**THE BRUSH ELECTRIC LIGHT WORKS, ROCHESTER, N. Y.**

The following description of the power station for the Brush Electric Lighting Company, of Rochester, N. Y., is from the *Milling World*. These works are located on the west bank of Genesee River, at what are styled "the Lower Falls," within the city of Rochester, N. Y., and they derive their motive power from the waters of that river. They are intended for generating electricity for lighting purposes in the city of Rochester and vicinity. They consist of a brick superstructural building or house, 100 feet long by 50 feet wide, and one story high, resting upon and supported by substantial substructural walls and piers of stone and brick, of various heights and forms, and substantially based upon prepared foundations at various levels in the solid rock.

Fig. 1 is a cross sectional elevation through the wheel and gear pit, as viewed from the north or down stream end. Fig. 2 is a longitudinal section from the bottom of the wheel pit upward, as viewed from the west or land side of the works

The superstructure is spanned across its width at the base of the roof with nine trussed girders, which support the roof and the line shafting with its leading wooden rimmed band wheel, 5 foot diameter by 4 foot 8 inch face, and 18 pairs of fast and loose wood-rimmed pulleys, 42 inch diameter by 13 inch face each, making 360 revolutions per minute, and connecting by 12 inch belts with 18 electro-dynamic machines arranged upon the floor near either side of the building, as shown in Fig. 1, giving them 756 revolutions per minute, at an expense of 40 horse power each, making a total of 720 horse power, supporting 720 lights, equal to 40 lights per machine, or one light per horse power. The magnitude of the lights is not stated. In Fig. 2 is a side elevation of one of the machines. The fast and loose pulleys which drive the dynamos were furnished by the Taper Sleeve Pulley Works of Erie, Pa., and they are so constructed and arranged that by one single and gradual movement of a double-headed oscillating cam, in connection with a belt shifter, the loose pulley, which hangs on a hollow independent bearing (not shown in the cut), concentric with and surrounding the shaft without contact therewith, is thrown into gear and set in motion, so that as the cam is continuously moved forward through the extent of its parallel arc, which holds the loose pulley in gear, the belt is shifted on to it, when, by a little further movement of the cam, its inclined part at the rear end disengages the clutch, and the loose pulley, together with the belt and the actuated machines, cease moving and remain idle, until the cam is moved in the reverse direction, setting the idler in motion, shifting the belt into working position, and setting the machine in motion, when by the inclined part of the opposite end of the cam from that afore-mentioned, the clutch is disengaged and the idler is again at rest, out of contact with any of the running parts.

It is in contemplation to add 9 more electric machines in this same building, to be driven by the same power, should time and circumstance demand it, making 27 in all, producing 1,080 lights and requiring 1,080 horse power. The power is to be obtained by the use of two Victor turbine water wheels, 20 inches in diameter, made by the Stilwell & Bierce Mfg. Co., Dayton, Ohio. This wheel is noted for the extraordinary power developed by it, in proportion to its diameter, while at the same time the percentage of power in proportion to water expended (according to tests made at the Holyoke testing flume) ranks it among the highest and best. Another advantage possessed by this wheel is that its comparatively small diameter for a given power causes it to revolve so rapidly as to make a considerable saving in the cost of shafting and gearing.

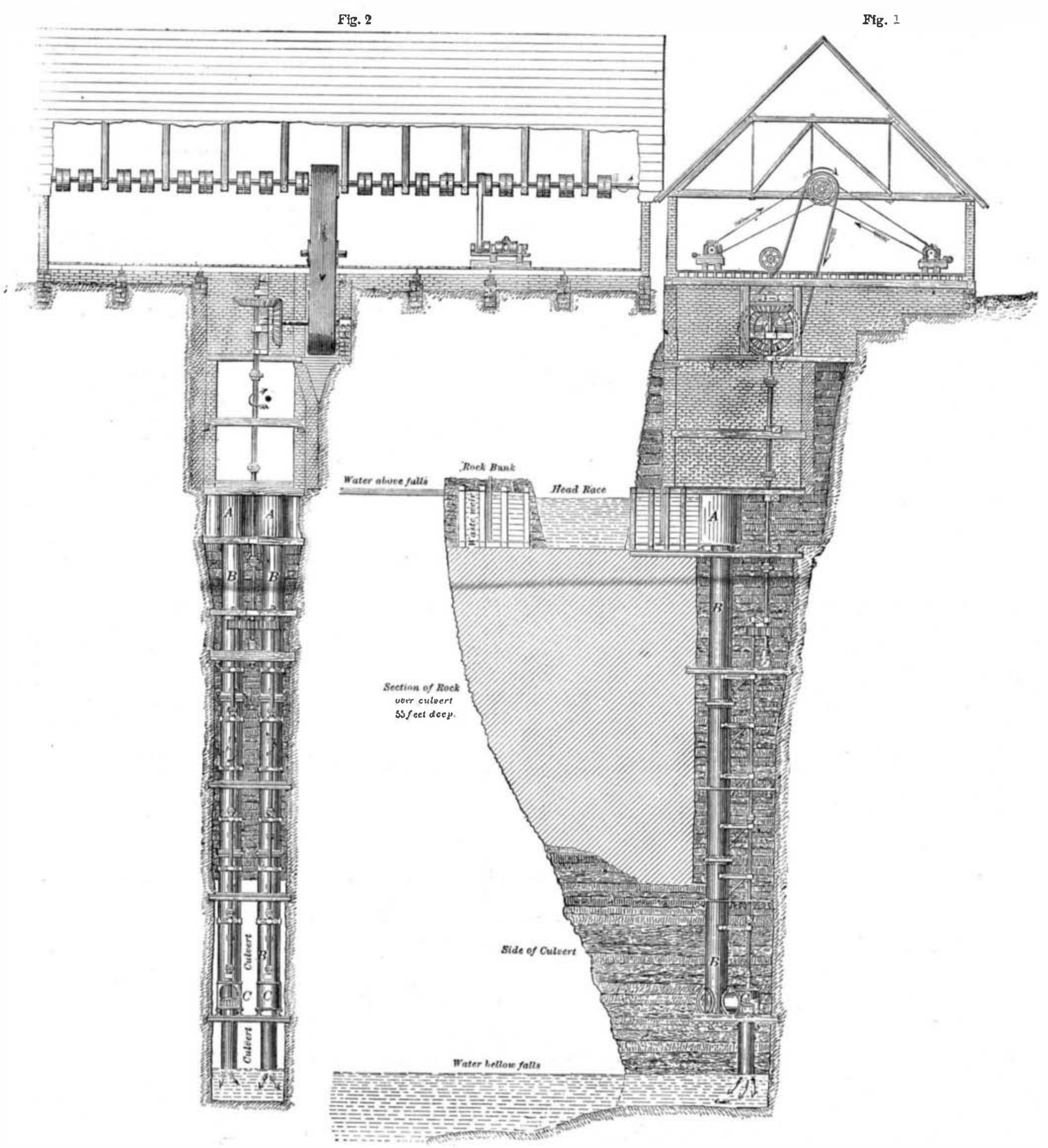
The situation and surroundings of the water wheels and their appurtenances in this case are indeed unique and extraordinary, and indicate a perspicacity of discernment, acuteness of conception, boldness of design, and thoroughness of execution on the part of the projector, that stamps him at once as eminently qualified to place and execute a work like this, environed as it is by great natural obstacles and serious practical difficulties. To make a proper place for the flume or forebay, an open recess or bay was cut into the upper rock bank about 32 feet horizontal depth by 20 feet wide and 46 feet perpendicular depth, down to a level with the bottom of the head race. The bottom of this bay is about 45 feet below the floor of the superstructure, and extends under it about 28 feet. From the bottom of this recess at its back side is a shaft about 12 feet square, sunk perpendicularly into the rock to a depth of about 90 feet, to a point some four or five feet below the surface of the backwater from the river below the falls, which are nearly 100 feet high, as will be seen by the cuts. From this shaft a culvert extending about 36 feet in height from the bottom of the shaft is cut through the rock out to the river, as shown in the cuts. Between the top of this opening or doorway, and the bottom of the race and forebay, is about 55 feet vertical thickness of rock, as shown in cuts, being represented in section in Fig. 1.

On the bottom of said recess in the rock, and partly over the shaft therein, is the flume, containing two U-shaped iron forebays, AA, seven feet high, opening toward the head race, and from the bottom of which are suspended two iron stand pipes, BB, 76 feet and 10 inches long by 42½ inches in diameter, their upper ends opening into the forebays to receive water to supply the wheels. At one side of each stand pipe, and connected thereto with a short cylindrical tube, is an iron wheel case, C, with a draught tube attached to its bottom, and extending some ten feet downward, and entering the back water. One wheel case in each figure is partly broken away, to show the wheels. Besides the support to the stand pipes by their connection with the iron forebays, A A, they and the wheel cases, C C, are supported at their bottoms by iron beams, as shown in cuts. The turbines are placed in the wheel cases, C, and each one has about 58 feet of steel shafting, 3⅛ inches in diameter, coupled to it and supported by bracket bearings projecting from the stand pipes, B B. Each of said shafts has on it, near its top end, a spur pinion 21¾ inches in diameter by 17 inch face, 17 teeth, 4 inch pitch, machine dressed. These gear into a core spur wheel 69⅛ inches in diameter, having 54 wooden cogs, and which is hung on near the bottom of a steel countershaft 6 inches in diameter and 60 feet long, on which, near its top end, is a bevel wheel 88 inches in diameter, 18 inch face, 55 teeth, 5 inch pitch, gearing into a core bevel wheel, 99·6 inches in diameter, with 56 wooden cogs, 18 inches wide.

This wheel is on a short, horizontal shaft, 6 inches in diameter, having on its farther end, beneath the floor of the building, an iron spider carrying a wooden rim band wheel, 10 feet in diameter by 4 feet 8 inches face, carrying a rubber belt 4 feet 6 inches wide by three-eighths inch thick, which connects with the heretofore described five-foot leading band wheel on the main line of shafting above, and drives them.

The turbines operate under 94 feet head of water, including the ten foot draught tubes, and are estimated to make 582 revolutions per minute, and develop 572 horse power each, which, combined, equals 1,144 horse power. The counter upright shaft makes 183·22 revolutions per minute, the counter horizontal shaft, with the ten foot band wheel, 179·95 revolutions per minute, the main line shaft about 359·9 revolutions per minute, and the electro dynamos 755·79 revolutions per minute.

This work has all been carried out under the direction and immediate supervision of Mr. Joseph Cowles, of Rochester.




ELEVATIONS OF THE BRUSH ELECTRIC LIGHTING WORKS, ROCHESTER, N. Y., SHOWING THE 500 H. P. TURBINES.

**The Fatal Cramp.**

A writer in the *British Medical Journal* calls attention to the frequent notices of death, by cramps, of bathers, and suggests some preventives—remedies are in these cases too late. He says that cramp is a painful and tonic muscular spasm. It may occur in any part of the body, but it is especially apt to occur in the lower extremities, and, in its milder forms, it is limited to a single muscle. Pain is severe, and the contracted muscles are hard and exquisitely tender. In a few minutes the spasm and pain cease, leaving a local sensation of fatigue and soreness. When cramp affects only one extremity, no swimmer or bather, endowed with average presence of mind, need drown; but when cramp seizes the whole of the voluntary muscular system, as it probably does in the worst cases, nothing, in the absence of prompt and efficient extraneous assistance, can save the individual from drowning. Its most powerful and most avoidable cause is the sudden immersion of the body, when its surface is highly heated, in water of a relatively low temperature.

**How a Woodchuck Looks to a Child.**

The Boston *Post* says, a gentleman from Boston was riding with his two little daughters in Maine the other day when a woodchuck scampered along the road in front of the horse. The youngest of the little girls, aged about 3½ years, watched the woodchuck with eager interest, and when he turned and disappeared in the woods, she said to her father, with the relieved air of having solved a mystery, "Papa, it was a sponge, wasn't it?"

### Development of the Artificial Ultramarine Industry.

The following abstract of a paper prepared by Dr. Ernst Rohrig for the *Chemiker Zeitung*, has been made especially for our columns as presenting facts of world wide interest. Although it is doubtful whether the animal consumption is steadily increasing, the German factories, according to Dr. Rohrig, show an increased production in the last ten years of about three million pounds. Aniline colors are fast crowding ultramarine to the wall for paper making, and the poor quality of some of the ultramarine that has been put on the market has also brought the whole into disrepute. Germany surpasses in number and size of its factories all other countries, although not protected by import duty on ultramarine, so that large quantities are imported from France and Austria. There are a few factories in this country, but they are not able to supply the home demand.

Artificial ultramarine was first prepared in 1828 by Guimet in Toulouse, and simultaneously by the celebrated German chemist Gmelin. The contest for priority of the discovery was settled by the late R. Von Wagner, by means of documentary evidence showing that the discovery was made independently by both. (The editor of the *Chemiker Zeitung* considers Gmelin's priority to have been very positively established.) Simultaneous discoveries in chemistry have been frequent enough, as in case of chloroform, gun cotton, and even oxygen.

Before artificial ultramarine was discovered, the natural ultramarine was made from the costly lapis lazuli, by a tedious method of grinding, washing, floating, and purifying, so that it cost then $225 per pound. Its use was very limited owing to its price.

The chemical composition, according to Clemens, and Desormes, is as follows:

| | |
|---|---|
| Silica | 35·8 per cent. |
| Alumina | 34·8 " |
| Soda (NaO) | 23·2 " |
| Sulphur | 3·1 " |
| Carbonate of lime | 3·1 " |
| | 100·0 |

While the process which Guimet discovered for making ultramarine remains a secret to the present day, Gmelin at once published his discovery and observations, and thereby became the creator of the German ultramarine industry.

Gmelin's publications in Liebig's *Annalen* induced many other scientific men to institute investigations into the theory of ultramarine production, but up to the present time no satisfactory theory has been established. For a closer study of the subject Rohrig refers to the excellent essays of Ritter and Ebell. Gmelin's discovery at once furnished the technical chemist with an impulse to institute experiments for making a practical use of the discovery. Each strove to invent for himself a practical method for making artificial ultramarine on a large scale, and in this way the different ultramarine factories of Germany have been gradually called into existence.

The earliest of these factories was that of Leverkus, established in 1834 in Cologne, and next that of Leykauf in Nuremberg, founded in 1837, in both of which a more or less independent process of manufacture was built up. And even at the present time each separate factory has its own special peculiarities of manufacture, some of which are more or less important, with others that are perfectly non-essential.

There are two kinds of ultramarine, known as sulphate ultramarine and soda ultramarine. They differ from each other in their external appearance, in their properties, in the methods of preparation, and in the raw material from which they are made.

The raw materials used in making "sulphate" ultramarine are kaoline clay with but little silica, sulphate of soda, sulphur, and resin or coal; those employed for soda ultramarine are silicious clay, quartz or infusorial earth, soda, sulphur, and resin. The proportions of each to be used will depend upon the shade and quality of the ultramarine to be produced. For example, an increase of sulphur deepens the color, more silica will better enable it to resist acids and alum, and gives it a reddish shade, while less sulphur, with but little silica, gives a light blue of little coloring power and unable to resist alum. The sulphate ultramarine has less resistance for acids, yet has greater coloring power, and the color shades toward green.

The manufacture of ultramarine embraces the following operations:

1. *Preparation and Mixing of the Raw Materials.*—The clays are ignited more or less strongly according to the requirements of ultramarine, and then ground as finely as possible by means of millstones, and the quartz likewise, if it is used. After the clay has been mixed with the other substances they are run one or more times through the millstones to secure an intimate and thorough mixing.

2. *Igniting or Burning the Mixture.*—This is mostly done in crucibles placed in rectangular furnaces with fire beneath or in muffle furnaces, and in a few cases in retort furnaces. The heating differs with the mixture and the furnace. The sulphate mixture, for example, requires a much greater heat in burning than the mixture for soda ultramarine, for it requires an orange-red heat to convert sulphate of soda into sulphide of sodium, while soda ultramarine is formed at a much lower temperature.

The chemical changes in this process take place in two stages; in the first, Ritter's white ultramarine is formed; a silicate of soda and alumina, which contains sulphide of sodium, either mixed or chemically combined. A polysulphide is likewise formed, which is mixed with it mechanically.

In the second stage, which begins as the furnace cools and the reducing gases disappear, the mechanically intermixed polysulphide is oxidized by the air to sulphate, and the white ultramarine changes to blue.

An intermediate stage is the production of green ultramarine, which is formed more largely in burning the sulphate ultramarine, because the white ultramarine, or mother substance, does not contain enough polysulphides to make a blue. To convert this green ultramarine into the blue requires special roasting with the addition of sulphur. Green ultramarine also finds considerable use directly as a pigment. Soda ultramarine made as above is perfectly blue at first.

3. *Washing the Crude Ultramarine.*—This operation is necessary in order to remove the soluble constituents (sulphate of soda and dirt) from the crude product, and is accomplished by boiling it separately in distilled water heated by steam.

4. *Grinding the Crude Ultramarine.*—Its power as a pigment is developed by grinding. The finer it is ground the greater its power and the lighter shade. It is ground on wet stones.

5. *Floating the Ground Ultramarine.*—This operation separates the coarser from the finer particles; the coarse grains have a darker color but less power than the finer ones.

6. *Drying the Ground Pigment.*—This is accomplished in kilns of various construction.

7. *Preparing the Dried Pigment for the Market.*—As it becomes somewhat packed in drying, it requires to be broken up and sifted. It now only requires suitable adulteration to fit it for the market.

### Induration of Soft Limestones with Fluosilicates.

The use hitherto made of alkaline silicates to harden limestones is far from satisfactory; it leaves the stone impregnated with soluble salts which are only expelled after long exposure to rain. These salts of potassa and soda rapidly nitrify, and assist the growth of fungous bodies for which the potassa salt is a manure. Another mischievous consequence, resulting from this process, is the formation of an enamel impermeable to water upon the surface of the stones which have reached a point of saturation with the alkaline wash, and this enamel upon the arrival of frost imprisons the water, which freezing underneath this obstinate varnish forcibly detaches the glassy coating and breaks and injures the underlying surface. M. L. Kessler has apparently succeeded in replacing this indurating bath by a solution of fluosilicates of bases whose oxides and carbonates are insoluble in a free state.

When soft limestone is saturated with a concentrated solution of a fluosilicate of magnesium, aluminum, zinc, or lead, a degree of induration is soon reached which is very considerable. In fact, except the liberated carbonic anhydride there is formed only fluorspar, silica, aluminic oxide, and carbonates of zinc and lead or fluoride of magnesium, all of which are less soluble than the limestone itself. No varnish is formed and therefore no danger threatened from the expansion of frost underneath it, the process has perfectly resisted the severe tests of winter, and this method of silicification is only slightly more expensive than the old process it is intended to replace.

It possesses unexpected advantages. It is frequently valuable to give to the surfaces of soft limestones the appearance and the polish of the hard marbles, if only to avoid the settlement of dust and soot upon their rough surfaces. In order to smooth and polish the coarsest limestone it answers to coat it with a paste made of the pulverized stone and water, and after drying to impregnate it with the fluosilicate chosen for its lapidification. It forms a homogeneous body finely granular in texture, and as hard and refractory as the stone itself. It is only necessary to take some very simple precautions to avert the carrying away of fine dust in the beginning of the operation, caused by the rapid disengagement of carbonic anhydride. The skill in its application consists in flowing the solution in a thin film over a surface sufficiently dried.

When a coloring substance insoluble in water is mixed with the paste, a very variable and interesting series of decorative effects are secured. Finally, by employing colored fluosilicates, as those of copper, chromium, iron, etc., the limestone is colored even in its interior by the formation of insoluble compounds. These colors follow the intimate construction of the stone and afford designs of considerable beauty.—*Les Mondes.*

### The Value of String.

Perhaps it is natural instinct that makes the "small boy" tie up to a piece of string. But the possession of string in an emergency is the subject of more than one truthful although romantic tale. The descent of a workman left on a chimney, by means of a string to pull up a rope, is familiar, and the stretching of a connecting cord across a Virginia chasm by means of a kite, saving three persons from the fate of Indian captives, in the early days of the country, is remembered. But a better because nearer exhibition of the value of string was given in New York city on the occasion of the fire at the Munro buildings in Rose Street. Fourteen firemen were cut off in the upper stories of the building by a "back draught," which surrounded them suddenly with smoke and flames, and cut off their retreat by the stairs or fire escape. They crawled on their hands and knees to a window and called for help, but the noise in the street prevented their cries from being understood, it being thought by those below that they were calling for more hose, and preparations were making to send it up to them. Meantime they were in danger of being suffocated, and the flames were gradually advancing upon them. Finally Chief Gicquel saw their peril, and a ladder was raised for their rescue, but it was too short. Finally one of the imprisoned men found a piece of string, which he lowered to the ground, a life line was drawn up, speedily made fast inside, and the men began their descent to the ground. One of them was so faint from exhaustion that he was unable to clasp the rope, and slid down it some fifty feet, lacerating his hands terribly. He was caught at the bottom by a companion, and saved from further injury. The others reached the ground in safety, but scarcely had they done so when the flames burst from the windows they had just abandoned.

### An Editor's Experience with Lightning.

Mr. H. M. Burt, editor of *Above the Clouds*, published at the Summit House, Mount Washington, N. H., writes to a friend in Hartford, Conn., detailing his experience with a bolt of lightning. He said that he was in his office at about six P.M., July 28, when he felt a tremendous blow in the back. "I could not imagine at first what caused it, but instantly thereafter I saw a ball of fire as large as a man's head in front of me, not three feet off. It exploded with a tremendous noise, seemingly as loud as a cannon, and then I knew what must have happened. My left leg seemed to be completely paralyzed, and I fell to the floor. Three of my printers were in the room at the time, two sitting at the table near me and one standing up a little further off. The latter had the skin on one hand torn up, another was hit in the back, and the third escaped without injury."

Mr. Burt gradually recovered from the temporary paralysis induced by the electric stroke, and he winds up his account by saying: "You have probably heard of the impression of a tree being found upon the bodies of those killed by lightning. The same thing was noticed upon my back, and, as there are no trees upon Mount Washington, it seems to me that the peculiar appearance must be the result of the blood settling in the smaller veins."

DR. HENRY MACAULAY, M.D., of Belfast, has recently made a suggestion which, if followed in tropical countries, will turn the tables on the sun with a vengeance. He suggests that Mouchot's sun engine should be used to pump cold air into dwellings, factories, etc., pointing out that the temperature, can in this way be reduced from 100° or more to 60°. He points out that not only will this reduce the temperature especially at night, thus rendering sleep possible, but fresh air will be guaranteed during the day, and the plague of flies and insects would be excluded. The weak point about this arrangement is that it requires ice. We think, however, adds *Nature*, that sooner or later in America where the heat in summer is more distressing than in any other part of the world, and ice is everywhere, this arrangement, or one like it, is certain to be adopted.

### Steel Nails.

At first the extra cost of steel nails was one and a half cents per pound, or $1.50 per keg, but it has now been reduced to $1. The great advantage of the steel nails is that they can be driven into hardwood as easily as an iron nail will go into a pine board. Steel nails have been driven into a white oak knot without bending. Nothing else is now used in laying hardwood floors, as they require no boring, but are driven readily. For all kinds of finish they are especially adapted, and as so much hard finish is now employed, their use must be on the increase. They are also used largely by builders, and box makers are increasing their demand for them. Box makers have been using the better grades of iron nails, as they desire those that can be drawn and redriven.

### Dakota Enterprise.

The following newspaper item well illustrates the rapid utilization of lumber in new sections of the country: "Towns grow out West. A denizen of La Bean, Dakota, was recently asked what the population of that town was, and he replied: "Well, the first lumber was received two weeks ago last Sunday. Now there are six general stores, one dry goods store, one hardware store, five saloons, one meat market, three lumber yards, one bank, one newspaper office, one telegraph office, a post office (with 280 calls and 80 lock boxes of the Yale pattern, in a building 20x30, two stories high), two hotels, and some other structures. Since then there has been started another bank, a 50 room hotel, a hardware store, a dry goods house 30x80, and a Presbyterian church."

### Over the Ocean on Wheels.

A dispatch from London, dated July 29, says that Terry, the man who left Dover at 9 o'clock yesterday morning on a floating tricycle, crossed the English Channel and arrived safely at Calais at 5 o'clock in the afternoon. His machine was a tricycle of two side wheels of large diameter and one steering wheel of smaller diameter, each of them buoyant by a hollow composition of water-tight material. The propelling power was his own legs, the larger wheels being furnished with paddles at proper distances on their peripheries.