we also received by courtesy of Dr. Sabin. The results of the rabbit skin tests are recorded in Table I, from which it becomes evident that both of the sera neutralized the strains equally (between 10 and 50 skin test doses). The same was true with sera from a group of children suspected of having toxoplasmosis and with sera from their mothers; both of the strains were neutralized to the same titer.

Of 16 rabbits used for the skin test, 8 died 9 to 12 days after the inoculation. At autopsy an enlarged spleen with white foci, containing toxoplasma, was found regularly. Of the 8 surviving animals 4 were re-inoculated intracutaneously with 0.2 cc of a 10% mouse brain suspension at 4 separate spots, in order to test cross-immunity. Skin lesions of moderate size developed, but without necrosis. The results of the cross-immunity experiments are shown in Table II.

There was no striking difference in the skin reactions produced by the strains used. Only one of the animals died, but at autopsy no lesions specific for toxoplasmosis could be found, so that an intercurrent death is suspected. Evidence of cross-immunity has been given by this experiment.

As no differences in behavior, morphology, virulence, cross-neutralization and cross-immunity between the strains Bk and S could be observed, we believe that they are closely related or even may be identical.

The infant died on September 21. Treatment with sulphathiazole was not successful. At autopsy Dr. H. E. Schornagel found toxoplasma-containing mononuclear infiltrations in the meninges, the walls of the ventricles and the cerebral tissue, and foci of necrosis with many mononuclear cells and extracellular parasites. In the subcutaneous tissue, the psoas muscle and the diaphragma, some toxoplasma-containing mononuclear infiltrations were found.

Summary. This is a report of a case of toxoplasmosis occurring in Holland in a six-week-old infant, in whom during life toxoplasma could be shown in the cerebrospinal fluid by smear and also isolated by mouse inoculation. The serum of the infant's mother showed a strongly positive neutralization reaction, which was carried out by Sabin's rabbit skin test. In cross-neutralization tests and cross-immunity experiments on rabbits, the Dutch strain appeared to be closely related, perhaps identical with an American one.

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Diffusion Constants of the *E. coli* Bacteriophages.

A. POLSON.* (Introduced by Ralph W. G. Wyckoff.)

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For determining the diffusion constants of substances which can be obtained pure in relatively large amounts, the conventional optical method of Lamm is most suitable. Unstable substances like bacteriophages and animal viruses, however, are often irreversibly altered by the purification procedures, and diffusion measurements on such systems are then subject to large errors. The diffusion of such substances is better investigated using impure solutions that are quantitatively evaluated through measurements of their biological activities.

Hershey, Kimura and Bronfenbrenner[1] have estimated the relative sizes of T^1 and T^2

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[1] Hershey, A. D., Kimura, Frances, and Bronfenbrenner, J., PROC. SOC. EXP. BIOL. AND MED., 1947, **64**, 7.

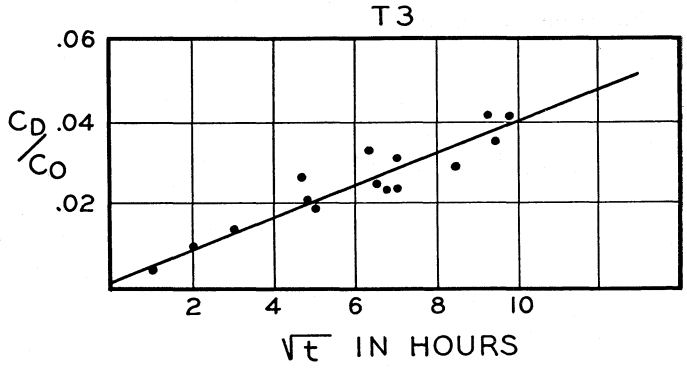

FIG. 1.
Ratio C_D/C_O plotted against the $\sqrt{t}$ for T_3 bacteriophage.

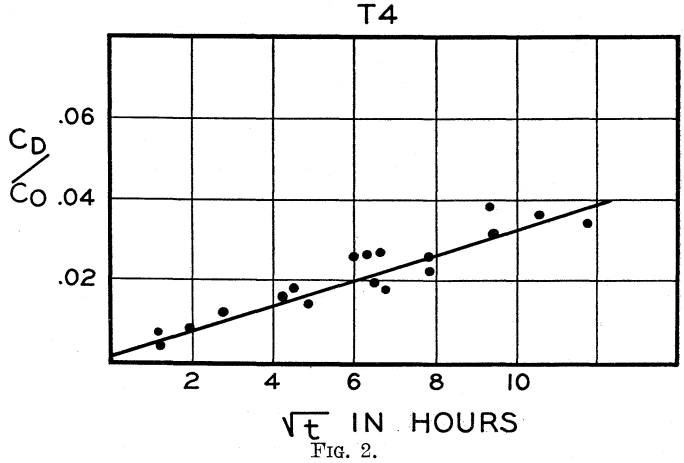

FIG. 2.
Ratio C_D/C_O plotted against the $\sqrt{t}$ for T_4 bacteriophage.

bacteriophages against *E. coli* by measuring their diffusion through thin agar, but such measurements are difficult to evaluate because of the different adsorption of these bacteriophages by the pores of the agar. The present paper is a preliminary account of the application of another diffusion technique to a tailed, T^4, and a tailless, T^3, bacteriophage. These bacteriophages were chosen to find out if the tail influences diffusion as well as to compare particle sizes computed from diffusion measurements with those measured with the electron microscope.

The method is essentially that previously employed by the author to determine the diffusion constant of African horse sickness virus.[2,3] The apparatus consists of 4 multi-chambered diffusion cells clamped onto a base plate provided with levelling screws. Sharp interfaces between bacteriophage and medium were formed by filling adjacent cells with medium and bacteriophage suspension and by rotating the top sections of the cells relative to the bottom until the 2 liquids came into exact apposition to one another. This was done by watching the index lines on the sides of the cells. The bacteriophage solution was diluted with 1% glucose broth solution to increase boundary stability and to insure a diffusion process free from disturbances by convection. This glucose broth solution, due to its higher density than the medium above it, forms a sharp boundary in the cell; the high rate of diffusion of its glucose into the broth produces a density gradient in the chamber into which the phage diffuses.

After suitable intervals the virus that dif-

[2] Polson, A., *Nature*, 1944, **154**, 823.

[3] Polson, A., forthcoming publication in *The Onderstepoort Journal.*

TABLE I.

Phage	D × 10^7 cm²/sec (obs.)	η_m	T	D_{20} × 10^7 cm²/sec (corr.)	Particle diameter in mμ
T_3	1.19	0.0101	295	1.19	36.2
T_4	0.798	0.0101	295	0.798	55.0*

* This figure is an equivalent spherical diameter, since this phage T_4, due to its tail, is obviously non-spherical.

fused past the initial boundary was isolated from that in the bottom by rotating the top sections to their cut-off position. The phage contents of the diffusates as well as of the original material in the lowest section were then determined by the usual plaque-count method.

The results are given in graphical form in Fig. 1 and 2, where the ratios of concentration in the diffusates C_D to that in the original material C_O are plotted against the square root of t, the time in hours. It is clear from these figures that C_D/C_O is a linear function of $\sqrt{t}$, a necessary requirement from the laws of diffusion in solutions.

Average diffusion constants were calculated from these data using the equation:[3]

$$D = (C_D/C_O)^2 \cdot \frac{H^2 \pi}{t}$$

where t is the time of diffusion in seconds, and H is the height of the column of liquid above the original boundary, regarding the chambers in the diffusion cells as cylinders. The value of H in these experiments has been 3 cm. Diffusion constants at the temperature of the experiment (22°C) calculated in this way are given in the second column of Table I. Constants for 20°C have been calculated from these with the expression:

$$D_{20°} = D_{22°} \cdot \frac{293°K}{295°K} \cdot \frac{\eta\, m}{\eta\, w}$$

where $D_{20°}$ is the diffusion constant at 20°C, η_m is the viscosity of the medium, and η_w is the viscosity of water at 20°C.

Particle sizes were computed from the well-known Einstein equation for the diffusion of a spherical particle:

$$D = \frac{RT}{N} \cdot \frac{1}{6\, \pi\, r\, \eta}$$

where R is the gas constant, T is the absolute temperature, N is Avogadro's number, r is the radius of the particle, and η is the viscosity of the medium. This yields the diameters of the last column of the table. They are to be compared with the diameters of T_3, 45 mμ, and of T_4, 65 x 80 mμ, as measured from previous electron micrographs.[4]

It is clear that the tail of the bacteriophage T_4 does not contribute to its motion in a liquid medium. The slightest propulsion that such a tail might give the particle would have increased its diffusion constant tremendously since diffusion increases as the square of the distance moved in Brownian motion.

4 Delbrück, M., *Biol. Rev.*, 1946, **21**, 30.

16281

A Free Swing Writer for Recording With Very Light Pressure on a Smoked Surface.

ALBERT E. AFFORD. (Introduced by S. Goldschmidt.)

From the Department of Physiology, School of Medicine, University of Pennsylvania.

The writing device to be described was developed for use in situations where recording on a smoked surface was unsatisfactory with the conventional type of "fixed" writing