

ANOMALOUS SUBSTITUTIONS AND REDUCTIVE DEHALOGENATIONS OF  $\alpha,\alpha$ -DIARYL- $\alpha$ -HALOGENO-  
-N,N-DIMETHYLACETAMIDES BY METHOXIDE

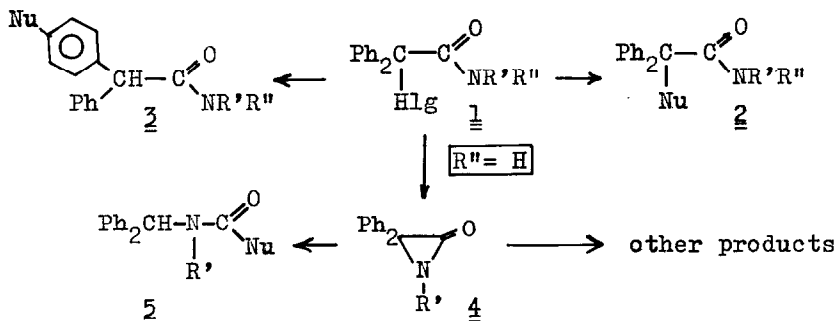
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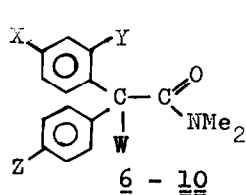
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$\alpha$ -HALOGENO- $\alpha,\alpha$ -diphenylacetamides (1) and related compounds are known to furnish both with simple and ambident nucleophiles (including NaH, NaBH<sub>4</sub>, NaNH<sub>2</sub>, amines, and N-cyanoamide anions, respectively), in addition to normal products (2) of substitution, p-substituted (3) and several types of further products, e.g. 5, formed through the intermediacy of aziridinones (4).<sup>1-7</sup>

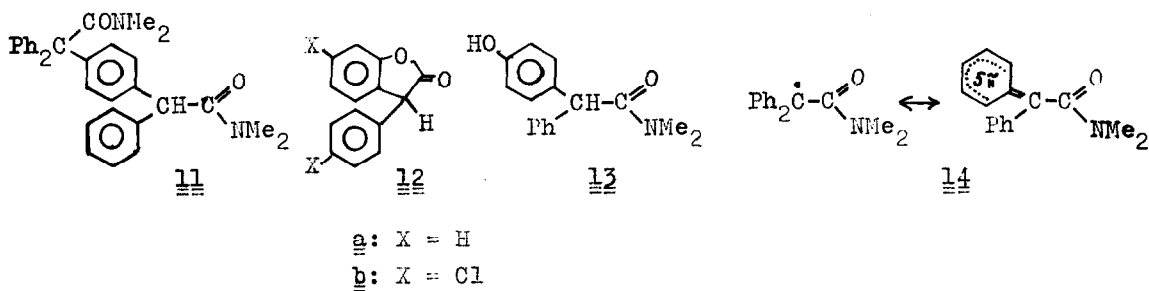


A limited number of reactions of type 1 compounds with alkali hydroxides and alkoxides in alcohols has so far been studied, and normal products (2) as well as products formed via 4 have been obtained.<sup>3b,8</sup>

We have reacted the  $\alpha$ -halogenoacetamides 6a,<sup>9</sup> 6b<sup>6</sup> and 6c<sup>10</sup> with 3-5 moles of NaOMe in MeOH or 2,2-dimethoxypropane (DMP) and obtained the products<sup>11</sup> shown in the table.



	<u>6a</u>	<u>b</u>	<u>c</u>	<u>7a</u>	<u>b</u>	<u>c</u>	<u>d</u>	<u>8a</u>	<u>b</u>	<u>c</u>	<u>9</u>	<u>10a</u>	<u>b</u>
X	H	H	Cl	H	H	Cl	Cl	H	MeO	Cl	MeO	H	Cl
Y	H	H	H	H	H	H	H	OMe	H	OMe	H	H	H
Z	H	H	Cl	H	H	Cl	Cl	H	H	Cl	Cl	H	Cl
W	Br	Cl	Br	OMe	OH	OMe	OH	H	H	H	OMe	H	H



Starting compound	Solvent	Conditions	Products and yields
$\underline{\underline{6a}}$	MeOH	5 days at r.t.	33-38% $\underline{\underline{7a}}$ , 0,5-3% $\underline{\underline{7b}}$ , 43-48% ( $\underline{\underline{8a}}+\underline{\underline{8b}}$ ) <sup>12</sup>
$\underline{\underline{6a}}$	DMP	2 hrs at r.t.	12% $\underline{\underline{7a}}$ , 9% $\underline{\underline{7b}}$ , 20% $\underline{\underline{10a}}$ , 24% $\underline{\underline{11}}$
$\underline{\underline{6b}}$	MeOH	7 days at r.t.	32-34% $\underline{\underline{7a}}$ , 1-4% $\underline{\underline{7b}}$ , 51-53% ( $\underline{\underline{8a}}+\underline{\underline{8b}}$ ) <sup>12</sup>
$\underline{\underline{6c}}$	MeOH	Refluxing for 4 hrs	50-58% $\underline{\underline{7c}}$ , 12-15% $\underline{\underline{8c}}$ , 3-11% $\underline{\underline{9}}$ <sup>13</sup>
$\underline{\underline{6c}}$	DMP	2 hrs at r.t.	7% $\underline{\underline{7d}}$ , 55% $\underline{\underline{10b}}$

$\underline{\underline{7a}}$ , mp. 127°C; IR (KBr): 1640, 760, 740, 700/690  $\text{cm}^{-1}$ . NMR ( $\text{CDCl}_3$ ):  $\delta$  7.45-7.05, m, 10H; 3.3, s, 3H; 2.95, bs, 6H. Authentic sample obtained in 90% yield by refluxing  $\underline{\underline{6a}}$  with MeOH. -  $\underline{\underline{7b}}$ , mp., m.m.p. and lit.<sup>6</sup> mp. 131-2°C. -  $\underline{\underline{7c}}$ , mp. 136-7°C; IR (KBr): 1640, 800  $\text{cm}^{-1}$ . NMR ( $\text{CDCl}_3$ ):  $\delta$  7.42+7.20,  $A_2B_2$ , J=9 Hz, 8H; 3.3, s, 3H; 3.0+2.9, two bs's, 6H. MS:  $m/e$  267 (69%, i); 265 (100%, M-CONMe<sub>2</sub>); 141 (15%, i); 139 (45%,  $p\text{-}^{35}\text{ClC}_6\text{H}_4\text{CO}$ ); 113 (5.4%, i); 111 (17%,  $^{35}\text{ClC}_6\text{H}_4$ ); 72 (11%, CONMe<sub>2</sub>). Authentic sample obtained in 73% yield by refluxing  $\underline{\underline{6c}}$  with MeOH. -  $\underline{\underline{7d}}$ , mp. 174-5°C; IR (KBr): 3300 b, 1630, 805  $\text{cm}^{-1}$ . Authentic sample obtained in 62% yield by reacting  $\underline{\underline{6c}}$  with aqu DMSO, cf. Ref.6.

$\underline{\underline{8a}}+\underline{\underline{8b}}$ , unseparable mixture; IR (KBr): 1640, 800, 740, 695  $\text{cm}^{-1}$ . NMR ( $\text{CDCl}_3$ ):  $\delta$  7.4-6.8, m, 9H; 5.17, s, 1H; 3.75, s, sh at 3.78, 3H; 3.00, s, 6H. Refluxing with AcOH/HBr furnished 6%  $\underline{\underline{12a}}$  and 54%  $\underline{\underline{13}}$  which were separated by chromatography.<sup>14</sup> -  $\underline{\underline{8c}}$ , mp. 183-4°C ( $\text{CHCl}_3$ -light petroleum; or MeOH); IR (KBr): 1630, 890, 850, 790  $\text{cm}^{-1}$ . NMR ( $\text{CDCl}_3$ ):  $\delta$  7.25-6.7, m, 7H; 5.45, s, 1H; 3.77, s, 3H; 2.97, s, 6H. MS:  $m/e$  339 (4.7%, i); 337 (7.1%, M); 267 (32%, i); 265 (47%, M-CONMe<sub>2</sub>); 217 (1.5%, i); 215 (3.8%, 265-[ $^{35}\text{Cl}+\text{Me}$ ]); 165 (7.1%); 152 (7.1%); 127 (19%, i); 125 (61%,  $\text{C}_6\text{H}_2\text{ClO}^+$ ); 72 (100%, CONMe<sub>2</sub>). Refluxing with AcOH/HBr and chromatographic work-up furnished 54% of  $\underline{\underline{12b}}$ .

$\underline{\underline{9}}$ , mp. 101-2°C (aqu EtOH); IR (KBr): 1645, 815, sh at 830  $\text{cm}^{-1}$ . NMR ( $\text{CDCl}_3$ ):  $\delta$  7.5-7.1, m 6H; 6.75, d, J=10 Hz, 2H, high field d of MeOC<sub>6</sub>H<sub>4</sub> group;

3.72, s, 3H; 3.28, s, 3H; 2.95, bs, 6H. MS:  $m/e$  263 (36%, i); 261 (100%, M-CONMe<sub>2</sub>); 141 (8.0%, i); 139 (27%, <sup>35</sup>ClC<sub>6</sub>H<sub>4</sub>CO); 135 (29%, MeOC<sub>6</sub>H<sub>4</sub>CO); 113 (2.8%, i); 111 (8.4%, <sup>35</sup>ClC<sub>6</sub>H<sub>4</sub>); 72 (11%, CONMe<sub>2</sub>).

10a, mp. 135-6°C, lit.<sup>15</sup> mp. 130°C; identical (IR, NMR) with an authentic sample.<sup>15</sup> - 10b, mp. 104-5°C (gasoline); IR (KBr): 1630, 790 cm<sup>-1</sup>. NMR (CDCl<sub>3</sub>): δ 7.5-7.0, m, 8H; 5.15, s, 1H; 2.97, s, 3H. Authentic sample obtained in 79% yield by reacting di(p-chlorophenyl)acetic acid with SOCl<sub>2</sub> and Me<sub>2</sub>NH.

11, mp. 160-1°C (acetone-light petroleum); IR (KBr): 1645, 800 w, 755, 700 cm<sup>-1</sup>. NMR (CDCl<sub>3</sub>): δ 7.3-7.05, m, 19H; 5.15, s, 1H; 2.95, s, 9H, three N-Me's; 2.3, bs, 3H, one N-Me. MS:  $m/e$  476 (3.4%, C<sub>32</sub>H<sub>32</sub>N<sub>2</sub>O<sub>2</sub>, M); 405 (25%); 404 (73%, M-CONMe<sub>2</sub>); 360 (0.54%); 359 (1.7%, 404-Me<sub>2</sub>NH); 333 (5.4%); 332 (15%, 404-CONMe<sub>2</sub>); 253 (4.2%); 252 (3.1%); 241 (5.4%); 239 (3.1%, M-237); 222 (3.5%); 165 (5.8%, C<sub>13</sub>H<sub>9</sub><sup>+</sup>); 72 (100%, CONMe<sub>2</sub>); metastables: 476  $\xrightarrow{-72}$  404, 404  $\xrightarrow{-45}$  359, 404  $\xrightarrow{-72}$  332, 404  $\xrightarrow{-332}$  72.

12a, mp. 112-3°C, lit.<sup>16a</sup> mp. 113-4°C; IR (KBr): 1810, 760, 730, 700 (sh at 710 cm<sup>-1</sup>). - 12b, mp. 121-2°C, lit.<sup>17</sup> mp. 119-21°C; IR identical with that of an authentic sample. - 13, mp. 172-3°C, lit.<sup>16b</sup> mp. 173°C; IR (KBr): 3500-2800, 1720, 820, 700 cm<sup>-1</sup>. Authentic samples of 12a, 12b and 13 were obtained as described in Ref's 16 and 17.

8a and 8b are the first anomalous o-substitution products isolated from reactions of type 1 compounds with nucleophiles, and 9 is the first "mixed" (α,p-disubstituted) product resulting from such a reaction. The formation of the dimer 11 suggests the intermediacy of the radicals 14 which, in turn, suggests a radical-anion chain mechanism (cf. Ref's 18-20) for the formation of 11 as well as of the type 8 anomalous products, the mixed product 9 and the reduction products 10. There are no indications yet as to whether the "normal" products 7<sup>21</sup> are the results of classical S<sub>N</sub>2 reactions of the halogenoamides 6 (as in a related case described in Ref. 20) or else are products of the same radical-anion chain reaction than the type 8-11 compounds (as in the cases described in Ref's 18-19).

## REFERENCES AND NOTES

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9. Obtained by reacting diphenyl ketene with N-bromodimethylamine, or  $\alpha, \alpha$ -diphenylacetyl chloride with  $\text{Br}_2$  and  $\text{Me}_2\text{NH}$ . Mp.  $129^\circ\text{C}$  (gasoline).
10. Obtained by reacting di(p-chlorophenyl)acetic acid successively with  $\text{SOCl}_2$ ,  $\text{Br}_2$  and  $\text{Me}_2\text{NH}$ . Mp.  $118-9^\circ\text{C}$  (gasoline).
11. All new compounds gave satisfactory microanalyses. NMR spectra were obtained at 60 MHz with a Perkin-Elmer R-12, mass spectra with an AEI MS-902 (70 eV,  $150^\circ\text{C}$ , direct inlet).
12. Yields of isolated products. Results of three runs.
13. Chromatographic work-up. Yields of isolated products.
14. Yields of recrystallized products.
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21. The low yields of the compounds 7b and 7d are consistent both with their formation by reaction of 6a and 6c, respectively, with traces of water and/or  $\text{OH}^\ominus$  ions present, and by demethylation of 7a and 7c, respectively, by  $\text{MeO}^\ominus$  ions, cf. Ref. 20.