Bureau Creek 5 miles to the northwest. The first section shows Tazewell loess above Bloomington drift. The profile of weathering of the loess extends only slightly into the underlying drift. The other sections consist, in descending order, of Wisconsin till, Iowan loess, late Sangamon loess, Illinoian gumbotil and Illinoian drift. The Iowan loess is entirely unweathered, but the late Sangamon loess is leached throughout. Peat occurs in the lower part of the Iowan loess and in the Sangamon loess. Outside the borders of the Wisconsin drift sheet the Tazewell and Iowan loesses combine to form the so-called Peorian loess of western Illinois and Iowa. These phenomena emphasize the intimate relationships of the Iowan and Wisconsin drifts and have resulted in the recent reclassifications of the Pleistocene, in which the Iowan and Wisconsin drifts and associated deposits are combined with the Recent to form the Eldoran series.

At noon the conference adjourned.

J. Marvin Weller

Urbana, Illinois

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW METHOD OF ILLUSTRATION

Clear and carefully chosen illustrations make for speed and ease of comprehension and thereby increase the value of geological articles. With the foregoing aim in view, the writer used the following method of illustrating a thesis dealing with joints in sedimentary rocks.

The field work was done in the Black River Valley region of New York State, where the thin bedding of the Ordovician strata and the close spacing of the approximately vertical joints made possible the collection of "joint blocks"—rock specimens, two of whose sides are normally bedding plane surfaces and the other sides joint plane surfaces. Care was exercised to obtain blocks with joint plane directions which represented the dominant strikes of the area from which they were taken. As each block was collected, the directions of the joint planes bounding it were carefully ascertained with a Brunton pocket transit and recorded on the block. The writer used a colored pencil for noting the directions, and it worked well on the smooth bedding plane surfaces. For rough surfaces, adhesive tape marked with ink would no doubt prove a better method.

In the laboratory, each joint block was brushed free of dust and loose particles and a six-inch white celluloid scale attached to the face by means of rubber cement. The specimen was then set up against a black background and photographed with a Vogtlander camera.

The use of the black background prevented halation and made possible a longer exposure to bring out details. Also, a black background, which on the negative would be light, made it possible to use opaque for printing and orienting the block on the negative.

The negatives were first coated with retouching fluid. Opaque, which is thick and must be thinned to proper consistency, for pen use, was then applied. The direction of each joint plane was printed parallel to the strike of the plane. A north-south arrow was drawn in the correct direction, after which the negative was squared with reference to the arrow. The negatives were printed in the usual manner, using No. 3 Velox paper.

In the resulting pictures, the strike relationships of the various joint sets were clearly evident. It is the opinion of the writer that a better presentation and conception of the facts was attained in this way, than if the directions of the joint strikes had been merely diagrammed.

Marjorie Hooker

Columbia University

A SIMPLE METHOD FOR MEASURING SMALL TIME INTERVALS

In many physiological laboratories it is inexpedient to supply each student with an electrically maintained tuning fork to measure small time intervals in nerve and muscle experiments. A dependable and simple arrangement has been in use here for some time where an accurate record of fractions of a second is required. The only conditions necessary are that the laboratory should be supplied with A.C. current from the mains, and the frequency of the current should be known.

The materials needed are a small signal magnet with a light flexible steel vibrator, a lamp socket, a 50 or 60 watt lamp, a push button or switch and a plug. The adjusting screw is removed from the signal magnet so that the vibrator is suspended free above the electromagnet. The coil of the magnet is connected in series with a lamp (as resistance) and a switch, and the circuit is completed by connecting across the mains. When the current is switched on, the vibrator is drawn towards the magnet and vibrates above it at double the frequency of the alternations in the mains. If the pointer of the signal is allowed to record lightly on a revolving kymograph drum, it will draw a series of waves of sufficient amplitude to serve as a time record. The peaks of the waves correspond to the alternate positive and negative surges in the line, so that the distance between two adjacent peaks corresponds to the time occupied by half an alternation. The wave may be slightly altered in form and amplitude by trying different signals and by altering the wattage of the lamp in circuit, but care must be taken not to burn out the coil.

In Medford, Mass., the local current is 110 v. 60 cycle A.C.; thus the distance between two peaks corresponds to a time interval of 1/120 second. The rate of alternation in A.C. current is very constant, and the above arrangement has been found very satisfactory, particularly for student use. It is accurate and simple and requires no attention or delicate adjustment.

K. D. ROEDER

TUFTS COLLEGE

SPECIAL ARTICLES

CONTRASTING PROPERTIES OF IONS, ZWITTERIONS AND UNCHARGED MOLECULES[1]

Apparent molal volume: The great density of such constituents of biological systems as amino-acids and most proteins depends largely upon the electrical charges borne by these molecules. Molecules can not be said to exist in the inorganic crystal, where each ion is related to all others surrounding it. By contrast the distances separating atoms within molecules of an uncharged organic crystal are far smaller than those between atoms of adjacent molecules.[2] Intermediate in behavior are the zwitterions recognized by Bjerrum[3] just a decade ago as being neither electrolytes nor uncharged molecules. Of great importance in physiology and morphology these charged molecules are closely packed and the density of the smallest of them, glycine, is 1.61 in the solid state.

The densities not only of amino-acids, but of certain proteins[4] appear to be greater in dilute solution than in the solid state. This results from electrostriction of the solvent, estimated to be approximately ten cc per mole per charge when these are widely separated from each other.[5] Electrostrictions of this magnitude are produced by ions slightly greater in radius than 2 Å. The smallest of the zwitterions, glycine, has a radius of 2.8 Å. When the positive $-NH_3^+$ group is separated from the COO^- group by only one carbon atom, as in all neutral α amino-acids, the combined electrostrictive effect is reduced to 13.4 cc per mole.[6]

Influence of concentration upon apparent molal volume: Not only the closeness of approach of charged groups in the same molecule, but increase in concentration of the solution increase the apparent molal volume. This increase has been shown to be proportional to the square root of the concentration for salts, and also for cane sugar and urea,[7, 8] though these molecules do not bear electrical charges, as may be demonstrated from the density of their solutions.[6] That the square root law holds for the latter substances[9] because of the polarity of the hydroxyl and amino groups is strongly suggested by study of aliphatic acids containing various substituents. Acetic acid does not obey the square root law, and increasing the length of the hydrocarbon chain, as in propionic, butyric and valeric acids, increases the deviation from linearity. Chloracetic acid, in which the strongly electronegative chlorine atom is substituted for a hydrogen atom, does, however, obey this law, as do di- and trichloracetic acids ($\frac{\delta\Phi}{\delta\sqrt{c}}=1.55$, 3.12, 6.00). Substituents which increase electrolytic dissociation appear also to increase the proportionality constant ($\frac{\delta\Phi}{\delta\sqrt{c}}$) relating the apparent molal volume to the square root of the concentration.

Glycine, which contains the electronegative amino group, obeys the square root law and so do its hydrochloride and sodium salts ($\frac{\delta\Phi}{\delta\sqrt{c}}=1.52$, 2.54, 3.89). Neither amino-acids of long hydrocarbon chains nor their hydrochlorides or sodium salts obey this law, however, but behave in this respect rather like aliphatic acids. The salts of amino-acids as of aliphatic acids must, however, be considered largely dissociated in solution. Thus the square root law appears to depend largely upon the polarity of the groups in the molecule.

The apparent molal volume of β alanine increases approximately with the first power of the concentration rather than with its square root. This is also true of glycyl-glycine, which contains the polar amide linkage, and of the sodium salt of ε amino caproic

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[1] Abstract of paper read at the meeting of the National Academy of Sciences in Cambridge, November 22, 1933.

[2] S. B. Hendricks, *Chem. Rev.*, 7: 431, 1930.

[3] N. Bjerrum, *Z. Physik. Chem.*, 104: 147, 1923.

[4] H. Chick and C. J. Martin, *Biochem. Jour.*, 7: 92, 1913.

[5] H. H. Weber, *Biochem. Z.*, 218: 1, 1930.

[6] E. J. Cohn, T. L. McMeekin, J. T. Edsall and M. H. Blanchard, *Jour. Biol. Chem.*, 100, Proc. xxviii, 1933.

[7] W. Geffcken, *Z. Physik. Chem.*, 155: 1, 1931.

[8] F. T. Gucker, *Chem. Rev.*, 13: 111, 1933.

[9] The melting points of cane sugar (186° C.) and of urea (133° C.) are also higher than those of most uncharged molecules. The amino-acids melt in the neighborhood of 300° C. and neutral salts at still higher temperatures.