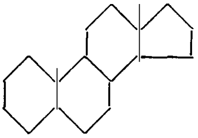
210. *Experiments on the Synthesis of Substances Related to the Sterols. Part XX. Preparation of Two Tricyclic Ketones.*

By F. J. McQuillin and Robert Robinson.

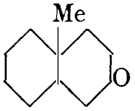
The method of du Feu, McQuillin, and Robinson (J., 1937, 53) for the preparation of *cyclo*hexenone derivatives has been applied to two dicyclic ketones containing angle-methyl groups. The constitution of one of the tricyclic substances has been ascertained.

The experience gained in the work described in Part XIV (*loc. cit.*) indicates that the ætiocholane skeleton (I) could be constructed from the dihydro-derivative of a ketone of the constitution (IX), which in its turn might be obtained from a ketomethylhydrindane. Some progress has been made in the attempt to realise this scheme of synthesis. In the decalin series the condensation proceeds in linear fashion, but it does not follow that the hydrindane must behave in the same way. Unfortunately we have not yet been able to decide the point. As we are engaged in another line of investigation, the results already obtained are submitted, but it is hoped that an opportunity to continue the work will be found.

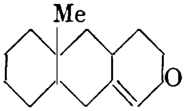
The crystalline 9-methyl-3-decalone (II) (Part XIV, *loc. cit.*, p. 59) has been condensed with 4-diethylaminobutan-2-one methiodide, and the product (III) dehydrogenated with formation of anthracene. The parent ketone has meanwhile been shown to have the *cis*-configuration (Linstead, Millidge, and Walpole, J., 1937, 1140).



(I.)



(II.)



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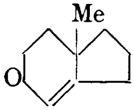
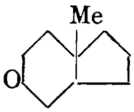
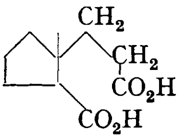


(IV.)

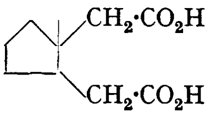
A liquid 5-*keto*-8-*methylhydrindane* (V) has been obtained by catalytic hydrogenation of (IV) (Part XIV, *loc. cit.*). It yields a homogeneous *semicarbazone* and may be oxidised to a *dicarboxylic acid*, $C_{10}H_{16}O_4$. This substance is presumably (VI) or (VII) and further work remains to be done to establish its structure and configuration.



(V.)

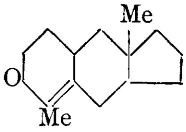


(VI.)

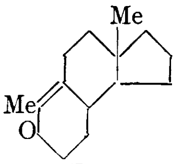


(VII.)

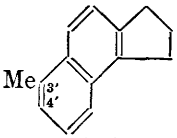
The hydrindane (V) has been condensed with the methiodide of 5-diethylaminopentan-3-one (Adamson, McQuillin, Robinson, and Simonsen, J., 1937, 1576) to yield a tricyclic ketone, $C_{15}H_{22}O$, which should be (VIII) or (IX). It was hoped to establish the structure by dehydrogenation, and one of the hydrocarbons (X) which might be obtained in this way has been synthesised by the method of Bogert (*J. Amer. Chem. Soc.*, 1934, **56**, 185, 959) starting from *o*-bromotoluene. No definite product has been isolated, however, the substance proving rather resistant to the action of selenium.



(VIII.)



(IX.)



(X.)

EXPERIMENTAL.

Methyl-2-keto-$\Delta^{1:13}$-dodecahydroanthracene.—*cis*-3-Keto-9-methyldecalin (36 g.) in ether (500 c.c.) was stirred during 6 hours with powdered sodamide (8·5 g.) in a stream of dry nitrogen. 4-Diethylaminobutan-2-one methiodide (62 g.) in alcohol (100 c.c.) was added with vigorous stirring during 3 hours. After 4 hours' heating on the steam-bath, the oil obtained on the addition of water was taken up in ether. Distillation of the dried extract gave recovered 9-methyldecalone (17·6 g.) and a fraction, b. p. 155—160°/2 mm. (5·5 g.). This yielded a *semicarbazone*, m. p. 220°, crystallising from aqueous dioxan (Found: C, 69·5; H, 8·8. $C_{16}H_{25}ON_3$ requires C, 69·8; H, 9·1%). The *ketone* regenerated by hydrolysis with warm 10% hydrochloric acid and isolated by means of ether had b. p. 149—151°/2 mm., $n_D^{18^\circ}$ 1·5351 (Found: C, 82·2; H, 10·1. $C_{15}H_{22}O$ requires C, 82·6; H, 10·1%). An attempt to effect this condensation in *tert.*-butyl alcohol with the help of potassium *tert.*-butoxide was unsuccessful, the product being almost entirely insoluble in ether.

Dehydrogenation of 2-Keto-11-methyldodecahydroanthracene.—The substance resisted the action of selenium at 330°, but was readily dehydrogenated at 360°. A mixture of the ketone (1 g.) with selenium (3 g.) was maintained at this temperature during 40 hours and the finely ground cooled product was thoroughly extracted with benzene. A small amount of a phenol was obtained from the alkali washings, and the dried benzene solution on evaporation yielded an almost completely crystalline material (25 mg.), m. p. 200° after vacuum sublimation. This yielded a 1 : 3 : 5-trinitrobenzene adduct, m. p. 163° alone or mixed with this derivative of anthracene, and a further specimen, oxidised with chromic acid, gave colourless needles, m. p. 283° alone or mixed with anthraquinone.

5-Keto-8-methyl-$\Delta^{4:9}$-tetrahydrohydrindene.—The crude condensation product from 2-methyl*cyclo*pentanone and 4-diethylaminobutan-2-one methiodide has been found to yield a *bis-2 : 4-dinitrophenylhydrazone*, m. p. 201° (pale yellow needles from acetic acid), evidently derived from 1-methyl-1-(γ-ketobutyl)*cyclo*pentanone (Found: C, 50·4; H, 4·5; N, 21·0. $C_{22}H_{24}O_8N_8$ requires C, 50·0; H, 4·5; N, 21·2%). It has therefore been found useful to treat this material with sodium ethoxide to complete the cyclisation. In a typical example the crude condensation product (25·4 g.) in ether (100 c.c.) was mixed with dry sodium ethoxide (5 g.) in alcohol (20 c.c.) and after a few hours the solution was refluxed (2 hours) and cooled, and the oil liberated on acidification was isolated by means of ether and purified as already described (du Feu, McQuillin, and Robinson, *loc. cit.*).

5-Keto-8-methylhydrindane.—A solution of 5-keto-8-methyl-$\Delta^{4:9}$-tetrahydrohydrindene (8·8 g.) in alcohol (30 c.c.) was shaken in hydrogen at 2 atm. pressure with 2% palladised strontium carbonate (3 g.). Rapid absorption of gas (1300 c.c.) occurred and the alcoholic solution on distillation afforded *5-keto-8-methylhydrindane* (8·6 g.), b. p. 110°/12 mm., $n_D^{14^\circ}$ 1·4782 (Found: C, 78·6; H, 10·8. $C_{10}H_{16}O$ requires C, 79·0; H, 10·5%). The *semicarbazone* formed glistening plates, m. p. 190°, from aqueous alcohol (Found: C, 63·2; H, 9·2. $C_{11}H_{17}ON_3$ requires C, 63·1; H, 9·1%).

Oxidation.—This saturated ketone (0·8 g.) was shaken at room temperature during several hours with a 2% alkaline permanganate solution (2·1 g. of $KMnO_4$); the solution was filtered and washed with ether. After concentration and acidification, thorough ether extraction and removal of the solvent afforded a semi-solid material. This crystallised (200 mg.) from dilute hydrochloric acid; m. p. 158° (Found: C, 60·3; H, 8·3. $C_{10}H_{16}O_4$ requires C, 60·0; H, 8·0%). The *substance* is being investigated further.

Condensation of 8-Methylhydrindan-5-one with 5-Diethylaminopentan-3-one Methiodide.—8-Methylhydrindan-5-one (15·2 g.) in ether (500 c.c.) was stirred under reflux during 4 hours with powdered sodamide (3·9 g.) in a stream of dry nitrogen and, after cooling, treated dropwise with 5-diethylaminopentan-3-one methiodide (29·9 g.) in alcohol (25 c.c.) with vigorous stirring. After 5 hours' heating under reflux, water was added, and the whole extracted with ether.

Distillation of the dried extract yielded unchanged methylhydrindanone, and a fraction (5·4 g.), b. p. 184—188°/10 mm., $n_D^{17°}$ 1·5026. This material in ether (130 c.c.) was refluxed with sodium ethoxide (2 g.) in alcohol (20 c.c.) for 4 hours and again isolated by acidification, ether extraction, and distillation; the oil (3 g.) had b. p. 189—191°/13 mm., $n_D^{18°}$ 1·5058 (Found: C, 82·3; H, 10·2. $C_{15}H_{22}O$ requires C, 82·6; H, 10·1%). The 2 : 4-*dinitrophenylhydrazone* separated in carmine prisms, m. p. 160°, from ethyl alcohol–ethyl acetate (Found: C, 63·2; H, 6·3. $C_{21}H_{26}O_4N_4$ requires C, 63·6; H, 6·5%). Experiments on the dehydrogenation of this ketone and of its reduction products have so far given uncrystallisable oils, but the work is being continued.

β-o-*Tolylethyl Alcohol.*—The Grignard reagent from *o*-bromotoluene (35 g.) and magnesium (5 g.) in ether (200 c.c.) was treated with ethylene oxide (9·2 g.) in ether (25 c.c.) with cooling in ice, and after 12 hours the ether was removed. The residue was heated on the steam-bath for 3 hours, acidified with ice-cold dilute hydrochloric acid, and extracted with ether. On distillation *o*-bromotoluene was recovered, and β-*o*-tolylethyl alcohol (11·4 g.) then obtained as a colourless oil, b. p. 133—134°/20 mm., $n_D^{21°}$ 1·5354 (cf. Grignard, *Compt. rend.*, 1905, **141**, 45).

β-*o*-Tolylethyl chloride, obtained in almost theoretical yield on treatment of the alcohol with dimethylaniline and thionyl chloride (cf. Cook and Hewett, J., 1933, 1107), had b. p. 109°/17 mm., $n_D^{20°}$ 1·5357 (cf. Bert, *Compt. rend.*, 1928, **186**, 372).

1-β-o-*Tolylethyl*cyclo*pentan*-1-*ol.*—β-*o*-Tolylethyl chloride was converted into the Grignard derivative with magnesium (1·7 g.) in ether (50 c.c.) and treated with *cyclo*pentanone (6 g.) with stirring and cooling in ice. After 12 hours, aqueous ammonium chloride and ether were added. The dried extract on distillation yielded some recovered material and 1-β-o-*tolylethyl*cyclo*pentan*-1-*ol* (5 g.), b. p. 141°/1 mm., $n_D^{22°}$ 1·5348 (Found: C, 82·1; H, 9·7. $C_{14}H_{20}O$ requires C, 82·3; H, 9·8%).

3′-*Methyl*-6 : 7 : 8 : 9-*tetrahydro*-4 : 5-*benzhydrindene.*—The above carbinol (3·7 g.) was cyclised by treatment with ice-cold 85% sulphuric acid (cf. Bogert, *loc. cit.*), yielding the *hydrocarbon* (2·5 g.), b. p. 97—99°/1 mm., $n_D^{21°}$ 1·5461 (Found: C, 90·2; H, 9·8. $C_{14}H_{18}$ requires C, 90·3; H, 9·7%).

3′-*Methyl*-4 : 5-*benzhydrindene* was obtained by dehydrogenation of the tetrahydro-compound with palladised charcoal at 340—360°. The distilled product, b. p. 105—110°/1 mm., rapidly crystallised and then separated from methyl alcohol in colourless prisms, m. p. 44° (Found: C, 92·0; H, 7·7. $C_{14}H_{14}$ requires C, 92·3; H, 7·7%). The *picrate* crystallised from ethyl alcohol in orange-red needles, m. p. 107° (Found: N, 10·0. $C_{14}H_{14},C_6H_3O_7N_3$ requires N, 10·2%)

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DYSON PERRINS LABORATORY, OXFORD UNIVERSITY. [*Received, June 8th,* 1938.]