very large compared with the time during which a particular doublet is in the neighborhood of B, is proportional to $ee' - k^2$ where k^2 is the mean value of the square of $f(t)$ for all the doublets which pass from A to B and arrive at B in this interval. In accordance with our previous hypothesis it seems reasonable to conclude that k^2 is proportional to the product of the masses of A and B.

If in the interval of time from t to $t + dt$, no doublets arrive at B while a doublet left A in the corresponding interval $t - (AB/c)$ to $t + dt - (AB/c)$ it is clear that the mean value of the electrical force between A and B in this interval depends on ee' and there is no gravitational action. Other cases may be considered in a similar way and it is clear that the gravitational action depends only on the doublets which go directly from A to B. The action of B on A depends likewise on the doublets which go directly from B to A.

The present theory indicates that there may be a slight screening effect when a third body C is interposed between two bodies A and B, for C may be supposed to receive some of the doublets which would ordinarily go directly from A to B or vice-versa. The recent work of Nipher[2] and Majorana[3] thus becomes of additional theoretical interest when it is considered in the light of the present theory.

Gravitational action may be slightly modified, too, by collisions between doublets travelling with velocity c. In this connection it may be worth while to point out that if P and Q are two doublets travelling along different straight lines with velocity c, then after a certain instant it is possible for a particle travelling with velocity c to meet first one doublet, say P, and then Q but not for such a particle to meet first Q and then P. A series of moving doublets may thus be arranged in a definite order; something which happens to one doublet may affect those which come later in the series but not those which come earlier. This result may have some connection with the damping of oscillations in the emission of light. A more imperfect form of the present electrical theory of gravitation has already been published in *Proc. London Math. Soc.*, T. 18 (1919), p. 95, and in the *Messenger of Mathematics*, T. 48, p. 55. The possibility of a connection with the work of Einstein and Majorana has not been pointed out previously. The present theory seems to be free from the objections raised against the older electrical thory of gravitation (see O. W. Richardson, "The Electron Theory of Matter," p. 596), there may, however, be some other fatal objections to it.

H. BATEMAN

[2] SCIENCE, September 21 (1917).

[3] *Phil. Mag.*, T. 39, May (1920), p. 488.

PROTOZOA IN SAWDUST FOR CLASS WORK

IN studying the method of excreta disposal by compositing night-soil with sawdust, the chance observation was made that microscopic examination of old sawdust piles revealed the presence of *Euglypha* cysts. Samples of sawdust were used for experimental culture of hookworm eggs and it was observed that the cultures showed profuse contamination with amœba, flagellates, ciliates, and free living nematodes. Samples from old sawdust piles were then moistened and incubated with the result that numerous specimens of protozoa and free nematodes were found.

The sawdust used was chiefly from southern pine.

This note is published with the thought that it may be of practical service to teachers in providing material for class work.

C. W. STILES

U. S. PUBLIC HEALTH SERVICE

CONCERNING DIASTROPHISM

Two papers have appeared during the current year which once again bring before American geologists the vexed question of systemic boundaries. In the first Böse[1] concludes that the ammonites found at Tularosa, New Mexico, 200 feet above the base of the Abo sandstone, are of Carboniferous age. This inter-

[1] Böse, E., *Am. Jour. Sci.*, Vol. 49, pp. 51–60, January, 1920.