

hexane-1:2-diol (adipic aldehyde); hydrobenzoin (benzaldehyde); lactic acid (acetaldehyde); mandelic acid (benzaldehyde). The initially rapid oxidation of lactic acid in aqueous solution soon stopped if the calculated amounts of reagent and lactic acid were used, presumably owing to the presence of unoxidizable esters. The reaction has been applied successfully on the 0.25-mol. scale for the preparation of ethyl glyoxylate and adipic aldehyde, and also of pelargonic aldehyde and azelaic aldehyde acid from 9:10-dihydroxystearic acid.

This type of oxidation is being further investigated, and work has been started on the oxidation of olefines by the same reagent: a full account will be published elsewhere in due course.

*Note added in proof.* In recent experiments the use of A.R. sodium bismuthate has been found more convenient, on account of its more uniform physical state.

W. RIGBY

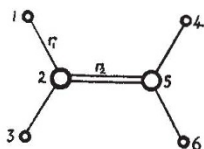
Department of Chemistry,  
Birkbeck College,  
London, E.C.4.  
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<sup>1</sup> Malaprade, *Bull. Soc. Chim.*, [4], **43**, 683 (1928), *C.R. Acad. Sci., Paris*, **186**, 382 (1928).

<sup>2</sup> Criegee, *Ber.*, **64**, 260 (1931).

### Interaction Terms in the Potential Functions for Polyatomic Molecules

It has been suggested that interaction terms in the potential functions for polyatomic molecules are derived from the changes in bond-hybridization which accompany the nuclear displacements<sup>1</sup>. The following considerations may be of some interest. In ethylene itself, the constant for interaction between the deformation of the terminal  $\widehat{CH}_2$  angles and the stretching of the C=C bond is not absolutely determinable, since the  $\widehat{CCH}$  angles change simult-



aneously. Referring to the accompanying figure, suitable valence force co-ordinates for the class  $A_2$  vibrations are as follows:

$$\begin{aligned} \nu_{CH}, & \Delta_1 = \Delta r_{12} + \Delta r_{23} + \Delta r_{45} + \Delta r_{56} \\ \nu_{C=C}, & \Delta_2 = \Delta r_{25} \\ \xi^s \widehat{CH}_2, & \Delta_3 = r_1 (\Delta \theta_{13} + \Delta \theta_{46} - \Delta \theta_{15} - \Delta \theta_{35} - \\ & \Delta \theta_{24} - \Delta \theta_{26}). \end{aligned}$$

If the force constants going with this set of co-ordinates are written as a matrix  $d$ , then the required constant is  $d_{23}$ ; but it is not possible to ascribe separate constants for the interactions  $\Delta r_{15} \cdot r_1 \Delta \theta_{13}$  and  $\Delta r_{25} \cdot r_1 \Delta \theta_{15}$ . If we destroy the symmetry by replacing atom 6 by a substituent, the nine planar vibrations fall into a single symmetry class, ( $A'$ ). With co-ordinates

$$\begin{aligned} \nu_{C=C}, & \Delta_1 = \Delta r_{25} \\ \xi^s \widehat{CH}_2, & \Delta_2 = r_1 (\Delta \theta_{13} - \Delta \theta_{15} - \Delta \theta_{35}) \\ \xi_{CH}, & \Delta_3 = r_1 (\Delta \theta_{46} - \Delta \theta_{24}) \\ \xi_{CH_2}, & \Delta_4 = r_1 (\Delta \theta_{15} - \Delta \theta_{35}); \\ & \dots \end{aligned}$$

and factoring<sup>2</sup> out the vibrations in the order  $\nu_1$  to  $\nu_4$  (having previously factored out the three C—H stretching modes), the following values for the interaction constants in vinyl chloride are obtained, using accepted assignments<sup>3</sup>:

$$\left. \begin{aligned} d_{12} &= -0.247 \\ d_{13} &= -0.249 \\ d_{14} &= 0.014 \end{aligned} \right\} \times 10^5 \text{ dynes/cm.}$$

The constant  $d_{23}$  in ethylene (normalized to correspond to  $d_{12}$ ), by the same procedure, takes the value  $-0.232$ , and the analogous constant in vinylidene chloride  $-0.255$ ,  $\times 10^6$  dynes/cm. The practically identical values of  $d_{12}$  and  $d_{13}$  for the vinyl group can only mean that the constant for interaction between deformation of the terminal angles and C=C stretching is negligible, there being a positive constant for the interaction  $\Delta r_{CC} \cdot r_{CH} \Delta \theta_{CCH}$  of magnitude  $\sim 0.25 \times 10^5$  dynes/cm. The negligible

value of  $d_{14}$  will be due to the two  $\widehat{CCH}$  deformations being out of phase in the  $CH_2$  bending mode.

I wish to express my gratitude to Courtaulds, Ltd., for making the present programme of work possible.

P. TORKINGTON

Physical Chemistry Laboratory,  
Oxford.  
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<sup>1</sup> Heath, D. F., and Linnett, J. W., *Nature*, **161**, 243 (1948). Coulson, C. A., Duchesne, J., and Manneback, C., *Nature*, **160**, 794 (1947). V. Henri Mem. Vol. (Liège: Desoer, 1947).

<sup>2</sup> Torkington, P., *Nature*, **162**, 370 (1948).

<sup>3</sup> Thompson, H. W., and Torkington, P., *Proc. Roy. Soc., A*, **184**, 21 (1945).

### Lactobacillus lactis Dorner for the Assay of Vitamin B<sub>12</sub>

Shorb<sup>1,2,3</sup>, Rickes<sup>4</sup> and Shive<sup>5</sup> have published accounts regarding the use of *Lactobacillus lactis* Dorner for assay of vitamin B<sub>12</sub>. The information disclosed by these authors does not, however, permit satisfactory assays to be uniformly conducted in liquid medium. Moreover, extreme inconsistency has been encountered by many workers in this field.

Investigations in these laboratories have resulted in the evolution of a technique which gives results comparing very favourably with other microbiological assays.

We have found that *Lactobacillus lactis* Dorner is remarkably prone to change its morphology under different cultural conditions, and that these changes alter its growth characteristics and its sensitivity to vitamin B<sub>12</sub>. When the organism is in an insensitive condition, satisfactory assays may be performed even when bacteriological peptone is used as the basal medium.

It is difficult to ensure a uniform degree of insensitivity; but the organism has been maintained in a constant condition of high sensitivity from a single colony isolation through more than 150 daily sub-cultures on agar containing 1 per cent 'Evans Bacteriological Peptone', 0.1 per cent 'Evans Hepamino', 0.1 per cent 'Tween 80' and either 5 per cent tomato juice or 0.01 per cent potato extract fraction. An overnight culture of this is washed into assay medium fortified with 0.1 per cent 'Hepamino', 0.1 per cent 'Tween 80', 2 per cent glucose and a source of *T.J.* factor. After incubation at 37° C. for 4–6 hours, the culture is washed twice with assay medium deficient in *LLD* factor, *T.J.*