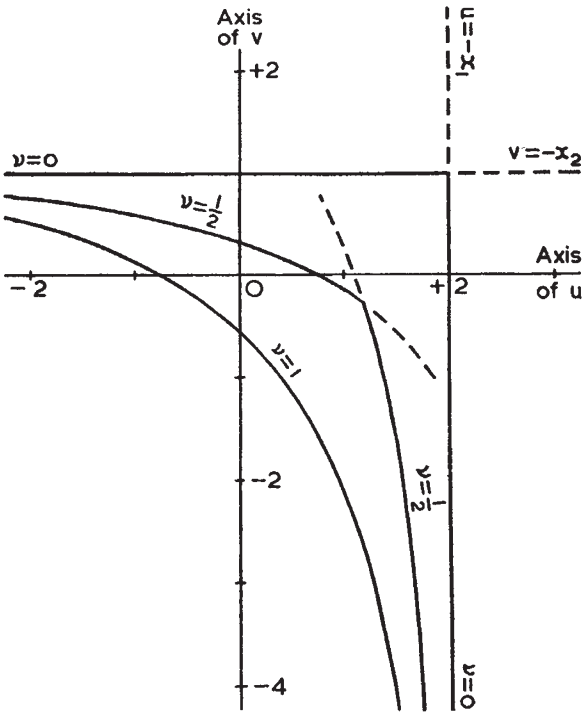

Fig. 1

and

$$\nu h^{(x_1+u)/\theta_1} + h^{(x_2+v)/\theta_2} \leqslant 1 \qquad (5)$$

Here h is the base of logarithms and ν is a parameter, ranging from 0 to 1, measuring the degree of similarity between the physiological actions of the two drugs. When $\nu = 0$, (3) is the equation for independent action that we obtained before; when $\nu = 1$, it is the equation for simple similar action.

Fig. 1 shows in plan exemplary regions of the bivariate normal surface defined by (4) and (5), and is comparable to a figure we gave before[2] to illustrate the regions for independent action. For Fig. 1, $x_1 = -2$, $x_2 = -1$, $\theta_1 = 4{\cdot}5$, $\theta_2 = 8$ and $h = 10$. The boundaries of integration are the continuous lines marked with the corresponding values of ν, namely, 0, $\frac{1}{2}$ and 1. The regions of integration lie to the left of and below the boundaries.

In the special case in which $\nu = 1$, and $\rho = +1$, (3) becomes

$$h^{(x_1-x)/\theta_1} + h^{(x_2-x)/\theta_2} = 1 \qquad (6)$$

where x is the normal equivalent deviation corresponding to $1 - q$. The equation that we put forward previously for simple similar action was (6) with the restriction that $\theta_1 = \theta_2$. Equation (6) with $\theta_1 \neq \theta_2$ accounts for some data[3] on the joint action of certain insecticides closely related chemically.

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[1] Plackett, R. L., and Hewlett, P. S., *J. Roy. Statist. Soc.*, Ser. B. **14**, 141 (1952).
[2] Plackett, R. L., and Hewlett, P. S., *Ann. App. Biol.*, **35**, 347 (1948).
[3] Turner, N., Connecticut Agric. Exp. Sta. Bull. No. 594 (1955).

Homoserine in Bleeding Sap of Pea Plants

In a recent paper[1], it was shown by means of paper chromatography that in bleeding sap of pea plants $5\frac{1}{2}$ weeks old, inoculated with effective strains of *Rhizobium*, some amino-acids and amides occurred. The chief of these compounds proved to be aspartic acid, asparagine, glutamine and a substance giving a colour with ninhydrin, of which the R_F values on nearly all chromatograms corresponded with those of threonine. Only when using phenol/water as solvent was a somewhat higher R_F value found. The other solvents used were: collidine/water; butanol/acetic acid/water; propanol/water[2].

In an attempt to identify the spot, the following solvents were used: 'Methylcellosolve' (ethyleneglycol monomethylether)/water[3]; methanol/water/pyridine[4]; *tert.*butanol/methylethylketone/water/diethylamine[4]. Of these three solvents, only the latter produced for the unknown substance an R_F value deviating from that of threonine, as phenol/water did.

By comparing a mixture of known amino-acids (including homoserine) with the substance on the chromatograms, and by adding homoserine to the bleeding sap before running the solvents, the unknown spot was finally identified[5–9] as homoserine (an isomer of threonine).

This homoserine was found for the first time in 1953 by A. I. Virtanen and co-workers[5,6] to be one of the principal free amino-acids (70 per cent ethanol-extract) occurring in pea plants. Later on it was found by Virtanen and co-workers[7] to occur as such also in other plants (even in non-legumes) although in smaller quantities.

The procedure described above proves that for chromatographical identification of amino-acids in fluids of unknown composition, it is imperative to determine R_F values in several different solvents (five at the least), before deciding upon the identity of a spot.

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[1] Wieringa, K. T., and Bakhuis, Janny A., *Plant and Soil*, **8**, 254 (1957).
[2] Boissonnas, R. A., *Helv. Chim. Acta*, **33**, 1966 (1950).
[3] Bender, A. E., *Biochem. J.*, **48**, xv (1951).
[4] Redfield, R. R., *Biochim. Biophys. Acta*, **10**, 344 (1953).
[5] Miettinen, Jorma K., Kari, Sigrid, Moisio, T., Alfthan, M., and Virtanen, A. I., *Suomen Kemistilehti*, **26**, B, 26 (1953)
[6] Virtanen, A. I., Berg, Ann Marie, and Kari, Sigrid, *Acta Chem. Scand.*, **7**, 1423 (1953).
[7] Berg, Ann Marie, Kari, Sigrid, Alfthan, M., and Virtanen, A. I., *Acta Chem. Scand.*, **8**, 358 (1954).
[8] Miettinen, Jorma K., *Ann. Acad. Sci. Fenn.*, A, **2**, 60, 520 (1955).
[9] Pfennig, N., *Arch. f. Microbiol.*, **24**, 8 (1956).

Abnormal Metamorphosis in Saturniid Moths infected by a Microsporidian

Deviations from the normal course of metamorphosis in insects may be caused by parasitic infections[1,2]. In studies on a microsporidian of the genus *Nosema*, found in *Hyalophora* (*Platysamia*) *cecropia* and afterwards sub-cultured in *Antheraea polyphemus* and *A. pernyi*[3], seventeen of the many infected animals failed to metamorphose normally. The most severely affected were adults of *H. cecropia*. They retained a number of pupal structures. The