[Contribution from the Chemistry Department, Faculty of Science, Cairo University]

Action of Grignard Reagents. XX. Action of Organomagnesium Compounds and of Lithium Aluminum Hydride on 3-Substituted 3,4-Dihydro-4-keto-1,2,3-benzotriazines

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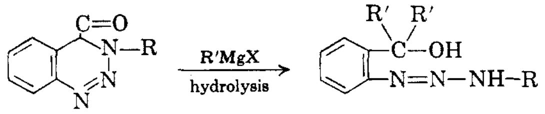
Treatment of Ib–h with Grignard reagents leads to opening of the heterocyclic ring with the formation of IIa–l. IIa–l now have also been obtained by the action of the same reagent on the corresponding methyl *o*-aryldiazoaminobenzoates (IIIa–g). Cleavage of the N—C bond of Ii and of Ij is effected by the action of phenylmagnesium bromide, and by the action of lithium aluminum hydride in the case of Ij. Treatment of Ij with aluminum chloride, similarly, effects elimination of the acyl group, with the formation of Ia. The stability of the —N═N— system in Ia toward the action of lithium aluminum hydride similates the behavior of methyl *o*-(*p*-tolyl)diazoaminobenzoate (IIIb) toward the same reagent, whereby, *o*-(*p*-tolyl)diazoaminobenzyl alcohol is produced.

The reactions of 3-substituted 3,4-dihydro-4-keto-1,2,3-benzotriazines have not been thoroughly studied. In their reactions, they behave as masked diazonium compounds and undergo ring opening; a number of these reactions have been described.[1] The recent literature[2,3] covers only the preparation and spectra of some new members of this class of compounds, the chemical properties of which are now further explored.

In continuation of the work of one of us on the ring-opening of heterocyclic compounds by the action of organomagnesium compounds, *e.g.*, in the case of benzoxazones,[4] of 2,3-diphenylquinazolone-4,[4] of benzo-, and of naphtho-2′,3′-oxazole-2-one, as well as their *N*-aroyl derivatives,[5] we now have investigated the behavior of 3-substituted 3,4-dihydro-4-keto-1,2,3-benzotriazines (Ib–h) toward the action of organomagnesium compounds and the action of lithium aluminum hydride. Thus, when 3-phenyl-3,4-dihydro-4-keto-1,2,3-benzotriazine (Ib) is treated with phenylmagnesium bromide, followed by hydrolysis, opening of the heterocyclic ring is effected with the formation of *o*-phenyldiazoaminotriphenyl carbinol (IIa). Similar treatment of Ic–h with the same reagent results in the formation of *o*-substituted phenyldiazoaminotriphenyl carbinols (IIb–g) respectively (*cf.* Scheme A). Action of methylmagnesium iodide on Ib–d, If, and Ig leads to the formation of *o*-substituted phenyldiazoaminodimethylphenyl carbinols (IIh–l).



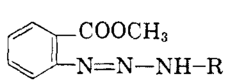
I II

Scheme A

Ia. R = H
b. R = C_6H_5
c. R = p-$CH_3C_6H_4$
d. R = p-$CH_3OC_6H_4$
e. R = o-$CH_3OC_6H_4$
f. R = p-BrC_6H_4
g. R = p-ClC_6H_4
h. R = m-ClC_6H_4
i. R = $COCH_3$
j. R = COC_6H_5

IIa. R = R′ = C_6H_5
b. R = p-$CH_3C_6H_4$; R′ = C_6H_5
c. R = p-$CH_3OC_6H_4$; R′ = C_6H_5
d. R = o-$CH_3OC_6H_4$; R′ = C_6H_5
e. R = p-BrC_6H_4; R′ = C_6H_5
f. R = p-ClC_6H_4; R′ = C_6H_5
g. R = m-ClC_6H_4; R′ = C_6H_5
h. R = C_6H_5; R′ = CH_3
i. R = p-$CH_3C_6H_4$; R′ = CH_3
j. R = p-$CH_3OC_6H_4$; R′ = CH_3
k. R = p-BrC_6H_4; R′ = CH_3
l. R = p-ClC_6H_4; R′ = CH_3

The assigned structure for the Grignard products IIa–l, is inferred from the fact that they are identical with those obtained by the action of the Grignard reagents on the appropriate methyl *o*-aryldiazoaminobenzoate (IIIa–g).



IIIa. R = C_6H_5
b. R = p-$CH_3C_6H_4$
c. R = p-$CH_3OC_6H_4$
d. R = o-$CH_3OC_6H_4$
e. R = p-BrC_6H_4
f. R = p-ClC_6H_4
g. R = m-ClC_6H_4

For further study of the effect of the acyl group attached to heterocyclic nitrogen compounds with Grignard reagents, the action of phenylmagnesium bromide on 3-acetyl- (Ii) and on 3-benzoyl-3,4-dihydro-4-keto-1,2,3-benzotriazines (Ij) now has been investigated. Ii and Ij undergo elimination of the acyl group by the action of the same reagent forming 3,4-dihydro-4-keto-1,2,3-benzotriazine (Ia) together with diphenylmethyl- and triphenylcarbinol, respectively. The elimination of the acyl group by the action of Grignard reagent is analogous to the behavior of *N*-benzoylphthalimide and of *N*-benzoylbenzotriazole toward the action of phenylmagnesium bromide.[5]

The effect of substituents on the facile opening of the hetero-ring in Ib–h by the action of Grignard

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[1] *The 1,2,3- and 1,2,4-Triazines, Tetrazines and Pentazines*, J. G. Erickson, P. F. Wiley, and V. P. Wystrach, Interscience Publishers, New York, 1956, p. 21–22.

[2] E. V. Heyningen, *J. Am. Chem. Soc.*, **77**, 6562 (1955).

[3] P. Grammatickis, *Compt. rend.*, **243**, 2094 (1956); Chem. Abst., **50**, 6189 (1956).

[4] A. Mustafa, W. Asker, M. Kamel, A. F. A. Shalaby, and A. E. A. E. Hassan, *J. Am. Chem. Soc.*, **77**, 1612 (1955).

[5] A. Mustafa, W. Asker and O. H. Hishmat, *J. Am. Chem. Soc.*, **77**, 5127 (1955).

TABLE I

o-SUBSTITUTED PHENYLDIAZOAMINOTRIPHENYL- AND DIMETHYLPHENYLCARBINOLS (IIa–g) AND (IIh–l)

Starting[a] Material	Product	Solvent[b]	M.P. °	Yield, %	Color with H_2SO_4	Formula	Carbon, %		Hydrogen, %		Nitrogen, %	
							Calcd.	Found	Calcd.	Found	Calcd.	Found
Ib IIIa	IIa	A	179–180	60 80	Red	$C_{25}H_{21}N_3O$	79.15	79.16	5.59	5.64	11.08	10.83
Ic IIIb	IIb	A	154	85 87	Red	$C_{26}H_{23}N_3O$	79.38	79.12	5.80	5.91	10.68	10.76
Id IIIc	IIc	B	132–133	87 90	Red	$C_{26}H_{23}N_3O_2$	76.28	76.97	5.62	5.82	10.27	10.34
Ie IIId	IId	C	166 dec.	70 75	Dark brown	$C_{26}H_{23}N_3O_2$	76.28	76.16	5.62	5.64	10.27	10.26
If IIIe	IIe	B	130	85 90	Red	$C_{25}H_{20}N_3OBr$	65.50	65.76	4.36	4.25	9.16	9.21
Ig IIIf	IIf	C	147 dec.	75 80	Yellowish brown	$C_{25}H_{20}N_3OCl$	72.55	72.98	4.83	5.11	10.15	10.15
Ih IIIg	IIg	C	181 dec.	65 70	Dark red	$C_{25}H_{20}N_3OCl$	72.55	72.66	4.83	4.79	10.15	10.23
Ib IIIa	IIh	A	140	72 80	Red	$C_{15}H_{17}N_3O$	70.58	70.95	6.66	6.52	16.47	16.62
Ic IIIb	IIi	C	144–145	75 80	Red	$C_{16}H_{19}N_3O$	71.30	71.75	7.24	7.32	15.61	15.72
Id IIIc	IIj	B	125–126	65 70	Red	$C_{16}H_{19}N_3O_2$	67.36	67.71	6.66	6.58	14.73	14.62
If IIIe	IIk	B	135	80 90	Red	$C_{15}H_{16}N_3OBr$	53.89	54.30	4.79	5.0	12.57	12.42
Ig IIIf	IIl	C	126	65 70	Yellow	$C_{15}H_{16}N_3OCl$	62.17	62.57	5.52	5.21	14.50	14.21

[a] For the methods of their preparation *cf.* ref. 3; If and IIIe were prepared after F. D. Chattaway and A. G. Walker, *J. Chem. Soc.*, 323 (1927). [b] A = Alcohol; B = benzene-benzine; C = petroleum ether (b.p. 90–120°).

reagents is illustrated by the stability of 3,4-dihydro-4-keto-1,2,3-benzotriazine (Ia) toward the same reagent.

Lithium aluminum hydride. The action of lithium aluminum hydride on organic compounds[6] has shown a far-reaching analogy with that of Grignard reagents. We have found that hydrogenolysis with the hydride, like treatment with phenylmagnesium bromide followed by hydrolysis, brings about cleavage of N—C bond of Ij with the isolation of benzyl alcohol. Hydrogenolysis, under the influence of the hydride, of the acyl group attached to a nitrogen compound has been reported in the reduction of *N*-acetylcarbazole,[7] of acylated 2-benzoylaminothiazole,[8] of 1-benzoylbenztriazole,[9] and of dibenzoyl-L-histidine.[10]

Treatment of Ij with anhydrous aluminum chloride at 120–125° effects elimination of the benzoyl group with the formation of Ia.

The stability of Ia toward the action of lithium aluminum hydride parallels its behavior toward phenylmagnesium bromide (see above). *o*-(*p*-Tolyl)-diazoaminotriphenyl carbinol (IIb) has now been found to be stable toward the action of the same reagent under the given experimental conditions.[11]

The stability of the —N=N— system[12] in IIb toward the action of lithium aluminum hydride has also been observed when methyl *o*-(*p*-tolyl)diazoaminobenzoate (IIIb) is subjected to similar treatment whereby *o*-(*p*-tolyl)diazoaminobenzyl alcohol is produced, identified as the corresponding urethane.

EXPERIMENTAL

Action of Grignard reagents on 3-substituted 3,4-dihydro-4-keto-1,2,3-benzotriazines (Ib–h) *and methyl o-aryldiazoaminobenzoates* (IIIa–g). The following exemplifies the procedure. To a Grignard solution prepared from 0.9 g. of magnesium and 9 g. of bromobenzene in 50 ml. of dry ether (in the case of phenylmagnesium bromide) was added a solution of 1 g. of Ib or IIIa in dry benzene (50 ml.). The mixture was heated for 3 hr. on a steam bath. After standing overnight at 25°, it was poured slowly into 100 ml. of saturated aqueous ammonium chloride solution, extracted with ether, dried, and evaporated. The oily residue was washed several times with hot petroleum ether (b.p. 60–80°) and the resulting solid was crystallized from the proper solvent.

The products IIb–l listed in Table I were prepared similarly. In general they are soluble in hot benzene and chloroform, but are sparingly soluble in petroleum ether.

Action of phenylmagnesium bromide on 3-benzoyl-3,4-dihydro-4-keto-1,2,3-benzotriazine (Ij). A solution of 1 g. of Ij in 40 ml. of dry benzene was treated with phenylmagnesium bromide as described in the case of Ib. The ether-benzene solution was evaporated, and the solid residue that was obtained was extracted with cold benzene (*ca.* 25 ml.) and the insoluble part was recrystallized from hot alcohol as colorless crystals (*ca.* 0.42 g.), m.p. 212–213°; identified as Ia.[13] The benzene extract gave, on concentration and cooling, colorless crystals (*ca.* 0.39 g.) which were shown to be triphenylcarbinol (melting point and mixed melting point).

Action of phenylmagnesium bromide on 3-acetyl-3,4-dihydro-4-keto-1,2,3-benzotriazine (Ii). Similarly, the action of phenylmagnesium bromide on a solution of 1 g. of Ii[14] in 40 ml. of benzene was worked up as described above. Ia (*ca.* 0.72 g.) and diphenylmethylcarbinol (*ca.* 0.23 g.) were obtained. The carbinol melted, after washing with petroleum ether (b.p. 80–100°), at 82–83°[15] (melting point and mixed melting point). It gives a red color with sulfuric acid.

Action of lithium aluminum hydride on Ij *and* IIIb. Solvents dried over sodium were used. To 0.5 g. of lithium aluminum hydride was added 50 ml. of ether. After 15 min., a benzene solution (30 ml.) containing 1 g. each of Ij[14] and IIIb was added in portions. The reaction mixture was refluxed for 3 hr. and then left overnight at room temperature. After treatment with cold dilute hydrochloric acid, the ethereal solution was dried and evaporated. The solid residue, after washing with petroleum ether (b.p. 60–80°) was crystallized to yield *ca.* 0.42 g. of Ia. The petroleum ether washings on evaporation gave benzyl alcohol which was identified as phenylurethane (melting point and mixed melting point).[16]

In the case of IIIb, the colorless product was treated directly with phenylisocyanate, and the corresponding urethane was crystallized from alcohol in colorless crystals (*ca.* 0.24 g.), m.p. 119–120°.

Anal. Calcd. for $C_{21}H_{19}N_4O$: N, 16.32. Found: N, 15.97.

Action of aluminum chloride on Ij. A mixture of 1 g. of Ij and 2 g. of aluminum chloride was heated in an oil bath and the temperature was maintained at 120–125° for 1 hr. The reaction mixture was cooled, then decomposed with 100 ml. of ice water containing 5 ml. of concd. hydrochloric acid. The solid, so obtained, was collected and crystallized from alcohol as colorless crystals (*ca.* 0.62 g.), m.p. 212–213°, identified as Ia by melting point and mixed melting point.[13]

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(7) K. Banholzer, T. W. Campbell, and H. Schmid, *Helv. Chim. Acta*, **35**, 1577 (1952).

(8) I. A. Kaye and C. L. Parris, *J. Org. Chem.*, **17**, 737 (1954).

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(10) P. Karrer, M. Suter, and P. Wasser, *Helv. Chim. Acta*, **32**, 1936 (1949).

(11) Triphenylcarbinol is recovered unchanged when treated with the same reagent under similar conditions.

(12) Azo compounds are resistant to attack by lithium aluminum hydride [R. Nystrom and W. G. Brown, *J. Am. Chem. Soc.*, **70**, 3738 (1948), W. Reid and F. Müller, *Chem. Ber.*, **85**, 470 (1952), D. H. Smith, J. R. Schwartz and G. W. Wheland, *J. Am. Chem. Soc.*, **74**, 2282 (1952)]. Reduction of Ia with zinc dust and ammonium hydroxide is followed by heterocyclic ring contraction to give 3-ketodihydroindiazole [G. Heller, *J. prakt. Chem.*, **111**, 1 (1925)]. Moreover, sodium amalgam does not appear to be effective in opening the heterocyclic ring in 3-substituted 3,4-dihydro-4-keto-1,2,3-benzotriazines [H. Mehner, *J. prakt. Chem.* **63**, 241 (1901)].

(13) H. Finger, *J. prakt. Chem.*, **37**, 432 (1888).

(14) G. Heller, *J. prakt. Chem.*, **111**, 1 (1925).

(15) A. Klages, *Ber.*, **35**, 2646 (1902).

(16) A. I. Vogel, *A Text Book of Practical Organic Chemistry*, Longmans, Green and Co. London (1951) p. 264.