passed by the State Legislature on the 14th of May, 1872. By the provisions of the act, the New York and Harlem Railway Company is directed to construct open cuts, bridges, tunnels, and a viaduct, at certain specified places, to lay temporary tracks, and alter the grade of the cross streets wherever necessary; the gas, water, and sewer pipes are ordered to be removed by the corporations owning them, and the Mayor and Aldermen of the city forbidden to obstruct, and authorized to adopt and facilitate, the work; the total expense of which is to be borne in equal proportions by the city and the railway company; that sustained by the city to be raised by a tax on real and personal property. A Board of Engineers was also created, who should have entire control and charge of the work, receiving, in return for their services, $8 for every day employed. In accordance with the requirements of the act, a Board of Engineers was appointed consisting of Alfred W. Craven, Allan Campbell, the Engineer of the Department of Public Works, Edward H. Tracy, and the Engineer of the Harlem Railway Company, the late Isaac C. Buckhout.

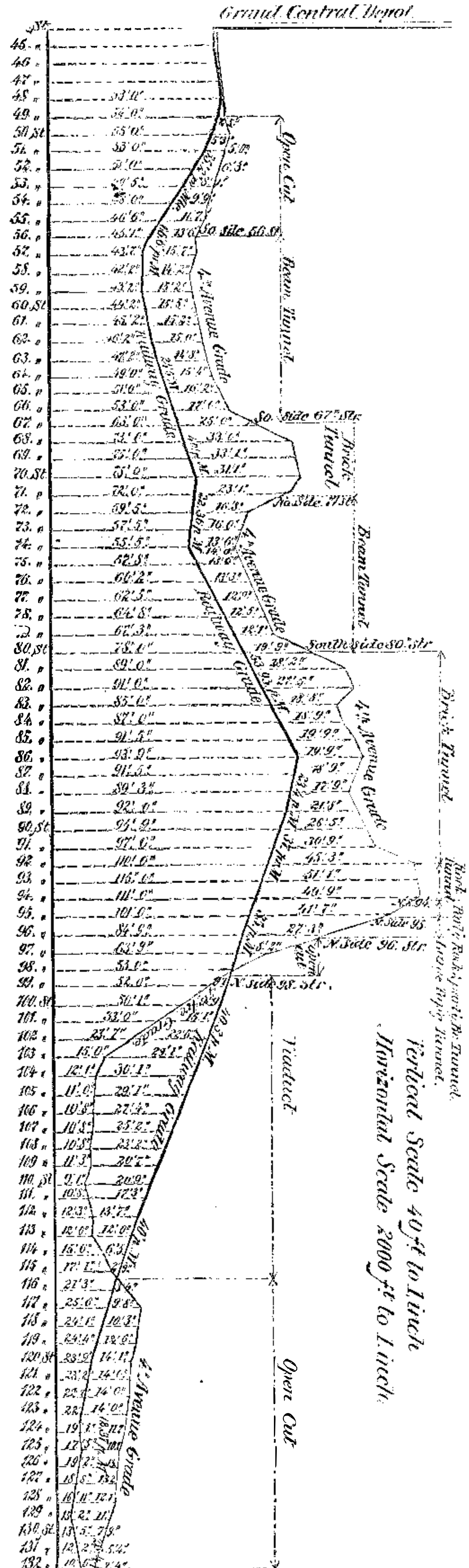

Fig. 3.—THE UNDERGROUND RAILWAY IN NEW YORK. PROFILE OF THE SECTION FROM 45TH STREET TO HARLEM RIVER. DISTANCE 4 1-4 MILES.

Estimates, plans, and specifications were prepared and bids opened for the work in the same year. Of all the bids offered, that of Messrs. Dillon, Clyde & Co. was selected, this firm contracting to do the work in the manner required for the sum of $6,395,070, or $285 per running foot, which was proportioned as follows:

Earth excavation and embankment	$579,000
Rock excavation in open cut	701,000
" " " tunnels	255,000
Retaining walls	1,013,000
Parapet walls	100,000
Foundation walls	238,400
Granite coping	134,700
Plank used in foundation	70,000
Piling used in foundation	182,200
Concrete	23,800
Removal of sewer, water, and gas pipe	300,200
Drain pipe	6,800
Ballasting	57,000
Brickwork in arches, etc	708,500
Blue stone	34,300
Bridge from 79th street, exclusive of parapet, coping, excavation, and drain pipe	334,100
Iron bridges and approaches	388,000
Wrought iron	498,500
Cast iron	23,500
Iron railing	79,200
Felting	36,500
Temporary track	50,000
10 per cent for contingencies	581,370
Total	$6,395,070

Late in the fall of 1872, ground was broken and the work commenced by the contractors and their sub-contractors, under the supervision of the Board of Engineers already mentioned, with Mr. I. C. Buckhout, of the Harlem Railway Company, as Superintending Engineer, Mr. W. L Dearborn, C.E., as Resident Engineer, Mr. F. S. Curtis, C. E., Principal Assistant, and a corps of four Division Assistants, Messrs. Geo. S. Baxter, C E., S. F. Dayo, C.E., Sevene Lee, C. E., and Milford Berrian, C.E. The names of the sub-contractors will be mentioned in connection with the work done by them.

We will briefly give the general plan of the work, and then pass to a detailed description of its parts, premising that, for the drawings which we publish and for much valuable information, we are indebted to the courtesy of Mr. F. S. Curtis, the principal assistant resident engineer, and to Mr. Horan, the chief of the drafting department.

In plan, the work consists of a four track railway, reaching from 42d street to the Harlem river, a distance of four and a quarter miles, and, with the exception of that portion passing over the viaduct on the Harlem flats, everywhere sunken below the level of the street, and covered in with tunneling over as large a part of the distance as the grade of the road and the grade of the avenue will admit. On that portion of the line which is covered with tunnels, three kinds of tunneling have been used, depending upon the character of the ground and the difference between road grade and avenue grade. Thus wherever sufficient headway could be obtained, arched brick tunnels are used; wherever the headway was too small to admit of an arched tunnel, a flat top beam tunnel is used; and where the headway was too small to permit the use of the beam tunnel, open cuts, spanned at the street crossings by iron plate girder bridges, sixty feet in width, were of necessity resorted to. The third kind of tunnel referred to is the rock tunnel at 92d street. The reason for the use of these three kinds of tunneling will, perhaps, appear more evident by a glance at the accompanying profile, Fig. 3, which, being so greatly reduced, will throw into bold relief the various grades used on the railroad and the avenue, and the difference between them, and will afford a good idea of the various species of work involved. It will there be noticed that the grade of the road begins to fall gradually from 45th to 48th streets, and that from this point to 57th street it increases rapidly, falling in this space 25 feet, 66·6 feet in the mile, which is the heaviest grade on the road. From 57th to 59th streets the grade runs level, then rises to 70th street through a hight of 15 feet and 9 inches, is again level to 71st street, falls between 71st and 73d streets 2 feet 4 inches, or 22·36 feet in the mile; is once more level to 74th street; rises 32·5 feet, or 53 9 in the mile, to 86th street, at which point begins the long descending grade which crosses the viaduct and extends to 129th street, falling in the distance 69·8 feet, after which begins the up grade, which reaches the street level at 133d street and Harlem Bridge.

At 56th street the railway grade is 13·6 feet below avenue grade; and at this point, the headway not being sufficient for an arched brick tunnel, a beam tunnel commences and extends to point 24 feet 9½ inches south of the south side of 67th street. Here the railway is 25 feet below the street; and the ground rising rapidly, a headway is obtained sufficient for an arched tunnel, which extends to a point 29 feet 2 inches north of the north side of 71st street, where the beam tunnels again begin and reach to 27 feet 7½ inches south of the south side of 80th street, where the ground commences to rise rapidly and the brick tunnels once more appear, ending at the beginning of the rock tunnel at 92d street. This tunnel is about 550 feet long and is followed by the partly rock and partly brick tunnels, which end at a point 31 feet 6 inches north of the north side of 95th street, and from this point to north side of 96th street extends a tapering tunnel formed by three tunnels passing into one. At 96th street the difference of grade is about 27 feet; and from this point, the land falls so rapidly to the Harlem flats that at 97th street the difference of grades is but 8 feet 2 inches, and consequently from this point to 98th street extends an open cut, ending at the south end of the viaduct, which reaches thence to the middle of the block between 115th and 116th streets, or a little over 717 feet short of a mile. [We shall continue the subject in our next and future numbers with various illustrations of the works.]

Correspondence.

The Crystallization of Carbon.

To the Editor of the Scientific American:

You refer, on page 247 of your current volume, to a new idea of making artificial diamonds by crystallizing carbon. It strikes me that the almost constant co-occurrence of native platinum or gold with diamonds is not merely fortuitous, and these metals may have something to do with the crystalization of carbon. It is a sufficiently proved fact that, at very high temperatures, chemical affinity is much modified, and perhaps disappears; the same modification may be a result of high pressure. Undoubtedly, in former geological ages, the atmospheric pressure was much higher than it is now, as is proved by the fact that liquid carbonic acid is enclosed in rock crystals. But a great pressure is also produced by a high column of water; and this may be one of the circumstances under which carbon is now crystalizing in the form of diamonds.

Let some one try a series of experiments, in which chloride of platinum, Pt Cl_2, or gold may act under the highest possible pressure on a suitable hydrocarburet (containing a maximum of carbon and a minimum of hydrogen), and see if such a decomposition as the following is possible:

$$2C_n H_m + mPt Cl_2 = 2mH Cl + mPt + 2nC,$$

n being greater than m, whereby Pt would fall down as a regulus, and C would crystalize as diamond.

If this be Nature's process of forming diamonds, the muriatic acid is of course washed away and deposited elsewhere in muriates; while the native metal and the diamonds are retained in the place of formation or carried along by the mechanical action of water. The highest pressure may be obtained by compressing water at a temperature of over 39·2° Fah., if only a material can be found for a vessel that can endure this pressure. It being desirable that the walls of the vessel are translucent, perhaps rock crystal or fluorspar could be used. But as the hydrocarburet is lighter than water, some means must be found to hold it, close to the bottom of the vessel (perhaps by means of a bladder, through which exosmosis takes place), in contact with the solution of chloride of platinum. Perhaps some liquid other than water may be desirable; but it must be lighter than the hydrocarburet, and not affect either the latter or the solution of platinum.

There is another series of experiments: It is generally known that air dissolved in water contains more oxygen than atmospheric air. Now, ozone is a modification of oxygen, produced, probably, by a denser formation of the atoms. The oxygen of the air in the water is probably turned into ozone by a high pressure, which would decompose the hydrocarburet by taking away the hydrogen and leaving the carbon, which would crystalize in the liquid. This process may have taken place where no platinum is found associated with diamonds. According to my opinion, it is worth trying whether one of these processes, or perhaps both combined, will have the result, so long sought for, of crystalizing carbon before our eyes. W. THIESE.

Rochester, N. Y.

Professor Tyndall and the Buddhist Philosopher.

To the Editor of the Scientific American:

In your issue of October 3, page 208 of your current volume, under the caption "Candle Flames and Streaks of Cloud," you quote the Buddhist philosopher: "It cannot be said that he (Buddha) is here or there; but we can point him out by the discourses he delivered. In these, he lives;" and you add: "Science has no further word to offer."

Both the ancient philosopher and the modern professor have erred in making the destiny of man analogous to the transmutation of the correlated forces, heat, light, elec tricity, motion. There is another law which Science cannot disregard. Life, whether vegetable or animal, does not necessarily become "extinguished as the flame." It becomes latent in the seed. It is there ready to resume its normal law of growth whenever the proper conditions are presented. It would be in accordance with strict deduction, from observed facts in the vegetable, to expect that the animal also, when planted, would return to its renewed form. This expectation is constantly disappointed as to the lower animals and generally as to man. But another series of facts must be also weighed by Science. A large part of our race has always expected a continued existence; and this expectation has been confirmed by human testimony to the rising from the dead of a certain Man who also raised others from the dead; and after thus proving his right to know, He declared that all others would eventually be raised to life again, having been planted (as it were) in the ground. Science must of necessity inquire: 1. Whether the facts of this resurrection and this assertion of a competent witness are duly proved according to the rules of evidence. 2. Whether the statement that growth may be resumed, after cessation for a great length of time, accords with this law of latency as found in plants. Science cannot concern with this as a matter of faith; but it cannot disregard facts duly proved by credible and competent witnesses. Taking up the subject in this line of hard logic, we believe it is to be shown beyond reasonable doubt that the destiny of man is not to melt into the "infinite azure," nor "to be extinguished as the flame," but to live again and to participate again in the affairs of this world. The mode of his return to life and the manner in which he will participate in the future world's affairs are not subjects for discussion here. A belief in the resurrection of a material and organized body leads one very far from the orthodoxy of the churches; but it brings the ascertained facts of Science and the literal words of Scripture into an harmony that does not seem to have been suspected by the scientists or the doctrinaires. E. X.

Lunar Acceleration.

To the Editor of the Scientific American:

There are good reasons why astronomers do not accept the theory of the above named phenomenon, published by your correspondent, Mr. John Hepburn, on page 260 of your current volume.

It has not yet been demonstrated that the sun's orbit is anything like a circle or an ellipse; but there is every reason to believe that his orbit is of a more complicated character, that it is without any period, and is not confined to any one plane. It is believed, also, that his motion is comparatively so slow that the change of direction of his course in 25,800 years amounts only to a small fraction of a degree. Unless your correspondent can prove the fallacy of our fundamental theories of dynamics, he dare not maintain that the sun is rotating in a circular orbit without a central body whose attraction is many times greater than the resultant of all attractions from the rest of the so called fixed stars. Without the sun's orbit be in the ecliptic, and of a circular or elliptic form, it is as absurd to speak of a retrograde motion as it is to speak of an above and below, of a before and behind, of a right or left hand side of the Universe.

There is no doubt but the travel of the terrestrial poles and the precession of the equinoxes have a common cause. If we depict the travel of either pole, as observed on a stellar globe, we find that for any one time both poles occupy directly opposite positions, and that the phenomenon can be produced by no other motion than a gyration of the earth's axis, of which the precession of the equinoxes is a necessary sequence. This being an established fact, I am unable to see what the alleged retrograde motion of the sun has to do with the explanation.

The period for a complete revolution of the recession of the eclipses is somewhat less than 19 years, and that of the precession of the equinoxes about 25,800 years, which is apparently not quite the same rate, as your correspondent states. Evidently the two phenomena have not a common cause, though they are results of the same principle, and have long ago been satisfactorily explained and experimentally demonstrated by the gyroscope.

Your correspondent subsequently takes refuge in a hypothetical and rather exorbitant increase of the motion of the sun, which no astronomer can take for granted on this ground only. Next he confounds increased with increasing motion. A rotation that makes 31° for 30°, 62° for 60°, and 93° for 90° is simply increased, not accelerated, as it would be if it would make 31° for 30°, 64° for 60°, 99° for 90°, according to the laws of accelerated motion. Lastly, he commits the mistake of referring the angle he found to the diurnal, instead of the annual, rotation of the earth. If he makes his calculations in accordance with the laws of dynamics, he will find no agreement whatever between his theory and the observations of astronomers.

I am afraid that the question is still open.

Philadelphia, Pa. HUGO BILGRAM.

The Potato Bug.

To the Editor of the Scientific American:

Several paragraphs in relation to the potato fly (*cantharis vittata*) have appeared in the SCIENTIFIC AMERICAN, and are now going the rounds of the press. It is strange that an insect well known to the medical profession for the last nineteen years, and which but twenty years ago amounted, in extensive districts of this country, to almost a scourge, should now have become so great a stranger. Under the head of "Potato Flies," the United States Dispensatory says (I quote from the ninth edition, page 171):

"Within the limits of the United States are several species of *cantharis*, which have been employed as substitutes for the *c. vesicatoria*, and found to be equally efficient. Of these, only the *c. vittata* has been adopted as officinal. * *

* The potato fly is rather smaller than the *c. vesicatoria*, which it resembles in shape. Its length is about six lines. The head is of a light red color, with dark spots upon the top; the feelers are black; the elytra or wing cases are black, with a yellow longitudinal stripe in the center, and with a yellow margin; the thorax is also black, with three yellow lines; and the abdomen and legs, which have the same color, are covered with a cinereous down. It inhabits chiefly the potato plant, and makes its appearance about the end of July or the beginning of August, in some seasons in great abundance. It is found on the plant in the morning and evening, but during the heat of the day descends into the soil. The insects are collected by shaking them from the plant into hot water, and are afterwards carefully dried in the sun. They are natives of the Middle and Southern States. * * If the potato fly has been found more speedy in its effects than the *cantharis* of Spain, the result is, perhaps, attributable to the greater freshness of the former. It may be applied to the same purposes, treated in the same manner, and given in the same doses as the foreign insect."

Black River Falls, Wis. E. S. WICKLIN.

Aniline Black Dyes.

To the Editor of the Scientific American:

Of late years the importance of aniline black to calico printers and dyers has steadily increased, and I think it may be of some interest to your readers, among whom you must have many printers of fabrics, to know something of the best methods of printing it and the *rationale* of the process.

Aniline black is produced upon cloth by the application of a mixture of a salt of aniline with a chlorate (usually chlorate of potassa) and generally a little sulphide of copper. Now the great causes of trouble in the process are the following:

I. Injury to the doctors (scrapers) and rollers by crystals of chlorate of potash.

II. Weakening of the cloth by the action of the acid.

III. The great difficulty of getting a steam color.

The first of these difficulties is avoided by the French printers by using chlorate of baryta instead of potassa, and in England by the use (in some works) of chlorate of soda, a very much more soluble chlorate than that of potassa, and one which can be procured perhaps as cheaply. The two last difficulties are insurmountable or nearly so, and it has been proposed to use an acetate of aniline instead of the chlorhydrate; but I have found by experiment that acetanilide is formed, which gives no black color with oxidizers.

By carefully aging in very damp rooms, the second difficulty may be surmounted; but the third, the production of a sufficiently cheap aniline black to steam without tendering the cloth is not yet a solved question. M. B. C. G.

Boston, Mass.

Cribbing in Horses.

To the Editor of the Scientific American:

Noticing an article and illustration in your valuable paper sometime ago, on the subject of cribbing in horses, I send the following plan of eradicating the habit:

Cribbing is caused in the first place by some foreign substance being pressed between the teeth, or by the front teeth growing too close together, thus causing pain. The horse, to avoid this, instinctively pulls at any hard substance, thus spreading the points of the teeth, and by that means affording temporary relief. To remedy this fault, it is only necessary to saw between the teeth with a very thin saw; this relieves the teeth of all side pressure, and effectually ends the trouble. The gulping of wind and the gurgling in the throat are effects that will cease with the removal of the cause.

Elmira, Ohio D. COOK.

Improvement in Gas Retorts.

To the Editor of the Scientific American:

I have a wrinkle to impart to those of the gas fraternity who use clay retorts. It is well known that clay retorts, when first fired up, are very open and porous, causing considerable loss in the yield of gas; and the same thing happens when they become coated with carbon on the inside and have been recently burned out. If those who use such retorts will, when they are new, coat them (both in and outside) with a solution of silicate of soda, of the consistence of ordinary sirup, the difficulty will be entirely removed. It is hardly necessary to add that the coating should be done before setting, and allowed to dry thoroughly.

Frankfort, Ky. M. L. JONES.

[For the Scientific American.]

CRUCIBLES.

The excellence of a crucible depends on the ready expansion and contraction of the ingredients of which it is made. The best crucibles are composed of the following compositions, which are of two kinds, namely, with and without plumbago.

WITHOUT PLUMBAGO.

Three parts by measure of the Stourbridge best crucible clay, two parts cement, consisting of old used-up fire bricks, and one part hard coke. These ingredients must be ground and sifted through a one eighth inch mesh sieve; the sieve must not be finer, otherwise the pot will crack. This composition must be mixed with sufficient clean cold water, trodden with the bare foot to the consistency of stiff dough, and allowed to stand for three or four days well covered with damp cloths, to admit of its sweating and the particles of clay becoming thoroughly matured. It is then ready for use, and must be blocked by hand on a machine. Dr. Ure, in his "Arts and Manufactures," gives drawings and methods of working the machine.

Owing to the coarseness of this composition, the pot cannot well be thrown on the potter's wheel; and in no instance an it be made by pressing.

The crucible must not be burnt in a kiln, but merely highly and thoroughly dried before being placed in the furnace for use. For brass and copper melting, it will stand one good hard day's work; but care must be taken to replace the pot again in the furnace after the metal has been poured. If the pot be not allowed to go cold, it will last for several days. It will, with the greatest safety, stand one melting of wrought iron. The cost, when made on the steel manufacturer's own premises, is about forty cents per pot, each pot holding from 100 to 120 pounds of metal.

HESSIAN CRUCIBLES.

Good Hessian crucibles are composed of two parts of the best German crucible clay and five parts pure fine quartz sand. This composition must be sifted through a one eighth inch mesh sieve; it is then tempered and trodden with the bare foot, as before described. When ready for use, it is pressed into different sizes of crucibles, which, when thoroughly dry, are placed in the kiln or furnace and burnt hard.

ANOTHER COMPOSITION.

Two parts best Stourbridge crucible clay, three parts cement; sift through a one eighth inch sieve. Temper as before described and block by hand on the machine. When thoroughly dry, it is placed in the kiln and burnt hard. These crucibles are principally used for melting gold and silver, and also for dry analysis.

The best and most perfect fire clay for crucible making is nearly always found in the pavement of coal. Some of the Pittsburgh fire clays, and those found to exist in the pavements of some of the Pennsylvania coal mines, are excellent fire clays. But the various compositions cannot be described, as they are as numerous as the different kinds of clays.

WITH PLUMBAGO.

The Birmingham soft tough pot consists of two parts of the best Stourbridge crucible clay, three parts plumbago, and one part cement, consisting of old used-up crucibles ground and sifted through a one eighth inch mesh sieve.

ANOTHER COMPOSITION.

Four parts of the best Stourbridge crucible clay, three parts plumbago, two parts hard coke, and one part cement, consisting of old pots ground and sifted as before. Where old pots cannot be had, the above composition must be burnt hard, ground, and sifted. The scales or chippings of the insides of gas retorts are far superior to the best common hard coke. But where scales and chippings cannot be had, hard coke is the best substitute. All the ingredients of this composition must be sifted through a one eighth inch sieve (but not finer), tempered, and made as before described. When thoroughly dry, it is placed in the kiln and annealed, but not burnt hard. This composition makes a pot (for melting the hardest metal) which cannot be melted at any pitch of heat, nor can it be cracked with the most sudden heating and cooling. It is regularly known to stand fourteen and sixteen meltings of iron, even wrought iron. I have often made it to stand more than that.

Any steel manufacturer can make the pot on his own premises at a cost of $1 20 or thereabouts, the pot holding from 100 to 120 pounds of metal. J. D.

Houston, Texas.

Utilization of Silk Rags.

According to *Les Mondes*, one of the wealthiest English velvet manufacturers, Mr. Lister, worked his way to success by years of patient labor in search of a way to utilize silk rags. He began by buying up all such waste at less than a cent a pound; and up to the year 1864, he had expended the immense sum of $1,312,500 in fruitless efforts to find a process. Nothing daunted, Mr. Lister continued his experiments; and within the past ten years, he has discovered a way of making the refuse into fine velvet. He carries on this industry at Manningham, Eng., in an establishment which employs not merely 4,000 workmen, but 283 travelers in all parts of the globe, whose sole business is to buy the silk waste. The factory is said to have cost nearly $3,000,000.

The practice of patenting imitations of articles of standard excellence is growing in favor at the Patent Office. A patent lately granted is for producing an imitation of Russian sheet iron. This is done by hammering the sheet between anvils and hammers that have indented surfaces, so as to give the sheet a mottled appearance. Another patent is for an imitation Swiss window shade, in which the lace work is imitated by stencils.

JOHN LAIRD, M. P.—The death of Mr. John Laird of Birkenhead, Eng., occurred on the morning of Thursday, October 29. He was the son of William Laird, of Greenock, Scotland, and was educated the Royal Institution, Liverpool. He was well known as an enterprizing and successful ship builder. We shall probably publish a portrait of him next week.

SULPHATE OF COPPER OPTICS.—If we receive the solar light reflected by a large crystal of sulphate of copper upon a sheet of platinum or tin plate, placed at a small distance from the crystal, the sheet assumes the color of metallic copper upon the part which receives the reflected light.