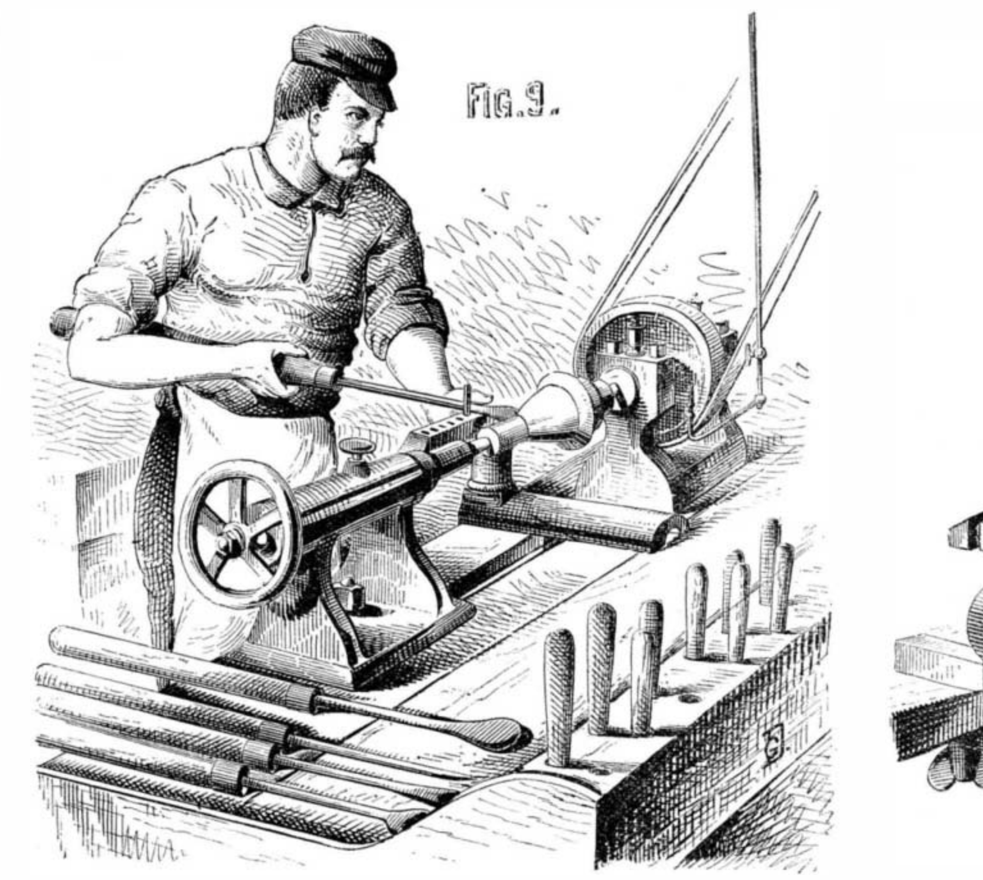
THE MANUFACTURE OF SILVERWARE.

There are certain industries which grade so insensibly into the fine arts that, in referring to those who follow them, one scarcely knows whether to use the terms workmen or artists. The manufacture of jewelry is one of these callings, that of silverware is another. The casual looker-on, seeing men with metal tools and hammers in their hands, bending over their benches, working at some dull-looking metal, instinctively regards them as mere manual laborers engaged upon no arduous task; but if he glances over their shoulders, and sees the ductile metal under their manipulation assume the most exquisite shapes, if he witnesses work produced not only of marvelous delicacy, but bearing the imprint of genius in every detail, the simple tools and begrimed garb of the workers are noticed no longer, and a feeling of genuine admiration comes uppermost in the mind capable of appreciating true artistic skill. Silver working has its prosaic side; for, despite beautiful ornamentation, forks and spoons are the commonest of every-day articles, and teapots, as teapots, are not conducive to lofty reflections. But on the other hand, such homely objects tend to make the industry what it is—art-workmanship, or to render it a link between the ideal and the actual, a means of adaptation of the airy conceptions of the artist to forms of utility. The manufacture of silverware may be divided into two parts: first, such as relates to the production of forks, spoons, and like small objects of definite form; and secondly, that relating to the making of hollow ware, which includes vessels of every description, whether for use or ornament. We propose in the following article to trace the various processes as practised at the largest establishment devoted to such work in the country—that of the well known firm of Tiffany & Co., of this city.



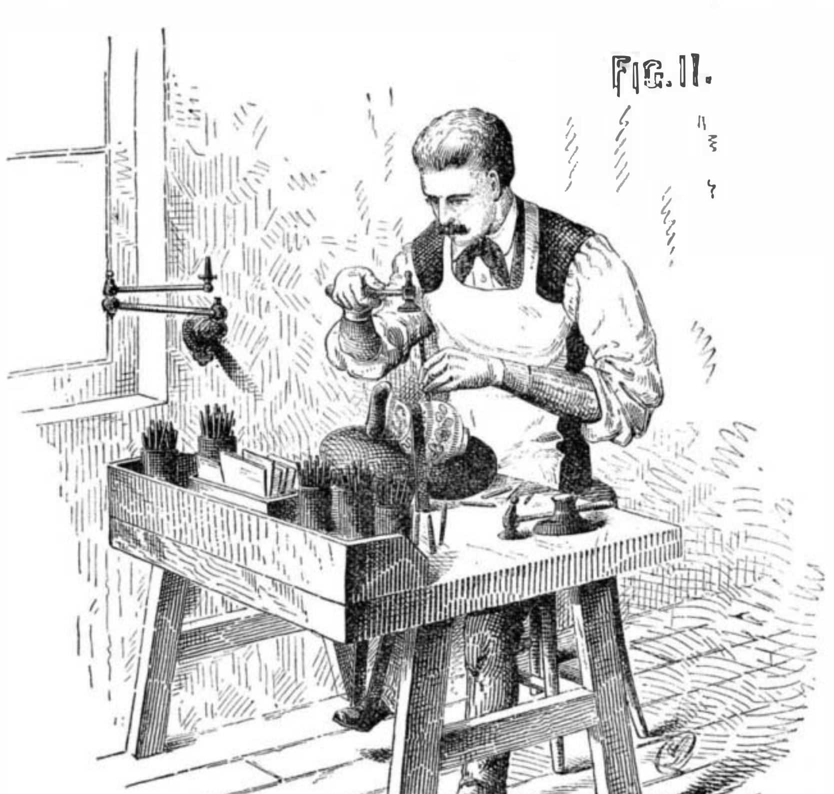
THE SPINNER AT WORK.

REPOUSSE WORK.—SNARLING.

The silver, to fit it for use, is alloyed with copper in the proportion of 0·075 copper to 0·925 of silver. The metal, on its reception at the factory, is weighed and tested to determine its standard quality, and is then sent to the melting hearth to be run into ingots of proper size. The operation of melting is represented in Fig. 1. (See front page.) The charge in each crucible is from 400 to 450 ozs., which, on becoming fused, is poured into either a skillet mold or else run into bars. The skillet is an ingot about 10 inches long by 6 inches broad, and 1½ inches thick, and is used for making the plates subsequently spun into hollow ware. The bars from which spoons, etc., are produced are some 20 inches in length, 1¼ inches in width, and ⅜ inch thick. As in these two forms of the metal are the starting points respectively of the two departments of the manufacture above noted, we shall trace the operations upon each separately, beginning with

THE MAKING OF FORKS AND SPOONS.

The bar of silver alloy above mentioned is placed between heavy rolls (Fig. 2, front page) and flattened out to ¼ inch in thickness. Ponderous shears then cut it into suitable lengths for the individual articles to be produced; and then rolling in a transverse direction flattens that portion which is to form the bowl of the spoon or tines of the fork, until at such part the width is about 2¼ inches. The blank, as it is termed, is now of the shape of A (Fig. 3, front page). It is then placed in dies in a drop press; and on the fall of the hammer, it emerges in the shape shown at B in the same figure. Next follows the rolling; and this involves the use of one of the most expensive machines employed. The outlay is incurred in the manufacture of the steel rolls, a pair of which is shown in Fig. 4 (see front page). On a single pair may be cut stamps for seven different articles. Thus we found the necessary patterns for dessert, table, tea, salt, and mustard spoons, besides those for large and small forks, on the two rolls represented, which, though quite small in size, cost about a thousand dollars to engrave. The designs are cut directly upon the cylindrical surface, and the metal is subsequently case-hardened. In operating the machine, the rolls are set in motion, and the workman inserts blanks for the articles desired, as the respective dies rotate in front of him. As the metal enters the rolls, it is caught by the deep notches made beside the pattern, and is thus prevented from slipping. On emerging, a spoon blank appears as in Fig. 5 (see front page). The pattern is perfectly stamped; but the bowl is flat, and around the spoon now outlined is a large amount of superfluous metal, which is clipped off by hand shears, the pieces falling into a locked box. Then the blank is carried to a file wheel, which removes all the material close up to the edge of the pattern; and if a fork is being made, a rotary file cuts the spaces between the tines.



REPOUSSE WORK.—CHASING.

The next operation is forming the bowls of spoons or the curved portions of other objects. This is done under the drop press by steel stamps, which force the portions to be curved into matrices made of tin. This metal is used because it is softer than the silver alloy, and yields to the raised portion of the ornamentation on the under side of the object as the blow is delivered. If the matrix were of steel, the ornament would, of course, be flattened out. The operation of drop pressing is shown in Fig. 6 (see front page). At A, a tin die for a spoon is separately exhibited.

The proper curve to the handle of the spoon is imparted by setting with a wooden mallet. Then follows smooth filing and weighing of the objects previous to their polishing. As a rule, about one third the metal in the original piece cut from the bar remains in the spoon; and during the various operations detailed, the absolute waste of material rarely exceeds 3 per cent. Nothing further is necessary but the buffing and polishing, which is done on wheels rotating at about 2,000 revolutions per minute, oil and sand being first used and then ordinary rouge powder. Fig. 7 (see front page) represents the polishing room. Meanwhile the elegant boxes, satin-lined and Russia-leather-covered, are being prepared from copper models of the objects which they are to contain; and in these receptacles, the gracefully shaped articles, dazzling in their fresh polish, repose in the sales-rooms of the iron palace on Union Square.

We may now retrace our steps back to the murky basement where the silver is melted and rolled, and thence follow the skillets in their final manufacture into hollow ware.

THE MANUFACTURE OF SILVER HOLLOW WARE.

Each skillet is passed some twenty times through the heavy 24 inch face rolls before mentioned (Fig. 2, front page), until it is reduced to a thickness indicated by 26 wire gauge (Brown and Sharpe's). Meanwhile the designers have produced detail drawings of the object to be manufactured, a pitcher, for example, of the form shown in Fig. 8 (front page). With the plate before him, a workman marks on the silver the lines laid down in the drawing, and, following them, rapidly cuts out the object. Our pitcher is now an assemblage of disks. Two, which answer to the upper and lower hemispheres of the lower portion; another forms the cover, and still another is to be made into the slightly flared straight intermediate portion. Then there are two narrow strips from which the ornamental bands are to be made. The decorative object on the cover and the handle are not provided for; but these we shall refer to further on.

The materials which are to be rendered concave are sent to a spinner, who has before him the drawing and a wooden pattern of the shape of the desired bowl. He pinches a disk in the fixed center screw of his lathe between two flat surfaces of wood, one of which is the wooden pattern. A burnisher resting against a pin in the lathe rest is now applied near the center of the metal, and the latter is gradually but rapidly bent or arranged until it fits close against the curved face of the block. The spinner at his work is represented in Fig. 9. The disks which are to form the upper part of the pitcher, globe, and also the cover, are treated in a similar manner, and the square-shaped pieces are flared by a similar process. While this is in progress, the narrow strips which are to form the ornamental bands are passed between engraved rolls, which impress upon them a suitable pattern. Their ends are soldered together, and they are bent around formers which give them the requisite flaring shape. Now the various parts of the pitcher being completed, nothing remains but to solder them neatly together, and the vessel assumes its desired form.

The handle and ornament for the cover, having been moulded in wax, and clay moulds prepared, are cast, an operation of the greatest delicacy, inasmuch as there is an immense amount of intricate undercutting work to look after. The moulds are made in fragments of every possible shape, and all are numbered so that they can be readily put together. At this stage, the handle and cover being affixed, our pitcher may be deemed complete. That is, it may be buffed and polished, and we should have a handsome plain article with a little tasty ornamentation on handle, cover, and on the fillets. If, instead of a pitcher, we had selected a snuff-box or waiter as our example, the spinning process would of course have been omitted, and the bent portions, forming the *bouge* (or bulge) of the waiter or sides of the snuff-box, would have been hammered over formers. No matter what the article is, however, the manufacture might as stated end here; but should we require an elegantly decorated object, we step at this point out of the region of handiwork and at once enter the realms of fine art.

HOW SILVER IS DECORATED.

We shall now proceed to explain the various ways in which our pitcher might be ornamented, and of these the simplest is the satin finish. This is done by a patented implement, small in itself, but, like a great many other little articles, very important in the office it performs. The object, having been polished, is held against a revolving bunch of fine brass wires, the latter being loosely held to the hub of a wheel. A stream of soapy water runs down on the brush while it is in revolution. The silver, being held up to the moving wires, is thus covered with minute stratches which finally produce upon the surface the soft sheen of satin. This is one of the most beautiful finishes that the metal can receive, and the rapidity with which it is done is remarkable.

Still more ornate is the flat chasing. By this process, tasteful figures are produced on the silver by dots and lines made with a punching tool. No metal is cut away; and in this respect the operation differs from engraving, in which sharp cutting gravers are employed to produce the design in sunken lines. *Appliqué* work is just the reverse of the foregoing, as the ornaments, instead of being made by indenting or removing the metal, are added by affixing portions to the surface. The metal is previously rolled or stamped into figures, scrolls, or braids, and these are simply soldered on the object to be ornamented. When finished, silverware in *appliqué* resembles that decorated by the *repoussé* process, which forms the subject of Figs. 10 and 11.

Repoussé work is probably the highest branch of the silversmith's art, and calls for the most consummate skill. The name means "repulsed" or "pushed back" work, and is applied because the metal is raised by hammering on the object from within, that is, it is dented outward. As it would be manifestly impossible to insert a hammer in many small narrow-necked vessels, or to use it in any hollow object with any convenience, the snarling tool is employed. This is simply a metal bar having one end bent and secured in a vise and the other turned upward and tapered to a dull point. The design having been scratched lightly on the exterior of the object, the latter is slipped over the bar, so that the vertical end of the same comes just under the portions which it is desired to have in relief. The workman then taps lightly on the snarling iron, close to the vise. The resiliency of the bar causes the blows to be transferred to the silver; and at the same time it tends somewhat to equalize their force. As soon as the entire pattern is raised, the vessel is annealed because the hammering hardens the silver, and the subsequent operations depend entirely upon its ductility. If the ornamentation is to be in very high relief, the snarling is repeated, and the ornamentation raised still higher. Then another annealing follows, and so on, until the artist judges that the raised parts sufficiently protrude.

The vessel is now filled with a resin composition, which sets hard and gives a firm backing, and is then placed on a pad before the artist who does the chasing, Fig. 11. This chasing differs from the flat chasing previously noted, in being a very much more elaborate process. The artist has before him hundreds of minute steel punches, and with these he literally pushes the metal into the designs called for by the drawing. To make a raised flower, for example, he has first merely a bulge on the surface produced by the snarling tool. With his little punches, he pushes certain parts of the metal under the edges of the protrusion, throws up other portions, and finally the shapeless swelling is converted into the thin delicate flower petals, in full relief from the surface. Of course this is very costly and very lengthy work. We were shown a single tea set of four pieces—all quite small—which were covered with exquisite flowers and arabesques, and on which one man had worked for eighteen months. The price of the articles was $1,500—a large sum to pay for the objects intrinsically considered, but not at all excessive when the work lavished on them is remembered. Ornaments for race cups and other decorations not attached to the surface are cast and afterwards carved.

There are three more processes for decorating silver, which we have yet briefly to review. Gilding is resorted to, not only for lining the interior of vessels but for producing tasteful designs on the exterior. The gold is deposited, by the electro-plating bath, upon such portions of the articles as may be desired, all of the surface of the latter save the pattern to be gilded being covered with wax. Enameling is an art by itself, and would form the subject of a paper even longer than the present general summary of the industry. It will suffice to say that the design is first engraved upon the object. Then the enamel, mixed with a little water into a paste, is painted in the incised portions. The article is then fired in a special furnace; the enamel fuses, vitrifies, and, when complete, is nothing more than colored glass inlaid in silver. A very beautiful mode of ornamentation which was practised in the middle ages, but which has remained for centuries almost unused until revived by Messrs. Tiffany & Co., is niello work, or the inlaying of silver with different metals and compositions. A black enamel and red copper are used, the first being inserted in the incised portion of the work by the process above described, and the second, by electro-deposition. The effect of the rich color of the copper and the solid black of the enamel, in contrast with the pure white luster of the silver, is exceedingly fine.

In Fig. 12 is represented the famous Bryant vase, a magnificent specimen of *repoussé* silver work, made at a cost of $10,000. The ornamentation is in high relief and chased with wonderful delicacy. This splendid work of art is in-

Fig. 12.—THE BRYANT VASE.

tended to symbolize Mr. Bryant's life and character through the medium of a classic form, covered with ornamentation drawn from Nature, and suggested by his works. The heavier lines of the fretwork are derived from the apple branch. Poetry is symbolized by the eglantine, and immortality by the amaranth, which is said never to lose its fragrance, and these are blended with the lines formed of the apple branch. The primrose, for early youth, and ivy, for age, form a border directly above the handles. Encircling the neck at the narrowest part, the immortal line "Truth crushed to earth shall rise again," is rendered *verbatim*, the beginning and end being separated by a representation of the fringed gentian, which Mr. Bryant remembers in one of his poems as always pointing to heaven. Eras in the poet's life are illustrated by a series of bas-reliefs. In the first, he is a child, looking up with veneration at a bust of Homer, to which his father points as a model. The second shows him in the woods, reclining in a meditative attitude. Between the first and second of these medallion pictures, is a portrait of the poet, laurel-crowned. Above this, the lyre for Mr. Bryant's verse, and beneath, the most primitive printing press, in remembrance of his connection for over half a century with the New York *Evening Post*.

In a smaller medallion is the waterfowl, used by Mr. Bryant as an emblem of faith. The ornament around the lower part of the vase is of the Indian corn, with a single band of cotton leaves, and at the foot is the water lily. The designer has introduced these symbols from Nature, as the fittest means of illustrating the life of an author whose writings teem with symbols drawn from the same source.

It would be remiss on our part to close this article with merely a cordial acknowledgment of the courtesy with which every detail of the manufacture we have described was submitted to our inspection. The work which Messrs. Tiffany & Co. are now carrying on is of national importance; for their establishment is not only a great business concern but a school of art. In this country, where art museums and similar means of educating popular taste are few and far between, our people are in large measure dependent upon the art industries of Europe; and an immense amount of money is yearly expended in the importation of objects of ornament made abroad, which could be equally well manufactured here, did the requisite degree of cultivated artistic skill exist among us. This fact is now well recognized, and efforts are being made by public spirited men to provide the necessary collections whereon correct standards of taste are based; but Messrs. Tiffany & Co. are doing even more than this, for they are directly educating men as art workers. In the designing department of their factory, boys are admitted at an early age and taught to design; and already many superior workmen and artists have in this way been made.

A Tremendous Mining Blast.

On April 19, a mass of iron ore, reaching to a height of 170 feet from the base and perforated with three large arches, was blown to fragments. It was situated in the famous "21 Mine" of the Port Henry Iron Ore Company, Essex county, N. Y. The mine had been dug to a depth of 300 feet and a diameter of 600 feet, in the center of which stood the mass to be broken up, which contained nearly 80,000 tons of the finest iron ore. In the pillars which formed the arches, 100 holes were drilled horizontally, of 3 inches diameter, some of them being 40 feet deep. The holes were completely filled with vigorite, a new explosive; and the charges were fired by electricity, in two blasts. The first was completely successful, but it somewhat marred the effect of the second by breaking some of the electric wires; 40,000 tons of ore were thrown down, and will be removed before the remaining charges of the second blast will be fired.

New Facts about Iceland Spar.

Professor A. K. Eaton, of Brooklyn, widely known as the inventor of an improved spectroscope, describes in the *American Chemist* a curious fact about Iceland spar. Hitherto the statement has been currently made and accepted that the axis of the crystal is the only direction along which there is no display of the curious property of the spar—double refraction. Wishing to obtain the widest possible divergence of the two rays from the spar, Professor Eaton cut it in planes perpendicular to the axis of the crystal; and to his great surprise, instead of getting the utmost separation of the rays, he found no double refraction perceptible. Finally he cut a crystal in the form of a sphere, and, by experiments upon it, ascertained that the two images of the ray are superposed on each other, so as to make no double refraction, not only when the ray passes through the axis, but also when it passes through in a plane direction perpendicular to the axis. From Professor Eaton's diagram it appears that the greatest divergence is to be attained by passing the ray through at an angle of 45° to the axis of the crystal. The fact is decidedly important in the use of the polariscope.

Driving Horses by Electricity.

The French papers describe an invention for driving horses by electricity. The coachman is to have under his seat an electro-magnetic apparatus, which he works by a little handle. One wire is carried through the rein to the bit and carried to the crupper, so that a current once set up goes the entire length of the animal along the spine. A sudden shock will, we are gravely assured, stop the most violent runaway or the most obstinate jibber. The creature, however strong and vicious, is transformed into a sort of inoffensive horse of wood, with the feet firmly nailed to the ground." Curiously enough, the opposite effect may be produced by a succession of small shocks. Under the influence of these the veriest screw can be endowed with a vigor and fire indescribable.

A Wonderful Spouting Well.

According to the *Miner*, the town of Wilcox, Pa., possesses a remarkable curiosity in the shape of a spouting gas well: It says: "There is an immense reservoir of gas in the hole, together with a seemingly endless supply of water, and there is evidently a gigantic and never-ceasing struggle between the two elements for the mastery. For a few moments the gas will throw the water to the height of one or two hundred feet, followed (by igniting the gas) by a volume of fire. Then the water will run back into the hole.

Communications.

Our Washington Correspondence.

To the Editor of the Scientific American :

The amount of cash receipts at the Patent Office would seem to indicate that business was reviving there as well as elsewhere—the money received on Friday of last week being over five thousand dollars, the largest amount, with one exception, ever realized in any one day since the establishment of the Office.

A few days since there was a report in the papers that Secretary Schurz would soon hear charges made against Commissioner Spear by J. McCleary Perkins, which was followed by this paragraph in the *Republican :*

"The statement that Secretary Schurz was to hear the evidence on certain charges made by one J. McCleary Perkins against Commissioner Spear, of the Patent Office, had no foundation in fact. There are several charges now pending against Perkins which may, when the Secretary finds time to examine them, result in barring Perkins from practising before the Department, and which will doubtless be heard before any charges preferred by Perkins against any officer of the Government."

From this, it would appear that Mr. J. McCleary Perkins does not get along quite as well with the present Commissioner as he did for a time with the last one. Shortly after Mr. Duell took his seat, Mr. Perkins, having much more time on his hands than clients to occupy it, undertook to oversee the business of the Office. For a time, it seemed, from the authority he assumed, that he considered himself as Acting Commissioner, or at least Assistant Commissioner. and actually took possession of and occupied a desk in one of the rooms for his own private business, until Mr. Duell got tired of his officiousness, and he was refused its further use, since which time he has become what one of our papers calls him—"a chronic grumbler."

There has been a vacancy for some time past in the Board of Appeals, owing to the inability of Mr. Marble to take the position on it to which he had been appointed, as he was filling another office; and having now been appointed Assistant Attorney General, he has formally declined the position. It having been determined to fill the vacant office by a competitive examination, the Commissioner, Assistant Commissioner, and Assistant Attorney General were appointed as an examining board, before whom the following gentlemen who competed for the position were examined: Messrs. Fox, Wilkinson, Dyrenforth, Burke, Bartlett, Hedrick, Tilden, Durnall, Bates, Wilber, Catlin, Bowen, and Antisell, all of whom are members of the examining corps, except Dr. Antisell, who formerly served in that capacity, but resigned many years since. The examination is said to have been entirely practical, and to have reference to office work only. The board will examine the papers as soon as they can spare time from their current work, and report the three last to the Secretary, who will then nominate one to the President for appointment.

Application having been made by a printing firm in your city to register as a label a print representing a race course, without any descriptive matter thereon, the intention being to sell the print to customers to ornament their goods, the examiner rejected it on the ground that it should be registered as a trade mark, if registered at all; but the Assistant Commissioner on appeal decided that such a print does not meet the requirement of a trade mark or copyright, and that it should therefore be properly registered as a label, as it is not to be considered as a work of art, but is to be used for "other articles of manufacture."

Reports from nearly nine hundred counties in which winter wheat is raised have been received by the Agricultural Department, of which about one quarter are unfavorable; but in the remainder the yield promises to be from average to superior. Of three hundred and twenty counties in the Ohio basin, only forty-five report below the average. Grasshopper ravages are reported in twenty-two counties of Kansas, and the wheat-growing districts of Texas are said to be alive with these insects. There is, however, an increase of the area of wheat in the latter State, and the prospects are favorable in other respects. In the other cotton States, a dry autumn and variable winter have depressed the condition of wheat below the average.

The sixth report of the Government Inspector of the works for the improvement of the South Pass of the Mississippi is just received; from which it appears that, since November 18, 1876, about 16,000 cubic yards of material have been dredged at points where the channel was the worst. A part of the west jetty has been raised by mattresses and a layer of stone, until it is of a height of from six inches to two feet above the average flood tide; and one hundred and sixty-seven additional piles have been driven. A table accompanying the report shows that the depth between the jetties has gradually deepened from nine and two tenths feet in June, 1875, to twenty and a half feet in March of this year. At the head of the passes, the west T head has been extended up the stream, and its upper part made a solid dyke; a line of mattresses has been carried from the east T head down to the head of Goat Island; a solid mattress dam has been built across the old east entrance to the South Pass; and about 30,000 cubic yards of digging has been done. The rising of the river caused a sharp scour between the T heads, so that near twenty-four feet could be taken from the Mississippi into the South Pass on March 7, 1877.

The National Academy of Sciences is now holding its fifteenth annual session, at the Smithsonian Institute in this city. The following papers have been read up to the time of writing this:

"On a new measuring instrument, the vernier microscope," by Professor A. M. Mayer. "On systematic errors in star declination," by Professor E. C. Pickering. "On the young stages of osseous fishes," by Professor Alexander Agassiz. "On critical periods in the history of the earth, and their relations to evolutions, and on the quarternary at such a period," by Professor Joseph LeConte, of San Francisco; read by Dr. John L. LeConte. "On the progressive motions of storms," by Professor Wm. Ferrel. "On the effect produced by mixing white with colored light," by Professor O. N. Rood. "On Newton's use of the term 'indigo,' with reference to a color of the spectrum," by Professor O. N. Rood. "Improved method of obtaining metallic spectra," by Professor G. F. Barker. "On the internal structure of the earth as affecting the phenomena of precision and mutation," by General J. G. Barnard, U. S. A. "On a proposed new method of solar spectrum analysis," by Professor S. P. Langley, director of the Alleghany Observatory. "On complex inorganic acids," by Professor Wolcott Gibbs. "On a micrometer level and topographical camera," by Professor E. C. Pickering. "On the determination of the co-efficient of expansion of solids," by Professor A. M. Mayer. "On the results of deep sea dredgings," by Professor A. Agassiz. "On a new detached gravity escapement, invented by Professor Young," by Professor Barnard. "On the laws ruling the vibrations of tuning forks," by Professor A. M. Mayer.

Many of these papers and the discussions that followed were deeply interesting; and as the session will continue a day or two more, it is probable that other equally interesting subjects will be discussed. The following gentlemen were elected members: Dr. John W. Draper, of New York; Dr. Scudder, of Cambridge; Dr. Elliott Cones, Dr. Henry Draper, of New York; and Mr. C. S. Pierce, of the Coast Survey.

The War Department will, it is said, at the coming extra session of Congress, call for an appropriation for the manufacture of improved arms, so that their accumulation might place the government in readiness for any emergency. It is stated that there will not be more than about 8,000 arms of the improved patterns on hand at the close of the present year; and that if the States should draw all they are entitled to, the stock of improved arms held in reserve would be exhausted. The style of gun now being manufactured is that known as the Springfield breech-loading rifle, and it is argued that these guns should be manufactured in sufficient quantities to render a gradual accumulation of them in store a certainty, as otherwise the government may find itself without arms at a time when they may be wanted very badly. The ordnance officers are also complaining about the meagre means of defense on our coasts and harbors, asserting that we have little or no means of operating against the heavily armored ships that the European powers could bring against us, excepting the torpedo boats, which are as yet but in the experimental state. It is stated that several experimental guns have been made; but they cannot be tested, as no money has been appropriated by Congress for that purpose.

In consequence of a recent decision of the Supreme Court respecting the eight hour law, Secretary Sherman is about to issue an order that hereafter no officer shall pay ten hours' wages for eight hours' work, thus practically reversing the order of General Grant constituting eight hours a day's work.

One of our street railroads has received permission to try the dummy engines now successfully used in Philadelphia, and will shortly introduce them on both their lines, if on trial they meet with approval.

Washington, D. C. OCCASIONAL.

Letter from the Oldest Locomotive Engineer now Living.

To the Editor of the Scientific American :

I am probably the oldest living locomotive engineer in the United States, possibly in the world. In the year 1832, I think, the Schenectady and Saratoga railroad went into operation, and in that year imported a locomotive engine from England, made by George Stephenson, and named after him; an engineer named Turner came with it and ran it for some months; but as he was a man in poor health, I frequently was called upon to fill his place, as I was then superintendent of Clute & Bailey's machine shop and foundry, where the work for that road was generally done. The engine above mentioned, I think, was the first in the United States placed and run upon any railroad. The Mohawk and Hudson was the first railroad built in the State, but was operated by horse power for several years, with stationary engines at both ends for hauling up and letting down the passenger cars on the inclined planes at Albany and Schenectady. I saw a short article in some paper a few years since, saying that the locomotive engine above mentioned was still in the city of Schenectady, laid up as a curiosity in some establishment there, for I assure you it was a curiosity, when compared with those of the present day.

I have never followed the occupation of an engineer either on a steamer or locomotive regularly, having always preferred that of a machinist, so as to be at home with my family at night, although in my younger days I have frequently operated on both when necessity required it. I am now 77 years old, and for the last 35 years have been living on my farm in the mountains of Georgia, enjoying good health; I am hearty and active, and can do as good work as I ever did, and can mount a horse as spry as when 45 years old. I presume you have had a description or descriptions of the locomotive alluded to, or I would send it, as well as my recollection serves me.

Clarksville, Ga. J. VAN BUREN.

Remarkable Explosions.

To the Editor of the Scientific American :

In the year 1873, some parties in this city conceived the idea of pulverizing brimstone, which was done successfully. The product very closely resembles flowers of sulphur, and many tons of it have been sold, the greater part to sheep farmers. At the time of the first attempt, we had pulverized about a hundred tons, and were just about stopping the machinery when a terrible explosion took place; and in a few minutes the mill building was all in flames and completely destroyed. The mill at the time was full of fine dust of sulphur, especially the upper story, where it was floating thick in the air. The explosion seemed to be mainly in the upper story. There was no fire in the building, nor was there any person smoking, and the affair seemed a mystery to everybody. Many who pretended to be chemists and experts said there was nothing to be feared from grinding sulphur; but I maintained that either sulphuretted hydrogen was generated in some way by the attrition, or that the impalpable dust, mixed with the air, was the cause of the explosion. I told the mill owner that it would explode again if the attempt was repeated; but he did not mind me, and when he rebuilt the mill he tried it again. When we were just about stopping after finishing a lot of seventy tons, on July 25, 1874, another terrible explosion took place, with the same circumstances attending it as on the previous occasion. The mill was burnt to the ground. Since then the owner of the mill never tried sulphur grinding again.

San Francisco, Cal. J. W. MORRISSEY.

Pneumatic Transmission of Time.

To the Editor of the Scientific American :

In your issue of April 21, 1877, is an article on the transmission of correct time in Vienna, Austria. Allow me to state that the transmission of time by a pneumatic system has been in use in San Francisco since February, 1874, where, in the London and San Francisco Bank Building, one regulator transmits the time to 14 dials. This invention (of Mr. H. Wenzel, of San Francisco) was patented in July, 1873, and is so satisfactory that it has been also introduced in the Nevada Bank Building, with 26 dials; in the San Francisco Club House, with 8 dials; in Baldwin's Hotel, with 62 dials, and into a number of private houses. One of these clocks, with a most ingenious, original improvement on the escapement, termed "force constant," and connected with several dials, to which any number of dials in the same or adjacent buildings may be added, is now in operation, and can be seen at Mr. C. W. Schumann's office, 24 John St., this city.

New York city. L. BECKERS.

Stream Power and its Utilization.

To the Editor of the Scientific American :

An article appeared in the SCIENTIFIC AMERICAN of April 28, 1877, under the above heading, for which you credit the *Millstone.* I know not to what the *Millstone* gave credit for the article; but I am sure that it ought to have given credit for the article to the SCIENTIFIC AMERICAN of January 14, 1871. If you will refer to that number of your journal, I think that you will acknowledge that no one can be more positive as to the origin of that article than your humble servant. It is one of the weaknesses of humanity to be pleased with due thanks for one's fugitive ideas and compositions.

Worcester, Mass. F. G. WOODWARD.

American Inventive Progress.

"Under the above heading the SCIENTIFIC AMERICAN of May 7th has a long and interesting article, from which we make the following extracts:

"'To show with what rapidity inventors made improvements on inventions embodying original principles,' says the writer, 'it may be noted that, in the early days of the sewing machine, 116 patents were granted for improvements thereon in a single year; and out of the 2,910 patents issued in the year 1857, 152 were for improved cotton gins and presses, 164 for improvements on the steam engine, and 198 for novel devices relating to railroads and improvements in the rolling stock. In the year 1848, three years after the publication of this paper was commenced, but 660 patents were granted; but under the stimulus of publishing these inventions as they were patented, ten years later, in 1858, the number had increased sixfold, reaching 3,710, while up to January 1, 1850, as already stated, the aggregate of patents issued amounted to 17,467; since that time and up to the present period the total is 181,015.

"'And curiosity here leads us (adds the editor) to review our own work, extending back, say, twenty years, or to 1857, a period during which 170,745 patents have been issued. We find, by actual count, that 62,062 applications have been made through the Scientific American Patent Agency for patents in the United States and abroad. This averages almost ten applications per day, Sundays excluded, over the entire period, and bears the relation of more than one quarter to the total number of patents issued in this country up to the time of writing.'"—*Philadelphia Evening Bulletin.*

PRACTICAL MECHANISM.

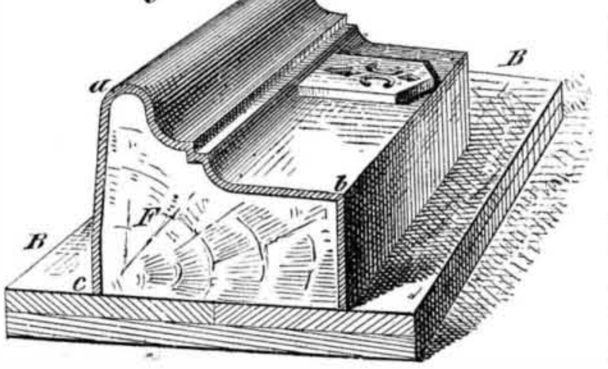
BY JOSHUA ROSE.

NEW SERIES—No. XXV.

PATTERN MAKING.—THIN WORK.

In the examples we have hitherto presented to the reader, we have supposed the pattern to be of such substance or thickness as to be able to bear the pressure of the sand being rammed about it in moulding without breaking or altering its form; but this is not always the case. The parts of a stove, for instance, are cast often less than ⅛ inch in thickness; the same may be said of most of the ornamental ironwork used in architecture, and even cornices and window sills range only about $\frac{3}{16}$ or a ¼ inch thick. It is true that for this kind of work metal patterns are almost invariably used; but for the pattern maker this is indifferent, as wood patterns have to be made from which the metal patterns are to be cast. Take, for example, the window sill shown in section in Fig. 187; to enable it to withstand the pressure of the sand while ramming, we must fill the interior with a

Fig. 187.



form or block, shown at F, which is to be used in conjunction with the board, B. This form and board are no less useful to the pattern maker than to the moulder; for let the form be once obtained of the proper size and shape, and the construction of the pattern is so far simplified as to be merely a covering of this form with wood slightly thinner than the required thickness of metal. Most thin work is made in this manner, especially if the patterns are of such size or shape as to need the joining together of many pieces; it is not the pattern itself that demands our first attention, but rather the form that supports it.

Thin work demands great care and patience on account of its fragile nature. Scarcely any hold can be obtained for nails; and though the best glue is used, it cannot always be relied upon. Dovetails for square corners, if they are end wood to end wood, will be found very superior to glued joints. Furthermore, as few joints should be made as possible, and the pattern should be well protected by several coats of varnish. In working out thin mouldings, as for instance, the portion of the sill from *a* to *b*, which should be of one piece, we plane up a piece of a suitable width and thickness, and trace the outline of the moulding upon each end of the piece; then, as it lies flat upon the bench, we work out on one side to the lines which will fit the form, as in Fig. 188, and then, by temporarily fastening the piece to the form, F, to give it proper support, we are enabled to work out the opposite side to the required shape. In working out thin mouldings, a circular saw with an adjustable table will be of great assistance, as by its means we may make a series of saw cuts so close together as practically to take out half the stuff, and form an excellent guide for cutting away the other half (see Fig. 188). The part from *a* to *c*, Fig. 187, should not be formed by glueing thin stuff together at the obtuse angle, but should be of one piece. Fig. 189 is a section of a cornice lying upon its bed or follower board, B; it may be made of one piece, as in the previous example.

Fig. 188.

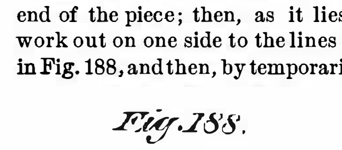
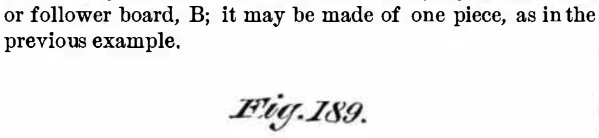
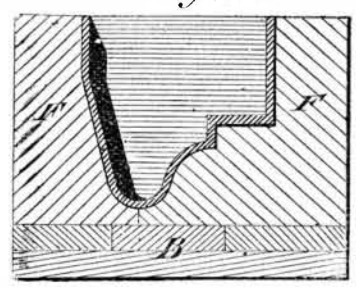


Fig. 189.



In moulding work of this kind, the procedure is as follows: The board, B, with the form and pattern, is placed upon a level bed of sand so that it may not wind or twist under the weight that is to be put upon it, which will consist of the nowel rammed full of sand. The board and nowel are fastened together by cramps, and, the ramming finished, the whole is turned over; the board and form are then removed. There is no longer any necessity for the support of the latter, as the sand, having been once rammed, does not press upon the pattern to its injury, but keeps its position and becomes a good and sufficient support to it during the ramming up of the cope, which is now placed in position, and the moulding continued in the usual manner. Instead of the form, F, which fills the interior of the pattern, we may provide a strong enveloping form, as shown in Fig. 190; the difference is that the reverse side of the casting will be uppermost as compared with the other case. The form must fit that side of the pattern which we wish to come next the cope. Forms of an irregular or difficult shape are often advantageously made by simply pouring plaster of Paris into the patterns for which they are intended. A great deal of thin work is formed by dry sand coring, often from necessity; but when practicable, the dry sand core is discarded and the pattern made to leave its own core. This insures greater accuracy, is cheaper, and causes the interior surface of the casting to be the same as the exterior. When dry sand cores are employed, there is no difference between thin work and thick, and therefore the methods described in former pages are a sufficient explanation of the process.

Fig. 190.



Duties of an Engineer in the Care and Management of a Steam Boiler.

The following instructions may be of little importance to skilled engineers, as such are supposed to be thoroughly versed in all the matters discussed; but to young and less experienced engineers, we believe that the directions, from the Indianapolis *Mechanical Journal*, will be found useful.

The first duty of an engineer when he takes charge of an engine and boiler is to examine his boiler and see that the water is at the proper level. The water should be kept up to the second gauge whilst working, and up to the third at night. The reason why the water should be raised at night is to prevent it from becoming too low from leakage or evaporation. In case the water should become dangerously low, the engineer should immediately draw the fire and allow the boiler to cool, and not admit any cold water to the boiler or attempt to raise the safety valve, as it would be positively dangerous. The reason why it would be dangerous is, that it would lessen the pressure in allowing the steam to escape from the boiler, thus allowing the water to rise up and come in contact with the overheated iron, and probably cause an explosion. In case the water supply should be cut off from the boiler for a short time, he should cover his fire with fresh fuel, stop his engine, and keep the regular quantity of water in the boiler until the accident is repaired and the water supply renewed. To get up steam, the engineer should first see that the water is at the proper level; he should then remove all ashes and cinders from the furnace, and cover the grate with a thin layer of coal; and after placing his wood and shavings on the coal he will be ready to start his fire. The advantage in placing a covering of coal on the grate before the wood or shavings is that it is a saving of fuel, as the heat that would be transmitted to the bars is absorbed by the coal, and the bars are also protected from the extreme heat of the fresh fire. An engineer should allow his fire to burn gradually when commencing to get up steam from cold water, as by allowing the fuel to burn very rapidly some parts of the boiler become expanded to their utmost limits, while other parts are nearly cold. Of course, a great deal depends upon the time in which he has to raise his steam. An engineer should regulate his fire at a uniform thickness, and not allow any bare places or accumulations of ashes or dead coals in the corners of the furnace, as these places admit great quantities of cold air into the furnace, and render the combustion very imperfect. An engineer should avoid excessive firing as much as possible, as it is attended with more or less danger, because the intense heat repels the water from the surface of the iron and allows the boiler to be burned. He should keep about three inches of anthracite coal and about five inches of soft coal on his fires, but he should regulate the thickness of the fire according to the capacity of the boiler. If the boiler is too small for the engine the fire should be kept thin, the coal supplied in small quantities and distributed evenly over the grate, and the grate kept as free as possible from ashes and cinders; but if the boiler is extra large for the engine, the thickness of the fire makes but little difference. If the fire becomes very low, he should neither poke nor disturb it, as that would have a tendency to put it entirely out; but he should place shavings, sawdust, wood or greasy waste on the bare places, with a thin covering of coal; then, by opening the draught to its full extent, the fire will soon come up. If it should become necessary to burn wood on a coal fire, it is always best to make an opening through the coal to the grate bars, so that the air from the bottom of the furnace can act directly on the wood and increase the combustion. He should give great attention to the regulation of the draught in the furnace, as it is one of the most important parts of an engineer's duties, for in fact it is next in importance to the regulation of the water in the boiler.

It is well known that immense quantities of fuel are recklessly wasted by ignorance and carelessness in the management of the draught. He should not have any more draught at any time than would produce a sufficient combustion of the fuel to keep the steam at the working pressure, as by opening the damper to its utmost limits great quantities of heat are carried into the chimney and lost. An engineer cannot carry out this plan in all cases—only in furnaces and boilers that are sufficiently large to furnish the necessary amount of steam without forcing.

Of course, where the boiler is too small for the engine, or has not sufficient heating surface, it is impossible to economize fuel. In some cases it is a good plan to throw a jet of steam under the furnace bars when the draught is insufficient to produce the necessary combustion of the fuel. It is considered an advantage, before clearing a fire, to throw some water under the grate bars, as the oxygen of the steam thus generated under the furnace will unite with the oxygen of the atmosphere, and insure a more rapid combustion of the fuel after the fire is cleaned.

Steam or water should not be thrown under the grate bars of locomotive boilers when such boilers are used for stationary engines, as steam or water in the ash-pit forms a lye with the ashes, and corrodes the iron and destroys the water legs of the boiler. An engineer should always keep his pit clean, as by allowing the ash pit to become filled with ashes and cinders the air becomes heated to a high temperature before entering the fire, which naturally interferes with the combustion of the fuel. The grate bars also become overheated, and in many cases badly warped or melted down. He should at all times watch his safety valve carefully, and keep it in good working order. He should do this at least once a day; the morning is the proper time, and then he will feel safe during the day. We have often seen safety valves with all kinds of weights on them, and it at once gave us a poor opinion of the engineer. No first-class engineer will do this. It should be one of the main reasons for discharging him. In blowing out a boiler, remove all fire from the furnace, and see that the steam is at the proper pressure—say from 45 to 50 lbs. Always close the damper.

At least one hour should pass between drawing the fire and blowing out the boiler. This will allow the furnace to cool and prevent the boiler from being injured with the heat after the water is all blown out. The higher the steam pressure, the higher the temperature of the iron, so that by blowing out the boiler under a high steam pressure the change is so sudden that it has a tendency to contract and cause the boiler to leak. The boiler should not be filled with cold water immediately after blowing out, as the introduction of cold water into the boiler before the temperature of the iron becomes lower would, in all probability, cause the boiler to leak. The boiler should be blown out whenever any appearance of mud is found in the water. When fresh water is boiled, it is supposed to deposit its mineral, and after that it is not advisable to blow out the pure water and fill the boiler with water holding matter in solution and suspension; and for this reason once in two or three weeks is often enough to blow out the boiler. When filling the boiler, some cock or valve in the steam room should be opened and allow the air to escape. If not, the air would retard the ingress of the water, and also collect in the steam-room of the boiler, and prevent the regular expansion of iron when the fire is started.

The steam-room in a boiler is that portion of the boiler occupied by steam above the water. The water room is that portion of the boiler occupied by water. The fire line of the boiler is a longitudinal line above which the fire cannot rise, on account of the masonry by which the boiler is surrounded. The tubes of a boiler should be cleaned at least once a week; all ashes and soot should also be removed from the outside of the boiler. This all makes a great saving in fuel, as it allows the fire to act directly on the iron. Boilers should be cleaned at least once in three months. All stays, braces, seams, and angles of the boiler should be examined carefully. He should also sound the shell of the boiler with a very light steel hammer. It is a good way to determine the condition of the iron.

The steam guage should be tested at least once a year. It should be done by a test-gauge, made expressly for the purpose. The water gauge should be kept clean, inside and out, and all points belonging to same. By opening the drip cock and closing the water valve and allowing the steam to rush down the glass, the steam will carry out the mud and sediment. They should also be swabbed out with a piece of cloth or waste on a small stick when the boiler is cold; but care should be taken not to touch the inside of the glass with wire or iron, as an abrasion will immediately take place.

Decay of Timber.

Wet and dry rots are the two forms of decay which attack timber that is exposed to the action of the weather, and the cause of both may be said to be heat with moisture. Confined air and evaporation cause dry rot, and imperfect evaporation wet rot to a greater or less degree.

Investigation shows that as a preventive against these rots the timber should be well seasoned, and if used where liable to be under the influence of sun and rain should be well well painted, or, if not painted, should be impregnated with linseed or oil of tar. The best preventive, however, is found to be that of allowing a free circulation of air around the timbers, and the walls to be allowed to dry thoroughly before the introduction of the timbers; should the timbers have taken either of these rots very little can be done to preserve them. In case the rot is perceived to be at the end of beams only—where in fact it generally commences—the best method of preserving the rest of the timbers is to effectually cut away the decayed portion and scarf with sound; if, however, this should not be practicable, the wood may be scraped and cleaned of all fungus or extraneous matter and then impregnated with any of the usual oils.—*Cincinnati Trade List.*