, ivory, horn, mother-of-pearl, tortoise shell, cocoanut, maple wood, etc. Ivory is mostly used for table knives. A solid piece is cut out of the right size, and a hole for the tang bored at one end. This is sometimes carried through, so that the tang may be visible. When it does not go through the tang is secured by cement. By a late contrivance, a little spring is attached to the tang which falls in a notch in the cavity of the handle, and prevents it from being withdrawn. Balance handles are made by introducing lead into the handle, to counterbalance the weight of the blade. The handles of penknives are complicated. The springs must be nicely adjusted, requiring a peculiar temper. The slips for the handles require great care in fitting. It is stated that a three-bladed knife passes through the finisher's hands a hundred times.

The manufacture of butcher and shoe knives is large in the state of New York. The state census gives it at 35,000 per annum, and these have a wide reputation.

The manufacture of forks is said to be one of the most unhealthy of the mechanical arts. It has been estimated that the destruction of life in it is greater than in any other pursuit, by reason of the fine dust evolved in the process of grinding, and which fills the atmosphere of the rooms, and invades the lungs of the operators. This takes place in the finishing. The forks are hammered out of square steel rods three-eighths of an inch thick. The tang and shank are roughly shaped at the end of the steel rod, and are then cut off, with about an inch of the square steel besides. This is drawn out flat for the prongs, and the tang and shank are then shaped by the dies. The other end, heated to a white heat, is laid in a steel die upon an anvil, another die attached to the under face of a heavy block of metal, is allowed to fall upon it to a hight of seven or eight feet. The prongs are thus shaped, and all but a thin film of steel removed from between them. This is cleared out by a machine called a fly press. A number of forks are collected together, and annealed by heating and allowing them to cool slowly. They are now sufficiently soft to be easily shaped by the file, and by bending. They are then heated to redness and suddenly cooled, by which the hardness is restored. The process of hardening renders all steel brittle, and it is intended to remove this by tempering. The higher the heat when the metal is hardened the softer and stronger will be the steel. A lower degree of heat gives more hardness and also more brittleness. The temper is indicated in the color, and temperature which produces that color follows a regular scale. Thus 430° of heat gives a very pale straw color, suitable for the temper of lancets. Higher degrees of heat give darker shades of yellow, suitable for razors, penknives, and chisels; until at 500° the color is brown yellow, adapted to axes and plane irons. Twenty degrees higher the yellow has a purple tinge, seen in table knives. Thirty degrees higher the dark color of a watch spring is obtained. Again twenty degrees the dark blue of saws is visible. At 630° the color has a tinge of green, and the steel is too soft for instruments. This color is supposed to be produced by the action of the oxygen of the air upon the carbon of the steel, and protects the metal from rust in some degree.

One of the most necessary tools for a new and agricultural country is the ax. The remains of all lost races generally disclose, in some rude form, that useful instrument; and the modern nations of Europe present it in an improved metallic form. The Spanish ax, which has no head, is made by hammering out the bar and turning it into a loop to make the eye. The manufacture of the ax has, however, like its use, been carried to its highest perfection in the United States. An American ax has a fame co-extensive with an American backwoodsman, who alone of all the nations that visit this continent is fitted to struggle with the mighty forests with which the country was covered. While the American pioneer, ax in hand, boldly buries himself in the forest to clear and subdue it, the European rather keeps to the plains as more easily managed. The experience in the use of the ax, and the various uses to which it is applied, have combined to produce great varieties, all of which have undergone considerable improvements. Formerly, the operator depended upon the rude forges and limited skill of blacksmiths to supply axes. With the improvements that suggest themselves, special factories sprang up, and the largest factory of the kind in the world is in New England. There, 1,200 tuns of iron and 200 tuns of cast steel are by machinery wrought annually into tools. In the most recent process hammered bar iron is heated to a red heat, cut off the requisite length, and the eye, which is to receive the handle, punched through it. It is then re-heated and pressed between concave dies until it assumes the proper shape It is now heated and grooved upon the edge to receive the piece of steel which forms the sharp edge. To make the steel adhere to the iron borax is used. This acts as a soap to clean the metal in order that it may adhere. At a white heat it is welded and drawn out to a proper edge by trip hammers. The next process is hammering off the tool by hand, restoring the shape lost in drawing out; it is then ground to form a finer edge. Afterwards it is ground upon finer stones, and made ready for the temperer. The ax is now hung upon a revolving wheel in a furnace over a small coal fire, at a peculiar red heat. It is cooled successively in salt and fresh water, and then tempered in another furnace, where the heat is regulated by a thermometer. It is then polished to a high finish, which will show every flaw and enable it to resist rust. It is then stamped, and the head blackened with a mixture of turpentine and asphaltum.

The manufacture of scythes has reached a high state of perfection in the Western States, and the patterns have been imitated to a great extent in Europe.

The manufacture of surgical instruments has become large in the cities, mostly in Philadelphia, where the manufacture has acquired great celebrity. The ingenuity and skill with which an infinite variety of instruments is adapted to the purpose of operations upon the living fibers of the body are marvellous in their way. The quantities supplied to the West and South are large.

WHEN the head of a cold chisel has been battered, so that the steel "rags" over the edge, the edges of the head should always be ground off. The "ragging" is very hard and flinty, and apt to fly at the blow of the hammer, and a particle lodged in the holding hand, is an uncomfortable companion.

CAST-IRON WORKING IN SCOTLAND.

We condense from the *Ironmonger* some interesting information respecting the manufacture of cast-iron wares at the Carron Iron Works in Scotland. These works were established in 1759, by Dr. Roebuck, who employed James Watt to erect a large steam engine, which was merely used to pump back into a reservoir the water that had passed over the water wheels, and so enable it to be used again and again to drive the machinery, instead of applying the engine direct for that purpose.

It appears that the Carron Company employs about 2,000 men and boys, who are well cared for and contented, and there is no trouble with them in the way of strikes or trade disputes, which is not to be wondered at as the Company takes a deep interest in all that concerns the welfare of the operatives, who have benefit societies, the most important one of which has been in operation for several years, and holds an interest in the Company.

THE PROCESS OF MOLDING.

Take, for example, a three-legged pot, the patterns for which consist of nine pieces, two for the body, three for the feet, and two for each of the ears. The body pieces have been formed by taking a completed pot, denuding it of feet and ears. These pieces the molder takes, and placing the severed edges together, lays them down on his bench with the bottom upward. He then incloses the pattern in a circular casing, which he fills up with sand. The sand is rammed down all round and over the pattern, care being taken during the process to insert the feet pieces, and also a wooden plug to form a "gate" through which to pour the metal. The molder then turns the box over and fills the inside of the pot with sand. The next part of the operation is to take out the pattern and leave open and entire the space it occupies. The advantage of having the casing and pattern in sections now becomes manifest. The upper section of the casing is unfastened and taken off, when it is seen that the sand bears an impression of the bottom of the pot. The side pieces are in like manner removed, leaving the body pattern clear. The latter is carefully lifted off, one half at a time, exposing the "core" or globular mass of sand which represents the interior of the plot. The whole surface of the sand is next thickly dusted with ground charcoal, and rubbed quite smooth—a process which makes the iron take a finer "skin" than it would otherwise do. The feet and ear pieces having been withdrawn, all that is now necessary is to put the casing together again, fasten it tight up, and prepare the "gate" by pulling out the plug and rounding off the edges of the hole. So compact does the sand become that the completed mold may be moved about freely without sustaining injury. An expert hand can mold a pot of the largest size in from fifteen to twenty minutes. After a certain number of molds have been prepared, the workmen proceed to "cast" them. The molten metal is carried from the furnaces in huge ladles, and appears to be as fluid as water. When it is poured into the mold, gas is at once generated, which finds its way through the sand, and issuing from the joints of the casing, become ignited, and burns with a beautiful purple flame. Were this gas not allowed to escape, the mold would burst, and the consequences to the workmen would be most disastrous. It is a curious fact, that while a few drops of water would ruin a mold, the boiling metal may be poured in from a hight of a couple of feet without disturbing a particle of the sand.

When the metal has cooled sufficiently, it is dug out of the sand and taken to the dressing shops, where roughnesses are removed. Articles cast in several pieces are then carried to the fitting shops, where they are put together. Kettles and stew pans, which are to be tinned, are first annealed, and then passed to turners, who put a smooth and bright surface on the inside. The tinning is then done, the handles put on, the outsides jappaned, and the completed goods removed to the warehouse. Portions of many of the articles are of malleable iron—such as the handles of kettles and pans; and in the making of these a large number of smiths are employed. The division of labor system is extensively applied in the works, and the result is that the men in the various departments display extraordinary expertness. When a boy enters on his apprenticeship, he chooses, or has chosen for him, the branch of work that he is to follow, and to that he adheres. Let us suppose that a boy selects pot molding. After some preliminary training he is intrusted with the making of pots of the smallest size. As he advances in years, so does the size of his pots increase; and by the time that gray hairs come, he finds his hands employed upon vessels so capacious that each might contain a dozen of those he made in his early days. This is one of the peculiarities of life at Carron; and though it looks as if designed to remind the men of the flight of time and the growth of years upon them, it is simply the result of promotion by seniority. The mold for a small pot requires nearly as much time to make as that for a large one; but there is a difference of price in favor of the latter, and these the older hands claim the privilege of making. Another peculiarity of the pot-making branch is the mode of payment, which is this: a man agrees to make a certain number of pots for half a crown, and he is allowed one shilling of premium on every hundred that he produces. Taken altogether, the men employed in molding make higher wages than those in the other departments, and it is no unusual thing for one of them to receive even as much as £3 for a week's work; but the general wages of the class may be set down at about twenty-five shillings for sixty hours' work.

ARTISTIC WORKS IN CAST IRON.

The Carron Company has devoted much attention to the production of cast iron goods of an artistic kind. When any new article is to be produced, a drawing of it is first made, and from that a modeler forms a pattern in wood, wax, or plaster. From the pattern a cast is taken in tin, a metal which takes a smooth surface, and from the tin copy, which is nicely chased up, the molder makes the impression in sand from which the iron is cast. A smoother surface is thus given to the iron than would be the case were a wood pattern used. In all cases, the details of the pattern are sharpened in the iron, after casting, by filing. Though no model seems to be too difficult for the molder to make in one piece, yet, as a matter of convenience, most articles of any size or complexity are made in several pieces. In the molding shop, in which the ornamental castings are made, we had an opportunity of seeing sand molding of the most difficult kind; but the operations of the workmen would require to be seen to be understood. A specimen of work from this shop was shown at the Exhibition of 1862, along with a variety of other castings, and excited a good deal of interest, as showing the capabilities of the sand-molding process. It was a small figure of a stag browsing; and, in order to cast it in one piece, the mold had to be made in upwards of one hundred parts, each part being simply a clod of moist sand, held together by compression.

CAPABILITIES OF CAST IRON.

It would appear that the capabilities of cast iron have not yet been fully developed by the ironfounders of the country. At the Paris Exhibition were shown specimens of Berlin castings in iron, which, by their delicacy and beauty of outline, attracted considerable attention. Some specimens of the same kind of work may also be seen in the Edinburgh Industrial Museum. The minutest details are sharply defined, and the entire surface has a bronze-like smoothness. It has been generally believed that this kind of work was made by mixing with the iron some metalloid, which has the effect of giving to the metal more fluidity and density; but this, we believe, is not the case. The specimens are made of iron alone, and are the result of the laborious researches and experiments of M. Schott, the manager of Count Stolbergs' works in Brunswick. "His attention," it is stated, "was first directed to the importance of procuring the finest quality of molding sand, and to prevent, as far as possible, the accumulation of air in the mold which is drawn in during the process of pouring the liquid metal". His sand is made by mixing burned clay with pulverized sandstone, having a maximum porosity. It has also the fineness of grain which is essential in producing a delicate mold. An incident is related which illustrates the importance of this in this branch of the art. M. Schott, in explaining the subject to some friends who were dining with him, sent a folded napkin from the table to the foundery, and shortly after showed them a casting which which correctly represented the indentations produced by the finely woven thread of the fabric. The most important part of the process, however, is the preparation of the metal. M. Schott made a series of experiments to determine the melting point of different kinds of pig iron; and, by mixing several in proper proportions, he has been enabled to vary the melting point at will. It will surprise even practical ironfounders to learn that his experiments proved that the melting point of different samples of charcoal iron, made at his own blast furnaces, varied more than 800° Fah. Charcoal iron generally melts at 700° higher temperature than coke iron. The contraction, on cooling, is greatest in the charcoal iron, and, in most cases, it has the greatest density when solid. In examining various specimens of casting, M. Schott brought to his aid the microscope, and was thus enabled to detect certain differences which chemical analysis had failed to explain. The iron ore used by him is not different from that found in many other places. It is reduced in a series of small charcoal furnaces in the vicinity of the mines, which are situated in Northern Germany, near the town of Brunswick.

Modern Naval Warfare.

MR. A. L. HOLLEY of Harrisburg, Pa., who is thoroughly acquainted with the subject, has published in *Engineering* a lengthy article in which he claims for the Messrs. Stevens of Hoboken, that they were the originators of many, if not most of the improvements in modern naval warfare. He sums up their claims that the Messrs. Stevens, father and son, either originated, or first developed, the following important features of modern naval warfare. Twin screw, 1805; armor plating, 1812; inclined armor, 1812 and 1841; training guns by rotating the vessel, 1812 and 1862; engines and screws below water in war vessels, 1841; large engines to work expansively at ordinary times, and with maximum power in action, 1841; concentrated fuel (working to petroleum ?), 1841; iron hulls for war vessels, 1841; wrought-iron rifled gun, 1841; the Armstrong lead-coated elongated shot, 1841; concentrated protection, a central battery, a belt of armor at the water line, and a shell proof deck, 1843 to 1854; protecting the hull by immersion to fighting draft, by means of water let into compartments for the purpose, 1843 to 1854; wrought iron engine framing, and a wrought-iron ship of 420 feet length, 1843 to 1854; loading a gun below deck by steam power, 1862.

As to the later inventions of Mr. Stevens, we can testify to the correctness of Mr. Holley's assertion, his plans having been repeatedly presented to this office by the venerable surviving inventor.

TRADES UNIONS ON TRIAL.—The case of Mr. Henry B. Dawson, against the Bricklayer's Union in Westchester county, N. Y., for conspiracy in preventing his son from obtaining employment, has so far resulted in a finding of a bill by the grand jury, the defendants having carried the case up to a higher court. The decision will be looked forward to with interest.