(b) Compare the relative efficiency of hydrostatic (manometric) pressure, and osmotic pressure including vapour tension in producing flow of water through a membrane.

(Dem.) A column of distilled water (say 4½ – 5 feet = mean arterial pressure of man) is supported in a glass tube by a strong membrane e.g. frog's skin. Measure the rates of exudation when the membrane is exposed externally to (1) distilled water; (2) the atmosphere, (3).3N KNO_3 (o.p. of blood) and calculate the rates due to the different forces separately.

(c) For the rôle of the osmotic pressure of colloids in preventing the escape of water from the blood vessels, and the use of gum acacia in intravenous injections to replace blood lost, see Bayliss Intro. p. 140.

10. Periodicity [Cf. A:1]. The lamination in starch grains, due to periodicity of growth (alternating water-rich layers). Dehydrate: no lamination.

How far the analogy holds as between the above is a matter of doubt. See however Bechhold (above cited), LeDuc ; Theorie physico-chemique de la vie, where other analogies are also mentioned.

SYNOPSIS VI.

DIGESTION. ROLE OF ENZYMES.

Lit. Bayliss, pp. 365-6, 372; Reynolds Green, "Soluble ferments and fermentation".

A. EXPERIMENTS IN DIGESTION OF STARCH

Food materials are presented to protoplasm generally in an insoluble, or if soluble, indiffusible (colloidal) condition. Digestion reverses these conditions. As a typical substance **starch** will serve.

1. Emulsoidal Solution.

Note that starch is insoluble in cold water but makes an emulsoidal complex in hot water. Heat a few starch grains in water on a slide and note the changed condition, using iodine to produce visibility in the miscroscope.

Large starch grains (potato or arrowroot) are placed in water on a slide and heated till swollen. Covere with a cover glass, run under diastase and observe the action on the grains.

2. Digestion.

Put some starch grains in a vial with a few c.c. of diastase for several hours, then examine to find evidence of attack of enzyme on starch in form of erosions.

Similar and extensive erosions may be seen in banana pulp if ripe. Compare cells of unripe and ripe bananas. Test small bits of pulp with Fehling's solution for reducing sugars.

3. Solubility Resulting.

Starch paste as an emulsoid is indiffusible. Test this by means of osmoscope, setting up a duplicate starch plus diastase. Place osmoscopes in shell vials with water. Test the dialysate after an interval for sugars, using a very small amount of Fehling's so as to avoid colour masking. An exceedingly small amount of sugar may be detected nephelometrically if the Tyndall effect is made use of. When positive results have been obtained, test for starch. Note red colour.

4. Stages in Digestion.

Pour some gelatin mixed with starch paste into a vial. After it has set add diastase and allow to stand for 24-48 hours. Note clear zone due to digestion of starch. The experiment may be varied by spreading a gelatin starch film on a glass slide and after it has set placing on it a drop of diastase solution. Diffusion may be observed after two hours. Iodine differentiates a violet zone between the completely digested and still unaffected starch. (Wijsman 1890. See Green "Soluble Ferments and Fermentation" p.59)

5. Diffusion of Enzymes.

Ferments are considered to be colloidal. Note however diffusion into gelatin occurs.

6. Temperature Relations.

Test the sugar reaction after the same period when mixtures of starch paste and diastase are kept at room temperature and 60°C respectively, all other conditions being alike.

Note that when heated to about 80°C. diastase loses its power.

The activity of ferments is minimum, maximum, and minimum at minimum, optimum (60°) and maximum temperatures respectively.

7. Inactivation.

In addition to effect of temperatures such as inactivate (kill) protoplasm, other reagents e.g. tannin and alcohol have been noted to have an inhibiting effect.

B. APPLICATIONS. (1) The general behaviour of ferments as such is well illustrated by diastase. (2) The conditions which necessitate digestion are duplicated. (3) Enzymes may be considered as approaching protoplasm in their characteristics.