Separations of mixtures containing individual components with R_{Ph}-values higher than *c.* 1·20 were often facilitated by using the slow No. 50 Whatman paper.

A fuller account of the work will be published in *Acta Chemica Scandinavica*.

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[1] Grote, I. W., *J. Biol. Chem.*, **93**, 25 (1931).
[2] Feigl, F., "Qualitative Analysis by Spot Tests" (3rd edit., New York—Amsterdam, 1946).

Use of Ion-Exchange Resins in Paper Chromatography of Sugars

THE recent communication by Phillips and Pollard[1] suggests that results obtained here may be of interest. In the paper chromatography of dilute and very impure sugar solutions, such as non-diabetic urines or certain protein hydrolysates, it is common practice to use beforehand a 'mixed bed' ion-exchange resin to remove interfering anions and cations[2]. For example, 'Bio-Deminrolit E', a mixture of a weakly basic resin containing amine groups and a sulphonic acid type resin, is shaken with the solution for 20 min. and, after centrifuging, the clear supernatant contains all the sugars (except amino-sugars and uronic acids) uncontaminated by ionizable substances[3]. When 'Bio-Deminrolit E' was replaced by 'Bio-Deminrolit' or 'Bio-Deminrolit F', which are mixtures of sulphonic acid type resins with strongly basic resins of the quaternary ammonium hydroxide type, it was found that all fructose, glucose, galactose, mannose and fucose were removed from the dilute solutions employed.

The effect was investigated using columns 1 cm. diameter and 2–5 cm. long of 'Amberlite IRA400' (OH form), and it was found that 2 mgm. of glucose, for example, was completely removed from solution by such a column and, with the quantity used, none or at most 10 per cent of the sugar was recoverable by immediate elution with dilute hydrochloric acid. Of the sugars investigated glucosamine[4], galactosamine and N-acetylglucosamine were anomalous in that, while they were completely removed by the resin, they were recovered quantitatively by hydrochloric acid elution. Non-reducing sugars were not investigated.

If 'Bio-Deminrolit' is saturated with carbon dioxide, the quaternary ammonium bicarbonate is formed. The resulting mixed resin is used in this laboratory in place of 'Bio-Deminrolit E' (now unobtainable) and is very satisfactory. There was no appreciable loss of fructose or glucose from a dilute solution of the sugars left over 'Bio-Deminrolit' (HCO_3' form) for nine days at 0 °C.

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[1] Phillips, J. D., and Pollard, A., *Nature*, **171**, 42 (1953).
[2] Partridge, S. M., *Biochem. J.*, **42**, 238 (1948).
[3] Woolf, L., *Great Ormond Street J.*, **1**, 61 (1951).
[4] Piez, K. A., Tooper, E. B., and Fosdick, L. S., *J. Biol. Chem.*, **194**, 669 (1952).

Separation and Structural Determination of the Olefinic Components of Poison Ivy Urushiol, Cardanol and Cardol

THE noxious saps of numerous members of the Anacardiaceæ, such as Japanese lac, poison ivy, cashew nut shell liquid, etc., contain phenolic bodies carrying long unsaturated side-chains attached to the benzene ring. Earlier investigators[1] have in certain cases established the length and the position of these alkenyl side-chains; but prior to the present investigation only very limited information was available concerning the structural details of the unsaturation. There is no doubt, however, that the unsaturation in the side-chain plays an important part both in the physiological properties[2] and industrial uses[3] of these compounds.

To explain the formation of a variety of oxidative degradation and ozonolysis products, Majima[1] concluded that Japanese lac urushiol is hetero-olefinic in character. He proposed structures for mono-, di- and tri-olefinic components; but he was not able to separate these components for their decisive structural identification. In fact, work now in progress in these laboratories[4] indicates that two of the structures proposed by Majima will have to be modified.

Earlier investigations[5] in this laboratory have established that the alkenyl phenols, anacardic acid and cardanol (also called anacardol[1]) obtained from the shell liquid of the cashew nut are also hetero-olefinic in character. However, no evidence has been available concerning the olefinic heterogeneity of cardol, the resorcinol component largely responsible for the dermatitis caused by cashew nut shell liquid[2].

Most of the interest in the United States in regard to the physiological properties of these alkenyl phenols has been focused on poison ivy. The difficulty of obtaining the toxic phenol in pure form from the poison ivy sap has seriously hampered efforts to gain more information about its unsaturated character. Poison ivy urushiol absorbs hydrogen equivalent to about two double bonds and is converted into 3-pentadecylcatechol[1b]. Although Mason and Schwartz[6] concluded on the basis of preliminary chromatographic experiments that at least three toxic components are present in poison ivy urushiol, they did not separate these components in a form suitable for structural elucidation.

By means of chromatographic adsorption of the methyl ethers of three of these alkenyl phenols (poison ivy urushiol, cardanol and cardol) on alumina, we now have been able to separate the different olefinic components in pure form. In the case of poison ivy dimethyl urushiol, four components have been isolated—one of which had a completely reduced side-chain and the other three possessed one, two and three double bonds. Each of the three olefinic components absorbed the theoretical amount of hydrogen on catalytic reduction and yielded in pure form the saturated component (3-pentadecylveratrole). The structures of the four components of poison ivy urushiol now established on the basis of the products isolated from ozonolysis and oxidative degradation involving the dimethyl ether are shown in the accompanying formulæ (p. 842).

Cardanol, the monophenol obtained from the cashew nut shell liquid, was found to absorb hydrogen equivalent to about two double-bonds. Its methyl ether was also separated into four chromatographically pure components, the side-chains of which proved to be identical with those of the corresponding

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