enlargement of the heart, rapid auricular fibrillation and heart failure with congestion was relieved by taking digitalis. When digitalis was withheld congestion recurred. Three attacks of heart failure were observed; on each occasion fever was present during the period of failure. No evidence of infection was obtained.

A comparison of skin and rectal temperatures during and after recovery from heart failure showed uniformly that during failure, the temperatures of the skin, more especially those of the extremities, were lower, that of the rectum higher than after recovery. When improvement had taken place, the surface temperatures were closer to each other and closer to the rectal temperatures. The thermal gradient from the interior to the surface of the body was greater during heart failure than after recovery.

This state of affairs is different from that observed in infections in which fever is present in persons whose circulation is supposedly normal for, as is well known, the skin under these conditions suffers an elevation of temperature. The inference which has naturally been drawn is that the elevated rectal temperature in heart failure is due to the difficulties which the embarrassed circulation encounters in distributing properly the heat which is produced within the body.

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Relation of Absorption Coefficients to Rate of Penetration of Dye into the Cell.

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Crystal violet penetrates slowly into the vacuolar sap of *Nitella*. Is this connected with the presence of 0.1 M KCl in the sap? To what extent can such an effect be interpreted by the multiple absorption coefficient theory? This theory deals only with rates and steady states (not with equilibrium); its basic principle is as follows: Other things being equal the rate of penetration of dye into the sap is a function of the concentration gradient (D'_o—D'_s) of the dye in the plasma membrane: D'_o and D'_s represent the concentrations of dye in the plasma membrane at the outer and inner phase boundaries, and are functions of the absorption coefficient* of the dye between the plasma membrane and the aqueous solution at the

* The absorption coefficients may represent solubility or chemical combination or both.

outer and inner phase boundaries. The rate is also a function of the diffusion coefficient of the dye in the plasma membrane.

The following experiments were made to test these conceptions. Employing a cell model[1] consisting of chloroform (representing the plasma membrane) placed between crystal violet (0.04%) at pH 5.5 and artificial sap at pH 5.5 (representing the vacuolar sap) the passage of dye through the chloroform into the sap during one hour was determined colorimetrically. Absorption coefficients were determined by shaking chloroform with the dye solution or with the sap; these are, C_o = conc. of dye in chloroform/conc. of dye in external dye solution, and C_s = conc. of dye in chloroform/conc. of dye in sap.

Results. (1) When $C_o = C_s = 6$, with no KCl in the dye solution or in sap, the rate of penetration of dye into the chloroform and from chloroform into the sap is relatively rapid. The rate is doubled when the concentration of dye in the dye solution is doubled. (2) When $C_o = 6$ and $C_s = 920$, with 0.1 M KCl added to the sap alone, there is no penetration of dye into the sap. The rate of entrance of dye into the chloroform from the dye solution is somewhat less than in (1). (3) When $C_o = 920$ and $C_s = 6$, with 0.1 M KCl added to the external dye solution alone, the dye enters the chloroform and the sap very slightly faster than in (1) but this increase is small as compared with the increase in C_o. (4) When $C_o = 920$ and $C_s = 920$, with 0.1 M KCl added to the dye solution and to the sap, there is no penetration of dye into the sap. The rate of entrance of dye into the chloroform is slightly less than in (3).

These results suggest the following possibilities: (*a*) Addition of 0.1 M KCl to the sap increases the value of C_s, thus decreasing the concentration gradient of the dye in the unstirred layer of the chloroform at the inner phase boundary, which in turn decreases the concentration gradient of the dye in the corresponding layer at the outer phase boundary. *(b)* The rate of diffusion of the dye in the chloroform may be also lowered by KCl owing possibly to the formation of colloidal dye by KCl. (*c*) These 2 changes (*a* and *b*) will reduce the rate of entrance of dye into chloroform from the dye solution as well as that of dye from chloroform into the sap. They will also decrease the effect of the rise in the value of C_o (which would tend to increase the rate by increasing the concentration gradient of the dye in the chloroform).

The slow rate of penetration of crystal violet into the sap of *Nitella* cells may be partly explained on this basis, since the sap con-

[1] For description see Irwin, M., PROC. SOC. EXP. BIOL. AND MED., 1928, **26**, 135.

tains 0.1 M KCl. But with *Nitella* a slightly soluble dye compound is formed in the sap which would tend to produce a more rapid rate of penetration than would otherwise be the case. Thus if sodium tannate is added to the artificial sap containing 0.1 M KCl, the rate of penetration of dye into the sap is hastened, owing to the formation of slightly soluble dye tannate in the sap.

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Cell Models Representing Various Types of Living Cells.

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The behavior of a variety of cells can be roughly imitated by models[1] consisting of a non-aqueous substance (representing the plasma membrane) placed between dye solution and artificial sap (representing vacuolar sap). The rates of penetration of dye into the sap are compared during one hour. The range of pH values studied is between pH 5 and pH 9.

(1) *When chloroform[1] is used as the membrane.* (*a*) Penetration of dye from cresyl blue solution at pH 9 into the sap at pH 5 has a high temperature coefficient ($Q_{10} = 2.3$ between 15° and 25°C.) This may depend on the change in the viscosity of chloroform. A similar explanation may account for the high temperature coefficient in the penetration of the dye into the sap of *Nitella* and *Valonia.* (*b*) From cresyl blue solution at pH 9 the dye accumulates rapidly in the sap at pH 5 as in *Nitella.*

(2) *When aniline is used as the membrane.* (*a*) The higher the pH value of the cresyl blue solution and lower the pH value of the sap, the more rapid is the rate of penetration and accumulation of dye in the sap. From the solution at pH 9, the dye passes into aniline chiefly as the dye base and upon reaching the sap it is converted to the dye salt. From the solution at pH 5 the dye passes into aniline chiefly as dye salt. (*b*) The lower the pH value of a phenol red solution and higher the pH value of the sap, the greater is the rate of penetration and accumulation of dye in the sap. The dye accumulates rapidly in the sap at a high pH from phenol red solution at low pH; the dye passes into aniline as free acid (yellow) and is converted by the sap to the dye salt (red). This may explain the accumulation of phenol red in the vacuoles of some cells of kidney tubules.

[1] For description see Irwin, M., PROC. SOC. EXP. BIOL. AND MED., 1928, **26**, 135.