tances apart, and applies it to the attraction of bodies near the earth, then it makes a difference where within the earth the seat of attraction lies.

So it was not until about 1685 when Newton demonstrated the beautiful propositions related to attractions within and without the earth, including that of the zero force of attraction of a homogeneous shell upon any point within the shell, that he could locate the earth's seat of attraction definitely at its center. Then he was able to announce his law of gravitation.

When all our attempts to free the radiometer of the pernicious effects of electrostatic fields had failed, I bethought me of this beautiful theorem and its electrical analogue that the force within a closed conductor is zero. I suggested to my colleagues that we insert a brass tube, of rather small radius, centrally within the quartz tube which contains the radiometer. Small holes are bored through the brass tube to admit radiation and the viewing of the vanes, and another opposite the reflecting mirror. We feared, indeed, that the holes might introduce disturbance, because the shielding would be not quite complete.

To our great delight this device works favorably. No electrostatic fields we can create on the outer quartz tube seem to greatly modify the time of swing of the radiometer suspended within the brass shield. Thus Sir Isaac Newton's beautiful theorem has saved the day for the radiometer of highest sensitiveness.

C. G. ABBOT

ASTROPHYSICAL OBSERVATORY,
SMITHSONIAN INSTITUTION

A 2,3-BUTANEDIOL-GLYCEROL FERMENTATION[1]

FORD'S strain of *Bacillus subtilis* (A.T.C.C. 2586) produces 2,3-butanediol and glycerol as the main products when grown at 30° C. on a glucose solution (3 per cent. glucose, 1 per cent. yeast extract, 1 per cent. $CaCO_3$) at pH 6.0–6.8 under anaerobic conditions. For each 100 mols of glucose fermented 57 mols of 2,3 butanediol, 40 mols of glycerol, 20 mols of lactic acid, 13 mols of ethanol and 5 mols of formic acid were found. The glycerol was isolated and identified as the tribenzoate and tri-*p*-nitrobenzoate; in each case a mixed melting point determination was made with an authentic sample. Ethanol was similarly identified as the *p*-nitro benzoate. Lactic acid was isolated as lithium lactate and identified by quantitative oxidation to acetaldehyde in boiling, dilute permanganate solution. The 2,3-butanediol was purified by distillation. Judging from its physical properties it is a mixture of the *levo* and *meso* isomers in approximately equal amounts. It was identified by bromine oxidation to diacetyl, the latter being identified by the melting point of its *bis*-phenyl-hydrazone. To the best of our knowledge this is the first time any species of bacteria has been shown to yield glycerol as a product of carbohydrate dissimilation.

[1] This work will be described more fully in the *Canadian Journal of Research.*

A. C. NEISH
A. C. BLACKWOOD
G. A. LEDINGHAM

DIVISION OF APPLIED BIOLOGY,
NATIONAL RESEARCH COUNCIL,
OTTAWA, CANADA

IS CASTE DIFFERENTIATION IN ANTS A FUNCTION OF THE RATE OF EGG DEPOSITION?

THE problem of caste differentiation in ants has been a moot question for many years. William Morton Wheeler, in a posthumously published book,[1] describes the situation as follows:

> It must be admitted—that the brood relationship in ants is so elaborate, the difficulties of submitting it to controlled experimental investigation so great, and observations of it so conducive to conflicting "explanations" that the controversy concerning the determination of castes in these insects has persisted with little change for years. This is shown by the attitudes of the two very eminent myrmecologists, Emery and Forel. Although both were thoroughly conversant with all the relevant facts established during their lifetimes, Emery, nevertheless, remained an intransigent trophogenist throughout his career, and Forel—was as thoroughly convinced that the castes are determined in the egg.

In view of this situation it is not surprising that it is through studies of non-social groups of Hymenoptera closely related to the ants that a possible answer to the problem of caste determination has been revealed, an answer that appears to reconcile the views of Emery and Forel.

Recently several students of the Hymenoptera have made observations which suggest that the castes are determined in the egg by trophogenic means.[2,3,4]

The amount of nutriment in a normal hymenopterous egg may be either sufficient or insufficient for the complete development of the embryo. The eggs of certain endoparasitic species appear to be devoid of nutriment. In the case of the chalcidoid *Coccophagus capensis* the egg contains enough nutriment for the development of the male embryo but not enough for the development of the female embryo. The female embryo obtains the necessary additional nutriment from the host by means of a trophic membrane.[5]

[1] William Morton Wheeler, "Mosaics and Other Anomalies Among Ants." 95 pp. Cambridge: Harvard University Press. 1937.
[2] W. Goetsch, *Naturwissenschaften*, 25: 803–808, 1937.
[3] Rudolf G. Schmieder, *Ent. News*, 50: 125–131, 1939.
[4] P. W. Whiting, *Jour. Hered.*, 29: 189–193, 1938.
[5] Stanley E. Flanders, *Jour. Econ. Ent.*, 35: 108, 1942.