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"Nec aranearum sane textus ideo melior quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes." JUST. LIPS. *Monit. Polit.* lib. i. cap. 1.

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XC. *On Voltaic Electricity, and on the effects of a Battery charged with Sulphate of Copper. By Mr.* W. De la Rue*.

THE greatest effect being always produced in those voltaic arrangements where the chemical agent exerted an action on only one of the metals constituting the battery, it occurred to me to use a saturated and perfectly neutral solution of the electro-negative metal, provided the other was capable of effecting its decomposition. I therefore tried the effect of a saturated solution of sulphate of copper† in an elementary voltaic battery of the ordinary construction. The zinc plate was four inches by two, the copper completely surrounding it: with this I was enabled to produce ignition of half an inch of platina wire one thirtieth of an inch in diameter, and continue it as long as the zinc plate lasted, which, being very thin, was dissolved in a couple of hours. The effects of this battery were considerably greater than those of one made of platina and zinc of the same dimensions, this being immersed in diluted nitric acid.

I afterwards constructed a battery with three four-inch zinc plates connected together; these were immersed in a copper trough with two partitions, so that the zinc should be opposed on both its surfaces to a plate of copper: with this battery one inch of fine iron wire was kept ignited for four hours. The zinc plate is always partially covered with a coating of copper, *which, however, is* NOT DETRIMENTAL *to the power of the battery*: the copper plate is also covered with a coating of metallic copper, which is continually being deposited; and so perfect is the sheet of copper thus formed, that, on being stripped off, it has the polish and even a counterpart of every scratch of the plate on which it is deposited. Besides this, the voltaic influence decomposes the water; the oxygen, uniting with a portion of the copper and hydrogen, being set at liberty. This may be readily shown by soldering at one end a piece of copper and a piece of zinc, coiling the two to form a small calorimotor, which is to be put into a glass jar filled with a solution of sulphate of copper, and inverted in a vessel of the same; metallic copper and its oxide will precipitate, and hydrogen gas fill the jar.

Seeing the effects so continuous in a simple battery, I tried a Cruickshank's, of one hundred pairs, each plate exposing to the action of the fluid a surface of twenty-five square inches. This was charged with a saturated *cold* solution of sulphate of copper, to each three gallons of which I added two ounce measures of nitric acid, for the purpose of cleaning the plates and freeing them from oxide; for half an hour the action was so feeble that I was on the point of emptying the trough, but I soon after noticed that the effect was rapidly increasing; I was then induced to proceed. The batteries attained their maximum of power in three quarters of an hour after charging.

Charcoal points were vividly and continuously ignited, the arc passing through a space of three eighths of an inch; this experiment was beautifully varied by dipping the charcoal in nitrate of strontian, the arc then being of a crimson colour.

Steel points of wire, a quarter of an inch thick, were then tried; the arc passed through an equal space; the steel rapidly fused, was deflagrated, and by the scintillations produced a beautiful effect.

Copper points treated in a like manner produced a green arc, and were rapidly destroyed.

Brass produced a blueish white arc; and the more fusible metals, such as bismuth and tin, produced likewise an arc, but the metal was soon carried from one point to the other and established a perfect contact.

A piece of platina wire, one eighth of an inch thick, was rapidly fused, by keeping it at a short distance from a disc of copper, so as to allow the arc to pass from it to the disc.

A *heap* of metallic leaves was burned with rapidity.

Thick tin-foil was deflagrated.

Very thick zinc-foil was rapidly consumed. A bunch of needles burned rapidly in mercury; the end of a file was deflagrated in the same manner.

Extraordinary as was the power of deflagrating metals, the effect of igniting was comparatively small; not more than an inch of iron wire could be ignited, though, if only twelve pairs of Wollaston's four-inch plates were used, charged with the same solution, two and a half inches could be kept ignited for some time.

The battery was then tried in decomposing common caustic potash, which it did with facility; the combustion of the potassium evolved, vividly igniting the thick platinum wire used for the negative pole. These experiments occupied about two

* Communicated by the Author.

† Daniell uses sulphate of copper, but not as the exciting agent.

[Professor Daniell's object was to obtain a voltaic combination constant in its effects while the connexion is completed, and totally inactive when the circuit is interrupted. Sulphate of copper, used as an exciting agent, he found unsuited for this purpose, and therefore relinquished this employment of it in his battery. That it did not escape Prof. D.'s attention, the following passage from his paper on Voltaic Combinations, in the first part of the Phil. Trans. for 1836, page 117, will show: "Upon adding sulphate of copper, in any considerable quantity, to the liquid in the cells, notwithstanding the amalgamation of the zinc, there was local action enough upon that metal to disengage hydrogen, which, in however small a quantity, was sufficient to commence the precipitation of the copper upon it. Single circles were thus immediately formed by the two metals, and local action increased to such a degree as speedily to cover the zinc with reduced copper." See also page 109 - Edit.]

hours. The charcoal points were then again tried; and if there were any alteration the power of the battery had increased. Batteries charged in this manner will continue in unabated action for upwards of three hours; in fact until there no longer remains any copper in the solution. It is worthy of notice, that after the batteries have been in action some time, a large portion of the sulphate of copper is expended, and replaced by sulphate of zinc, *yet the action continues the same.* This naturally suggests using a saturated solution of any neutral salt, common salt for example, and adding merely as much of the solution of copper as will serve for the time required. It is not unlikely that the effect would be more continuous than with a solution of copper only. I intend trying this, as I am still pursuing my inquiries on this subject, the object of which is to simplify as much as possible the voltaic battery.

At the Marylebone Institution, on Monday, September 12, when a lecture was delivered on this subject by Mr. Hemming, the President, the power used was the hundred pairs of Cruickshank's arrangement before alluded to, and one hundred and thirty-two pairs of Wollaston's four-inch plates, making in all two hundred and thirty-two pairs.

The batteries I charged *before* the commencement of the lecture, and they were not used till an hour afterwards; the effects were very striking. The arc from the charcoal points passed through a space of three quarters of an inch, and the effect continued unabated for as long a time as could be spared for this experiment; soda was rapidly decomposed, and the sodium brilliantly deflagrated: all the other experiments before cited were repeated on a much grander scale. The lecture being concluded two hours and a quarter after charging the batteries, the charcoal points were again ignited to light up the spacious theatre, the gas having been extinguished. The shock was very powerful, even when taken with the hands dry*.

Fifty pairs of four-inch plates on Cruickshank's plan suffice for all the above experiments, except the decomposition of the fixed alkalies.

* [As similar experiments to those here detailed have been performed with batteries of no extraordinary dimensions, charged in the usual way, it would have been more satisfactory had the author informed us of the size and number of the plates requisite to produce the same effects when sulphate of copper was not employed. We refer our readers who are interested in the philosophical investigation of this subject to an admirable Essay by Dr. Marianini of Venice, of which an abridgement will be found in the *Annales de Chimie et de Physique*, vol. xxxiii. p. 113. In his investigation of the various causes which influence the energy of the pile, he has been led to examine the effect of different liquid solutions, and gives a table of the relative advantages of forty-nine acids and salts, one part of each being dissolved in one hundred of distilled water.—Edit.]

Water was decomposed with extraordinary rapidity by a battery of this description, and also muriatic acid, the chlorine of which bleached a solution of sulphate of indigo in a few seconds.

Its effects on the animal system, as exhibited by Mr. Hemming to the audience, were almost terrific. A rabbit recently killed, an eel, and frogs were thrown into more violent muscular action than I had ever previously witnessed *.

The *tension* of electricity seems to be greatly increased by this mode of charging the voltaic battery.

Bunhill Row, Sept. 15, 1836.

XCI. *On the Constitution of Bitumens.* By M. Boussingault.

M. BOUSSINGAULT remarks, that bitumens, so abundantly met with on the surface of the earth, and the uses of which seem continually to increase, have hitherto been but slightly examined, so that, if we except the researches of M. de Saussure on the naphtha of Amiano, we are still nearly ignorant of the particular nature of these substances.

It has always been admitted that the great combustibility of bitumens is owing to their being chiefly composed of carbon and hydrogen, and the water which some varieties afford by dry distillation favours the idea that they are not always free from oxygen. In this memoir the author shows that they do not owe their fluidity to naphtha. The bitumen of Bechelbronn, which M. Boussingault has principally studied, is viscid and of a dark brown colour. From its uses it has been called mineral fat, it being advantageously used instead of organic fatty substances to diminish the friction of machines, &c. Alcohol at 40° acts on bitumen, particularly when heated, and acquires a yellow tint. Sulphuric æther readily dissolves it. Heated in a retort to 212° Fahr. nothing distils: this proves that it contains no naphtha.

By distilling the bituminous sand with water, M. Boussingault has obtained a volatile oily principle, which he calls *petrolene*, considering it to be the volatile principle of petroleum: it possesses the following properties:

Petrolene is of a pale yellow colour, of a slight taste, and possesses an odour resembling bitumen; at the temperature of 70° Fahr. its specific gravity is 0·891; at 18° Fahr. it does not lose its fluidity; it stains paper like the essential oils, burns with much smoke, boils at 536° Fahr.; alcohol dissolves a small quantity of it, but it is much more soluble in æther. It is composed of

Carbon,	.. 88·5
Hydrogen,	.. 11·5

so that it is a carburet of hydrogen isomeric with the essential oils of

* [That a battery of two hundred and thirty-two pairs of four- and five-inch plates, or even of a hundred pairs, should violently convulse rabbits, eels and *frogs*, is by no means an extraordinary result. The really terrific experiments made by Dr. Ure on the murderer Clydesdale, at Glasgow, were performed with a voltaic battery consisting of 270 pairs of four-inch plates, charged with dilute nitro-sulphuric acid.—Edit.]

† From *L'Institut, Sept.* 21, 1836.