fer, pH 9.0, only one peak was seen. The latter occupied the position allotted to the minor peak at pH 6.0). The amino acid composition of both samples agreed closely with that reported in the literature.[2]

In our studies with the sequencer, the two preparations yielded identical results.

For the automatic Edman degradation the Beckman sequencer (Model 890B) and the slow protein-Quadrol program was utilized.[3] Phenylthiohydantoins were identified by gas chromatography.[4]

When the intact enzyme was analyzed, the sole sequence at the amino end was found to be:

1 2 3 4 5 6 7 8
Val – Asn – Gly – Thr – Leu – Met – Gln – Tyr –
9 10 11 12
Phe – Glu – Trp – Tyr

As expected, after exposure of the enzyme to CNBr a component (A) was isolated that began as follows:

Gln – Tyr – Phe – Glu – Trp – Tyr

(The treatment with CNBr was performed by allowing a solution of 100 mg enzyme in 25 ml 70 % formic acid to stand for 17 h at room temperature followed by dilution with water and lyophilization. Chromatography on Sephadex G-100 utilizing 0.2 M ammonium hydroxide and monitored at 280 nm yielded two peaks. The first one to emerge was the fraction designated above as component A. This material seemed homogeneous upon polyacrylamide gel electrophoresis while the second fraction appeared heterogeneous).

Further studies of the primary structure of the α-amylase are in progress.

1. Mitchell, E. D., Riquetti, P., Loring, R. H. and Carraway, K. L. *Biochim. Biophys. Acta 295* (1973) 314.
2. Junge, J. M., Stein, E. A., Neurath, H. and Fischer, E. H. *J. Biol. Chem. 234* (1959) 556.
3. Edman, P. and Begg, G. *Eur. J. Biochem. 1* (1967) 80.
4. Pisano, J. J. and Bronzert, T. J. *J. Biol. Chem. 244* (1969) 5597.

Received June 12, 1974.

The Effect of *gem*-Dimethyl Groups in the Cyclization of Diynes

GERD BORGEN and GUDMUND GAUPSET

Kjemisk Institutt, Universitetet i Oslo, Blindern, Oslo 3, Norway

Since the smallest ring obtainable by oxidative coupling of a *gem*-dimethyl substituted diyne has been shown [1] to be the 18-membered, and the possibility of making cyclic compounds with *gem*-dimethyl groups in different positions is also limited in this method, other cyclization methods had to be considered in order to prepare certain *gem*-dimethyl-substituted rings required for conformational studies.

Cyclization of terminal diynes with dibromides in liquid ammonia to give unsubstituted cyclic diynes has been described earlier [2,3] and this method has now been tried on *gem*-dimethyl substituted diynes.

The cyclization reactions are specified in Table 1 where the corresponding yields and melting points of the cyclic acetylenes formed are also given.

No cyclization to the corresponding 16-membered ring was obtained using 5,5-dimethylnona-1,8-diyne and dibromoheptane. With the same diyne and dibromononane the yield was only 6 %. The longer diyne chain, 6,6-dimethylundeca-1,10-diyne, however, reacted with the shorter dibromide, dibromopentane, to give 15 % yield of cyclic product, and with the *gem*-dimethyl substituted dibromoheptane to give a cyclic, crystalline reaction product in 59 % yield.

The results can be explained by considering the possible conformations of the reactants. Bends on the carbon chain, caused by *gauche* bonds, will most easily occur at the carbon alpha to the acetylene bond or at the *gem*-dimethyl substituted carbon.[3,4] As pointed out earlier,[1] this effect and the additional effect of the steric requirements of the *gem*-dimethyl groups, reduces the number of probable conformers for 5,5-dimethylnona-1,8-diyne to only one, shown in Fig. 1A, having the *gem*-dimethyl group at the "corner" of the chain. The terminal acetylene groups are, however, quite distant in this conformer, and they point in directions unfavourable for cyclization. This explains why no cyclization was obtained with 5,5-dimethylnona-1,8-diyne in its reaction with 1,7-dibromoheptane, as well as the low yield obtained with the same diyne and 1,9-dibromononane. With a *gem*-dimethyl group in the 4-position of dibromoheptane the dibromide chain should more easily become bent and the chances for cyclization should increase; in another work [5] the corresponding 16-membered ring was indeed obtained.

The conformational situation after extension of the diyne chain with one methylene on each

Table 1. Yields and melting points in cyclization of *gem*-dimethyl substituted diynes and dibromides.

Reactants		Cyclic product	Yield	M.p.
Diyne	Dibromide		%	Cyclic diyne °C
5,5-Dimethylnona-1,8-diyne	1,7-dibromo heptane	[5,5-dimethylcyclohexadeca-1,8-diyne]	0	
»	1,9-dibromo-nonane	5,5-dimethylcyclo-octadeca-1,8-diyne	6	Liquid
6,6-Dimethylundeca-1,10-diyne	1,5-dibromo-pentane	6,6-dimethylcyclo-hexadeca-1,10-diyne	15	26
»	4,4-dimethyl-1,7-dibromo-heptane	6,6,15,15-tetramethyl-cyclo-octadeca-1,10-diyne	21 – 59	91

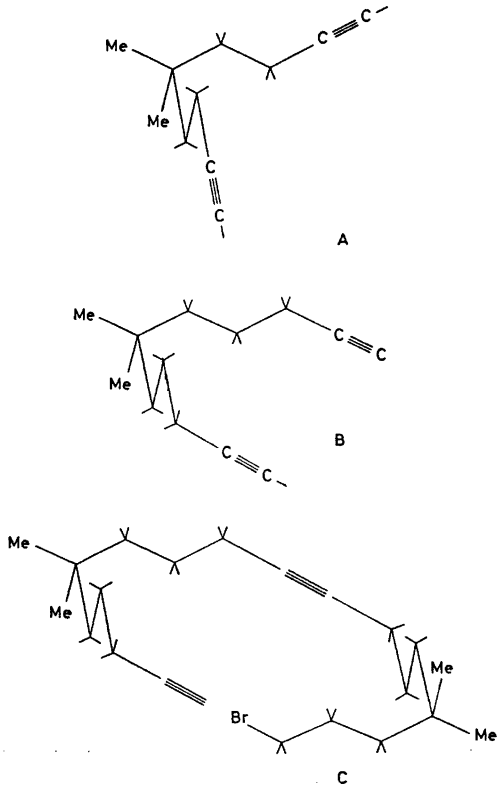

Fig. 1. Conformations before cyclization of:
A, 5,5-dimethylnona-1,8-diyne.
B, 6,6-dimethylundeca-1,10-diyne.
C, 6,6-dimethylundeca-1,10-diyne in reaction with 4,4-dimethyl-1,7-dibromoheptane.

side is shown in Fig. 1B. A conformation with the *gem*-dimethyl groups on a "corner" and with parallel terminal acetylene bonds well fitted for cyclization is then possible. This explains why this diyne gave with 1,5-dibromopentane a cyclic product in 15 % yield. In Fig. 1C the same diyne is shown to fit perfectly together with a conformationally more favourable dibromide. Here the two reactants can take similar conformations and their reacting end groups thereby come in very close positions before the final cyclization. This explains the good yield of cyclic diacetylene obtained in the reaction, as well as the stability of the conformation of the crystalline cyclic compound. It melts as high as 91 °C and shows the same infrared absorptions in the solid phase as in carbon disulfide solution.

Experimental. 5,5-Dimethylcyclo-octadeca-1,8-diyne. To a solution of sodamide, made by dissolving sodium (2.2 g = 0.094 mol) in liquid ammonia (600 ml) was added 5,5-dimethylnona-1,8-diyne [1] (7.0 g = 0.047 mol). After 1 h of stirring 1,9-dibromononane (13.5 g = 0.047 mol) was added. Stirring was continued under refluxing ammonia for 5 d. A condenser with solid carbon dioxide was used. Dry diethyl ether was added (400 ml) and stirring continued for 2 d. Thereafter water was added (500 ml), the ether phase thoroughly washed with water and dried with magnesium sulfate. After filtration and evaporation of ether the residue (9.0 g) was purified on an alumina column, eluted with a solution of benzene/pentane 1/3 whereby *5,5-dimethylcyclo-octadeca-1,8-diyne* (0.8 g = 6 %) was isolated. The compound did not crystallize above – 100 °C. Mol. w. 272 by mass spectrometry. Calc. M = 272. Further identified by the hydrogenated product.[8]

6,6-Dimethylundeca-1,10-diyne. Monosodium acetylide was prepared [6] by passing acetylene into a solution of sodium amide, prepared from sodium (5 g) in liquid ammonia (300 ml). 1,7-Dibromo-4,4-dimethylheptane, prepared in 8 steps from β,β-dimethylglutaric acid [7] was added during 20 min and the reaction mixture stirred for 40 h. The ammonia was allowed to evaporate,

water and diethyl ether added, the ether extract washed with water and dried over magnesium sulfate. Evaporation of the ether gave the crude *6,6-dimethylundeca-1,10-diyne* (7.6 g = 65 %) which was found by IR spectroscopy to contain no dibromide and was used in the next step without further purification.

13,13-Dimethylcyclohexadeca-1,8-diyne. To a stirred solution of sodamide, made from sodium (2.02 g = 0.088 mol) in liquid ammonia (600 ml), was added 6,6-dimethylundeca-1,10-diyne (7.5 g = 0.044 mol). After 1 h 1,5-dibromopentane (12 g) was added and the stirring continued for 8 d under refluxing ammonia. The ammonia was slowly evaporated, the residue dissolved in water and the water solution extracted with ether. The ether extracts were dried with magnesium sulfate, and the ether evaporated. The crude reaction product (7.3 g) was purified on an alumina column, and by elution with a benzene/pentane 1/3 solution was obtained the 13,13-dimethylcyclohexadeca-1,8-diyne (1.5 g = 15 %), m.p. 26 °C. (Found: C 88.33; H 11.45. Mol. w. 244 (by mass spectrometry). Calc. for $C_{18}H_{28}$: C 88.45; H 11.55. Mol. w. 244).

6,6,15,15-Tetramethylcyclo-octadeca-1,10-diyne. 6,6-Dimethylundeca-1,10-diyne (8.5 g = 0.05 mol) was added to a solution of sodamide, made from sodium (2.3 g = 0.1 mol) in liquid ammonia (600 ml) and stirred for 1.5 h.

4,4-Dimethyl-1,7-dibromoheptane [7] (14.3 g = 0.05 mol) was added and the reaction mixture was stirred and refluxed for 5 d. Dry diethyl ether (500 ml) was added, the ammonia evaporated and the ether solution stirred at room temperature for 2 d. Water was added, the ether solution washed with more water, dried with magnesium sulfate. After evaporation of ether the crystalline residue (8.5 g) was dissolved in petane and purified through a short alumina column. After recrystallization with ethanol was obtained: *6,6,15,15-tetramethylcyclo-octadeca-1,10-diyne* (3.0 g = 21 %, 8.5 g = 59 % yield as crystalline reaction product), m.p. 91 °C. (Found: C 87.79; H 12.04. Mol. w. 300 (by mass spectrometry. Calc. for $C_{22}H_{36}$: C 87.92; H 12.08. Mol. w. 300).

1. Borgen, G. and Dale, J. *Acta Chem. Scand. 26* (1972) 159.
2. Wotiz, J. H., Adams, R. F. and Parsons, C. G. *J. Amer. Chem. Soc. 83* (1961) 373.
3. Dale, J., Hubert, A. J. and King, G. S. D. *J. Chem. Soc.* (1963) 73.
4. Dale, J. *J. Chem. Soc.* (1963) 93.
5. Björnstad, S. L. and Borgen, G. *Acta Chem. Scand. B 29* (1975). *In press.*
6. *Inorg. Syn. 2* (1946) 75, 128.
7. Blomquist, A. T., Wheeler, E. S. and Chu, Y. *J. Amer. Chem. Soc. 77* (1955) 6307.
8. Björnstad, S. L., Borgen, G. and Gaupset, G. *Acta Chem. Scand. B 28* (1974) 821.

Received June 25, 1974.

Base-promoted Non-stereospecific 1,2-and 1,4-Elimination Reactions

ALF THIBBLIN and PER AHLBERG

Institute of Chemistry, University of Uppsala, Box 531, S-751 21 Uppsala, Sweden

The stereochemistry of elimination reactions from the two diastereomeric 1-(1-acetoxyethyl)-indenes (A_1 and A_2) and from 3-(1-acetoxyethyl)indene (B) have been studied in MeO^-/MeOH. The mechanisms of the elimination reactions are discussed.

When a methanol solution 0.03 M in substrate was reacted with KOMe or NaOMe (0.06 M) at 30 °C, *trans-* and *cis-*1-ethylideneindene (C_1 and C_2) were obtained (Scheme 1). The proportions varied considerably with the substrate structure (A_1, A_2, and B). The thermodynamic equilibria exclusively favour C_1 and C_2, no trace of A_1, A_2, or B being observed after long reaction times. Neither any epimerization of A_1 or A_2 nor any 1,3-proton transfer to B could be observed when a deficiency of base was used. The reactions were studied using a quench – – extraction – NMR procedure. The results are given in Table 1.

Table 1. Product compositions obtained with A_1, A_2, and B in MeO^-/MeOH at 29.96 ± 0.07 °C.

Initial substrate conc. 0.03 M	Initial [NaOMe] M	Initial [KOMe] M	$\frac{100\ C_2}{C_1+C_2}$
A_1	0.06		37.1 ± 2.0
A_1		0.06	37.0 ± 2.0
A_2	0.06		8.1 ± 2.0
A_2		0.06	8.2 ± 2.0
B	0.06		22.6 ± 2.0
B		0.06	22.5 ± 2.0
A_1[a]	0.02		38 ± 3
A_2		0.01	7.4 ± 2.0

[a] 0.05 M.

A preliminary correlation between diastereomers and structures (A_1 and A_2) has been made assuming *anti* elimination from substrate A_2 to be favoured over *syn* elimination. The same structure assignments were obtained using Cram's rule. In NMR-spectra of mixtures of C_1 and C_2 the methyl group of C_2 appears at 0.18 ppm lower field. The proximity of the methyl group of C_2 to the deshielding region of the benzene ring is assumed to yield proton resonance at lower field than the methyl protons of C_1.