

dry benzene until the gas was no longer absorbed. The mixture was stirred for three hours and then poured into an ice-hydrochloric acid mixture. The semi-solid product was heated with ammonium hydroxide for a short time, cooled and extracted with ether. The crystalline product remaining after the evaporation of the ether was recrystallized from alcohol; m. p. 130–131°.

*Anal.* Calcd. for  $C_{23}H_{19}N$ : C, 89.28; H, 6.19; N, 4.53. Found: C, 89.18; H, 6.21; N, 4.60.

**B. From *p*-Chlorobenzallepidine.**— $\alpha$ -Benzohydrillepidine was obtained from *p*-chlorobenzallepidine by a procedure similar to the preceding one.

**$\beta$ -Phenylbenzalquinaldine (III).**—This compound was prepared by the method of Ziegler and Zeiser.<sup>4</sup> Its structure was confirmed by oxidation. With chromic acid it gave benzophenone.

**$\alpha$ -Benzohydrilquinaldine (IV).**—This compound was prepared by the reduction of  $\beta$ -phenylbenzalquinaldine. The reduction was carried out in two ways.

(a) **By the Friedel-Crafts Method.**—A mixture of 5.5 g. of  $\beta$ -phenylbenzalquinaldine, 50 cc. of dry benzene and 15 g. of anhydrous aluminum chloride was saturated at room temperature with dry hydrogen chloride gas. The mixture was shaken in a closed container for twenty hours. The color changed from bright red to brown. The reaction mixture was decomposed in an ice-hydrochloric acid mixture. The semi-solid hydrochloride was separated on a filter, washed with benzene and with water and finally heated with ammonium hydroxide for one hour to regenerate the free amine. The solid was recrystallized from alcohol; m. p. 119–121°. The yield was 92%. A mixed melting point determination with  $\alpha$ -benzohydrilquinaldine showed no depression.

(b) **By Catalytic Reduction.**—Hydrogenation in the presence of a platinum-platinum oxide catalyst converted the  $\beta$ -phenylbenzalquinaldine into  $\alpha$ -benzohydrilquinaldine. The samples prepared by methods (a) and (b) and

that of Hoffman, Fuson and Farlow proved to be identical.

**1-*p*-Chlorophenyl-1-phenyl-2-(2-quinoly)-ethanol.**—The method of Ziegler and Zeiser for the halogen-free carbinol was used. From 30 g. of *p*-chlorobenzophenone was obtained 43 g. of carbinol melting at 127–130°. The pure compound (from alcohol) melted at 140.5–141°.

*Anal.* Calcd. for  $C_{22}H_{19}ONCl$ : C, 76.75; H, 5.02. Found: C, 76.60; H, 5.18.

Attempts to dehydrate this carbinol by treatment with sulfuric acid, iodine, potassium bisulfate or acetic anhydride were unsuccessful. The only solid product which was isolated was *p*-chlorobenzophenone.

**2-Phenyl-4-styrylquinoline (VI).**—To an ether solution of benzallepidine an excess of phenylmagnesium bromide was added. The mixture was heated, with stirring, for five hours. Decomposition with ice and hydrochloric acid gave a gummy mass which, when treated with ammonium hydroxide, gave the free base. The pure compound (from alcohol) melted at 102.5–103.5°.

*Anal.* Calcd. for  $C_{22}H_{17}N_2$ : N, 4.56. Found: N, 4.74.

A mixture of this compound with a specimen of 2-phenyl-4-styrylquinoline, prepared by the method of John and Fischel,<sup>5</sup> melted at 102–103°.

### Summary

1. Benzallepidine and *p*-chlorobenzallepidine react with benzene in the presence of aluminum chloride and hydrogen chloride to give  $\alpha$ -benzohydrillepidine.
2. Benzallepidine reacts with phenylmagnesium bromide to give 2-phenyl-4-styrylquinoline.
3. The structure of  $\alpha$ -benzohydrilquinaldine has been confirmed by synthesis.

URBANA, ILLINOIS

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[CONTRIBUTION FROM THE ORGANIC CHEMICAL LABORATORY OF THE UNIVERSITY OF FLORIDA]

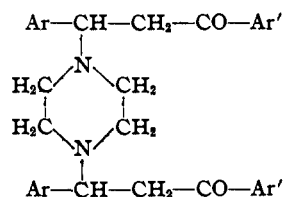
## Derivatives of Piperazine. IX. Addition to Conjugate Systems. I

BY VINCENT E. STEWART AND C. B. POLLARD

Additive compounds of benzalacetophenone (chalcone) with ammonia and primary aromatic amines were prepared by Tambor and Wildi.<sup>1</sup> The reaction goes readily in the cold, generally with or without alkali. They were not successful in adding secondary aromatic or mixed secondary bases. An addition compound of benzalacetophenone with piperidine was prepared by Georgi and Schwyzer;<sup>2</sup> upon heating with water it splits into the original substances. Bain<sup>3</sup> reported that he obtained an addition compound of benzal-

acetophenone with piperazine. We have verified his results, and have endeavored to determine the generality of this addition.

Chalcone and most substituted chalcones readily add piperazine to yield a compound of the type



The addition is effected readily by refluxing the

(1) Tambor and Wildi, *Ber.*, **31**, 349 (1898).

(2) Georgi and Schwyzer, *J. prakt. Chem.*, **86**, 273–276 (1912).

(3) Bain, unpublished work, University of Florida.

TABLE I

	Piperazine	M. p. (corr.), °C.	Formula	Analyses, % N	
				Found	Calcd.
1	1,4-Bis-chalcone	128.0-128.3	C <sub>24</sub> H <sub>34</sub> O <sub>2</sub> N <sub>2</sub>	5.58	5.57
2	1,4-Bis-(3-nitrochalcone)	143.0-144.0	C <sub>34</sub> H <sub>32</sub> O <sub>2</sub> N <sub>4</sub>	9.45	9.46
3	1,4-Bis-(2-chlorochalcone)	110.9-111.3	C <sub>24</sub> H <sub>32</sub> O <sub>2</sub> N <sub>2</sub> Cl <sub>2</sub>	4.85	4.91
4	1,4-Bis-(4'-chlorochalcone)	117.7-118.1	C <sub>24</sub> H <sub>32</sub> O <sub>2</sub> N <sub>2</sub> Cl <sub>2</sub>	4.88	4.91
5	1,4-Bis-(4-chlorochalcone)	146.8-147.0	C <sub>24</sub> H <sub>32</sub> O <sub>2</sub> N <sub>2</sub> Cl <sub>2</sub>	5.03	4.91
6	1,4-Bis-(4,4'-dichlorochalcone)	148.4-158.7	C <sub>24</sub> H <sub>30</sub> O <sub>2</sub> N <sub>2</sub> Cl <sub>4</sub>	4.42	4.38
7	1,4-Bis-(4'-bromochalcone)	116.3-117.3	C <sub>24</sub> H <sub>32</sub> O <sub>2</sub> N <sub>2</sub> Br <sub>2</sub>	4.24	4.24
8	1,4-Bis-(4-methylchalcone)	145.5-146.0	C <sub>26</sub> H <sub>38</sub> O <sub>2</sub> N <sub>2</sub>	5.22	5.28
9	1,4-Bis-(4'-methylchalcone)	132.0-132.5	C <sub>26</sub> H <sub>38</sub> O <sub>2</sub> N <sub>2</sub>	5.38	5.28
10	1,4-Bis-(4-methoxychalcone)	109.5-110.1	C <sub>26</sub> H <sub>38</sub> O <sub>2</sub> N <sub>2</sub>	5.16	4.98
11	1,4-Bis-(4,4'-dimethylchalcone)	175.4-175.8	C <sub>28</sub> H <sub>42</sub> O <sub>2</sub> N <sub>2</sub>	4.96	5.02
12	1,4-Bis-(4-methoxy-4'-methylchalcone)	149.8-150.2	C <sub>28</sub> H <sub>42</sub> O <sub>4</sub> N <sub>2</sub>	4.74	4.75

chalcone with anhydrous piperazine in toluene solution for a few hours; alkali does not facilitate the reaction. The addition compounds separate in minute crystals upon cooling. They can be recrystallized readily from toluene, and in most cases are pure white. The compounds are insoluble in water, alcohol and ether, moderately soluble in hot benzene and toluene and readily soluble in chloroform and other halogenated solvents. In most cases the yield of crude product is almost the theoretical; however, subsequent recrystallizations increase the melting point markedly although a substantial loss of product is incurred.

The compounds are all stable under ordinary conditions, and are not decomposed by heating with water as is the case with the piperidine additive compound. Treatment of 1,4-bis(chalcone) piperazine with dilute hydrochloric acid, or passing dry hydrogen chloride into a chloroform or hot toluene solution of the compound, induces complete decomposition into piperazine dihydrochloride and chalcone. Similarly, refluxing the toluene solution of the compound with ethyl iodide results in complete decomposition into chalcone and a substance identical with the product obtained by refluxing piperazine with ethyl iodide. These decompositions are noteworthy, since the unsaturated ketone results; however, this is entirely analogous to the usual degradation of amines whereby the alkyl group is split off as an unsaturated hydrocarbon.

Certain  $\alpha,\beta$ -unsaturated ketones, including some chalcones, apparently do not yield addition compounds with piperazine. These are being investigated further, and a classification of these compounds will form the basis of a forthcoming publication.

### Experimental

**Preparation of Chalcones.**—These were prepared readily by the Claisen reaction. The theoretical quantities of the corresponding aldehyde and the ketone were dissolved in a suitable quantity of alcohol, and 100 g. of 10% aqueous sodium hydroxide was added per mole of reactant. Separation of the chalcone generally occurred immediately. Alcohol or commercial heptane is most suitable as a solvent for recrystallization.

**Preparation of Addition Compounds.**—Anhydrous piperazine (0.05 mole) was dissolved in a minimum amount of toluene under reflux, and a toluene solution of the chalcone (0.1 mole) was added. The solution was refluxed for about ten hours and then allowed to stand in the ice-box for several hours. The addition compound separated upon cooling. It was filtered, washed with alcohol and water to remove unreacted piperazine, air-dried and recrystallized from toluene three times before being subjected to analysis.

### Summary

1. Addition compounds of piperazine with conjugate systems have been studied. One mole of piperazine and two moles of a chalcone are involved in the addition.

2. Some  $\alpha,\beta$ -unsaturated ketones apparently do not yield addition compounds with piperazine. These are being investigated further.