The equation represents data on a number of non-ideal binary mixtures[2,3,4] (showing different types of curves) quite satisfactorily, as will be apparent from a perusal of Table I which gives data for typical cases of good, fair and bad fits. In some cases, the equation agrees with data within much closer limits than other equations (McLeod,[4] Spells,[5] Srinivasan[6]). Thus, for the remarkably non-ideal mixture ethyl alcohol-water, which is not satisfactorily represented by any equation, the maximum divergence with the present equation is 9·7 per cent., as against 18·8, 18·1 and 18·0 per cent. for the other equations mentioned. Fig. 1 shows graphically the percentage divergence from experimental values (for each equation) plotted against composition of the mixture and the curves clearly demonstrate the superiority of the present equation.

TABLE I

Weight per cent. (first component)	Density	η (observed)	η (calculated)	Per cent. difference
Good fit : Pyridine-Benzene : Curve almost linear : $m = 0$.				
0	0·87374	0·006038	0·006038	0
39·73	0·91444	0·007169	0·007059	1·5
59·35	0·93465	0·007726	0·007579	1·9
79·64	0·95564	0·008345	0·008264	0·9
89·77	0·96600	0·008601	0·008367	2·7
100	0·97832	0·008775	0·008775	0
Fair fit : Pyridine-Ethyl alcohol : Curve shows minimum : $m = -1$.				
0	0·79037	0·011532	0·011532	0
29·92	0·84317	0·010340	0·010044	2·9
49·97	0·88449	0·009591	0·009136	4·7
66·07	0·92418	0·008792	0·009077	−3·2
79·96	0·94564	0·008773	0·009107	−3·8
100	0·97832	0·008775	0·008775	0
Bad fit : Ethyl alcohol-Water : Curve shows maximum : $m = 2$.				
0	0·99973	0·01308	0·01308	0
10	0·98393	0·02179	0·01967	9·7
20	0·97252	0·03165	0·02901	8·3
30	0·95977	0·04050	0·03833	5·3
40	0·94238	0·04390	0·04278	2·5
50	0·92162	0·04180	0·04202	−0·5
60	0·89927	0·03770	0·03822	−1·3
70	0·87602	0·03268	0·03315	−1·4
80	0·85197	0·02710	0·02731	−0·8
90	0·82654	0·02101	0·02119	0·8
100	0·79784	0·01466	0·01466	0

The constant m in the equation ranges between +4 and −4 in the cases examined and is 0 for mixtures showing almost linear or slightly sagged curves. The corresponding constant in Srinivasan's equation assumes very high values, varying from +16 to −18·5. As compared to McLeod's two-constant equation, the present equation has one constant only.

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* This work was done in the Chemical Laboratory, Science College, Patna.

A SIMPLE INEXPENSIVE HAND MICROTOME

IN experiments on suction pressure, permeability and rate of uptake of salts and water by plant cells use is often made of thin discs of potato tuber, carrot, etc.[1,2,3] It is essential to minimize the time lag necessary for the different layers of cells to reach the same stage of water uptake by using sufficiently thin discs of uniform thickness.

In the course of work on the oxidation of potato tubers at this Institute a simple hand-microtome illustrated in Fig. 1 was developed. It consists of a cork-borer, 1–2 cm. in diameter, fitted with a glass plunger which is calibrated into 1·0 mm. marks. The scale is drawn on a piece of paper and introduced into the glass tube. Melted paraffin is then poured into the tube to hold it in position.

In order to operate the apparatus the glass plunger is removed from the cork borer and a symmetrical cylinder of potato tuber is bored out. The plunger is then introduced into the cork-borer and pushed sufficiently in to make contact with the lowest end of the cylinder of potato tuber contained in the cork-borer. The plunger is now pressed in so that the cylinder of potato tuber juts out at the upper end of the borer. A sharp blade is held in level with the rim of the cork-borer and with a quick horizontal sweep a disc is cut from the exposed end of the potato cylinder. First two or three cuttings are discarded as the discs are likely to be uneven. Thereafter the plunger is pressed in gently 1 mm. at a time and discs are cut.

Mean fresh weight per disc in mg. is given for six experiments (each with 25 discs) in table below:—

Mean weight per disc (mg.)

Expt. No.	*Disc wt.*
1	142
2	136
3	138
4	140
5	138
6	133

The agreement appears to be fairly good.

This apparatus has the following advantages over a standard hand-microtome which is generally used by research workers engaged on problems of permeability and absorption and accumulation of solutes by living plant cells: (i) It is simple and inexpensive in design; (ii) in the case of a hand-microtome the soft tuber material will have to be either unsupported or mounted in pith which often leads to uneven cutting. The cork-borer used in

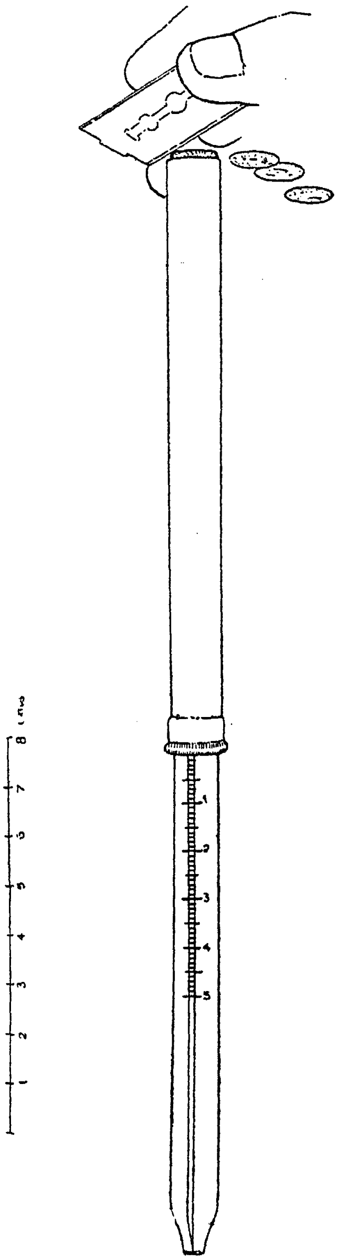

FIG. 1

this apparatus, on the other hand, gives a good support to the material during the process of cutting discs thus ensuring a fairly uniform surface.

For the above-mentioned experiments it is of course necessary to have as thin and even a disc as possible. The ideal condition would be to have only one layer of cells as pointed out by Baptist. It is, however, very difficult in practice to achieve this without injuring the cells. The difficulty is obviously overcome by cutting discs having four or five layers of cells which have been found to sufficiently minimize the time-lag necessary for the different layers of cells to attain equilibrium.

As use of a razor or a razor blade is common to the present arrangement as well as to any standard hand-microtome available in the market the uncertainties of the personal factor are likely to affect the evenness and contour of the cut surface. This constitutes a serious drawback in instruments of this nature.

This defect can, however, be remedied by making use of a mechanical device for cutting sections. Attempts are being made at this Institute to make a hand-microtome with a mechanical device for cutting sections.

In the meanwhile it is hoped that this simple device will prove useful to research workers as well as to teachers for practical demonstration work in physiological laboratories.

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December 5, 1946.

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A MICRO-GLASS ELECTRODE FOR pH DETERMINATION

ATTEMPTS[1,2,3,4,5] have been made from time to time to construct glass electrodes of suitable designs. They, however, suffer from serious disadvantages such as difficulties in cleaning and filling, leakage paths necessitating thorough insulation, requirement of 20 to 30 ml. of liquid of unknown pH, high resistance of the system, etc. Claff[2] has recently devised a glass electrode for determination of pH of small quantities of culture media. Great care has to be exercised in preventing air bubbles from vitiating pH measurement with such a glass electrode.

In the course of physiological work on soil-plant growth, a need was felt for designing a glass electrode which could be used with very small quantities of plant extracts. Essential details of such an electrode are featured in Fig. 1.

The conducting membrane *g* (about 25 μ in thickness) is blown in the form of a small cup (15 mm. diameter, 7 mm. depth) in the upper region of an eccentrically blown bulb of (Corning 015) glass of high conductivity which is itself quite thick-walled. The total capacity of the cup is about 1 ml. The bulb is filled with a saturated solution of quinhydrone in 1 N HCl. Contact is made by a platinum wire connected with the gold plated terminal T_1. Contact between the liquid of unknown pH and the saturated calomel electrode C is made by means of the KCl-bridge D in such a manner that the end of the tube rests just above the glass membrane *g*.

Method.—A Cambridge Direct Reading pH Meter calibrated for a range of 14 pH units (Cambridge Instruments for Hydrogen-ion measurements List, No. 108) was found to be suitable in combination with the above electrode system. The standardization of the instrument is checked at frequent intervals.