

sodium or calcium chloride, exert a compensatory effect upon one another, is almost the same as that in which the electrolytes in question exert antagonistic or compensatory effects on one another in biological systems.

In some recent papers (*Zeit. anorg. Chem.*, 142, 345; 149, 139, 1925; *Jour. Phys. Chem.*, 29, 517, 1925) I have examined the behaviour of several colloidal solutions from this point of view, and have shown that a general explanation for all these cases of ionic antagonism is that the similarly charged ion goes to stabilise the suspension, which effect is antagonised by the presence of a coagulating ion. The equilibrium in biological systems, the inversion of emulsions, and the coagulation of colloids in the presence of mixtures of salts can all be explained from this simple view, which is also supported by experimental facts.

The effect of such non-electrolytes as the organic anaesthetics in antagonistic experiments is similar to the salts of calcium, as has been shown by Lillie and others. In these cases we are dealing with the coagulating effect of the non-electrolytes on the dispersoid system. Thus it is now known that copper ferrocyanide membranes, which also show under suitable conditions a reversible variation in permeability like protoplasmic membranes, can be coagulated by means of propyl and other alcohols, but in the presence of membrane-forming materials the coagulation of the membrane is retarded. This is to be attributed to an antagonism between the non-electrolyte and the electrolyte in question. Consequently a general statement of the observed antagonism in diphasic systems is that *all antagonistic actions occur between a peptising agent and a coagulating agent*. This antagonism need not be confined to two electrolytes only, but may occur between an electrolyte and a non-electrolyte. If the concentration of one of these is constant, then at a particular concentration of the other the whole system will be in equilibrium. In freely reversible systems the equilibrium ratio of these will be approximately constant, but this cannot be expected in systems which are irreversible. In the case of ionic antagonism, it has been found that the adsorption of similarly charged ions stabilises the suspension towards another coagulating ion and naturally, therefore, the nature of the electric charge on the surface of the dispersoid or emulsoid particles in the case of physiological systems must be of fundamental importance in showing a variable permeability under different conditions.

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Lightning.

DR. SIMPSON'S rejoinder accompanying my recent letter (*NATURE*, August 7) indicates that I have signally failed to convey to him the ideas which I endeavoured to present. For this I am sorry. A more detailed discussion, being inappropriate for these columns, will be presented elsewhere, but two items of his rejoinder should be mentioned here and now. Dr. Simpson quotes and by implication interprets an isolated sentence. I fail to see how this implied interpretation can be considered to be compatible with the remainder of the paragraph from which the sentence was taken. Second, he is quite mistaken in thinking that the electronic darts which I pictured are but little different from the negative discharges which he considered. His discussion of the latter contains no suggestion of such darts.

N. ERNEST DORSEY.

August 17.

DR. DORSEY complains that my interpretation of the sentence which I quoted from his letter is incompatible with the remainder of the paragraph from which it was taken. If this is so it is not my fault, for the paragraph in question contains the two following incompatible sentences: "the branches are not outgrowths from the trunks but ingrowths to it" (which is the sentence I quoted), and "a branch may grow in length and may branch."

I can assure Dr. Dorsey that I did my best to understand his difficult letter and to explain the points in which his theory appears to differ from mine. I cannot, of course, expect him to agree with me, but I regret that he considers that he has cause for complaint.

G. C. SIMPSON.

August 31.

The Absorption Spectrum of Formic Acid Vapour in Relation to Molecular Associations.

THE absorption spectrum of formic acid vapour at room temperature and above (to 145° C.) consists of about thirty-five bands, lying between $\lambda = 2565$ and 2250 Å.U.; at the ultra-violet end of this band spectrum there appears to be a continuous absorption.

The law of distribution of practically all the bands may be represented with close approximation by the formula:

$$\frac{I}{\lambda} = 41700 + n \cdot 1050 + p \cdot 385,$$

where $n = -2, -1, 0, +1, +2$ and $p = -7$ to $+7$.

The null-band ($n=0, p=0$) is the strongest band and corresponds to

$$\lambda = 2398 \cdot 0 \text{ Å.U.}, \quad \frac{I}{\lambda} = 41700 \text{ cm.}^{-1}$$

There are two fundamental periods of atomic vibrations in the molecule, $\alpha = 1050$ and $\beta = 385 \text{ cm.}^{-1}$. It is important to mention that the larger fundamental period is of the same order of magnitude (about 1000 cm.^{-1}) as is obtained for a number of molecules with a C-O group: formaldehyde (V. Henri and Shou, $\alpha = 965 \text{ cm.}^{-1}$), diacetylene (V. Henri and L. Light, 1100 cm.^{-1}), paraquinone (V. Henri and L. Light, 1110 cm.^{-1}), benzaldehyde (V. Henri and Almasy, 945 cm.^{-1}), furfural (V. Henri and Almasy, 1080 cm.^{-1}), acrolein (V. Henri, 1260 cm.^{-1}), phosgene (V. Henri and Howell, 902 cm.^{-1}). In the infra-red there is a strong carbon monoxide band at $\lambda = 9 \cdot 2 \mu$, $1/\lambda = 1087 \text{ cm.}^{-1}$. It is therefore quite probable that this period 1050 cm.^{-1} of formic acid vapour corresponds to the vibration of the oxygen relative to the carbon atom.

With increasing temperatures (using a constant mass of 60 mgm. in the absorption tube, between the room temperature and 145° C.) the absorption limit approaches the visible, and more bands of the same kind appeared towards the visible end of the spectrum.

The simplicity with which the above formula represents all the bands leads to the belief that these bands are due to the absorption of one kind of molecular species. The fact that at elevated temperatures the number of single molecules (HCOOH) is much increased, while the number of double molecules (HCOOH)₂ is decreased, leads to the conclusion that the banded absorption spectrum is due to the single molecules. (At 145° C. the ratio of single molecules to double is about 7 : 1, and at the room temperature it is about 0.3 : 1.)

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