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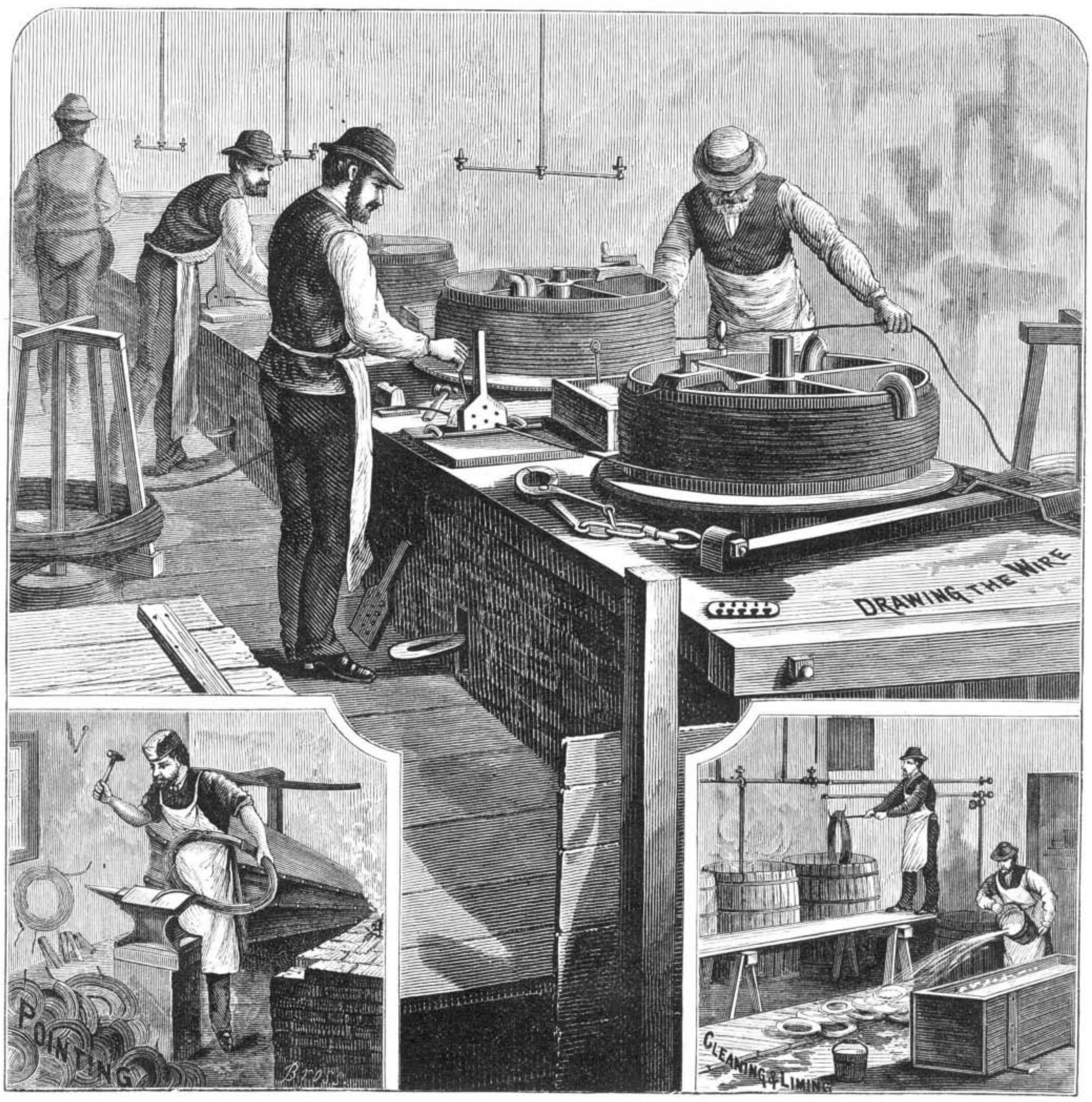
## THE WIRE FOR THE EAST RIVER BRIDGE.

The work of manufacturing the crucible steel wire, from which the great cables and other portions of the superstructure of the East River Bridge are to be made, is now in active progress at the factory of Mr. J. Lloyd Haigh, in South Brooklyn. Some twenty-two months will be devoted to drawing the 6,800,000 lbs. of wire required. The size of wire at present being made is of No. 8 gage, or 0·165 inch. Each of the nineteen strands of each of the four main cables will contain 331 wires of this diameter, so that in each cable there will be 6.289 wires.

The mode of manufacture, which is illustrated in the engravings herewith presented, is quite simple, and its processes are few. The steel is received at the factory in the form of rods rolled to about one quarter inch in diameter, and made into coils. Each coil in turn is brought to a forge, where one end of the rod is heated and then hammered to a point by hand. If the wire to be produced is to be of fine gauge, necessitating several drawings, it is softened by annealing in a suitable furnace. The bridge wire, however, does not require this treatment, and therefore is carried at once to the cleaners, in order that any oxide or foreign matter on its surface may be removed. The cleansing process consists in dipping the coils in vats containing dilute sulphuric acid until the surface is sufficiently attacked. Then the further action of the acid is arrested by dashing a mixture of lime and water over the coils as they lie upon the floor. The wire is now transported to a large oven in which it is placed and there kept until thoroughly dry, when it is ready for the principal operation which it has to undergo, namely, the drawing. This, with the pointing and cleansing processes already described, are illustrated in the large engraving, Fig. 1. The drawplate is simply a piece of very hard steel, of the shape shown in the illustration, and firmly affixed to the table or bench. From the flat side of this plate (at which they have their larger extremity) to the opposite side (which is not necessarily a truly flat surface) several conical holes are pierced, their smaller orifices being carefully finished to the sizes they are respectively intended to give to the wire drawn through them. The holes in each plate are made successively smaller by minute gradations, so that the reduction of the wire and the effort required shall be, at the successive drawings, as nearly uniform as possible. The drawplate is usually about 10 inches long and 1½ inches thick, and it is made with great care. In France it is formed by repeatedly fusing and hammering, to insure their complete union, the two lateral parts of a compound bar, one part being of wrought iron and the other of a sort of steel called *potin*, previously obtained by melting to a paste fragments of cast iron pots with white wood charcoal, throwing this into cold water, and repeating the melting and sudden cooling ten or twelve times. When the union of the two parts is complete, the plate is reheated and extended; and it is then several times heated and punched with successively smaller punches to secure tapering holes; though these, which are of course smallest at the steel or hardest side, are left to be finished in the cold plate by the wire drawer himself. For extremely fine wire, the drawplates are sometimes made of the hardest precious stones. With a plate having a hole pierced through a ruby of 0·0033 inch in diameter, a silver wire 170 miles long has been drawn so nearly uniform that neither the micrometer nor the weighing of equal lengths at the two ends showed any difference in size. Generally, however, for steel wire drawplates, a very hard steel, known as savage or wild steel, and made out of pig metal, is employed.

It will be observed in the large illustration that the workmen stand before a bench on which are a number of cylinders. These are heavily built, and are rotated by vertical shafts which extend under the bench. Just below each drum is a cam which acts upon the pivoted lever shown in the foreground on the left. To the end of this lever is fastened a chain which is attached to nippers or to a dog. Having thrown his coil over a reel, the workman inserts the pointed end as far as possible through the proper hole in the drawplate. Then, with the dog, he grasps the extremity which protrudes through, watching his chance to do so as the cam on turning allows the nippers to be moved to the right. As soon as a firm hold of the wire is obtained, the cam in its revolution acts upon the lever with great power, and thus the wire is dragged through the plate for several inches. The nippers are loosed, and a fresh grasp is ob-

[*Continued on page* 130.]




**MAKING THE WIRE FOR THE EAST RIVER BRIDGE.—Fig. 1.**

Fig 2.

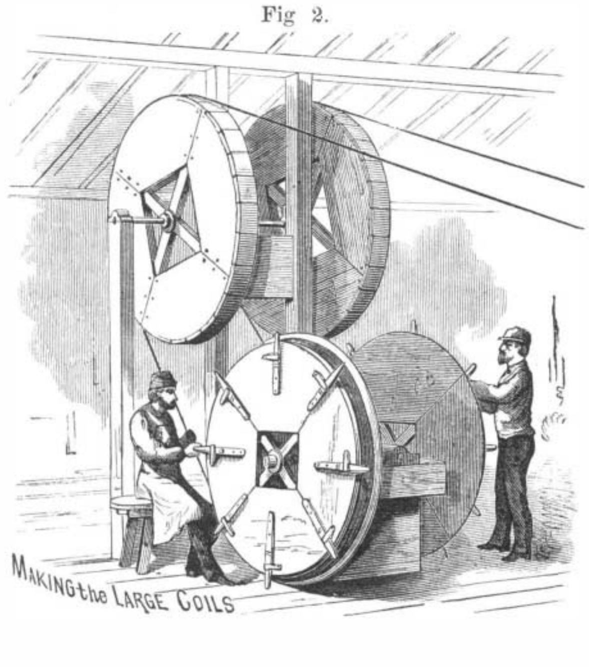



Fig. 3.

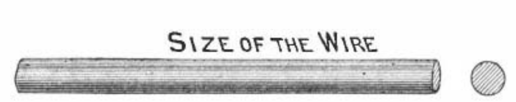
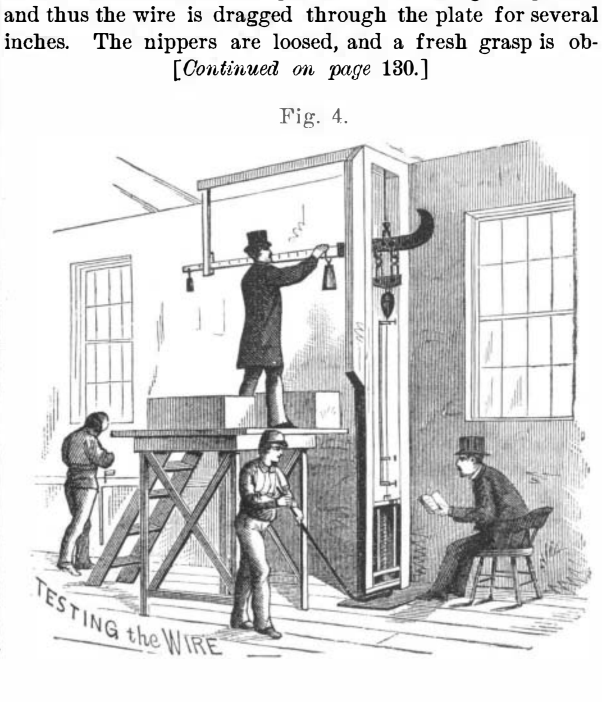



Fig. 4.



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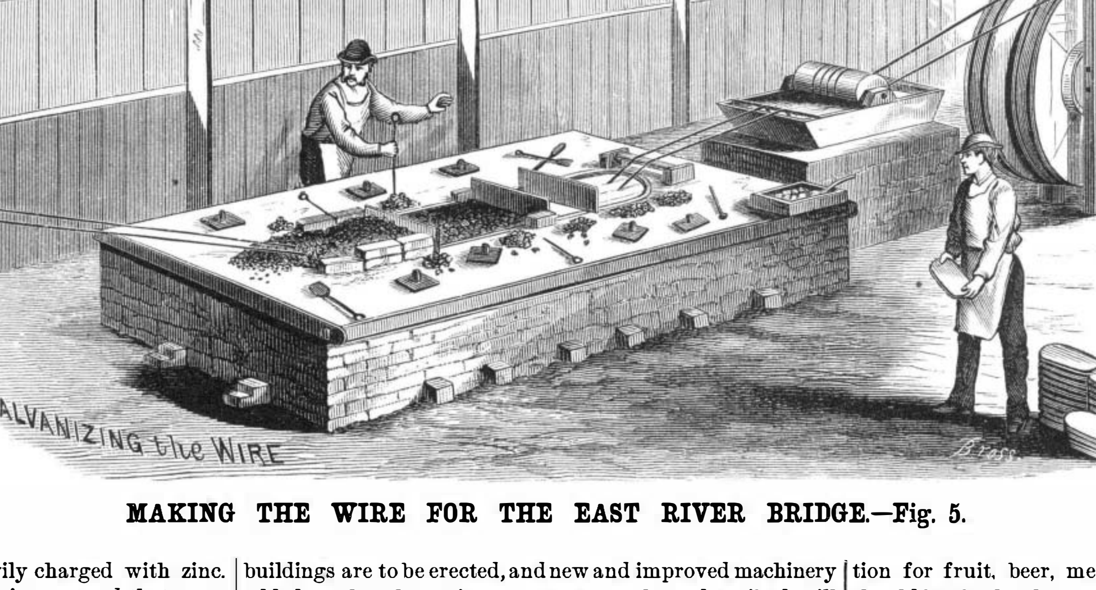
tained close to the plate, and this is repeated until a sufficient length of wire is made to allow the end to be carried to the cylinder and there secured in the vise provided for the purpose. The cylinder, meanwhile, is out of action; but as soon as the wire is fastened to it, the workman presses a treadle, a clutch connects the cylinder and shaft, and the latter slowly rotates, thus drawing the wire continuously through the plate. Should the wire break, the machine is stopped, the end repointed, and the operation already described begun again. This continues until the rough rod is all drawn down to a neat cylindrical wire, which, however, is yet considerably too large in diameter. To reduce it, a second drawing through smaller holes is required; and if the wire is to be very fine, sometimes as many as twenty-four drawings are had, annealing in such case taking place between each drawing. The bridge wire of the size before mentioned requires to be drawn but two or three times to reduce it the necessary 0·085 inch.

The next process is illustrated in Fig. 5, and is the zincing or, as it is commonly termed, galvanizing. The wire is led over rollers into a bath of dilute muriatic acid already heavily charged with zinc. The acid bites a clean surface, and it is supposed that some zinc is precipitated on the wire, which better insures the deposition of the melted zinc, through a large bath of which the wire is subsequently led. The zinc covering of course protects the wire from oxidation and effects of the weather. The wire is next led to large reels, Fig. 2, whereon it is made into coils, each containing 840 feet, weighing 60 lbs., and measuring some 4 feet 6 inches in diameter. All the wire is required to be straight wire: that is to say, when a ring is unrolled upon the floor, the wire behind must lie perfectly straight and neutral, without any tendency to spring back in the coiled form. In order to produce this straight wire, the patented process of Colonel W. H. Paine, assistant engineer of the bridge, is used. The wire is led from a point within the galvanizing trough in a straight line, under considerable tension, to a guide sheave or winding drum, which is located at such a distance as to permit the wire to be cooled and set before it is coiled thereon. The size of the drum is such as to cause no permanent bending of the wire.




MAKING THE WIRE FOR THE EAST RIVER BRIDGE.—Fig. 5.

The turning of the drum is represented as being done by hand in Fig. 2; but of course when the manufacture of the wire is further advanced, and when many such drums are necessitated, the work will be done by suitable machines.

Nothing further remains to be done but to test the finished product to find whether it meets all the contract requirements. The machine for this purpose is represented in Fig. 4. It consists simply of a long scale arm on which the weights are adjusted, and so caused to pull, at a very strong leverage, on the sample adjusted in jaws connected with the arm. Pieces of wire are cut from each coil, secured one at a time between the jaws, and broken. One person, who adjusts the weights, notes the breaking strain; while another, who watches the behavior of the sample, notes the amount of stretch which it undergoes on a suitably arranged scale. For the No. 8 wire the contract tensile strength is 3,400 lbs., and the stretch 3½ per cent. These requirements, we learned, are generally exceeded, as the breaking strain has gone up as high as 4,480 lbs., and averages about 4,000 lbs.: while the stretch is about 4 per cent. A further test is also made by bending the wire in order to determine its behavior under flexion and torsional stress.

There is an interesting process in the way of utilizing waste connected with this wire manufacture which may well be noted here. Of course, in cleaning large quantities of wire, very large amounts of sulphuric acid are needed, and the vats need constant replenishment, as the acid becomes charged with impurities. There is, beside, in a factory of this kind, a great deal of waste metal and scrap of all sorts. In order to utilize both varieties of refuse, the acid is turned into a huge vat and there boiled, by steam, down to a proper density. Into it the scrap metal is thrown, and the whole is heated together. Then the green resulting liquid is run off into tanks and allowed to cool. The acid and iron both disappear; but instead, on pieces of wood suspended for the purpose in the cooling tanks, appears a copious deposit of sulphate of iron (copperas), a substance of commercial value. Each of the large cooling tanks is capable of yielding some 14 barrels of this product daily.

Some improvements have recently been made at Mr. Haigh's works, introducing automatic cut-offs to each wire block, which materially reduce the labor and form perfect safeguards against accidents to the workmen.

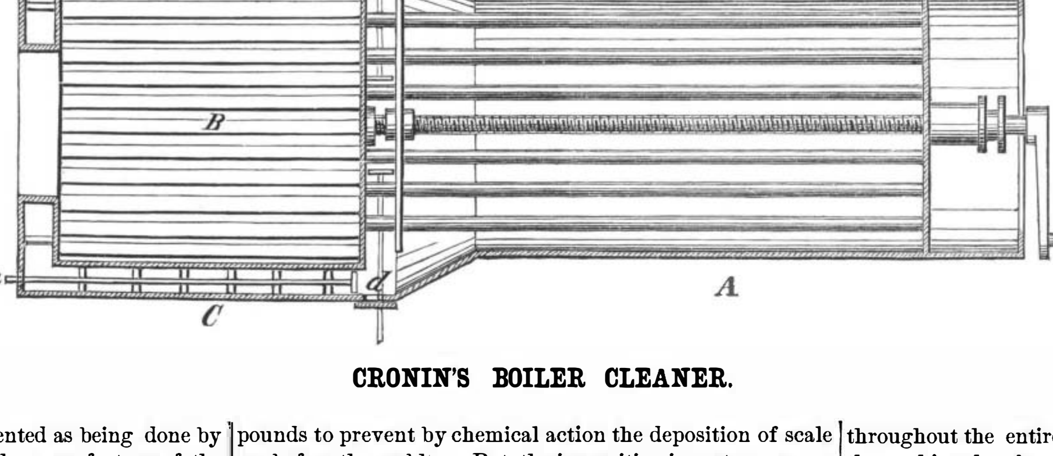
It should be added that Mr. Haigh's facilities for the production of the wire are to be greatly increased. Entire new buildings are to be erected, and new and improved machinery added, so that the various processes we have described will be carried on, on a much greater scale than is here indicated.

### A NEW BOILER CLEANER.

The danger of the explosion of any boiler in which scale is allowed to accumulate is well known; and many compounds to prevent by chemical action the deposition of scale are before the public. But the impurities in water vary so that no chemical preparation can be a panacea; and it is frequently necessary to remove the scale by mechanical means.

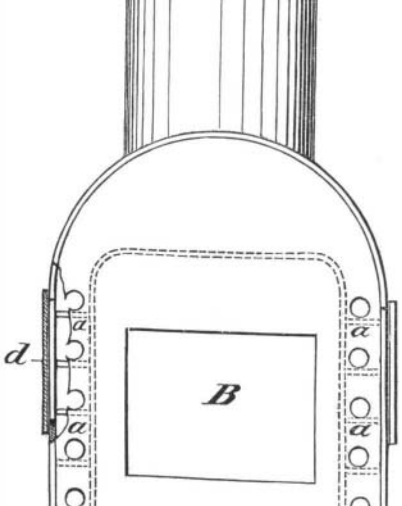
Mr. Cornelius J. Cronin, of Barnhart's Mills, Pennsylvania, has patented through the Scientific American Patent Agency, November 14, 1876, a novel device for preventing the formation of scale in steam boilers, which we illustrate in the annexed engravings. A, Fig. 1, represents a tubular boiler of the usual construction, and B the fire box, that is surrounded at the sides and top with a straight and arched boiler section, C. This boiler section or shell, inclosing the fire box, is constructed with a series of holes, *a*, Fig. 2, near the sides of the front wall, so arranged that the scraper may be introduced to the inside of the side wall at any height up to the water level, and the side walls and stay bolts then be readily cleaned by working the scraper. The holes, *a*, are closed by tightly fitting screw plugs when the boiler is in use.

Fig. 1.




CRONIN'S BOILER CLEANER.

Fig 2.




The bottom of the front section, C, is cleaned by the customary handholes, *b*, at the front or rear wall, which are closed tightly by steam-tight plates.

The inside of the rear wall is reached by means of a side opening, *d*, of sufficient length to allow the scraping device to be introduced horizontally between the flues and clear the parts of the rear wall between the same. This opening is closed by a tightly fitting plate attached by stud bolts.

### New Test of Salicylic Acid.

Salicylic acid, which is now largely employed for therapeutic purposes as an antiseptic in lieu of carbolic acid, and as a means of preservation for fruit, beer, meat, etc., in order to be efficacious should be absolutely pure and in crystallized form. Impure acid, which almost always betrays itself by the disagreeable taste left in the mouth, may, when constantly used, become dangerous to health. In order to determine the purity of the acid, M. Kolbe advises that about 7·7 grains be dissolved in a drachm and a half of concentrated alcohol, and that the clear solution, placed in a test tube, be allowed to evaporate slowly at ordinary temperature. The salicylic acid deposited will then form a ring of crystals around the interior of the tube. This crystallization is pure and white if the acid is pure and has been repeatedly crystallized; it is more or less yellow if the acid has been simply precipitated. But if it is brownish or brown, the acid examined, although it may appear ordinarily as a perfectly white pure powder, should be rejected as unsuitable for any therapeutic application.

### The New Bergen Tunnel.

It has been decided by the Delaware, Lackawanna and Western Railroad Company that the new tunnel under Bergen Hill shall be arched with brick throughout the entire length, 5,200 feet. Of this distance the arching has been completed, except 600 feet. It will give an idea of the work when it is stated that 7,000,000 brick have been laid in the arching. All the shafts have been torn down and will be rebuilt in such a manner that the ventilation will surpass that of any tunnel in the country. The cost of the additional arching will, in the opinion of Mr. Sloan, President of the Delaware, Lackawanna, and Western Railroad, be more than compensated by the security against accidents from falling rock.

### Density of Alum Solutions.

The following table will be found useful for ascertaining the percentage of alum present in solution by simply taking the specific gravity with a hydrometer:

| POTASH ALUM. | Specific gravity | AMMONIA ALUM. | Specific gravity |
|---|---|---|---|
| 1 per cent | 1·0065 | 1 per cent | 1·0060 |
| 2 " " | 1·0110 | 2 " " | 1·0109 |
| 3 " " | 1·0166 | 3 " " | 1·0156 |
| 4 " " | 1·0218 | 4 " " | 1·0200 |
| 5 " " | 1·0269 | 5 " " | 1·0255 |
| 6 " " | 1·0320 | 6 " " | 1·0305 |

It will be noticed that a solution of ammonia alum has a slightly lower specific gravity than one of potash alum containing an equal quantity of the salt.—*O. Schluttig, in Deutsche Industrie Zeitung.*

### The St. Louis "Practical Photographer."

This is the title of a new and handsome monthly magazine devoted to the rapidly growing art of photography, edited by J. H. Fitzgibbon. The second number, for February, contains for its principal illustration a photo of the great steel bridge over the Mississippi river at St. Louis, which may be justly regarded as the last wonder of the world. The general contents embrace an extensive variety of subjects. We welcome the appearance of the new periodical, and wish for it every success.