[CONTRIBUTION FROM THE NOYES CHEMICAL LABORATORY, UNIVERSITY OF ILLINOIS]

Rearrangement of α-Aminoketones during Clemmensen Reduction. X. Influence of Phenyl Substitution[1]

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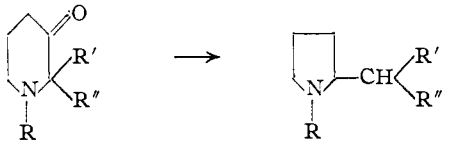
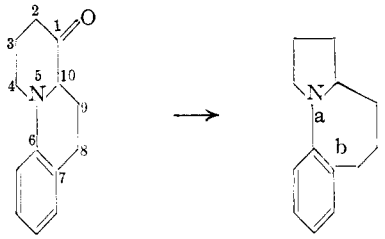
Phenyl substitution in monocyclic α-aminoketones has been found to exert no inhibiting effect on the Clemmensen reduction–rearrangement, at least with ketones in which ring contraction is not prevented sterically. 1-Phenyl-3-piperidone, 1-ethyl-2-phenyl-3-piperidone and 1-methyl-4-phenyl-3-piperidone were reduced under Clemmensen conditions and all three yielded pyrrolidines.

Previous investigations of the Clemmensen reduction–rearrangement of α-aminoketones (*e.g.*, I → II) have dealt almost exclusively with alkyl-



I II

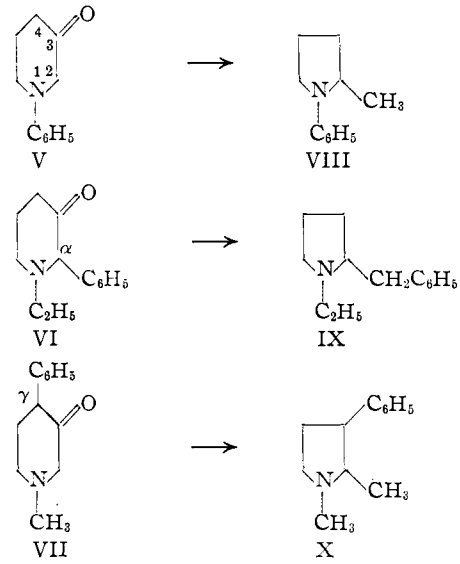
or alkylene-substituted compounds.[2] One exception is to be found in the report of von Braun and Weissbach[3] that ω-dimethylaminoacetophenone, under Clemmensen reduction conditions, yielded the cleavage product, ethylbenzene. Another is the report of the Clemmensen reduction—rearrangement of 1-keto-6,7-benzoquinolizidine (III)[4] to the product indicated as benzo[b]-1-azabicyclo[5.3.0]decane (IV).[5] For a systematic study



III IV

of the influence, if any, of an aryl substituent on the course of the Clemmensen reduction of α-aminoketones, a series of 3-piperidones has been employed in which a phenyl group was attached to the nitrogen, the α-carbon, or the γ(α′)-carbon. 1-Phenyl-3-piperidone (V), 1-ethyl-2-phenyl-3-piperidone (VI), and 1-methyl-4-phenyl-3-piperidone (VII) all gave pyrrolidines (VIII, IX and X, respectively) under Clemmensen reduction conditions.

The first member of the series, 1-phenyl-3-piperidone (V), bears a close resemblance to compound III, which has been shown to undergo ketone-ring contraction upon reduction by the Clemmensen method. It is also analogous to 1-methyl-3-piperidone (I, R = CH_3; R′ = R″ = H), which



V VIII

VI IX

VII X

likewise bears no substituent on the α-carbon of the piperidone ring and has been shown to give 1,2-dimethylpyrrolidine (II, R = CH_3; R′ = R″ = H) on Clemmensen reduction. It was therefore to be expected that the predominant reduction product of 1-phenyl-3-piperidone (V) would be 1-phenyl-2-methylpyrrolidine. The physical properties of the product and its derivatives correspond to those reported by von Braun[6] for VIII. The identity was established by direct comparison of the picrate of the Clemmensen reduction product with an authentic sample of 1-phenyl-2-methylpyrrolidine picrate.

The yield of pyrrolidine IX from the Clemmensen reduction of 1-ethyl-2-phenyl-3-piperidone (VI) was substantially lower than the yield of VIII from V; however, no other product, either open-chain or cyclic amine, could be isolated from the reaction mixture. In the absence of any positive evidence as to what the attendant reduction products might be, we are not willing to advance any hypothesis for the low yield of rearrangement product from the α-phenyl substituted ketone (VI). The Clemmensen product isolated from VI formed a picrate, m.p. 135°. By contrast, the picrate of the Wolff–Kishner reduction product, 1-ethyl-2-phenylpiperidine, melted at 189–190°. An authentic sample of 1-ethyl-2-benzylpyrrolidine (IX) picrate melted at 135° and was identical with the picrate of the Clemmensen reduction product. The unequivocal synthesis of 1-ethyl-2-benzylpyrrolidine was achieved by condensation of benzylmagnesium

(1) For article IX in this series, see N. J. Leonard, R. C. Sentz and W. J. Middleton, THIS JOURNAL, **75**, 1674 (1953).

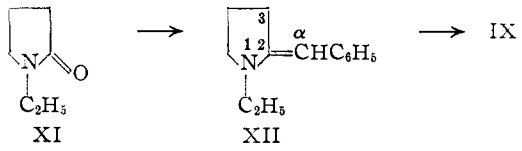
(2) For example, see N. J. Leonard and E. Barthel, Jr., *ibid.*, **72**, 3632 (1950).

(3) J. von Braun and K. Weissbach, *Ber.*, **62**, 2416 (1929).

(4) G. R. Clemo, J. G. Cook and R. Raper, *J. Chem. Soc.*, 1318 (1938).

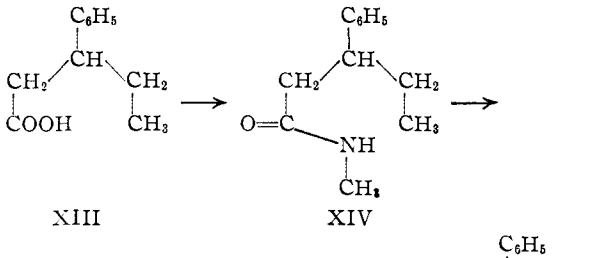
(5) N. J. Leonard and W. C. Wildman, THIS JOURNAL, **71**, 3089 (1949).

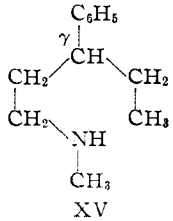
(6) J. von Braun, *Ber.*, **42**, 4548 (1909).



chloride with 1-ethyl-2-pyrrolidone (XI) to give 1-ethyl-2-benzyl-Δ^2-pyrroline or 1-ethyl-2-benzalpyrrolidine (XII),[7] followed by catalytic hydrogenation.

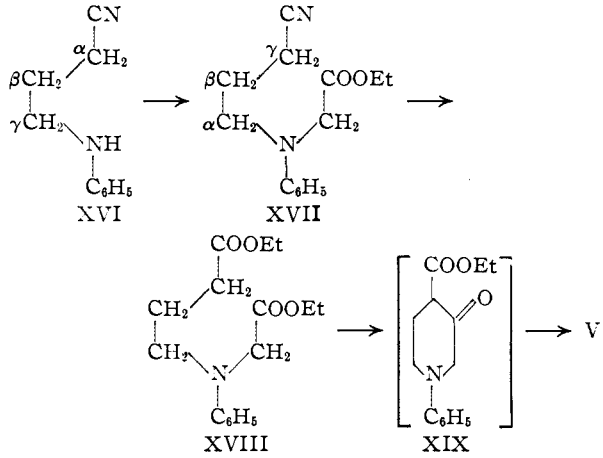
The Clemmensen reduction–rearrangement of 1-methyl-4-phenyl-3-piperidone (VII) to 1,2-dimethyl-3-phenylpyrrolidine (X) was established by elimination of the other possibilities rather than by independent synthesis of X and direct comparison. Our earlier work had shown that where the structure of the reduction–rearrangement product possessed two asymmetric carbons, both racemates could be expected to be formed.[8,9] In order to circumvent the isolation and direct identification of both racemates of X, we chose to compare the Clemmensen reduction product (picrate, m.p. 169–172°, with decomposition)[10] with the two alternative possibilities and thereby eliminate these in favor of X. The first possibility (very unlikely in view of the accumulated experience on the *rearrangement* of α-aminoketones during Clemmensen reduction), 1-methyl-4-phenylpiperidine, was eliminated by reason of the melting point of its picrate, 239–240°.[11] The second possibility, N-methyl-γ-phenylamylamine (XV), which could theoretically result from C_α-N cleavage followed by isolated carbonyl reduction,[12] was previously unknown but was synthesized readily from β-phenylvaleric acid (XIII)[13] by an unexceptional procedure. The melting point (114.5–116°) and infrared absorption spectrum of the picrate of N-methyl-γ-phenylamylamine (XV) indicated that XV and the Clemmensen reduction product of VII could not be identical.





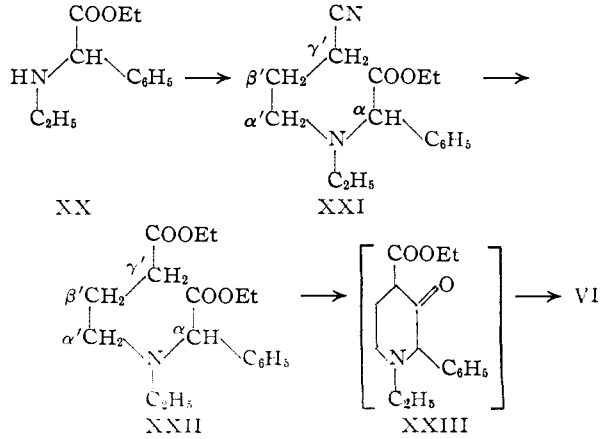
The fact that each of the three phenyl-substituted 3-piperidones (V, VI, VII) underwent piperidone-ring contraction under Clemmensen reduction conditions indicates that phenyl substitution, whether N-, α-, or γ-, apparently has no general or selective influence on the reduction–rearrangement process encountered with cyclic α-aminoketones. It may be said, however, that the phenyl-substituted α-aminoketones were less stable and underwent more side reactions in contact with zinc amalgam and hydrochloric acid than the corresponding alkyl-substituted α-aminoketones.

1-Phenyl-3-piperidone (V) was particularly unstable, and satisfactory Clemmensen reduction was realized only when the ketone, as liberated by hydrochloric acid hydrolysis from the corresponding β-ketoester (XIX), was used directly in the acid solution. The intermediate γ-anilinobutyronitrile (XVI), required for the synthesis of 1-phenyl-3-piperidone, was obtained by the alkylation of aniline with γ-bromobutyronitrile in the presence of potassium carbonate. This compound was subsequently treated with ethyl chloroacetate in the presence of carbonate to give N-carbethoxymethyl-N-γ-cyanopropylaniline (XVII). The diester XVIII obtained by ethanolysis of XVII was



converted by a Dieckmann condensation with sodium ethoxide to the ketoester XIX (alternative structure not excluded), which was hydrolyzed directly to 1-phenyl-3-piperidone (V).

The synthesis of 1-ethyl-2-phenyl-3-piperidone (VI) was realized by a similar reaction sequence



(7) The position of the double bond ($\Delta^{2,3}$ or $\Delta^{2,\alpha}$) was not determined since hydrogenation of either, or a mixture, would lead to IX.

(8) N. J. Leonard and S. H. Pines, THIS JOURNAL, **72**, 4931 (1950).

(9) N. J. Leonard and E. D. Nicolaides, *ibid.*, **73**, 5210 (1951).

(10) Isomeric purity was not established.

(11) F. Bergel, J. W. Haworth, A. L. Morrison and H. Rinderknecht, *J. Chem. Soc.*, 264 (1944); *cf.* O. Eislab, *Ber.*, **74**, 1433 (1941).

(12) N. J. Leonard and R. C. Sentz, THIS JOURNAL, **74**, 1704 (1952).

(13) G. P. Reynolds, *Am. Chem. J.*, **44**, 305 (1910).

(XX → XXII), culminating in a Dieckmann condensation and direct hydrolysis (XII → VI).

Acknowledgment.—The authors are indebted to Dr. S. M. McElvain, University of Wisconsin, for his kindness in supplying a sample of 1-methyl-4-phenyl-3-piperidone (VII) hydrochloride.[14]

Experimental[15]

γ-Anilinobutyronitrile (XVI).—A mixture of 186 g. (2 moles) of aniline, 138.2 g. (1 mole) of potassium carbonate and 148 g. (1 mole) of γ-bromobutyronitrile was stirred at 25° for 24 hours, then heated at *ca.* 100° for 3 hours. The mixture was cooled, water was added, and the organic layer was separated and dried. The excess aniline was removed at atmospheric pressure and the residue was distilled *in vacuo*, b.p. 138–140° (1 mm.), $n^{20}D$ 1.5609, yield 108.5 g. (68%). The γ-anilinobutyronitrile was identified by formation of the chloroplatinate, m.p. 190–192°, with decomposition (reported[16] 191°).

N-Carbethoxymethyl-N-γ-cyanopropylaniline (XVII).—A mixture of 64 g. (0.4 mole) of γ-anilinobutyronitrile, 55.5 g. (0.4 mole) of potassium carbonate and 50 g. (0.41 mole) of ethyl chloroacetate was heated with stirring on the steam-bath for 9 hours. The mixture was cooled, 200 ml. of water was added, the organic layer was separated, and the aqueous layer was extracted with four 30-ml. portions of ether. The organic layers were combined and dried, and the solvent was removed. The residue was distilled *in vacuo*, and the distillate was dissolved in 100 ml. of 95% ethanol. When the solution was cooled to −70°, the desired product separated as colorless crystals, m.p. 48–49°; yield 20.2 g. (15%). The infrared spectrum indicated the presence of an ester group (1740 cm.$^{-1}$), a phenyl group (1603 cm.$^{-1}$) and a nitrile group (2244 cm.$^{-1}$).

Anal. Calcd. for $C_{14}H_{18}N_2O_2$: C, 68.27; H, 7.37; N, 11.38. Found: C, 68.32; H, 7.27; N, 11.33.

The N-Carbethoxymethyl-N-γ-carbethoxypropylaniline (XVIII).—A solution of 32 g. (0.13 mole) of XVII in 250 ml. of absolute ethanol was saturated with anhydrous hydrogen chloride and 2.3 ml. of water was added. The resulting solution was heated under reflux for 2 hours on the steam-bath and then cooled. The supernatant was decanted from the precipitated ammonium chloride and concentrated *in vacuo*. Water (75 ml.) was added to the cooled solution, followed by 50% aqueous potassium hydroxide to alkalinity. The mixture was extracted with five 50-ml. portions of ether, the extracts were dried, the ether was removed, and the product was distilled in vacuum, giving a colorless liquid, b.p. 132° (0.1 mm.), $n^{20}D$ 1.5143, yield 9.2 g. (24%). The infrared spectrum showed the presence of the ester function (1733 cm.$^{-1}$) and the absence of the nitrile function.

Anal. Calcd. for $C_{16}H_{23}NO_4$: C, 65.50; H, 7.90; N, 4.78. Found: C, 65.71; H, 7.87; N, 5.06.

1-Phenyl-3-piperidone (V).—To a toluene (250 ml.) suspension of sodium ethoxide, prepared from 0.7 g. (0.03 gram atom) of sodium, was added 8.1 g. (0.028 mole) of XVIII, and the mixture was distilled until the boiling temperature rose to 106°. After cooling, the mixture was extracted with four 25-ml. portions of concentrated hydrochloric acid. The hydrochloric acid extracts were combined and heated on the steam-bath for 12 hours. Most of the acid was removed by distillation *in vacuo*. The residue was cooled and made basic with 50% potassium hydroxide. Three 25-ml. ether extracts were combined with the original organic layer that separated. The ether was removed and the residual brown oil was subjected to vacuum distillation. Only a few drops of liquid were collected, b.p. 111° (0.2 mm.), $n^{20.5}D$ 1.5773. Infrared analysis indicated the presence of a ketone carbonyl (1722 cm.$^{-1}$). The yellow liquid began to decompose immediately, even when stored under nitrogen.

Anal. Calcd. for $C_{11}H_{13}NO$: C, 75.39; H, 7.48. Found: C, 75.94; H, 7.87.

Clemmensen Reduction of 1-Phenyl-3-piperidone.—Since 1-phenyl-3-piperidone was so unstable, the Dieckmann cyclization mixture from 22.2 g. (0.075 mole) from N-carbethoxymethyl-N-γ-carbethoxypropylaniline (XVIII) was hydrolyzed with concentrated hydrochloric acid, and the acid concentrate was reduced directly with zinc amalgam made from 20 g. of granulated zinc and 3 g. of mercuric chloride. After 12 hours at the reflux temperature, the reaction mixture was cooled and made basic with 50% potassium hydroxide. The zinc hydroxide was filtered and the filtrate was extracted with five 50-ml. portions of ether. The extracts were combined and dried, the ether was removed, and the product was distilled as a colorless liquid, b.p. 77–80° (0.2 mm.), $n^{24}D$ 1.5667, yield 5.6 g. (46% based on diester). The **picrate**, formed in ethanol, was recrystallized from the same solvent as tiny yellow needles, m.p. 109–110°.

Anal. Calcd. for $C_{17}H_{18}N_4O_7$: C, 52.30; H, 4.65; N, 14.35. Found: C, 52.47; H, 4.75; N, 14.22.

1-Phenyl-2-methylpyrrolidine (VIII).—This compound, made by the method of von Braun,[17] was converted to the **picrate**, m.p. 109–110°.

Anal. Calcd. for $C_{17}H_{18}N_4O_7$: C, 52.30; H, 4.65; N, 14.35. Found: C, 52.59; H, 4.80; N, 14.47.

This picrate and the picrate of the Clemmensen reduction product of 1-phenyl-3-piperidone were identical as determined by the melting points of mixtures and by infrared absorption spectra (Nujol mull).

Ethyl α-Ethylaminophenylacetate (XX).—To a solution of 75 g. of sodium cyanide in 250 ml. of water was added 106 g. (1 mole) of benzaldehyde and 425 ml. of a saturated aqueous solution of sodium bisulfite. The orange mandelonitrile was separated from the aqueous layer and dried. A solution of the liquid in 400 ml. of absolute ethanol was saturated with gaseous ethylamine and heated under reflux for 2 hours on the steam-bath. The ethanol was removed *in vacuo*, 500 ml. of concentrated hydrochloric acid was added to the residue, and the acid solution was heated for 12 hours on the steam-bath. The solution was concentrated until a solid mixture of α-ethylaminophenylacetic acid hydrochloride and ammonium chloride separated. The solid mixture was dried in an oven at 110°, then placed in 500 ml. of absolute ethanol saturated with hydrogen chloride. The mixture was heated under reflux for 12 hours, cooled, and the ammonium chloride was removed by filtration. The hydrogen chloride and ethanol were removed *in vacuo*, until bumping began to occur. The mixture was then basified with 50% aqueous sodium hydroxide. The organic base was isolated in the usual manner and distilled, b.p. 110° (0.5 mm.), $n^{20.5}D$ 1.4993, yield 22 g. (11%). The infrared absorption spectrum indicated the presence of carbonyl (1736 cm.$^{-1}$) and N-H (3333 cm.$^{-1}$) groups.

Anal. Calcd. for $C_{12}H_{17}NO_2$: C, 69.53; H, 8.27; N, 6.76. Found: C, 69.25; H, 8.28; N, 6.68.

Ethyl α-(N-Ethyl-N-γ'-cyanopropylamino)-phenylacetate (XXI).—The condensation of 21.9 g. (0.105 mole) of XX with 11 g. (0.105 mole) of γ-chlorobutyronitrile in the presence of 15 g. (0.107 mole) of potassium carbonate was carried out in a manner analogous to the formation of XVI. The product was distilled at 114° (0.09 mm.), $n^{20.5}D$ 1.5030, yield 13.9 g. (49%). The infrared spectrum indicated the presence of an ester (1736 cm.$^{-1}$) and nitrile (2249 cm.$^{-1}$) group.

Anal. Calcd. for $C_{16}H_{22}N_2O_2$: C, 70.04; H, 8.08; N, 10.21. Found: C, 70.25; H, 8.17; N, 10.30.

Ethyl α-(N-Ethyl-N-γ'-carbethoxypropylamino)-phenylacetate (XXII).—Ethanolysis of XXI was accomplished by following directions similar to those for XVIII. The product boiled at 121° (0.1 mm.), $n^{20.5}D$ 1.4904, yield 50%. The infrared spectrum indicated the presence of ester carbonyl (1736 cm.$^{-1}$) and the absence of nitrile.

Anal. Calcd. for $C_{18}H_{27}NO_4$: C, 67.26; H, 8.47. Found: C, 67.39; H, 8.50.

1-Ethyl-2-phenyl-3-piperidone (VI).—A Dieckmann condensation was carried out on 7.1 g. (0.022 mole) of XXII with sodium ethoxide from 0.7 g. (0.03 gram atom) of sodium, in the same manner as that employed for the synthe-

(14) S. M. McElvain and P. M. Laughton, THIS JOURNAL, **73**, 448 (1951).

(15) All melting points are corrected. Microanalyses were performed by Miss Emily Davis, Mrs. Jean Fortney, Mrs. Katherine Pih, Mrs. Esther Fett and Mr. Joseph Nemeth, and the infrared absorption spectra were determined by Miss Elizabeth M. Petersen and Miss Helen Miklas.

(16) P. Blank, *Ber.*, **25**, 3040 (1892).

(17) J. von Braun, *ibid.*, **42**, 4541 (1909).

sis of V. The reaction mixture was extracted with concentrated hydrochloric acid, and the acid solution was heated for 12 hours on the steam-bath to effect hydrolysis of the ketoester XXIII and subsequent decarboxylation. The resulting solution was concentrated under vacuum and made basic with saturated aqueous potassium carbonate solution. Extraction with ether, followed by drying of the ethereal solution and removal of the ether, furnished the α-aminoketone VI, which distilled as a colorless liquid, b.p. 106–106.5° (0.25 mm.), $n^{20.5}$D 1.5328, yield 2.9 g. (64%). The compound exhibited an absorption maximum in the infrared characteristic of the ketone carbonyl group (1721 cm.$^{-1}$).

Anal. Calcd. for $C_{13}H_{17}NO$: C, 76.81; H, 8.43. Found: C, 76.26; H, 8.56.

The **picrate**, prepared in ethanol and recrystallized from chloroform, formed yellow prisms, m.p. 146°.

Anal. Calcd. for $C_{19}H_{20}N_4O_8$: C, 52.78; H, 4.66; N, 12.96. Found: C, 52.65; H, 4.94; N, 13.11.

Wolff–Kishner Reduction of 1-Ethyl-2-phenyl-3-piperidone. 1-Ethyl-2-phenylpiperidine.—The Wolff–Kishner reduction of VI was carried out using the Huang-Minlon modification,[18] and the 1-ethyl-2-phenylpiperidine was isolated in low yield as the **picrate**, recrystallized from ethanol as yellow prisms, m.p. 189–190°.

Anal. Calcd. for $C_{19}H_{22}N_4O_7$: C, 54.53; H, 5.30; N, 13.39. Found: C, 54.45; H, 5.35; N, 13.35.

Clemmensen Reduction of 1-Ethyl-2-phenyl-3-piperidone.—A solution of 1.15 g. (5.7 millimoles) of 1-ethyl-2-phenyl-3-piperidone in 30 ml. of concentrated hydrochloric acid was reduced with zinc amalgam prepared from 7 g. of granulated zinc and 1 g. of mercuric chloride. The Clemmensen reduction and product isolation were carried out as with compound V. The **picrate** of the reduction product, prepared in and recrystallized from 95% ethanol, formed yellow needles, m.p. 135°; yield 0.23 g. (10%).

Anal. Calcd. for $C_{19}H_{22}N_4O_7$: C, 54.53; H, 5.30; N, 13.39. Found: C, 54.29; H, 5.31; N, 13.43.

An authentic sample of 1-ethyl-2-benzylpyrrolidine picrate (see below) gave no depression in melting point (135°) when mixed with this picrate. The two picrates had identical infrared absorption spectra (Nujol mull).

1-Ethyl-2-pyrrolidone (XI).—This compound was prepared by the procedure given by Adams and Mahan[19] for 1-alkyl-2-pyrrolidones. From 43 g. (0.5 mole) of butyrolactone and 30 g. (0.67 mole) of ethylamine kept at 280° for 4 hours in a 250-ml. steel bomb was obtained 42.5 g. (75%) of XI, b.p. 97° (20 mm.).

Anal. Calcd. for $C_6H_{11}NO$: C, 63.68; H, 9.80; N, 12.38. Found: C, 63.58; H, 9.80; N, 12.28.

1-Ethyl-2-benzyl-Δ²-pyrroline or 1-Ethyl-2-benzalpyrrolidine (XII).—Benzylmagnesium chloride was formed from 16.2 g. of magnesium (0.66 gram atom) and 84 g. (0.66 mole) of benzyl chloride in 600 ml. of ether. To this solution was added during 2.5 hours with stirring 30 g. (0.26 mole) of 1-ethyl-2-pyrrolidone.[19] The mixture was stirred an additional 12 hours and then hydrolyzed with 3 *N* hydrochloric acid. The aqueous layer was separated from the ether layer and was made basic with 50% potassium hydroxide. The basified solution was steam distilled, and the distillate was acidified with hydrochloric acid, then concentrated *in vacuo*. The concentrate was made basic with 30% sodium hydroxide. Ether extraction, drying of the combined extracts, and removal of the ether yielded a residue which boiled at 79–85° (23 mm.) as an orange liquid; yield 3.0 g. (7%). An orange **picrate**, formed in ethanol–ether, was recrystallized from ethanol, yellow-orange prisms, m.p. 100–101°.

Anal. Calcd. for $C_{19}H_{20}N_4O_7$: C, 54.80; H, 4.84; N, 13.46. Found: C, 54.81; H, 5.07; N, 13.41.

1-Ethyl-2-benzylpyrrolidine (IX).—A solution of 1.5 g. (0.016 mole) of the unsaturated compound (see above) in 50 ml. of ethanol was hydrogenated at 3 atmospheres during 1 hour using platinum oxide catalyst. The catalyst was removed, and picric acid was added to the ethanol. The **picrate** was recrystallized from 95% ethanol, yellow needles, m.p. 135°.

Anal. Calcd. for $C_{19}H_{22}N_4O_7$: C, 54.53; H, 5.30; N, 13.39. Found: C, 54.52; H, 5.35; N, 13.49.

Clemmensen Reduction of 1-Methyl-4-phenyl-3-piperidone (VII).[14]—A solution of 0.31 g. (1.3 millimoles) of 1-methyl-4-phenyl-3-piperidone hydrochloride in 30 ml. of concentrated hydrochloric acid was reduced with 7 g. of amalgamated zinc during 10 hours. The acid solution was decanted from the zinc, concentrated in vacuum, and made basic with 50% potassium hydroxide. The basic mixture was subjected to steam distillation. The distillate was extracted with three 10-ml. portions of ether. Picric acid in ethanol was added to the combined ethereal solution, and the **picrate** was recrystallized from ethanol, yellow platelets, m.p. 169–172° with decomposition; yield 0.18 g. (34%).

Anal. Calcd. for $C_{18}H_{20}N_4O_7$: C, 53.46; H, 4.99; N, 13.86. Found: C, 53.59; H, 5.08; N, 14.12.

N-Methyl-β-phenylvaleramide (XIV).—A mixture of 29.6 g. (0.166 mole) of β-phenylvaleric acid (XIII)[13] and 29.7 g. (0.25 mole) of thionyl chloride was allowed to reflux for 30 minutes on the steam-bath. The excess thionyl chloride was removed by distillation. To the residue was added slowly with shaking a solution of 15 g. of methylamine in 50 ml. of ether. When the reaction subsided the ether solution was filtered from the solid methylamine hydrochloride. The solid was washed with ether and the ether washes were added to the filtrate. The ether was removed and the product distilled, b.p. 160–161° (1 mm.), n^{20}D 1.5247, yield 25.5 g. (80%). The infrared absorption spectrum indicated the presence of carbonyl (1640 cm.$^{-1}$) and amide C–N–H– (1565 cm.$^{-1}$) groups.

Anal. Calcd. for $C_{12}H_{17}NO$: C, 75.35; H, 8.96; N, 7.32. Found: C, 75.58; H, 9.10; N, 7.55.

N-Methyl-γ-phenylamylamine (XV).—To a stirred slurry of 3 g. (0.079 mole) of lithium aluminum hydride in 150 ml. of anhydrous ether was added over a period of 1 hour a solution of 12.5 g. (0.065 mole) of N-methyl-β-phenylvaleramide in 150 ml. of anhydrous ether. The mixture was refluxed for 1 hour. The excess lithium aluminum hydride was then decomposed by addition of water. Enough 6 *N* sulfuric acid was added to make the mixture acidic, the ether layer was removed and the water layer was extracted with ether. The water layer was next made strongly basic with 30% potassium hydroxide and continuously extracted with ether for 45 hours. The extract was dried over anhydrous sodium sulfate and the ether was removed. The product was distilled, b.p. 134–135° (30 mm.), n^{20}D 1.5042, yield 6.9 g. (60%). The infrared absorption spectrum indicated the presence of N–H (3200 cm.$^{-1}$) and the absence of a carbonyl group.

Anal. Calcd. for $C_{12}H_{19}N$: C, 81.30; H, 10.80; N, 7.90. Found: C, 81.40; H, 10.67; N, 8.10.

The **picrate**, prepared in ether and recrystallized from a mixture of 1 part tetrahydrofuran and 9 parts ether formed yellow prisms, m.p. 114.5–116°. The melting point and the infrared spectrum showed it to be different from the picrate of the Clemmensen reduction product of 1-methyl-4-phenyl-3-piperidone.

Anal. Calcd. for $C_{18}H_{22}N_4O_7$: C, 53.20; H, 5.46; N, 13.79. Found: C, 53.37; H, 5.69; N, 13.82.

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