The natives were weighed and measured according to the Du Bois linear formula method of determining surface area, as well as for standing and sitting heights. Blood pressures were also measured, and katathermometer readings and wet and dry temperature measurements were obtained to give a basis for computing cooling power. When these data and those obtained previously are worked out it is hoped that conclusions may be drawn as to whether there is a true racial variation in basal metabolism; and whether the specific dynamic effect of protein meals on these natives, living with so little margin above a bare sustenance, is the same as for civilized Europeans; and that other important information will be obtained.

Blood-grouping showed again that only Groups A and O occur amongst the Central Australian natives. Out of 84 examined, 32 belonged to Group O and 52 to Group A.

Dr. Fry found that the class system of the Pintubi, which composed the majority of the natives, was of the 4-class nomenclature, but with the additional recognition of the 8-class of the adjacent Loritja. The legends and songs in relation to five ceremonies were obtained, together with their translations. Conception stories and dreams were obtained from five mothers.

Three hundred photographs were taken, which included standard photographs of bust and full-length, and a number of others concerning ceremonial records, pathological data and special features. Complete plaster casts were secured of the busts, including the faces, of two old men, of two young men, of two adult women, of one young woman, and of one newly born male baby; and a face cast of one young woman.

Pathological observations were recorded. The presence in some subjects to a slight degree of boomerang legs, and in several instances a soft enlargement of the parotid glands on each side was noted. Almost without exception pediculi were present in the hair.

It is the custom amongst these people for the mother to kill at birth an infant who is born whilst she is suckling its predecessor. The new-born baby, whose plaster cast was obtained, had been killed by its mother and stuffed into a rabbit's burrow, almost at the moment of arrival of the expedition at Mt. Liebig. Next day members became aware of this event, and with the concurrence of the natives and their assistance the body of the baby was unearthed and a complete description of it obtained. The placenta was attached. Soil or ashes are placed in the baby's mouth to stop its cries before the mother kills it.

Dr. T. D. Campbell and Mr. H. Gray obtained further standard records of measurements of adults and children, together with samples of hair, outlines of hair tracts, notes on the teeth and on the color of the skin, hair and eyes, and special information as regards the curve of the spine, shape of the foot, etc. The peculiar rubbery texture of the soles of the feet was again seen in a number of natives, but not in all.

Extensive cinematograph records were obtained of ceremonies, of daily occupations, of collecting and preparing foods, of making weapons and utensils, and of the meeting of two friendly parties of natives. Various animal and vegetable foods used by these natives were collected.

A meteorological equipment was taken and a very useful set of climatic records was obtained. Other incidental studies, such as geology and physiography, helped in an appreciation of the natives' physical environment.

The expedition proved successful, and has emphasized the value of team-work and the amount of information that can be collected in a short period of time by an intensive study.

J. B. CLELAND

SCIENTIFIC APPARATUS AND LABORATORY METHODS

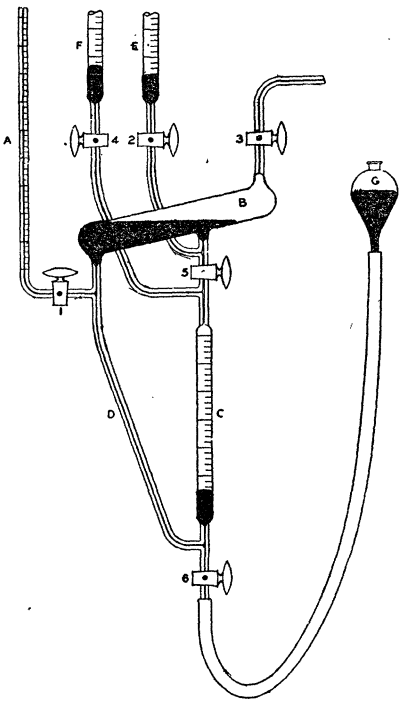
A UNIVERSAL DILATOMETER

SINCE the publication of Ostwald's work on "Volume Chemistry" in 1877, several papers have appeared, discussing from a theoretical and experimental point of view the change of volume which takes place during the process of neutralization of an acid by a base. Ostwald[1] first noticed the phenomenon and investigated its relation to the nature of the acid and of the base. His work was extended and confirmed by Ruppin.[2] The influence of the concentration was then studied by Tammann,[3] who worked with solutions of concentrations between 0.1 and 0.005 normal and who proposed an hypothesis to explain the change of volume. An extensive experimental investigation was later carried out by Miss Freund,[4] who concerned herself with the influence of temperature and of the concentration at higher concentrations than those with which Tammann had worked. During the course of a physico-chemical study of the process of neutralization, Cornec[5] determined the densities of mixtures of solutions of potassium hydroxide and

[1] W. Ostwald, *Jour. prakt. Chem.*, 16: 385, 1877.
[2] E. Ruppin, *Zeit. physik. Chem.*, 14: 467, 1894.
[3] G. Tammann, *Zeit. physik. Chem.*, 16: 91, 139, 1895.
[4] I. Freund, *Zeit. physik. Chem.*, 66: 555, 1909.
[5] E. Cornec, *Ann. chim. phys.*, (8) 29: 490, 1913.

phosphoric acid and by plotting density against molecular composition, there were shown decided breaks in the density-composition curve corresponding to the salts KH_2PO_4 and K_2HPO_4. More recently Saslawsky and Standel[6] have determined the volume change upon mixing solutions of acids and bases not only at the neutralization point but also in a series of mixtures of the constituents in other proportions. While their work is not intended to be of an accuracy comparable to any of that previously performed, it is of value in that it covers the concentration range from about 2 to 12 normal.

All the above work was performed by determining experimentally the densities of the solutions of the acid and base, and of the salt formed upon neutralization, and from these values, calculating the volume change taking place upon the formation of the salt



solution. As several of these investigators have pointed out, the value of the volume change so calculated depends upon the precision of the density determinations. Owing to the care necessary for the precise estimation of the density of a solution, even when allowing an error of ± 0.00005, it was thought that a dilatometric method, whereby the volume change might be directly observed, would expedite the extension of this type of work. The changes of volume accompanying oxidation-reduction reactions and those reactions involving the formation of complexes, for example, have not as yet been studied although they have occasionally been utilized for other purposes.[7]

To this end an apparatus has been devised, as illustrated diagrammatically in the accompanying figure, with which it is possible to add known volumes of one liquid to a known volume of another, and, after equilibrium has been established, to read directly the volume change which has occurred. It is based upon a simple hydrostatic principle, which will be obvious after a description has been given of the method of use.

The apparatus, set in a thermostat at the required temperature, is filled with mercury from the reservoir G through stop-cock 6. Stop-cocks 1, 2, 3, 4 and 5 are opened and the mercury allowed to rise into the burettes E and F, into the capillary A, and into the outlet tube through stop-cock 3. All the stop-cocks are then closed. The burettes E and F are filled with the liquids under investigation, note being taken of the amount in E. In opening stop-cocks 4 and 6 and lowering the mercury reservoir, the liquid in F flows down to fill the burette C. The stop-cocks are then closed. On opening stop-cocks 2 and 6 the liquid in E flows through 2, bubbles up through the mercury in B and occupies the upper portion of the tube. Meanwhile the mercury flows through D to the reservoir. When the required amount of liquid from E has been transferred to B, the flow of mercury is reversed by raising the reservoir, sending mercury back up again into the burette E. The difference between the volume of the liquid remaining and of that originally present in E gives the volume transferred to B. Stop-cock 2 is now closed. By opening stop-cock 1 the position of the mercury in the capillary A may now be adjusted to a suitable portion of the scale, depending upon whether the alteration of volume to be measured is an expansion or a contraction. Stop-cock 6 is closed. The thread of mercury running from B to C through stop-cock 5 is removed by opening the latter till the liquid in C rises to the constriction just at the entrance to B. The apparatus is now in the condition depicted.

The level of the mercury in C is noted and also the volume of the closed-off system as measured at A. Portions of the liquid in C are allowed to pass up into B by opening and then closing stop-cock 5. To insure thorough mixing of the two liquids, the tube B is at a slight angle to the horizontal so that by rocking the apparatus sideways, the motion of the mercury layer sets up a turbulence in the liquid above it. Any volume change which occurs will be evident from the displacement of the meniscus of the mercury in the capillary A. Opening and closing stop-cock 5, observing the change of height of the mercury in C,

[6] I. I. Saslawsky and E. G. Standel, *Zeit. anorg. allgem. Chem.*, 180: 241, 1929; 186: 171, 1930.

[7] A. Benrath, *Jour. prakt. Chem.*, 80: 283, 1909.

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.