the complex sequence of thermally-induced rearrangements in $4CaO{\cdot}Al_2O_3{\cdot}13H_2O$ which were reported by Buttler, Dent-Glasser and Taylor[7].

It has been determined that a reaction somewhat similar to that described above takes place between wetted mixtures of hydrous alumina and magnesium hydroxide. In this case the reaction is not rapid, the X-ray diffraction peaks for the new phase becoming evident only after several hours and slowly increasing in intensity over a period of several days. This product is apparently a double hydroxide of magnesium and aluminium. The X-ray pattern observed (Fig. 2) is very nearly identical with that given by Feitknecht and Gerber[8]. The present product yields a (001) spacing of 8·2 Å, which is slightly higher than the 7·9 Å spacing reported by these authors and the 7·95 Å and 7·63 Å spacings reported for different magnesium–aluminium double hydroxide preparations by Mortland and Gastuche[9].

I thank J. L. White, W. L. Dolch and E. B. Kinter for their advice.

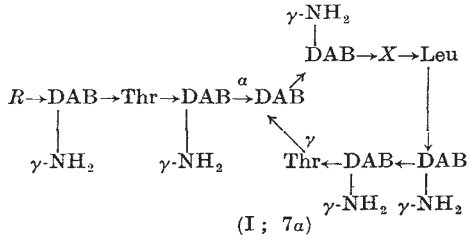
SIDNEY DIAMOND

U.S. Department of Commerce,
Bureau of Public Roads,
Washington, D.C.

[1] Glenn, G. R., and Handy, R. L., *Highway Res. Bd. Rec.*, **29**, 70 (1963).
[2] Diamond, S., White, J. L., and Dolch, W. L., in *Proc. Twelfth Nat. Clay Conf.*, edit. by Bradley, W. F. (Pergamon Press, New York, 1964; in the press).
[3] Roberts, M. H., *J. App. Chem.*, **543** (1957).
[4] Seligmann, P., and Greening, N. R., *J. Res. Develop. Lab., Portland Cement Assoc.*, **4**, 2 (1962).
[5] Alegre, R., *Rev. Matér. Constr. Trav. Publics*, **301** (1963).
[6] Hunt, C. M., thesis, Univ. Maryland (1959).
[7] Buttler, F. G., Dent-Glasser, L. S., and Taylor, H. F. W., *J. Amer. Ceram. Soc.*, **42**, 121 (1959).
[8] Feitknecht, W., and Gerber, M., *Helv. Chim. Acta*, **25**, 131 (1942).
[9] Mortland, M. M., and Gastuche, M. C., *C. R. Acad. Sci., Paris*, **255**, 2131 (1962).

## Structures of Polymyxin *B*2 and Polymyxin *E*1

FROM the degradative investigations of Suzuki *et al.*[1], and finally by its synthesis[2], the structure of polymyxin *B*1 has now been established as (I): ($R$ = (+)-6-methyloctanoyl, $X$ = D-Phe), in which each of the six αγ-diaminobutyric acid units is of the L-configuration[1,3].



(I; 7*a*)

Suzuki *et al.*[4] have also shown that the structure of colistin *A* is identical with that of polymyxin *B*1, except that the D-Phe in the latter is replaced by D-Leu (that is, I; $R$ = (+)-6-methyloctanoyl, $X$ = D-Leu).

From the partial acid hydrolysate of polymyxin *B*2 by fractionation on 'Dowex 50', using gradient elution with ammonium formate–ammonium acetate buffers, we have now isolated and identified the following peptides:

6-methylheptanoyl$\xrightarrow{\alpha}$L-DAB; Thr$\xrightarrow{\gamma}$DAB; Thr$\xrightarrow{\alpha}$DAB;

D-Phe→L-Leu; Leu$\xrightarrow{\alpha}$DAB; DAB→Phe;

Thr$\xrightarrow{\alpha}$DAB→DAB$\xleftarrow{\gamma}$Thr; D-Phe→Leu$\xrightarrow{\alpha}$DAB;

Thr$\xrightarrow{\gamma}$DAB$\xrightarrow{\alpha}$DAB; DAB→Phe→Leu; DAB$\xrightarrow{\alpha}$(DAB)$_n$;

Thr$\xrightarrow{\gamma}$DAB$\xrightarrow{\alpha}$DAB→Phe and Leu$\xrightarrow{\alpha}$DAB$\xrightarrow{\alpha}$DAB

With the exception of the first of these peptides, which is replaced by (+)-6-methyloctanoyl$\xrightarrow{\alpha}$DAB, they are identical with those obtained from a comparable hydrolysate of polymyxin *B*1.

We have also re-examined more thoroughly the partial acid hydrolysate of polymyxin *E*1 and by the procedure outlined above have isolated and characterized the following peptides:

D-Leu→L-Leu; (+)-6-methyloctanoyl$\xrightarrow{\alpha}$L-DAB; Thr$\xrightarrow{\gamma}$DAB;

Thr$\xrightarrow{\alpha}$DAB; L-Leu$\xrightarrow{\alpha}$DAB; Leu→Leu$\xrightarrow{\alpha}$DAB;

DAB$\xrightarrow{\alpha}$DAB→Leu→Leu; DAB→Leu→Leu;

Thr$\xrightarrow{\alpha}$DAB→DAB$\xleftarrow{\gamma}$Thr; Thr$\xrightarrow{\gamma}$DAB$\xrightarrow{\alpha}$DAB→D-Leu;

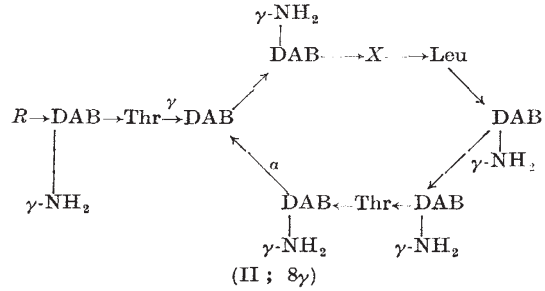
Thr$\xrightarrow{\gamma}$DAB$\xrightarrow{\alpha}$DAB; Thr$\xrightarrow{\gamma}$DAB$\xrightarrow{\alpha}$DAB→Leu→Leu;

DAB$\xrightarrow{\alpha}$(DAB)$_n$; DAB$\xrightarrow{\alpha}$DAB→Leu; Thr→DAB→DAB
↑
DAB$\xleftarrow{\alpha}$Thr

Thr$\xrightarrow{\alpha}$DAB$\xrightarrow{\alpha}$DAB→Leu→Leu; Leu$\xrightarrow{\alpha}$DAB$\xrightarrow{\alpha}$DAB

and Leu→Leu$\xrightarrow{\alpha}$DAB$\xrightarrow{\alpha}$DAB

The re-assembling of each of these two series of peptides in turn indicates that the structure of polymyxin *B*2 is restricted to either (I) or (II) ($R$ = 6-methylheptanoyl and $X$ = D-Phe) and that of polymyxin *E*1 to either (I) or (II) ($R$ = (+)-6-methyloctanoyl and $X$ = D-Leu).



(II; 8*γ*)

In the determinations of the unequivocal structures of both polymyxin *B*1 and colistin *A* by Suzuki *et al.*[1,4], the differentiation between formulæ (I) and (II) was not forthcoming from the products of partial acid hydrolyses but in each case only by the isolation of the peptide $R\xrightarrow{\alpha}$DAB→Thr$\xrightarrow{\alpha}$DAB by enzymatic hydrolysis. The close relationship between the physical properties of polymyxins *B*1 and *B*2 and their identities in the case of polymyxin *E* and colistin have already been described[5] so that fundamental differences between the structures of these pairs of antibiotics would not be expected, particularly taking into consideration, for example, the difference in optical rotation between the 7α and 8γ-type peptides synthesized by Vogler *et al.*[6]. It is intended to subject polymyxin *E*1 and polymyxin *B*2 to enzymatic degradation to confirm the correctness of structure (I).

S. WILKINSON
L. A. LOWE

Wellcome Research Laboratories,
Beckenham, Kent.

[1] Suzuki, T., Hayashi, K., Fujikawa, K., and Tsukamato, K., *J. Biochem.* (Japan), **54**, 555 (1963).
[2] Vogler, K., Studer, R. O., Lanz, P., Lergier, W., and Böhni, E., *Experientia*, **20**, 365 (1964).
[3] Wilkinson, S., and Lowe, L. A., *Nature*, **202**, 1211 (1964).
[4] Suzuki, T., Inouye, H., Fujikawa, K., and Suzeka, Y., *J. Biochem.* (Japan), **54**, 25 (1963). Suzuki, T., Inouye, H., Fujikawa, K., and Nagasawa, S., *ibid.*, **54**, 173 (1963). Suzuki, T., Hayashi, K., and Fujikawa, K., *ibid.*, **54**, 414 (1963).
[5] Wilkinson, S., and Lowe, L. A., *J. Chem. Soc.* (in the press).
[6] Vogler, K., Studer, R. O., Lanz, P., Lergier, W., Böhni, E., and Fust, B., *Helv. Chim. Acta.*, **46**, 2824 (1963).