cent of the total space. The tendency is always for narrower places to fill first with water, which has the effect of trapping bubbles in the larger cavities. These bubbles may be made to rise to the surface by jarring the flooded material. The increments of moisture take place at lower values of pressure deficiency than those for decreasing moisture, so that the suction–moisture curve when plotted passes round a hysteresis loop.

A fuller treatment of the subject, particularly in relation to soil studies, has been given in the *Journal of Agricultural Science* (**17**, p. 264; 1927).

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Theory of Electrical Migration of Ions.

THE object of this note is to show that the theory of moving boundaries as developed by Kohlrausch and Weber overlooks the unequal transfer of the common ion at the boundary and consequently rests on a misconception of the conditions on the 'indicator' side of the boundary. For a stable boundary it is necessary that the slower moving ion follows the faster moving one and both should move at the same speed. This happens when the concentrations of the two electrolytes *AR* and *BR* on the two sides of the boundary are related as in the equation (1) $\alpha/n_A = \beta/n_B$, where α and β are respectively the concentrations of the electrolytes *AR* and *BR*, and n_A and n_B are the transport numbers of the ions *A* and *B* in the electrolytes *AR* and *BR*.

In deducing this relation it is assumed that the electrolytes are completely dissociated and that the ionic mobilities are constant and independent of the concentration. Kohlrausch's differential equations are only true for continuous transitions of concentrations in the liquid through which an electric current is passing, and cannot be extended as such to the discontinuous transition at the boundary between *AR* and *BR*. Both Kohlrausch and Weber recognise this. Of discontinuous transitions they consider in detail the transference of ions across boundaries between two concentrations: (i) of a single electrolyte *AR*, and (ii) of a mixed solution of several electrolytes with a common ion.

The fundamental assumption of Kohlrausch is the validity of Ohm's Law at all points in the electrolyte, and Kohlrausch shows that the total number of ions of any sign entering or leaving a layer during the interval *dt* is the same whether the change in concentration is continuous or discontinuous. Both Kohlrausch and Weber conclude that they are justified in treating discontinuous transitions, including that at the boundary between *AR* and *BR*, as being a limiting case of continuous transitions, and the mistake which has been overlooked since then consists in considering that the differential equations are applicable to the boundary between *AR* and *BR*.

Let us consider a cylindrical tube of unit cross-section containing the boundary and assume that the electrodes are situated at a great distance such that the products of electrolysis do not enter the tube. The concentration of the two electrolytes are related as in equation (1). Now, if a current passes through the tube, there will not be any mixing of the ions *A* and *B*, and the condition of electrical neutrality underlying the validity of Ohm's Law would be maintained at and in both sides of the boundary had it not been that more of the ions *R* leave the layer of the electrolyte *BR* just contiguous to the boundary than enter it from the layer *AR*. In other words, there will be an excess of ions *B* in this layer, which means that Ohm's Law cannot be valid. As a result of this there would be a drag and an adjustment of potential gradient, which for the steady state would mean an equal number of ions *R* entering and leaving the same layer during the interval *dt*.

The magnitude of the excess is obviously given by $i.\{(n_R)^{BR}(n_R)^{AR}\}$, where the terms within the brackets are respectively the transport numbers of the ion *R* in the electrolytes *BR* and *AR*. Overlooking for the present the consequent drag on the ions in this layer, we find that a layer of thickness which is equal to $H \,.\, V_R.\ dt$, where *H* is the potential gradient, in the layer *BR*, and V_R is the mobility of the ions *R*, will be depleted of all the ions *R* if we put in these equations the current densities and concentrations used in such experiments. In contrast to the condition in the layer *BR*, the *A* ions always move in a 'uniform ionic environment,' as the ions *R* which move past them always come from the layer of electrolyte *AR*, and the number thus crossing past the ions *A* are little, if at all, affected by the drag on the *BR* side of the boundary.

This consideration also explains why it is necessary to distinguish the electrolyte with the slower moving ion as the 'indicator' solution. This distinction is based on experience, but is not contemplated in the theory of Kohlrausch and Weber. These considerations also explain the observations of Steele, of Abegg and Gauss and subsequent workers, that equation (1) is not sufficient to define the conditions of a sharp boundary even when proper precautions have been taken against the disturbances resulting from the heating effect of the current and from the differences in density. MacInnes has in recent years shown that the adjustment of concentration postulated by Kohlrausch takes place only within a small range of concentrations. A paper containing a fuller treatment has been communicated for publication.

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Porbeagle Shark in the River Towy.

ON Oct. 2 I had a letter from Mr. George M. King, Superintendent of Water Bailiffs for the River Towy Fishery District, recording the capture of an unusual fish in the Towy on Sept. 30. He enclosed a photograph, here reproduced (Fig. 1), from which it was clear that the fish was *Lamna cornubica* Gm., the Porbeagle shark. At my request the fish was afterwards sent on to the National Museum of Wales, where it will be mounted.

There are, of course, not a great many definite records of the Porbeagle round our coasts, though the fish is probably not uncommon in some areas. Day, in "The Fishes of Great Britain and Ireland," gives about twenty-four records for Great Britain and five for Ireland. Dr. J. Travis Jenkins, in "The Fishes of the British Isles" (1925), adds several more.

As regards Welsh records, Pennant described one from the Menai Straits, whence the species has sometimes been called the Beaumaris shark; one was washed against a pier at Swansea in a storm in October 1835 (Dillwyn), and picked up nearly dead; J. J. Neale, in a paper entitled "Surface Fishes of the Bristol Channel" (*Transactions of the Cardiff Naturalists' Society*, vol. 21, part I.; 1889), lists the Porbeagle, but does not refer to any particular instance of its occurrence; Walton, Fleure, and Wright, in an account of the fauna of Cardigan Bay,[1]

[1] "Aberystwyth and District"; a guide prepared for the Conference of the National Union of Teachers, 1911.