

2-AMINO-2-THIAZOLINE. III.<sup>1,2</sup> THE DIFFERING BEHAVIOR OF  
PHENYLISOTHIOCYANATE AND PHENYLISOCYANATE TOWARD  
2-AMINO-2-THIAZOLINE

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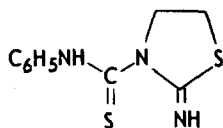
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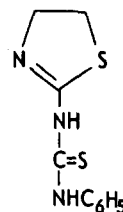
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Fromm and Kapeller-Adler (3) reported that the reaction of 2-amino-2-thiazoline with phenylisothiocyanate in ethanol when performed "under strong cooling" gave 2-imino-3-phenylthiocarbamoylthiazolidine (I), m.p. 60°,



I

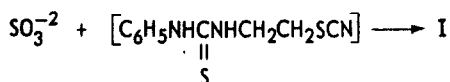
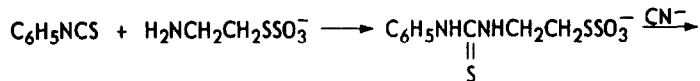


II

resolidification point 80°, m.p. 129°, and that the identical reactants, when heated on a steam bath, gave 2-phenylthiureido-2-thiazoline (II), m.p. 130°. Upon careful repetition of these experiments, only one mono-adduct, C<sub>10</sub>H<sub>11</sub>N<sub>3</sub>S<sub>2</sub>, m.p. 148-149°, was obtained as yellow crystals, regardless of the temperature at which the reaction was run.

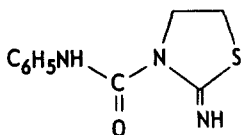
In order to distinguish between structures I and II for this product, an unequivocal synthesis of I was accomplished. The sodium salt of 2-aminoethanesulfuric acid was treated with phenylisothiocyanate as described

by Ferris, Salerni and Schutz (4) and the resulting phenylthiureido derivative was converted *in situ* by the action of cyanide (1) in low yield to compound I, m.p. 148-149°. The infrared spectra of I made by the two

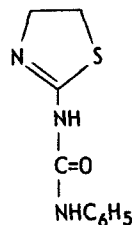


methods were identical and the mixture m.p. was undepressed.

The reaction of 2-amino-2-thiazoline with phenylisocyanate in acetonitrile gave a white crystalline mono-adduct,  $\text{C}_{10}\text{H}_{11}\text{N}_3\text{OS}$ , m.p. 149-150°, which was tentatively considered to be 2-imino-3-phenylcarbamoylthiazolidine (III), by analogy with the reaction between 2-amino-2-thiazoline and phenylisothiocyanate. An attempt was made to prepare an authentic sample



III



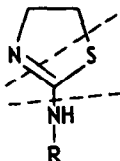
IV

of III, but while it was possible to make sodium 2-phenylureidoethylthio-sulfate in acetonitrile solution, this compound failed to react with cyanide to give the desired cyclic product, only bis(2-phenylureidoethyl) disulfide, m.p. 198-203°, being isolated.

The conversion of I to III by the action of alkaline hydrogen peroxide according to the method of Papadopoulos (5) was similarly unsuccessful. The major product which was isolated was N,N'-diphenylurea, m.p. 240-241°, mixture m.p. 240-241°, which was identified by its infrared spectrum.

Behringer and Zilliken reported (6) that the Raney nickel degradation

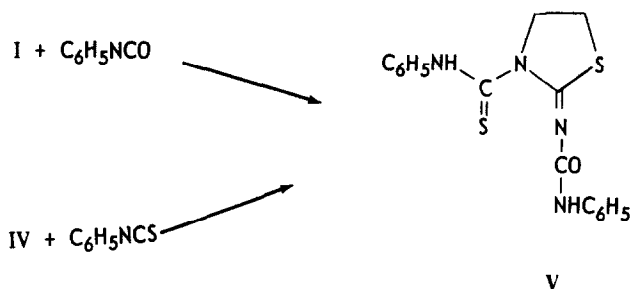
of 2-amino-2-thiazoline-4-carboxylic acid in aqueous solution gives  $\alpha$ -alanine and it has been found (2) that similar treatment of 2-ureido-2-thiazoline yields urea. These results suggest that degradation of the thiazoline ring system occurs in the direction shown below:



Treatment of the phenylisocyanate adduct of 2-amino-2-thiazoline with Raney nickel gave N-phenylurea, m.p. 147-148°, mixture m.p. was undepressed. The infrared spectrum was identical with that of an authentic sample of N-phenylurea. This suggests that the phenylisocyanate adduct is 2-phenylureido-2-thiazoline (IV).

These findings were confirmed by a labelling experiment. Phenylisocyanate was condensed with 2-( $^{15}\text{N}$ )-amino-2-thiazoline which had been prepared (2) from sodium 2-aminoethylthiosulfate and potassium cyanide- $^{15}\text{N}$  (99.7% isotopic purity), to give the phenylureido derivative. This adduct was treated with Raney nickel, as before, and the N-phenylurea which was isolated, m.p. 142-144°, was shown by mass spectrometry to contain the  $^{15}\text{N}$  in the primary amino group. The molecular ion,  $[\text{C}_7\text{H}_8^{14}\text{N}^{15}\text{NO}]^+$  requires m/e 137.061; found m/e 137.061. This result shows conclusively that the phenylisocyanate reacted with the exocyclic amino group. Cyanate ion has also been demonstrated (2) to react with the primary amino group of 2-amino-2-thiazoline.

Upon treating I with phenylisocyanate or IV with phenylisothiocyanate, the identical compound was obtained,  $\text{C}_{17}\text{H}_{16}\text{N}_4\text{S}_2\text{O}$ , m.p. 141.5-142.5°, mixture m.p. was undepressed. These cross reactions, in which 2-phenylcarbonylimino-3-phenylthiocarbonylthiazolidine (V) was obtained, provide further evidence



for the correctness of the structural assignments of the two mono-adducts.

All new compounds reported here gave satisfactory analytical data.

#### REFERENCES

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