Order of Magnitude of Morphogenetic Forces

The experimental analysis of embryonic development has been mainly concerned with elucidating the chemical mechanisms which cause different parts of the egg to develop into the organs and tissues of which the adult is composed. Much less is known about the physical forces which cause the changes in relative position which are such an important part of the developmental process. Preliminary measurements were therefore made of some of the physical magnitudes associated with the process of gastrulation in the eggs of the newt *Triton alpestris*.

In the first set of experiments, small steel balls were placed in the blastocœl cavity of young gastrulæ, and subjected to the magnetic field produced by one pole of a long bar magnet. The pole and the egg were gradually brought closer together until the ball was pulled through the blastocœl roof. Two sets of experiments were made: in the first, with a ball 0·216 mm. in diameter, breakage of the roof occurred at distances of 0·83, 2·0, 1·83, 1·0, 1·33, 1·0, 1·0 mm., average 1·36; in the second, with a ball 0·3 mm. in diameter, breakage occurred at 1·5, 1·5, 1·83, 1·5, 1·33, 2·0, 1·83, average 1·66. Converting these measurements into mgm. of pressure per sq. mm. of the hemispherical surface of the ball in contact with the roof, the averages for the two series are 7·02 and 7·29 mgm./mm.^{2}.

In another series of experiments, balls were placed among the gastrulating cells in such a way that the applied magnetic force was opposed to their normal movements; the eggs were placed at various distances from the magnet, and it was noted whether any movement of the balls took place over a period of about eight hours. For balls of diameter about 0·083 mm. placed in the mesoderm, movement occurred at distances of 9·5, 8·0, 6·83 (?), 6·66, 6·33, 6·0, 5·83 mm., no movement at 7·83, 5·5, 5·3, 5·16, 4·66, 4·0. For similar balls in the endoderm, movement occurred at 8·5, 5·83, not at 7·16, 6·0, 5·5, 5·0, 4·66, 3·83, 3·66, 3·33 mm. If we take for both tissues the limit at which movement could occur at about 5·66 mm., the maximum force exerted by the gastrulating tissues is equivalent to 0·34 mgm./mm.^{2} of the hemispherical surface.

These measurements are of a preliminary nature, and no great accuracy is claimed for them. It is interesting to note that the force exerted by the gastrulating cells is much less than the breaking strain of the tissue. Before any attempt can be made to interpret this it will be necessary to know something of the rigidity, and the viscosity at various rates of flow, of the tissues concerned.

C. H. Waddington.

Zoological Laboratory,
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Points from Foregoing Letters

The quantitative discrepancy between the observed and the theoretical ratio of the life-time of the free meson to that of a light radioactive element can be removed, according to C. Møller, L. Rosenfeld and S. Rozental, by combining a vector and a pseudoscalar field for the meson in the calculations.

D. Dervichian finds that when a protein is dissolved in water to which a trace of a capillary active substance able to lower the surface tension is added, the protein can be spread on the surface of an aqueous solution. He also discusses the meaning of 'spreading number'.

C. H. Townes discusses the presence, in the spectrum of carbon containing ^{13}C, of bands, hitherto ascribed to the carbon molecule, which he believes are due to a persistent impurity of complex molecular structure.

It has been found by J. S. McPetrie and J. A. Saxton that in the ultra-short radio wave-band 2–3 metres the attenuation of received field-strength for positions within the shadow of hills is most pronounced for radiation polarized with the electric vector horizontal.

A. R. Ubbelohde and Miss I. Woodward find that when deuterium replaces hydrogen in potassium dihydrogen phosphate, this substance crystallizes in a new structure, thus giving further evidence of the difference between hydrogen and deuterium bonds in crystals.

O. N. Trapeznikowa and G. A. Miljutin find two maxima, which shift with pressure, in the specific heat of methane between 12° K. and 30° K., at pressures up to 2000 kgm./cm.^{2}. The effect of substituting deuterium for hydrogen in methane has a similar effect to increasing the pressure on ordinary methane.

Specimens of blue and red celestine from Yate, Glos., have been examined by J. N. Friend and J. P. Allchin, who attribute the colour to colloidal gold.

J. H. Quastel and D. M. Webley find that the oxidation of acetic acid by suspensions of propionic acid bacteria grown on a vitamin B_1-deficient medium is greatly accelerated by the addition of small quantities of the vitamin, complete oxidation of the acetic acid taking place.

The statement has recently been made that the decomposition of hydrogen peroxide by catalase can only take place in the presence of molecular oxygen. F. H. Johnson and K. L. van Schouwenburg describe an experiment in which decomposition occurred under completely anærobic conditions.

H. W. Kosterlitz discusses the role of galactose-1-phosphoric acid as an intermediary in the metabolism of galactose in liver and in yeast. This ester is fermented by dried galactose-adapted *S. cerevisiœ* Frohberg about six times as rapidly as is galactose. There is an appreciable accumulation of the ester in the liver during galactose assimilation.

B. Mukerji and R. Ghose report that in recently induced and long-standing liver damage, a significant increase in free chloral concentration of blood occurs within an hour of the oral administration of chloral hydrate to dogs. Blood clearance of free chloral may, therefore, be employed as a test for detoxication function of the liver.

C. H. Waddington describes measurements of morphogenetic forces made by means of steel balls embedded in gastrulæ of *Triton alpestris* and then subjected to magnetic forces. The breaking strain of the blastocœl roof was of the order of 7·15 mgm. per sq. mm. of the hemispherical surface of the ball in contact with the tissues. Gastrulating mesoderm and endoderm could move the balls against a maximum force of 0·34 mgm./sq. mm.