

- [28] J. A. Cifonelli & F. Smith, *Analyt. Chemistry* 26, 1132 (1954); H. J. Gordon, W. Thornberg & L. N. Weran, *ibid.* 28, 849 (1956); D. F. Mowery, *ibid.* 29, 1560 (1957).
- [29] E. Wiesenberger, *Mikrochem.* 33, 51 (1947).
- [30] a) M. Schulz & B. Tollens, *Liebig. Ann. Chem.* 289, 20 (1896); b) A. T. Ness, R. M. Hann & C. S. Hudson, *J. Amer. chem. Soc.* 65, 2215 (1943).
- [31] M. Lounasmaa, A. Karjalainen, C.-J. Widén & A. Huhtikangas, *Acta chem. scand.* 26, 89 (1972); vgl. M. Lounasmaa, C.-J. Widén & T. Reichstein, *Helv.* 54, 2850 (1971).
- [32] D. Vorländer, *Z. analyt. Chem.* 77, 241 (1929); G. Klein & H. Linser, *Mikrochemie Pregl Festschr.* 1929, 204; *Chem. Zentralbl.* 1930, I. 2085; F. C. Horning & M. G. Horning, *J. Org. Chemistry* 11, 95 (1946).

163. The Epimerization of Trimethylsilyl Ethers During Their Gas Chromatographic Analysis

by Jacques Kagan and David A. Harrison

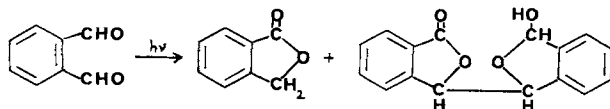
Chemistry Department, University of Illinois at Chicago Circle,
Chicago, Illinois 60607

(9. V. 72)

We are grateful to the donors of the *Petroleum Research Fund*, administered by the *American Chemical Society*, to the *National Science Foundation* and to the *Research Board* of the University of Illinois for support of this research, to Dr. B. Willhalm for useful comments and to the Department of Organic Chemistry, University of Geneva, for its hospitality (1971/72).

Trimethylsilylation is the most powerful method presently available for increasing the volatility of sugars and other hydroxylated molecules, and making them suitable for gas chromatographic analysis [1]. Its major characteristics are ease of formation of the derivative, stereochemical reliability and thermal stability. Thus, anomeric sugars such as α - and β -glucose were reported to give different trimethylsilyl (TMS) ethers, which had different retention times [1]. In contrast, we now wish to present evidences for a thermal isomerization of TMS ethers occurring during their glc analysis.

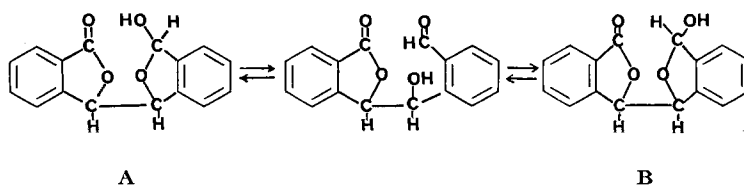
The photolysis of *o*-phthalaldehyde (OPT) gives phthalide and dimers [2], the product composition being solvent and concentration dependent [2] [3] [4].



The dimer structure has three chiral centers. Oxidation of the hemiacetal removes one of them, and Cohen, Pinkey & Smith [5] reported that they obtained an oxidized dimer which was exclusively *meso*, corresponding to an *erythro* structure for their original dimer. By a combination of glc and nmr analyses, we found that the oxidized dimers were, in fact, a mixture of *d,l* and *meso* in a ratio depending on the nature of the solvent used in the photolysis [3] [4]. While the dimers obtained in heptane or chloroform were almost exclusively *erythro*, photolysis in dimethylformamide yielded a dimer containing ca. 40% of *threo* products.

The dimers belonging to the *threo* and *erythro* series could be separated quite cleanly by taking advantage of the difference in their solubility in acetone. The acetone soluble products belonged to the *threo* series, while the insoluble fraction was *erythro*, as proved by oxidation to *d,l* and *meso* 3,3'-bipthalide, respectively. Upon trimethylsilylation [1] and glc analysis (on-column injection at 190°, 5% SE-52 on Chromosorb-W), the *threo* and *erythro* dimers gave two peaks each, and these four peaks were matching those of the TMS ethers of the crude photodimers. That the glc analyses gave a reliable representation of the *threo/erythro* ratio was shown in two ways. A known mixture of these two types of dimers was silylated and the glc analysis with an internal standard agreed well with the composition of the sample. Furthermore, nmr analysis of the isolated product responsible for one single glc peak showed that no decomposition had taken place. The logical conclusion was that the double glc peaks observed for the *threo* as well as for the *erythro* TMS dimers corresponded to epimeric hemiacetals.

In the *erythro* series, the parent epimeric hemiacetals could be isolated in nearly pure form as follows. The crude reaction product in the photolysis of OPT in heptane showed one intramolecular hydrogen bond in the ir. The nmr. analysis of this dimer **A** and its TMS ether showed each of them to be practically pure. Isomerization of the hemiacetal was observed when a solution of **A** in dimethylsulfoxide was allowed to stand at room temperature. Monitoring by nmr. showed that the evolution of the spectrum had stopped after 40 hours and that the isomer **B** was present in about 80% at equilibrium. This compound was precipitated by dilution with water, and the ir. showed it to lack the intramolecular hydrogen bond found in **A** and to show a normal hydroxyl, with intermolecular hydrogen bonding only. Confirmation that epimerization of the hydroxyl had been the only change suffered by **A** was obtained by oxidizing both **A** and **B** to the same product, *meso*-3,3'-bipthalide.



The foregoing established that the TMS ethers of **A** and **B** were well recognizable entities, and it was therefore logical to expect them to show different retention times in a glc analysis. However, when the analysis was performed in the conditions which had led to the resolution of four peaks for the TMS ethers of the crude photodimers, the TMS ethers of **A** and **B** gave identical chromatograms, each one consisting of *two* peaks. Furthermore, these two peaks were also observed when the material corresponding to one of them was reinjected in the same conditions. We find, therefore, no alternative to the conclusion that thermal isomerization of the TMS ethers had

1) Trimethylchlorosilane-hexamethyldisilazane in pyridine or *bis*-(trimethylsilyl)-acetamide were used with identical results.

occurred during the glc analyses²⁾. The methodological importance of this finding is obvious³⁾ 4).

BIBLIOGRAPHY

- [1] C. C. Sweeley, R. Bentley, M. Mikita & W. W. Wells, *J. Amer. chem. Soc.* **85**, 2497 (1963).
 [2] J. Kagan, *Tetrahedron Letters*, 1966, 6097.
 [3] D. A. Harrison, R. N. Schwartz & J. Kagan, *J. Amer. chem. Soc.* **97**, 5793 (1970).
 [4] D. A. Harrison & J. Kagan, in preparation.
 [5] K. F. Cohen, J. T. Pinhey & R. J. Smith, *Tetrahedron Letters*, 4729 (1968).
 [6] J. A. Gustafsson, R. Ryhage, J. Sjövall & R. M. Moriarty, *J. Amer. chem. Soc.* **91**, 1234 (1969);
 D. J. Harvey, M. G. Horning & P. Vouros, *J. chem. Soc.*, D 1970, 898; G. A. Razuvaev, N. S. Vasileiskaya, D. V. Muslin, N. N. Vavilina & S. N. Uspenskaya, *Zh. Org. Khim.* **6**, 980 (1970).
 [7] A. J. Ashe, III, *Tetrahedron Letters* 1970, 2105; H. Schmidbaur & W. Tronich, *Angew. Chem. Int. Ed. Engl.* **7**, 220 (1968); M. A. Cook, C. Eaborn & D. R. M. Walton, *J. Organometal. Chem.* **24**, 301 (1970).

- 2) The increased lability of the hemiacetal TMS ethers in this series compared to that of the glucopyranosides may result from their benzylic character. However, it is not known whether the epimerization results from initial C—O or O—Si bond breaking.
 3) For inter- and intra-molecular migrations of trimethylsilyl groups upon electron impact see [6].
 4) For migration of trimethylsilyl groups under mild conditions see [7].

164. Die Photolyse von Anthranilen in saurer Lösung; Vergleich mit der photochemischen und thermischen Zersetzung entsprechender 2-Azido-acylbenzole in saurer Lösung¹⁾

Vorläufige Mitteilung²⁾

von Th. Doppler³⁾, H.-J. Hansen und H. Schmid

Organisch-Chemisches Institut der Universität Zürich

(12. VI. 72)

Summary. Anthranils **1a**, **b**, **4** und **5** yield on irradiation in conc. sulfuric acid 2-amino-5-hydroxy-acylbenzenes **2a**, **b**, **6** and **7** which are isolated mainly as their acetates. Small amounts of 2-amino-3-hydroxy-acylbenzenes **3a** and **3b** are formed as by-products (*cf.* tables 1 and 2). Similar results were obtained when the corresponding 2-azido-acylbenzenes were decomposed thermally in conc. sulfuric acid (*cf.* tables 1 and 2). 3,5-Dimethylantranil (**8**) forms, on irradiation in sulfuric acid and subsequent acetylation, 2-acetamino-5-acetoxy-6-methylacetophenone (**6**) and 2-acetamino-5-acetoxymethyl-acetophenone (**10**). The same compounds were obtained from the thermal decomposition of 2-azido-5-methyl-acetophenone (**19**) in sulfuric acid.

Vor kurzem wurde berichtet, dass Anthranile **1** bei der Bestrahlung in stark schwefelsaurer Lösung mit einer Quecksilberhochdrucklampe 2-Amino-5-hydroxy-acylbenzole **2** liefern [2] [3]. In geringer Menge werden daneben auch 2-Amino-3-hydroxy-acylbenzole **3** gefunden [3]. Bei der Bestrahlung in konz. Salzsäure entstehen die entsprechenden 5-Chlorverbindungen [2]. Ähnlich wie Anthranile verhalten sich

¹⁾ 23. Mitteilung über Photoreaktionen; 22. Mitteilung: [1].

²⁾ Eine ausführliche Mitteilung soll in dieser Zeitschrift erscheinen.

³⁾ Teil der geplanten Dissertation, Universität Zürich.