

BICYCLIC ENAMINES WITH DIPHENYLCYCLOPROPENONE

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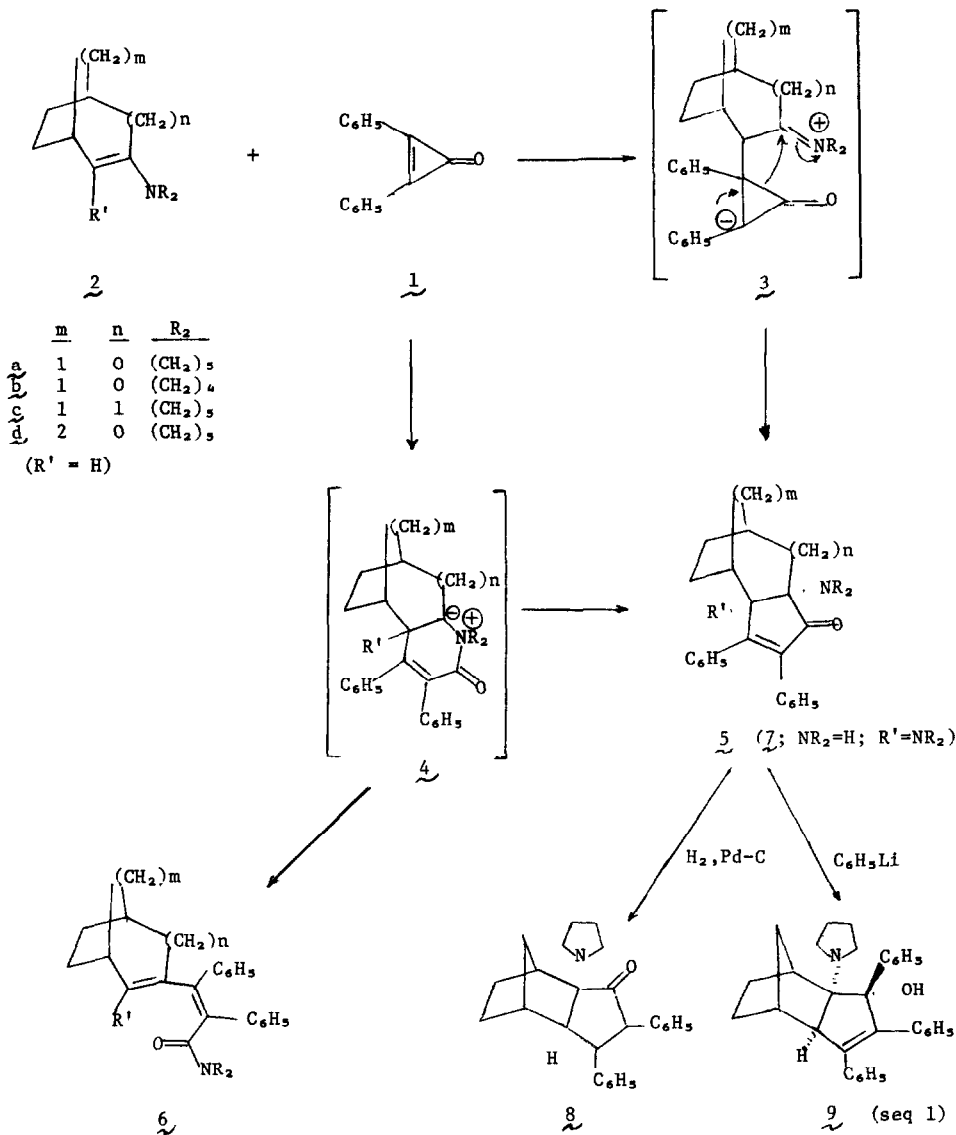
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The reaction of cyclic and acyclic enamines with diphenylcyclopropenone (1) has been shown to lead to a variety of products designated recently as arising via C,N- or C,C-insertions, condensation, and addition.<sup>1</sup> Over the past few years, we have also been involved in this area and have found that bicyclic enamines<sup>2</sup> afforded dramatic changes in the course of the reaction.

Treatment of 1 in benzene with an equimolar amount of enamine 2a or 2b afforded on refluxing the solution after the initial exothermic reaction a good yield of aminoketone 5a and 5b respectively (Table I) (seq 1). Although exo and endo ring fusion are both possible, the aminoketones were assigned as the indicated exo fused-ring based on literature precedence.<sup>3</sup> The alternative structure (e.g. 7) for these materials (upon inspection of only the infrared spectra<sup>4</sup> and elemental analysis) was ruled out on consideration of their NMR spectra (Table I) and the catalytic hydrogenation and phenyl lithium reaction of 5b to 8 [mp 148-150° (ethyl acetate-ethanol);  $\nu_{\max}^{\text{nujol}}$  1715s and 1605w  $\text{cm}^{-1}$ ] and 9 [HCl salt, mp 184-186° (as a hydrate from water); free base, froth,  $\nu_{\max}^{\text{nujol}}$  highly bonded OH-trace band at 3570  $\text{cm}^{-1}$ ], respectively (seq 1).

Derivation of the aminoketones can be pictured from several charged intermediates (e.g. 3 or 4<sup>5</sup>); direct evidence for one of these was achieved by maintaining the reaction for 5a at 20°C whereupon a mixture of 5a and 4a (or another equilibrium zwitterion)<sup>1</sup> which analyzed for  $\text{C}_2\text{H}_2\text{NO}$  was obtained: 4a portion,  $\nu_{\max}^{\text{nujol}}$  1590w and 1700s  $\text{cm}^{-1}$  and  $\lambda_{\max}^{\text{CH}_3\text{OH}}$  309. Refluxing of the mixture in benzene afforded only 5a.<sup>7</sup>

Employment of bicyclic enamines 2c<sup>2c</sup> and 2d<sup>2c</sup> yielded aminoketones 5c and 5d and amides 6c and 6d (seq 1). Zwitterion intermediate 4 can be considered the source of 6 but only in the case of these examples was this material obtained in isolatable yields.



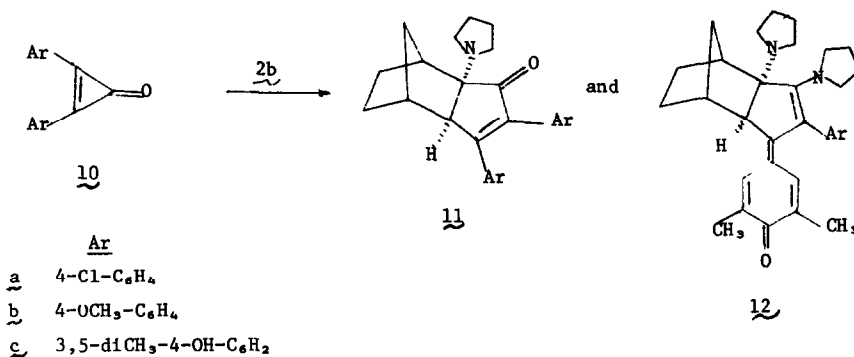
Presence of substituents in the phenyl rings of 1 can have an effect on the result of the transformation. For example, enamine 2b and cyclopropanone 10a<sup>b</sup> and 10b<sup>b</sup> gave aminoketones 11 (Table I); however, 10c (mp 269-270°, hydrate from ethanol) afforded enamine 12 [mp 239-240° (tetrahydrofuran-methanol);  $\nu_{\max}^{\text{nujol}}$  1630m, 1600s, 1590s;  $\lambda_{\max}^{\text{CH}_3\text{OH}}$  240 sh (1,080), 256 sh (8,650), 296-312 plat. (5,330), and 430 (19,400)] (seq 2). Possible routes of derivation for 12 are under investigation.

TABLE I<sup>9</sup>  
Experimental Results and Physical and Spectral Properties

Compound	mp (°C)	Yield %	$\nu_{\text{max}}^{\text{nujol}}$ (cm <sup>-1</sup> )	$\lambda_{\text{max}}^{\text{CH}_3\text{OH}}$ (m $\mu$ )
<u>5a</u>	159.5-160.0 <sup>a</sup>	50	1678s; 1610w	226 (17,000); 298 (11,800)
<u>5b</u>	197-8 <sup>b</sup>	68	1674s; 1604w	226 (17,300); 298 (12,600)
<u>5c</u>	147-9 <sup>c</sup>	16 <sup>d</sup>	1687s, 1616m; 1590w	226 (16,400); 297 (10,300)
<u>5d</u>	176-8 <sup>e</sup>	35.5 <sup>f</sup>	1682s; 1612m; 1590w; 1563w	226 (17,300); 296 (11,500)
<u>6c</u> <sup>g</sup>	182-4 <sup>c</sup>	14 <sup>d</sup>	1616s; 1560w	228 (19,100); 283 (10,300)
<u>6d</u> <sup>h</sup>	178-180 <sup>i</sup>	10 <sup>f</sup>	1621s; 1572w	231 (18,600); 290 (12,300)
<u>11a</u>	209-210 <sup>j</sup>	42	1685s; 1610w; 1590m	230 (7,000); 302 (5,150)
<u>11b</u>	147-9 <sup>c</sup>	37.5	1678s; 1600s; 1570w	234 (20,500); 292 sh (11,700); 312 sh (13,100); 330 (16,000)

a = ethyl acetate; b = 95% ethanol; c = ether; d = yield after extensive chromatography on alumina; e = ethyl acetate-hexane; f = crude yield of mixture was 86.4%; extensive chromatography on alumina was then performed; g =  $\delta_{\text{TMS}}^{\text{CDCl}_3}$  6.10 multiplet, vinyl H; h =  $\delta_{\text{TMS}}^{\text{CDCl}_3}$  6.33 doublet of doublets, J = 2.0 and 7.0 Hz, vinyl H; i = ether-hexane; j = tetrahydrofuran-ether; m = medium; s = strong; and w = weak.

Sequence 2



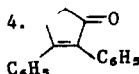
Products arising from either C,C-insertion<sup>1c</sup> or condensation<sup>1e</sup> were not observed with the aforementioned reactions (extensive chromatography was performed). Further examples of predominant aminoketone formation will be reported upon completion of work in progress.

#### References

1. (a) M.A. Steinfels and A.S. Dreiding, Helv.Chim.Acta., 55, 702(1972); (b) V. Bilinski, M.A. Steinfels, and A.S. Dreiding, ibid., 55, 1075(1972); (c) V. Bilinski and A.S. Dreiding, ibid., 55, 1271(1972); (d) T. Eicher and S. Böhm, Tetrahedron Letters, 2603(1972); (e) J. Ciabattoni and G.A. Berchtold, J.Org.Chem., 31, 1336(1966).

2. Synthesis of several of these materials is described in: (a) A.G. Cook, W.C. Meyer; K.E. Ungrodt, and R.H. Mueller, ibid., 31, 14(1966), and A.G. Cook, W.M. Kosman, T.A. Hecht, and W. Koehn, ibid., 37, 1565(1972); (b) J.F. Stephen and E. Marcus, ibid., 34, 2535(1969); (c) 2c, bp 75° (0.2 mm); 2d, bp 75° (0.4 mm).

3. (a) F. Scheinmann, D. Barraclough, and J.S. Oakland, Chem.Commun., 1970, 1544; (b) J.F. Stephen and E. Marcus, J.Hetero.Chem., 6, 969(1969); (c) Direct proof for such an assignment would follow from the singlet nature of the endo hydrogen in the nmr spectrum since it would not be expected to couple with the bridgehead hydrogen in the case of 5. However, the region of the spectrum where this hydrogen would appear is masked by the rest of the hydrogens of the molecule.

4.   $\nu_{\text{max}}^{\text{liq}}$  1681;  $\lambda_{\text{max}}^{\text{isooctane}}$  225 (17,800) and 290 (12,300). C.F.H. Allen and

J.A. VanAllan, J.Am.Chem.Soc., 77, 2315(1955).

5. The first step in the mechanism is postulated as attack by the enamine on nitrogen<sup>6</sup> at the carbonyl position of 1 with subsequent addition to the  $\beta$ -carbon of the vinyl ammonium ion.

6. G. Stork, A. Brizzolara, H. Landesman, J. Szmuszkowicz, and R. Terrell, J.Am.Chem.Soc., 85, 207(1963).

7. Evidence for a similar zwitterionic intermediate was recently described in ref. 1d.

8. R. West, D.C. Zecher, and W. Goyert, J.Am.Chem.Soc., 92, 149(1970) and T. Eicher and A.-H. Hansen, Chem.Ber., 102, 319(1969).

9. Acceptable elemental analyses ( $\pm 0.3\%$ ) and nmr spectra were obtained on all new compounds.