314. *Syntheses in the Octahydropyrrocoline and Octahydropyridocoline Series.*

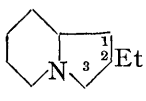
By G. R. Clemo and T. P. Metcalfe.

One of the two unidentified basic compounds obtained by the degradation of strychnine (J., 1936, 1695) has now been shown to be 4-methyl-3-ethylpyridine. 2-Methyloctahydropyridocoline (III) and 1-ethyl- and 2-ethyl-octahydropyrrocoline (I) have been prepared by synthetic methods not previously employed in the preparation of compounds of this type, but no correspondence has been found with the reduced strychnine base. 1-Methyloctahydropyrrocoline, the only hitherto undescribed methyloctahydropyrrocoline having the methyl group in the five-membered ring,

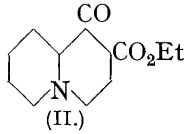
is also described. 2-Keto-octahydropyrrocoline has been synthesised, and from the point of view of the nature of the products of its reduction by the Clemmensen reaction the mechanism of this reaction is discussed.

In a recent publication on the degradation of strychnine with potassium hydroxide (Clemo, J., 1936, 1695), two unidentified basic compounds, A ($C_8H_{11}N$) and B ($C_{10}H_{11}N$), were described, and the suggestion was made that B was possibly 2-ethylpyrrocoline or methylpyridocoline, a feature of the recent formulæ advanced by Robinson, Leuchs, and others being that the tertiary nitrogen atom of the strychnine molecule is present in either the octahydropyrrocoline or octahydropyridocoline systems, *e.g.*, (I) or (III). The base A has now been proved to be 4-methyl-3-ethylpyridine, by oxidation to pyridine-3 : 4-dicarboxylic acid, and by direct comparison with the synthetic compound made by the method of Rabe and Jantzen (*Ber.*, 1921, **54**, 925), but the base B has not yet been identified. 1-Ethyl- and 2-*ethyl-octahydropyrrocoline* and 2-*methyloctahydropyridocoline* have been prepared, but no correspondence has been found with the reduced base B ($C_{10}H_{19}N$). It is significant, however, that the boiling points of the last base and of 2-methyloctahydropyridocoline are of the same order, and are appreciably higher than those of the other isomeric bases, and since theoretically there are four possible forms of 2-methyloctahydropyridocoline, only two of which have been prepared, the strychnine base may be one of the others.

The synthesis of the ethyloctahydropyrrocolines and 2-methyloctahydropyridocoline has required methods not previously employed for the preparation of compounds of this type.



(I.)



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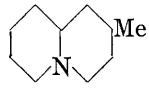
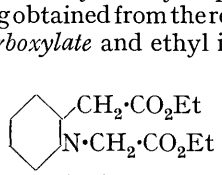


(III.)

2-Ethyloctahydropyrrocoline (I) was prepared in very good yield by treating 2-*keto-octahydropyrrocoline* with an excess of ethylmagnesium iodide in ethereal solution, the resulting 2-*hydroxy*-2-*ethyloctahydropyrrocoline* being dehydrated with phosphorus pentachloride, and the *dehydro*-compound catalytically reduced. The isomeric 1-ethyloctahydropyrrocoline was obtained from 1-keto-octahydropyrrocoline (Clemo and Ramage, J., 1932, 2969) in the same way.

When, however, 2-keto-octahydropyridocoline (Clemo, Metcalfe, and Raper, J., 1936, 1429) was treated with methylmagnesium iodide, the yield of 2-hydroxy-2-methyloctahydropyridocoline was extremely small, but 2-methyloctahydropyridocoline (III) was readily prepared by treating the potassio-derivative of ethyl 1-keto-octahydropyridocoline-2-carboxylate (II), for the preparation of which an improved method is given (compare Clemo and Ramage, J., 1931, 437), with methyl iodide. It is noteworthy that the ethyl 1-keto-2-methyloctahydropyridocoline-2-carboxylate so formed was converted under the above conditions, with the loss of the ester group, into 1-*keto*-2-*methyloctahydropyridocoline*. The Clemmensen reduction of this keto-compound gave one form of 2-methyloctahydropyridocoline, and the Wolff reduction gave an isomeric 2-methyloctahydropyridocoline (compare the reduction of 1-keto-octahydropyridocoline to octahydropyridocoline and *nor*lupinane; Clemo, Metcalfe, and Raper, J., 1936, 1429). We were, however, unable to prepare ethyloctahydropyrrocoline by this method, no 1-keto-2-ethyloctahydropyrrocoline being obtained from the reaction of the potassio-derivative of *ethyl* 1-*keto-octahydropyrrocoline*-2-*carboxylate* and ethyl iodide.



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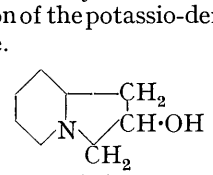

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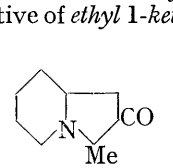
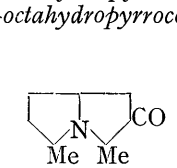


(VI.)



(VII.)

Of the methyloctahydropyrrocolines having the methyl group in the five-membered ring, the 2- and the 3-methyl compound have been previously recorded (Ochiai and Tsuda, *Ber.*, 1934, **67**, 1011; Clemo and co-workers, J., 1935, 1743; 1936, 1429), and the 1-*methyl*

compound has now been prepared by the process used in the preparation of 2-ethyloctahydropyrrocoline. It is rather remarkable that 2-keto-octahydropyridocoline should react differently towards the Grignard reagent from the 1- and the 2-keto-octahydropyrrocoline, and it is significant that models show that, if the first compound exists in the enolic form, a co-ordinate link can be formed without strain between the hydroxylic hydrogen and the nitrogen atom, whilst this is not possible in the other two cases.

2-Keto-octahydropyrrocoline, obtained by the Dieckmann reaction on *ethyl piperidyl*-1 : 2-*diacetate* (IV), has been reduced by both the Wolff and the Clemmensen reaction to octahydropyrrocoline, the same form of the base being obtained by each method. The Clemmensen reaction is, in this case, of especial interest in that, together with octahydropyrrocoline, 2-*hydroxyoctahydropyrrocoline* (V) was also obtained. Two forms of the 2-hydroxy-compound are possible from the reduction of the ketone, and the stereoisomeric form was obtained by reduction of 2-keto-octahydropyrrocoline with sodium amalgam in aqueous-alcoholic solution. Both the alcohols were unchanged after refluxing with amalgamated zinc in concentrated hydrochloric acid solution, and it therefore appears that the mechanism of the Clemmensen reaction does not involve the reduction of the carbonyl group to a secondary alcohol as the intermediate stage, but that direct reduction to the methylene group must occur, the alcohol being produced by a secondary reaction.

In favour of this view, Clemo, Morgan, and Raper (J., 1935, 1743) found that the Clemmensen reduction of 2-keto-3-methyloctahydropyrrocoline (VI) gave only the 2-hydroxy-compound; and the reduction of 4-keto-5 : 5′-dimethyldi(1 : 2)pyrrolidine (VII) (Clemo and Metcalfe, J., 1936, 606) also gave the hydroxy-compound. These two ketones have a methyl group α to the carbonyl, but the position of this methyl group is unlikely to be the cause of the reduction stopping at the hydroxy-stage, since 1-keto-2-methyloctahydropyridocoline, which has a similar structure, is completely reduced.

Experimental.

Ethyl Piperidyl-1 : 2-*diacetate*.—Ethyl piperidyl-2-acetate (8 g.), ethyl chloroacetate (6·7 g.), and anhydrous potassium carbonate (6 g.) were mixed and heated on the water-bath for 12 hours. Water was added, and the *ethyl* ester extracted with ether and distilled (10·2 g.; b. p. 155°/12 mm., 140°/1 mm.) (Found: C, 60·7; H, 9·1. $C_{13}H_{23}O_4N$ requires C, 60·7; H, 9·0%).

2-*Keto-octahydropyrrocoline*.—The di-ester (3·4 g.) was added quickly to potassium (1·1 g.), powdered in xylene (8 c.c.) and cooled in ice. The whole was allowed to rise slowly to room temperature, whereupon a vigorous reaction occurred, controlled by cooling in ice, and the reaction mixture solidified. After 2 hours' heating on the water-bath, water (6 c.c.) and concentrated hydrochloric acid (30 c.c.) were added, the solution was heated in the water-bath for 18 hours and evaporated to dryness, and the residue basified with potassium hydroxide solution (50%) and extracted with ether. The ethereal extract, dried over potassium carbonate, gave on distillation the *ketone* as a colourless, mobile liquid (0·75 g.; b. p. 76—77°/11 mm., 61°/1 mm.) (Found: C, 69·2; H, 9·7. $C_9H_{15}ON$ requires C, 69·0; H, 9·4%). It rapidly became brown on keeping. The *picrate* formed bright yellow needles, m. p. 187° (decomp.), from alcohol, in which it is difficultly soluble (Found: C, 46·0; H, 4·7. $C_9H_{15}ON,C_6H_3O_7N_3$ requires C, 45·6; H, 4·4%).

2-*Hydroxy*-2-*ethyloctahydropyrrocoline*.—To the Grignard compound prepared from magnesium (2 g.), ethyl iodide (12 g.), and anhydrous ether (15 c.c.), and cooled in ice, 2-keto-octahydropyrrocoline (1·2 g.) in ether (5 c.c.) was added slowly. The two solutions reacted vigorously, and a white solid was formed which dissolved on shaking. After 12 hours at room temperature, wet ether was added to the solution, then water, and finally excess of dilute hydrochloric acid (30%). The slight excess of magnesium was not removed. The aqueous layer was separated, the ether extracted twice with a little dilute hydrochloric acid, the combined aqueous extract evaporated to dryness, and the residue basified and steam distilled, 400 c.c. of the distillate being collected. This was acidified, evaporated to dryness, basified, and extracted with ether. The ethereal extract on fractionation gave the *hydroxy*-compound as a colourless viscous liquid (1·03 g., b. p. 82°/1 mm.) (Found: C, 71·2; H, 11·3. $C_{10}H_{19}ON$ requires C, 71·0; H, 11·2%). In some cases a small amount of unchanged ketone was also obtained. This was removed by conversion of the product into the picrate, the picrate of the ketone being almost insoluble in cold ethyl alcohol, whereas that of the tertiary alcohol is extremely soluble. The *picrolonate* separated from alcohol in greenish-yellow prisms, m. p. 198° (Found: C, 55·4; H, 6·5. $C_{10}H_{19}ON,C_{10}H_8O_5N_4$ requires C, 55·4; H, 6·3%).

2-*Ethylhexahydropyrrocoline.*—The tertiary alcohol (0·2 g.) was treated with an excess of phosphorus pentachloride, added in small lumps. A vigorous reaction occurred, and was controlled by cooling in ice. The mixture was heated at 100° for 15 minutes, cooled, glacial acetic acid (3 c.c.) added, and the solution refluxed gently for 1 hour. The addition of zinc dust increases the yield, probably by preventing atmospheric oxidation. Hydrochloric acid (1 c.c.) was then added, the solution evaporated to dryness, and the residue basified and steam distilled. A colourless oil passed over in the first few c.c.; solid potassium hydroxide was added to the distillate (15 c.c.), and the oil extracted with ether, dried over potassium carbonate, and distilled. The tertiary alcohol (1·2 g.) gave the *dehydro-base* (0·61 g.; b. p. 50°/1 mm., 73—74°/11 mm.) (Found: N, 9·3. $C_{10}H_{17}N$ requires N, 9·3%). The *picrolonate* separated from alcohol in bright greenish-yellow plates, m. p. 191° (Found: C, 58·0; H, 6·1. $C_{10}H_{17}N,C_{10}H_8O_5N_4$ requires C, 57·8; H, 6·1%). A colourless mobile liquid (0·2 g., b. p. 100°/11 mm.) was also obtained. This contains non-ionic chlorine and is presumably the 2-chloro-2-ethyloctahydropyrrocoline.

The tertiary alcohol (0·1 g.) and finely powdered potassium hydrogen sulphate (0·5 g.) were well mixed and heated in a sealed tube at 130° for 3 hours. The reaction mixture was basified and extracted with ether, and gave the picrolonate, m. p. 191° (0·13 g.), identical with that obtained by dehydration with phosphorus pentachloride.

2-*Ethyloctahydropyrrocoline.*—The hexahydro-compound (0·25 g.), platinum oxide (0·04 g.), and glacial acetic acid (10 c.c.) were shaken for 12 hours in hydrogen at 100 lb./sq. in. After filtration and addition of hydrochloric acid (2 c.c.), the filtrate was evaporated to dryness, and the residue basified and extracted with ether. The ethereal extract, dried over potassium carbonate, gave the *base* on distillation as a colourless mobile liquid (0·24 g., b. p. 41°/1 mm.) (Found: C, 77·7; H, 12·3. $C_{10}H_{19}N$ requires C, 78·3; H, 12·5%). The *picrate* separated from alcohol in bright yellow needles, m. p. 149° (Found: C, 50·2; H, 6.0. $C_{10}H_{19}N,C_6H_3O_7N_3$ requires C, 50·3; H, 5·8%); and the *picrolonate* in pale yellow needles, m. p. 161° (slight decomp.) (Found: C, 57·4; H, 6·7. $C_{10}H_{19}N,C_{10}H_8O_5N_4$ requires C, 57·6; H, 6·5%); and the methiodide in colourless needles from acetone, m. p. 232° (decomp.).

1-*Hydroxy*-1-*ethylhexahydropyrrocoline.*—To the Grignard compound prepared from magnesium (1·5 g.), ethyl iodide (9·0 g.), and anhydrous ether (12 c.c.) was added 1-keto-octahydropyrrocoline (0·8 g.) in ether (6 c.c.). The white solid which immediately formed, dissolved readily on shaking. The solution was left at room temperature for 24 hours and treated as in the case of the 2-hydroxy-2-ethyloctahydropyrrocoline; the ethereal extract on fractionation gave the tertiary *alcohol* as a colourless, viscous liquid (0·78 g., b. p. 85—87°/1 mm.) (Found: N, 8·1. $C_{10}H_{19}ON$ requires N, 8·3%).

1-*Ethylhexahydropyrrocoline.*—The tertiary alcohol (0·76 g.) was treated with an excess of phosphorus pentachloride as in the case of the 2-ethyl compound (above), the reaction being controlled by cooling in ice. The *hexahydro-base* was obtained as a colourless, mobile liquid (0·4 g., b. p. 74—75°/1 mm.) (Found: N, 9·6. $C_{10}H_{17}N$ requires N, 9·3%). The base was unstable in air, becoming dull yellow within an hour. The *picrolonate* formed light brown aggregates of needles, m. p. 185°, from alcohol (Found: C, 58·2; H, 6·4. $C_{10}H_{17}N,C_{10}H_8O_5N_4$ requires C, 57·8; H, 6·1%).

1-*Ethyloctahydropyrrocoline.*—The hexahydro-compound (0·35 g.) in glacial acetic acid (10 c.c.) was shaken with platinum oxide (0·1 g.) in hydrogen at 100 lb./sq. in. for 6 hours. The filtrate from the platinum was evaporated to dryness, the residue basified, and the octahydro-compound extracted with ether (0·34 g., b. p. 64°/11 mm.). The *picrate* formed bright yellow needles, m. p. 134°, from alcohol (Found: C, 50·0; H, 6·1. $C_{10}H_{19}N,C_6H_3O_7N_3$ requires C, 50·3; H, 5·8%), and the *picrolonate*, dull yellow rosettes of needles, m. p. 176° (Found: C, 57·5; H, 6·7. $C_{10}H_{19}N,C_{10}H_8O_5N_4$ requires C, 57·6; H, 6·5%).

Ethyl Piperidyl-2-*acetate*-1-β-*propionate.*—Ethyl piperidyl-2-acetate (5·1 g.), ethyl β-chloropropionate (5 g.), fused sodium acetate (5 g.), and barium carbonate (3 g.) were mixed, and heated on the water-bath for 7 hours. Water and saturated potassium carbonate solution were added, and the *ethyl* ester extracted with ether and distilled (5·1 g., b. p. 165—169°/11 mm.) (Found: C, 62·2; H, 9·4. $C_{14}H_{25}O_4N$ requires C, 62·0; H, 9·2%).

Ethyl 1-*Keto-octahydropyridocoline*-2-*carboxylate* (*improved method*).—Ethyl 2-carbethoxy-piperidyl-1-γ-butyrate (5·1 g.) was added to potassium (1·6 g.) powdered in xylene (10 c.c.), and the mixture cooled in ice. When the vigorous reaction had abated, the mixture was heated on the water-bath for 2 hours and cooled; ether, saturated with water, was added to remove the excess of potassium, and the solution just acidified to Congo-red with dilute hydrochloric acid. The aqueous layer was separated, and the ether extracted twice with a little water. The combined aqueous extract was treated with an excess of solid sodium bicarbonate, and extracted

with ether. The pale yellow ethereal extract, dried over sodium sulphate, gave on distillation the β-keto-ester as a pale yellow liquid (2·85 g., b. p. 131—134°/1 mm. without decomp.).

1-*Keto*-2-*methyloctahydropyridocoline*.—The β-keto-ester (2·06 g.) in anhydrous ethyl alcohol (1·0 c.c.) was added to a warm alcoholic solution of potassium ethoxide, prepared from potassium (0·36 g.) and ethyl alcohol (1·8 c.c.). After the viscous solution of the potassio-derivative of the keto-ester had stood at room temperature for 15 minutes, methyl iodide (1·2 g.) in ethyl alcohol (1·0 c.c.) was added. The solution became cloudy, and a cream-coloured solid rapidly separated. After 15 minutes the reaction mixture was heated on the water-bath, and the contents of the flask became semi-solid owing to separation of solid. After 30 minutes the mixture was cooled, water (3 c.c.) added, the solution acidified with hydrochloric acid and evaporated to dryness, and the residue basified and extracted with ether. The ethereal extract, dried over potassium carbonate, gave on distillation the *ketone* as a pale yellow, mobile liquid (0·57 g., b. p. 80°/1 mm.) (Found : C, 72·1; H, 10·2; N, 8·7. $C_{10}H_{17}ON$ requires C, 71·8; H, 10·3; N, 8·4%). The *picrate* was difficultly soluble in cold acetone and crystallised in light yellow needles, m. p. 176° (Found : C, 48·9; H, 5·4. $C_{10}H_{17}ON,C_6H_3O_7N_3$ requires C, 48·5; H, 5·1%), and the methiodide formed colourless needles, m. p. 167°, from alcohol–ether.

2-*Methyloctahydropyridocoline*.—The ketone (0·57 g.), amalgamated zinc (5 g.), and concentrated hydrochloric acid (9·5 c.c.) were refluxed for 16 hours after standing at room temperature for 2 hours. The residual zinc amalgam was filtered off, the filtrate evaporated to dryness, and the residue basified and steam-distilled. The colourless oil which passed over in the first few c.c. was extracted with ether. The ethereal extract, dried over potassium carbonate, gave on distillation a colourless mobile liquid (0·34 g., b. p. 56—57°/1 mm.) (Found : C, 78·1; H, 12·2. $C_{10}H_{19}N$ requires C, 78·3; H, 12·5%). The *picrate* crystallised from alcohol in bright yellow plates or needles, m. p. 182° (Found : C, 50·3; H, 5·8. $C_{10}H_{19}N,C_6H_3O_7N_3$ requires C, 50·3; H, 5·8%), and the picrolonate in bright yellow aggregates of needles, m. p. 189°. Attempted fractional crystallisation of the picrate from alcohol or benzene showed it to be homogeneous.

The ketone (0·63 g.) and hydrazine hydrate (0·4 g. of 90%) were gently refluxed for 18 hours. On cooling, the hydrazone separated as a cream-coloured solid. It was taken up in ether, the solution dried over sodium sulphate, and the ether distilled off. The residue (0·55 g.), in ethyl alcohol (3 c.c.), and sodium ethoxide from sodium (0·4 g.) were heated together in a sealed tube at 160° for 14 hours. Water was added, the solution acidified with hydrochloric acid and evaporated to dryness, and the residue basified and extracted with ether. The extract on fractionation gave 2-methyloctahydropyridocoline (0·13 g., b. p. 58°/1 mm.). The *picrate* crystallised from alcohol in bright yellow needles, m. p. 158° (Found : N, 14·9. $C_{10}H_{19}N,C_6H_3O_7N_3$ requires N, 14·7%), and was homogeneous. The picrolonate formed bright yellow plates, m. p. 219°, from alcohol.

1-*Hydroxy*-1-*methyloctahydropyrrocoline*.—To the Grignard compound, prepared from methyl iodide (13·5 g.), magnesium (2·6 g.), and anhydrous ether (4·5 c.c.) and cooled in ice, was added 1-keto-octahydropyrrocoline (1·85 g.) in ether (10 c.c.). A white solid separated but dissolved on shaking, and the solution was left at room temperature for 24 hours; it was then treated as in the case of 2-hydroxy-2-ethyloctahydropyrrocoline and gave the tertiary *alcohol* (1·28 g., b. p. 72—73°/1 mm.) (Found : C, 69·6; H, 11·0; N, 9·2. $C_9H_{17}ON$ requires C, 69·7; H, 11·0; N, 9·0%). A small amount of unchanged ketone was always recovered, and this was easily separated from the tertiary alcohol by conversion into the picrate in cold ethyl-alcoholic solution; the insoluble ketone picrate was filtered off, and the tertiary alcohol recovered from the filtrate. The *picrate* was very soluble in alcohol, and crystallised from alcohol–ether in yellowish-brown prisms, m. p. 142° (Found : C, 46·9; H, 5·4. $C_9H_{17}ON,C_6H_3O_7N_3$ requires C, 46·9; H, 5.2%), and the *picrolonate* in light brown rectangular prisms, m. p. 207°, from alcohol (Found : C, 54·1; H, 5·9. $C_9H_{17}ON,C_{10}H_8O_5N_4$ requires C, 54·4; H, 6·0%).

1-*Methylhexahydropyrrocoline*.—The tertiary alcohol (0·1 g.), cooled in ice, was carefully treated with a slight excess of phosphorus pentachloride, and when the vigorous reaction had ceased, heated in the water-bath for 10 minutes. Glacial acetic acid (4 c.c.) was added, and the solution gently refluxed for 2 hours, and treated as in the case of 2-ethylhexahydropyrrocoline. The *hexahydro-base* (0·05 g., b. p. 70°/11 mm.) was extremely unstable, becoming dull yellow in five minutes, and a tar separated within an hour (Found : C, 77·7; H, 11·4. $C_9H_{15}N$ requires C, 78·8; H, 11·0%). It was also oxidised by an alcoholic solution of picric acid to a deep red solution. The *picrolonate* formed aggregates of light brown prisms, m. p. 183°, from alcohol (Found : C, 57·0; H, 6·0. $C_9H_{15}N,C_{10}H_8O_5N_4$ requires C, 56·85; H, 5·7%).

1-*Methyloctahydropyrrocoline*.—The hexahydro-base (0·25 g.) in glacial acetic acid (15 c.c.) was shaken for 6 hours with platinum oxide (0·1 g.) in hydrogen at 100 lb./sq. in. The filtrate

from the platinum was evaporated to dryness, the residue basified with potassium hydroxide solution (50%), extracted with ether, and distilled, giving the *octahydro-base* as a colourless, mobile liquid (0·23 g., b. p. 62°/11 mm.) (Found : N, 10·2. $C_9H_{17}N$ requires N, 10·1%). The *picrate* formed lemon-yellow prisms, m. p. 191° (decomp.), from alcohol (Found : C, 48·7; H, 5·6. $C_9H_{17}N,C_6H_3O_7N_3$ requires C, 48·9; H, 5·4%), and the *picrolonate* light brown prisms, m. p. 198° (decomp.) (Found : C, 56·5; H, 6·5. $C_9H_{17}N,C_{10}H_8O_5N_4$ requires C, 56·6; H, 6·2%).

Reduction of 2-Keto-octahydropyrrocoline by the Wolff Method.—The ketone (0·87 g.) and hydrazine (0·5 g. of 90%) were gently refluxed for 10 hours, and the hydrazone isolated and treated with sodium ethoxide (from 0·4 g. of sodium) in the usual manner at 160—170° for 18 hours, giving octahydropyrrocoline (0·16 g., b. p. 45°/11 mm.), and a pale yellow, viscous liquid (0·185 g., b. p. 110°/11 mm.), which was not further investigated. The picrate of octahydropyrrocoline crystallised from alcohol in lemon-yellow plates, m. p. 228° (decomp.). Attempted fractional crystallisation of the picrate from alcohol and from benzene showed that it was homogeneous.

Reduction of 2-Keto-octahydropyrrocoline by the Clemmensen Reaction.—The ketone (0·8 g.), amalgamated zinc (10 g.), and concentrated hydrochloric acid (20 c.c.), after standing for 2 hours at room temperature, were gently refluxed for 36 hours. The filtrate from the zinc was evaporated to dryness, and the residue basified and steam distilled. The distillate was acidified and evaporated to dryness, and the residue basified and extracted with ether. The extract gave on distillation octahydropyrrocoline (0·2 g., b. p. 45°/11 mm.). The picrate, crystallised from alcohol, melted at 228°, and was identical with that from the Wolff reduction. A colourless viscous liquid, *2-hydroxyoctahydropyrrocoline* (0·25 g., b. p. 90°/11 mm.) (Found : N, 9·85. $C_8H_{15}ON$ requires N, 9·9%), was also obtained. The *picrate* crystallised from alcohol, in which it is easily soluble, in bright yellow prisms, m. p. 133° (Found : C, 45·7; H, 5·1. $C_8H_{15}ON,C_6H_3O_7N_3$ requires C, 45·4; H, 4·9%); and the *picrolonate* in yellow-ochre aggregates of prisms, m. p. 174° (decomp.) (Found : C, 53·3; H, 6·1. $C_8H_{15}ON,C_{10}H_8O_5N_4$ requires C, 53·3; H, 5·7%).

Under more drastic conditions (addition of zinc chloride) a better yield of the fully reduced base was obtained.

Isomeric 2-Hydroxyoctahydropyrrocoline.—The ketone (0·8 g.), sodium amalgam (30 g. of 4%), absolute alcohol (10 c.c.), and water (2 c.c.) were heated on the water-bath under a reflux condenser for 20 hours, the solution rapidly becoming dark brown. Water (10 c.c.) was added, and the solution decanted from the mercury and steam-distilled. The distillate (80 c.c.) was acidified with hydrochloric acid and evaporated to dryness, and the residue basified and extracted with ether. The extract gave on distillation the secondary *alcohol* as a colourless, viscous liquid (0·16 g., b. p. 95°/14 mm.) (Found : N, 9·8. $C_8H_{15}ON$ requires N, 9·9%). The *picrate*, which was less soluble than that of the 2-hydroxyoctahydropyrrocoline obtained from the Clemmensen reaction, crystallised from alcohol in bright yellow needles, m. p. 175° (Found : N, 14·6. $C_8H_{15}ON,C_6H_3O_7N_3$ requires N, 14·7%).

Ethyl 1-Keto-octahydropyrrocoline-2-carboxylate.—Ethyl 2-carbethoxypiperidyl-1-β-propionate (4·7 g.) was added to potassium (1·6 g.) powdered in xylene (10 c.c.), and the mixture heated on the water-bath for 2 hours. Treated as in the case of the preceding keto-ester, it gave a pale yellow liquid (1·4 g., b. p. 103°/1 mm.) (Found : C, 62·7; H, 8·3. $C_{11}H_{17}O_3N$ requires C, 62·6; H, 8·1%).

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