The Specific Conductivity of Solutions of Oxyhæmoglobin.

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When preparing a paper on the mechanism of hæmolysis two or three years ago* my attention was accidentally called to a statement in a paper by the late Prof. A. Gamgee in the 'Proceedings' of the Royal Society,† that "although solutions of oxyhæmoglobin possess a low conductivity this is very much higher than has been found in the previous observations of Stewart." In a note appended to my paper I suggested that this could only mean "that either his (Gamgee's) oxyhæmoglobin or his distilled water was less thoroughly freed from electrolytes than mine. In observations of this kind the error must appear as too high and not as too low a conductivity."

Prof. Gamgee having laid stress on the purity of his distilled water and oxyhæmoglobin, this result seemed very puzzling, all the more as my object in determining the conductivity of some specimens of oxyhæmoglobin‡ was merely to control their suitability for addition to blood in the determination of the relative volume of corpuscles and plasma by a colorimetric method described in the paper, and no such effort has been made to carry the exclusion of foreign electrolytes to the practically possible limit as would have been deemed indispensable had the conductivity of hæmoglobin been investigated for its own sake.

Having tried in vain to procure a full report of the Croonian Lecture in which Prof. Gamgee's research was embodied, I had almost given up hope of being able to solve the puzzle. A few weeks ago, however, on looking again at the abstract in the 'Proceedings' of the Society, the probable explanation of Prof. Gamgee's mistake occurred to me. My experiments on the conductivity of animal liquids were begun more than 20 years ago,§ and specific conductivity in all the papers was expressed, as was usual at that

* 'Journ. Pharm. and Exper. Therap.,' 1909, vol. 1, p. 49.

† 1902, vol. 70, p. 82.

‡ 'Journ. Physiol.,' 1899, vol. 24, p. 356.

§ 'Studies from the Physiological Laboratory of the Owens College, Victoria University, Manchester,' 1891, p. 124; 'Physiol. Soc. Proc.,' Nov. 8, 1890; 'Journ. Physiol.,' vol. 11, p. 15; Boston Society of Medical Sciences, June 15, 1897; 'Journ. Physiol.,' 1897, vol. 22, p. 159; *ibid.*, 1899, vol. 24, p. 211, etc.

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time, in terms of that of mercury, the conductivity of a column of mercury 106·3 cm. in length and 1 sq. mm. in cross-section being taken as unity. Since the resistance of a column of mercury of these dimensions at 0° C. is an ohm, the unit of conductivity was spoken of, for the sake of brevity, as a reciprocal ohm. This unit is 10^4 times smaller than the unit now employed. All my results must therefore be multiplied by 10^4 to express them in the new unit. The further factor 1·063 by which it is necessary to multiply conductivities expressed as the reciprocals of resistances measured in Siemens units must not be applied to my results. It is perhaps worth while stating this, as Höber,* in transposing some of my results to the new unit, multiplies not only by 10^4 but also by 1·063. This is erroneous.

The specific conductivity of a 3·5-per-cent. solution of oxyhæmoglobin at 5° C. was given by me† as $0{\cdot}90 \times 10^{-8}$, and that of a 1·2-per-cent. solution‡ as $0{\cdot}53 \times 10^{-8}$. In the new unit these numbers would be $0{\cdot}90 \times 10^{-4}$ and $0{\cdot}53 \times 10^{-4}$, *i.e.*, 9×10^{-5} and $5{\cdot}3 \times 10^{-5}$ respectively. Now for a 3·07-per-cent. solution of oxyhæmoglobin Prof. Gamgee gives as the conductivity at 0° C. $2{\cdot}626 \times 10^{-5}$, and at 18° C. $4{\cdot}432 \times 10^{-5}$. For a 2·23-per-cent. solution of oxyhæmoglobin he gives at 0° C. $2{\cdot}23 \times 10^{-5}$, and at 18° C. $3{\cdot}25 \times 10^{-5}$. Although he does not use the symbol K, and merely states that his numbers are "expressed in reciprocal ohms," it may be assumed that he meant to give them in the new unit. Accordingly, it would appear that the conductivities observed by him, instead of being very much higher than mine, are really lower, which is perfectly intelligible.

* 'Physikalische Chemie der Zelle und der Gewebe,' 1st edit., p. 132.

† 'Journ. Physiol.,' 1899, vol. 24, p. 358.

‡ *Ibid.*, p. 359.