washing once each with equal volumes of water (to take out the color and triethylamine hydrochloride salt), 5% sodium bicarbonate (to remove mercaptoacetate), and 0.5 N hydrochloric acid (to remove amino acid ester and excess triethylamine). The chloroform phase was dried over magnesium sulfate and concentrated by rotary evaporation. Products were obtained in yields of 97 to 100%, generally as colorless oils (Etc-L-AlaOMe solidified in 1 day to white crystals, mp 60–62 °C). Only trace impurities were occasionally seen by thin-layer chromatography, and the products were carried over for subsequent reactions without further purification.

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Registry No.—**6**, 2905-52-4; **7**, 140-89-6; **8**, 3278-35-1; **9** (R′ = R^2 = CH_3), 2491-20-5; **10**, 25554-84-1; ethyl chloroformate, 541-41-3; sodium chloroacetate, 3926-62-3; glycine, 56-40-6; L-valine, 72-18-4; Etc-glycine, 66270-46-0; Etc-L-valine, 66270-47-1; Etc-L-AlaOMe, 66270-48-2.

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Conjugate Addition of Grignard Reagents to *p*-Nitrotoluene. Competitive Attack of Entering Alkyl Group to Ortho and Para Positions

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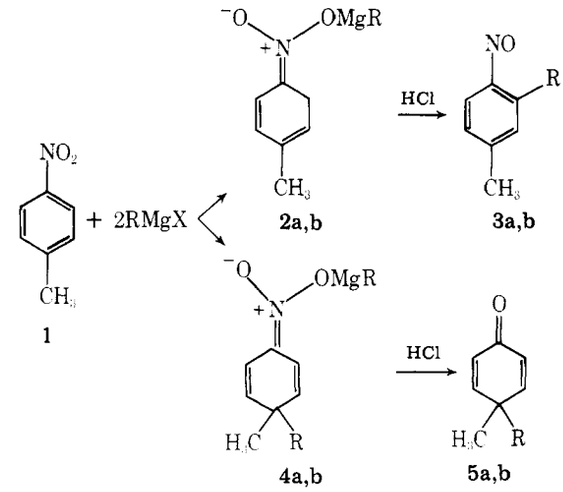
We have recently found[1] that reaction between alkylmagnesium halides and mononitro derivatives of bicyclic aromatic systems proceeds through conjugate addition of RMgX to the nitroarenic system, leading to nitroso compounds alkylated within the aromatic nucleus.

Scheme I



a, R = CH_3; b, R = n-C_4H_9

These results have led us to question the generally held belief[2] that aromatic mononitro compounds undergo 1,2 addition only in reactions with alkyl Grignard reagents.

As preexistent literature data on 1,2 addition were obtained mainly from reactions carried out on monocyclic aromatic systems, while our results were restricted to reactions of bicyclic systems, we were prompted to check the validity of our findings in the case of monocyclic nitroarenes also.

We wish to report now our recent results on reactions of a typical monocyclic substrate such as *p*-nitrotoluene, which show that conjugate addition is predominant with alkyl reagents.

In addition our data indicate that the entering alkyl group has an even likelihood to attack either an alkylated (ipso attack) or a hydrogenated aromatic carbon.

When 2 mol of RMgX were allowed to react for a few seconds with 1 mol of *p*-nitrotoluene (**1**) in tetrahydrofuran or diethyl ether, after addition of aqueous hydrochloric acid two reaction products were isolated in substantial amounts: 2-alkyl-4-methylnitrosobenzene (**3a,b**) and 4-methyl-4-alkyl-2,5-cyclohexadien-1-one (**5a,b**).

The mechanistic pattern of formation of nitroso derivatives such as **3a,b** has been previously described.[1]

Formation of **5a,b** could occur exclusively through a 1,6 addition of RMgX to the nitroarenic system, leading to cyclohexadiene nitronate adducts **4a,b.**

Unlike **2, 4a,b** will not undergo an elimination reaction by addition of hydrochloric acid; therefore they will be hydrolyzed (Nef reaction[3]) to yield **5a,b.**

As shown in the Experimental Section, we were forced to carry out the reaction under conditions considerably milder than those adopted for reactions in bicyclic systems.[1] This was due to the fact that when the reactions were carried out either at room temperature or at 0 °C the yields of **3a,b** and **5a,b** were low, while those in tars were high; in addition small amounts of several unidentified side products appeared.

Yields of nitroso derivatives were larger than those of cyclohexadienone (see Experimental Section). However, if we take into account that the attack in the ortho position is twice as likely as that in the para position, we can conclude that each kind of attack is almost competitive.

The two products can be easily separated by quantitative chromatography on a silica gel column.

Therefore, although the yields of these products are low, our method could represent a reasonable alternative with respect to conventional ways[4] to synthesize cyclohexadienones that require multistage reactions.

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The present results are at variance with previous reports on the reactivity pattern of C_2H_5MgI with nitrobenzene.

Oddo[5] in 1904 reported formation of *N*-ethylaniline and two unidentified distillation fractions.

Conversely, formation of tetrasubstituted hydrazine as the main product was reported by Gilman and McCraken.[6]

No products of N-alkylation were isolated from our experiments.

Comparison of the present findings with our previous data[1] and the ones on reactions with aryl Grignard reagents[7,8] strongly suggest that prevalence of each type of addition will not be dependent upon the aromatic substrate[1c] carrying the nitro group, but it appears to be dependent upon the nature of the Grignard reagent; thus conjugate addition will prevail with alkyl reagents, while with aryl derivatives 1,2 addition takes place.

Finally the ortho and para orientation of the attack with respect to the nitro group confirms the nucleophilic character[1c] of the alkylation process.

Experimental Section

IR, UV, and ^{1}H NMR spectra were recorded with Perkin-Elmer 275, Perkin 402, and Jeol 60 MHz [$(Me)_4Si$ as internal standard] instruments, respectively.

THF and diethyl ether were purified by distilling under a nitrogen atmosphere after refluxing over sodium. They were stored over sodium wire and distilled from lithium aluminum hydride before using.

Reaction Procedure. A solution of alkylmagnesium halide (0.02 mol) in THF or Et_2O (50 mL) was added dropwise at −70 °C under nitrogen to a solution of *p*-nitrotoluene (0.01 mol) in the same solvent (50 mL). The cooling bath was removed immediately after addition was completed, and 5 mL of aqueous HCl (27%) was added. The reaction mixture was allowed to stir for 1 min and then diluted with cold water. After extraction of the aqueous mixture with CH_2Cl_2, the organic layer was washed several times with water, dried, and evaporated at low pressure. The residue was submitted to chromatographic separation on a silica gel column. Elution with cyclohexane–ethyl acetate (4:1) gave product **3; 3a** (R = CH_3) was obtained free of impurities. It was crystallized from *n*-hexane: mp 39–41 °C dec (lit.[9] 38–41.5 °C) (yield 48–53%);[10] UV ($CHCl_3$) λ_{max} (ϵ) 765 nm (32); IR (CCl_4) 1450 cm^{-1} (N=O); ^{1}H NMR ($CDCl_3$) δ 2.50 and 3.45 (s, 3 H and 3 H, CH_3 and CH_3), 6.30 (d, $J_{5,6}$ = 8.5 Hz, 1 H, H-6), 7.05 (dd, $J_{3,5}$ ~ 2 Hz, 1 H, H-5), 7.45 (d, 1 H, H-3).

3b (R = *n*-C_4H_9) was obtained mixed with 5% of a product which has been tentatively identified from the ^{1}H NMR spectrum of the mixture as the corresponding nitro derivative. It was purified by chromatography on silica gel using *n*-hexane as eluent.

3b: green oil (yield 45–50%);[10] IR 1450 cm^{-1} (N=O); UV ($CHCl_3$); λ_{max} (ϵ) 765 nm (32); ^{1}H NMR (CCl_4) δ 0.8–2.20 and 3.75–4.15 (m, 7 H, 2 H, *n*-C_4H_9), 2.45 (s, 3 H, $-CH_3$), 6.15 (d, $J_{5,6}$ = 8.5 Hz, 1 H, H-6), 7.00 (dd, $J_{3,5}$ ~ 2 Hz, 1 H, H-5), 7.45 (d, 1 H, H-3).

Anal. Calcd for $C_{11}H_{15}NO$: C, 74.54; H, 8.53; N, 7.90. Found: C, 74.65; H, 8.21; N, 8.01.

Further elution of the column with cyclohexane–ethyl acetate (1:1) gave **5** free from impurities.

5a (R = CH_3, yield 11–15%)[10] showed physical and spectroscopic characteristics identical with those reported in literature.[4,11]

5b (R = *n*-C_4H_9, yield 22–25%):[10] pale yellow oil; IR (in film) 1660 (C=O), 1620 (C=C) cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 0.8–1.9 (m, 9 H, *n*-C_4H_9), 1.25 (s, 3 H, $-CH_3$), 6.15–6.75 (AB system, J = 10 Hz, 2 H and 2 H, H-2, H-6 and H-3, H-4).

Anal. Calcd for $C_{11}H_{16}O$: C, 80.44; H, 9.83. Found: C, 80.05; H, 9.77.

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Registry No.—**1**, 99-99-0; **3a**, 38974-06-0; **3b**, 66270-57-3; **5a**, 1073-14-9; **5b**, 66270-58-4.

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A New and Convenient Synthesis of 1-Aryl-1,2-alkanediones

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The conversion of a methylene group α to a ketone into a carbonyl group to afford a 1,2-dione is an important functional group transformation in organic synthesis.

Numerous syntheses of the title compounds have been reported already, among others oxidation of aryl alkyl ketones,[1,2] alkenes,[3] alkynes,[4] and acylmethylenephenylphosphoranes.[5] By far the most used procedure for the synthesis of α-diketones **5** involved the base-induced α elimination of α-nitrato ketones.[6,7,8] More generally applicable methods for the synthesis of α-diketones involved the use of less general reagents such as *tert*-butoxybis(dimethylamino)methane[10] and pentacarbonyliron.[11] Finally, acetoxylation of β-keto sulfides leads also to 1,2-dicarbonyl compounds.[12]

We wish to report a convenient and mild method for the synthesis of 1-aryl-1,2-alkanediones **5**. Our method can be used in molar quantities and proceeds according to the reaction sequence outlined in Scheme I.

Recently,[13] we described a high-yield synthesis of 1-aryl-2,2-dichloro-1-alkanones **2** involving conversion of alkyl aryl ketones **1** into the corresponding *N*-cyclohexylketimines, which were chlorinated in the α position of the imino function by means of *N*-chlorosuccinimide in carbon tetrachloride at room temperature, the resulting *N*-1-(1-aryl-2,2-dichloroalkylidene)cyclohexylamines being hydrolyzed with aqueous hydrogen chloride solution to the corresponding previously unknown α,α-dichloro ketones **2**.

Treatment of 1-aryl-2,2-dichloro-1-alkanones **2** with sodium methoxide in methanol (2 N solution) at room temperature for a short time (1 h) afforded a mixture of isomeric α,α-dimethoxy ketones, namely 1-aryl-2,2-dimethoxy-1-alkanones **3** and 1-aryl-1,1-dimethoxy-2-alkanones **4**, the formation of which was explained via an epoxide intermediate **6** (Scheme II).[14] The ratio **3/4** was dependent on the substitution of the substrate (R, R'), the concentration of the nucleophile, and the temperature control.[14] In general the ratio varied between 40:60 for **3d/4d** and 70:30 for **3b/4d**. Acidic hydrolysis of this mixture of isomers **3** and **4** with 8 N aqueous hydrogen chloride solution provided pure 1-aryl-1,2-alkanediones **5** in high yields.

It is stressed that all steps of the pathway mentioned here proceed cleanly and that all intermediate compounds may be obtained in very high yields. Starting from ketones **1**, the three-step conversion into α,α-dichloro ketones **2** was exe-

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