aggregate. The organisms themselves also tend to bind the soil particles.

Since plants and humus deposits differ in chemical composition, it is likely that organic matter from various sources will not affect the physical properties of the soil alike. In certain experiments designed to determine the effect of various typs of organic matter on the physical properties of the soil, related to soil erosion, a field soil was treated with alfalfa, straw, manure and peat material. At various intervals the total organic carbon, moisture-holding capacity, infiltration capacity and dispersion ratio were determined. The results showed that all four types of organic matter increased the infiltration capacity, with peat being most effective. Alfalfa, straw and manure brought about a rapid increase in the number of water-stable aggregates, as measured by the dispersion ratio, with alfalfa producing the greatest increase. Peat caused only a small increase in aggregation. After three months' decomposition, under favorable moisture and temperature conditions, the increase in aggregation had almost disappeared in the case of straw and peat; it was still apparent to some extent in the case of the manure and was quite marked in the alfalfa-treated soil.

In conclusion it may be stated that the role of microorganisms in soil conservation is highly important and is closely associated with the transformation of the organic matter added to the soil.

The detailed results of these experiments and the methods employed will be published in *Soil Science*.

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ON THE MOLECULAR WEIGHT OF THE TOBACCO MOSAIC VIRUS PROTEIN

IN recognition of the unreliability of the value of 17 million for the molecular weight of the tobacco mosaic virus protein, as calculated from the sedimentation constant[1,2] of $170\text{–}200 \times 10^{-13}$, Stanley[3,4,5] and his co-workers have recently attempted a correction for the molecular weight by a combination of the data obtained by means of the standard Ostwald viscometer and the Kuhn, the Eisenschitz and the Perrin equations. The assumptions were that one could estimate the value for the relative dimensions of the elongated particles from viscosity data, and that these relative dimensions could be used in calculating the asymmetry constant to be used in conjunction with the data obtained from the ultracentrifuge. It has been protested[5] that the failure of the protein-water system to follow the Poiseuill's and Fick's law is not of sufficient importance to impair the usefulness of these methods in determining the asymmetry constant, and that all the data relative to the size and shape of the virus protein molecule are in good agreement.

An appreciation of the extent to which sols of the virus protein deviate from Fick's law may be obtained from Fig. 1. The data presented were obtained from a

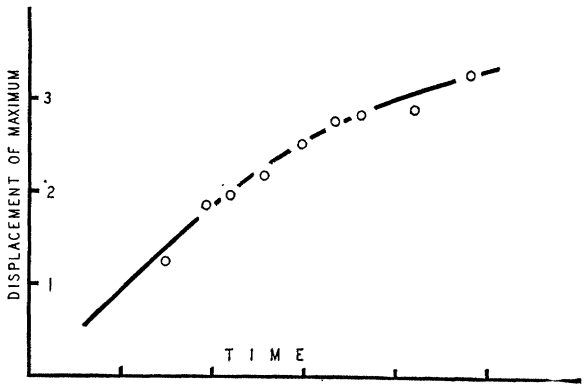

FIG. 1.

diffusion study, using the refractory method of Lamm,[6] of a sol containing .87 per cent. electrodialyzed protein dispersed in distilled water. As has been pointed out,[7,8] the curves obtained by plotting the displacement of the scale lines against the original line positions in the case of the virus protein are skewed, and the point of maximum displacement is shifted toward the solvent side. The rate of drift of the point of maximum displacement is shown in Fig. 1. The abscissa is in 10^5 seconds; the ordinate is in millimeters. The ratio of the distance from the midpoint of the diffusion cell to the lens to the distance from the midpoint of the cell to the scale was .78. Substances that obey the normal laws of diffusion yield curves that are symmetrical with the maximum displacement at the original interface.

The normalized curves deviate markedly from the ideal. The maximum ordinates in normalized coordinates obtained after 1.78 and 5.85×10^5 seconds respectively were .62 and .74. The ordinate of the maximum for the ideal curve

$$y = \frac{1}{\sqrt{2\pi}} \quad e^{\frac{-x^2}{2}}$$

is .40. Following the "maximum height" method of

[1] Eriksson Quensel and T. Svedberg, *Jour. Am. Chem. Soc.*, 58: 1863, 1936.
[2] R. W. G. Wyckoff, S. Biscoe and W. M. Stanley, *Jour. Biol. Chem.*, 117: 57, 1937.
[3] M. A. Lauffer, SCIENCE, 87: 469, 1938.
[4] H. S. Loring, M. A. Lauffer and W. M. Stanley, *Nature*, 142: 841, 1938.
[5] M. A. Lauffer and W. M. Stanley, *Chem. Rev.*, 24: 303, 1939.
[6] O. Lamm, *Zeit. Physik. Chem.*, Abt. A 138: 313, 1928.
[7] V. L. Frampton and A. M. Saum, SCIENCE, 89: 84, 1939.
[8] H. Neurath and A. M. Saum, *Jour. Biol. Chem.*, 126: 435, 1938.

Lamm,[9] in calculating the diffusion constant, and neglecting the viscosity, values of 2.0 and 2.1×10^{-8} were obtained from the initial and final photographs. It seems fair to state, however, that one is justified in calculating the molecular weight of the virus protein from these data, providing he can account for the peculiar diffusion behavior in a quantitative manner.

In Fig. 2, values for the ratio of the short to the

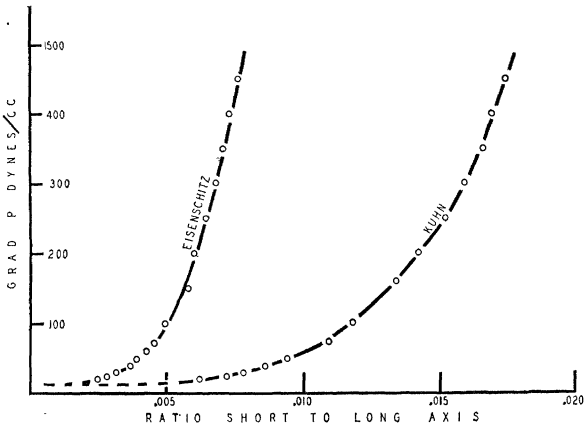

FIG. 2.

long axis of the virus protein at various shearing stresses, as calculated from Frampton's[10] data using the Kuhn and Eisenschitz equations, are plotted against the pressure gradient along the capillary of the capillary viscometer. These two equations may legitimately be used for solutions of elongated particles that obey Poiseuille's law in the case of a random orientation of the particles—ostensibly for a solution at rest. The extrapolated value of the short to long axis is zero; that is, the extrapolated value for the ratio of the long to the short axis for the quiescent fluid is infinite. In the Perrin equation

$$\frac{1}{R} = \frac{\left(\frac{a}{b}\right)^{2/3}}{\sqrt{1-\left(\frac{a}{b}\right)^2}} \log \frac{1+\sqrt{1-\left(\frac{a}{b}\right)^2}}{\frac{a}{b}},$$

where a/b is the ratio of the short to the long axis and R is the asymmetry constant, as a/b becomes smaller and smaller, the value of

$$\frac{\left(\frac{a}{b}\right)^{2/3}}{\sqrt{1-\left(\frac{a}{b}\right)^2}}$$

approaches zero more rapidly than

$$\log \frac{1+\sqrt{1-\left(\frac{a}{b}\right)^2}}{\frac{a}{b}}$$

approaches infinity. That is, in the limit, 1/R is zero, and R is infinite. Substituting the value of R in the well-known equation

$$R = \frac{M(1-\zeta v)}{6\pi\eta_0 N S_{20} \left(\frac{3Mv}{4\pi N}\right)^{1/3}}$$

where M is the molecular weight, we see that in the legitimate use of these methods the corrected value for the molecular weight of the virus protein, as determined by ultracentrifuge means, is infinite. From a similar consideration, the corrected value for the molecular weight as determined by means of diffusion is zero.

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UPWARD TRANSPORT OF MINERALS THROUGH THE PHLOEM OF STEMS

IN 1937 Gustafson and Darken[1,2] showed that radioactive phosphorus was conducted upward in the stem of a plan through the bark. In the second paper it was suggested that to get a quantitative comparison between the conduction in the xylem and the phloem the part of the plant above the cut of xylem or phloem should be ashed and the total activity determined. This has now been done with *Bryophyllum calycinum* and *Salix* sp.

The experiments were conducted as before, except that the activity was determined with a Geiger counter. Usually three plants as alike as it was possible to select were used in each experiment; one was used as control, the second had a section of the xylem removed and the third plant a girdle of bark removed. In some plants the xylem was separated from the bark for a distance of several centimeters, but a piece was not removed, only a cut was made at the lower end of the xylem-phloem separation. The lower end of this bare xylem was kept in a test-tube of water during the experiment to supply the top with an abundance of water, as it was found in some experiments, where a portion of xylem had been removed, that the leaves wilted soon after the experiment was set up.

At the end of the experiment the plants were cut off at the level where the girdle had been made and the two parts ashed separately. The lower part has been designated roots, even though several inches of the base of the stem was included. The ashing was done in a muffle furnace at 650° C.

The ash was dissolved in 10 to 20 ml of 10 per cent. HCl, depending upon the amount of ash. An aliquot (.2 to 1.0 ml, depending upon the activity of the phosphorus) was allowed to be absorbed by a piece of blot-

[9] O. Lamb, *Zeit. Physik. Chem.*, Abt. 143: 177, 1929.
[10] V. L. Frampton, *Jour. Biol. Chem.*, 129: 233, 1939.

[1] F. G. Gustafson and Marjorie Darken, SCIENCE, 85: 482–493, 1937.
[2] F. G. Gustafson and Marjorie Darken, *Amer. Jour. Bot.*, 24: 615–621, 1937.