

been accumulating. The detailed account will appear elsewhere.

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Density of Propionic Acid Solutions in Water.

IN an experiment for the observation of the Faraday rotation of fatty acid solutions in water the density of the solution of propionic acid for different concentrations was determined as no detailed result for this is given in the *I.C.T.*¹ Some previous works, however, are referred to in those tables, but as far as the old literature could be consulted no systematic and exhaustive work seems to have been done in this direction. Thus Wilsdon and Sidgwick² give experimental values for only three low concentrations (from 1.945 to 10.28% of acid by volume) together with three other interpolated values for about the same range. Drucker³ has also given results for eight different concentrations low and high, of which only two are for concentrations beyond 50%. Thus, it was necessary to make some fresh and systematic determinations.

All measurements were made at 25°C. and the variation of temperature was about ± 0.02 . A specific gravity bottle of 50 c.c. capacity was employed for density determination. The results are given in the table below (Table I) and also plotted in the graph. It is found that the density of the solution goes on increasing with the addition of the acid, but after reaching a maximum for about 51.2% of the acid (by volume), it decreases gradually. It is to be noted that the maximum density occurs at about a concentration when the acid and the water are mixed in equal quantities by weight. The phenomenon is also supported by the fact that in observing the Faraday rotation, the intensity of the light passing through the solution considerably diminishes at this concentration in comparison with concentrations higher and lower.

In the graph dots give the results of the present experiment and the small circles the Drucker's values. Of the latter, the value

of the density for 74.01% of the acid (by volume) is rather high.

The Faraday rotation of the solution, however, does not show any maximum but goes on increasing with increase in the percentage of water, although it does not conform to the Schonrock-verdet mixture rule.

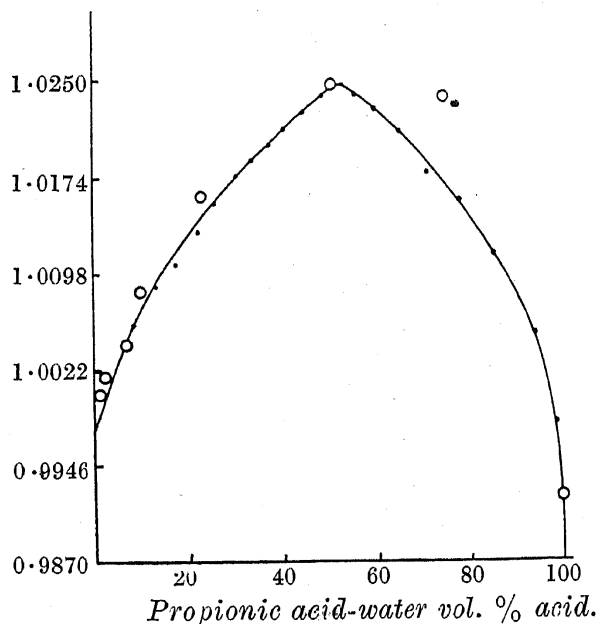


TABLE I.

Concentration % by volume	d_4^{25}	Concentration % by volume	d_4^{25}
7.098	1.0060	48.08	1.0244
11.36	1.00862	52.91	1.0250
15.91	1.01094	58.21	1.02370
20.69	1.01354	64.04	1.0222
24.84	1.01584	70.47	1.0186
29.85	1.01784	76.95	1.01624
32.84	1.01921	83.97	1.01204
36.11	1.02046	92.39	1.0058
39.73	1.02190	98.01	0.9882
43.70	1.02310		

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The Number of Microsporangia in each Stamen in *Asclepiadaceæ*.

THE available literature on the family, *Asclepiadaceæ*, discloses the fact that this family is characterised by the presence of only two microsporangia in each stamen. Frye,¹ however, expresses his doubt on this fact and appears to hint at the possibility of the existence of four microsporangia

¹ *I.C.T.*, 3.

² Wilsdon and Sidgwick, *J. Chem. Soc.*, 103, 1959.

³ Drucker, *Zeits. f. Phys. Chemie*, 52, 641.

in the small group, Secamoneæ of Synanchoideæ² where the pollinia in each half anther are paired and the parts adhere closely. With this object in view the study of the following eight genera, each being

represented by a single local species, was taken up. Three genera out of eight, namely, Hemidesmus, Cryptostegia and Cryptolepis, exhibit the presence of four sporangia in each stamen.

Table to show a few important characters in the Floral Organisation of the Species.

Name of Genera	Name of Species	Arrangement of Pollen-mother-cells	Arrangement of Tetrads	Number of Sporangia in each Stamen	Organisation of Pollinium
1. Calotropis ..	<i>C. gigantea</i> ..	Radial ..	Linear ..	Two ..	Well organised
2. Dæmia ..	<i>D. extensa</i> ..	Do. ..	Do. ..	Do. ..	Do.
3. Holostemma ..	<i>H. rheedei</i> ..	Do. ..	Do. ..	Do. ..	Do.
4. Pergularia ..	<i>P. pallida</i> ..	Do. ..	Do. ..	Do. ..	Do.
5. Dregea ..	<i>D. volubilis</i> ..	Do. ..	Do. ..	Do. ..	Do.
6. Hemidesmus ..	<i>H. indicus</i> ..	Do. ..	Do. * ..	Four ..	Do.
7. Cryptostegia ..	<i>C. grandiflora</i> ..	Irregular ..	Tetrahedral ..	Do. ..	Loose mass
8. Cryptolepis ..	<i>C. buchanani</i> ..	Do. ..	Do. ..	Do. † ..	Do.

Whether the sporangia in each case mentioned above are evolved at a later stage of development from a common mass of arche-sporium by the interjection of plates of sterile tissue, as in *Lemna minor*³ or independently from the beginning, is a question still to be solved in some cases. Their independent origin in Hemidesmus, Dæmia, Pergularia and Cryptolepis has, however, been well established, while in the remaining cases their history has been definitely traced upto the very early stages of pollen-mother-cell development. Again, so far studied, neither there is any indication of suppression nor fusion of sporangia at any stage of development from four to two in those cases where two sporangia in each stamen is a rule. From the table given above it may be concluded then: (1) that there are some genera in the family, *Asclepiadaceæ*, which possess four microsporangia in each stamen; (2) that for the organisation of pollinium the radial arrangement of pollen-mother-cells and consequently the linear tetrads are necessary; (3) that the arrangement of tetrads and the number of sporangia are not in any way correlated because *H. indicus* possesses four sporangia while *D. extensa* and others

only two in each stamen, yet the linear tetrads exist in the two groups. Again, *H. indicus* and *C. grandiflora* exhibit four sporangia in each stamen and yet the tetrad arrangement is different in both the cases, i.e., linear and tetrahedral respectively; (4) that for the organisation of pollinium the presence of linear tetrads as has been already said above is necessary and mechanical principle also demands this, hence with some variations here and there, as in *H. indicus*,* all members belonging to the group, *Cynanchoideæ*, where pollinia are well organised, will exhibit linear tetrads, irrespective of their number of sporangia in each stamen.

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* Besides the presence of usual linear tetrads in *H. indicus* there are other variations as well, such as T-shaped and double †-shaped tetrads, etc. A paper on this will shortly appear elsewhere.

† In advanced stages of development the partition between the two adjacent microsporangia, in *C. buchanani*, breaks down resulting in a single loculus. In advanced conditions, therefore, the stamen in this species contains only two cavities.

A Few Important References.

¹ Frye, T. C. "Development of the pollen in some *Asclepiadaceae*." *Bot. Gaz.*, **32**, 325, 1901.

² Willis, J. C. Cambridge Biological Series: "Flowering Plants and Ferns," 1925.

³ Coulter and Chamberlain. *Morphology of Angiosperm*, 2.

The Physics of Olfaction.

NUMEROUS workers since Liégois and Prevost have tried to formulate a physical basis for smell, Teudt's (1919) electronic theory being one of the most recent. It is unlikely that a satisfactory theory would be derived from a consideration of physics alone, owing to the psychological and other factors intimately bound up with the oldest and most neglected of our senses. However, it is not correct to say that no physics of olfaction exists at all.

In 1904 Berthelot suggested that the lower limit of the number of molecules perceptible by smell lay between 10^8 and 10^{11} . Zwaardemaker and Heyninx arrived independently at a figure of the order of 10^9 . Lord Rayleigh, following Töpler and Boltzmann, equated the energy of minimal stimuli of sound and light at about 40 ergs, which, in the case of sound, can be expressed as a change of compression of the order of 10^{-10} atmospheres. Assuming an olfactory inspiration of about 1 cubic inch, this figure is of the same order as the smallest number of odorous molecules which require to be drawn into the nasal passage to excite the sense of smell, as I have shown in the *Perfumery and Essential Oil Record*, **17**, 1926, p. 176.

The quantity of odorous material perceptible to the nose may be inconceivably small when expressed in fractions of a milligram, yet be numerically large if regarded as a number of molecules. The molecules in a cubic inch of ordinary air would form a line many times longer than the circumference of the earth, if they were placed side by side, but a number of molecules perceptible by smell could be strung along a length of less than a meter. For comparison with the intensity of sound stimuli, it may be of interest to mention that a crowd of a hundred thousand persons would need to shout for an appreciable period to emit as much sound energy as would equal the heat in a cup of tea.

Tyndall suggested a theory of odour based upon the heat absorbed by odorous

substances. Grijns in 1919, and the writer more recently, have shown that the heat absorption of essential oils can be referred almost entirely to an adventitious content of water. A physical investigation of odorous substances at the concentrations at which they are perceptible to the nose would require very delicate apparatus, as it would be necessary to deal with partial pressures of considerably less than a millionth of an atmosphere.

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On the Development of the Intervertebral Ligament in Teleostean Fishes.

MACBRIDE¹ in summarising the observation of Ramanujam³ on the development of the vertebral column of herring, states with reference to the formation of the intervertebral ligament that "the notochordal tissue intervening between the chorda centra projects as a series of gelatinous pads which are ultimately transformed into intervertebral ligaments". The various species of teleostean fishes that I have studied so far present, however, a different story altogether.

The sclerotomic cells aggregate round the notochord as perichordal sheath; soon after this, the perichordal sheath of the vertebral portions becomes osseous, while the intervertebral portions remain membranous (Fig. 1). Outside these membranous intervertebral portions of the perichordal sheath, migratory connective tissue cells become arranged side by side into three bands and these enter the membranous portions of the perichordal sheath (Fig. 2). I^{2(a) & 2(b)} have shown how such migratory connective tissue cells enter through the intervertebral portions of the vertebral columns both in Urodela and Anura in order to form ophisthocœlous and procœlous vertebræ respectively. The middle band of the connective tissue cells situated at the intervertebral portions of the teleostean fishes, contributes to the formation of the intervertebral ligaments, whereas the two lateral bands of the connective tissue cells which ultimately become cartilaginous give rise to the formation of the two surfaces of the centrum. This sort of formation of the intervertebral ligaments