BULLETIN OF THE CHEMICAL SOCIETY OF JAPAN, VOL. 46, 2257—2258 (1973)

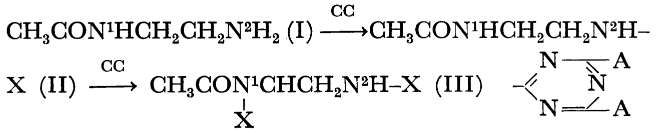
$N^2 \rightarrow N^1$ Migration of *s*-Triazinyl Group in the Reaction of *N*^{1}-Acetyl-*N*^{2}-(*s*-triazinyl)alkylenediamines

Seiichi Uno, Kenji Nakamura, Yukio Inoue, Shizen Sekiguchi, and Kohji Matsui
Department of Synthetic Chemistry, Gunma University, Tenjincho, Kiryu, Gunma

(Received August 2, 1972)

A report was given by West and Stewart1) on the anionic migration of an aryl group in arylhydrazines. We studied the $N^1 \rightarrow N^2$ rearrangement of an s-triazinyl group in *N*^{1},*N*^{1}-bis(*s*-triazinyl)-*o*-phenylenediamines.2) The reactions of *N*^{1}-acetyl-*N*^{2}-(4,6-dichloro-*s*-triazin-2-yl)alkylenediamines with cyanuric chloride (CC) were carried out in order to obtain information on the migration of an s-triazinyl group in *N*^{2},*N*^{2}-bis(*s*-triazinyl)alkylenediamines.

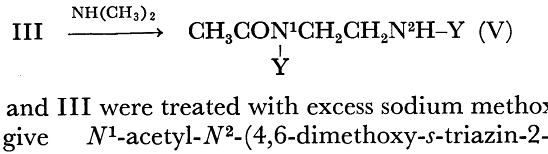
Reaction of N^1-*Acetyl*-N^2-*(4,6-dichloro*-s-*triazin-2-yl)-ethylenediamine with Cyanuric Chloride.* Two moles of cyanuric chloride at −20 °C under alkaline conditions to give *N*^{1}-acetyl-*N*^{2}-(4,6-dichloro-*s*-triazin-2-yl) ethylenediamine (II). One mole of I was subjected to reaction with two moles of cyanuric chloride at 0—5 °C under alkaline conditions to give *N*^{1}-acetyl-*N*^{1},*N*^{2}-bis(4,6-dichloro-*s*-triazin-2-yl)ethylenediamine (III). Two singlets appeared at δ 7.91 and 9.00, assignable to N^1-H and N^2-H, respectively, in the NMR spectrum of II, and a singlet at δ 9.00 (assignable to N^2-H in that of III, their structures being shown to be as follows.



$$\mathrm{CH_3CON^1HCH_2CH_2N^2H_2\ (I)} \xrightarrow{\mathrm{CC}} \mathrm{CH_3CON^1HCH_2CH_2N^2H\text{–}X\ (II)} \xrightarrow{\mathrm{CC}} \mathrm{CH_3C\underset{\displaystyle X}{\underset{|}{O}N^1}CHCH_2N^2H\text{–}X\ (III)}$$

X, A=Cl
Y, A=N(CH$_3$)$_2$
Z, A=OCH$_3$

For the sake of confirmation, II and III were treated with excess dimethylamine to give *N*^{1}-acetyl-*N*^{2}-[4,6-bis(dimethylamino)-*s*-triazin-2-yl]- (IV) and *N*^{1}-acetyl-*N*^{1},*N*^{2}-bis[4,6-bis(dimethylamino)-*s*-striazin-2-yl] ethylenediamines (V), since II and III are slightly unstable. In the NMR spectrum of IV the two singlets at δ 7.83 and 6.53 are assignable to N^1–H and N^2–H, respectively, and in that of V the singlet at δ 6.53 to *N*^{2}-H.



$$\mathrm{II} \xrightarrow{\mathrm{NH(CH_3)_2}} \mathrm{CH_2CON^1HCH_2CH_2N^2H\text{–}Y\ (IV)}$$

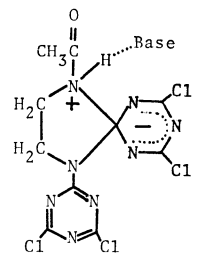
$$\mathrm{III} \xrightarrow{\mathrm{NH(CH_3)_2}} \mathrm{CH_3CO\underset{\displaystyle Y}{\underset{|}{N^1}}CH_2CH_2N^2H\text{–}Y\ (V)}$$

II and III were treated with excess sodium methoxide to give *N*^{1}-acetyl-*N*^{2}-(4,6-dimethoxy-*s*-triazin-2-yl)-ethylenediamine (VI) and *N*^{1},*N*^{2}-bis(4,6-dimethoxy-*s*-triazin-2-yl)ethylenediamine (VII) under cleavage of an acety lgroup. In the NMR spectrum of VI two singlets appeared at δ 7.83 and 7.92, assignable to N^1–H and N^2–H, respectively, and in that of VII a singlet at δ 7.88 only, assignable to N^1–H (or N^2–H).

$$\mathrm{II} \xrightarrow{\mathrm{NaOCH_3}} \mathrm{CH_3CON^1HCH_2CH_2N^2H\text{-}Z\ (VI)}$$

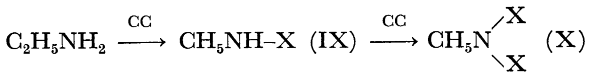
$$\mathrm{III} \xrightarrow{\mathrm{NaOCH_3}} \mathrm{Z\text{-}N^1HCH_2CH_2N^2H\text{-}Z\ (VII)}$$

The following reactions were carried out to clarify whether cyanuric chloride reacts directly with the N^1–H group to produce III, or with the N^2-H group to produce III *via* the transition state or the intermediate (VIII). It is not clear whether VIII is the transition state or the intermediate. Neither *N*-methyl acetamide nor *N*^{1},*N*^{2}-diacetylethylenediamine (XIX) reacted with cyanuric chloride under alkaline conditions, but ethylamine did so under the same conditions to give *N*-(4,6-dichloro-*s*-triazin-2-yl)(IX)3) and *N*,*N*-bis(4,6-dichloro-*s*-triazin-2-yl)-ethylamines (X).4) These results confirm the $N^2 \rightarrow N^1$ migration of a dichlorotriazinyl group.



VIII

$$\mathrm{CH_3CONHCH_3} \xrightarrow{\mathrm{CC}} \text{no reaction}$$



$$\mathrm{C_2H_5NH_2} \xrightarrow{\mathrm{CC}} \mathrm{CH_5NH\text{-}X\ (IX)} \xrightarrow{\mathrm{CC}} \mathrm{CH_5N}\begin{matrix}\diagup X\\ \diagdown X\end{matrix}\ \mathrm{(X)}$$

Cyanuric chloride did not react with *N*-(4,6-dimethoxy-*s*-triazin-2-yl)ethylamine5) or VI under alkaline conditions. This indicates that cyanuric chloride does not react directly with the N^1-H group and supports the view that the $N^2 \rightarrow N^1$ migration of a dichlorotriazinyl group occurs in the reaction of II with cyanuric chloride.

$$\mathrm{C_2H_5NH\text{-}Z} \xrightarrow{\mathrm{CC}} \text{no reaction}$$

$$\mathrm{CH_3CON^1HCH_2CH_2N^2H\text{-}Z\ (VI)} \xrightarrow{\mathrm{CC}} \text{no reaction}$$

The NMR measurement on the reaction of II with triethylamine was carried out in order to determine with which nitrogen atom cyanuric chloride reacts at first. When triethylamine (0.00020 mol) was added to II (0.00010 mol) in DMSO-d_6–CDCl$_3$ (1 : 3 vol) at 0 °C, the peak (N^2-H) at δ 9.16 immediately decreased, but the peak (N^1–H) at δ 8.33 did not change. The area ratio of the peaks at δ 8.33 and 9.16 was

---

1) R. West and H. F. Stewart, *J. Amer. Chem. Soc.*, **92**, 853 (1970).

2) K. Nakamura, N. Nohara, and K. Matsui, This Bulletin, **45**, 3140 (1972).

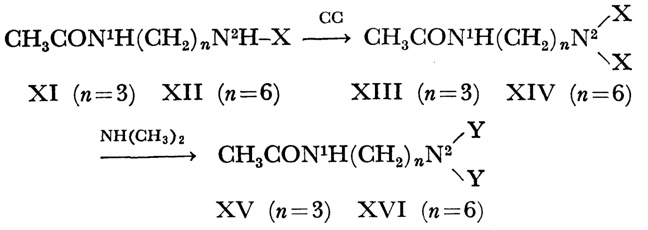
3) O. Diels, *Ber.*, **32**, 691 (1899).

4) N. Nohara, S. Sekiguchi, and K. Matsui, *J. Heterocyclic Chem.*, **7**, 519 (1970).

5) K. Stammbach, H. Kilchler, K. Freiedrich, M. Larser, and G. Szekely, *Weed. Red.*, **4(1)**, 64 (1964).

about 2. The ratio remained constant for 25 min after addition of triethylamine, the peak area at δ 8.33 being unchanged. This supports the veiw that cyanuric chloride reacts at first with N^2 atom under alkaline conditions.

Reaction of N^1*-Acetyl-*N^2*-(4,6-dichloro-*s*-triazin-2-yl)-tri- (XI) or -hexamethylenediamine (XII) with Cyanuric Chloride.* Under alkaline conditions cyanuric chloride reacted with XI and XII to give *N*¹-acetyl-*N*²,*N*²-bis(4,6-dichloro-*s*-triazin-2-yl)tri- (XIII) and -hexamethylenediamines (XIV),[6] respectively. A singlet appeared at δ 7.75 only, assignable to N^1–H, in both NMR spectra of the dimethylamino derivatives of XIII and XIV. This indicates that two dichlorotriazinyl groups are attached to N^2 atom in XIII and XIV, no rearrangement of an *s*-triazinyl group taking place. It is therefore concluded that the number of methylene groups in alkylenediamines plays an important role in the N^2→N^1 migration of an *s*-triazinyl group in the title reaction.



$$\mathrm{CH_3CON^1H(CH_2)_nN^2H{-}X} \xrightarrow{\mathrm{CC}} \mathrm{CH_3CON^1H(CH_2)_nN^2}\genfrac{}{}{0pt}{}{/\mathrm{X}}{\backslash \mathrm{X}}$$

XI ($n=3$) XII ($n=6$) XIII ($n=3$) XIV ($n=6$)

$$\xrightarrow{\mathrm{NH(CH_3)_2}} \mathrm{CH_3CON^1H(CH_2)_nN^2}\genfrac{}{}{0pt}{}{/\mathrm{Y}}{\backslash \mathrm{Y}}$$

XV ($n=3$) XVI ($n=6$)

Experimental

N^1*-Acetylethylenediamine (I),* N^1*-Acetyltri- (XVII), and -hexamethylenediamines (XVIII), and* N^1,N^2*-Diacetylethylenediamine (XIX).* Compounds I and XIX were prepared by the method of Hill and Aspinall.[7] Compounds XVII and XVIII were prepared in the same manner as for I. Yield for I 56%; bp 143°C/10 mmHg (lit,[7] bp 128°C/3 mmHg). Yield for XVII 65%; bp 140°C/6 mmHg (lit,[10] bp 146—8°C/15 mmHg). Yield for XVIII 52%; bp 165°C/3 mmHg, d_{25}^{25} 0.9738 $n_D^{22.5}$ 1.4778. Found: C, 61.01; H, 11.69%. Calcd for $C_8H_{18}N_2O$: C, 60.72; H, 11.46%. Compound XIX was obtained as a by-product in the preparation of I, yield *ca.* 10%, mp 174—5°C (lit,[7] 172°C).

N^1*-Acetyl-*N^2*-(4,6-dichloro-*s*-triazin-2-yl)ethylenediamine (II).* A solution of 6.7 g (0.036 mol) of cyanuric chloride in 70 ml of acetone was added dropwise at −20°C to a stirred solution of 7.5 g (0.073 mol) of I in 100 ml of acetone. After stirring for 2.5 hr, the mixture was poured into 200 ml of ice–water. The precipitate was filtered and dried.

N^1*-Acetyl-*N^1,N^2*-bis(4,6-dichloro-*s*-triazin-2-yl)ethylenediamine (III).* A solution of 15 g (0.015 mol) of I in 30 ml of acetone was added dropwise at 0—5°C to a stirred solution of 5.4 g (0.029 mol) of cyanuric chloride and then 7.8 ml of a 20% sodium carbonate solution dropwise. After being stirred for 2 hr, the mixture was processed according to the procedure for II.

N^1*-Acetyl-*N^2*-[4,6-bis(dimethylamino)-*s*-triazin-2-yl]-(IV) and* N^1*-Acetyl-*N^1,N^2*-bis[4,6-bis(dimethylamino)-*s*-triazin-2-yl]-ethylenediamine (V).* These compounds were prepared from 1.0 g (0.0040 mol) of II and 2.4 g (0.0060 mol) of III, respectively, by the method described previously.[8]

N^1*-Acetyl-*N^2*-(4,6-dimethoxy-*s*-triazin-2-yl)ethylenediamine (VI).* To a stirred solution of 3.5 g (0.02 mol) of 4,6-dimethoxy-2-chloro-*s*-triazine (CDMT)[9] in 50 ml of acetone was added dropwise at 0—5 °C a solution of 2.1 g (0.020 mol) of I in 20 ml of acetone and then 5.3 ml of a 20% sodium carbonate solution dropwise. After being stirred for 6.5 hr at the same temperature, the mixture was stirred at *ca.* 20°C for 6 hr. The mixture was then concentrated under reduced pressure and cooled. The precipitate was filtered and dried.

N^1,N^2*-Bis(4,6-dimethoxy-*s*-triazin-2-yl)ethylenediamine (VII).* A solution of 3 g (0.050 mol) of ethylenediamine in 30 ml of acetone was added dropwise at *ca.* 20°C to a stirred solution of 17.6 g (0.10 mol) of CDMT in 100 ml of acetone. After being stirred for 30 min, 26.5 ml of a 20% sodium carbonate solution was added dropwise to the mixture. After being stirred for 4 hr at 30°C, the mixture was poured into 300 ml of ice–water, filtered and dried. Recrystallization from dioxane yielded 17.0 g (quantitative), mp 237.0—237.5°C. Found: C, 42.64; H, 5.64; N, 32.93%. Calcd for $C_{12}H_{18}N_8O_4$: C, 42.60; H, 5.36; N, 33.11%.

N^1*-Acetyl-*N^2*-(4,6-dichloro-*s*-triazin-2-yl)tri- (XI) and -hexamethylenediamines (XII).* These compounds were prepared from 2.3 g (0.020 mol) of XVII and 4.7 g (0.030 mol) of XVIII in the same manner as for III.

N^1*-Acetyl-*N^2,N^2*-bis[4,6-bis(dimethylamino)-*s*-triazin-2-yl]-tri- (XV) and -hexamethylenediamines (XVI).* A solution of 4.5 g (0.017 mol) of XI in 80 ml of acetone was added dropwise at 0°C to a stirred solution of 4.8 g (0.026 mol) of cyanuric chloride in 120 ml of dioxane–acetone (1 : 1 vol). After 1.46 g (0.026 mol) of potassium hydroxide in 4 ml of water had been added in small portions, the mixture was stirred for 5 hr at 0—5 °C. The mixture was processed according to the procedure described previously.[8]

Yields and melting points are summarized in Table 1. The results in elemental analysis are within the experimental error. NMR spectral data are in DMSO-d_6

Table 1. *s*-Ariazine derivatives of *N*-acetyl-alkylneediamines

Compound No.	Yield (%)	Mp (°C)	Recryst. Solv.
II	44	134—134.5	Benzene
III	40	153—154	Benzene-Ligroin
IV	85	116—117	Ligroin
V	92	197—197.5	Ligroin
VI	67	142—142.5	Acetone
XI	64	179—179.5	Dioxane-Ligroin
XII	57	111—111.5	Benzene-Ligroin
XV[b]	33	142—142.5	Ligroin
XVI	57	145—145.5	Ligroin

a) These values agreed with the calculated ones within the usual limit of variation of elemental analysis.

b) Mass spectrometry, *m/e* 446 (medium, attributable to the parent peak; Hitachi RMS-4 mass spectrometre).

---

6) Since XIII and XIV were too unstable to be isolated, they were prompty transformed into dimethylamino derivatives.

7) A. J. Hill and S. R. Aspinall, *J. Amer. Chem. Soc.*, **61**, 822 (1939).

8) Y. Fukushima, N. Nohara, Y. Hashida, S. Sekiguchi, and K. Matsui, This Bulletin, **44**, 794 (1971).

9) J. R. Dudley, J. T. Thurston, F. C. Schaefer, D. H. Hansen, C. J. Hull, and P. Adams, *J. Amer. Chem. Soc.*, **73**, 2986 (1961).

10) H. Mkolajewska and A. Kotelko, *Acta Polon. Pharm.*, **22 (3)**, 219 (1965).