

On the Particulate Size of Bacteriophage.

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All existing evidence seems to indicate that the active agent responsible for transmissible lysis of bacteria is distributed in the medium as if it were particulate.¹ Several authors are inclined to consider these particles as autonomous units of an organized protoplasm.

In this connection it is of interest to measure and in other ways to identify these particles as such. Several attempts have been made to measure them. In most instances, these particles were^{2, 3, 4, 5} forced through membranes of presumably known porosity. Because of the limited value of this method, von Angerer⁶ tried to arrive at more reliable figures by the nephelometric method, and Bechold⁷ used an ingenious gold cast method. While the figures obtained by these various procedures are not identical, they are sufficiently close to indicate, at least, that in all cases authors were dealing with particles of approximately the same order of magnitude.

A recent paper of Northrop and Anson⁸ offers means to inquire into this question by the use of a different technique. By a suitable modification of the classical procedure for establishing diffusion rates,⁹ they have proposed a comparatively simple method for obtaining the diffusion constants of complex biological substances. The size of the particles in solution can be calculated from these diffusion constants by the use of Einstein's equation.¹⁰

Following the procedure as used by them* for carbon monoxide hemoglobin, we have obtained the following results for *B. coli* bacteriophage:

¹ Bronfenbrenner, J., *J. Exp. Med.*, 1927, xlv, 873.

² Prausnitz, C., *Klin. Woch.*, 1922, i, 1639.

³ Stassano, H., and deBeaufort, A. C., *Compt. rend. Soc. de Biol.*, 1925, xciii, 1378.

⁴ Eliava, G., and Saurez, E., *Compt. Rend. Soc. de Biol.*, 1927, xciv, 462.

⁵ Zinsser, H., and Jang, F., *J. Exp. Med.*, 1927, xlv, 357.

⁶ von Angerer, *Arch. fur Hyg.*, 1924, xcii, 312.

⁷ Bechold, H., and Villa, L., *Z. Hyg. u. Infekt.*, 1925, cv, 601.

⁸ Northrop, J. H., and Anson, M. L., *J. Gen. Phys.*, 1929, xii, 543.

⁹ Oholm, L. W., *Z. physik. Chem.*, 1910, lxx, 378.

¹⁰ Einstein, A., *Z. Electrochem.*, 1908, xiv, 235.

* We wish to acknowledge our indebtedness to Dr. Northrop for placing this method at our disposal in advance of its publication.

TABLE I.

Diffusion cell	Cell constant (K) as determined with 0.1 N HCl	Time in days	Phage diffused as cc. of original filtrate	D. for phage in cm. ² /days
No. 1	.1975	.0208	.00188	.0178
" 1	.1975	.0208	.00188	.0178
" 2	.1975	.0208	.000406	.0192
" 2	.1975	.0208	.000406	.0192
" 3	.1975	.0208	.00133	.0182
" 3	.1975	.0208	.0015	.0205
Average.....				.0188

Using this average value of $D = (.0188)$ in the Einstein equation,¹⁰ the radius of an average size particle of phage is calculated as having approximately the value of 6.1×10^{-7} cm. (or $6 \mu\mu$). Of course, one has still to determine whether such particles represent the units of bacteriophage or serve merely as carriers for a more highly dispersed agent.¹¹

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Differentiation Between Types of Fibers in Certain Components of Involuntary Nervous System.

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Criteria discussed in a previous report¹ have been employed to distinguish between 3 different types of fibers which occur together in nerves of the involuntary nervous system. Comparative measurements of threshold² have also been extended to these fibers. The cervical sympathetic trunk of one variety of turtle serves as a typical nerve containing such axons, recognizable by 3 groups of waves in their conducted action potential record on the oscillograph. These groups will be designated as the A, B, and C groups.

A second type of turtle has only 2 groups of waves in the cervical sympathetic nerve trunk, the second and third. Sections of the first type of nerve* show scattered, larger, and for the most part thinly

¹¹ Bronfenbrenner, J., see pages 527-529 in the "Newer Knowledge of Bacteriology and Immunology," Jordan and Falk, University of Chicago Press, 1928.

¹ Heinbecker, P., *PROC. SOC. EXP. BIOL. AND MED.*, 1929, xxvi, 349.

² Bishop, George H., and Heinbecker, P., *PROC. SOC. EXP. BIOL. AND MED.*, 1928, xxvi, 241.

* We are indebted to Mr. William Masek of the Department of Cytology for making sections of these nerves.