Imine Photoalkylations: Quinoline and Isoquinoline[1]

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ON the basis of our results on papaverine photolysis,[2] the production of 6-ethylphenanthridine by irridiation of phenanthridine in acidified ethanol,[1] and the production of alkylated pyrimidines by irradiation of pyrimidines in acidified alcohols,[3] we suggested[1] that photoalkylation of aromatic nitrogen heterocycles should prove to be a general reaction. The present results confirm this suggestion, provide cases where the alkylation takes place other than adjacent to nitrogen, and are to be compared to the recently reported[4] photoalkylations of the same compounds using alkylcarboxylic acids.

Quinoline, 8-methylquinoline, and isoquinoline were irradiated (Pyrex, N_2, Hanovia Type L 450 w lamp, 0·001 M) in 95% ethanol (4·5 l.) to which 36 ml. of conc. hydrochloric acid had been added. The solutions were evaporated to dryness, the residues were passed through a column of alumina, and the collected fractions were analysed and purified by g.l.p.c. The results are given in the Table. The quinoline and isoquinoline derivatives are known compounds and our products were compared with literature data on the physical properties of the compounds or their derivatives. The n.m.r. and mass spectra were consistent with the structures given. Satisfactory elemental analyses, derivatives, and mass spectra were obtained for the new compounds 2-ethyl-8-methylquinoline and 4-ethyl-8-methylquinoline. The position of substitution could be unequivocally established by the combination of mass spectra and n.m.r. spectra. Our general mechanism[1] for imine photoalkylation is broadened to accommodate alkylation non-adjacent to nitrogen.

Evidence for this mechanism is provided by our preliminary results on similar irradiations carried out in the absence of acid. Thus, after irradiating quinoline or 8-methylquinoline for 40 hr. under similar conditions, but without added acid, we were able to isolate 20% of (IIIa) and (IIIb), respectively. Recovery of starting material was

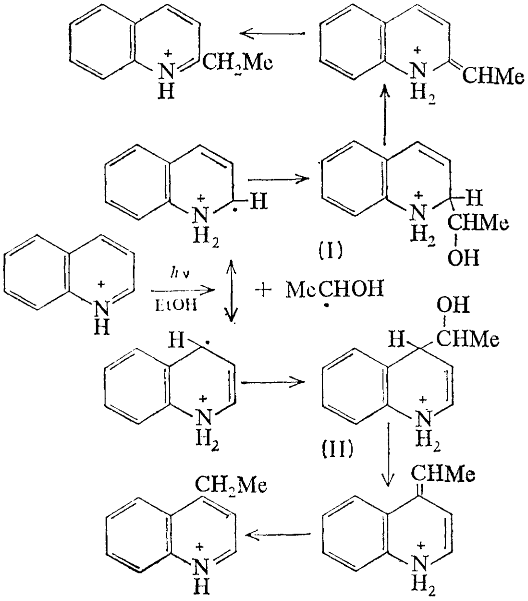
TABLE

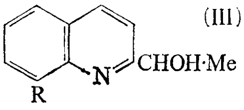
Photoalkylation of quinolines and isoquinoline

Compound	Irradiation time (hr.)	Recovered starting compound	Products 1-Ethyl	2-Ethyl	4-Ethyl	Other
Quinoline	80	63%	—	7%	10%	—
8-Methylquinoline	80	42%	—	10%	30%	6%[a]
Isoquinoline	40	48%	22%	—	—	—

[a] A dimer, the structure of which is being investigated.

about 50%. The 1,2-dihydro-derivatives of (III) could easily serve as precursors (as suggested in our mechanism) since it has been shown[5] that 1,2-dihydroquinolines are converted into the quinolines on standing in ethanol solution.





(III) a, R=H
b, R=Me

Recently, pyridazine *N*-oxides were found[6] to incorporate ethanol to form compounds such as (III), and alkyliminium salts undergo related reactions.[7] A hydrogen abstraction and coupling mechanism similar to that given in the scheme can account for the unexplained formation[8] of 1- and 3-cyclohexylbenz[*h*]isoquinolines during the photocyclization of 4-stilbazole. The observed[4] photoalkylations of isoquinoline and quinoline with alkylcarboxylic acids can probably be explained in a similar manner rather than by assuming[4] decarboxylation prior to coupling.

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