### The Malleability of Iron.

The mill manager of Messrs. W. Hallam & Co., of the Upper Forest Tin Works, near Swansea, succeeded in making a sheet of the finest appearance and thinness that has ever yet been seen by mortal eye. The iron from which the sheet was rolled was made on the premises. It was worked in a finery with charcoal and the usual blast; afterward taken to the hammer, to be formed into a r gular flat bottom; from thence conveyed to the balling furnace, and when sufficiently heated taken up to the rolls, lengthened, and cut by shears into proper lengths, piled up, and transferred to the balling furnace again; when heated it was passed through the rolls, back again into the balling furnace, and when duly brought to the proper pitch was taken to the rolls, and made into a thoroughly good bar.

It was then taken to the tin mills and rolled till it was supposed to be thinner than 23 grains, afterward passed through the cold rolls to give it the necessary polish, and it stands on record as the thinnest sheet of iron ever rolled. The sheet in question was 10×5½ inches, or 55 inches in surface, and weight but 20 grains, which being brought to the standard of 8×5½ inches, or 44 surface inches, is but 16 grains, or 30 per cent less than any previous effort, and required at least 4,800 to make one inch in thickness.—*Paper Maker's Journal, England.*

### Great Circle Sailing.

The advantages to be derived from sailing upon the arc of a great circle are described in the North Atlantic Pilot Chart for July, issued by the United States Hydrographic Department, as follows:

It is too common a practice among mariners to accept the straight line of the Mercator chart, *i. e.*, the rhumb line, as a direct route. The rhumb line, in itself, offers the single advantage of a true course (technically, so called) which is constant; but this is more an imaginary than a real advantage, because the true course must frequently be corrected for the magnetic variation, and the original rhumb is never strictly maintained over long distances.

Although the chart serves to direct a vessel's course and to mark her progress, the vessel herself actually sails upon the surface of the sphere. When her course is shaped by the rhumb, she approaches her port in a roundabout way, in reality never heading for her port until it is in sight. The rhumb line of the sphere is a spiral, which has the property of making a constant angle with the meridians. Upon the Mercator chart it projects as a straight line, and thus presents a false appearance of minimum distance.

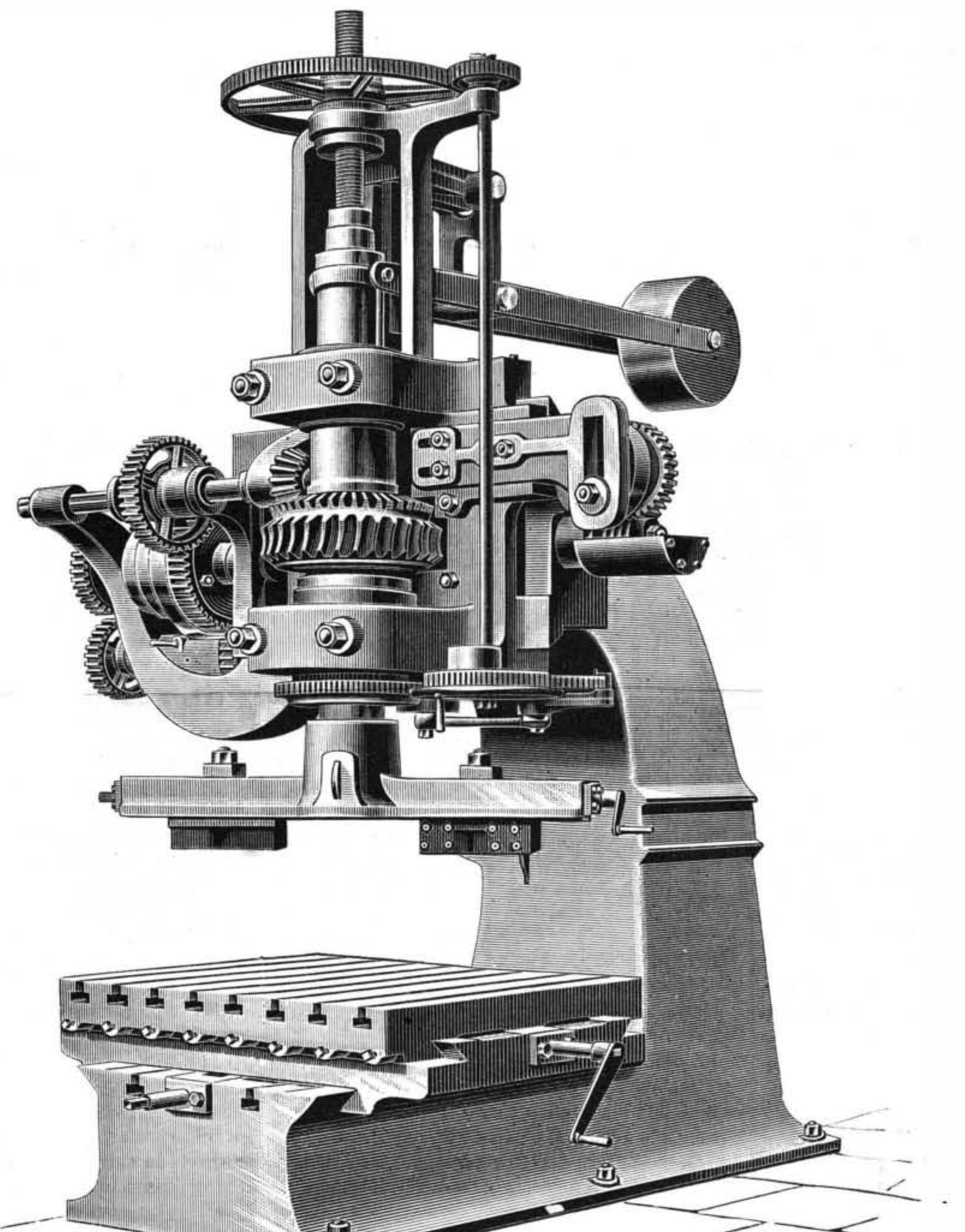
A glance at a globe, or at a thread stretched across its surface, makes it apparent that the shortest distance between any two places upon the surface of the sphere is along the great circle which joins them, and that it is only while maintaining her great circle course that the vessel heads for her port as if it were constantly in sight. Except when sailing along a meridian, or the equator, the true course upon a great circle changes gradually with the advance of the vessel, but so slowly that in practice a new course need be set only for each 100 or 200 miles of distance made good. Since the great circle course for any position of the vessel is quickly found, the necessity for a change of course may be easily investigated.

When a great circle route is to be taken, the whole route should be projected upon the sailing chart, either by a continuous line or by frequent points, that it may be examined for general direction, obstructions, meteorological conditions, etc. When a vessel falls off the original great circle, she should not attempt to regain it, for the shortest distance then is upon the great circle that joins her position to her place of destination. Her course is always the great circle course at her actual position. In general, it will suffice for sailing vessels to shape courses as usual, following the general direction of the original great circle as projected, but it is preferably for fast steamers to ascertain the exact great circle courses. From what has been said it is seen that a vessel, in pursuing a great circle route, practically sails upon a series of short rhumbs closely approximating a great circle.

The distance saved by a great circle route, as compared with a rhumb route, varies greatly, according to conditions. Between Yokohama, Japan, and Cape Flattery, Washington, it is 268 nautical miles; from Belle Isle to Malin Head it is only 36 miles, the total distance being only 1,692 miles.

### IMPROVED CIRCULAR AND ELLIPTICAL BORING MACHINE.

We illustrate from *Engineering* a circular and elliptical boring machine constructed by Messrs. G. & A. Harvey, Albion Works, Govan. On the upper surface of the main frame or standard, which is of box section, there is bolted a slide or bed having planed V's and carrying a belt, cone and spur-driving gear. On the front of the bed there is fitted a saddle with a bearing for a sleeve, through which passes the boring spindle, which is 8 inches in diameter. On this sleeve a worm and bevel wheel are securely fixed, the former gearing into a bevel pinion on the end of the spur wheel shaft, the motion of either driving arrangement being conveyed direct from three-stepped cone or double gear, as desired. The spindle carries a double-ended tool slide having 8½ inches in vertical travel, the tool boxes of which are movable horizontally for boring diameters from 3½ inches to 60 inches. By using one tool box and giving motion along the slide to the saddle by means of worm, worm wheel, disk and connecting bars, holes may be bored varying from a complete circle to those of an elliptical form, whose transverse and conjugate diameters have not more than a difference of 7 inches. The spindle is counterbalanced by lever and weight, and has 14 inches vertical travel by hand or self-acting feed when the double-ended slide is removed. On the upper tool slide there is fitted a compound table adjustable by hand by means of screws. The upper table is furnished with ⊥-slots for securing the work required to be operated upon.



IMPROVED CIRCULAR AND ELLIPTICAL BORING MACHINE.

BY mixing a saturated solution of carbonate of soda with ordinary carmine ink, red lines may be successfully drawn on blue prints.

### Practicability of Increased Tractive Power on the New York Elevated Railroad Structures.

The experience of the "Alley" elevated road in Chicago shows very conclusively, says the *Railroad Gazette*, that six, seven, and even eight-car trains are readily handled, so far as loading and unloading are concerned, whenever the platforms are made of snitable length. This is practically a demonstration that the capacity of existing elevated roads can be increased materially by hauling a greater number of cars at the hours when more capacity is needed.

In Chicago, for instance, the number of trains that can be sent out from Congress Street in an hour is limited to the delivery of a single stub terminal. The headway so far has been about 2½ minutes. With a six-car train this accommodates about 500 passengers each 2½ minutes, or 14,400 passengers an hour. With eight-car trains it would be 19,200 passengers an hour. The only extra cost of hauling the greater number of passengers lies in the increased number of guards on the trains and some additional expense for fuel. The increased fuel used is not in proportion to the increase in train, being much less; so that the total train expense per passenger is materially decreased by using the longer train. The result then is a decrease in train expense per passenger, and increase in total capacity by using more cars per train.

To make the same time over the road this requires a heavier engine, as elevated railroad motors are, as a rule, worked to their full capacity. In Chicago their capacity is about seven cars per train. So far as the structure is concerned, it is not strained practically any more by a longer train than by a short one, except perhaps on curves; but as the trains are allowed to float around the curves at a slow speed, probably no greater strain would be produced there. The limit of train length with the present form of steam motor lies in the limit of weight that can be made available for adhesion on the locomotive. The locomotives in New York weigh about 47,000 pounds; in Chicago about 58,000 pounds. If all of the weight of the Chicago engines could be made available for adhesion, the locomotives would be sufficiently powerful to haul at least nine cars per train. The steam supply is quite sufficient on those engines for the increased work that would be demanded. As the engines are designed, they have trucks under the tank which carry about 18,000 pounds, or nearly one-third of the total weight. This weight is useless for adhesion, and is, in fact, a dead weight that has to be carried without serving any really useful purpose.

This explains the preliminary facts relating to the point we wish to bring out, which is that the existing elevated railroad structures could be made to carry much longer trains by a proper arrangement of the weight of the locomotive. Before radical steps are taken, if ever they are, to modify existing structures of elevated roads, it should be seriously considered whether longer trains would not be more profitable than the five-car trains now run.

### Sudden Death to Flies.

"Come inside a minute," said a Fourth Avenue dealer in pianos, yesterday afternoon. "I have discovered the greatest fly trap on earth and I want to show it to you." He led the way to an instrument at the rear of the store on which was a newspaper. On the paper had been placed a bunch of sweet peas. At least a thousand dead flies were lying on the paper in the immediate vicinity of the bunch of flowers. "I threw these here by chance," he continued, "and in about ten minutes I happened to notice that every fly that alighted on the flowers died in a very short time." Even as he spoke a number of the insects which had stopped to suck the deadly sweet had toppled over dead. They alighted with their usual buzz, stopped momentarily, quivered in their legs, flapped their wings weakly several times, and then gave up the ghost.—*Louisville Journal.*

### Carbonizing Metal.

One method used in Germany for introducing carbon into a molten metal bath is by mixing pulverized anthracite and lime water together, and forming the mass in briquettes under great pressure, these briquettes being then brought into contact with the molten metal; in this way, exactly, the desired proportion of carbon for the formation of steel of various tempers and qualities can be imparted to the converter. The method of recarbonizing is stated to cost only about one-sixth that of the ferro-manganese plan, but the most important advantage presented is the greater accuracy and uniformity with which any required quality of steel may be produced, ranging all the way from the hardest to the very toughest sorts. It is anticipated that rails made according to this new system will have a life of from 35 to 40 years, while girders made in this way possess very great additional durability.—*Iron Trade Review.*

### Xylolith or Wood Stone.

Xylolith, or wood stone, says the *American Architect*, is coming into extensive use in Germany. A recent number of the *Bautechniker* gives a variety of additional particulars. Xylolith, or steinholz, or wood stone, is made of magnesia cement, or calcined magnesite, mixed with sawdust, and saturated with a solution of chloride of calcium. The pasty mass, before the cement sets, is spread out into sheets of uniform thickness, and subjected to an enormous pressure, amounting to more than a thousand pounds to the square inch. The compressed sheets are then simply dried in the air. The original invention of this material dates back to 1883, but it is only within the last five years that a single firm, that of Otto Sening & Co., at Pottschappel, near Dresden, has undertaken the manufacture of it on a large scale, and has met with such success that it is already engaged in the erection of extensive additional works in the Austrian territory, to supply the South German market. In 1888, a series of tests of xylolith was made at the royal testing station for building materials in Berlin, covering its chemical as well as mechanical qualities. In resistance to tension it was found, naturally, that the dry material was much superior to the same soaked with water, dry specimens resisting a tension of about 100 pounds per square inch, while pieces saturated with water resisted only two-thirds as much. Soaking the dry material in linseed oil increased the tensile strength about ten per cent, and freezing diminished it slightly. The resistance to compression proved to be about 300 pounds to the square inch. This was diminished about ten per cent by freezing, and increased to about the same extent by careful drying and saturation with linseed oil.

The specific gravity of the new substance was found to be 1·553. The fractured surfaces showed a yellow color, with a perfectly uniform and close grain. When immersed in water, unbroken sheets of perfectly dry material took up 2·1 per cent of their weight of water in twelve hours and 3·8 per cent in two hundred and sixteen hours. Broken pieces absorbed in the same time about twenty per cent more water than the unbroken sheets. To try the resistance to the influences of the weather, a large number of samples were taken, and subjected to boiling in water, brine, soda-lye, hydrochloric acid, and solutions of sulphate of iron, sulphate of copper and sulphate of ammonium, alternating the boiling with sudden cooling. After several days' treatment with hydrochloric acid a loss of 2·3 per cent in weight was observed, but the properties of the pieces under test were not perceptibly affected. In the other cases no loss of weight could be detected, nor was there any other apparent alteration, and the liquids used for treating the samples remained perfectly clear. Exposure to superheated steam, in a Papin's digestor, also produced no visible effect. In hardness, the material was found to occupy a position between feldspar and quartz, being scratched by the latter, but not distinctly so by the former. As a conductor of heat, the xylolith was found to rank between asbestos and cork, being, therefore, one of the best non-conductors known. To test its fire-resisting qualities, sheets were exposed for three hours to the flame of a Bunsen gas burner, by which the actual surface touched by the flame was charred, although there was no crumbling, or extension of the charring beyond the marks of the flame. Similar pieces, laid on the burning coal in the fire box of a drying oven, and kept for some time at a red heat, were rendered brittle, and crumbled at the edges, but kept their shape and cohesion, and showed no sign of breaking into a flame.

For use, xylolith is delivered in sheets, from a quarter of an inch to an inch and a half thick, and of all sizes, up to a meter square. The dimensions are almost unchangeable by dryness or moisture. A sheet measuring one meter square when perfectly dry will expand from one to two-tenths of one per cent when soaked in water, and a moist sheet will contract in drying to about the same extent. Being so little subject to contraction and expansion, it is extensively used for floors in railroad stations, hospitals and similar buildings, and for decks of vessels. It is readily planed, sawed, bored and fashioned with ordinary wood working tools, and may be painted or decorated in the same manner as wood. It is itself nearly waterproof, and with suitable putty in the joints, and a good coat of paint, it may be made entirely so. It is not surprising that a material possessing so many advantages should have come into extensive use abroad, and we trust that its manufacture may be introduced here. It is sold in Germany, in sheets of thickness suitable for flooring, at about seven cents per square foot, and the laying costs, complete, about four cents more.

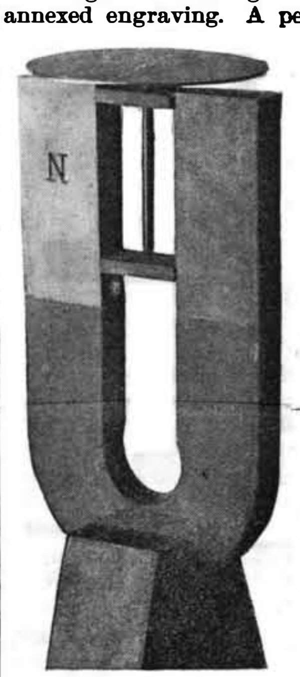
### EXPERIMENT SHOWING MAGNETIC LAG.

BY GEO. M. HOPKINS.

Most students of electricity know theoretically what is meant by magnetic retardation, or magnetic lag, and electrical engineers and manufacturers of electrical machines understand the causes and effects of this action in the armatures of dynamos and motors; but to most people, and especially to students who really desire to fix an idea in their minds, an experimental demonstration is more valuable than any amount of theory.

It is of course impossible to see what goes on in an armature while moving, but it is known that the armature core becomes a magnet by induction, and that its poles are of the opposite name to the adjoining poles of the field magnet. It is also known that time is required for the magnetization and demagnetization of the armature. The time element is thus seen to be one which cannot be left out of the calculation in designing dynamo-electric machines.

A very simple experiment, which helps to an understanding of what magnetic lag is, is shown in the annexed engraving. A perforated block is inserted between the polar extremities of a U-magnet to receive a pointed spindle attached to a soft iron disk held near the poles of the magnet. The pointed end of the spindle rests upon a cross bar inserted between the arms of the magnet. The disk, which turns very freely, absorbs the magnetic lines and becomes strongly magnetic. When the disk is at rest, poles are developed in the disk in front of the poles of the magnet, but when the disk is turned ever so little, the poles in the disk are carried forward in the direction of rotation. This is proved by the action of the disk when it stops. It immediately moves a short distance in a retrograde direction, showing that the points of greatest magnetic density in the disk lie beyond the poles of the magnet in the direction of the rotation of the disk, and that these points are attracted toward the magnet poles. Owing to the friction of the bearings of the spindle, and to the almost immediate readjustment of the magnetic lines in the material of the disk, the return movement does not represent the entire lag, but it shows in a striking manner what lag is.




EXPERIMENT SHOWING MAGNETIC LAG.

### The Next World's Fair.

It is announced that the next World's Fair will be held in Antwerp in May, 1894. The Antwerp Exposition will be much smaller than the World's Fair at Chicago. Antwerp has the advantage of being able to take exhibits directly from the vessels in which they are transported, as the river Scheldt will float vessels of 8,000 tons burden. Antwerp is readily reached in a few hours from Paris and all parts of Belgium, Holland, and the Rhine provinces of Germany. London and Antwerp are only eight or nine hours apart by the Harwich route or the Ostend route, while Antwerp is directly accessible from the United States by the Red Star line, which furnishes first-class accommodations at moderate rates. In Belgium there is no hostility to government appropriations and no municipal prejudice. There will be no sandbagging by the railroads, and it is to be hoped none of the disgraceful wrangles which have characterized our Fair. Although there is not the slightest possibility that the Antwerp Fair can compare with ours, still when Paris celebrates the opening of the new century in 1900 it is probable that the Chicago Exposition will be equaled if not surpassed.

Already the French engineers are making preparations for 1900, plans are being made for the railroads which are to convey the passengers to the Bois du Boulogne, for while the Champs de Mars has not grown smaller since 1867, the size of international expositions has increased.

### Blue Focusing Glass.

*Photographic Work* says: A blue focusing screen has been suggested as eliminating the effect of color in the case of the camera image, and so enabling the photographer to better judge as to how his work will look; the colors of a landscape often giving a charm to the scene which is not realized in the photograph.

It is suggested to wash over the ordinary ground-glass screen with an alcoholic solution of an aniline blue; but in this case the screen could not be readily cleaned. Hence a much better course would be to fine-grind a piece of blue glass.

It is very easy to make a fine ground focusing screen by using the finest emery of the shops—sold as "flour emery." This should be mixed with water, and worked on one surface of the glass with a rubber consisting of a piece of thick plate glass about an inch square. The progress of the work can be seen by rinsing the emery off, when special attention can be given to any imperfectly ground parts. It is obviously desirable not to scratch the back of the plate, and to insure this the plate should be held steadily on a flat surface while the rubber or muller is being used. A flat-topped bottle stopper often makes a convenient muller.

### The August Meteors.

Happening to be in Ithaca, N. Y., on the night of August 10, I watched for Perseids from 10:20 P. M. until midnight, 75th meridian time. With the exception of about three minutes, I kept my face directed toward the radiant point of the meteors during the entire interval of an hour and forty minutes. The sky was cloudless, but covered with a light haze, which slightly dimmed the fainter stars. I counted forty-five meteors. Of these, thirty-five were plainly Perseids. All but one of the others traveled in approximately parallel paths from near the square of Pegasus toward or across Andromeda. None moved in any other direction except one rather large meteor, which shot from west-southwest, passing overhead about 11:45. It should be said that my view toward the west as well as toward the south and southeast below the square of Pegasus was shut off by neighboring buildings and trees, so that if any meteors appeared in those quarters moving from Pegasus as a center, I could not see them. All of the meteors just described as not traveling from the Perseid radiant were, with the exception of the one seen overhead, small and swift-moving.

A few of the Perseids were as bright as first and second magnitude stars and left beautiful though evanescent trails. These bright meteors had a distinct reddish tint. One of them, which shot straight across underneath the Pole star at 10:45, was at least as bright as Sirius. Its visible path was not less than 20° in length. It was yellow bordered with a flare of red, but at the moment of extinction these colors were swallowed up in an outburst of white and vivid green. After its disappearance a greenish white train, five or six degrees long, remained visible along the latter portion of its track for half a minute. This train undulated rapidly like a ribbon streaming in the wind, and gradually shrunk and faded until it vanished, when a fourth magnitude star suddenly made its presence manifest at the point where the last shred of the meteoric train had been seen. The star had not been noticed when it was behind the train.

At about 10:55, while my eyes were fixed in the direction of the radiant, a faint stellar object made its appearance a few degrees northeast of Chi Persei, and quickly brightened until it equaled a third magnitude star, when it vanished. It was evidently a meteor coming "end on" toward my eyes. I had a distinct impression that its light appeared drawn out into an excessively brief trail, like a short dash in the Morse alphabet, which would indicate that the meteor was not moving exactly in the line of sight. But the deviation was so slight that I could form no accurate estimate of its amount. The point where this meteor appeared was, by estimation based on a subsequent consultation of a star chart, in right ascension 2 h. 50 m., declination north 58°.

About half an hour before beginning my watch I saw three Perseids within two minutes. Two of them were large and reddish, making conspicuous trails. They appeared not more than fifteen seconds apart. Both started from near the radiant point and they moved in paths almost exactly at right angles to one another. The effect was surprising and beautiful.

It seemed to me during my watch that the larger meteors showed a gregarious tendency. If one appeared after a long interval, during which only small ones had been visible, it was almost invariably followed within a short time by another of more than ordinary size and brilliancy, but not traveling in the same direction across the sky. Afterward again only small ones were seen for a considerable time.

GARRETT P. SERVISS.

IT is estimated that about 250,000 canary birds are raised every year in Germany. The most important market is the United States, which take about 100,000 birds per annum.