

phoresis, and it has been shown that the observed rates of movement, under 6 V./cm., for the C_{10} , C_{12} , C_{14} , C_{16} , C_{18} acids were respectively 4.5, 1.5, 0.33, 0.07 and 0.0017 cm./hr. These observed velocities are presumably the result of the electro-endosmotic flow (approximately 1.6 cm./hr.), a differential adsorption of the acids on paper resulting in a range of R_F values and ionic mobilities of the organic acid anions. When these influences are taken into account, the ionic mobilities would appear to be 42.1, 22.5, 16.4 and 13.9×10^{-5} cm./sec./V./cm. for C_{10} – C_{18} respectively. It is not possible to say directly what the figure for C_{18} would be, because this acid is adsorbed so strongly on paper that we have been unable to determine its R_F value under the experimental conditions employed with the other acids, but the extrapolated value is of the order of 13.0×10^{-5} cm./sec./V./cm.

The above results for ionic mobilities may be compared with the corresponding figures of Gonick⁴ and McBain *et al.*⁵ (see Fig. 1).

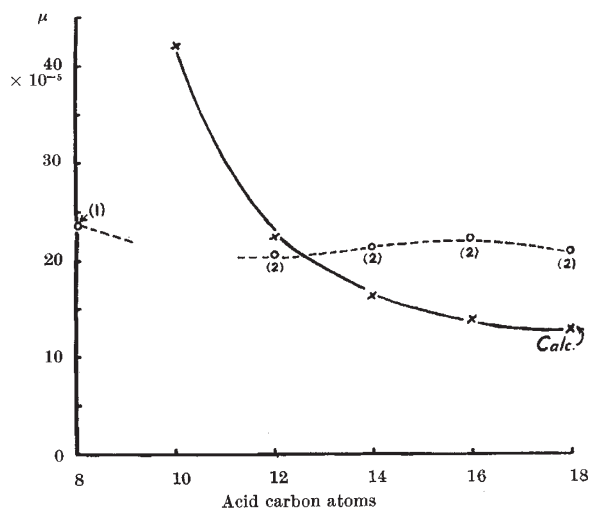


Fig. 1. Ionic mobilities of straight-chain higher fatty acids. x—x, as determined by the electrophoretic method described; O—O, as determined by other workers: Gonick (2); McBain *et al.* (1).

Oleic, elaidic and stearic acids move at similar rates, and no separation of these from one another is possible; but it has been demonstrated, by the above electrophoretic method, that lauric and myristic acids are present in oleic acid B.P. to the extents respectively of 0.04 per cent and 1.5–2.0 per cent. In addition, another acid, so far unidentified, has been found in oleic acid B.P. which moves more quickly than C_{16} and more slowly than C_{14} . The existence of this acid was confirmed by chromatography². A full account of this work will be published elsewhere.

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Production of Electric Power by mixing Fresh and Salt Water in the Hydro-electric Pile

WHEN a volume V of a pure solvent mixes irreversibly with a much larger volume of a solution the osmotic pressure of which is P , the free energy lost is equal to PV . The osmotic pressure of sea-water is about 20 atmospheres¹, so that when a river mixes with the sea, free energy equal to that obtainable from a waterfall 680 ft. high is lost. There thus exists an untapped source of power which has (so far as I know) been unmentioned in the literature.

There are many methods (using osmotic and other forces) which might, in theory, be used for obtaining power by reversibly mixing fresh water and sea-water. In any such process, the extraction of the energy will cool the liquids by a fraction of a degree. The one which appears most practicable depends on the ionic nature of salt and uses membranes (incorporating ion exchange resins) selectively permeable to ions of one sign or the other. If such a membrane separates two salt solutions of different strengths, a potential difference appears across it.

If alternate layers of salt and fresh water are separated by alternate basic and acidic membranes², the membrane electromotive forces (each of order 30 mV.) are effectively connected in series, and an e.m.f. large compared with electrode polarization voltages can be built up.

An apparatus (the 'hydroelectric pile') has been constructed; in it 47 acidic and 47 basic membranes, each 8 cm. square, are separated by 93 spaces each 1 mm. thick. Fresh and salt water pass through a system of holes and washers and flow across alternate spaces between the membranes, and current is led off from compartments at the ends of the pile. A continuous supply of electricity is thus obtained. The fresh water becomes slightly salt during its passage through the pile, and the current drawn from the pile accounts for about 90 per cent of the salt transferred.

The maximum e.m.f. obtained has been 3.1 V.; the membranes used (of polythene mixed with resins based on cross-linked polystyrene) have resistivities higher than those of the pure resins, and give the pile an internal resistance of about 250 ohms at 10°C. The maximum external power obtained has been 15 mW. (at 39°C.).

The internal resistance is higher, and the power output is lower, at low temperatures. The pile is therefore likely to be more economic in a warm and equable climate. Its economics probably hinge on the time for which it will run before the membranes need replacing or the interior needs cleaning; the present pile has run satisfactorily for three months on $N/2$ sodium chloride solution and tap water.

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