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It fulfils the foregoing condition,
\[ \text{Pole} = \text{Current \times Length}. \]

It appears to me that Clausius's result must be accepted as the correct one.

Belfast, April 24, 1882.

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ON THE ELECTROLYSIS OF DISTILLED WATER.

BY D. TOMMASI.

Several physicists have questioned the possibility of decomposing chemically pure water by means of a galvanic current. According to M. Bourgoin*, water is not an electrolyte, the substance mixed with it to render it conductive is alone decomposed.

The few experiments which I have made in regard to this subject have proved to me the contrary—that is to say, that water can be electrolyzed even by the current of a very feeble battery, provided that the calories liberated by the battery are at least equal to those absorbed by water in decomposing into its elements (about 69 calories). Those experiments are as follows:

(1) Into a U-tube filled with distilled water I introduce two platinum electrodes connected with two Daniell elements. The distance between the electrodes is about 2 centim. No visible effect is produced, even after some time. The calories liberated by the battery are nevertheless more than sufficient to effect the decomposition of the water—in fact, 98 > 69. If, then, the water in this case undergoes no decomposition, that is owing solely to the resistance opposed by it to the passage of the current, and not to insufficiency of energy produced by the battery.

(2) If in the preceding experiment the positive electrode be replaced by a silver wire, this is what is observed:—After 18 hours no appreciable alteration is noticed in the liquid; but if, after taking out the silver wire, a drop of hydrochloric acid be poured into the branch in which it dipped, a very manifest white turbidity makes its appearance, having all the characters of chloride of silver. The hydrochloric acid does nothing more than precipitate the minute quantity of oxide of silver which was dissolved in the distilled water. Now silver does not decompose water at the ordinary temperature; but, in order to produce oxidation, the water must have been decomposed; and consequently the distilled water must have been passed through by the current. The electrodes in this experiment were distant from each other about 7 centim. It is evident, then, that, if the positive electrode is of silver, we can, with the aid of two small Daniell elements, overcome the resistance of a column of distilled water of 7 centim. length.

(3) With three Daniell elements the effect is much more marked. After 15 minutes it can already be ascertained, with the aid of hydrochloric acid, that the silver has begun to dissolve. At the end of 18 hours all the curved portion of the tube is found covered with a coat of oxide of silver, partly reduced by a secondary action.

(4) If, in the experiment I have just spoken of, six Bunsen elements be substituted for the Daniell battery, the decomposition, as might have been expected, takes place with much more intensity. After 18 hours the quantity of oxide of silver, in part reduced, found at the bottom of the tube is relatively considerable.

(5) Gold employed as the positive electrode is not oxidized in the presence of distilled water, even by the action of the current of eight Bunsen elements.

Is silver, then, the only metal which possesses the property of decomposing distilled water under the action of a galvanic current? No, fortunately; for it might be objected to me that, if water is decomposed when silver serves for the positive electrode, it may be due to this—that the oxide of silver, being soluble in water*, always suffices to render the water sufficiently conductive to be electrolyzed. This objection, however, would not be quite relevant; for it would not account for the current passing at the commencement of the experiment, since at that moment the water contains no foreign substance, and it is only after some time that the silver begins to dissolve. Therefore it is not the oxidation of the silver that permits the current to pass; but it is the current that, by decomposing the water, oxidizes the silver. It is true that, once the water contains a little oxide of silver, its conductivity is increased, and consequently electrolysis can take place with more facility; but, I repeat, the oxidation of the silver is not the determining cause of the decomposition of the water, but only the effect of that decomposition. Be that as it may, here is an experiment which will show positively that the solubility of the silver oxide plays only a secondary part in the electrolysis of distilled water:—

(6) The oxides and the hydrates of copper are completely insoluble in distilled water; and hence they cannot in any way augment the conductivity of the water. Now I have found that copper possesses, like silver, the property of decomposing distilled water when it is connected with the positive pole of a battery. The experiment is made as before; that is to say, a platinum wire and a copper wire are immersed in the two branches of a U-tube filled with distilled water, the former joined to the negative, and the latter to the positive pole of a battery composed of three Daniell elements. The distance separating the two electrodes is about 4 centimetres. At the end of 18 hours, upon a length of about 2 centim. at the lower part a coat of reduced copper is found adhering to the sides of the tube. A portion of the copper is deposited on the platinum wire. The decomposition of the water in this case can be explained only on the hypothesis that the copper employed as the positive electrode tends to diminish the resistance of the water, and consequently to render it more apt to be electrolyzed. It is the same with silver employed as positive electrode.—Comptes Rendus de l'Académie des Sciences, April 5, 1882, pp. 948-951.

* Oxide of silver dissolves in 3000 times its weight of water.