4. **Adsorption of pigments and stains.**

(*a*) Observe that colouring matter is held in haematocytes and plastids (e.g. chloroplasts) by adsorption. Evidence for this: (i) Treat haematocytes with water, or saponin in normal salt and (ii) plant cells containing chlorophyll, with alcohol. (Make microscopic mounts to see these experiments.) Observe carefully the stromata remaining after the release of the pigments. Mount haematocytes in solutions of dyes, in physiologically normal NaCl. Do they stain ? Heat slightly and note results.

(*b*) Expose living Spirogyra or other suitable material to weak solutions of dyes, e.g. methylene blue, eosin, Congo red. Does the cell wall adsorb these dyes ? Does the (living) protoplasm ? After staining place the filaments in water. Is the stain removed ? Kill in any other manner you may choose and test these dyes, noting result.

(*c*) The cut or broken surface of muscle and nerve fibres absorb certain dyes, e.g. neutral red, Congo red, which are not adsorbed by the rest of the surface—(electrolytes relieved at cut ends change the sign of charge on dye.)

If filaments of Spirogyra are allowed to lie in a solution of methylene blue, this pigment is adsorbed by a body in solution in the sap. Tannic acid is present. Pfeffer states that another body (albumin) is also present (Pfeffer, 1886). The above solution must be very weak, i.e. very light blue, the colour scarcely perceptible.

(*d*) Tannic acid is adsorbed by a cellulose-like body in certain cells. Tannic acid is soluble in water.

Treat tannin cells from the pulp of banana fruit with ferric chloride, and compare with result on adding reagent to tannin solution under the microscope. (Lloyd 1912, see Dekker, Die Gerbstoffe, 1913).

SYNOPSIS III

COLLOIDAL STATE

Colloidal Systems

Heterogeneous or discontinuous systems—Diphasia.

Make the following suspensions (resp. emulsions). Observe Tyndall (Faraday) effect.

1. External Gas Internal Liquid — cloud of steam (H_2O in air)
2. " " " Solid — smoke (carbon in air)
3. " Liquid " Gas—aerated water, foams: soap, gelatin, albumin, saponin.
4. " " " Liquid—emulsions e.g. oil in water. Alcohol solution of oil poured into H_2O; or disperse by shaking, stabilise by hydrophile emulsion (gum, acacia, soap).
5. " " " Solid — suspensions
   (i) Coarse suspensions; properties. Experiments with sand and beads in water.
   (ii) Ultramicroscopic examination of colloidal suspensions. Gold, carbon, gamboge, arsenious sulphide.
6. Ext. Solid Int. Solid — ruby glass: gold susp. etc.
   Emulsoids, Hydrophile colloids.
   Ext. liquid (H_2O) Int. solid with imbibed liquid (H_2O) or vice-versa: gelatin, agar, casein, albumin, gum acacia.

Properties of Colloids

A. PHYSICAL EXAMPLES

1. Diffusibility: The relative diffusibility of colloids and crystalloids:

Using a small dialyser (gut tied over flanged end of a glass tube) dialyse (Thomas Graham, Philosoph, Trans. 1861) a mixture of starch paste and of NaCl. Test the dialysate for both substances (iodine and AgCl.) Note that care is necessary in this experiment, aq. dist. being used throughout.

Repeat the above with egg-albumin instead of starch.

2. Phase relations; viscosity.

(a) **Demonstration.**

Physical properties of a mixture of sand, etc. and water.

(b) **The effect of the viscosity of the external phase on Brownian movement, and on sedimentation.**

Make suspensions of carmine (or other suspensoids) in gum arabic of different concentrations (from 5% downwards).

(1) Observe the amplitudes of Brownian movements microscopically. (Note that this is to be done also ultramicroscopically with smaller suspensoids.)

(2) Cf. amplitude of movement when the slide is heated to various degrees.

(3) Allow the preparations to stand to permit sedimentation, and note the rate at which this occurs.

(c) **The stabilization of a diphasic system; the viscosity of such a system.**