This slope will ascend to the surface at the south side about 100 feet south of the shaft, and at the north side about 150 feet north of Queen street, in the field adjoining to the Commercial Road; making the total length of the tunnel about 2,010 feet.

All the earth that is above low water mark may be re moved with spades.

The wooden tunnel, for which this cut is to be prepared, is to be made of elm, in lengths of from 180 to 200 feet of six-inch plank, placed two in thickness, or in two layers, laid so that the joints shall be covered by the planks in the other layer, fastened together with trennels, hooped outside with iron, calked, pitched, and made water tight like a ship. The hooping to be put on in a spiral form, with the spirals two feet asunder.

The ends of each length of the tunnel are to be made to fit into each other, or to be put together with cast-iron ferrules, of 6 feet long, similar to the joints of a flute.

Each of these wooden cylinders will weigh about 200 tuns, and may be movedin water nearly as easily as a loaded barge. As many of these cylinders are to be prepared as will extend from side to side of the river above low water mark, when joined end to end, which will be about 1.340 feet. From each end of the wooden tunnel to the entrances, the passage is to be left at intervals open to the surface, to admit light, and is to have both its sides and bottom constructed of brick work 18 inches thick. This part will extend about 670 feet (at each side), and will complete the tunnel from the surface at one side of the river to that at the other. Staircases for descending into the tnnnel are to be formed at each side; the interval of the tunnel between these, which will be about 876 feet, must be lighted by lamps always; the remaining 464 feet (at each side) will receive daylight through apertures made like wells from the surface, at intervals of about 30 feet from each other.

After the cut is excavated, piles are to be driven at its eastern side, about 60 or 70 feet asunder, to guide the wooden tunnel into its place: Then the wooden cylinders (which are intended to be made near the Surrey Docks) being ready, are to be rolled into the docks from the banks, and to be towed to the cut, a little before low water, when there is little or no tide, being previously loaded with rubbish sufficient to sink them, but kept buoyant by empty casks attached to them. Here they are to be placed across the river, resting against the piles above mentioned, their ends to be joined into each other and to be drawn tight together by a rope and chain put through them from end to end.

At extreme low water the lashings or cords are to be slipped from the casks, and the cylinders are to be let to sink altogether to the bottom of the cut, which is to be then filled up with strong clay, well rammed down, even with the bottom of the river. A hole is then to be bored into the bottom of the tunnel from the roof the drift (which is to be previously dug beneath the cut), to let the water down from the tunnel to the well of the steam engines.

When the tunnel is drained it will have a great tendency to float, but having an average of eight feet of clay above its top, with the weight of the road inside, its buoyancy will be overbalanced. If, after a number of years, the wooden cylinders decay, they may be easily replaced by putting cast-iron cylinders, one inch and a quarter thick inside; and if any difficulty is found in letting down the whole of the cylinders at one time, they may be put down separately, and afterward be joined together beneath the water.

ESTIMATE OF COST FOR 1,340 FEET AND THE LAYING THEREOF UNDER THE RIVER.

Cutting from low water mark to the first light well at both sides, 690 feet long, 80 feet wide at top, and 36 deep, about 45,000 tuns, at 2s.	£4,500
Cutting from said light wells to each entrance, 640 feet long, about 30 feet wide, and 12 deep, estimated at 6.500 tuns, at 1s. 6d.	487
Wooden tunnel, 1,340 feet long, 16 feet diameter from out to out, 1 foot thick, estimated 94,470 feet, of rough elm, or 2,362 loads, at £7 per load	16 534
Making, calking, and paving the tunnel, at £2 per load	4,724
Hoop iron for ditto., half-inch thick, and 3 inches wide, 150 tuns, at £30.	4,500
Covering the tunnel with 60,000 tuns of clay, at 1s. per tun	3,000
Piles and sundry other timber for the works	500
Bringing and fixing the wooden tunnel in its place, with ropes, anchors, boats, etc	500
Keeping the engine at work one year, attendance, agency, etc. at £50 per week	2,600
Incidental charges, 10 per cent on the whole amount	5,400
Total	£42,745

To be continued.

Oil Well Pumping.

MESSRS. EDITORS:—In your issue of December 14th, page 370, appears a communication, signed M. R. M. Robinson, Franklin, Pa., concerning oil well pumping, and his experiments and experience in that line, and which he concludes by asking for information, etc.

Allow me, through the same channel, to say that Mr. Robinson's assumptions of what constitutes a vacuum and its effects in his or any case are simply wrong and absurd, and I am surprised that your responsible editor should publish it, in its present form, without remarks or corrections, and for the reason that they are contrary to natural laws.

Mr. Robinson states, that he has, in his oil well, placed his seed bag one hundred and thirty-one feet above the bottom of his tubing, where his pump chamber is located, and assumes that the well fills up to the seed bag with water and oil; when not pumped; and that the well is air tight below the seed bag. He also asserts, that when he has pumped the water until its surface in the well has fallen, say thirty-five feet below this seed bag, that a perfect vacuum is formed; and consequently he cannot lower the water by pumping, but must have still remaining in the well, outside the tubing, the balance of this column of water and oil standing ninety-six feet above the bottom of the tubing, and that he cannot secure the oil which remains above the water in this column until he has supplied this vacuum of thirty-five feet with air or water which he admits through the half inch pipe, which pipe extends from the top of the well down, and just through the seed bag, and communicates with the well at this point below the bag. Now, this statement of facts is simply impossible, and for the same reason as first stated, and as will appear.

The offices of a pump are two-fold: the first is to lift the weight of the atmosphere from or off the column of water below it, and which is about fifteen pounds per square inch; and, secondly, to lift the superincumbent weight of water above the pump.

In thus lifting the sucker valve, a vacuum is formed beneath it by this removal of the atmospheric pressure; and if the surrounding water is open to the atmosphere with its pressure upon it, the water will thereby be forced into and up the pump, and will follow this sucker upwards until the weight of this column of water within the pump shall have attained the limit of fifteen pounds to the incb, when the column will cease to rise further, and it will remain just balancing with the atmosphere without. The sucker may be raised as much higher as one pleases, but the water will not follow it. Should the water or oil be heavier or lighter than fresh water, the hight will be more or less in the same proportion—fresh water raising about thirty-three feet at the ocean level.

Again, if the outside pressure of the atmosphere be impeded or removed, then the water within the pump will be raised less or not at all, as the case may be. Now, if by pumping his well, he can produce a vacuum, it must be the same within the pump as in the well outside the tubing; and as the water will find its own level with the same surroundings, it follows that, even with a perfect vacuum, the water or oil will flow into the pump, and fill it, so long as the surface of the water outside the tube is two feet above the bottom of tubing; and if it is but one foot above the bottom, it will stand the same hight within the pump, and the sucker in descending into the half filled pump will produce a thumping concussion, and continue to thump so long as the pump chamber is partially filled at each stroke.

If, however, the small pipe be opened, and a supply of air admitted to the well, and the pressure of the atmosphere therein restored, then the water and oil will be forced into the pump to its full capacity at each stroke, so long as there is a supply of either within the well to reach the lower end of the tubing.

If the letting down of water by the small pipe increases the flow of oil, it is from some other cause than that named by Mr. Robinson, and probably may be accounted for by the washing and floating down the oil from the sides of the well and from the crevices and small reservoirs which have been left full by the receding column in the last pumping; on no other hypothesis can the advantages of his "Fresh Water Washing Down" be accounted for, and on no other grounds can it be more advantageous than the admission of air, while the water makes just so much more work for the pump to lift it out again. The query which concludes his article is too inconsistent to need comment, when his statement in the same is so definite and plain.

I trust this will be acceptable, and received in the same spirit with which it is written, and that is to correct error, and to answer the communication referred to.

Albany, Dec. 10, 1867. HORACE L. EMERY.

The Warming of Cars.

MESSRS. EDITORS:—When reading the account of the terrible accident of the 18th inst., on the Lake Shore Line of railroad at Angola, it appeared to me to be the imperative duty of every newspaper of respectability to raise a voice for heating cars by hot water instead of stoves. Statistics appall one when we realize the horrors arising from fire in such cases as the accident spoken of. N. F. P.

APPLICATIONS OF ELECTRICITY AS SEEN AT THE PARIS EXPOSITION.

The following notices are from the correspondent of the *Nation*, and form an interesting group of paragraphs concerning electricity, although few of the inventions are new in this country. Most of them have been long in use here:—

THE METEOROGRAPH.—This is an apparatus destined to register meteorological phenomena, by means of graphic curves traced upon paper, the movement of which is registered by clock-work. It was invented by Father Secchi, director of the Observatory at Rome, Italy, and occupied a conspicuous place in one of the principal streets of the Palace. It was constantly at work, and was deemed worthy of a grand prize by the jury of awards. There were two prominent faces to the apparatus; one of them was surmounted by a clock, and provided with a paper tablet on which were registered automatically the indication of the barometer, the wet and dry thermometer, and the hour of rain. This roll or tablet of paper would finish its course in two days and a half, and present well developed curves, the study of which would give all of the details of the phenomena, especially the sudden changes during storms. The second face presented a tablet on which was registered the force and direction of the wind, as well as the indications of the metallic thermometer. This roll finishes its course in ten days, and its principal advantage is to present a *résumé* of the variations of the elements in the way to permit of an easy comparison. The manner in which the various instruments are connected with a galvanic battery is too complicated to admit of a detailed description without the aid of diagrams, but a general description may enable the reader to form a clear conception of the ingenious invention. A properly counterpoised piston floating on the mercury in the barometer, with pencils attached, and applied according to the parallelogram of motion, gives the curves on the tablet. The psychrometer consists of two thermometers, with dry and wet bulb. The thermometers are open at the top, and at the bottom have platinum wires fused into the bulbs to connect with the battery. Two platinum wires, supported on a frame which moves vertically, enter the capillary tubes of the thermometer, and can be plunged at any moment far enough to touch the mercury and thus establish the circuit with the battery. The clock sets in motion every quarter of an hour a little chariot, on which is a miniature Morse telegraph, and which marches back and forth recording in the neatest manner the variations between the wet and dry bulbs, and the moisture of the air. The hour of the rain is marked by the movement of a magnet attached to a wheel provided with buckets and placed on the top of the house. The quantity of the rain is measured by the indications of a float in a suitable reservoir in the basement, and is also automatic in its motions. The direction of the wind is measured by four telegraphs—the force of the wind by peculiar hemispherical wheels or capstans. The battery employed was a modification of Daniell's which only required the addition of a little water and sulphate of copper every month. A similar apparatus had been in operation for nearly seven years at the Observatory in Rome, and bound volumes of the observations taken during all that time were exhibited in Paris. The cost of the apparatus was $10,000, but it was unnecessarily luxurious in its appointments, and similar ones could be manufactured on a large scale, in a similar style, for one-fifth of that amount. It was a matter of regret among Americans in Paris that the automatic registering and printing barometer of Mr. G. W. Hough, which is in operation in the Merchants' Exchange in New York, was not sent to the exhibition, for comparison and criticism. It is now universally admitted that only by automatic instruments can we ever hope to solve the question of storms and other meteorological phenomena, and therefore all the inventions of this character must be studied and compared before we can hope to see any particular form universally adopted. Father Secchi's ingenious apparatus was pronounced by competent judges to do its work thoroughly and well, and we should be glad to see it introduced into this country.

ALARM THERMOMETER.—In the agricultural department was a self-regulating and alarm thermometer, constructed upon a plan similar to the one adopted by Secchi. A platinum wire is fused into the bulb, and a second wire inserted at the degree to which it was proposed to raise the temperature in a hot house or other building, and both wires were connected with a battery which drove a magneto-electric machine so situated that it could be seen at all times by the director of the establishment. In this way control was kept of the temperature, and any neglect on the part of servants at once noted.

ELECTRIC LIGHT FOR LIGHTHOUSE ILLUMINATION.—The English had a lighthouse of the natural size, the illumination in which was obtained from electro-magnets driven by a two-horse power engine. This light was visible at night from nearly all parts of Paris, and was of dazzling brilliancy. The value of this application for lighthouse purposes consists in the intensity of the light. The light is condensed into the smallest possible space, and, while it is not diffused enough for photographic purposes, excepting near by, its intensity exactly adapts it to be seen at great distances. An oil flame would require to be two thousand times larger to produce the same amount of light. The cost beyond the wear and tear was stated to be the fuel required to raise steam for the small engine and the carbon points used in the burners.

AN ELECTRIC PIANO.—A piano driven by electricty was certainly a novelty. The instrument was in the section of machinery, and looked exactly like an ordinary upright piano. It was provided with a key-board, and could be played upon in the ordinary way, or attached to a battery and made to work by electricity. It was the invention of a Swiss, familiar with the construction of music boxes, and was suggestive in its form of that class of instruments. There was a long metallic barrel driven by clock work, over which revolved a piece of thick pasteboard in which the musical notes were cut. Resting upon the pasteboard were teeth or copper pointers just like those in a music box, each one of which corresponded with the notes of the piano. The pointers were pressed down upon the barrel by springs, and were connected at the other end with a galvanic battery. As long as the pasteboard intervened between the end of these pointers and the revolving barrel, the current was broken and no notes are struck; but as often as the pointer came over a hole cut in the paper, it was thus brought in contact with the metal of the barrel, and the connection in the circuit was established and a note struck on the piano. By bringing these holes opposite the proper pointers, and at distances to correspond to the time of the piece, a complete tune could be played. The papers with the notes cut out looked like a pattern for weaving. Several pieces of music were performed by electricity, and the time and expression were so well imitated that any one would have supposed that the instrument was being played by hand.

MAGNETO-ELECTRO MACHINES.—There were several machines of this character, for which it was claimed that they could replace the ordinary galvanic battery in most operations, as, for example, telegraphing, electro-plating, and electric-light and it was asserted that they could be used as a motive power. For some unexplained reason, none of these machines appear to be successful. They looked well as specimens of workmanship; they were ingeniously contrived; they were theoretically correct, but in practice they do not secure the confidence of the public. The electro-magnetic company of Birmingham claimed for their motor that it could replace steam, especially where the force required was small, that the cost was the same as that of steam power, without danger of explosions. The price of a one-horse power was two hundred and fifty dollars. Some of the magneto-electric machines were so covered up that it was impossible to study their interior construction. In all of them the principle of the revolution of helices around magnets appear to obtain.

ELECTRIC ATTACHMENT TO LOOMS.—In case a thread broke in weaving, the fact was indicated by the violent ringing of a bell. and the stoppage of the machinery, all by automatic motion, and through the aid of a battery. The same attachment could have been applied to any other machine as well as to a loom.

ENGRAVING BY ELECTRICITY.—There were inventions of this character for copying in fac-simile any pattern whatsoever. One arm of a pointer moved over a picture, and the other over a lithographic stone or a metal plate, and the cutting instrument, by making or breaking the current of electricity, was made to cut or to pass over the plate, and to repeat the shading and depth of any original picture. There were several instruments of this character which apparently did their work well.

ELECTRIC CAR BRAKE.—The engineer is able to put down all of the brakes on a train of cars at the same moment, and to stop the train very suddenly by simply placing his thumb on the key which makes the connection with the battery. There were large cars with this attachment, and the whole thing worked well in the model.

ELECTRIC CAR SIGNAL.—In case the cars were broken asunder the fact would be instantly communicated to the engineer by the ringing of a bell.

ELECTRIC CLOCKS were as numerous as the ordinary timepieces—in fact all the clocks on the towers appeared to be driven by electricity, and they consequently kept uniform time.

CASSELLI'S TELEGRAPH.—This instrument was one of the greatest curiosities in the Exhibition. It represented in autograph the message of the sender. If instead of signing your name to a dispatch you were to make a skillful portrait of yourself with a peculiar kind of ink, an exact copy of the same would be sent. Writing, pictures, patterns, and autographs could be transmitted by this machine with entire accuracy, and if the apparatus was to be attached to the electric engraving machine previously mentioned, the dispatch could be engraved at the distance of a thousand miles from the original copy. A pointer moving over magnetic ink, by making and breaking the circuit, was made to repeat it in fac-simile whatever was put under it. It was all the same whether it was plain writing, a drawing, a pattern, or a picture. The electrograph of Lenoir was a modification of Caselli's, and appeared to work very well. We saw numerous pictures copied by it.

ELECTRIC SIGNALS of all kinds were exhibited. To announce that a switch was wrong, that the draw was open, that the down train had not started, that there was danger ahead, was all practically arranged. For use in the house there was no end to contrivances. If the servant did not answer the bell, the bell would keep on ringing all day and all night until it was attended to. If a burglar entered a door or window, his approach would be announced by a lusty ringing of bells. If the water was too low in the boiler, ding dong would go the bell. If the house was growing cold, the mercury would sink in the thermometer and again the bell would ring.

ELECTRIC GAS LIGHTING.—There were contrivances for turning on and off gas by electricity, lighting any number of burners at the same instant of time. By connecting this with the burglar alarm telegraph, the opening of a door or window would set the bells ringing and light all the burners in the house at the same instant.

THE CHRONOGRAPH.—For measuring short intervals of time no instruments have been devised at all equal to those in which electricity is employed. A most important instrument was exhibited by Professor Glassner, of Liège. for measuring the velocity of a cannon ball by recording the interval of its passage from one point to another. The ball in its flight was made to break copper wires placed on its track at measured intervals, and the breakage of the galvanic current was recorded upon a revolving cylinder in a way to indicate the smallest fraction of time. The variation in the velocity of the ball from the commencement in the cannon until it was spent was accurately measured in this way. The same instrument was adapted to the measurement of time in all other observations, the record in all cases being made by electricity.

ELECTRIC MIRRORS.—In order to attract larks in hunting it is customary to have revolving mirrors. But the machinery hitherto employed has rather served to frighten away the birds. Electric mirrors were exhibited which were claimed to be perfect in their way.

ELECTRIC SAFETY LAMP.—The danger of explosions in coal mines from the careless use of Sir Humphry Davy's safety lamp has been frequently demonstrated. It is proposed to obviate this danger by the introduction of a lamp composed of Geissler tubes properly protected by wire and driven by a small Ruhmkorf coil and battery carried in a knapsack on the back of the workman. These tubes have the air pumped out of them and the light comes from a constant stream of electricity passing from one end to the other. If the glass breaks, no fire can be communicated to the outer gases, as the connection with the battery is broken at the same instant and no spark can pass. This kind of a lantern could be used by travellers for reading at night on the railroad, as the whole apparatus can be carried in a carpet bag and can be easily suspended from a hook.

TESTING IRON BY MAGNETISM.

It is well known to engineers that it is a most difficult and often impossible thing to find out the existence of a false weld in a forging, or of a blow hole or honeycomb in an iron or steel casting. The only safe way of doing this is by carefully measuring the elongation of the piece under a given load, as with a false weld all the work is thrown on the diminished area at the defective weld, and the thicker parts are scarcely extended by the force which is perhaps rupturing the bar at the flawed spot. It need scarcely be said that there are many important cases where this process, or the equivalent, but dangerous one, of trying the effects of an impulsive force, could neither be mechanically nor commercially practicable. Every one knows that a simple method by which internal flaws and solutions of continuity in constructive details could be easily detected would be of enormous value to the world. Such a method, says the *Engineer*, has undoubtedly been discovered by Mr. S. M. Saxby, R. N.,who has very judiciously been allowed by the Admiralty, during the course of this year, to experiment with it in the royal dockyards. Though comparatively new, and not yet completely worked out, the process will possibly have a yet more extended application than finding out only mechanical flaws in iron, and possibly in cast iron and steel.

The principle upon which this method is founded is so simple that it certainly seems strange that it had previously escaped notice. It has been known for nearly a century and a half, that when a bar or any mass of soft iron is placed in the position of the dipping needle, it is at once sensibly magnetic; the lower extremity being a north pole in our latitudes, and the upper extremity a south pole. In the southern hemisphere the poles are of course reversed. The same action, only weakened, takes place in a bar hanging in a vertical or any other position; only the effect is weaker the more the position of the longitudinal axis, for instance, a long bar, departs from that of the magnetic dipping needle.

When a small compass needle is slowly passed in front of a bar of very good iron, placed in an east and west direction, the needle will not be disturbed from its proper direction, which is of course at right angles to this, or north and south.

But this is true only with homogenous bars of best quality—to bars without any mechanical solutions of continuity. With internal flaws or interruptions of continuity the bar is no longer regularly magnetic. It has long been known that a good compass needle, or a good permanent magnet, must be homogeneous and without flaws in order to take and retain its maximum amount of magnetism. In a word, any mechanical solution of continuity is accompanied with a polar solution of continuity, and the given bar or mass with flaws —whether permanently magnetised or temporarily so by the inductive action of the earth—is no longer one regular magnet, but severél different magnets, with the different magnetism separated from each other. The delicately-poised magnet of a compass can thus be made to tell the presence of such solutions of continuity.

In making tests, practically, the bar is placed in the equatorial magnetic plane, or east and west. On moving the magnetic needle in a line parallel with the axis of the bar, as long as the iron is sound, the position of the needle is east and west; but on the recurrence of a flaw the latter deviates more and more until entirely reversed, when placed over the imperfect spot.

By the enlightened permission of the Admiralty Board, Mr. Saxby, as stated, has already been allowed to test his method in various ways in the royal dockyards of Sheerness and Chatham, and we will describe some of the practical results of these experiments. Amongst these were a number of very remarkable trials conducted in the presence of the master smiths, the foremen of the testing houses, and several of the chief engineers of the royal navy. Mr. Saxby, for instance, was requested to find out the weakest spots in a number of bars, and to tie a string or make a chalk mark on each spot. Immediately afterwards all these bars were put into the testing machine and broken, the prediction in every case being verified.

The smiths of the royal dockyarks seem to have properly tried Mr. Saxby's powers in almost every possible way, and most ingenious devices were sometimes resorted to for the purpose. As examples out of many, in the center of a bar of 1 inch square forged iron, was welded a piece of unmagnetised steel about 5 inches long. The needle detected a fault at about the center of the piece of steel.

A bar welded together out of a piece of bowling and a piece of common iron, had at about its middle a drilled hole, into which a magnetised steel pin had been riveted. The compass magnet soon found out the pin, the difference in quality of the two ends of the bar, and also an unsuspected fault at the end. A bar of round iron was brought to him painted over; it had been "jumped together" in three different pieces and qualities of iron—a bar worked up out of scrap of galvanised iron, another of common iron, and the third of bowling. The needle detected very unequal qualities, the verdict being that the bar was unfit for being manufactured into any article.

In another case, in which Mr. Saxby's experiments were carried out in the presence of a large number of naval chief-engineers, he put down in writing the results of his magnetic examinations, in order that they might be subsequently compared with what was known as to the actual quality of each bar. A bar, one and a quarter inch round, and three feet eleven inches long, was pronounced by the compass needle as being not of the same iron throughout, and with a south end better than the other. It was then stated by the master smith to have been made up of pieces of good and bad. A rather shorter bar was found to be good iron, but doubtful in condition; it was afterwards explained to be "uncertain," and on testing it in the machine it was stated to be "crystallised." A third piece was found to be of very good iron, but with slight irregularities; the smiths stated it to be scrap iron, and the best to be got in the shop. Two pieces of five-eighth inch manufactured iron were discovered to be not good. Another piece of one and a quarter inch bar was found to be good iron, though made of different qualities—it had been afterwards annealed. With another bar, to Mr. Saxby's written question whether it was not steel, it was answered that the bar in question was a near approach to steel, being a piece of galvanised wire rope welded up. To the remark that another bar was unfit for use he was told that it had been twisted round when at a low heat, and then hammered cold. Some singular proofs of the power of magnetic testing over the ordinary methods of determining quality and condition of iron have been shown. Pieces of iron brought for testing by most able and experienced master smiths, of such quality as would be selected for the most important work, have, on being tested, been marked at spots as defective, and on cutting have accordingly been found at those spots to be partially fibrous, partially crystallised.

The following experiment was made in order to throw light on an important practical question in smiths' work: A round bar 17½ inches long was specially worked, and had been brought to be tested without anything of its history being known to Mr. Saxby. He found that in the middle of its length it was seriously faulty, and even unfit for use. He was then told that the bar, though solid, had been "upset" in the middle of its length, and then hammered down to its original diameter at a temperature below welding heat. This will be held to confirm the opinion of good workmen that "upsetting" should be done at a temperature as near as possible below that of welding.

Mr. Saxby has not yet been successful in testing rolled plates for lamination. In these, again, the neutral, or zero lines, should run at right angles to the dip in a homogeneous plate; but the more complex structure of the plates has made the investigation more difficult. Another difficulty doubtless consists in the fact that the usual shape of a plate does not allow the magnetism to separate itself in such a marked way as in a bar, usually longer by many diameters. The investigation, with a resulting perfect method, can scarcely be said to be completed in this direction. The chief difficulty at present seems to be that the internal structure is too irregular.

Up to the present but few experiments have been made with steel, and very few with cast iron; those already made have, however, been satisfactory. Any difficulty that might be supposed to attend the presence in wrought iron of what is termed by the Astronomer Royal sub-permanent magnetism is easily overcome. A few taps on the end of a bar of wrought iron, when lying east and west, sufficient to cause vibration, would demagnetize it, and leave it in a fit state to be examined by the needle; and polarity subsequently found would indicate either a steely nature of the bar or inferior iron.

Some brief considerations will now determine the value of Mr. Saxby's invention to engineers, whether for trying new work of all kinds, or even working details in a suspicious state. In estimating the value, in the widest sense of the term, of any wrought iron forging, three qualifications may be considered as governing: (a) Its limits of elasticity, or the amounts it will yield in any given direction without taking permanent sets; (b) its ductility, or the permanent alteration it will take before actual rupture; and (c) its ultimate resistance, or the amount of the load it will stand, per original unit of cross sectional area, before actual rupture. These three qualifications, in a complete forging, are evidently—1st, The absence of defective welds, or of large solutions of continuity in the mass; 2d, the absence of smaller flaws or solutions of continuity—either due (a) to the presence of scoria or slag, causing what are termed "greys," or small flaws, either parallel or across the longitudinal axis of a bar, or (b) to cracks (often unsuspected) caused in the working when portions of the forging are too cold; or (c) to actual separations at the facets of the elongated crystals of which iron always consists, and due to loads of whatever kind beyond the elastic limit; 3d, the chemical constitution of the bar—such as its freedom from phosphorus, sulphur, arsenic, silicium, manganese, etc. (apparently everything but carbon in small quantities)—originally governing its mode of crystallization, and hence more or less its elasticity, ductility, and ultimate resistance to rupture. Now Mr. Saxby's method can detect the presence, and negatively of course the absence, of small or large solutions of continuity. It can detect false welds, smaller flaws caused by bad workmanship or wear, and, we believe, what is commonly termed "crystallization," which will, probably, once be generally acknowledged to consist in a disruption or parting of the facets of the amorphously arranged crystals of which iron is built up. It can, of course, only detect the results of the chemical constitution of iron, as evidenced in the less perfect cohesion of the crystals when alloyed, in relatively considerable quantities, with foreign bodies. There is little doubt that the magnetic method is a test of the homogeneous character of the iron and of its freedom from fissures and cracks, and so far it undoubtedly forms a test of quality. It will appear scarcely credible that a common pocket compass needle should be able—almost like the divining rod said to be used for finding out springs of water—to discover important defects in large iron bars. A mere statement of the fact does sound almost incredible until the simple means actually employed are explained.—*Engineer*.