JACKSON JOHNSON, late chairman of the board of the International Shoe Company, has bequeathed $250,000 to Washington University Medical School as a fund to aid students.

THE issue of SCIENCE for February 1 contained a note relating to the gift of Mr. John D. Rockefeller, Jr., to the laboratory of anthropology at Santa Fe. It was there stated that the gift was made to the University of Chicago, whereas the university is only one of several institutions participating in the work.

ASSEMBLYMAN JAMES R. ROBINSON, of Ithaca, has introduced a bill in the legislature providing $1,000,000 for the construction of a home economics building at Cornell University.

BY the will of the late William Lyman Underwood, the sum of $20,000 is left to the Massachusetts Institute of Technology for the benefit of the biological department, with which he was connected for many years.

DR. HAROLD LINDSAY AMOSS, associate professor of medicine of the Johns Hopkins School of Medicine, has been elected professor of medicine at Duke University.

DR. J. V. HOFMANN, assistant director of the Pennsylvania State Forest School, has been appointed head of the division of forestry at the State College of North Carolina at Raleigh, N. C.

M. LÉON BRILLOUIN, assistant director of the laboratory at the Collège de France, has been appointed the first incumbent of the new chair of theoretical physics at the Sorbonne.

DISCUSSION

ON THE PRESENCE OF ALUMINUM IN PLANT AND ANIMAL MATTER

IN an article entitled, "A Study of the Possible Rôle of Aluminum Compounds in Animal and Plant Physiology," by E. V. McCollum, O. S. Rask and J. Ernestine Becker, published in the *Journal of Biological Chemistry*, Vol. 77, p. 753, 1928, these authors arrived at the conclusion that aluminum is not a constituent of either plant or animal matter. Since this conclusion is so contrary to what has been found by practically all previous investigators, we have checked the work of McCollum and coworkers in the laboratory and have found that they are quite in error. Using the Hilger quartz prism spectrograph, as they did, we found aluminum to be present in egg, potato, carrot, English walnut meat, peach pit, apricot pit, pop-corn, lima bean, navy bean, lupine bean, peanut kernel, lean beef, beef tendon and human cancerous tissue excised from the breast by the surgeon. The complete experimental details will soon be ready for publication.

LOUIS KAHLENBERG,
JOHN O. CLOSS
CHEMICAL LABORATORY UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN,
FEBRUARY, 1929

TO DEMONSTRATE THE COURSE OF SAP ASCENT IN PLANTS

THE usual methods for demonstrating the course of the ascending sap stream, or transpiration stream, through the wood of the vascular bundles of land plants, are open to manifest objection. The commonest method—that of allowing an amputated plant or branch to draw up a colored solution (*e.g.*, red ink) through the cut end—is undesirable because of the tendency of the dissolved pigment either to diffuse or to attach itself to *ad*sorbent walls. The usual alternative to this—a suspension of insoluble particles such as finely ground India Ink, which is also drawn up by the ascending sap stream—while it carries admirably, is also objectionable because it does not stay in place when one attempts to make sections of the tissues into which it has been drawn. One may engage in the time-consuming processes of fixing, imbedding, microtome sectioning, etc., in order to avoid dragging or scattering the carbon by the knife or razor-blade.

But it has occurred to me that one may have the advantages of a non-diffusing suspensoid without the risk of dislocation by sectioning, if one use a suspension of finely ground starch. This innocuous material will also be drawn up through the ducts. When the process has continued as far as one wills, the granular starch may be fixed in place by subjecting the plant or branch to sufficient heat to make paste. The part may then be sectioned, stained with iodine, and examined. The starch will be found to be more or less completely filling the ducts.

Experiment made by Mr. Edwin D. Woodhouse, one of our graduate students, showed that starch was drawn up through six internodes by castor bean (*Ricinus communis*) branches in about twenty-four hours, and that it was drawn through six inches of leaf stalk in about half an hour, in the warm dry air of the laboratory. While Mr. Woodhouse and I are proceeding with our investigation of what he has called sap hydraulics, presently publishing our results elsewhere, I believe this method is so remarkably useful for demonstrations that I should be glad to have it used in this way while we are testing it in others. It is obvious that we shall be able, by using

starch of suitable fineness, to test the powers of the different parts of the conducting systems of vascular plants, determining by the presence of starch the course of the streams, the cells actually used, whether some or all the constituents of a vascular bundle are employed, etc. In this way we may also be able to throw the light of facts upon the disputed subject of the energetics of sap ascent.

GEORGE J. PEIRCE

STANFORD UNIVERSITY,
CALIFORNIA,
DECEMBER 15, 1928

RING METHODS FOR SURFACE TENSION MEASUREMENTS

IN recent years there have appeared a number of papers treating of the ring methods employed for the measurement of surface tension. Most of those that have appeared in this country have been concerned more particularly with the Du Noüy tensiometer, and have ignored the fact that that instrument might conceivably be used for either of two distinct methods.

As a ring is slowly raised from an extended surface of a liquid that wets it, the resultant downward pull of the liquid passes through a distinct maximum, and, if the ring is not too small,[1] it then reaches a lower and constant value before rupture occurs. These changes have been described and explained by Sondhauss,[2] Hall,[3] Lenard,[4] Fahrenwald,[5] and others. Reducing the thickness of the ring reduces the difference between the constant and the maximum pull.

The surface tension may be derived from either of these values of the pull, but the procedures differ. As the maximum pull is the least that will suffice to detach the ring from the liquid, the method based on it may be called the ring detachment method. The lower and constant pull, observed when the ring is raised sufficiently higher than the position of maximum pull, corresponds to the existence of a true double film between the liquid and the ring, and the method based on it may be called the ring film method. In the detachment method, a portion of the pull arises from the suction exerted by the column of liquid, in bulk, pendent from the ring and extending from it to the main body of the liquid. In the film method, a portion of this column has been replaced by the film, and only the weight of the small portion lying above the top of the film contributes to the pull, the rest of the pull being due to the film itself.

In practice, the ring is suspended from the arm of a torsion, or other, balance by which the pull exerted by the liquid is measured. If the balance is pliant, so that the force exerted by it varies very little with the elevation of the ring, and if the motion of the ring is not suitably restricted, then rupture will occur when the maximum pull is reached. But if the balance is stiff, then the rise that occurs as the ring passes the position of maximum pull may relax the balance sufficiently to restore equilibrium, and then a further adjustment is required in order to produce rupture; this adjustment draws out the true film, and the pull registered at rupture will be that corresponding to the film method. By suitable care and control of the motion of the ring, either method can be realized with either type of balance, but without such care and control each balance favors one method rather than the other.

Before data obtained by such an instrument can be satisfactorily discussed and interpreted, it is necessary to know by which of these methods they were obtained. Each experimenter should determine and clearly indicate the method employed. The absence of such indication detracts greatly from the value of the work, and compels the reader to infer the method from a consideration of the manner in which the instrument has been most frequently used by others. Unfortunately, it seems impossible to determine with certainty from the published papers whether the Du Noüy tensiometer usually functions as a detachment or as a film instrument. In the paper[6] describing his first instrument, Du Noüy regards the method as a mere refinement of that of Weinberg,[7] which was a detachment method. But in a later account[8] of the origin of the instrument, he groups the method with that of Sondhauss (film) as well as with that of Timberg and of Weinberg (detachment). In his study of the instrument, Harkins[9] speaks definitely of measuring the maximum pull, thus showing that he used it as a detachment instrument. Klopsteg[10] classes the method with that of Weinberg (detachment), but a little further along he says that at a certain stage before rupture occurs "the liquid adher-

[1] Its internal diameter must be no less than that of the tube in which the liquid will rise to a height equal to the elevation of the ring when the pull is a maximum.

[2] C. Sondhauss. Pogg. Ann., Erg. Bd. 8: 268–298; 1878.

[3] T. P. Hall. *Phil. Mag.* (5), 36: 385–413; 1893.

[4] Lenard, v. Dallwitz-Wegener, and Zachmann; *Ann. d. Physik,* 74: 381–404; 1924.

[5] A. W. Fahrenwald. *J. Opt. Soc. Am. and R. S. I.,* 6: 722–733; 1922.

[6] P. L. Du Noüy. *J. Gen. Physiol.,* 1: 521–524; 1919.

[7] B. Weinberg. *Zeits. f. physik. Chem.,* 10: 34–50; 1892.

[8] P. L. Du Noüy. "Surface Equilibria of Colloids," p. 23, Chemical Catalog Co., New York, 1926.

[9] Harkins, Young and Cheng, SCIENCE, 64: 333–336; 1926.

[10] P. E. Klopsteg. SCIENCE, 60: 319–320; 1924.