409. *A Synthesis of Dibenzo*[c,k]*sparteine.*

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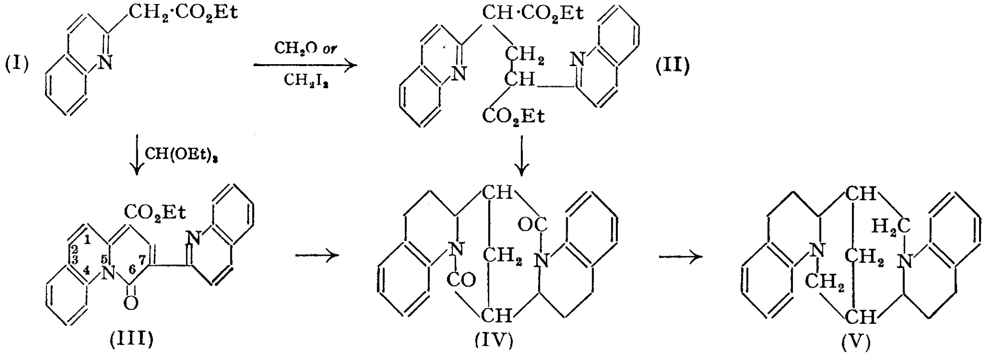
The synthesis of dibenzosparteine (V) from diketodibenzosparteine (IV) is described. The latter was obtained by two routes from ethyl 2-quinolylacetate (I).

Synthesis of dibenzo[*c,k*]sparteine (V) has been effected from ethyl 2-quinolylacetate (I) by condensation with formaldehyde or methylene iodide yielding diethyl αα′-di-2-quinolylglutarate (II), or with ethyl orthoformate yielding ethyl 6-keto-7-2′-quinolyl-3 : 4-benzopyridocoline-9-carboxylate (III), followed by reductive cyclisation over copper chromite in dioxan to give (IV). On reduction with lithium aluminium hydride (IV) gave (V).



The starting material (I) was prepared from quinaldine by Woodward and Kornfeld's method (*Org. Syn.*, **29**, 44), or, more conveniently, by the alkali-amide process of Weiss and Hauser (*J. Amer. Chem. Soc.*, 1949, **71**, 2023). As reported by Leonard and Boyer (*ibid.*, 1950, **72**, 2980) the former method can be complicated by the addition of phenyllithium to the azomethine grouping of quinaldine, but conditions for the smooth production of (I) are given below. The products (II) and (III) were prepared from (I) by methods analogous to those used for the corresponding pyridyl compounds (*J.*, 1936, 1025; 1948, 663).

EXPERIMENTAL

Ethyl 2-*Quinolylacetate* (I).—(*a*) This was prepared from quinaldine (36 g.) in the same way as ethyl pyridylacetate (Woodward and Kornfeld, *loc. cit.*). The crude product was fractionally distilled under reduced pressure, giving quinaldine (24 g.), a light orange oil (2·4 g., 20% based on unrecovered quinaldine), b. p. 145—150°/0·4—0·6 mm., and a red viscous oil (3 g., 25% on the same basis), b. p. 180—185°/0·4—0·6 mm. The last crystallised in the refrigerator as colourless plates, m. p. 90—92°, gave a picrate, m. p. 194—196°, and possessed the same properties as 1 : 2-dihydro-2-methyl-2-phenylquinoline (Leonard and Boyer, *loc. cit.*). The lower-boiling paler ester oil did not crystallise (Found : C, 72·6; H, 5·85. Calc. for $C_{13}H_{13}O_2N$: C, 72·6; H, 6·05%). It gave a picrate, m. p. 152—153° (decomp.) (Found : C, 50·9; H, 3·4. Calc. for $C_{13}H_{13}O_2N,C_6H_3O_7N_3$: C, 51·3; H, 3·6%); Borsche and Manteuffel (*Annalen*, 1936, **526**, 22) report m. p. 152°.

(*b*) A suspension of sodamide prepared from sodium (9·2 g.) in dry ether (100 ml.) was stirred with exclusion of air and moisture while quinaldine (57·2 g.) in an equal volume of dry ether was added. The mixture was then heated to the b. p. on the steam-bath, ether (600 ml.) was added gradually as the ammonia was liberated, and the mixture was finally refluxed and stirred for 10 hours. After cooling, ethyl carbonate (23·6 g.) in dry ether (50 ml.) was added gradually at such a rate as to maintain gentle refluxing. The mixture was stirred for 1 hour, cooled in an ice-bath, and acidified (3N-hydrochloric acid), the acid solution saturated with sodium hydrogen carbonate, and extracted with ether, the extract washed with water and dried (Na_2SO_4), the solvent removed, and the deep orange liquid fractionated, giving quinaldine (36 g.) and a light orange liquid (7 g., 34%), b. p. 140—145°/0·4—0·6 mm. (Found : C, 72·5; H, 6·2. Calc. for $C_{13}H_{13}O_2N$: C, 72·6; H, 6·05%). The picrate (from ethanol) had m. p. 152—153°, not depressed when mixed with picrate of ethyl 2-quinolylacetate prepared by method (*a*) (Found : C, 51·6; H, 3·5%).

Ethyl 6-*Keto*-7-2′-*quinolyl*-3 : 4-*benzopyridocoline*-9-*carboxylate* (III).—A mixture of ethyl 2-quinolylacetate (8 g.), ethyl orthoformate (10 g.), and acetic anhydride (12 ml.) was refluxed for 3 hours. The acetic anhydride and excess of orthoformic ester were distilled off in a vacuum, and the residue was dissolved in benzene, decolourized with charcoal and filtered. On addition of a large volume of light petroleum to the filtrate and cooling, light yellow *ethyl* 6-*keto*-7-2′-*quinolyl*-3 : 4-*benzopyridocoline*-9-*carboxylate* (2·4 g.) was obtained, having m. p. 150—155°, raised to 161—162° by two crystallisations from light petroleum (Found : C, 75·9; H, 4·8. $C_{25}H_{18}O_3N_2$ requires C, 76·1; H, 4·6%). The solution showed a green fluorescence. The *picrate*, m. p. 178—179° (decomp.), crystallised from acetone (Found : C, 59·6; H, 3·5. $C_{25}H_{18}O_3N_2,C_6H_3O_7N_3$ requires C, 59·7; H, 3·4%).

Diethyl αα′-*Di*-2-*quinolylglutarate* (II).—(*a*) A mixture of ethyl 2-quinolylacetate (5 g.), paraformaldehyde (0·5 g.), and a drop of piperidine was heated. At about 100° the reaction became slightly exothermic. The temperature was raised to 140° and kept thereat for 10 minutes and then at 30° for 36 hours. On distillation under reduced pressure the water and some starting material distilled to 140°/0·4—0·6 mm., being followed by a viscous red oil (2·1 g.), b. p. 180—200°/0·4—0·5 mm. The *diester* redistilled at 190—197°/0·4—0·6 mm. (Found : C, 72·95; H, 6·1. $C_{27}H_{26}O_4N_2$ requires C, 73·3; H, 5·9%). The *dipicrate*, crystallised from acetone, had m. p. 198—201° (Found : C, 52·3; H, 3·6. $C_{27}H_{26}O_4N_2,2C_6H_3O_7N_3$ requires C, 52·0; H, 3·6%). The dark brown distillation residue was dissolved in benzene, decolourised with charcoal, and filtered. Addition of light petroleum to the filtrate gave, after 2 days, brown crystals (0·3 g.), which recrystallised from light petroleum in yellowish-brown crystals, m. p. 160—162°, not depressed by admixture with (III). The picrate had m. p. 178—180° (decomp.), not depressed by that of (III).

(*b*) A solution of ethyl 2-quinolylacetate (5 g.) in dry benzene (15 ml.) was added to a suspension of finely powdered potassium (1·5 g.) in dry benzene (100 ml.) during 30 minutes with stirring. The reaction mixture was refluxed for 2 hours, methylene iodide (5·5 g.) added dropwise to the well-stirred mixture, and the whole refluxed 6 hours. The reaction mixture was cooled in ice and treated with an excess of dilute hydrochloric acid. The aqueous layer was separated, basified (K_2CO_3), and extracted with ether, the extract dried (Na_2SO_4), the solvent removed, and the residue distilled, giving diethyl αα′-di-2-quinolylglutarate as a red oil (1·23 g.), b. p. 190—200°/0·4—0·5 mm. (Found : C, 73·3; H, 6·4%). The picrate crystallized from acetone had m. p. 197—199°, not depressed when mixed with the picrate obtained by method (*a*) (Found : C, 51·8; H, 3·3%).

6 : 13-*Diketodibenzo*[c, k]*sparteine*.—(*a*) *From* (III). The ester (III) (3 g.), copper chromite

(2 g.) and purified dioxan (50 ml.) were heated at 200—220°/200—230 atm. under hydrogen for 2½ hours. The catalyst and solvent were removed and the residue on distillation gave the *dilactam* as a light yellow oil (1·6 g.), b. p. 115—122°/0·5 mm. (Found: C, 77·3; H, 6·1. $C_{23}H_{22}O_2N_2$ requires C, 77·1; H, 6·2%).

(*b*) *From* (II). Diethyl αα′-di-2-quinolylglutarate (2 g.), copper chromite (1·5 g.), and purified dioxan (60 ml.) were subjected to reductive cyclization at 200—230°/220—230 atm. for 3 hours. After removal of the catalyst and the solvent, the product was distilled under reduced pressure, yielding a light yellow oil (0·8 g.), b. p. 113—120°/0·4—0·6 mm. (Found: C, 77·3; H, 6·2%).

Dibenzo[c,k]*sparteine*.—A solution of the diketodibenzosparteine (1 g.) in dry ether (5 ml.) was added dropwise to a solution of lithium aluminium hydride (excess) in dry ether (15 ml.). The mixture was refluxed overnight, the solvent removed, and after the residue had been cooled in an ice-bath enough water was added, cautiously, to decompose the unused lithium aluminium hydride. The insoluble complex was heated under reflux with dilute sulphuric acid (10%) for 1 hour. The clear solution was made strongly alkaline (K_2CO_3), extracted with chloroform, and dried (Na_2SO_4), the solvent removed, and the product distilled, yielding the *base* as an oil (0·6 g.), b. p. 130—135°/0·5—0·6 mm. (Found: C, 83·8; H, 8·0. $C_{23}H_{26}N_2$ requires C, 83·6; H, 7·9%). Its *dipicrate*, crystallized from ethanol, had m. p. 156—158° (Found: C, 53·1; H, 4·0; N, 14·2. $C_{23}H_{26}N_2,2C_6H_3O_7N_3$ requires C, 53·3; H, 4·1; N, 14·2%).

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