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Mr. Thomas Pollock

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XX. *On Mr. SAMUEL SEAWARD'S Claim to the Invention of a Hydro-pneumatic Pump for compressing Gases, &c. By Mr. JOHN MARTINEAU.*

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,

I OBSERVE in your last Number a drawing and description of a pump for condensing gases, by Mr. S. Seaward, which pump he states to be his invention.

As far as I am myself concerned, I should have hardly thought it worth while to contradict his statement; but I cannot in justice to yourself allow your respectable Journal to be made the vehicle for conveying a falsehood to the public.

This pump was constructed at the manufactory of which I am a proprietor, during the time that Mr. Seaward filled a situation as draughtsman in it. In that capacity he made the necessary drawings connected with it; but I do most positively assert, that he did not invent or suggest any one essential part of it.

I content myself with simply stating the above facts,

And remain

Your most obedient servant,

City Road, Aug. 10, 1824.

JOHN MARTINEAU.

XXI. *An Attempt to explain the Action of the Voltaic Pile. By Mr. THOMAS POLLOCK.*

THE power of the Voltaic pile as an instrument of chemical analysis is owing to the influence its action produces upon the radiant matter which common matter contains, and to which its various forms are owing, and which, when in motion produces heat.

The action of the pile may be readily explained when one fact is previously assented to,—that a radiant matter capable of producing heat, when in motion, pervades all the matter, solid, fluid and gaseous, of the universe; and that no motion whatever can take place upon the surface of our globe without producing a change in the distribution of this general pervading principle. If a gas become a fluid, or a fluid a solid, there is a diminution of capacity for heat; there is contraction of volume, and the form this matter has now assumed, owing to contraction, demands less of this general pervading principle, and heat is presented to surrounding bodies. If this change take place with rapidity, and bodies possessing a great capacity for heat,

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as water or moisture, be absent, light will frequently result; hence the electric spark. While, on the contrary, if a solid become a fluid, or a fluid a gas, there is an increase of capacity, there is expansion of volume, and the form now assumed will, owing to this expansion, demand more of this pervading principle, and cold will be presented to, or their pervading heat abstracted from, surrounding bodies. Moreover, if a gas merely contract or expand without assuming either the fluid or solid form, the same effect will be produced upon the pervading principle of heat in surrounding bodies. Here, perhaps, the explosion of euchlorine may be objected as an instance of expansion attended by heat and light; but this change takes place with rapidity, and the abstraction of the radiant principle from surrounding bodies will likewise be effected with rapidity, producing light and heat.

There is no necessity for supposing the existence of heat, light, an electric, galvanic, or perhaps a magnetic fluid distinct from this pervading principle; they are all branches from the same root. Electric or galvanic attraction between bodies is the result of their containing different proportions of the pervading principle; and by the electric spark the excess is given off and an equilibrium is restored. Thus the thunder cloud being formed from vapour in the atmosphere, there is a contraction of volume, an excess of the pervading principle, which, by being transmitted to the earth beneath, produces lightning.

Previously to making an attempt to explain the action of the Voltaic pile, it may be necessary to inquire upon what conducting power and capacity for heat depend. Conducting power appears to be the reverse of capacity for heat, as the best conductors have generally the worst capacity. In conductors, as metals, attraction predominates; but in bodies possessing the greatest capacity, as gases, repulsion of particles predominates. Metals are the densest bodies known, at least those forming a component part of the pile. Density must depend upon a strong attraction between the particles of the substance.

Conducting power appears, then, to be the consequence of the strong mutual attraction existing between the particles of matter; as in a metal; because if a metal, by exposure to a higher temperature, become expanded, yet, when exposed to a lower temperature, it will again contract more suddenly than a non-conducting substance, because the attraction between the particles of a conducting substance must be comparatively stronger than that of a non-conducting substance, as the superior density of the former demonstrates: and as the particles

particles of a metal must contract more suddenly than those of any other substance, heat will be imparted to surrounding bodies, and to that part of the metal which has not been equally exposed to the heat-making body, with greater rapidity. Thus, conducting power appears to depend upon the particles of the conductor being nearer each other, thereby producing a more rapid contraction after being heated.

Capacity for heat appears, then, to be the consequence of the greater want of attraction between the particles of the substance than of a conductor; for if a substance possessing a greater capacity do expand by exposure to a higher temperature, yet by exposure to a lower temperature, it will, owing to the greater want of attraction, unlike the metals, not contract in the same sudden manner they do, and therefore cannot be so powerful a conductor. Thus, owing to the greater mutual attraction between the particles of a conductor, metals possess the least capacity for heat of all the forms of matter. In water these two powers are more equally blended than in any other body; it possesses a greater conducting power than any other fluid of equal density, and has a great capacity for heat. It exists in three forms, solid, fluid and gaseous, at a less variation of temperature than any other fluid compounds, and, by the action of heat alone, differs from all others in being unalterable in composition.

The Voltaic pile consists of a number of series, generally about 200, arranged in the form of a pile; each series consisting of zinc, silver or copper, both about the size of a half crown, and cloth of the same size moistened with some saline or acid solution, as of nitre, common salt, or sal ammoniac, sulphuric, nitric or muriatic acid. This apparatus is variously arranged for the sake of convenience, but the principle is still the same; as by arranging the plates of the two metals soldered together cross-ways in a wooden trough, and filling the interstices with the saline or acid solution; if the hands moistened be applied to each extremity of the pile, a shock will be perceived.

If two platina wires, one in contact with the zinc extremity, the other with the copper extremity, be connected by means of a small piece of charcoal, the charcoal will be ignited.

If the wires be immersed in the same portion of water, oxygen will be given off at the positive wire, that connected with the zinc extremity; and hydrogen gas at the negative wire, that connected with the copper extremity.

If the wires be introduced into strong acid solutions, oxygen separates at the positive wire, and the inflammable component at the negative wire. Strong saline solutions are

acted upon in a similar way. Solution of muriatic acid in water gives off chlorine at the positive and hydrogen at the negative pole.

By the action of the Voltaic apparatus, the metals of the alkalies and alkaline earths, and boron, may be separated from their combinations with oxygen; sulphur and carbon, from their combinations with hydrogen.

The greater the number of the series, the more energetic will be the action of the apparatus.

By keeping in mind that the pile itself is pervaded by a radiant matter which by its motion can produce heat, the cause of its power may be traced out.

The action going on in each series between the metals and acid or saline solution, should now be considered.

First, the water is decomposed, by the union of some of the zinc with the oxygen of the water, and hydrogen gas given off from the surface of the copper; the acid then combines with the oxide of zinc, and remains in solution.

That portion of the metal, zinc, forming the oxide, by changing the conducting for the non-conducting form, as it exists in the newly formed solution, undergoes an expansion, and an increased capacity for heat; and the pervading heat which this increase demands will be supplied from that substance with which it is in the most intimate state of contact, which is the remaining metal, zinc: this zinc will in its turn instantly attempt to remunerate itself at the expense of that conducting substance with which it is in contact, which is the copper. The oxide of zinc will unite as soon as formed with the acid in the solution; there is now a diminution of capacity, a contraction, and the heat thus liberated is seized upon by that body present, which has the greatest capacity for it, which is the hydrogen gas. This gas containing an excess of what the copper is deficient in, they attract each other; and the equilibrium being restored, the hydrogen gas is given off from the surface of the copper.

Here, perhaps, it may be considered strange that the hydrogen, being produced in close contact with the zinc, should be elicited from the surface of the copper in preference to that of the zinc; but the very instant that the zinc suffers a loss of radiant matter, that very instant will this loss be supplied by the copper, as metals are conductors, and the copper remunerating itself at the expense of those bodies in its vicinity, as the solution, the hydrogen will naturally be attracted by it, and repelled from that part where the saline compound of zinc must be formed, which must be in contact with the zinc.

Thus, as it appears that in the series of the zinc, copper and solution,

solution, the conducting metals suffer a loss of their natural quantity of radiant matter, capable of producing heat, it is reasonable to suppose, that when a number of these series are brought within the range of the conducting influence of each other, as in the pile, the effects produced must be heightened; as the metals, such delicate tests of the presence of radiant matter, must be peculiarly sensible of the diminution of the radiant matter of those conducting bodies in their vicinity; as in the adjoining series of the pile.

The energy of the pile as a chemical agent increases in proportion to the number of the series; and when the supply of radiant matter capable of producing heat, which the metals in all the different series of the pile demand, owing to the change going on in the pile, is concentrated by being conveyed into it along two small platina wires, and when this supply is derived from a small mass of non-conducting matter, as the hydrate of potassa, the action of the pile must be almost irresistible, and the non-conducting compound will be as it were torn asunder by virtue of two attractions, by the abstraction of that radiant matter, or latent heat, upon which its very existence in the non-conducting form depends; and by which two attractions its matter is divided into two parts, which under other circumstances possess a strong attraction for each other, but here are attracted by the positive and negative poles of the pile.

Thus, the change which matter undergoes in its relations to temperature, when exposed to the action of the wires of the apparatus, is the very reverse of that going on in the pile; there, the quantity of conducting matter is diminished by the action of the menstruum upon the metal zinc: here, on the contrary, by the action of the two wires upon the hydrate of potassa, conducting matter is formed, as potassium is produced.

Why, it may here be inquired, should a metal, as potassium, be separated at the negative, and oxygen at the positive wire? why should this preference be given by each body to each of these wires? A current of radiant matter proceeds from the negative towards the positive extremity, where, by an accumulation, a tendency is imparted to bodies, such as a metal, to enter into a state possessing a greater capacity for heat, or in other words to form an oxide; while metallic matter, as potassium, is separated at the negative extremity, because, instead of an accumulation, there is a deficiency. This circumstance of excess of the radiant principle in one body, and its deficiency in another, is the cause of attraction in general. To explain more fully: the potassium being formed from the non-conducting

ducting hydrate of potassa, suffers a diminution of capacity for heat, while the oxygen gas gains an increase: thus the potassium has an excess of radiant matter to impart, while at the negative extremity of the pile there is a deficiency; therefore the potassium and copper naturally attract each other. The reason why oxygen should be attracted by that pole where radiant matter is in excess, and thereby have a tendency imparted to it of combining with metallic matter, may readily be admitted. Why in common cases do we heat a metal in order to combine it with oxygen? Is it to furnish the latent heat which the increase of capacity of the newly formed oxide demands? Yes.

East Smithfield, July 28, 1824.

THOMAS POLLOCK.

XXII. *Of Semi-decussation of the Optic Nerves.* By WILLIAM HYDE WOLLASTON, M.D. V.P.R.S.*

WHETHER we consider the astonishing subtlety of that medium which renders visible to us objects existing at the most immeasurable distances from us, or that delicately constituted organ which, by its general structure, collects the rays of light, and by a nice adaptation of its parts concentrates their force on the sentient fibres of the retina, expanded over its inner surface, we can feel no surprise that such great talents should have been devoted to investigate the curious properties of the one, or that the structure of the other should have been examined with so much assiduity.

The keenness of inquiry manifested by the cultivators of anatomy, in observing the most minute parts that have escaped the notice of their predecessors, shows that any addition to the common stock of our information on this subject will be gratifying to a certain portion of the members of this Society, and probably not uninteresting to the Society at large.

It is not my object, in the present paper, to examine either the *first* effect of the cornea in rendering the rays of light convergent, or the power of the crystalline lens in *finally* bringing them to a focus on the retina. It is not my intention to investigate whether the adaptation of the eye to different distances is effected by alteration of the *form* of the lens from its own muscular structure, or by alteration of its *place*, from the agency of other muscles. Nor do I mean to consider either the *involuntary* motions of the iris dependent on the quantity of light present, or that *voluntary* contraction of it by which we adapt the aperture of the pupil for distinct vision

* From the Philosophical Transactions for 1824, Part I.