1,2- or 1,4-Addition in the Interaction of Quinolines and Organolithium Compounds

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Summary The reaction of 4-methylquinoline with organo-lithium reagents followed by ethyl chloroformate leads to N-ethoxycarbonyl-1,2-dihydroquinolines, and not the 1,4-analogues as recently postulated.

ADDITION reactions of pyridines[1] or quinolines[2] with organo-lithium reagents result in 2-substitution. Several workers have produced evidence in support of these reactions proceeding through 1,2-addition.[3] Recently, however, it was proposed, largely from spectral data of the derivatives (Ia and b), that reactions between 4-methylquinoline and phenyl- or n-butyl-lithium proceeded *via* 1,4-addition followed by rearrangement.[4] We have repeated these experiments, obtaining compounds with identical m.p. and b.p.,[4] which are now reformulated as the corresponding 1,2-dihydro-derivatives (IIIa,b).

Authentic 1,2-dihydro-4-methylquinoline (IVc)[5] gave the N-ethoxycarbonyl-derivative (IIIc) when treated with ethyl

Table
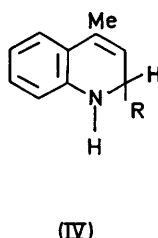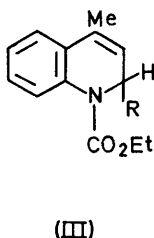
N.m.r. spectral data of (IIIa—c) and (IVa—c)

Compound	2-H	3-H	4-Me	$J_{2,3}$	$J_{2,4-Me}$	$J_{3,4-Me}$
	τ (CDCl$_3$; Me$_4$Si)			Coupling constants (in Hz)		
(IIIa)	3·96(m)		7·89(t)	—	—	—
(IIIa)[a]	1·56(m)	3·85(dq)	7·71(t)	6·4	1·0	1·0
(IIIb)	5·13(q)	4·20(dq)	7·98(q)	6·2	1·0	1·3
(IIIc)	5·71(m)	4·23(m)	7·97(q)	4·5	1·6	1·6
(IVa)	4·63(m)		8·02(t)	5·0	1·2	1·2
(IVb)	5·93(m)	4·66(m)	8·06(t)	5·0	1·5	1·5
(IVc)	6·12(m)	4·81(m)	8·23(q)	5·0	2·0	2·0

[a] With Eu(fod)$_3$ (0·25 mol. equiv.).
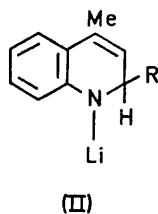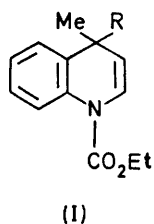
chloroformate. The relative positions, intensities, and multiplicities of the 2-H, 3-H, and 4-Me n.m.r. signals of these compounds clearly indicate that (IIIc) contains the 1,2-dihydroquinoline nucleus (see Table). The n.m.r. spectrum of the n-butyl derivative (Ib or IIIb) shows that the positions of the 2-H and 3-H signals are little affected by alkyl substitution. Decoupling experiments show that the 2-H signal is coupled to 3-H and the α-protons of the 2-butyl group: τ 5·13 (q, $J_{2,3}$ 6·0, $J_{2,\alpha}$ 6·2 Hz), with smaller coupling to methyl $J_{2,4-Me}$ 1·0 Hz), and that due to 3-H, τ 4·20 (dq), is coupled to 3-H and 4-Me ($J_{2,3}$ 6·0, $J_{3,4-Me}$ 1·3 Hz). Structure (IIIb) is therefore indicated. The 2-H and 3-H signals of the phenyl derivative (Ia or IIIa) overlap. The large downfield shift of the 2-H signal is typical of that due to deshielding by an adjacent phenyl group[6] and indicates structure (IIIa). In the presence of the shift reagent[7] Eu-(fod)$_3$, (fod: 1,1,1,2,2,3,3-heptafluoro-7,7-dimethyl-4,6-octanedionato-) however, the 2-H and 3-H signals were separated, that for 2-H to lowest field, producing a much simplified spectrum from which the respective coupling constants were easily obtained (see Table).

(I) (II) a, R=Ph ; b, R=Bu^n

(III) (IV) a, R = Ph ; b, R = Bu^n ; c, R = H

These structural assignments are further supported by the similarity between the spectra of the parent heterocycles (IVa,b), [prepared from 4-methylquinoline and phenyl- or n-butyl-lithium respectively, followed by careful aqueous hydrolysis] and reported analogues.[8] There seems little doubt that addition of organolithium reagents to quinolines proceed *via* 1,2-addition.

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