The underlying idea of the work is to supply data on the history of edible plants whether accounted of little or much value, and especially regarding their early uses in all parts of the world by primitive peoples and others, and to trace their introduction into cultivation, and their expansion into varieties as known at the present time. In these respects he has greatly added to the knowledge available in DeCandolle's "Origin of Cultivated Plants," Pickering's "Chronological History of Plants," and other standard works on the history of esculents.

The wealth of material brought together may to some extent be judged from the fact that DeCandolle's work, generally considered the best available on the history of cultivated plants, treats scarcely of 250 kinds, while the present work embraces nearly 3,000 kinds. The work is, moreover, only the choicest part of a vast storehouse of information secured by Dr. Sturtevant, which he would undoubtedly have elaborated into a still more extensive work, had it not been for his premature death. The extent of the research involved, a specially valuable portion being the knowledge obtained from rare and obscure writings, can be inferred from there being upwards of 6,000 citations, referring to some 500 publications.

But the work is not simply that of a bibliophagist and collector of data, for Dr. Sturtevant was a life-long student of constancy and variation in both plants and animals. As joint proprietor with his brothers of Waushakum Farm and Director of the New York Agricultural Experiment Station he possessed great opportunities for direct observations, which his keen and richly endowed mind combined with energy and initiative utilized to fullest degree. This practical knowledge has insured the omission of improbable travellers' tales and fanciful myths, and made the entries as scientifically historical and accurate as is possible.

Large credit must be given for preparing and issuing this volume to the broad-visioned director of the station at Geneva, Dr. W. H. Jordan, who authorized its preparation, and to the editor, Dr. U. P. Hedrick, who has shown in the arrangement of its contents a fine knowledge of the subject, rich scholarship and unflagging zeal. It was necessary for Dr. Hedrick to select the material from a vast amount of manuscripts, notes, and card catalogue items that had lain in the station library for twenty years, and to verify and complete the long list of citations. He has also supplied a very full and sympathetic account of Dr. Sturtevant's scientific career. The writer of this notice was associated with Dr. Sturtevant during the larger part of his directorship, and can therefore more fully realize the extent and value of the original material and of the labor expended upon it by the editor.

J. C. Arthur

Purdue University,
Lafayette, Indiana

SPECIAL ARTICLES

THE DISPLACEMENT METHOD FOR OBTAINING THE SOIL SOLUTION [1]

There have been several methods proposed for obtaining the soil solution. Among the most promising of the methods are those which depend upon the principle of the displacement of the soil solution by another liquid. Schloesing[2] was probably the first to use the displacement method, using water as the displacing liquid. Istcherekov[3] used ethyl alcohol as the displacing liquid and obtained results indicating that the true soil solution was secured. Morgan[4] has modified the displacement method, using a heavy oil as the displacing liquid and applying pressure to force the oil into the packed soil.

The present investigation was suggested by the work of Istcherekov, and the procedure followed was essentially the same as used by that investigator. Several displacing liquids were tried, including those miscible and non-miscible with water. The most satisfactory results were secured by use of ethyl alcohol.

The method consists of packing the moist

[1] Published with the permission of the Director of the Wisconsin Agricultural Experiment Station.

[2] *Compt. Rend. Acad Sci. Paris*, 63, 1007 (1866).

[3] *Jour. Exp. Landw.* (Russia), 8 (1907).

[4] Mich. Agr. Exp. Sta. Tech. Bul. 28 (1916).

soil in a cylinder provided with an outlet at the bottom. The ethyl alcohol is then poured on top of the soil column and as it penetrates the soil it displaces some of the soil solution which forms a zone of saturation below the alcohol. This zone increases in depth as it is continually forced downward by the alcohol. When the saturated zone reaches the bottom of the soil column the soil solution, free of alcohol, drops from the soil as gravitational water.

The only apparatus required is a cylinder in which to pack the soil. Brass soil tubes or glass percolators were used for this purpose. The diameter of the tube and the height of the soil column determine the rate and time required for displacement.

The soil was packed in the cylinders by means of a short wooden rod. No difficulty was experienced in obtaining uniform packing. The degree of packing required for the best results is determined by the kind of soil and its moisture content. Sands and peats can be packed very firmly, but with heavier soils care must be taken that they are not puddled in packing, in which case displacement is exceedingly slow or entirely prevented. To prevent puddling it is best to use the heavier soils at moisture contents slightly below their optimum for plant growth. After a little experience one can readily determine the proper degree of packing for any soil at a given moisture content.

The time required for displacement varies widely depending on the moisture content of the soil, the degree of packing, the soil type, and the height of the soil column. In most cases it is possible to complete the displacement in one day, often in a much shorter time, if the soil column is not over twelve to fifteen inches in height. However, in some cases it required several days to complete the displacement.

It is practicable to obtain 35 to 45 per cent. of the soil solution by this method. However, it is possible to displace a much larger percentage of the soil solution than this. Using a silt loam soil at a moisture content of 23.3 per cent. a 75.6 per cent. displacement has been secured. Istcherekov reports that with a soil at saturation it is possible to displace about 95 per cent. of the soil solution before the appearance of alcohol.

The method has been successfully used on a number of soils including sands, loams, clays and peats. The results obtained indicate that the true soil solution is secured. Successive portions of the displaced solution have the same composition as is indicated by total salt and freezing point determinations. It is probable that the solution obtained is a true aliquot of the entire soil solution, that is, the displaced solution is of the same composition as the portion remaining in the soil. A comparison was made of the amount of total salts and nitrates obtained by the displacement method and by a 1 : 5 water extraction of the soil. The results given in Table I. shows that the two methods give approximately the same amount of total salts. The results for nitrate nitrogen are the same within experimental error.

TABLE I

Total Salts and Nitrate Nitrogen in the Dry Soil as determined by the Two Methods

	NO_3		Total Salts	
Kind of Soil	P.P.M. Water Extract	Nitrogen Displacement	P.P.M. Water Extract	Displacement
Clay loam	71.5	75.2	796	747
Clay	29.4	24.7	370	306
Sand	18.7	22.4	205	275
Sand	57.0	61.2	1,400	1,512
Silt loam	10.8	9.7	223	161
Silt loam	79.8	71.0	732	648
Silt loam	48.3	54.5	506	512

Although the displacement method has received only slight recognition, the writer believes it has many possibilities. It seems to offer an opportunity for a more careful study of the concentration, composition, and reaction of the soil solution. A more complete knowledge of the changes that take place in the soil solution should aid in the solution of many of the problems of the soil fertility, plant nutrition, and related subjects.

F. W. PARKER

UNIVERSITY OF WISCONSIN