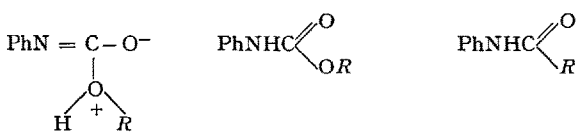
Brèves communications - Kurze Mitteilungen
Brevi comunicazioni - Brief Reports

The Structure of Phenylurethanes

Phenylurethanes are formed by the interaction of phenols (or alcohols) with phenyl*iso*cyanate and it has long been known[1] that this reaction can be reversed by heating the urethane. Recently ILLARI and MARENGHI and co-workers[2] have studied the thermal decomposition of various phenylurethanes and they concluded that in general the products obtained by interaction of phenols and phenyl*iso*cyanate are *not* phenylurethanes but "molecular complexes", probably of type (I). (BAKER and GAUNT[3] have shown that the uncatalysed reaction between phenyl*iso*cyanate and alcohols proceeds via an intermediate complex of this type.) On the other hand the products obtained from β-naphthol and eugenol were considered to have the authentic urethane structure (II) since they gave rise, on pyrolysis, to carbanilide and a diaryl carbonate along with some phenyl*iso*cyanate and the original phenol. The basis on which ILLARI *et al.* assign structures (I) or (II) to phenyl*iso*cyanate–phenol reaction products is very inadequate and their formation in pyridine solution[4] appears to exclude structure (I) (cf. BAKER and GAUNT[5]).



(I) (II) (III)

We have now examined the infra-red spectra of a number of the compounds prepared by ILLARI *et al.* Anilides (III) show their carbonyl stretching band in the region 1660–1680 cm^{-1} (THOMPSON and RICHARDS[6]). Comparison of the carbonyl frequencies of simple ketones and esters indicates that an oxygen atom adjacent to the C=O group raises its frequency about 30–40 cm^{-1}. Therefore if phenylurethanes have structure (II) a carbonyl frequency of 1690–1720 cm^{-1} would be anticipated. On the contrary structure (I) would not be expected to give any band in this region except a C=N band probably between 1630 and 1670 cm^{-1}. The following values were found.

In addition all the spectra showed a band near 1530 cm^{-1} which is characteristic of the –CO–NH– group. These figures agree with those of THOMPSON, NICHOLSON, and SHORT[1] and provide clear evidence for the accepted structure (II) of phenylurethanes.

Phenylurethane (solid)	cm^{-1}
Menthol	1697
tert. Butyl alcohol	1690
Phenol	1715
β-Naphthol	1720
o-Nitrophenol	1705
	1728
p-Nitrophenol	1715

N. F. HAYES, R. H. THOMSON, and M. ST. C. FLETT.

Chemistry Department, The University, Old Aberdeen, Scotland, and Imperial Chemical Industries Ltd., Dyestuffs Division, Hexagon House, Blackley, Manchester 9, England, July 27, 1954.

Zusammenfassung

Die Infrarotspektren verschiedener Phenylurethane zeigen, dass diese die angenommene Struktur (II) besitzen und nicht molekulare Komplexe darstellen, wie ILLARI *et al.*[1] annehmen.

[1] R. LEUCKART and M. SCHMIDT, Ber. dtsch. chem. Ges. *18*, 2339 (1885).

[2] G. ILLARI, I. MARENGHI, and E. TARANTELLI, Ann. Chim. Appl. Roma *43*, 55 (1953). – G. ILLARI, I. MARENGHI, and A. STUANI, Ann. Chim. Appl. Roma *43*, 744 (1953).

[3] J. W. BAKER and J. GAUNT, J. Chem. Soc. *1949*, 19.

[4] G. ILLARI, I. MARENGHI, and A. STUANI, Ann. Chim. Appl. Roma *43*, p. 744. (1953).

[5] J. W. BAKER and J. GAUNT, J. Chem. Soc. *1949*, 9.

[6] H. W. THOMPSON and R. E. RICHARDS, J. Chem. Soc. *1947*, 1252.

[1] H. W. THOMPSON, D. L. NICHOLSON, and L. N. SHORT, Farad. Soc. Discussions *9*, 229 (1950) (The senior author has confirmed that the figure 7000 in Table II is an error and should be 1700.).

A New Synthetic Sulfur-Containing Amino Acid: S-Aminoethylcysteine

The mechanism by which the organism acquires the mercaptoethylamine for the synthesis of CoA is still completely unknown. While we know that pantothenic acid, necessary for such a synthesis, must be brought to the organism from outside, we have no information indicating that mercaptoethylamine too must be obtained from the diet.

It is highly probable therefore that mercaptoethylamine is synthesized by the animal in one of the following ways:

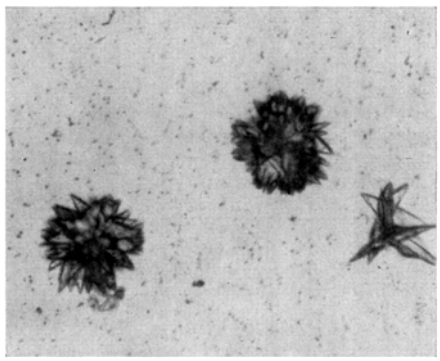
(1) decarboxylation of cystine or cysteine; (2) dismutation of cystamine disulfoxyde; (3) transulfuration from cysteine or homocysteine to ethanolamine. The last mechanism might be of real interest after the discovery of biological transulfuration reactions from homocysteine to serine with the production of cysteine[1].

[1] V. DU VIGNEAUD, G. B. BROWN, and J. P. CHANDLER, J. Biol. Chem. *143*, 59 (1942). – F. BINKLEY, W. P. ANSLOW, and V. DU VIGNEAUD, J. Biol. Chem. *143*, 559 (1942). – F. BINKLEY, J. Biol. Chem. *155*, 39 (1944).

In order to have some indication of the existence of a biological mechanism of transulfuration between a sulfur-containing aminoacid and ethanolamine, it was found necessary to prepare the hypothetical intermediate: aminoethylcysteine (I) and its homologue aminoethylhomocysteine. We have started with the

$$NH_2CH_2{\cdot}CH_2{-}S{-}CH_2{\cdot}CHNH_2{\cdot}COOH \qquad (I)$$

synthesis of the cysteine derivative in order to have information on such types of synthesis and because this substance is more easily obtainable.



S-aminoethylcysteine monohydrochloride recrystallized with acetone from an hydroalcoholic solution (about 150 ×).

Experimental. 5 g of L-cysteine hydrochloride were dissolved in 10 ml of bidistilled water through which a flow of nitrogen was run for a period of 15 min. Keeping an atmosphere of nitrogen, 6 g of KOH dissolved in 10 ml oxygen-free water were added. Then by heating on a water bath at 60–70°, 7 g of β-bromoethylamine hydrobromide[1] were added in a period of 10 min. The solution was then left at room temperature under nitrogen for 3 h, neutralized with concentrated HBr and 80 ml alcohol added. After 4–5 h at 0°, a precipitate of KBr was removed and the filtrate was concentrated, on a boiling water bath at reduced pressure, to about 20 ml. 60 ml of alcohol were added and the suspension dissolved by warming and adding a small amount of water. The solution was left overnight at 0° and filtered from a new precipitate of KBr. The supernatant which contained the aminoethylcysteine as a mixed hydrobromide and hydrochloride was passed through a column, 2·5 × 40 cm, of Dowex 50, in the acid form, ground to 80–100 mesh. The column, washed with 500 ml of water, was eluted with NH_3 1 N and the effluent, from the appearance of the ammonia, was collected for a total amount of 200 ml. The collected solution was brought to dryness on a boiling water bath at reduced pressure. The oily residue was dissolved with 20 ml water and neutralized up to a slight acidity with concentrated HCl. Then 80 ml alcohol were added and the crude hydrochloride was precipitated by slowly adding, with vigorous shaking, 100 ml of acetone. In this way an oily precipitate is first obtained which, by shaking and rubbing, solidifies into a semi-crystalline mass. After few days at 0°, the supernatant was removed, the solid mass was mechanically detached from the walls of the container, broken in the presence of acetone, filtered and dried. The crude aminoethylcysteine hydrochloride weighed 4·8 g (75% of the theoretical value); a negative nitroprusside test was obtained before and after treatment with NaCN.

[1] F. CORTESE, *Organic Syntheses*, Coll. Vol. II, p. 91.

The recrystallization was complicated by the tendency of the compound to precipitate from aqueous solutions in a semi-oily form carrying water with it. We have obtained good crystallization by the following procedure: 1 g of the above precipitate was suspended in 30 ml 95% alcohol; when boiling, water was added in small portions until a complete solution was obtained. The solution was filtered and acetone was added, while shaking, until a slight permanent turbidity was reached; the solution was clarified by boiling and left at room temperature for a few hours. Acetone was then added in drops until a slight turbidity was obtained again: after rubbing the walls and after a permanence at 0° for 24 h, the compound begins to crystallize in the form of needleshaped crystals assembled in rosettes (Figure). The treatment with acetone up to a slight turbidity, followed by standing at 0° for several hours, was repeated 4–5 times. Finally the liquid was poured out, the crystals washed with alcohol, collected and dried in a dessiccator; yield 0·5 g. From the mother liquor, further 0·15 g of pure crystalline material were obtained following the same treatment for several days.

The analyses made on the crystalline compound gave the following results:

$C_5H_{12}O_2N_2S{\cdot}HCl$	calculated	S 15·97%	N 13·96%
200·69	found	S 15·66%	N 13·40%

The nitrogen was shown to be entirely present as amino nitrogen by the VAN SLYKE procedure: 98% of the theorical value. M.P. 192°–192·5°; at the microstage with the KOFLER apparatus. $[\alpha]_D^{25} = +7{\cdot}2°$: 1% in aqueous solution.

The ninhydrin test and the iodoplatinate test for sulfur-containing amino acids[1] were strongly positive. By paper chromatography only one spot was shown to be present with the following R_f: 0·80 in phenol; 0·19 in collidine-lutidine.

Acknowledgments: The present work was supported by a grant of the Consiglio Nazionale delle Ricerche. We are grateful to Prof. MAROTTA, Director of the Istituto Superiore di Sanità, for the permission given to us to have the microanalyses made in his Institute by Dr. MARZADRO.

D. CAVALLINI, C. DE MARCO, B. MONDOVÌ, and G. F. AZZONE

Institute of Biological Chemistry, University of Rome, June 24, 1954.

Riassunto

L'aminoetilcisteina, composto intermedio ipotetico di transulfurazione tra cisteina e etanolamina, è stata preparata cristallina sotto forma di monocloridrato, trattando la cisteina con bromoetilamina in ambiente alcalino.

[1] H. M. WINEGARD, G. TOENNIS, and R. J. BLOCK, Science *108*, 506 (1948).

Branched Polyamino Acids

Most of the known poly-α-amino acids were prepared from N-carboxy-α-amino acid anhydrides, using water or amines as polymerization initiators. The linear polypeptides thus obtained are usually of an average degree of polymerization of 10 to 100. Branched polyamino acids of a considerably higher molecular weight have been prepared by us, using polylysine[1] as a polyvalent amine initiator, according to the following scheme:

[1] E. KATCHALSKI, I. GROSSFELD, and M. FRANKEL, J. Amer. Chem. Soc. *70*, 2094 (1948).