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in manganesic oxide of iron (*jacotinga*), and the rock is schistose specular iron ore; and at Catta Preta, where the vein-stone is quartz, and the country quartzose sandstone. At Gongo Soco the *shoots* dip eastward from the granitoid rocks of the Serra de Tejuco, whilst at Catta Preta they incline westward from similar rocks near Inficionada.

There is not only a remarkable similarity between these facts and the disposition of the *shoots* of ore in Cornwall and Devon*, but the *striæ* present a second class of phænomena, which are either less conspicuous† or altogether wanting there.

There are some remarkable analogies between the arrangement of gold in Brazil and that of tin ore in Cornwall, but I reserve their discussion until another opportunity.

The auriferous rocks of Brazil afford but few data for assigning their geological epoch; there is, however, much probability that they may eventually be found the equivalents of the metalliferous formations of the West of England.

Gongo Soco Gold Mines, June 29, 1844.

W. J. HENWOOD.

LVIII. On *Electro-Rotatory Points*, and the *Pyro-Electricity of Glass*. By JOSEPH READE, Esq., M.D.‡

IN the year 1750 Dr. Franklin made a number of experiments to ascertain the attractions and discharges of the electric force from points, but as these points were *fixed*, such as a needle held in the hand before a conductor, or a shoemaker's punch under a pair of excited scales to represent the clouds, Dr. Franklin says "he could not account for the attractions." If the scales were electro-positive, the punch must have been electro-negative. Rotatory points were first used in 1660 by Dr. Gilbert (described in his work *De Magnete*). This instrument at present, with some little alterations, is known as Häüy's electroscope, and consists of a slender wire revolving on a pivot, and armed at both ends with gilt pith-balls. In the year 1785, a celebrated French philosopher, Coulomb, invented the balance of torsion, and turned his attention to electric points, but as they were *fixed*, like those of Franklin, the same objections remain. Indeed the only revolving points were the electric fly and the electric orrery, and in these the revolutions were erroneously attributed to recoil between the air and the electric force when discharged,—a physical impossibility. An imponderable acting on a ponderable substance is unknown in the science of statics; as well might light recoil.

* Cornwall Geol. Trans., vol. v. p. 193. Edin. New Phil. Journal, vol. xxii. p. 157.

† Cornwall Geol. Trans., vol. v. p. 182.

‡ Communicated by the Author, through Mr. E. W. Brayley.

Experiment 1.—Having heated and excited a glass tube by means of a silk handkerchief*, I held it parallel to a brass needle about three inches in length and one-fourth of an inch in width, and placed on a pivot with a wide and shallow cap and insulated stand; the needle began immediately to revolve on its centre of motion, and continued for fifty or sixty revolutions; it then began to oscillate, and after about twenty rounds fixed at right angles to the tube. The following diagram may give a more defined explanation:—

Let A B C D E F G H represent a horizontal plane, through which the needle or brass bar A E revolves on the fulcrum or centre of motion *m*. When the excited glass tube is held parallel at K, the arm of the bar A E is powerfully attracted to C, where it becomes like the glass tube, electro-positive; consequently it is now repelled to E with a force equal to that of attraction. By this motion E has taken the place of A, and is become, by giving out electricity, electro-negative, and is therefore attracted. Thus continual revolutions are produced so long as the electric force, viz. attraction, repulsion, and moment, are together equal to 180° ; the velocity being in a direct ratio to the force of attraction and repulsion, so that

$A : C :: E : C$, &c., $\frac{CE}{A} = C$. After some time the attraction

and repulsion A C, E C decrease, and being together less than 180° , oscillation takes place, say within the sector B m D, continuing according to a decreasing series. Biot and Coulomb have established the law, that "the loss of electricity is equal in equal time," and equal to the force of attraction and

* This experiment can be conveniently made with a warm excited tumbler or wine-glass; thus $\square \top$

repulsion. The oscillations are then explained. At C the bar becomes electro-positive and at B and C electro-negative; finally, the bar fixes at G *m* C perpendicular to K. Although stationary, we are not to infer that all electricity has been dissipated, for to my surprise, on holding the point of my fore finger at O perpendicular to the bar, C was repelled to B. Here my finger must have become electro-negative, the same as the needle; when my finger was held at *n* the bar was attracted; from this we are not to infer any electro-polarity, for my finger must have changed its electricity with the distance; on substituting an excited stick of sealing-wax instead of the glass tube, I found that the needle was likewise repelled, according to the received opinion, that excited sealing-wax is always electro-negative; in this case the bar and also my finger must be electro-positive by induction. However, I shall not stop to theorize on these interesting facts, for facts in our present state of experimental philosophy are more valuable than theories; fortunately inductive reasoning is gaining ground, and the wild dreams of the greatest men melting away, and only an *ipse dixit* is at a discount.

For some time I have used this brass needle as a revolving electrometer for measuring relative electricities, insensible to either the gold-leaf or torsion electroscopes, for it is a misnomer to call them by any other name; I used it in the following manner:—Having surrounded the insulated stand with a graduated semicircle, it was placed parallel to the substance to be examined, and then, if the electricity was very weak, the arm was moved to 45° ; on removing the hand the needle oscillated, and the number of oscillations indicated the relative force. When the bar was stationary, by repelling with the point of my finger I could ascertain the most minute quantity. Let us now apply this revolving electrometer* to an entirely new subject;—the pyro-electricity of glass, considerably greater than that of the tourmaline.

Experiment 2.—On the Pyro-Electricity of Glass.

October 10, 1844.—When the thermometer was at 64° with the door of the parlour open, I placed the needle on its insulated stand on the hob, and then placed two tumblers, one at each side, so as to allow the lever to revolve; the needle immediately began to revolve at the rate of sixty or a hundred, according to the heat, in a minute, and continued the motion as long as the fire was sufficient. When the tumblers were removed, the revolutions decreased and finally

* This instrument may be seen at Messrs. Watkins and Hill's, Charing Cross.

stopped. Having shown this novel experiment to some scientific friends, it was suggested that the electricity might be produced by currents of heated air circulating around the glasses. To ascertain this, I blew with a bellows on the glasses without stopping the rotations: these revolutions are explained by the before-mentioned diagram, and arise from attraction and repulsion. To show beyond doubt that the phenomenon was electric, I removed one of the glasses and brought the arm of the needle so as to touch the other glass; it was immediately repelled, and both arms stood parallel to a tangent, sometimes one arm being somewhat attracted and then repelled. A heated glass tube attracted either arm. When the doors were shut the revolutions decreased; this did not arise from any draught up the chimney, but from pure air being more favourable than stagnant and warm air, in some measure deprived of its oxygen. I now dipped my tumblers in water, and on replacing them the velocity was increased to one hundred in a minute; filling them with cold or hot water made no difference. Did the evaporation increase the electricity?

I also caused the needle to revolve between two cylinders of china, which I afterwards powerfully excited with a silk handkerchief. These experiments, if confirmed, open a new and wide field in the science of electricity, which I hope may be cultivated with success. I have come to the conclusion, after numerous experiments, that all bodies reflecting radiant heat become electric, even different coloured cloths; and consequently that *radiant heat and electricity are mutually convertible*. When the needle was placed in the focus of the iron-curved side of the grate, it became electric and revolved. I found also that the needle revolved in the focus of a polished mirror, opposite a fire or another mirror, with a heated ball, similar to the late Sir John Leslie's experiment. I am almost sanguine enough to believe that a very delicate needle may be made magnetic by radiant heat, such as that of the sun. I believe Mrs. Somerville advanced the same opinion.

On returning from the Polytechnic Institution*, highly pleased with Mr. Armstrong's hydro-electric machine, I placed a bright copper kettle, more than half-full of distilled water, on the fire, insulated by four black bottles; when rapidly boiling I placed the revolving electrometer near it on the hob, the revolutions immediately began; after continuing for some time I took off the cover, still the revolutions proceeded, but somewhat decreased. Were I to venture an opinion

* The author begs leave to thank Prof. Bachoffner and the gentlemen of that Institution, for their courtesies in permitting him to experiment with their powerful apparatus.

after the able experiments and inferences of Dr. Faraday and Mr. Armstrong, I should attribute the electricity to the friction of the water against the sides of the boiler, caused by rapid currents of steam passing from the bottom, aided by immense pressure and heat. If it were the steam carrying water, surely the greatest electrical force should be at the exit, and not at the sides; the steam may be a carrier and give shock. To show the conducting power of steam, attach a pith-ball by a silk thread and wax to an excited glass tube. On bringing this near a lighted candle the electricity is dissipated. The celebrated philosopher, M. Arago, states that this is occasioned by the conical blaze, whereas it arises from the vapour of the candle.

In my next communication to your valuable Journal I shall make known some perfectly new, and I hope interesting, experiments on the pyro-electricity of the glass cover of the binnacle compass produced by the solar rays, giving a new view of that deflection of the needle which was attributed to local attraction. Humanity makes this a subject of great interest, and therefore I shall give the experiments much attention.

LIX. *Description of a Simple Method of Magnetizing Steel Bars.* By P. ELIAS of Haarlem*.

AT the present day, when the possession of powerful steel magnets must be desirable to experimentalists, it will perhaps not be without interest to many to become acquainted with the method by which the smallest needle as well as the heaviest steel bar can be instantly magnetized to saturation with the greatest facility.

The method hitherto employed is that of the double passing, discovered by Knight and improved by Duhamel and Mitchell. Several persons have proposed the employment of electro-magnets for this purpose, others suspending the steel bar to be magnetized at a red heat to the pole of an electro-magnet, and allowing it to cool in that position. The first method is inconvenient, as it is not possible to move electro-magnets about so freely as steel magnets; the latter, as every one knows, is without effect; consequently the old method has been retained. This however has the inconvenience, that in the first place it is necessary to be well acquainted with the manipulation of magnetizing; and secondly, that you must already possess that

* From Poggendorff's *Annalen*, vol. lxii. p. 249; communicated by W. Francis, Ph.D.