

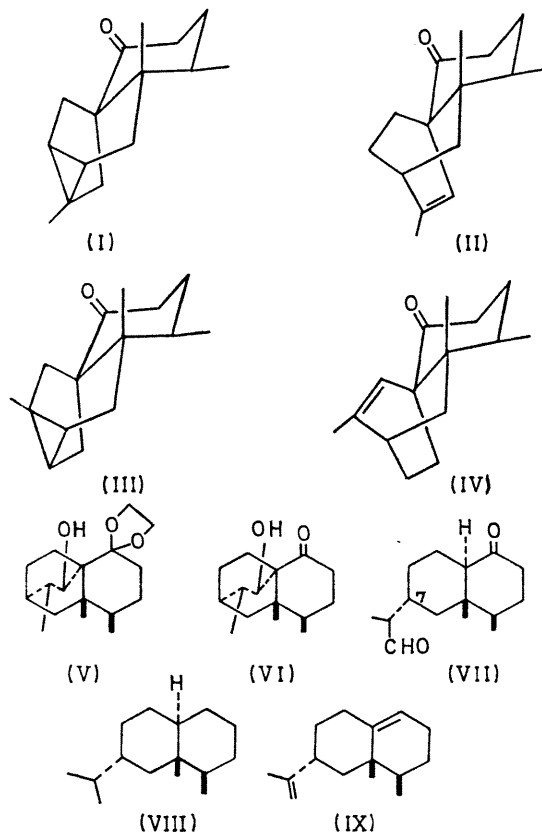
## Absolute Stereochemistry of Ishwarone

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**Summary** The absolute stereochemistry of ishwarone, the tetracyclic sesquiterpene ketone from *Aristolochia indica*, has been rigorously established as (I) by chemical correlation with (+)-nootkatane.

We offered evidence<sup>1</sup> for structures (I) and (II) for ishwarone



and isoishwarone, respectively. The alternative stereostructures (III) and (IV) for these two compounds were considered less likely on the basis of n.m.r. spectral data. We now record conclusive chemical evidence which uniquely defines the absolute configuration at all the asymmetric centres present in ishwarone.

The ethylene acetal<sup>†</sup> of isoishwarone,  $C_{17}H_{26}O_2$ , m.p. 82–84°,  $[\alpha]_D - 43.78^\circ$  and n.m.r. signals at  $\delta$  0.97 (s, C-CH<sub>3</sub>), 0.67 (d,  $J$  7 c./sec., CH-CH<sub>3</sub>), 1.73 (d,  $J$  2 c./sec., olefinic methyl), 3.87 (multiplet, -O-CH<sub>2</sub>-CH<sub>2</sub>-O-), and 5.75 (unresolved multiplet, olefinic H) on hydroboration followed by oxidation with alkaline H<sub>2</sub>O<sub>2</sub> gave exclusively the alcohol (V)  $C_{17}H_{28}O_3$ , m.p. 105–108°, n.m.r. signals at 1.03 (s, C-CH<sub>3</sub>), 0.80 (d,  $J$  6 c./sec., CH-CH<sub>3</sub>), 1.07 (d,  $J$  6 c./sec., CH-CH<sub>3</sub>), and 3.87 (m, -O-CH<sub>2</sub>-CH<sub>2</sub>-O-). Deacetalisation gave the aldol (VI)  $C_{15}H_{24}O_2$ , m.p. 172–174°,  $[\alpha]_D - 62.82^\circ$ ,  $\nu_{max}$  (Nujol) 3470 (OH) and 1690 cm.<sup>-1</sup> (C=O) and n.m.r. signals at  $\delta$  0.82 (s, C-CH<sub>3</sub>), 0.88 (d,  $J$  7 c./sec., CH-CH<sub>3</sub>), 1.08 (d,  $J$  6 c./sec., CH-CH<sub>3</sub>), and 4.15 (d,  $J$  6 c./sec., CHO). Alkali-induced retroaldolisation of (VI) resulted in the opening of the bicyclo[2,2,2]octane bridge to yield an amorphous keto-aldehyde (VII) without affecting the stereochemistry at C-7. The bis-semicarbazone of (VII),  $C_{17}H_{30}N_6O_2$ , m.p. 220–225°, gave on treatment with KOH in diethylene glycol at 200°, a single hydrocarbon (VIII),  $C_{15}H_{28}$ , b.p. 80°/1 mm.,  $[\alpha]_D + 9.85^\circ$ , whose i.r. spectrum was different from that of 7 $\beta$ -eremophilane, and the hydrocarbon was identical in all respects (t.l.c., i.r., and g.l.c.) with an authentic sample of (+)-nootkatane,  $C_{15}H_{28}$ , b.p. 80°/1 mm.,  $[\alpha]_D + 10.07^\circ$ , prepared by reduction of valencene<sup>2</sup> (IX). Thus, ishwarone and isoishwarone are represented by structures (I) and (II), respectively.

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<sup>†</sup> All new compounds gave satisfactory analytical data.

<sup>1</sup> A. K. Ganguly, K. W. Gopinath, T. R. Govindachari, K. Nagarajan, B. R. Pai, and P. C. Parthasarathy, *Tetrahedron Letters*, 1969, 133.

<sup>2</sup> G. L. K. Hunter and W. B. Brogden, jun., *J. Food. Sci.*, 1965, 30, 1.