STUDIES IN SESQUITERPENES

Part III. Syntheses of 2: 4-Dimethyl-eudalene (1: 2 : 4-Trimethyl-7-isopropylnaphthalene) and (1: 3-Dimethyl-6-isopropylnaphthalene)

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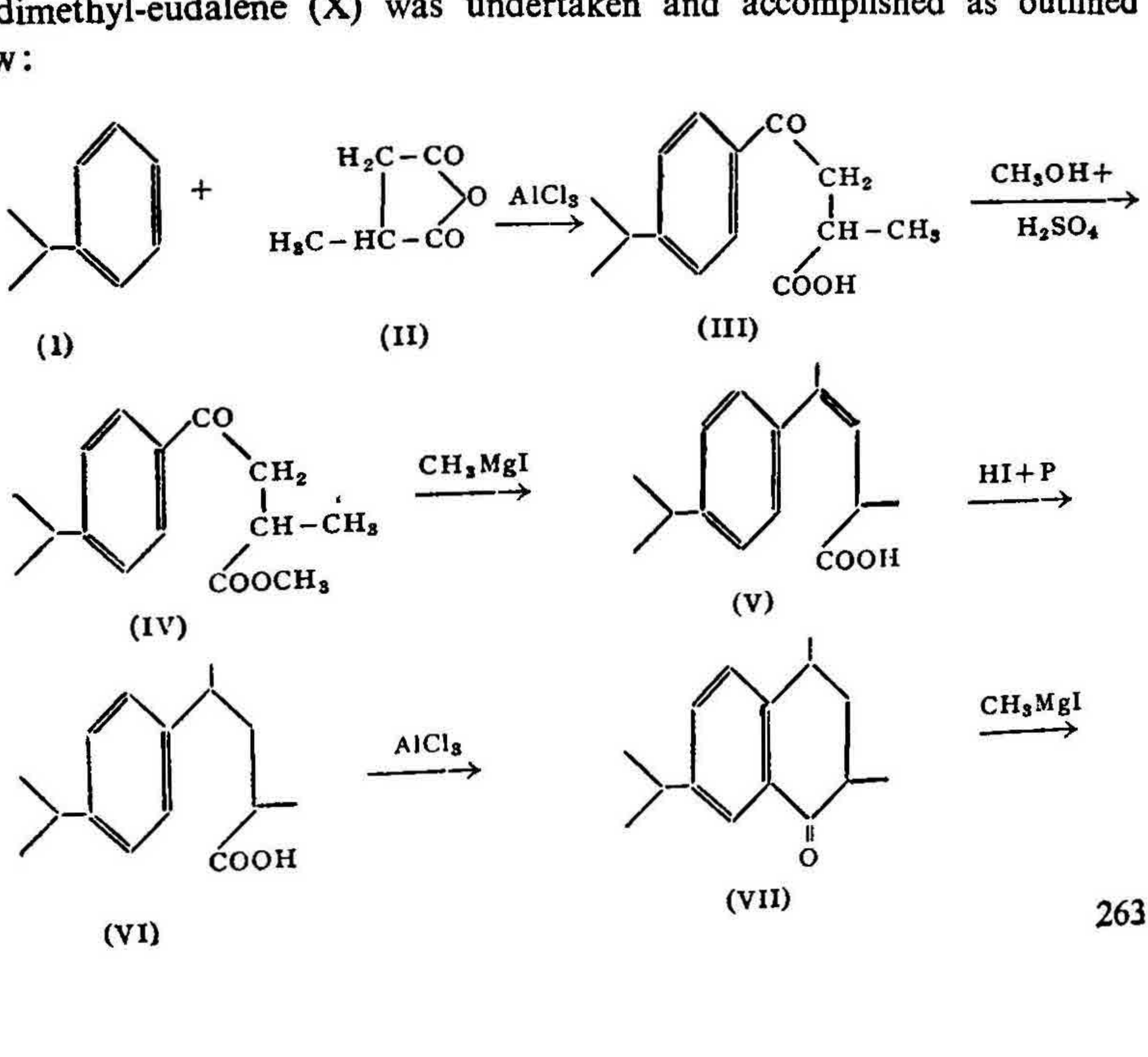
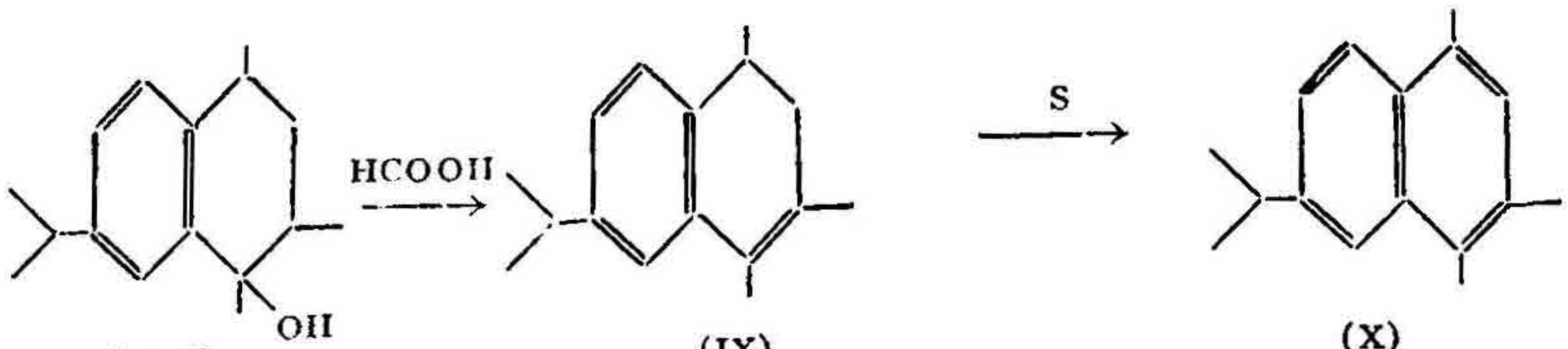
In Part I of this series (Gupta and Muthana, *J. Ind. Inst. Sci.*, 1953, **35 A,** 131) the object of synthesizing all the dimethylcadalenes has been described. With similar purpose the syntheses of all the theoretically possible dimethyl-eudalenes have been undertaken. With the exception of 8-methyl-eudalene, all the possible methyleudalenes have been synthesised during the course of investigation on the structures of α-cyperone and eremophilone. None of the dimethyl eudalenes is known by synthesis. The synthesis of 2: 4-dimethyl-eudalene (X) was undertaken and accomplished as outlined below:



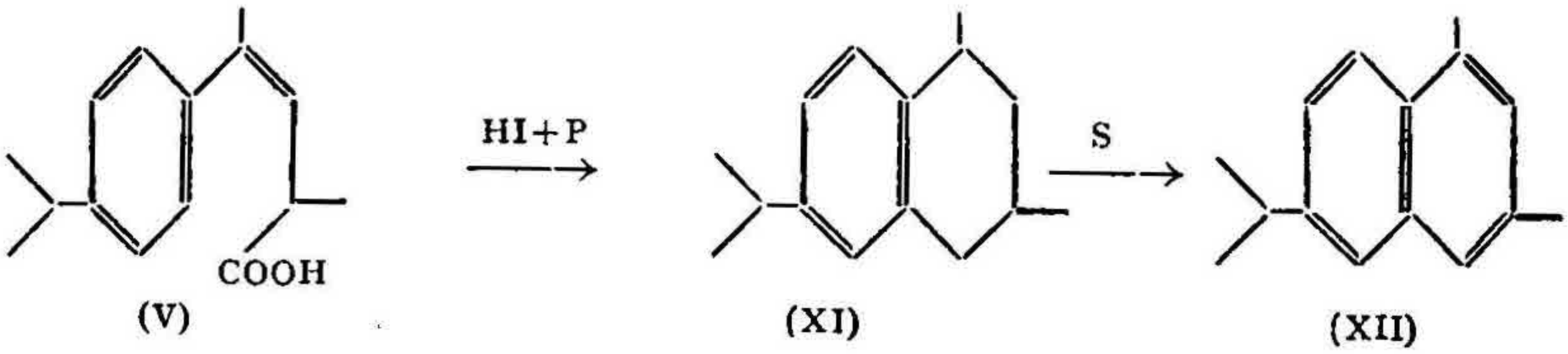


(VIII) (IX) (X)

2 : 4-Dimethyl-eudalene

Isopropylbenzene (I) on condensation with methylsuccinic anhydride (II) in the presence of anhydrous aluminium chloride gave β-(*p*-isopropyl benzoyl)-α-methyl-propionic acid (III). The latter on esterification with methyl alcohol and sulphuric acid furnished methyl-β-(*p*-isopropyl-benzoyl)-α-methyl propionate (IV), which on treatment with methyl magnesium iodide yielded γ-(*p*-isopropylbenzene)-α : γ-dimethylvinyl-acetic acid (V). The unsaturated acid (V) was reduced to γ-(*p*-isopropyl-benzene)- α : γ-dimethylbutyric acid (VI) with hydriodic acid and red phosphorus. The substituted butyric acid (VI) was cyclised in presence of anhydrous aluminium chloride to give 2: 4-dimethyl-7-isopropyl-tetralone-1 (VII), which on treatment with methyl magnesium iodide gave the carbinol (VIII) which in turn was dehydrated with formic acid to 1 : 2 : 4-trimethyl-7-isopropyldihydronaphthalene (IX). The latter on dehydrogenation with sulphur furnished 2 : 4-dimethyl-eudalene (X).

1 : 3-Dimethyl-6-isopropylnaphthalene (XII) was synthesised during the course of this work, for the first time as follows :



(V) (XI) (XII)

γ-(*p*-isopropylbenzene)-α : γ-dimethylvinyl-acetic acid (V) was obtained with similar reactions reported in the synthesis of 2 : 4-dimethyl eudalene. It was then refluxed with a mixture of iodine, red phosphorus and phosphoric acid (Sukh Dev, *J. Ind. Chem. Soc.*, 1948, **25**, 323). The 1 : 3-dimethyl 6-isopropyltetralin (XI) thus obtained was dehydrogenated with sulphur when 1 : 3-dimethyl-6-isopropylnaphthalene (XII) was obtained.

EXPERIMENTAL

Synthesis of 2 : 4-*dimethyl eudalene*

(i) *β-(p-isopropylbenzoyl)-α-methyl propionic acid* (III).—Methyl-succinic anhydride (II, 30·5 g., 1 mol.) was condensed with isopropyl benzene (I,

33·5 g.; 1·1 mol.) in nitrobenzene (150 c.c. freshly distilled) in the presence of anhydrous aluminium chloride (80 g., 2·2 mols.). [For details, *cf.* the preparation of β-(*p*-cymoyl-2-)-α-methylpropionic acid (Sukh Dev and Guha, *J. Ind. Chem. Soc.*, 1948, **25**, 13)]. The syrupy greenish yellow complex thus obtained was decomposed with ice (100 g.) and concentrated hydrochloric acid (60 c.c.). After removing nitrobenzene the oil solidified, which was filtered, washed with water and dissolved in sodium carbonate solution (Na_2CO_3. 60 g. and water 200 c.c.). The acid was precipitated with concentrated hydrochloric acid (Congo-red), filtered, washed, dried in vacuum and crystallised from a mixture of ether and petroleum ether (30–60°). Colourless long plates were obtained. M.p. 118–19° C. (Found: C, 72·03; H, 7·68; $C_{14}H_{18}O_3$ requires C, 71·79; H, 7·69 per cent.).

(ii) *Methyl-β-(p-isopropylbenzoyl)-α-methylpropionate* (*IV*).—The above acid (54 g.), methyl alcohol (100 c.c.) and concentrated sulphuric acid (7 c.c.) were refluxed together for 10 hours, and the ester was worked up in the usual manner. B.P. 175–80° C./3 mm. Yield, 50 g.

(iii) *γ-(p-isopropylbenzene)-α : γ-dimethylvinyl-acetic acid* (*V*).—A Grignard solution prepared from magnesium (3·92 g., 1·6 mol.), methyl iodide (23 g., 1·6 mol.) and ether (25 c.c.), was added to a solution of ester (IV, 25 g., 1 mol.) in ether (50 c.c.). (For details, *cf.* the preparation of γ-(*p*-cymyl-2-)-α : γ-dimethylvinyl-acetic acid (Gupta and Muthana, *J. Ind. Inst. Sci.*, 1953, **35 A**, 131). The magnesium complex was decomposed with dilute hydrochloric acid (1 : 2, 90 c.c.). On working up the product the acid was obtained as colourless viscous liquid. B.P. 145–50° C./1 mm. Yield, 23 g. (Found: C, 77·12; H, 8·53; $C_{15}H_{20}O_2$ requires C, 77·59; H, 8·62 per cent.).

(iv) *γ-(p-isopropylbenzene)-α : γ-dimethylbutyric acid* (*VI*).—The above unsaturated acid (46 g.) was refluxed for 12 hours with a mixture of hydriodic acid (250 g.) and red phosphorus (30 g.) at 130–40° C. The reduced acid was isolated similarly as γ-(*p*-cymyl-2-)-α : γ-dimethyl-butyric acid (Gupta and Muthana, *loc. cit.*). The acid distilled as a colourless viscous liquid, m.p. 150–53° C./1 mm. Yield, 20 g. (Found: C, 76·45; H, 9·7; $C_{15}H_{22}O_2$ requires C, 76·93; H, 9·4 per cent.).

(v) 2 : 4-*Dimethyl-7-isopropyltetralone*-1 (*VII*).—The acid (VI) (25 g., 1 mol.) after conversion into acid chloride with phosphorous-pentachloride (26·1 g.; 1·1 mol.) in benzene solution, was cyclised in presence of anhydrous aluminium chloride (16·66 g., 1·1 mol.). [*cf.* the preparation of 2 : 5-dimethyl-8-isopropyl tetralone-1 (Sukh Dev and Guha, *J. Ind. Chem. Soc.*, 1948, **25**, 18)]. The tetralone (VII) was obtained as a colourless mobile

liquid, b.p. 122–3° C./1 mm. Yield, 20 g. (Found: C, 83·22; H, 9·15; $C_{15}H_{20}O$ requires C, 83·33; H, 9·258 per cent.).

2:4-*Dinitrophenylhydrazone* was prepared by the sulphuric acid method and crystallised from alcohol in bright red needles, m.p. 132–33° C.

(vi) 1:2:4-*Trimethyl-7-isopropyl-dihydronaphthalene* (*IX*).—To Grignard solution, prepared from magnesium (3 g.; 1·6 mols.), methyl iodide (16 g., 1·6 mols.) and ether (25 c.c.), a solution of the ketone (VII, 16 g., 1 mol.) in ether (50 c.c.) was gradually added (*cf.* the preparation of 1:5:6:8-tetramethyl-4-isopropyldihydronaphthalene (Gupta and Muthana, *loc. cit.*). The complex was decomposed with a mixture of ammonium chloride (80 g.), water (40 c.c.) and ice (250 g.). The carbinol (VIII) was dehydrated with 85 per cent. formic acid (60 c.c.). The hydrocarbon was purified and isolated by distillation over sodium. A colourless mobile liquid was obtained. B.P. 116–17° C./2 mm. Yield, 11 g.

(vii) 2:4-*Dimethyleudalene* (*X*).—The hydrocarbon (IX, 7 g.) was dehydrogenated in the presence of sulphur (1·05 g.) by heating at 230° C. for 30 minutes and at 260° C. for further half an hour. The dehydrogenated product was purified by repeated distillation over sodium, b.p. 115–6°/2 mm., which solidified and was crystallised in beautiful rhombic crystals, m.p. 65° C. Yield, 4 g. (Found: C, 90·53; H, 9·27; $C_{16}H_{20}$ requires C, 90·57; H, 9·43 per cent.).

Trinitrobenzene derivative was prepared by mixing hot alcoholic solution of trinitrobenzene and the hydrocarbon. Bright yellow needles were obtained which were crystallised twice from alcohol, m.p. 137–38° C.

Picrate was prepared from alcohol in the usual manner. Orange red needles were obtained, which were crystallised several times from alcohol, m.p. 120–21° C.

Synthesis of 1:3-*dimethyl*-6-*isopropyl-naphthalene*

(i) 1:3-*Dimethyl*-6-*isopropyl-tetralin* (*XI*).—γ-(*p*-Isopropyl benzene)-α:γ-dimethyl-vinyl-acetic acid (V, 10 g.) was refluxed with a mixture of phosphoric acid (d, 1·75; 30 c.c.), red phosphorus (10 g.) and iodine (5 g.) for 60 hours at 170–80° C. The tetralin was worked up in the usual manner (*cf.* preparation of 1:6:7:8-tetramethyl-4-isopropyl tetralin. "7:8-dimethylcadalene". Gupta and Muthana, *ibid.*, 1953, **35 A**, 131). A colourless mobile liquid was obtained. B.P. 98–100° C./1 mm. Yield 5 g. (Found: C, 88·36; H, 10·3; $C_{15}H_{22}$ requires C, 89·108; H, 10·892 per cent.).

(ii) 1:3-*Dimethyl*-6-*isopropylnaphthalene* (*XII*).—The hydrocarbon (XI; 5 g.) was dehydrogenated with sulphur (1·5 g.), by heating at 230° for 30

minutes and at 260° for further 30 minutes. The dehydrogenated product was purified by repeatedly distilling over sodium. A colourless mobile liquid was obtained. B.P. 108-110° C./2 mm. Yield, 2·5 g. (Found: C, 91·19; H, 9·3; $C_{15}H_{18}$ requires C, 90·93; H, 9·06 per cent.).

Picrate was prepared from alcoholic solution in the usual manner and crystallised from alcohol in orange red needles, m.p. 110° C.

Trinitrobenzene derivative was prepared from alcoholic solution in bright yellow needles and twice crystallised from alcohol. M.P. 128–29° C.

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