

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 organolithium reagents followed by ethyl chloroformate leads to *N*-ethoxycarbonyl-1,2-dihydroquinolines, and not the 1,4-analogues as recently postulated.

ADDITION reactions of pyridines¹ or quinolines² with organolithium 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).

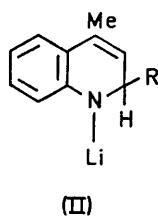
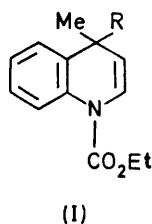
Authentic 1,2-dihydro-4-methylquinoline (IVc)⁵ gave the *N*-ethoxycarbonyl-derivative (IIIc) when treated with ethyl

TABLE

N.m.r. spectral data of (IIIa-c) and (IVa-c)
 τ (CDCl₃; Me₄Si)

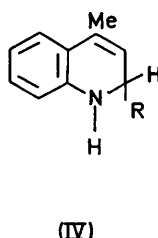
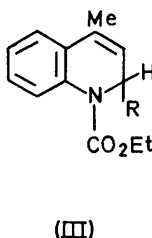
Compound	Coupling constants (in Hz)					
	2-H	3-H	4-Me	$J_{2,3}$	$J_{2,4-Me}$	$J_{3,4-Me}$
(IIIa)		3.96(m)	7.89(t)	—	—	—
(IIIa) ^a	1.56(m)	3.85(dq)	7.71(t)	6.4	1.0	1.0
(IIIb)	5.13(q)	4.20(dq)	7.98(q)	6.2	1.0	1.3
(IIIc)	5.71(m)	4.23(m)	7.97(q)	4.5	1.6	1.6
(IVa)		4.63(m)	8.02(t)	5.0	1.2	1.2
(IVb)	5.93(m)	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.).



a, R = Ph ;

b, R = Buⁿ



a, R = Ph ;

b, R = Buⁿ ;

c, R = H

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 group⁶ and indicates structure (IIIa). In the presence of the shift reagent⁷ 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).

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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