$$= \Big[(q + \alpha c)x\Big]_{c=0}^{c=\bar{c}} - \int_{0}^{\bar{c}} \Big(\frac{dq}{dc} + \alpha\Big)\, x\, dc \qquad (2b)$$

$$= \bar{q}\bar{x} + \alpha\bar{c}\bar{x} - v\bar{c} \qquad (2c)$$

Thus we obtain for the amount adsorbed

$$\bar{q} = f_{(\bar{c})} = (\,[\mu]_{\bar{c}} + v\bar{c})/\bar{x} - \alpha\bar{c} \qquad (3)$$

Since μ is obtained experimentally as the total subsequent eluate in grams when $\bar{x}$ represents the length of the column, the complete adsorption isotherm can be obtained from a single chromatographic experiment simply by measuring the concentrations of successive eluted fractions.

The same integration can be carried out for two (and more) solutes. The fundamental equations for the mixed band of varying concentration

$$v/x - \alpha = dq_1/dc_1 = dq_2/dc_2 \qquad (4)$$

require that co-existing values of c_1 and c_2 are functions of each other only; so that

$$q_1 = f_{(c_1 c_2)} = \Phi_{1(c_1)} \qquad (5a)$$

$$q_2 = g_{(\bar{c}_1 \bar{c}_2)} = \Phi_{2(c_2)} \qquad (5b)$$

This means that within the diffuse mixed band the two solutes behave individually like single solutes, having an adsorption isotherm which is modified by the presence of the other solute. They follow the equations :

$$v/x - \alpha = d\Phi_{1(c_1)}/dc_1 = d\Phi_{2(c_2)}/dc_2, \qquad (6)$$

where the functions Φ_1 and Φ_2 depend on f and g, and also on the initial concentrations $c_1{}^0$ and $c_2{}^0$. This makes it possible to integrate equation 6 in the same way as equation 1, resulting in :

$$\bar{q}_1 = f_{(\bar{c}_1\bar{c}_2)} = (\,[\mu_1]_{\bar{c}_1\bar{c}_2} + v\cdot\bar{c}_1)/\bar{x} - \alpha\bar{c}_1 \qquad (7a)$$

$$\bar{q}_2 = g_{(\bar{c}_1\bar{c}_2)} = (\,[\mu_2]_{\bar{c}_1\bar{c}_2} + v\cdot\bar{c}_2)/\bar{x} - \alpha\bar{c}_2 \qquad (7b)$$

The presence of the tail band of pure component I seems to complicate the procedure, but this is actually not so; it can be shown that the total amount contained in the pure tail band is identical with what it would contain if equation 6 were continued beyond the point x_0, where solute II becomes zero. Thus μ_1 actually represents the total amount of solute I—both pure and mixed—which remains in the column when the eluate reaches the concentration $\bar{c}_1$.

This method of determining the adsorption isotherms of binary mixtures was found to give accurate and reproducible results, provided that the chromatographic separation was carried out with negligible 'channelling' and sufficiently slowly, so as to reach local equilibrium between solution and adsorbent everywhere. Several elution experiments using widely different ratios of $c_1{}^0/c_2{}^0$ are required to cover the whole range of a binary adsorption isotherm. Details and experiments will be published in due course.

Incidentally, if equation $7a$ is applied to the state of complete chromatographic separation of two solutes (by making $\mu_1 = m_1$, that is, the total solute I, $c_1 = c_1' = [c_1]_{c_2=0}$ and $x = x_0 = v\cdot[\alpha + dg_{(c_1 0)}/dc_2{}^{-1}]$), this leads to the volume of pure solvent V required for complete separation :

$$V = m_1 \cdot \frac{\alpha + g'_{(c_1' 0)}}{f_{(c_1' 0)} - c_1' \cdot g'_{(c_1' 0)}}, \qquad (8)$$

which is in agreement with equation 6 of an earlier communication[2] where α had been neglected.

E. GLÜCKAUF.

University Science Laboratories,
Durham.   Sept. 7.

[1] de Vault, D., *J. Amer. Chem. Soc.*, **65**, 532 (1943).
[2] Glückauf E., *Nature*, **156**, 205 (1945).

Efficacy of D.D.T. in Soap

ONE of the remarkable features of the successful use of D.D.T.-impregnated clothing against the louse is the prolonged insecticidal effect of the clothing after several launderings, which would appear to indicate a strong absorption of the compound on the textile fibres. It occurred to us that animal hair might behave in the same way, and that useful results might be obtained in veterinary practice by the simple expedient of incorporating D.D.T. in soap[1].

Rather more than a year ago, we began experiments using varying proportions of the insecticide milled with household soap, and through the kindness of several dog owners and veterinary surgeons we were enabled to arrange practical trials. Twelve dogs were treated, including spaniels, sheepdogs and other long-haired breeds, having infestations either of the dog flea, *Ctenocephalus canis*, or the dog louse, *Trichodectes canis*, varying from slight to heavy. The animals were washed with the soap and warm water for 10–15 minutes, then rinsed down and rubbed dry in the usual manner. All fully grown parasites on the dogs were seen to be killed by this treatment. Seven of the dogs were kept under observation for a further three months, during which period they were freely exposed to re-infestation. The first sign of this appeared nine weeks later, and was limited to one animal, the others remaining free from re-infestation for the duration of the trials. In two instances eggs of the insects were known to be present, but these failed to hatch during the normal period. It therefore seems that a considerable degree of immunity from such parasites can be conferred upon animals by washing with D.D.T. soap, and this should be of importance not only to dog owners, but also to farmers and animal breeders in general.

With the view of estimating the amount of insecticide left on the hair, we analysed samples from treated and untreated animals by solvent extraction, and found that the percentage of hydrolysable chlorine in untreated hair was 0·002 per cent, whereas treated samples ranged from 0·005 to 0·007 per cent, equivalent to 0·05–0·07 per cent of D.D.T. It is surprising that these minute amounts of D.D.T. should give such a lasting effect. In the case of clothing impregnated with D.D.T., a concentration of only 0·01 per cent of the compound in the impregnation solution gave surfaces displaying noticeable insecticidal properties against the louse[2]. It would appear, therefore, that there is a similar absorption on the surface of the hair which prevents the D.D.T. from being washed off with the soap medium. Experiments to examine the mechanism further are in hand.

G. A. CAMPBELL.

The Geigy Co., Ltd.,
Manchester, 3.

F. C. HYMAS.

Spratt's Patent, Ltd.,
London, E.14.

T. F. WEST.

Stafford Allen and Sons, Ltd.,
London, N.1.
Aug. 29.

[1] Geigy Company, Ltd., B.P. Application 1944.
[2] Domenjoz, R., *Schweiz. med. Wchschr.*, **74**, 954 (1944).