consisting of small needles or fibres and giving a satin-like sheen is produced, and this is centrifuged off. The precipitate is now dissolved in water and reprecipitated several times with dilute ammonium sulphate solution and with acid at about pH 4.8. If this fails to give colourless solutions, further purification can be effected by high-speed centrifugation or by incubation with trypsin. Highly purified preparations of the cucumber viruses, if sufficiently concentrated, separate into two liquid layers; the lower layer is spontaneously birefringent and the upper layer readily shows the phenomenon of anisotropy of flow.

Systemic infections of cucumber plants were obtained by inoculating 1 c.c. of a solution containing 10^{-9} gm. of these nucleoproteins, and specific precipitates with antiserum were obtained with $1/8 \times 10^{-6}$ gm. No infection of tobacco, tomato, *Nicotiana glutinosa* or Golden Cluster beans (all of which are susceptible to tobacco mosaic virus) was obtained, even when they were inoculated with concentrated solutions.

Purified preparations of cucumber viruses 3 and 4 do not differ appreciably from one another in any of the properties yet investigated, but they differ in some respects from those of tobacco mosaic virus. Their precipitation point with acid in dilute salt solutions is about pH 4.8, and in the absence of salts about pH 5.5, whereas for tobacco mosaic virus preparations these points are pH 3.4 and 4.2 respectively. It is tempting to associate the difference in host range of the two groups of viruses with their behaviour with acid, for the pH of expressed cucumber sap is about 7.8 whereas that of tobacco sap is about 5.8.

The preparations of cucumber viruses 3 and 4 are very similar to one another antigenically, and they are also serologically related to those of tobacco mosaic virus. They differ antigenically, however, much more from tobacco mosaic virus than from one another, and much more than the recognized strains of tobacco mosaic virus differ from each other. As yet only preparations of viruses serologically related to tobacco mosaic virus have been found to show anisotropy of flow and to form spontaneously birefringent solutions. From plants infected with five distinct viruses not serologically related to tobacco mosaic virus, we have been unable to isolate any substances with these properties by precipitation with acid or strong salt solutions, although highly infective preparations have been obtained.

With these cucumber viruses, as with those previously described, we have been unable to dissociate virus activity from the liquid crystalline nucleoproteins, but there is no proof that our preparations contain only particles capable of infecting susceptible plants.

We wish to thank Dr. G. C. Ainsworth for supplying us with cucumber viruses 3 and 4, and Mr. E. T. C. Spooner for preparing the antisera used.

F. C. BAWDEN.

Rothamsted Experimental Station,
Harpenden, Herts.

N. W. PIRIE.

Biochemical Laboratory,
Cambridge.

Latent Impurities in Electrodes used for Spectrographic Research

THE recent communication in NATURE by D. A. Webb¹ is of particular interest to me because for the last six years a minor part of my time has been devoted to an attempt to evolve a satisfactory spectrographic method for analysing plant material for the twenty or so elements usually present. Great progress has recently been made as a result of invaluable and much appreciated help given voluntarily by Mr. A. L. Tackley from September to January. The resulting method promises to be satisfactory and it is hoped to standardize it shortly. The great importance of the determination of the minor, as well as the major, elements in plant and animal tissues, in view of the increasing realization of their importance to the organism, seems to justify some mention of the progress made in meeting the difficulties mentioned by Webb.

The method consists in preparing small electrodes from the plant material itself without the addition of any foreign substance, except platinum wire, and comparing its spectrogram with that given by one of known composition prepared by adding pure substances to the purest grade of filter paper.

The plant material is kept at 200° C. for 24 hours, after which it is ground in an agate mortar. 0.0035 gm. of the dark brown powder is compressed in a specially constructed press under a pressure of the order of 500 tons per sq. in. around the end of a short length of platinum wire of diameter 0.005 in. The electrode is transferred by its platinum wire to a small specially designed electric furnace, in which the carbonization is effected by heating for five minutes at a low red heat, following a preliminary heating for the same length of time with half the current flowing. Two such electrodes, each measuring about 2 mm. in diameter and 1 mm. long, are held by the platinum wire and sparked in an atmosphere of nitrogen. Practically the whole of the material may, if desired, be disintegrated. It is fortunate that, under the conditions of excitation so far employed, the platinum spectrum has not appeared on the plate.

As is well known, even the purest filter paper contains minute quantities of impurities, mainly calcium and silicon. This admittedly is a drawback, but it is not a serious one, because these elements occur in comparatively large amount in almost all parts of plants. Filter paper has the great advantage for the purpose of being composed of one of the main organic constituents of the plant, namely, cellulose, so that the resulting electrode should resemble closely in texture the one prepared from plant material. Further, by means of specially designed micro-pipettes, known volumes of standard solutions may be quickly and accurately added to the paper. The pipette is filled by capillarity when its tip touches the surface of the liquid and is emptied by being allowed to touch the filter paper. The pieces of filter paper with their charges of salts are dried and treated in the same way as plant material.

The method, with slight modifications, should be applicable to a variety of types of material. In view of the promising results so far obtained, it will be developed as rapidly as limited man-power allows.

W. A. ROACH.

East Malling Research Station,
Kent.
Feb. 12.

¹ Webb, D. A., NATURE, 139, 248 (1937).

¹ Bawden, F. C., Pirie, N. W., Bernal, J. D., and Fankuchen, I., NATURE, 138, 1051 (1936).

² Ainsworth, G. C., Ann. Appl. Biol., 22, 55 (1935).