We have already seen that voltaic electricity at rest, like ordinary electricity, produces attractions and repulsions. We shall therefore proceed to give an account of the effects of voltaic electricity in motion, or of voltaic currents.

Sect. I.—*On the conducting Power of Solids and Fluids for Voltaic Electricity.*

When a voltaic battery is in a state of activity, and when wires of different metals are placed between the poles of the battery, so as to complete the circuit, the current of elec­tricity passes through them with different degrees of facility, that is, the different metals transmit the electricity with dif­ferent degrees of resistance.

The following table contains the results obtained by Davy, Becquerel, Pouillet, &c., respecting the conducting power of different metals, for different kinds of electricity.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Becquerel.@@1 | Davy. | Harris.@@’ | Cumming.@@3 | Christie.@@4 | Pouillet.@@4 |
| Voltaic Electricity. | Voltaic Electricity. | Ordinary Electricity. | Thermo-Electricity. | Electricity of Induction. | Electricity of a single couple. |
|
| Copper, | 100 | 100 | 100 | 100 | 100 | 100 |
| Gold, | 93∙6 | 73 | 66∙7 | 35∙2 | 110 | 84 |
| Silver, | 73∙6 | 109 | 100 | 176∙5 | 15∙2 | 116 |
| Zinc, | 28∙5 |  | 33∙3 | 53 | 52∙2 |  |
| Platina, | 16∙4 | 18 | 20 | 21∙6 | 24∙5 | 13 |
| Iron, | 158 | 14∙5 | 20 | 24∙3 | 22∙3 | 16 |
| Tin, | 15∙5 |  | 16∙7 | 23∙9 | 25∙3 |  |
| Lead, | 8∙3 | 69 | 8∙3 | 16∙8 | 12∙4 | brass 12 |

These results are, generally speaking, greatly at variance, the only ones that admit of comparison being those of Bec­querel and Mr Snow Harris. Much depends on the purity of the metals ; and Mr Harris has ascertained that the con­ducting power of alloys is very different from that of their component metals. This appears very distinctly from the number for brass, which bears no relation in Μ. Pouillet’s column, to the measures for copper and zinc, and also from his measure for gold of 18 karats, which we find to be only the 7th of copper, and the 6th of fine gold. The conduct­ing power in tne same metal increases directly as the area of the section of the wires, and inversely as the length of the wire.

Μ. Pouillet has found that the same law holds in liquids included in cylindrical tubes. By comparing, in this way, the conducting power of different saline solutions, the con­ducting wires being formed of the metal whose oxide was in solution, he found, as Fechner had done, that the inten­sity was rigorously in the direct ratio of the section and the inverse ratio of the conductibility. In this way he found that 433 feet of platinum wire 0·006 inch in diameter, had the same conducting power as a column of saturated so­lution of sulphate of copper 3¼ feet in length, and 0∙8 inch in diameter, from which it follows that the conducting power of the platinum is *two million and a half* times greater than that of the solution.

The following table shows the results of his observations, the conducting power of the copper solution at 59° Fahr., being taken as unity.

|  |  |  |
| --- | --- | --- |
|  | Conducting Power. | |
| Saturated solution of sulphate of copper,.... | | 1∙00 |
| Do. diluted with one volume of water... | | 0·64 |
| Do. do. two do | | 0∙44 |
| Do. do. four do., | | 0∙3l |
| Do. do. sulphate of zinc, | | 0∙417 |
| Distilled water, | | 0∙0025 |
| Do. with 1/20000 of nitric acid, | | 0∙015 |

Μ. Marianini has obtained a great number of interesting results respecting the conducting power of water holding in solution different acids, alkalis, or salts, compared with that of distilled water, at the temperature of 3° of Reaumur. The following is a selection from his results.

|  |  |
| --- | --- |
| Distilled water, temperature, 3β Reaumur, | 1∙000 |
| Hydrocyanate of soda, | 10∙96 |
| Hydrocyanic acid, | 18∙27 |
| Liquid ammonia, | 24∙45 |
| Soda, | 32∙06 |
| Phosphate of potash, | 44∙74 |
| — — of Soda, | 46∙00 |
| Tartrate of potash and antimony, | 50∙07 |
| Sulphate of zinc, | 51∙69 |
| Potash, | 55∙68 |
| Nitrate of lime | **57∙00** |
| Acetate of potash, | 59∙02 |
| Nitrate of Baryta, | 60∙02 |
| Carbonate of potash, neutral, | 66∙07 |
| Benzoic acid, | 70∙67 |
| Sulphate of soda, | 74∙02 |
| Sulphate of potash, | 80∙00 |
| Citric acid | 85∙71 |
| Tartrate of potash, | 92∙00 |
| Tartaric acid, | 98∙66 |
| Sea water, | 100∙00 |
| Hydrochlorate of lime, | 110∙00 |
| Oxalate of potash | 149∙00 |
| Acetate of copper, | 154∙00 |
| Oxalic acid | 179∙00 |
| Sulphuric acid, | 239∙00 |
| Nitrate of silver | 298∙00 |
| Nitric acid, | 358∙00 |
| Hydrochlorate of platinum, | 418∙00 |

The conducting power of solutions increases as the quan­tity of salts dissolved, but more slowly as the solution ap­proaches to saturation. The preceding table shows that the *acid* solutions have the *greatest,* and the *alkaline* and neut­ral solutions, the *least* conducting power.

The relation between the contractibility of non-metallic bodies in the solid state, and that of the same bodies in the liquid state, has been investigated by Dr Faraday, with his usual ability and success. Having found that a thin plate of *ice* stopped the electric current, while the same current passed when the ice was converted into water, Dr Fara­day examined a great number of non-metallic solids, and found that they assumed the conducting property during liquefaction, and lost it during congelation ; but what was remarkable, all those bodies underwent decomposition when

@@@> Traité De L’ Electricité, vol. iii. p. 91.

@@@, Phil. Trans. 1817.

@@@∙ Camb. Trane. 1823, p. 63.

@@@‘ Phil. Trans. 1833, p. 95.

@@@∙ Traité de Physique ii, p. 315.