SCIENTIFIC AMERICAN

[Entered at the Post Office of New York. N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION. ART. SCIENCE, MECHANICS. CHEMISTRY AND MANUFACTURES.

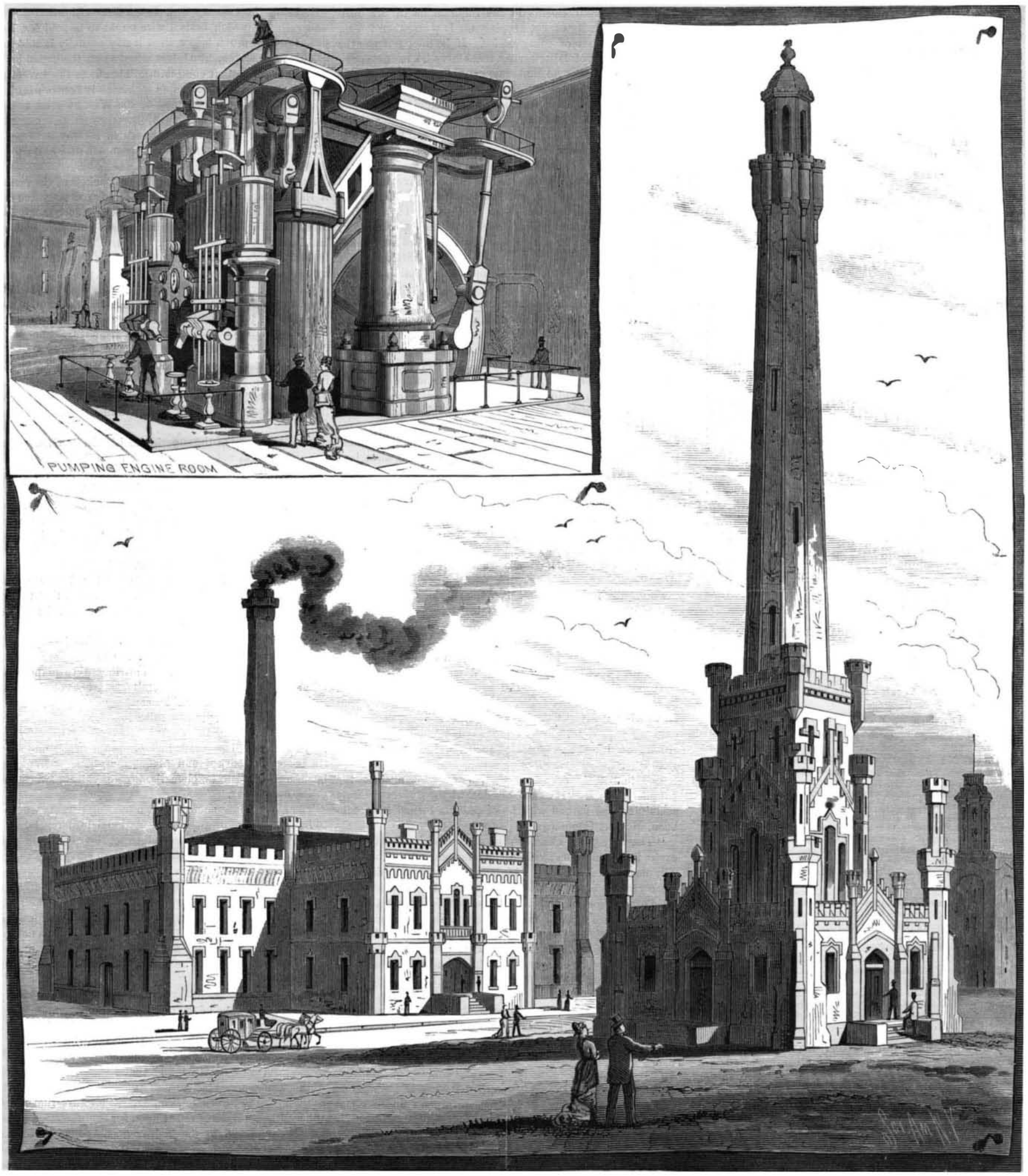
Vol. XLIV.—No. 19. [NEW SERIES.] NEW YORK, MAY 7, 1881. [$3.20 per Annum. [POSTAGE PREPAID.]

THE CHICAGO WATERWORKS.

The city of Chicago is justly noted for its business activity, its bold enterprises, its live way of doing things generally; and the history of the city water supply system, from its comparatively small beginning to its latest development, is characteristic of the progressive spirit that pervades the great Northwest. Lying, as the city does, on a flat prairie, with no natural elevation upon which to place a reservoir to insure a proper distribution of the water, and with no desirable near source of supply, the engineers encountered exceptional difficulties in planning and executing the work.

Finding the first means of water supply inadequate, improvements were immediately made, and these in time proving insufficient, further improvements were instituted, involving a tunnel extending two miles into Lake Michigan. An accident having occurred which cut off the supply of water for a time, rendering a large area liable to the dangers of an uncombated conflagration, steps were taken to provide a water supply of such character and extent as to render the possibility of even a temporary interruption very

[*Continued on page* 290.]



NORTH SIDE WATERWORKS, CHICAGO.

THE CHICAGO WATERWORKS.

[*Continued from first page.*]

remote if not impossible. The first water works in Chicago were commenced in 1851, when the population of the city was about 35,000.

It was then thought that the small quantity of water discharged from the river would not affect the quality of the water in the lake at a point 1½ miles south. The works were put in operation in February, 1854, and consisted of one reservoir, containing about a half million of gallons, and eight and three-quarters miles of iron pipe, beside the pumping engine. The population at this time had increased to about seventy thousand, and the growth of the city, together with the introduction of sewerage and the establishment of packing houses, distilleries, etc., increased the quantity of filth flowing into the lake to such an extent that complaints of the impurity and offensiveness of the water were frequently made, and it was proposed to extend an iron pipe, five feet in diameter, one mile out into the lake, to obtain a supply beyond the effect of the sewage. Various other experiments were discussed, but it was finally decided to extend a tunnel two miles into the lake. The work was commenced May 26, 1864, and the tunnel with all of its appurtenances was completed in March, 1867. In this tunnel provision was made for extension either lakeward or landward without interrupting the supply through it, except for a very short time; but it was not supposed that an extension would be required for many years. The breakage of a siphon under Chicago Avenue Bridge, August 18, 1869, deprived the west division of the city of water for about sixty hours, greatly endangering a large portion of the city.

This circumstance led the City Council to direct the Board of Public Works to take immediate action with reference to the wants of the city in this respect.

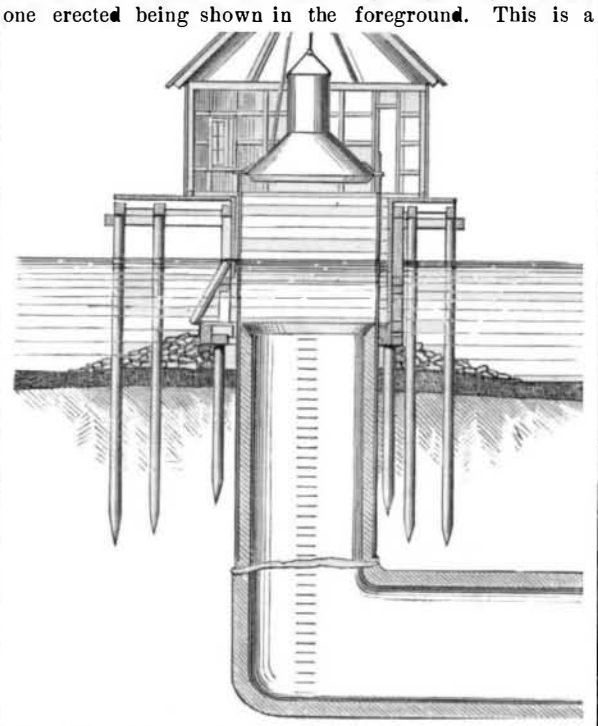
It was decided to build a new tunnel, seven feet in diameter, parallel with the old one, extending six miles into the lake. This great work was commenced July 12, 1872, and finished July 7, 1874. Great difficulty was experienced in sinking both shore and crib shafts, but the work was finally accomplished in the most satisfactory manner. In the construction of the new tunnel, as in the old, provision was made for extending it lakeward should sewage contaminations hereafter make it necessary or desirable.

The crib is a substantial structure of solid masonry, the three lower courses of which are built of granite, on account of its superior frost resisting qualities. The upper courses are of limestone, the arches are of brick, the filling of rubber, and the deck is composed of ordinary concrete, on the top of which is placed a layer of asphalt concrete. The light-house tower is of brick, with an iron stairway. Upon the deck is built a brick house, in which the family of the person in care of the crib resides. No more desolate and isolated place of residence could be imagined than this is in winter. One might as well be on a desert island as far as human companionship is concerned, although there is a telephone line to the shore. But there are many days when the storms blow and the waves beat in their fury, and the broken, floating ice dashes against its sides, that no one goes out from the shore. It is said that some of those who have lived at the crib have found the isolation so intolerable as to almost drive them insane. In the summer, however, boats constantly ply between the shore and the crib, carrying visitors, it being a favorite resort for boating and sailing parties.

Since the completion of the tunnel the immense growth of the city has so increased the sewerage flowing into the lake that it is believed that at times it extends as far as the crib and contaminates the water. Many plans have been suggested to remedy this, and on all hands it is confessed that the problem is a very grave one. It is probable that in ten years from now, with the present rate of increase, Chicago will have a million of inhabitants, and in that case no tunnel extending directly into the lake could insure pure water. The latest suggestion for procuring pure water for the city is that of Chicago's eminent architect, Mr. W. W. Boyington, who proposes that the city shall purchase 100 acres of land in Highlands, some 20 miles north of the city, where the ground is 130 feet higher than the city level. Here should be built an immense reservoir, into which water should be pumped from the lake, and thence conducted by a viaduct to the city.

The shore end of the tunnel is connected with the new North Side pumping works shown in our engraving, and extends to the West Side works. The building is a model of architectural beauty. Its style is castellated, and the tall water tower gives it a very imposing appearance.

The building contains four large pumping engines, two of which are in continual use, while the other two are held in reserve. The general appearance of these magnificent machines is seen in the upper view in the large engraving, the last one erected being shown in the foreground. This is a

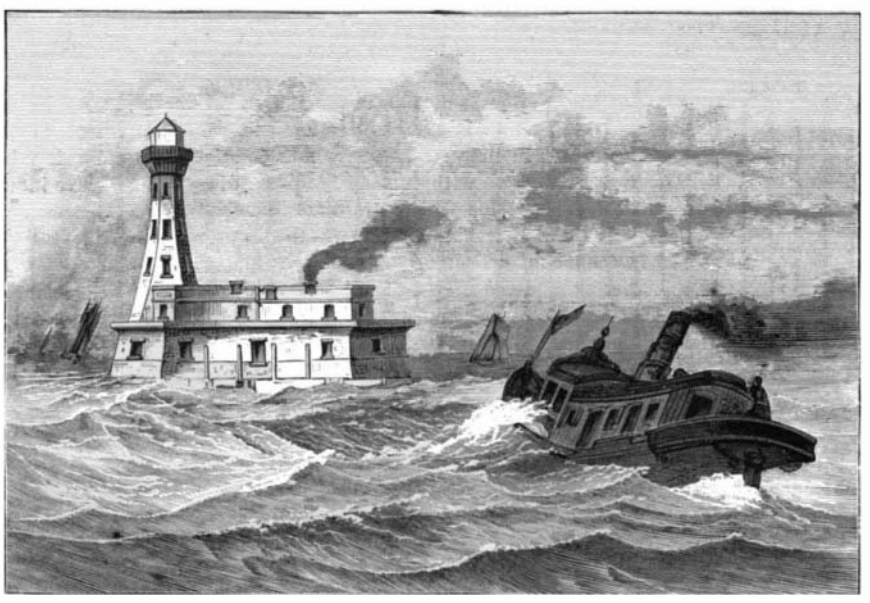


THE FIRST CRIB—SHOWING THE CAST IRON RINGS AND GATE.

double engine, having a capacity of 36,000,000 gallons in twenty-four hours. The steam cylinder is 70 inches in diameter, stroke 10 feet. The water pumps are 57 inches in diameter, stroke 10 feet. The working beams are each 28 feet long and weigh 20 tons. The fly wheel is 26 feet in diameter and weighs 40 tons.

The first engine was erected at these works in 1853. It had a capacity 7,500,000 gallons in twenty-four hours. The second engine, erected in 1857, had a capacity of 13,000,000 gallons in twenty-four hours, and the third had a capacity of 18,000,000 gallons daily. The first and second engines were single, the third and fourth double. These engines are supplied with steam from five boilers 12 feet in diameter and 20 feet long.

In 1871 Chicago had 271 miles of pipe, now it has 500 miles, and it has over 3,000 fire hydrants. This extensive system of water supply has been perfected at an expense of about $8,000,000.



THE CRIB.

SECTION OF TUNNEL.

The Value of Authenticity.

The British Government has bought of Lord Suffolk, for $45,000, a picture by Leonardo da Vinci. Some twenty years ago the picture was stolen from Lord Suffolk's country seat, being cut from the frame. Afterward it was offered for sale in London. When shown to the President of the Royal Academy he pronounced it a copy of the well known "La Vièrge aux Rochers," and no one would buy it. Some one, remembering the robbery, subsequently took pains to inquire into the matter, and traced the picture to the possession of a messenger or door porter at the Foreign Office, Downing street, who produced it, rolled up, from one of the servant's closets there. The picture was taken to Lord Suffolk's, and fitted exactly the cut part, proving incontestably that it was the stolen *chef d'œuvre* of Leonardo da Vinci. That £9,000 is not too much for this picture is inferred from the fact that, at the time when it was restored to its owner, it was remarked that while not authenticated as an original work, £5 could not be got for it, but when it was authenticated it was well worth £10,000.

The Telephone.

The national gathering of telephone men at Chicago, on the 5th April, emphasizes better than anything else the rapid and prodigious growth of that very recent invention. At their previous meeting, held at Niagara Falls, September 7–10, 1880. there was represented $10,000,000 of stock, which, after an interval of only seven months, now represents something like $17,950,000 of stock, all being unpurchasable. Indeed, among all the wonders of the age, there is nothing more wonderful than the invention and progress of the telephone, made practicable only five years ago. Prof. Bell claims that the date of the invention of his method of articulate speech was Jan. 15, 1876. It is already found in use in all parts of the world, as popular and useful in Egypt, New Zealand, and China as in America and Europe. This year alone the English post office authorities have given orders for 20,000 telephones, while its rapid spread in this country is almost beyond calculation. It is introduced with equal eagerness for commercial and domestic uses; it is fast driving out the old fire-alarm telegraphs, while for purely scientific purposes—such as detecting faults in ocean cables without resorting to the old and expensive process of cutting and splicing them—its availability seems beyond calculation.

Much of this is due to the restless energy and genius of its inventor and promoters, for the telephone has drawn to its assistance some of our most profound scientists and brightest business men. It has, in return, brought them in one short lustrum wider fame and ample fortune; the latter statement being best illustrated by an incident which recently occurred in England. At a meeting of the United Telephone Company, last autumn, the discussion developed the remarkable fact that two men who had paid $3,500 for their privilege of acting as the company's agents for the sale of telephones had refused $150,000 offered by the company to cancel that engagement. The number of exchanges in operation in this country has increased in one year from 138 to 408, and the number of instruments in use from 60,873 to 132,692, so that in the United States only one city having a population of over 15,000 is now without a telephone exchange. Other items in the same department show how the introduction of the telephone is being extended abroad as well as at home.

But the uses of the telephone must still be widely extended. Rapid strides are already being made in long-distance telephoning, speech having been recently transmitted from Tours to Brest, a distance of over 800 miles, with a single Leclanché element, the experiment being witnessed by Prime Minister Jules Ferry and other dignitaries. These experiments must be pushed further, for the application of the telephone to long distances has become a necessity, and its use must not stop with the shore. It must be applied to ocean cables, and made audible during the noise of military operations, and even above the roar of battle. Connecting the most remote corners of the earth, like the telegraph, it must rise superior to that invention, and bring them virtually within *speaking* distance.

We have taught ourselves to believe that there is no such word as fail, and with so many men of genius at work perfecting the details of this new agent of intercommunication, with so much capital eager to back their enterprise, and with so much organizing talent and executive ability as is displayed to-day in the telephone business, the great invention of Alexander Graham Bell is

springing forward to success unparalleled in the history of scientific discovery.—*The Operator.*

IMPROVEMENT IN THE CONSTRUCTION OF FENCES AND POSTS.

The engravings illustrate several forms of iron fence and railings, together with constructive details of the fence fastenings, which have been patented by Mr. J. B. Wickersham, of 505 Cherry street, Philadelphia, Pa., who is manufacturing and has pretty thoroughly introduced the various forms, which have proved highly satisfactory wherever used.

Figs. 1 and 2 show different forms of railing and fencing. Fig. 5 shows a double fastening for holding the two rods forming the rail of an ornamental iron fence, the fastening being effected by nails, which are broken off and do not show after the fence is finished. The wrought iron bars project through the cast iron ornaments of the railing, as shown in detail in this figure, thereby strengthening the cast iron portions of the iron railing, preventing them from being broken off by mischievous persons. Fig. 3 shows a farm fence on a level, also on an incline, supported by Mr. Wickersham's improved iron post. The fastening of the fence rods is effected by driving nails through holes in the overlapping ends of the rods on opposite sides of the post, as shown in Fig. 4. The rods are grooved longitudinally, so that nails may be driven in at every post through which the rod passes.

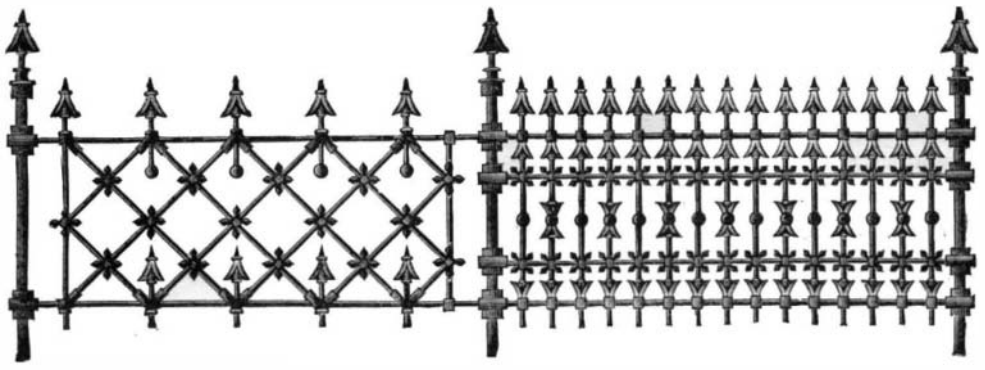


Fig. 1.—ORNAMENTAL IRON RAILING.

Fig. 6 shows the method of fastening flat bars in the posts, also fastening the pickets to the bars. The bars are grooved upon one side to receive the fastening nails.

This iron fence is suitable for farms, lawns, and country places, as a substitute for the barbed wire fences; at the same time it is a more visible fence than strands of wire produce, enabling horses and cattle to see it and avoid injury.

Fig. 9 shows in perspective and in section a fastener for securing a picket to an angle-iron rail by means of an eye, a washer, and a nail.

Fig. 2.—IRON FENCE.

Either wrought or cut nails are used for fastening the parts of the fence together, the portions being nailed together as readily and easily as pieces of hard wood. The process might properly be termed keying, but the inventor has appropriately named it "nailing iron to iron." Key-seats are formed in the iron to receive the nails; a hammer and nails are all that are required, with the several parts of the work, to form and erect handsome and durable iron railings and fences of either heavy or light patterns.

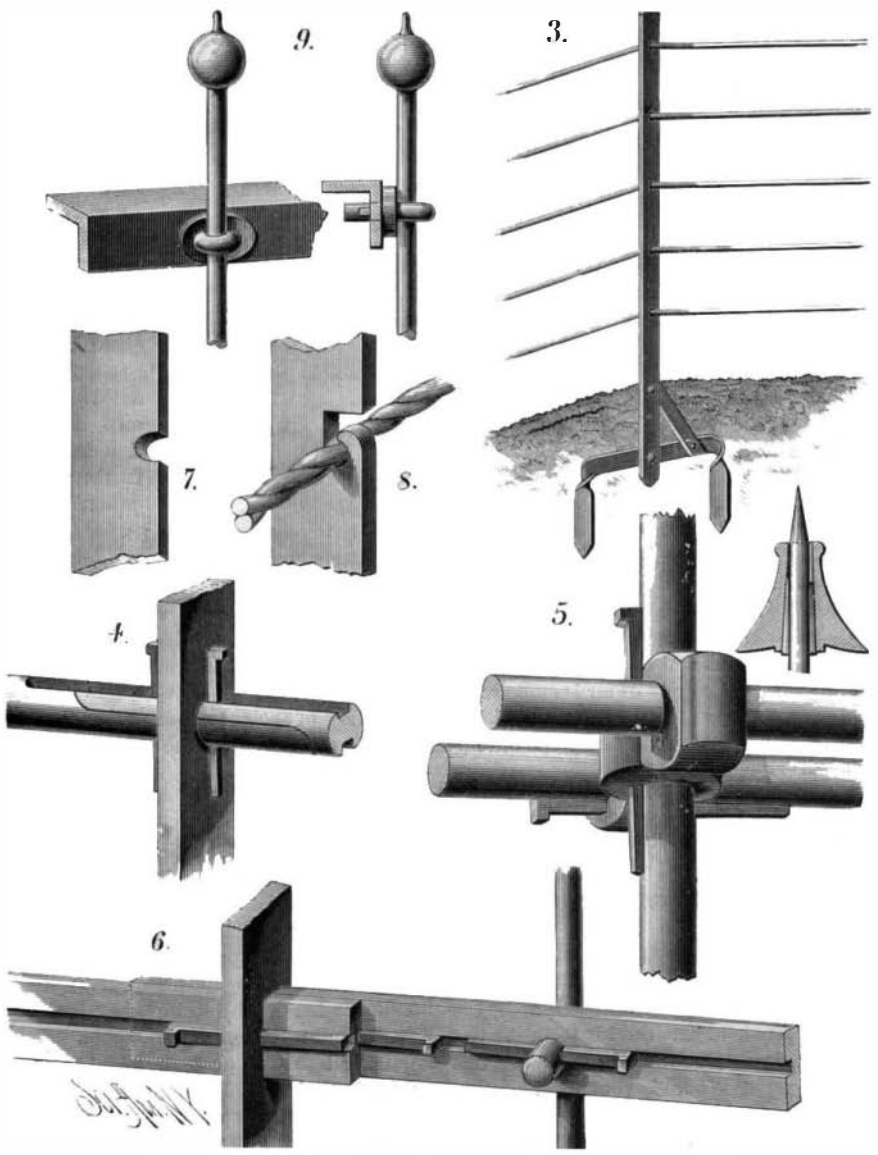
Fig. 7 shows a post with a semicircular notch for receiving barbed wire or wire cable, and a hole for receiving the fastening wire. In Fig. 8 is shown a post having a square notch for receiving a fence wire rod or cable.

The improved posts, shown in Fig 3, have been adapted for round, flat, or square iron, also for barbed and plain wire, to meet the requirements of cheapness, combined with strength and durability. By the method illustrated, the parts of the fence and posts can be quickly and strongly fastened together.

In the manufacture of plain fences composed of horizontal bars or rods for farm purposes, the joints of the rails at the intersections with the posts are secured by various ways in lapping of the rails and by nailing the parts securely together, at the same time allowing the rails and pickets to grade to any inclination of the ground or to expand and contract under changes of temperature. An important feature is the construction and planting of the improved iron post for farm purposes. The object has been to make an iron post which will resist the action of the frost, being so constructed that when planted the parts act in the same capacity as the roots of a tree in sustaining it in an upright position. The brace at the lower part of the post is buried under the ground, and assists in holding. It has been shown that where these posts have been in actual use for several years past they keep their vertical position.

We are informed that these iron posts cost no more than wooden posts. Being of iron they cannot burn in times of fire, or float away in a freshet, and will outlast any post made of wood; besides, there is always an intrinsic value in the old iron.

A large industry has been developed under these patents, and we are informed that this fence is largely coming into public use, supplanting fences of the English and other styles. Furth information may be obtained by addressing the inventor and manufacturer as above.



PARTS OF FENCE FASTENED BY NAILING.

A New Hospital.

Mr. George I. Seney has given the handsome sum of $270,000 for another general hospital, to be located in the southern section of Brooklyn, N. Y. An entire block of ground has been secured. The plan of Mr. Seney contemplates the erection of a number of small buildings rather than a single large one, so that particular diseases may be located and treated apart. Possibly one of these buildings may be made a lying-in department. for which there is ample room; another may be devoted to contagious diseases, for which at present there is absolutely no provision within the city limits. The plans will be matured and work begun within a few months.

The Channel Tunnel.

Close to the western entrance in the Abbot's Cliff, near Folkestone, are the Channel Tunnel works, now progressing under Colonel Beaumont, R.E., by which it is hoped ultimately to realize railway communication between France and England—distance 22 miles. The project, both in design of plan and mode of execution, is practical and ingenious. The chalk strata of England and France are geologically continuous, and the dip of the beds is the same, namely, toward the east, on both sides of the English Channel. The lowermost portion, known as the "gray chalk," is of more clayey nature than the other portions of the chalk formation, and is sufficiently impervious to water to render perforation feasible. The plan proposed is to follow by a descending tunnel the natural dip of the gray chalk towards Dover, until a depth of 200 feet below the sea bed of the Channel is attained. The Channel Tunnel will then be driven horizontally right across from shore to shore. A similarly inclined tunnel on the French side, rising along the direction of the dip of the strata, will make communication again with the upper surface of the land. The gray chalk is thus entered and followed throughout along its natural position—from daylight on the one side, and in its subterranean and submarine depths, to daylight on the other side of the Channel. The works at Abbot's Cliff consist of a short drift-way from the sea front of the "Warren" to the commencement of the trial tunnel, which is circular, 7 feet in diameter, and runs parallel with the existing line of the South-Eastern Railway. It has already attained a length of 300 yards. The chalk is drilled by a circular disk of iron cutters, worked by a compressed air engine by means of a shaft with bevel wheel gearing, the shaft and engine extending for a length of 30 feet. The cutting disk makes two revolutions per minute, and is fed forward a quarter of an inch at each revolution. The total advance of the whole face of the boring is half an inch per minute. The *débris* cut out by the revolving disk is received in a sort of large iron tray, which is hauled back every now and then by a chain worked by an auxiliary air engine, and the water which percolates the chalk is easily kept under by a small donkey pump. The promise of success so far seems good, but the 7-foot tunnel has not yet been driven much, if anything, below low-water tidal level, and we have yet to learn whether any powerful jets of water may get in through fissures as the subterranean depth is increased. Trial shafts have been driven vertically down a considerable distance both on the English and French shores, and there have been no signs of extraordinary difficulty from such sources. Nevertheless, the question of a possible fissure or deep crack in the continuity of the gray chalk itself in mid channel, along a line passing between the "Varne" and the "Ridge," can only be actually settled when the Channel Tunnel itself solves it, and ends, once and for ever, all discussions upon the subject.—*Building News.*

Coal in Venezuela.

In a report by Mr. Plumacher, of the United States Consulate, at Maracaibo (Venezuela), some information is given concerning coal deposits in that country. It is stated that those parts of the country lying between Rio Zulia and Rio Gantatumbo and the Cordilleras, abound in asphalt mines and fountains of petroleum, and generally what is described as a large coal formation. Beyond the Rio Zulia, in the upper part of the department of Colon—that does however not extend to the foot of the Cordilleras—there are stated to be no coal mines, but Mr. Plumacher states that he has been informed by persons of truth and respectability, that the valleys of Cucuta, and the territories of the State of Tachira, abound in coal mines. Near San Antonio, in the ravine called "La Carbonera," exist some of considerable size, from which is frequently dug coal for the use of the smiths' forges in that place; and at the foot of the Cordilleras, on the northern side, there are a considerable number of coal mines, asphalt deposits, and also some fountains of petroleum. In the territory of the department Sucre, just opposite Gibraltar, at the foot of the mountain line, a large quantity of coal and asphalt is found. Mr. Plumacher states that among the samples of coal which he has examined during his