where it is distributed to the risers which pass back down the columns, single risers being used to supply radiators and return water of condensation. All distributors in the attic are laid at a grade of not less than 1 ft. in 20 ft., and the foot of all risers are connected into a return system to the basement. The bottom of the 8 in. main riser rests on a masonry foundation, so that its expansion shall be upward throughout its entire length. The risers, which are to be inclosed in the fireproofing surrounding columns, are to be fastened firmly to floor beams at third, seventh, and twelfth floors, so that expansion shall be in both directions from these points. On each distributing riser an expansion joint is to be set at the fourth and eighth floors. This expansion joint is to be placed just above the radiator connection. In order to have free access to these expansion joints, easily removable wooden panels are placed in the columns in front. This arrangement admits of easy inspection, and avoids the necessity of tearing down the fireproof when repairs are necessary.

In fixing upon the sizes of connections of radiators with risers, a 1 in. pipe was to supply not more than 30 square ft., a 1¼ in. pipe was to supply not more than 60 square ft. and a 1½ in. pipe was to supply not more than 120 square ft. The square feet of radiating surface of radiators varies on each floor, gradually reducing from the lower floor upward, its greatest area being 1108 square ft. and its smallest area 738 square ft. All radiators are provided with an automatic electric temperature regulating system, complete with thermostats, etc. They are to be of the hot water pattern, having the loops connected on top as well as bottom, and each being supplied with an automatic air valve.

The specifications for the structural metal work are pretty stringent, as the following extracts from the specification show:

"Quality of Material.—The steel may be made either by the Bessemer or open hearth process. It must be uniform in quality, and must not contain over 0·10 of one per cent. of phosphorus. The steel shall have an ultimate strength of 60,000 lb. per square in. and shall not vary from this more than 4,000 lb. per square in. either way. It shall have an elastic limit of not less than one-half the ultimate strength, an elongation of not less than 25 per cent. in 8 in., and a reduction of area of not less than 45 per cent. at point of fracture. All blooms, billets, or slabs shall be examined for surface defects, flaws, or blowholes, before rolling into finished sections, and such chipping and alterations made as will insure perfect solidity in the rolled sections. A test from the finished metal will be required, representing each blow or cast; in case the blows or casts from which the blooms, slabs, or billets in any reheating furnace charge are taken, have been tested, a test representing the furnace heat will be required, and must conform to the requirements as heretofore enumerated. A duplicate test from each blow or cast and furnace heat will be required and it must stand bending 180 deg. over a mandrel the diameter of which is equal to one and a half times the original thickness of the specimens, without showing signs of rupture either on convex or concave side of curve. After being heated to a dark cherry and quenched in water 100 deg. Fah., must stand bending as before. The original blow or cast number must be stamped on each ingot from said blow or cast, and this same number, together with the furnace heat number, must be stamped on each piece of the finished material from said blow, cast or furnace heat. No steel beam or angle shall be heated in a forge or other fire after being rolled, but shall be worked cold unless subsequently annealed.

"Rivet Steel.—Steel for rivets throughout this structure shall have an ultimate tensile strength of not less than 56,000 lb. nor more than 62,000 lb. per square in., an elastic limit of not less than 30,000 lb. per square in., an elongation of not less than 25 per cent. in 8 in., and a reduction of area at point of fracture of at least 50 per cent. Specimens from the original bar must stand bending 180 deg. and close down on itself without sign of fracture on convex side of curve. Specimens must stand cold hammering to one-third its original thickness without flaying or cracking, and stand quenching as heretofore specified for rolled specimens.

"Wrought Iron.—Where wrought iron is required by plans and specifications, it shall be tough, fibrous, and uniform in quality. It shall have an elastic limit of not less than 26,000 lb. per square in. It shall be thoroughly welded during the rolling, and free from injurious seams, blisters, buckles, cinders, or imperfect edges. When tested in small specimens the iron in no case shall show an ultimate tensile strength of less than 50,000 lb. per square in. and shall have an elongation of 18 per cent. in 8 in. The same sized specimens taken from angle and other shaped irons shall have an ultimate strength of not less than 50,000 lb. per square in. and shall elongate 15 per cent. in 8 in. All iron and specimens from plate, angle, and shape iron must bend cold for about 90 deg. to a curve whose diameter is not over twice the thickness of the piece, without showing fracture. When nicked on one side and bent by a blow from a sledge, the fracture must be nearly all fibrous, showing but few crystalline specks.

"Cast Iron.—Cast iron shall be the best quality of metal for the purpose. Castings shall be clean and free from defects of every kind, boldly filleted at the angles, and the arrises sharp and perfect. Cast iron must stand the following test: A bar 1 in. square, 5 ft. long, 4 ft. 6 in. between bearings, shall support a center load of 550 lb. without sign of fracture."

"THE ELECTRIC LADY."

IN the early years of the eighteenth century, while Du Fay and the Abbe Nollet watched with astonishment "the first sparks that were ever drawn from the living body," and long before Kruger had conceived the idea of electro-therapeutics, or Kratzenstein had given that idea form, electrical phenomena, says the Lancet, were attracting much attention. Many earnest experimenters were investigating the "thing" which, since the days of Gilbert, had come to be called "electricity;" philosophers were gaining a first insight into its possibilities; a new science was quietly winning its way. At the same time the less serious portion of the society of the period, aware of the newly discovered phenomena, was amusing itself by "drawing sparks" as "electric rain," or "the electric star," or perhaps, occasionally, in the form of the "electric kiss." At the end of the nineteenth century electrical science has made an amazing progress—a progress, however, with which its more frivolous developments seem scarcely to have kept pace. They have, it is true, got beyond the stage of the frictional machine, but it cannot be said that the entertaining young man of the period yet knows how to conjure playfully with currents of "Teslaic" frequency or to amuse an audience by a skillful adaptation of the Hertzian wave. The "penny shocker" is, from the electrical standpoint, a painfully coarse experience of a coil current, and even the "electric lady" of these latter days is, on the whole, a very poor thing. "She is found to be so highly charged with animal electricity that when she immerses her hand in water any one placing a finger in the bowl at the same time experiences a shock." About the latter there can be no question; the sensation is that of an unmistakable induction current. Neither is it to be denied that she is "charged with electricity." In other words she is connected with one pole of a large coil kept carefully out of sight and hearing. She places her hand in water; a second person, standing "to earth," and doing the same, offers a passage to the current through the body, and a fall of potential is the result; but there is no obvious means of completing the circuit. This may surprise those who work only with the ordinary medical coil, but any one accustomed to larger coils and to so-called "idle pole" work, is aware that under such circumstances no metallic connection with the other pole is necessary. The circuit is completed via the body of the second person through the ground and so back to the second pole; and the more effectively the latter is "earthed," the more palpable will be the effects in question. This unpolar method is from its medical aspect something more than a mere experiment. It affords a very serviceable method of electrization. If a person lightly insulated and holding an ordinary moistened electrode attached to one pole of the secondary of a large coil be touched on the forehead by a person standing "to earth," the former will experience a not unpleasant electrical sensation—an effect, however, scarcely perceptible on the arm. But if the "operator" places his foot upon the firegrate (thus making a better earth), the effect is stronger. If, however, the idle pole itself be well "earthed" by being connected to a gas or water pipe, then, if the person holding the electrode as above be insulated on glass and be touched as before on the arm, a distinct effect just short of muscular contraction is produced. By altering the amount of the insulation and varying the "earthing" of either pole a variety of electrical effects are obtainable. Muscular contractions of a widely varying strength and cutaneous stimulation of every degree of intensity may be thus secured.

ON SOME MAGNETIC CHARACTERISTICS OF IRIDIUM.*

By S. H. BRACKETT.

THIS paper does not claim to present all the characteristics of iridium in its magnetic relations, or to discuss the facts to which attention is called, but merely to state some points of interest which seem not to have been noted before, and which suggest reason for further investigation. The work here alluded to was done in intervals of busy elementary science teaching, and may be made more complete when further opportunity occurs.

Iridium was not left out of the list of substances so carefully examined by Faraday, and is mentioned by him as being very slightly diamagnetic. Iridium, as at present manufactured, may be presumed to differ from that used by Faraday, and in the absence of analysis of the specimens here tested, there is to be allowed a presumption that they are not pure; but the manufacturer, Mr. John Holland, is authority for saying they are more than 98 per cent. pure, with some platinum, a trace of phosphorus and no iron, and no iron has been employed in manipulation.

The first bar tested with such results as to excite further interest in the subject was 13·3 mm. long, 3·2 mm. wide, and 0·9 mm. thick. It was one of several different substances being tested for small amounts of magnetism or diamagnetism. A large electromagnet of portative force of about 5,000 grammes per square centimeter of surface was furnished with soft iron pole pieces, shaped so as to furnish a very strong field of force. When the bar of iridium was brought near the poles it was strongly attracted sidewise, and could not be made to stand radially. It acquired a permanent transverse polarity so strong as to appear to be a permanent diamagnet. Its extremely small thickness rendered test of attraction and repulsion inoperative.

In the field of any ordinary magnet it everywhere set itself at right angles to the lines of force, and when suspended by a fiber under a glass, it readily assumed the east and west position. In a place where H is determined as 0·158, its period of oscillation was 18·7 seconds, as compared with a steel bar of the same length and weight, whose period in the same place was 5·3 seconds, so that the ratio of its intensity of magnetism to that of steel was nearly as 1 to 12.

It was very difficult to magnetize it longitudinally by the ordinary stroking methods, which were likely to leave it in a very heterogeneous condition, so that it might take a position oblique to the lines of force.

To make further investigation and to determine some of its properties quantitatively, a bar was procured of Mr. Holland, 25·7 mm. long and 3·3 mm. square, weighing 3·57 grammes. Apparatus was constructed suitable to the size of this bar, and careful tests were made of its permeability, which was found to be practically unity. Whether the bar had been previously magnetized or had had nearly all magnetism removed by heating, no change of strength of current produced any perceptible change of the lines of force. Even striking it forcibly while it was in the coil failed to produce any magnetism by induction, and it could only be magnetized by actual contact with a magnet and then jarring it.

On placing it axially between the soft iron pole pieces of the magnet, and using successively currents of different strength, striking the pole pieces each time, different degrees of magnetic intensity were given to it, and on plotting the magnetization as ordinates and the current as abscisses, a curve was obtained similar to those usually made of permeability.

This bar, as well as the other, is much more readily magnetized transversely than longitudinally. It has only to be placed between flat pole pieces, so as to be in a uniform field of force, and jarred vigorously. A steel bar of the same size, tempered glass hard, cannot be magnetized transversely when subjected to the same conditions.

When attempts had been made to magnetize it longitudinally, as mentioned above, discrepancies between its magnetic moment at different trials and that obtained by transverse polarity led to further examination of the distribution of its magnetism. The field around it was platted by means of a little steel magnet 2·5 mm. long, suspended by a cocoon fiber, and the distribution was found to be very irregular. To see if a more uniform distribution could be secured, a method was devised which might be called octuple touch. Stroking was done on all four sides of the bar at once, from the middle to each end. The iridium was held by a small clamp in the center of the space between the poles of the magnet, held only by its center. Four soft iron levers were hinged so that their ends would grasp the iridium near the clamp on one side of it, and four similar levers did the same on the other side of the clamp. These sets of levers were laid on the poles of the magnet, so that when the latter was excited the levers became the real poles of the magnet. When they were applied the circuit was closed, and the sets of levers were held tightly against the magnet, and pulled off in opposite directions at the same time. By this means much better results were obtained, but the distribution was still somewhat irregular, representing the four sides of the magnet.

When magnetized transversely the field of force is much more regular, and it was feasible to delineate this field by sifting filings through a handkerchief on very thin paraffined paper, fixing them by warming and then photographing.

Very low permeability and great coercitive force, with a high intensity of magnetization, are plainly exhibited by these specimens of iridium, and these characteristics are consistent with the known physical properties of the substance.

* From the Physical Review.

THE KONISCOPE.*

By DR. J. G. MCPHERSON, F.R.S.E., Lecturer on Meteorology in the University of St. Andrew's.

MR. JOHN AITKEN, F.R.S., has just given us the results of some careful observations on color phenomena connected with cloudy condensation, and an account of his new instrument, for detecting the impure state of the air in rooms by means of color alone, may be interesting to readers of Knowledge. No more painstaking or persevering physicist lives than the discoverer of the now acknowledged theory of the formation of dew. He has elucidated the formation of fog particles by the attraction of dust for water vapor, and has enumerated the particles of dust in a cubic inch of air, and this is another example of his assiduity and success.

If steam be blown into the air inside a glass vessel, the cloudy condensation will in time undergo a change. Of course, the dust particles in the air have seized hold of the water vapor of the steam to form visible steam particles, each dust atom forming a free surface for the adherence of the moisture. Particles fall and leave the upper part clearer, and particles fall to the bottom also. Yet the principal cause of the thinning change is in the smaller particles becoming absorbed by the larger ones. The smaller drops begin to lose their accumulated moisture, while the larger ones are still increasing in size, growing at the expense of the gradually diminishing smaller ones. In the end a comparatively small number of drops have absorbed the moisture which was previously distributed over a vast number of particles. The larger particles have devoured the smaller, and inanimate cloud particles have been struggling for "the survival of the fittest."

Steam escaping into the air has been observed to be colored when seen against the sun. Sometimes in that case the sun appears like silver (light blue), blue or green. Mr. Lockyer saw the sun look vivid green through the steam of a little paddle boat on Lake Windermere. Though the shadow of an ordinary steam jet on a white screen is nearly colorless, yet when it is electrified the shadow becomes of a dark orange-brown color.

In studying the subject, Mr. Aitken has inclosed the steam jets in tubes. For a jet from a nozzle of one millimeter bore, a tube of seven centimeters diameter and about fifty centimeters long is employed. The steam nozzle should be placed outside the tube and a little to one side, so that the eye can be brought into a line with the axis of the cylinder. This is a beautiful experiment. When the amount of steam, dust, and other conditions are properly proportioned, the colors seen through the tube are very attractive. With ordinary condensation the color varies from a fine green to lovely blues of different depths. The pale blues equal any sky blue, while the deeper blues are finer than the dark blues seen in the sky, as they have none of the cold hardness of the dark sky blues, but have a peculiar softness and fullness of colors.

Suppose now the tube is fitted up pointing to a clouded sky, and that the steam jet, under slight pressure, is blowing through it. If the exit end of the tube be open, very little color is visible; but if the end of the tube be partially closed with a glass plate to prevent a draught, the tube looks as if filled with a transparent colored gas. The first decided color is generally green, then blue of different shades.

If, now, the number of the dust particles in the tube be increased, or the pressure of the steam be increased so as to command some negligent dust particles to seize the moisture and add to the number of cloud particles, thereby making the steam more dense, then the color seen through the tube also changes. If the color was green, it now becomes deep blue; and if the ordinary condensation gave blue, the dense condensation (a strange but unavoidable connection of words) produces a dark yellowish brown. But between the blue and the yellow there is always an intermediate stage, when all color disappears and the light is simply very

* From Knowledge.