

organisms without realizing that type of flagellation may occur which is essentially peritrichic, although some cultures are monotrichic. True polar flagellation includes lophotrichic and definitely monotrichic organisms. True peritrichic flagellation is best shown by forms that possess four or more flagella. A degenerate type of peritrichic flagellation, on the other hand, may show one to four flagella and, if only one, the attachment may be either polar or lateral.

It is felt that much greater progress can be made in the classification of bacteria if organisms with only one flagellum are not separated from those which have three or four peritrichic flagella. A more satisfactory plan seems to be to group them on the basis of a correlation of characters. A considerable number of organisms have been observed (*e.g.*, the violet bacteria, the legume nodule organisms, *Bacterium radiobacter*, *Alcaligenes fecalis* and numerous still unidentified soil non-spore-formers) which either show this type of flagellation or else lack all flagella. These organisms resemble each other in their physiological characteristics. Such a classification as that here suggested, therefore, does not run counter to the prevailing systems of grouping bacteria, in which much weight is laid on fermentation reactions and similar characters, as well as on morphology.

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THE MOLECULAR WEIGHT OF CRYSTALLINE CATALASE¹

THE apparent relationship of the enzyme catalase and methemoglobin, as suggested by comparison of the absorption spectra and hematin side-chains of these two substances, makes the determination of the molecular weight of catalase of considerable interest. Recently Stern and Wyckoff² concentrated horse catalase of a purity of 4,000 to 9,000 *Kat.f.* by sedimentation in an air-driven high-speed centrifuge and obtained a product with a *Kat.f.* of from 8,500 to 33,400. The sedimentation constant of this material they found to be 11×10^{-13} , indicating a molecular weight of 250,000 to 300,000. They obtained a sedimentation constant of 12×10^{-13} for a nearly pure catalase preparation from beef liver, but do not tell how this catalase was prepared.

The method of Sumner and Dounce³ for preparing crystalline catalase from beef liver has made it easy to

obtain this enzyme in what is apparently pure condition. We have prepared the enzyme in this laboratory and have determined the sedimentation constant of the recrystallized material by centrifuging an approximately 1 per cent. solution at 65,000 r.p.m. The value obtained over a pH range of 6.3 to 9.6 was 12.0×10^{-13} . A complete description of the method employed will be given in a later publication. Here, it suffices to note that the catalase was found to be a homogeneous substance, very slightly contaminated by impurity. Qualitative tests after centrifuging in a separation cell⁴ showed that there was no enzymatic activity found in the solution removed from the upper portion of the cell and that the activity followed the high-molecular colored substance. Determination of the diffusion constant gave a value of 4.1×10^{-7} , while the partial specific volume was found to be 0.73. From these data the molecular weight of beef liver catalase is calculated to be 263,000. This value is almost exactly 4-fold the molecular weight of horse hemoglobin.⁵ Now the percentage of iron in catalase is one fourth of that of hemoglobin, and accordingly the number of iron atoms per molecule must be four in catalase as well as in hemoglobin.

In conclusion, we wish to express our thanks to Professor The Svedberg for the use of his laboratory and to the Guggenheim Foundation for generous financial assistance.

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⁴ A. Tiselius, K. O. Pedersen and T. Svedberg, *Nature*, 140: 848, 1937.

⁵ T. Svedberg, *Nature*, 139: 1051, 1937.

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¹ From the Institute of Physical Chemistry University, Upsala, Sweden.

² K. G. Stern and R. W. G. Wyckoff, *SCIENCE*, 87: 18, 1938.

³ J. B. Sumner and A. L. Dounce, *Jour. Biol. Chem.*, 121: 417, 1937.