and measuring the volume on A, gives a complete record of the changes of volume taking place upon mixing the two liquids. The outlet through 3 has been introduced for the purpose of discarding the solutions after use and for cleaning.

In the apparatus as built, the tube B has a volume of approximately 120 cm³ with a length of about 20 cm and a diameter of about 3 cm. The burettes C, E and F are graduated for a volume of 50 cm³ by 1/10 cm³. The capillary A is graduated in millimeters over a length of 80 cm. To facilitate its mounting upon the frame of the apparatus, the capillary was wound into the form of a flat spiral with an average diameter of about 12 cm. Its volume after bending was calibrated with mercury in the usual way. One millimeter has a volume of 0.0021 cm³.

Besides being of use in the study of neutralization and of other chemical reactions between solutions, the dilatometer should be of value for the investigation of volume changes under many other conditions. The expansions or contractions taking place upon dilution of concentrated solution have been incompletely studied. To date the phenomenon has been investigated with only a few of the many electrolytes,[8] with alcohol[9] and with a few other organic compounds. Solutions of substances in other solvents than water have been almost completely neglected. The relation between the miscibility of liquids and the accompanying volume change may perhaps be a fruitful source for information concerning the nature of the liquid state and of solutions.

Another form of dilatometer with which it is possible to measure directly the alterations of volume on mixing two liquids has just recently been described.[10] Its applicability to work of a general nature is limited in that the volume change is given on mixing the two liquids in only one proportion. It is obvious that with the dilatometer described above the value of the volume changes for a series of mixtures of the two liquids may be obtained in one experiment.

Further details concerning the design, construction and manipulation of the apparatus, as well as some of the results obtained by its use, will be published in more extended form elsewhere. This notice has been given for the description of a new type of dilatometer, constructed easily and at small cost, which may facilitate greatly the study of a fundamental property of liquids.

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[8] G. P. Baxter and C. C. Wallace, *Jour. Amer. Chem. Soc.*, 38: 70, 1916.

[9] F. L. Teed, "Volume Alterations on and in Solution," London, 1926.

[10] J. H. Hildebrand and J. M. Carter, *Jour. Amer. Chem. Soc.*, 54: 3592, 1932.

## PERMANENT SLIDES FOR USE IN TEACHING THE HOWARD METHOD

MANY food analysts throughout the country are employing the Howard method[1] of testing various comminuted food products to determine the condition of the raw material as regards decomposition due to mold, and it frequently happens that analysts come to this laboratory for instruction in the technique of the method. In the course of his training it has been customary for an experienced analyst to check field by field with the student analyst in order to determine the ability of the student to recognize mold filaments of various types. However, a saving in time would result if, instead of using the standard Howard cell, permanent slides with clearly defined fields marked on them were employed.

The preparation of such slides has been accomplished in the following manner: Tomato pulp or catsup of rather thin consistency is used for the test material. One and one half per cent. (1.5 per cent.) of agar is added to the sample and dissolved by boiling. Before cooling, 4 to 5 per cent. of commercial formaldehyde is added.

The following method of delimiting the fields has been found most advantageous. Twenty-five perforations, each 1.31 mm in diameter, are made in colored cellophane, the holes being spaced about 1 mm apart and arranged in five rows of five holes each. This particular sized perforation was used since it is just slightly smaller than the field specified for use in the Howard method, namely 1.382 mm in diameter. A punch for making the holes can conveniently be made by cutting off a 0.052 inch drill at the upper limit of the twist and placing the shank in a suitable holder. By placing the cellophane over a hard fiber board it is readily possible with a hammer to make clean-cut perforations. A special die has been found useful in cutting the holes, although this is not necessary. The excess cellophane at the edge of the square is trimmed off, leaving a narrow margin of about 0.5 mm.

The cellophane mask is cemented to a clean microscope slide with the aid of balsam and covered with a cover glass. After the balsam is dry, a drop of the tomato agar preparation, previously softened in a boiling water bath, is placed on the cover glass and quickly spread out into a thin layer by means of a second cover slip. Excess pulp is removed after it hardens and the whole is sealed by ringing with balsam.

When ready for use, each field is examined for the presence or absence of mold filaments of the required length and a permanent record is made to accompany the slide.

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[1] "Methods of Analysis," Assn. of Official Agric. Chemists, pp. 400–401.