pology, University of Chicago, "cultural relationships of Apache tribes"; George M. Peterson, assistant professor of psychology, University of New Mexico, "the effect of variations in the wave form of an electric stimulus on the response of conscious animals"; Otis C. Trimble, associate professor of psychology, Purdue University, "analysis of wave-form as a determining factor in auditory localization"; Wilson D. Wallis, professor of anthropology, University of Minnesota, "anatomic lag."

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

REGULATING THE FLOW OF SOLUTION FOR PLANT CULTURES

SEVERAL articles have recently appeared in SCIENCE on devices for securing a slow and accurately controlled flow of a liquid.[1] The purpose of the present note is to call attention to the simple and efficient method devised by Shive and Stahl[2] and to describe a modification of this method that permits considerable latitude in regulating the rate of flow.

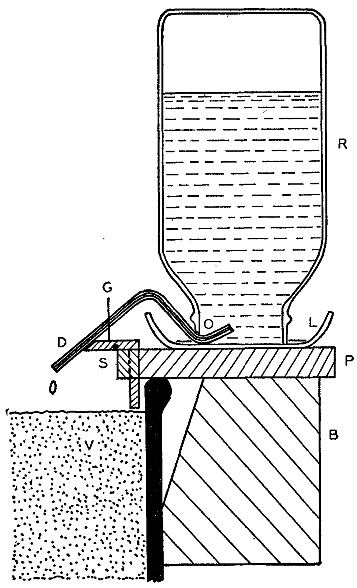

FIG. 1

Fig. 1 shows the main features of the Shive and Stahl apparatus. The solution reservoir (R) is a 2-quart Mason jar with a V-shaped orifice (O) that has been cut with a whetstone. The reservoir, acting as a Mariotte flask, maintains an approximately constant level of solution in the glass dish (L)—a Woolworth "ash tray." Solution flows at a practically constant rate through the small-bore delivery tube (D) and drips regularly into the sand in the culture vessel (V). The apparatus is supported on a platform (P) provided with a bracket (B).

The modification consists in the addition of a notched support (S) for the delivery tube. The desired rate of flow through the delivery tube (D) is then readily obtained by adjusting the position of the apparatus on the platform (P). Movement to the right raises the delivery tube (D), since this rests on the notched support (S) and is guided between two wire nails (G); this decreases the "head" and, consequently, decreases the rate of flow through the tube. To increase the rate of flow, the apparatus is moved to the left on the platform. A change in "head" of about 3.5 cm may be obtained with the apparatus illustrated. After the apparatus has been adjusted to the desired rate of flow, a mark is made with a wax pencil on the delivery tube even with the guide nails (G); this allows immediate resetting of the apparatus after the reservoir is refilled.

The addition of the tube support allows the rate of flow to be varied through a considerable range, and therefore obviates the necessity of extreme care in the selection of capillary tubing of suitable bore. In culture studies the rate of flow may easily be increased as the plants grow.

Small fluctuations in the solution level in the reservoir dish (L) occur, since air is admitted intermittently into the reservoir; changes in the temperature of the air in the reservoir also affect the solution level. These sources of variation in the rate of flow, though generally not significant in culture studies, may be avoided by employing a separate constant-level device, provided with an overflow.[3] But the simplicity, compactness and ease of manipulation of the apparatus of Shive and Stahl make it extremely useful in investigations of the mineral nutrition of plants.

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[1] J. H. Wales, SCIENCE, 79: 545–546, 1934; W. A. McCubbin, SCIENCE, 80: 144, 1934; H. F. Pierce, SCIENCE, 80: 339, 1934; R. H. Lambert, SCIENCE, 80: 361–362, 1934.

[2] J. W. Shive and A. L. Stahl, *Bot. Gaz.*, 84: 317–323, 1927.

[3] S. F. Trelease and B. E. Livingston, SCIENCE, 55: 483–486, 1922. Pierce, *loc. cit.*

THE CHICAGO SOIL-NUTRIENT-TEMPERATURE TANK

THE Botanical Laboratory of the University of Chicago has developed the Wisconsin soil-temperature tank into a soil-nutrient-temperature tank.[1] By its use the direct pathogenic effects of deficient soil aera-

[1] W. H. Tisdale, *Phytopathology*, 7: 356–360, 1917; L. R. Jones, *Plant World*, 20: 229–237, 1917; J. John-