fluid, with the single exception of the *periodide of mercury,* which, though it insulated when solid, and conducted when fluid, was not decomposed in the latter state. Dr Faraday found also a great variety of bodies, which acquired no con­ducting power in the fluid state, such as *sulphur, phospho­rus,* &c*.,* and they were not decomposed in this last state.

The relation between conduction and decomposition is a very important one ; but no less so is the relation of the conducting power for electricity to that for heat. “ As the solid becomes a fluid,” says Dr Faraday, “ it loses almost entirely the power of conduction for heat, but gains in a high degree that for electricity ; but as it reverts back to the solid state. It gains the power of conducting heat, and loses that of conducting electricity.”

Dr Faraday has given the following summary of the con­ditions of electric conduction in bodies:—

“ 1. All bodies conduct electricity in the same manner from metals to lac and gases, but in very different degrees.

“ 2. Conducting power is in some bodies powerfully in­creased by heat (such as in sulphuret of silver, fluoride of lead, periodide of mercury, and corrosive sublimate), and in others diminished, yet without our perceiving any accom­panying essential electrical difference, either in the bodies, or in the changes occasioned by the electricity conducted.

“ 3. A numerous class of bodies, insulating electricity of low intensity, when solid, conduct it very freely when fluid, and are then decomposed by it.

“ 4. But there are many fluid bodies which do not sensibly conduct electricity of this low intensity; there are some which conduct it, and are not decomposed, nor is fluidity essential to decomposition.

“ 5. There is but one body yet discovered (periodide of mercury, to which Dr Faraday subsequently added corrosive sublimate), which, insulating a voltaic current when solid, and conducting it when fluid, is not decomposed in the lat­ter case.

“ 6. There is no strict electrical distinction of conduction which can, as yet, be drawn between bodies supposed to be elementary, and those known to be compounds.”@@1

Sir Humphry Davy@@2 has shewn, that, as a class, metals have their conducting power diminished by heat; and Mr Snow Harris has proved, that heat does affect gaseous bo­dies, or at least air.@@3

Sect. II.—*On the Intensity and Direction of Voltaic Currents.*

The two electricities of the pile, when disengaged by the chemical action of its elements, tend continually to reunite and form a neutral fluid, by entering the conducting bodies in their vicinity. The quantity of electricity which remains free, constitutes the *tension* of the pile, or the intensity of the current, as we have already explained.

The tension of the pile is affected by various causes. When its two extremities are united by a metallic arc, the tension at first diminishes rapidly, but the diminution be­comes slower and slower, till it reaches its limit, beyond which the tension no longer decreases, however great is the length of time during which the circuit is closed.

The loss of tension in a given time increases with the number of voltaic couples, and the pile is longer in reaching the limit beyond which the tension does not decrease.

The loss of tension is more rapid when the liquid exer­cises a more powerful chemical action on the oxidable metal of the voltaic couple, and the longer it is in reaching the limit of decrease. In these experiments, which we owe to Marianini, the conducting power of the metallic arc has no influence.

The electric tension lost under the preceding circum­

stances, is again restored by opening the pile, that is, re­versing the metallic arc which united its extremities ; but it requires more time to recover its primitive tension, the longer the circuit has been closed.

In studying the change produced upon the tension when the circuit is not closed by a metallic arc, M. Marianini found, that a battery with new plates loses less tension in a given time, than one with oxidated plates, the new appara­tus reaching its limit sooner than the old one. In piles con­sisting of gold and zinc couples, tension diminishes more rapidly than in the ordinary pile, and reaches its limit in a very short time ; whi1st in piles with lead and zinc, the tension diminishes less rapidly than with copper and zinc.

The *direction* as well as the intensity of electric currents, depends on the degree of chemical action exerted by the liquid on one of the metals, particularly the most oxidable one. When the liquid and the metals are therefore known, the direction of the current can be predicted. The metal most acted upon takes away from the liquid negative elec­tricity. Zinc, for example, is more attacked by brine than copper, and therefore takes from the brine its negative elec­tricity ; but if the liquid is a solution of sulphuret of potas­sium, which affects the copper more than the zinc, the cop­per will take from the solution its negative electricity, and the current will take an opposite direction. Hence, in a pile with brine, the *zinc* extremity will give *positive* elec­tricity; whereas, in a pile with a solution of sulphuret of potassium, the *zinc* extremity will give *negative* electricity.

M. Delarive obtained the following interesting results, by immersing different voltaic couples in nitric acid of dif­ferent strengths. Each metal in the two columns is *posi­tive* in relation to the one which precedes it.

In Concentrated Nitric Acid.

Oxidated iron.

Silver.

Mercury.

Lead.

Copper.

Iron.

Zinc.

Tin.

In Dilute Nitric Acid. Silver. Copper. Oxidated iron. Iron. Lead. Mercury. Tin.

Zinc.

Μ. Becquerel mentions *arsenic* and *iron* as a remarkable example of a change of polarity produced by the chemical action of the fluid. With a voltaic couple of *iron* and *arsenic,* the *iron* is strongly *positive* compared with the arsenic, when they are immersed in diluted acid, which acts slightly upon the arsenic ; but when they are immersed in potash kept in fusion, the *arsenic,* upon which the potash acts powerfully, becomes *positive.*

M. Delarive has illustrated this branch of science with a number of valuable experiments on the changes produced upon electric currents, while passing through liquid con­ductors, interrupted by metallic plates. The following are the results at which he arrived :—

1. One or more metallic laminæ (platina), placed per­pendicularly to the direction of the electric current, in a liquid conductor, diminish the intensity of the current which traverses them.

2. This diminution is almost nothing when the electric current is very energetic, and proceeds from a pile contain­ing a great number of couples ; but the intensity diminishes the more rapidly in passing through the same number of plates, as its original intensity is less energetic.

3. If one or two electrical currents of the same intensity, the one an original one, and the other one which has pre­viously passed through several metallic plates, the first will have its intensity much more diminished by the interposi­tion of a plate than the second. Hence, these currents have

@@@■ Researches, § 444-449.

@@@« Phil. Trans. 1821, p. 431.

@@@a Id. 1834, p. 230.