that exposure to high frequency radio energy has not denatured the proteins of the contractile system. The possibility that this might occur due to resonant absorption of the dry proteins[6] led to the abandonment of the use of microwaves which were employed in the preliminary phases of this study[7]. Most routine drying of tissue and plasma proteins can be done in the temperature range of efficient heating for these wavelengths although it is somewhat high to prevent completely the formation of histological artifacts. If the same relationship exists between wavelength and temperature of maximum absorption as exists in silica gel[4], then the use of an oscillator generating longer wavelengths should be capable of heating tissues at lower temperatures. Even with the present equipment it has been possible to reduce the time required to reach complete dryness by more than one half, as indicated by a modification of the technique described by PATTEN[8].

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*Department of Anatomy, Western Reserve University, Cleveland (Ohio), June 12, 1958.*

*Zusammenfassung*

Die dielektrische Heizung mittels 30-cm-Funkwellen kann gebraucht werden, um die Trocknung von biologischem Material in gefrorenem Zustand zu beschleunigen. Diese Wellenlängen heizen nur jenen Teil des Materials, welcher Wasser enthält, und erwärmen oder verletzen das trockene Material nicht.

[6] B. COMMONER, J. TOWNSEND, and G. E. PAKE, Nature *174*, 689 (1954).
[7] A. L. HOPKINS, Anat. Rec. *127*, 310 (1957).
[8] S. F. PATTEN, JR., and A. L. HOPKINS, Exp. Cell Res. *14*, 647 (1958).

## PRO LABORATORIO

### A Convenient Cell for the Determination of the Electrophoretic Velocity of Microscopic Particles

Two forms of cell have been commonly used for determining the electrophoretic velocity of suspended particles by the microscopic method. The all-glass *flat* cell of ABRAMSON[1] is excellent but is very difficult, and therefore expensive, to construct and is fragile. (*Cemented* flat cells are unsatisfactory because of the considerable danger of contamination.) The cylindrical all-glass cell of MATTSON[2] is easier to construct but has certain disadvantages. Firstly, an optically clear 'window' must be ground and polished on the upper side of the cell and, unless the grinding is carried almost to the inner bore and the polishing is of good standard, it is impossible to get particles near the bottom of the cell in clear focus. Secondly, the optical resolution for very small particles is necessarily poor because of the presence of the plano-cylindrical lens formed by the wall of the tube. Thirdly, the lens effect also introduces an important focussing error in measurements of the positions of particles within the cell[3]. It is highly desirable to determine the velocity of particles at a series of accurately known depths from top to bottom of the cell in order to obtain a correct elimination of electro-osmotic flow (for theory and examples see ABRAMSON *et al.*[1]).

A modified cylindrical cell which overcomes these difficulties with little loss of precision and which can readily be constructed in any laboratory is described below. Except for a tiny cemented window, it is constructed throughout of sealed 'Hysil' or similar resistance glass.

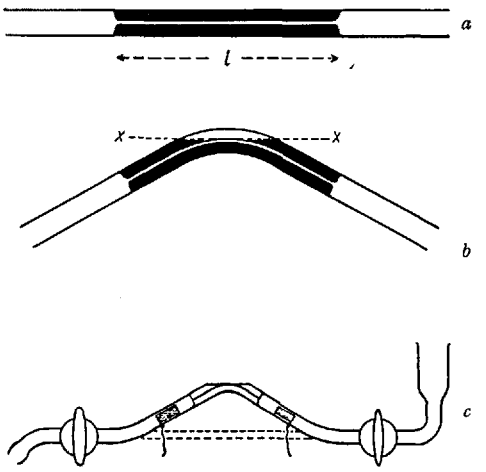


Fig. 1.—Construction of electrophoresis cell

A 5-cm length of precision-bore (e.g. 1 mm) capillary tube is first joined to wider tubing, as in Figure 1*a*, and the length of capillary *l* determined. The capillary is then bent at the middle into an arc of radius about 2·5 cm until the two ends make an angle of about 120° C (Fig. 1*b*). Great care is taken to avoid constricting the bore, and to this end a close-fitting soft copper wire can be inserted before bending and be pulled out afterwards.

Next, the corner of the bend is ground away along the plane *xx* by pressing it against a rotating glass plate carrying coarse carborundum powder moistened with water. When the glass has been ground almost down to the inner wall, the carborundum is changed to a fine grade and the grinding carried on cautiously, with frequent inspections, until a very small hole is pierced into the inner bore, when the grinding is stopped. The hole should be no larger than will fill the field of view of the microscope to be used (e.g. 4-mm objective, with 20× eyepiece). On to this hole a small piece of thin microscope cover-glass is sealed—for example, with Canada balsam—to form a window. This allows particles to be seen at any depth with perfect definition and no focussing error.

The cell is completed by bending the side tubes and fitting cylindrical platinized platinum foil electrodes, small stopcocks and arrangements for filling and emptying as shown in Figure 1*c*. Two glass rods (not shown) are also sealed across either side of the bend to strengthen it. It is convenient to connect the electrodes to platinized bands deposited on the outsides of the tubes and to solder light connecting leads to these bands.

[1] H. A. ABRAMSON, L. S. MOYER, and M. H. GORIN, *Electrophoresis of Proteins* (Reinhold Publishing Corp., New York 1942).
[2] S. MATTSON, J. phys. Chem. *32*, 1532 (1928); *37*, 223 (1933).
[3] A. M. BUSWELL and T. E. LARSON, J. phys. Chem. *40*, 833 (1936). – D. C. HENRY, J. chem. Soc. *1938*, 997.

The cell is mounted on a special adjustable stand on the microscope stage so that the window can be located exactly in the field of view. The whole cell can be cleaned by short treatments with chromic acid, since attack on the balsam is slight and it is easy to replace the window from time to time. There is very little contact between the balsam and the solution in the cell and hence the danger of contamination is minimized. Suspensions can be introduced into the cell without removing it from the microscope.

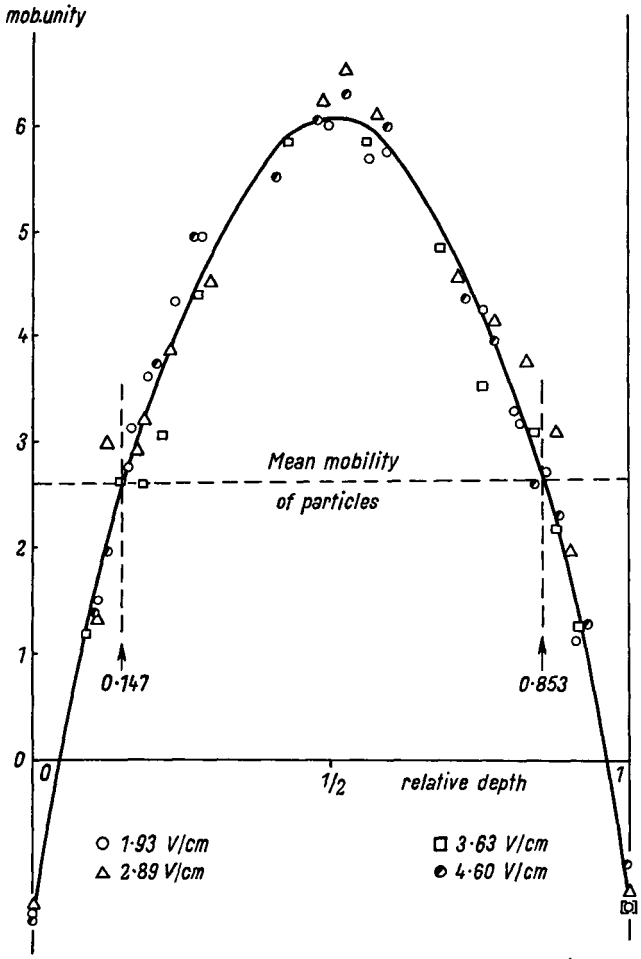


Fig. 2.—Mobility for different fieldstrengths in $KNO_3 10^{-4}$ *N*

In use, about 25 volts from a dry-battery gives a suitable rate of electrophoresis. The potential gradient is calculated from the applied voltage and length of the capillary with a small correction for the potential drop along the wider parts of the tube. (Alternatively, ABRAMSON's method of determining the gradient can be used[1].) The platinum electrodes are suitable for work with dilute solutions up to about $2 \times 10^{-2}$ *N*; for more concentrated solutions the usual non-gassing electrode systems must be employed.

In carrying out a determination, the top and bottom of the cell are first located in the microscope and their readings on the microscope's fine-adjustment micrometer noted. The velocities of migration of particles at different depths are then determined, taking a mean of repeated timings back and forth on reversal of the field. A graph of mobilities as a function of depth is plotted and the mobilities at the 'stationary levels' (0·147 and 0·853 of the diameter from the sides) read off (Fig. 2). The two values may differ by several per cent because of the curvature of the tube, but their mean will be sufficiently close to the correct value for a straight tube.

In all electrophoretic work with very dilute solutions it is advisable to repeat each series of determinations with a fresh portion of suspension to check against the possibility of contamination. Results reproducible to about ± 2% can be readily obtained with this apparatus.

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J. H. SCHENKEL and J. A. KITCHENER

*Chemistry Department, Imperial College, London, July 28, 1958.*

*Zusammenfassung*

Es wird eine modifizierte Glaselektrophoresezelle von zylindrischem Querschnitt beschrieben, die in jedem Laboratorium leicht hergestellt werden kann. Der Vorteil der Modifikation hinsichtlich der Fokussierung und der Beweglichkeit wird besprochen.

## PRO EXPERIMENTIS

### Culture *in vitro* d'un tissu nymphal de lépidoptère

Les processus de pathogénèse ou de métabolisme, sont de plus en plus étudiés sur cultures de cellules *in vitro*. De telles recherches sont envisagées depuis peu sur les insectes en raison de l'augmentation constante du nombre de leurs affections pathologiques connues.

Les tentatives de culture de tissus d'invertébrés sont peu nombreuses et un développement cellulaire n'a été que rarement observé[1]. Chez les insectes, l'émigration et la multiplication de fibroblastes ont été notées à partir de gonades femelles de larves.

Nous avons essayé de réaliser la culture de tissus provenant de nymphes de lépidoptères. Ce stade de la métamorphose représente en effet, un état physiologique particulier (lyse tissulaire accompagnée de phagocytose et formation des organes de l'imago, notamment de ceux de la reproduction).

Les cultures réalisées à partir de chrysalides du Lépidoptère *Bombyx mori* L., ont été faites en gouttes pendantes, en micro-tubes plats et en flacons à surface plane permettant l'observation pendant la culture[2].

Le milieu très simplifié comprend pour 100 g d'eau bidistillée:

| | |
|---|---|
| $NaH_2PO_4$ | 100 mg |
| $MgCl_2 6H_2O$ | 300 mg |
| $MgSO_4 7H_2O$ | 350 mg |
| KCl | 300 mg |
| $CaCl_2$ | 100 mg |
| $NaHCO_3$ | jusqu'à pH 6,5–6,7 |
| Glucose | 100 mg |
| Hydrolysat de lactalbumine | 500 mg |
| Pénicilline | 20000 UI |
| Streptomycine | 5 mg |

Cette solution est complétée de 10% d'hémolymphe de larves ou de nymphes de *B. mori*. Les chrysalides sont

[1] P. BOHUSLAV, Arch. exp. Zellforsch. *14*, 139 (1933). – J. B. GATENBY, J. HILL et T. J. MACDOUGALD, Quart. J. micr. Sci. *77*, 129 (1935). – W. TRAGER, J. exp. Med. *51*, 501 (1935). – C. VAGO, *Mikroskopie*, 1958 (en cours d'impression). – C. VAGO et S. CHASTANG, Exper. *14*, 110 (1958). – S. S. WYATT, J. gen. Phys. *39*, 841 (1956).

[2] C. VAGO, *Mikroskopie*, 1958 (en cours d'impression).