

553. The Preparation of Dimethyltetrahydrocarbazoles.

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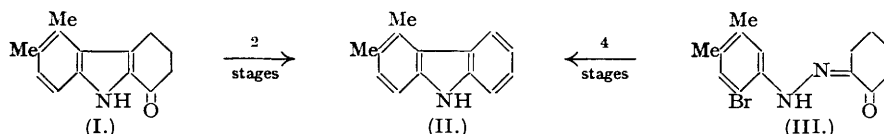
Dimethylcarbazoles are conveniently prepared by Clemmensen reduction of 1-keto-1:2:3:4-tetrahydrocarbazoles, followed by chloranil dehydrogenation of the resulting tetrahydrocarbazoles. The dimethyltetrahydrocarbazoles have a pronounced tendency to form peroxides (cf. Beer *et al.*, *Nature*, 1949, **164**, 362; Campbell and McCall, in the press). Some statements in the literature on the bromination of *o*-4-xylidine are corrected.

COFFEY (*Rec. Trav. chim.*, 1923, **42**, 528) showed that *cyclohexane*-1:2-dione phenylhydrazone, readily prepared by the action of benzenediazonium chloride on 2-hydroxymethylencyclohexanone, yields with acids 1-keto-1:2:3:4-tetrahydrocarbazole. Since the keto-group can be reduced to a methylene group (cf. Mears, Oakeshott, and Plant, *J.*, 1934, 272) and the resulting tetrahydrocarbazoles can be smoothly dehydrogenated by chloranil (Barclay and Campbell, *J.*, 1945, 530), a method for the preparation of substituted carbazoles suggests itself.

It was hoped that the carbonyl group of ketotetrahydrocarbazole would enable us to insert alkyl and aryl substituents in the 1-position, but the carbonyl group proved to be quite inert towards Grignard reagents. An explanation of this was sought in chelation between the carbonyl and the imino-group, but must be ruled out since the same inertness occurs in 9-methyl-1-ketotetrahydrocarbazole. The carbonyl group, however, functions normally on Clemmensen reduction (see below).

Attempts to prepare dimethyltetrahydrocarbazoles by the Borsche method or Rogers and Corson's modification thereof (*J. Amer. Chem. Soc.*, 1947, **69**, 2910) were unsatisfactory or unsuccessful. Diazotised xylidines, however, condensed readily with 2-hydroxymethylencyclohexanone to give *cyclohexane*-1:2-dione xylidylhydrazones, which were readily converted by acids into 1-keto-dimethyltetrahydrocarbazoles and thence by Clemmensen reduction into dimethyltetrahydrocarbazoles. The outstanding feature of the latter substances is the ease with which they combine with a molecule of oxygen when crystallised from light petroleum. These oxygenated substances have a strong green fluorescence in methanol, and peroxide formulæ have been assigned to them (Beer *et al.*, *Nature*, 1949, **164**, 362). Chloranil dehydrogenation of the tetrahydrocarbazoles gave 1:2-, 1:4-, 1:3-, 2:3-, and 3:4-dimethylcarbazoles.

As is to be expected, *o*-4-xylidine gave two ketodimethyltetrahydrocarbazoles, m. p. 201° and 225—227°. These are respectively 1-keto-6:7-dimethyl- and 1-keto-5:6-dimethyl-carbazole (I) since the latter is converted into 3:4-dimethylcarbazole (II) whose structure follows from its synthesis from *cyclohexane*-1:2-dione 2-bromo-4:5-dimethylphenylhydrazone (III) by ring-closure, reduction, dehydrogenation, and dehalogenation.



The required 5-bromo-*o*-4-xylidine was obtained by the bromination of aceto-*o*-4-xylidide (Mills and Nixon, *J.*, 1930, 2510). There can be little doubt that bromination occurs at the 5-position since the product differs both from the 6-bromo-compound (Crossley and Bartlett, *J.*, 1913, **103**, 1300) and the 3-bromo-compound (Mills and Nixon, *loc. cit.*). However, we have completely failed to substantiate the claim of Jaeger and Blanksma (*Rec. Trav. chim.*, 1906, **25**, 354) that bromination of aceto-*o*-4-xylidide yields the 3:6-dibromo-compound; repeated attempts gave only the above monobromo-product. The results of Jaeger and Blanksma can scarcely be correct, especially since substitution in the 6-position in preference to the 5 is most unlikely (cf. Hinkel *et al.*, *J.*, 1934, 283).

Most carbazoles give a characteristic deep bluish-green colour with sulphuric acid and a drop of nitric acid. It is therefore noteworthy that 1:4- and 3:4-dimethylcarbazole and 1-bromo-3:4-dimethylcarbazole give only an amber colour with this reagent.

EXPERIMENTAL.

General Procedure.—The methods used are exemplified by the preparation of 1 : 2 : 3 : 4-tetrahydrocarbazole. 2-Hydroxymethylenecyclohexanone and benzenediazonium chloride gave cyclohexane-1 : 2-dione phenylhydrazone, m. p. 183—185° (33%), which afforded 1-keto-1 : 2 : 3 : 4-tetrahydrocarbazole, m. p. 170° (55%), by Coffey's method (*loc. cit.*). The keto-compound was obtained in colourless crystals by running a benzene solution through a column (6" × $\frac{1}{2}$ ") of alumina. The keto-compound (1 g.) in the minimum volume of ethanol was added in portions during 3 hours to amalgamated zinc (25 g.) in boiling concentrated hydrochloric acid (7 ml.) and water (3 ml.) and further amounts of acid being added portionwise during this time. The mixture was boiled for a further 3 hours, the solution was decanted, the amalgam was washed twice with hot ethanol (5 ml.), and the washings were added to the decanted solution. Addition of water gave a precipitate which was extracted with ether and dried (Na_2SO_4). Evaporation of the ether and crystallisation of the residue from light petroleum (b. p. 100—120°) gave tetrahydrocarbazole, m. p. and mixed m. p. 113—114° (0.5 g.). Chloranil dehydrogenation (Campbell and Barclay, *loc. cit.*) gave an 80% yield of carbazole.

8-Methyl-1 : 2 : 3 : 4-tetrahydrocarbazole.—cycloHexane-1 : 2-dione *o*-tolylhydrazone, m. p. 95—96°, gave 1-keto-8-methyl-1 : 2 : 3 : 4-tetrahydrocarbazole, m. p. 166—167° (33%), which on reduction afforded 8-methyl-1 : 2 : 3 : 4-tetrahydrocarbazole, m. p. and mixed m. p. 97—99° (87%) (Found : C, 84.0; H, 8.2. Calc. for $\text{C}_{13}\text{H}_{15}\text{N}$: C, 84.3; H, 8.1%). Crystallisation from light petroleum gave a peroxide, m. p. 122° (decomp.) (Found : C, 72.6; H, 7.5. $\text{C}_{13}\text{H}_{15}\text{O}_2\text{N}$ requires C, 71.9; H, 6.9%).

Synthesis of 1 : 2-Dimethylcarbazole.—cycloHexane-1 : 2-dione *o*-3-xyllylhydrazone, deep-red prisms (from light petroleum), m. p. 89—91° (53%) (Found : C, 73.1; H, 7.8. $\text{C}_{14}\text{H}_{18}\text{ON}_2$ requires C, 73.1; H, 7.8%), gave 1-keto-7 : 8-dimethyltetrahydrocarbazole, needles (from benzene or ethanol), m. p. 200—201° (46%) (Found : C, 79.4; H, 7.0. $\text{C}_{14}\text{H}_{18}\text{ON}$ requires C, 79.5; H, 7.1%), and thence 7 : 8-dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, plates (from light petroleum), m. p. 84—86° (Found : C, 83.9; H, 8.8; N, 7.2. $\text{C}_{14}\text{H}_{17}\text{N}$ requires C, 84.4; H, 8.5; N, 7.0%). The last-mentioned compound forms a picrate, chocolate-coloured needles (from benzene), m. p. 157—158° (Found : N, 13.2. $\text{C}_{20}\text{H}_{20}\text{O}_7\text{N}_4$ requires N, 13.1%), and a peroxide, m. p. 115° (decomp.) (Found : C, 72.2; H, 7.3. $\text{C}_{14}\text{H}_{17}\text{O}_2\text{N}$ requires C, 72.7; H, 7.4%). 1 : 2-Dimethylcarbazole, obtained from the tetrahydro-compound as prisms (from light petroleum), m. p. 147—148° (42%) (Found : C, 85.6; H, 6.9. $\text{C}_{14}\text{H}_{13}\text{N}$ requires C, 86.2; H, 6.7%), forms a picrate, orange-red needles (from benzene), m. p. 162—163° (Found : N, 13.2. $\text{C}_{20}\text{H}_{18}\text{O}_7\text{N}_4$ requires N, 13.2%).

Synthesis of 1 : 4-Dimethylcarbazole.—This synthesis involved cyclohexane-1 : 2-dione *p*-xyllylhydrazone, yellow plates (from methanol), m. p. 71—73° (56%) (Found : C, 72.6; H, 7.8%), 1-keto-5 : 8-dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, needles (from methanol), m. p. 224—225° (54%) (Found : C, 78.7; H, 7.2%), and 5 : 8-dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, prisms [from aqueous methanol or light petroleum (b. p. 80—100°)], m. p. 88—89° (98%) (Found : C, 84.0; H, 8.0; N, 7.0%), which forms a picrate, chocolate-brown needles (Found : N, 13.1%), and a peroxide, m. p. 128° (decomp.) (Found : C, 72.7; H, 7.5; N, 6.1%). 1 : 4-Dimethylcarbazole, needles (from light petroleum), m. p. 79—82° (yield 52%) (Found : C, 85.3; H, 6.5%), gives a picrate, red needles (from benzene), m. p. 142—143° (Found : N, 12.8%).

1 : 3-Dimethylcarbazole.—The following were obtained. cycloHexane-1 : 2-dione *m*-4-xyllylhydrazone, dark-red prisms (from light petroleum) or orange rhombic prisms (from ethanol), m. p. 81—83° (55%) (Found : C, 72.2; H, 7.7%). 1-Keto-6 : 8-dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, prisms (from methanol), m. p. 191—192° (45%) (Found : C, 78.7; H, 7.0%). 6 : 8-Dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, prisms (from light petroleum), m. p. 92—94° (72%) (Found : C, 83.7; H, 8.6%), which gives a picrate, chocolate-brown needles, m. p. 162—163° (Found : N, 12.6%), and a peroxide, m. p. 130° (decomp.) (Found : C, 73.7; H, 7.7; N, 5.9%). 1 : 3-Dimethylcarbazole, prisms, m. p. 94° (26%) (Found : C, 86.1; H, 6.8%), which gives a picrate, bright red needles (from benzene), m. p. 186—187°.

2 : 3- and 3 : 4-Dimethylcarbazole.—cycloHexane-1 : 2-dione *o*-4-xyllylhydrazone (10 g.), yellow plates (from acetic acid or ethanol), m. p. 163—165° (74%) (Found : C, 73.0; H, 7.8%), on ring-closure gave a mixture, m. p. 170—178° (6.5 g.), which was separated into its components by dissolution in a boiling mixture of acetone and glacial acetic acid (2 : 1) and allowing the solution to cool slowly in a stoppered vessel without shaking. After two days the resulting crystals were separated by hand into elongated prisms (*A*), m. p. 196—198°, and compact prisms (*B*), m. p. 175—185°. *A* on recrystallisation gave 1-keto-6 : 7-dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, m. p. 201°, yellow elongated prisms (Found : C, 78.6; H, 7.2; N, 6.7%). The crystals *B* were crystallised from the same mixture of solvents and yielded elongated and compact prisms which were mechanically separated. The former, m. p. 201°, were identical with *A* and the latter after three crystallisations from acetone-glacial acetic acid gave 1-keto-5 : 6-dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, m. p. 225—227° (Found : C, 79.5; H, 7.1%).

6 : 7-Dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole, m. p. 119—130° (yield, 78%) (Found : C, 84.1; H, 8.6; N, 7.0%), gave a picrate, chocolate-coloured needles (from benzene), m. p. 168° (Found : N, 13.0%), and on dehydrogenation yielded 2 : 3-dimethylcarbazole, plates (from benzene), m. p. 250—252° (42%) (Found : C, 86.2; H, 6.9%). The picrate separated from benzene in red needles, m. p. 166—168° (Found : N, 12.6%).

5 : 6-Dimethyl-1 : 2 : 3 : 4-tetrahydrocarbazole was obtained as an oil which on dehydrogenation gave 3 : 4-dimethylcarbazole, prisms (from benzene), m. p. 159—160° (Found : C, 85.8; H, 7.1%), which gave no m. p. depression when mixed with 3 : 4-dimethylcarbazole prepared by the method given below.

Synthesis of 3 : 4-Dimethylcarbazole.—Bromination of aceto-*o*-4-xylidide in glacial acetic acid gave aceto-5-bromo-*o*-4-xylidide, prisms (from ethanol), m. p. 165—166° (Found : N, 5.5; Br, 32.3. Calc. for $\text{C}_{10}\text{H}_{12}\text{ONBr}$: N, 5.8; Br, 33.0%), which on hydrolysis gave 5-bromo-*o*-4-xylidine, plates [from light

petroleum (b. p. 80—100°), m. p. 85—87° (Found : Br, 41.0. Calc. for $C_8H_{10}NBr$: Br, 40.0%). The diazotised amine gave by the methods outlined above first *cyclohexane-1:2-dione 5-bromo-o-4-xylyl-hydrazone*, deep-red prisms (from light petroleum), m. p. 154—156° (Found : N, 8.9; Br, 26.4. $C_{14}H_{17}ON_2Br$ requires N, 9.1; Br, 25.9%), and thence *8-bromo-1-keto-5:6-dimethyl-1:2:3:4-tetrahydrocarbazole*, colourless prisms, m. p. 211°, after crystallisation first from ethanol-acetic acid and then benzene (Found : N, 4.9; Br, 27.4. $C_{14}H_{14}ONBr$ requires N, 4.8; Br, 27.4%). Clemmensen reduction gave *8-bromo-5:6-dimethyl-1:2:3:4-tetrahydrocarbazole*, prisms (from ethanol or light petroleum), m. p. 101° (74%) (Found : Br, 29.5. $C_{14}H_{16}NBr$ requires 28.8%). It forms a *picrate*, reddish-brown needles (from benzene), m. p. 173—174° (Found : N, 11.0. $C_{20}H_{19}O_7N_4Br$ requires N, 11.0%). Attempts to remove the bromine atom by alkali and aluminium-nickel alloy were unsuccessful. Chloranil dehydrogenation yielded *1-bromo-3:4-dimethylcarbazole*, which was purified by passing through a column of alumina. A pale yellow band with a blue fluorescence on elution gave the carbazole which crystallised from light petroleum in prisms, m. p. 98—99° (50%) (Found : Br, 29.3. $C_{14}H_{12}NBr$ requires Br, 29.2%). It forms a *picrate*, red needles (from benzene), m. p. 163° (Found : N, 10.3. $C_{20}H_{15}N_4Br$ requires N, 11.1%). The carbazole (0.33 g.), red phosphorus (0.2 g.), and hydriodic acid (d 1.96; 5 ml.) were boiled for 4 hours and poured into aqueous potassium iodide solution. After 1 hour the mixture was extracted with ether and the extract shaken in turn with aqueous sodium hydroxide, water, aqueous sodium thiosulphate, and water. Evaporation gave a brown residue which was dissolved in benzene and passed through a column of alumina (3'' × 1''). A band with a bright blue fluorescence was eluted and yielded *3:4-dimethylcarbazole*, prisms [from light petroleum (b. p. 80—100°)], m. p. 159—160° (43%).

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