



V. On the employment of carbon in voltaic combinations

Mr. John Thomas Cooper

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72. Palm Squirrel, adult, (*Sciurus palmarum*). Dry; most commonly 1-3692nd, extreme sizes 1-4800th and 1-3000th. In their own serum or in urine they seemed contracted, the corpuscles often cup-shaped, bent, or shrunk, ranging from 1-4800th to 1-4000th. Blood from a prick of the tail.

73. Furnier's Capromys, adult, (*Capromys Furnieri*). Dry; common diameters 1-3530th and 1-3429th. Extreme sizes 1-4000th and 1-3000th. Blood from a prick of the ear.

74. Bandicoot Rat, adult, (*Mus giganteus*). Corpuscles in their own serum very irregular in size, most frequently 1-4000th of an inch, and many from 1-5333rd to 1-3200th. There was evidently considerable shrinking of the corpuscles while under examination, as observed in several trials. In dried specimens the disks were generally from 1-4000th to 1-3600th. Extreme sizes 1-4800th and 1-3200th. Blood from a prick of the tail.

75. Hoary Marmot or Whistler, an old animal, (*Arctomys pruinosa*). Dry; most commonly 1-3600th. Extreme sizes 1-4000th and 1-3000th. Blood from a prick of the upper lip.

Regent's Park Barracks, Nov. 22, 1839.

V. *On the Employment of Carbon in Voltaic Combinations.*

By MR. JOHN THOMAS COOPER, *Lecturer on Chemistry, &c. &c.*

To Richard Phillips, Esq., F.R.S., &c.

DEAR SIR,

IT occurred to me on reflecting upon the use of the platinum as employed by Mr. Grove in the construction of his very energetic voltaic combination*, as it was only to conduct the electricity from the decomposing nitric acid, that any cheaper substance which conducted electricity, and upon which nitric acid had no action, might be employed with equal advantage, and probably supply the place of the more expensive material. With these views I was induced to make trial of *charcoal*, and the other forms of carbon, viz. plumbago, and a peculiar kind of carbon which is frequently met with as an incrustation in the retorts in which coal is decomposed for the purpose of gas lighting; and was gratified on making the experiments in finding my anticipations fully realized. In order to show the comparative value of each of the substances, I here subjoin the results of some of the experiments made with acids of the same strength, and with amalgamated zinc cylinders, each presenting to the action of the dilute sulphuric

[* See Lond. & Edinb. Phil. Mag., Oct. 1839, vol. xv. p. 287.]

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acid as nearly an equal surface as it was possible to obtain *. The figures represent the volumes of gas obtained by the vol-
tammeter in equal times.

Thick platinum foil soldered
to the zinc.

3·4
3·4
3·4
3·6
3·6
3·5
3·75
3·5
3·5

9)31·65

Mean 3·517 cub. inch.

Well-burned charcoal clamped
to the zinc.

2·8
3·0
3·1
3·2
3·25
3·25
3·25
3·4
3·25

9)28·50

Mean 3·17 cub. inch.

Plumbago clamped
to the zinc.

3·2
3·2
3·3
3·2
3·2
3·6
3·6
3·7
3·5

9)30·5

Mean 3·4 cub. inch.

Hard carbon from gas retorts
clamped to the zinc.

2·6
2·8
3·3
3·4
3·4
3·45
3·5
3·6
3·4

9)29·45

Mean 3·27 cub. inch.

From the above results it will be evident that the platinum appears to possess a trifling advantage over the other substances ; this, however, I am inclined to ascribe to the more perfect contact of the platinum with the zinc by soldering than to its superior qualities as a conductor of electricity ; and when the difference of expense is taken into consideration in the construction of large and extensive combinations, the application of the above-mentioned substances must be regarded as of great importance to the chemist, and to those who may have occasion to employ such combinations as electro-motors, seeing that either with the charcoal, plumbago, or hard carbon,

* The battery consisted of four zinc cylinders, each having $6\frac{1}{4}$ inches surface, and the pipeclay cups, 1 inch in diameter and $1\frac{1}{4}$ inch long, which gave the above quantity of gas in two minutes.

the purity of the nitric acid is a matter of indifference, strong commercial acid answering every purpose.

I remain, dear Sir, very truly yours,

JOHN THOMAS COOPER.

82, Blackfriars Road, London, Dec. 10, 1839.

P.S. I have found within these few days that some kinds of common coke, such as is very brilliant, close-grained, and has a columnar fracture, is equally good with the other varieties of carbon, and admits of being selected of almost any variety of form and size.

J. T. C.

VI. *On Derivation of Coexistence: Part I. Being the Theory of simultaneous simple homogeneous Equations.* By J. J. SYLVESTER, F.R.S. & R.A.S., Professor of Natural Philosophy in University College, London*.

Art. (1.) WE shall have constant occasion in this paper to denote different quantities by the same letter affected with different subscribed numerical indices.

Such a letter is to be termed a "Base."

Every character consisting of a base and an inferior index I call an argument of the base, viz. the first, second, or n th argument, according as 1, 2, or in general (n), be the number subscribed.

Art. (2.) I use the symbol PD to denote the product of the differences of the quantities to which it is prefixed (each being to be subtracted *from* each that follows); thus

PD ($a\ b\ c$) indicates $(b-a)\ (c-a)\ (c-b)$.

PD ($o\ a\ b\ c$) indicates $a\ b\ c\ (b-a)\ (c-a)\ (c-b)$.

PD ($o\ a\ b\ c\ \dots\ l$) indicates $a\ b\ c\ \dots\ l \times$ PD ($a\ b\ c\ \dots\ l$).

Art. (3.) For want of a better symbol I use the Greek letter ζ to denote that the product of factors to which it is prefixed is to be effected after a certain symbolical mannner. This I shall distinguish as the zeta-ic product.

The symbol ζ will never be prefixed except to factors, each of which is made up of one or more terms, consisting solely of linear arguments of different bases, i.e. characters bearing indices below but none above.

I am thereby enabled to give this short rule for zeta-ic multiplication: "Imagine all the inferior indices to become superior, so that each argument is transformed into a *power* of its base; multiply according to the rules of ordinary algebra; after the multiplication has been *done fully out* depress all the

* Communicated by the Author. Part I. appeared in L. & E. Phil. Mag. Dec. 1839, vol. xv. p. 428.