

accurate measurement of peak areas; an overall spread similar to that quoted was obtained.

R. S. EVANS
P. G. W. SCOTT

W. G. Pye and Co., Ltd.,
Cambridge.

¹ Lovelock, J. E., *J. Chrom.*, **1**, 35 (1958).

² Willis, V., *Nature*, **184**, 894 (1959).

³ Lovelock, J. E., *Gas Chromatography*, 1960 (Butterworths, London, 1960).

An Organo-clay Complex for the Separation of Isomeric Dichlorobenzenes using Gas Chromatography

WHITE¹ has shown that dimethyldioctadecyl ammonium bentonite is particularly suitable as a stationary phase for the chromatographic separation of aromatic and aliphatic compounds, while Hughes, White and Roberts² have shown that this material is equally suitable for the separation of isomeric xylenes, toluidines and cresols. Further work by Cowan and White³ has shown that similar organo-clay complexes are adsorbents for phenols, the adsorbents showing widely differing specificity for the various isomers, and from the data presented the authors propose that the electronic transitions occurring within the sorbate molecules are the main contributory forces governing the extent of adsorption. In consequence, the use of organo-clay complexes for separating isomeric compounds is particularly appropriate and a further example, the separation of dichlorobenzenes, has been investigated and the results obtained compared with those for a conventional liquid stationary phase.

The relative retention volumes for the dichlorobenzenes are given in Table I and these are expressed relative to the *para* isomer—in all cases the values are corrected for the dead space of the column. A typical chromatogram is shown in Fig. 1 and this was obtained with a column 200 cm. long \times 0.4 cm. bore containing 10 gm. 60–80 mesh 'Celite' as a diluent for 1.0 gm. of dimethyldioctadecyl ammonium bentonite ('Bentone 34', Abbey Chemicals, Ltd.)—the detector was a β -ray ionization unit as supplied by Gas Chromatography, Ltd.

It is noted that using 'Bentone 34' as a stationary phase, a complete resolution of the dichlorobenzenes is obtained whereas with the silicone oil virtually no separation of the *para* and *meta* isomers is effected. Furthermore, even with a capillary column and dinonyl sebacate as a stationary phase complete resolution of these isomers is not possible. It is also noted that, with the solid 'Bentone' stationary phase, symmetrical elution peaks are obtained.

Table 1

	Relative retention volume			
	Silicone oil		'Bentone 34'	
	80° C.	110° C.	80° C.	110° C.
Benzene	0.08	—	0.11	—
Chlorobenzene	0.28	0.37	0.68	0.79
<i>p</i> -Dichlorobenzene	1.00	1.00	1.00	1.00
<i>m</i> -Dichlorobenzene	1.02	1.02	2.23	2.14
<i>o</i> -Dichlorobenzene	1.17	1.12	5.64	4.80
1,2,4-Trichlorobenzene	3.11	2.47	—	16.0
	Specific retention volume (ml.)			
<i>p</i> -Dichlorobenzene	440	161	840	246

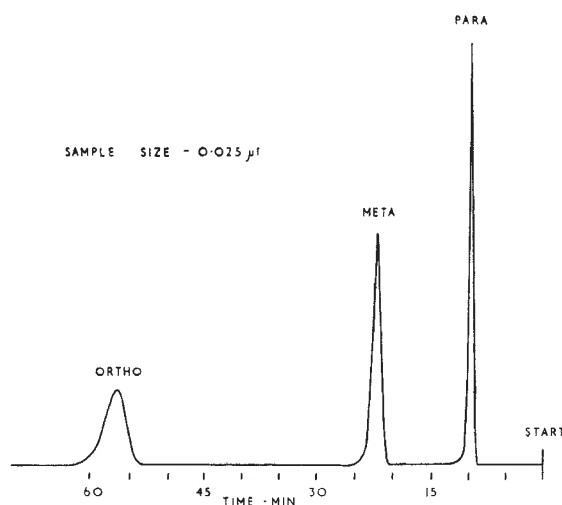


Fig. 1

From the results and those obtained by previous workers, it is suggested that the use of organo-clay complexes as stationary phases in chromatography warrants more detailed investigation. Since inter-lamellar distances within the clay complex play an important part in the adsorptive properties, and as these distances are governed by the size of the substituting amine ion⁴, it is expected that further work will reveal that it is possible to prepare an organo-clay stationary phase of pre-determined resolving characteristics for a specific separation of organic compounds.

We thank the directors of the Fullers' Earth Union, Ltd., for permission to publish this communication.

C. T. COWAN
J. M. HARTWELL

The Fullers' Earth Union, Ltd.,
Patteson Court,
Nutfield Road,
Redhill, Surrey.

¹ White, D., *Nature*, **179**, 1075 (1957).

² Hughes, M. A., White, D., and Roberts, A. L., *Nature*, **184**, 1796 (1959).

³ Cowan, C. T., and White, D., *Proc. Ninth National Clay Conf., Lafayette*, 1960 (in the press).

⁴ Grim, R. E., *Clay Mineralogy*, 250 (McGraw-Hill, 1953).

The Possibility of obtaining E.M.F. directly from Acid-Base Reactions: Electrodes of the Third Kind reversible to Alkaline Earth and Other Ions

SOME years ago Shedlovsky^{1,2} suggested that proton transfer reactions could give rise directly to e.m.f., and apparently confirmed this idea by demonstrating that a glass electrode, coated with lauric acid and barium laurate, acted as a barium electrode. There is a simpler explanation of this result, however: namely, the glass electrode with lauric acid and barium laurate acts as an electrode of the third kind. In a barium chloride solution saturated with these substances, the activities of barium and hydrogen ions must be related by the equation:

$$a_{\text{H}} = (k_{\text{HL}}/k_{\text{BaL}_2})^{1/2} \cdot a_{\text{Ba}}^{1/2}$$

k representing the thermodynamic solubility product. In such solutions the glass electrode, responding to