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# The Electromotive Force of the Daniell Cell

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tion, in which the formation heat of the copper salt is less, the value of the heat energy transformed in the cell is increased, and its electromotive force correspondingly *increased*. If, on the other hand, the zinc is dissolved into a more concentrated solution, the formation heat of the zinc salt is less, and the electromotive force of the combination is correspondingly *decreased*.

Similar thermochemical considerations, of the varying solution heats of sulphuric acid of varying dilutions, are applicable to explain part of the variations of electromotive force of the lead accumulator.

These thermochemical data are such well-established facts, and their applicability to explain the variations in the Daniell cell referred to, as well as to concentration cells in general, so patent and necessary, that it seems that the statement of Prof. Carhart must be revised so as to take these into account.

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## CORRESPONDENCE.

### THE ELECTROMOTIVE FORCE OF THE DANIELL CELL

*To the Editor of the Electrochemical Industry:*

SIR:—Professor Carhart is quoted in your September issue, page 9, in his "Contributions to the Theory of Concentration Cells," as saying that the increase of the electromotive force of the Daniell cell with the increase of density of the copper sulphate solution, and its decrease with increase of density of the zinc sulphate solution, is clearly explained by his thermo-electric theory, and that "the only other explanation of this fact ever given is based on osmotic pressure."

Without going into any criticism of the thermo-electric theory of concentration cells (which theory the writer is not yet ready to accept as explaining the *origin* of their electromotive force), the writer wishes to call attention to the fact that another explanation of the Daniell cell phenomenon is to be found, which is based neither on a thermo-electric theory, nor on the theory of osmotic pressure, but on a few well-demonstrated *experimental facts*.

We all agree that the difference in the heats of formation of zinc sulphate and copper sulphate, in aqueous solution, is the chief, if not the only, source of the electromotive force of the cell in question. But, these heats of formation vary with the concentrations of the solutions formed, both of them increase as the solutions formed are the more dilute. Therefore, if the copper is deposited from a more concentrated solu-