shops, great and small, in the mills and factories, the forge is an essential element.

The portable forges made by this company are so well known everywhere that it seems almost superfluous to enter into any detailed description of them. Before the issue of the patents under which these forges are made, all portable forges in the United States were operated, by means of the laborious crank motion, which necessarily confines the operator close to the fire. The chief improvement consists in operating the blower by means of a lever and ratchet, the lever having the swivel motion so natural to the blacksmith. This improvement was recognized immediately, and was one of the novel features that distinguished this style of forge and insured its great success.

The original and novel power blower made by this company for cupolas, forge fires, etc., is deserving of special notice. All blowers previously made had the shell or case made in halves, necessitating the bolting of the parts together around the entire circumference of the blower, resulting in a cumbrous, ill shaped machine at an unnecessary expense. The Buffalo blowers have a shell cast in one solid piece, combining the elements of beauty, strength, and economy, and this, with the improved journal bearings, makes this machine not only low in price, but better in quality than others of the same class.

The shavings exhaust fan for planing mills, furniture and piano factories, and all uses requiring a partial vacuum has a peculiar mouthpiece, by means of which the material to be conveyed may be carried to the right or left, or in both directions if desired, by simply loosening four bolts. The company also manufacture exhaust fans, especially adapted for ventilating mines and all underground apartments; for removing smoke and gas generated in blacksmith shops, chemical works, and factories in general; for removing dust from emery and other polishing wheels, buffing machines, sand wheels, and tumbling machines used in cleaning and polishing castings; for removing offensive odors from try kettles, dyeing works, varnish factories; and for use in packing houses and refrigerating cars, etc.

They also manufacture all the accessories, such as countershafts and pulleys, blast gates, etc.; in fact, everything pertaining to this line of business, from the miniature forge for miners, jewelers, dentists, locksmiths, farmers, and tinsmiths to the mammoth blowers and exhaust fans for the largest uses

The works in which all this variety of manufacture is carried on occupy Nos. 480 to 490 Broadway, and 166 to 182 Mortimer Street, Buffalo, N. Y.

The buildings are shown in the central view of our engraving, and interior views and representations of some of the products are shown in the marginal views.

The first floor of machine shop is 50 x 135 feet, fitted up with special tools for the speedy and economical execution of the work. Prominent among these are a large, special pulley lathe and special pulley borer, built by Niles Tool Works, of Hamilton, O., and kept running to their full capacity. This floor is almost exclusively devoted to fitting up forges and hand blowers.

The second floor is used for fitting and setting up power blowers and exhausters, and on the third floor are found the wood workers, tinsmiths, and painters; on the fourth floor, pattern making department, and experimenting rooms.

The building adjoining is used on the ground floor for blacksmith shop and tumbling rooms, and on upper floor as warehouse and shipping department.

The foundry, situated back of the machine shop and warehouse, is a commodious structure 60 x 100 feet, with two wings, each 30 x 40 feet. It has every facility for first class work, and is fitted up with a view to the comfort of employes.

We are informed that the company has now in hands of the printer a new and complete forty-page catalogue of specialties, making a hand book indispensable to every mechanic and farmer who wishes to keep up with the times, and which they will mail on application to any address.

The Corrosion of Iron and Steel.

M. Gruner recently communicated to the Academie des Sciences some observations on the relative perishability, under certain circumstances, of cast iron, steel, and soft malleable iron. Plates of different composition were immersed during equal periods in water acidulated with 0·5 per cent of sulphuric acid, and also in sea water, and exposed in moist air. It was found that in moist air chromate steels were most rapidly corroded, and tungsten steels less than carbon steel. In similar conditions cast iron oxidized less than steel and soft iron; and white specular iron rusted less than gray cast iron. Thus hard white cast iron is the best for withstanding damp air—an observation which agrees with common experience. Sea water, on the other hand, attacks cast iron more than steel, and especially the white specular kind. Tempered steel stands in sea water better than the same steel annealed; and soft steel is less attacked than manganese or chromate steel. Acidulated water acts upon gray cast iron like sea water, strongly affecting the more impure gray cast iron. White specular iron is not so much affected. These experiments agree with the results obtained by Mallet in 1843, and are valuable as indicating the best kind of material for iron structures in certain localities and for different purposes. The atmosphere of Manchester and similar places is known to have a very powerful acid reaction, and this circumstance may be taken into account when the material for lofty exposed structures, such as gas holder framings, has to be decided upon. Wrought iron and steel in such localities are thus seen to be exceptionally liable to decay.

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SIX HUNDRED AND FIFTY MILES BY TELEPHONE.

In our last issue we gave an account of recent successful experiments in telephoning over the new wire of the Postal Telegraph Company, between this city and Cleveland, Ohio, a distance of six hundred and fifty miles.

We have now to report the results of further experiments over the same line, made by ourselves on the invitation of the officers of the company. On the 13th inst. we visited the Postal Telegraph Company's headquarters in this city—the large and splendid building No. 49 Broadway. Here we were received by Mr. F. W. Cushing, the able and obliging Manager of the company, who at once placed at our disposal, for the purposes of the experiment, the use of the line wire to Cleveland, with the necessary instruments for transmitting and receiving conversation.

The new wire, as our readers will remember, is composed of steel and copper, its chief peculiarity and merit being its extraordinary conductivity. So great is the facility of the new wire for carrying the electrical current, that sounds and signals may be sent through it for lengths of a hundred miles as easily as through a common wire of ten miles; the new wire thus annihilates space, brings far distant places near together, and realizes the long sought desideratum of easy telegraphic and telephonic communication.

The instrument used by us in this experiment was a Hopkins transmitter, worked by two cells of the Leclanché battery. The principal novelty of this transmitter consists in a carbon electrode that floats on mercury, and the buoyancy of the carbon presses it into contact with the diaphragm of the telephone, without the intervention of spring or weight. The instrument is, therefore, constantly self-adjusting, always operative under the loudest as well as the softest sounds, and admirably suited for general telephonic purposes.

The wire is poled with forty or forty-five poles to the mile, and insulated in the ordinary manner throughout the line, except at the Hudson River, under which it passes in a cable 4,980 feet in length; and by a short cable under the river at Cleveland.

The transmitter was hung upon the wall like the ordinary instruments, and we gave the usual call, "Hullo! Hullo!" to Cleveland. We were instantly answered in clear tones by Mr. C. H. Rudd, the superintendent of the Postal Company in Cleveland. With him we then maintained a telephonic conversation for a considerable time; several other gentlemen in the party did the same, among whom was Mr. G. M. Hopkins, the inventor of the transmitting instrument. Finally, to make the test as thorough as we could, we asked Mr. Rudd to read something from the editorial page of the Cleveland *Herald* of that morning, which he proceeded to do, his reading being written down by us at this end of the line. He read several items. A day or two following, on the arrival here of the mail from Cleveland of March 13, we obtained a copy of the *Herald* and found therein, *verbatim et literatim*, all the items that were read to us by Mr. Rudd.

Those of our readers who have had any considerable experience in telephoning, especially in the city of New York, know that this was a satisfactory test of the Cleveland wire. If the reading of random newspaper items can be intelligently done, then anything may be sent. We have only to add that the noise from induction was about the same as on our city lines, and we were able to speak to Cleveland and hear the answers with greater ease and satisfaction than we often experience in trying to talk from our office to points in town that are only two or three miles apart.

For the accomplishment of this remarkable result, the opening of telephonic communication for distances of six hundred and fifty miles, the public is indebted to the enterprise of the stockholders and directors of the Postal Telegraph Co. and the corps of able manufacturers, inventors, and electricians whom the company has been so fortunate as to associate with them.

The construction and success of this wire marks the opening of a new and important era in the march of electrical progress. Its benefits and influence will indeed be far reaching. It opens the prospect of a more extensive, better, and cheaper system of electrical communication than has ever been employed, or hardly dreamed of as possible. One wire will have the business capacity of many common wires; one improved wire will, in fact, enable us to do things that could by no possibility be accomplished by the ordinary wires

The Postal Telegraph Company's compound wire has a diameter of $\frac{3}{32}$ of an inch, consists of a steel wire core, weighing 200 pounds per mile, that will resist a tensile strain of 1,650 pounds, on which copper is deposited to the extent of 500 pounds per mile, with a resistance to the electric current not exceeding 1·7 ohms. The wire has seven times greater conductivity than iron wire of equal size, copper being the best conductor known except silver. It has double the tensile strength of iron wire of equal weight when strung on the lines, will last longer, permits the use of low tension currents and small batteries.

Ninety per cent of the wires now in use are No. 9 iron, with a resistance of 20 ohms per mile, and the very best are No. 6 iron, with a resistance of 10 ohms, while the compound wire to be used by this company has a resistance of only 1·7 ohms. The resistance of No. 9 iron wire on a line from New York to Chicago, 1,000 miles, is over 20,000 ohms, and on a No. 6 iron wire over 10,000 ohms, and on the compound wire less than 1,700 ohms, thus bringing Chicago telegraphically as near to New York as Philadelphia, and San

Francisco as near as Cleveland, compared with the best wires now in use.

The company is now finishing the line from Cleveland to Chicago, and in a few days we shall probably be able to chronicle the wonderful fact that telephonic communication between New York and Chicago—distance about 1,000 miles—is established.

This remarkable conductor is made by Wallace & Sons, of Ansonia, Conn. The process of manufacture is peculiar. The steel wire, arranged in the form of spirals, is slowly screwed forward through the electro-plating batteries, by which the copper, to the above thickness, is deposited on the wire. We understand that no less than twenty large electrical dynamo-machines are employed to effect the deposition of the metal.

We believe that Professor Moses G. Farmer was the original inventor of the compound steel and copper wire. This was in 1869. Its introduction has been retarded for lack of proper means for its successful manufacture. The copper was originally proposed to be wound around the steel in the form of a ribbon; afterwards the attempt was made to draw the copper upon the steel by rolling; but neither of these methods proved satisfactory. The plan adopted by Messrs. Wallace has been crowned with success, enabling them to cover the wire with copper to any desired thickness, while it is so tenacious that the wire may be tied into a close knot without disturbing the copper.

EARLY STEAM ENGINES AND BOILERS.

In a recent paper read by Mr. John Whitelaw before the Civil Engineers' Club, of Cleveland, O., he gave some interesting information about the performances of steam engines as made about a hundred years ago.

In this country the duty of a pumping engine is estimated by the number of pounds of water raised one foot high on a consumption of one hundred pounds of coal. Thus the record of the pumping engines at Lynn, Mass., is stated to be in round numbers 104,000,000 pounds of water raised one foot high for each 100 pounds of coal burned.

These results show remarkable gains over the old-time engines. In 1770 Jonathan Hornblower and John Nancarrow were the most noted builders of pumping engines. The best average duty which they were able to get from 100 pounds of coal was, in round numbers, 6,000,000 foot pounds; so the Lynn engine does more than sixteen times as much work for the same fuel as the old style of machines. These were vacuum engines. Steam was only used to make a vacuum, and thus generating power. James Watt's improvements followed, and in 1793 he had so far improved the steam engine that his best machine made an average duty of 27,000,000 foot pounds per 100 pounds of coal. The Lynn engine does about four times better than that. Watt at this time pronounced his engine perfect, and said that no further improvement could be expected.

In 1814 Arthur Woolf made engines that showed a duty of thirty-four millions of foot pounds; and in one example a duty of seventy millions was reported.

In 1828 Capt. Grose made improvements on his engine, and the duty was found to be a little over eighty-seven millions.

In 1834 William West produced an engine that yielded a duty of close on to ninety-nine millions of pounds.

In 1840 Hocking and Loam extended the expansion principle, and in 1842 one of their engines showed a duty of one hundred and seven millions of pounds—a result that is hard to beat at the present time.

The boiler engineering and firing of the old time was very peculiar. Instead of increasing the number of boilers when more steam was required, they used to have one boiler of gigantic dimensions, with correspondingly enlarged fireplace. They also placed the fire bars eight or ten feet below the bottom of the boiler, and then filled up the space with coal. They thought the more coal they burned the more steam they would get. A boiler at Dalcoath mine was 24 feet in diameter and 24 feet high. The furnace was 7 feet below the bottom of the boiler, was 9 feet wide, and extended from one side of the boiler to the other. Trevithick said the fire in this boiler was 7 feet thick, and had in it 30 tons of burning coal.

Engineers have learned a thing or two about steam and boilers during the past hundred years; but there is doubtless a vast amount of knowledge on the subject yet to be acquired.

THE LEFFEL TURBINE.

We lately had the pleasure of inspecting a magnificent specimen of this motor, recently constructed by James Leffel & Company, of Springfield, Ohio, to order of the Smithsonian Institution, Washington, D. C. The wheel in question is very strong, having been built for a high head of water; its mechanical execution is perfect, and its finish resplendent. All the parts are highly polished, and heavily plated with gold and silver. This wheel is intended for the permanent museum of the institution, and was selected as the representative of standard excellence among American made water wheels—a fact which is of course highly gratifying to the manufacturers, as well as thousands of manufacturers who use this effective and reliable machine. The Leffel is a double action wheel, being in fact two wheels combined on one shaft; is fitted with adjustable gates, and contains the latest improvements.

SANITARY PRECAUTIONS AFTER FLOODS.

The following instructions emanate from the *Comité Consultatif d'Hygiène Publique*, dated June 12, 1856, and from the *Conseil d'Hygiène Publique, etc., de Salubrité du Departement de la Seine*, dated January 5, 1883, both of France. They are of peculiar interest to us at the present time on account of the Western floods.

Sanitation of Houses.—Habitations which have been invaded by the waters should receive special care, so that those whom the flood has expelled should not occupy them before they have been made sufficiently healthy for habitation.

They should first be cleaned out as quickly and thoroughly as possible, and freed from all dirt and *débris* deposited in their different parts by the water.

Continuous aeration and the most active ventilation are the best and most energetic agents of sanitation for houses.

To increase these as much as possible, where it can be done, a large fire should be maintained on the hearth, and the doors and windows opened, so that the light and heat of the sun may contribute their part to purifying the air.

At the same time care must be taken to dig a ditch 10 to 15 inches deep around each house, whose interior is in many cases below the level of the ground, which proceeding realizes one of the simplest and most active sewage systems.

It will also be well, after having torn down all plastering, which will be in a bad condition, to scrape to their bottom all joints in the walls, and to replaster them in the parts of the house most injured, and where bad deposits have principally accumulated. The floors, where such exist, should be carefully attended to, and the soil under them covered with a disinfecting substance, such as pounded charcoal, or sand, or else with an impermeable material, such as flagging, paving blocks, cement, etc. Where the house is several stories high, the top stories should be the first occupied.

Great precautions should also be followed in the treatment of certain articles of furniture, such as beds and mattresses, which must be renovated or replaced, and which should never on any account be used until thoroughly dried.

Sanitary treatment, such as adopted for houses, should be applied with no less vigilance to stables and barns to prevent epizootics, whose deplorable consequences there is no need to allude to here.

One peculiar feature it is important to note, though it can only be accidentally produced: it is the possible alteration of the water of wells and springs of potable water, in whose neighborhood matter in a state of decomposition may have been deposited, or piles of excrementitious and organic *débris*, or which sources of water supply may have been contaminated by the contents of privy vaults. Attention should be directed to this danger.

To disinfect cellars into which, by agency of the inundations, the contents of privy vaults may have penetrated, commercial sulphate of zinc may be used, either by sprinkling it in powder in the cellar, or by watering the ground when the water has gone down with a concentrated solution of this salt.

For the same purpose the solution of chloride of zinc, a disinfectant known as "St. Luke's Water," may be employed. It is in daily use in the civil hospitals.

The concentrated solution of sulphate of iron does well, but the disinfection is not so complete as with salts of zinc; it is, however, cheaper.

The last consideration is of little importance, because two kilogrammes (nearly five pounds) of zinc salt, costing less than one franc, are enough. T. S.

Rarefied Air as a Conductor of Electricity.

Edlund continues his researches upon this subject. A number of experiments are described to show that the phenomena of the opposition to the passage of sparks from terminal to terminal in rarefied air cannot be explained by the theory that a vacuum does not conduct electricity. He carefully discusses the question of the contrary electro motive force which is developed at the terminals. "It is not the resistance of the gas but this electro-motive force, increasing with the rarefaction and connected with the electrodes, that presents an obstacle to the passage of the current. Everything is in favor of the hypothesis that vacuum opposes a very feeble resistance to the propagation of electricity." Without the employment of electrodes, one can excite an induction current in a Geissler tube, which is sufficient to produce light. This would be impossible if the highly rarefied gas or vacuum were an insulator.—*Phil. Mag.*

Simple Cure for Cold Feet.

The following remedy for cold feet is recommended by the *Fireman's Journal* for sedentary sufferers, as well as policemen, car drivers, and others who are exposed to the cold: All that is necessary is to stand erect and very gradually to lift one's self up upon the tips of the toes, so as to put all the tendons of the foot at full strain. This is not to hop or jump up and down, but simply to rise—the slower the better—upon tiptoe, and to remain standing on the point of the toes as long as possible, then gradually coming to the natural position. Repeat this several times, and, by the amount of work the tips of the toes are made to do in sustaining the body's weight, a sufficient and lively circulation is set up. A heavy pair of woolen stockings drawn over thin cotton ones is also a recommendation for keeping the feet warm, and at the same time preventing their becoming tender and sore.

Solid and Hollow Iron Columns.

A confusion of ideas is sometimes found among practical men respecting the comparative strength of solid and hollow pillars. One hears it often said, for instance, says the *Building News*, that a hollow pillar is stronger than a solid one. Now this is, as one able authority has pointed out, not absolutely the case; it is perfectly true, that, comparing the strengths of two pillars of the same height and diameter, one solid and the other hollow, the latter has the advantage of being economically stronger. The fact is, the solid column is stronger than the hollow of the same external diameter; but the lesser area is more effective than the greater, because the central portions of the solid pillar are less useful in resisting the bending force than the metal in the circumference of the hollow pillar. But if the quantity of material in both the solid and hollow pillar of equal height is the same, the hollow pillar is by far the stronger. A simple geometrical construction will enable any one to understand this fact, by enabling us to proportion a hollow column of the same area as that of a solid one, by one of the diameters being given.

It is shown, in fact, that hollow columns of the same area of metal as a solid one may be made to any larger diameter, their strengths increasing proportionately till a limit is reached by the shell of the metal becoming too thin to insure a sound casting. Taking an example from Downing's work, a hollow pillar 9 inches in external diameter, having an internal diameter of 8·062 inches, and a thickness of metal of 0·47 inch, or about ½ inch, is 5½ times stronger than a solid pillar with the same quantity of metal. A thickness of ½ inch may be regarded as a practical limit in manufacture.

The Material for Good Superintendents.

The *Northwestern Lumberman* mentions a conversation had with a gentleman largely interested in the lumber trade at the West, when he said that there are grand chances for young men, of the right stamp, to find employment in the lumber business. The gentleman further remarked that it was almost impossible for him to find the right kind of men to superintend the different branches of his business. They must have a quick and sound judgment, and know the business from the stump up. He advertised for men, and out of seventy applicants there were but two that he dared to give a trial. There are plenty of men who are willing to step in as managers, but they want to begin at the top. If anything goes wrong under them, they are ignorant as to the way to correct it. The boys who began work moneyless and friendless have succeeded best. They began at the bottom round of the ladder, did not know more than their superiors, were willing to work and learn, were temperate, and now some of them are filling positions of trust and profit, while others are doing a good business for themselves.

It is not in the lumber trade alone where the boy commencing on the bottom round of the ladder has made his way upward and been crowned with success. But it is a fact, patent to all observers, that the successful men in all branches of business are generally those that commenced on the bottom round, and by their own unaided exertions worked their way upward, some to the top of the ladder, others to various heights; but most all who possess those qualifications our contemporary suggests as requisite for a manager in the lumber business to have, are sure of a fair degree of success at almost any business they may undertake.

Bleaching by Electricity.

Dr. Dobbie and Mr. J. Hutcheson, of Glasgow, in the course of certain experiments on the action of electric currents upon a solution of common salt, found that there is a formation of hypochlorite of soda—*i. e.*, bleaching soda. If the solution is neutral, there is an escape of chlorine during the action of the electric current, while a certain quantity of hypochlorite remains in the liquid. If the solution is kept alkaline, all the salt is converted into hypochlorite. If it is made acid, all the chlorine escapes, and no hypochlorite remains in the solution. Experiments on the subject are now in progress in a Scottish bleach works on a large scale. The yarn or cloth to be bleached is saturated with brine, and passed between two rollers, each of which is in connection with one of the poles of a galvanic battery. The current passes through the moist goods and produces hypochlorite of soda (bleaching soda), or free chlorine, according as the solution of salt was alkaline or acid.

In the former case the goods must be taken through sours to complete the bleaching; in the latter case this is not necessary. Discharge styles upon cotton goods can be produced with rollers, which are partly covered with non-conducting materials. The current then passes only through the parts left uncovered. An advantage of the new process for bleaching is that in many cases it will supersede the previous bowking and washing, as the electric current has a decomposing action upon the resinous impurities.

A Medal of Honor.

The Pratt & Whitney Company Hartford, Conn., have just been awarded by the city of Philadelphia, on recommendation of the Franklin Institute, the John Scott Legacy Medal: "To the most deserving." The engraved award on the medal reads: "To the Pratt & Whitney Co., Hartford, Conn., for their standard gauges, taps, and dies; on the recommendation of the Franklin Institute." The medal is of bronze, four inches diameter, and is a fine specimen of the die-maker's art.