2-(1-PHTHALAZINYL)PHTHALAZ-1-ONE, A HYDROLYSIS PRODUCT OF 1-CHLOROPHTHALAZINE*

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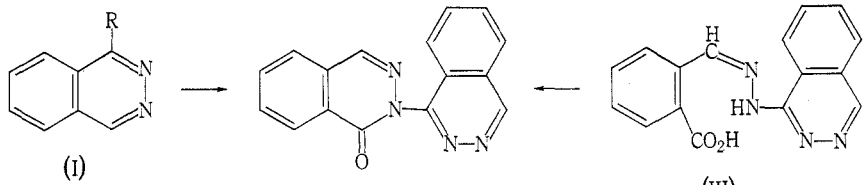
The hydrolysis of 1-chlorophthalazine (I; R = Cl) with very dilute hydrochloric acid proceeds anomalously: the "normal" hydrolysis product, phthalaz-1-one (I; R = OH) is a minor product, the major product is a compound for which the 2-(1-phthalazinyl)-phthalaz-1-one structure (II) has been suggested;[1] analogous structures have been proposed for the compounds formed in the spontaneous decomposition of 4-halogenopyridines[2] and of 1,4-dichloropyridazines.[3] Christensen and



(I) (II) (III)

his co-workers[4,5] have reported the formation (in a different manner) of analogous compounds in the quinazoline series. 2-(1-Phthalazinyl)phthalaz-1-one has now been synthesized and shown to be identical with hydrolysis product.

Phthaldehydic acid condenses readily with 1-phthalazinylhydrazine (I; R = NH_2NH)[6] to give the hydrazone (III; R = H). Thermal cyclodehydration of the hydrazone by pyrolysis or in high boiling inert solvents was unsuccessful, as were attempts at cyclization in polar solvents under acidic conditions; a reaction in n-pentanol containing hydrochloric acid gave the n-pentyl ester (III; R = C_5H_{11}). However, treatment of the hydrazone with pure thionyl chloride at room temperature gave the required product in good yield.

The stereochemisty of the phthalazinylhydrazone (III; R = H) has not been investigated but the ease of cyclodehydration with thionyl chloride would suggest a *cis* structure (with the secondary amino and the carboxyl groups in juxtaposition). Acid catalysed cyclization of phthaldehydic acid hydrazones normally proceeds

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[1] Badger, G. M., McCarthy, I. M., and Rodda, H. J., *Chemy Ind.*, 1954, 964.

[2] Wibaut, J. P., and Brockman, F. W., *Rec. Trav. chim. Pays-Bas*, 1939, **58**, 885.

[3] Druey, J., Meier, K., and Eisenberger, K., *Helv. chim. Acta*, 1954, **37**, 121.

[4] Tomisek, A. J., and Christensen, B. E., *J. Am. chem. Soc.*, 1948, **70**, 874.

[5] Cuthbertson, H., Willits, C., and Christensen, B. E., *J. Am. chem. Soc.*, 1954, **76**, 3533.

[6] Druey, J., and Ringier, B. H., *Helv. chim. Acta*, 1951, **34**, 195.

without difficulty[7] and its failure in the present case may be associated with steric hindrance due to the phthalazine ring. To test the influence of such a steric factor we have investigated the cyclodehydration of the α- and β-naphthylhydrazones of phthaldehydic acid. The latter cyclizes so readily that reaction of β-naphthylhydrazine and phthaldehydic acid gave directly 2-(β-naphthyl)phthalaz-1-one; but all attempts to cyclo dehydrate the α-isomer were unsuccessful. An examination of molecular models reveals significantly greater steric crowding around the reacting centres of the molecule in the α- as compared to the β-isomer.

Experimental

Phthaldehydic Acid Phthalazinylhydrazone

The *hydrazone* was prepared in the normal manner from phthaldehydic acid and 1-phthalazinylhydrazine. It was recrystallized from aqueous carbitol, m.p. 208° (Found: C, 65·6; H, 4·3; N, 18·9. $C_{16}H_{12}N_4O_2$ requires C, 65·7; H, 4·1; N, 19·1%).

Attempted cyclodehydration by refluxing the hydrazone in n-pentanol/hydrochloric acid gave only the *n-pentyl ester*, m.p. 142° from alcohol (Found: C, 69·6; H, 6·1; N, 15·5. $C_{21}H_{22}N_4O_2$ requires C, 69·6; H, 6·2; N, 15·3%).

2-(1-Phthalazinyl)phthalaz-1-one

Phthaldehydic acid phthalazinylhydrazone (1 g) was added to cold pure thionyl chloride (10 ml). The solid dissolved with vigorous effervescence to give a clear solution which was allowed to stand at room temperature for 1 hr. Excess thionyl chloride was removed under reduced pressure and the solid residue was dissolved in water. Neutralization with solid sodium bicarbonate deposited a pale yellow solid which was washed with cold dilute sodium hydroxide and hot alcohol and recrystallized dilute acetic acid, m.p. 279–280°. It was identical with 2-(1-phthalazinyl)phthalaz-1-one from the hydrolysis of 1-chlorophthalazine.[1]

Phthaldehydic Acid α-Naphthylhydrazone

The *hydrazone* was prepared in the normal manner; m.p. 152° from ethanol (Found: C, 74·6; H, 5·0; N, 9·9. $C_{18}H_{14}N_2O_2$ requires C, 74·5; H, 4·9; N, 9·7%). All attempted cyclodehydrations to the phthalazone were unsuccessful.

1-(β-Naphthyl)phthalaz-1-one

Phthaldehydic acid (1·6 g) and β-naphthylhydrazine (1·5 g) were dissolved in alcohol (20 ml) and heated under reflux for 3 hr. The white product deposited on cooling the solution was recrystallized from ethanol, m.p. 168° (Found: C, 79·7; H, 4·6; N, 10·3. $C_{18}H_{12}N_2O$ requires C, 79·4; H, 4·5; N, 10·3%). The intermediate hydrazone was never isolated.

[7] Simpson, J. C. E., in "The Chemistry of Heterocyclic Compounds." (Ed. A. Weissberger.) p. 95. (Interscience: New York 1953.)