

SODIUM BORODEUTERIDE REDUCTION OF N,N-DIMETHYL- α -CHLORO- α,α -DIPHENYL-
ACETAMIDE AND THE MECHANISM OF THE "NORMAL" REACTION OF α -CHLORO- α,α -
-DIPHENYLACETAMIDES WITH NUCLEOPHILES

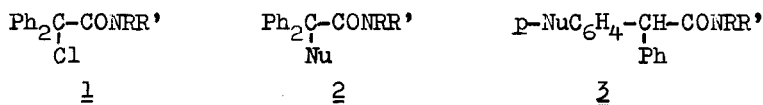
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The reaction of α -chloro- α,α -diphenylacetamides 1 with nucleophiles such as amines and N-cyanoanilide anions is known to yield either normal α -2 and/or anomalous p-substitution products 3.¹ In order to get some insight into the mechanism of these reactions, the NaBH₄ reduction of 1a

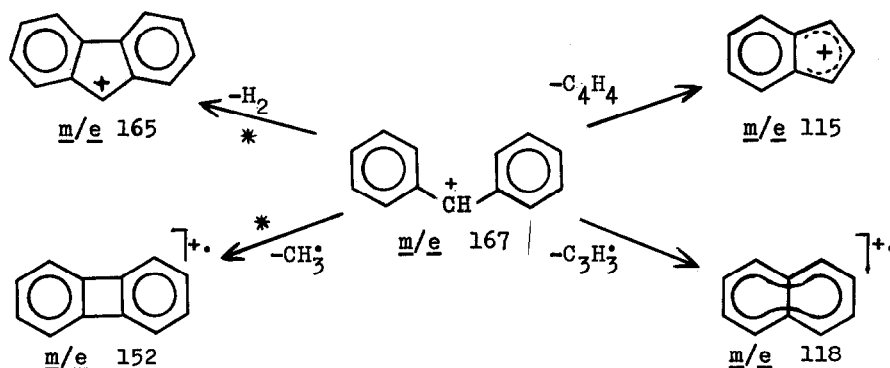


1 = 1, R = R' = Me/ was studied with the aid of the isotopic tracer method.

When an ethereal solution of 1a was stirred at r.t. with an aqueous solution of NaBH₄ /7 moles/, the reduction product 2a 1 = 2, R = R' = Me, Nu = H; 63%/,² and the hydrolysis product 2b 1 = 2, R = R' = Me, Nu = OH; 19%/³ were obtained after chromatographic work-up. When the reagent was replaced by NaBD₄/D₂O, 35 % of monodeutero-2a, 14 % of /presumably O-deuterated/ 2b and non-deuterated starting material were obtained. When 1a was reduced with NaBH₄ in D₂O, only non-deuterated 2a and 1a were obtained in addition to O-deuterated 2b /total recovery: 71 %/. No H-D exchange was observed when an ethereal solution of 2a was stirred at r.t. with NaBH₄/D₂O.

The distribution of the D-label in the monodeutero-2a ions was establish-

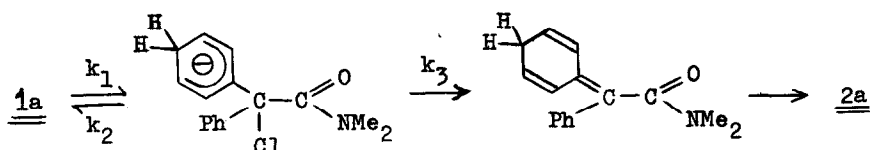
ed on the basis of the mass spectrum /70 eV, direct inlet system, source temperature: 120 °C/. The crucial fragment of non-deuterated 2a is the m/e 167 ion /Ph₂CH⁺/ which is known⁴ to be transformed under elimination of one ortho proton, each, of the phenyl rings into the m/e 165 and 152 ions.



In addition, elimination of a C₃H₃[•] and a C₄H₄ fragment from the m/e 167 ion give rise to the formation of the m/e 128 and 115 ions, respectively. The m/e 167 and 165 peaks in the mass spectrum of monodeutero-2a are shifted to m/e 168 and 166, respectively, and peaks at m/e 153, 129 and 116 are present in addition to the m/e 152, 128 and 115 peaks, respectively. The corrected ionic abundances are shown in the table. From the intensity ratio I¹⁵³/I¹⁵² in the mass spectrum of monodeutero-2a it can be seen that approximately 2/3 and 1/3 of the m/e 168 ions and, consequently, of the monodeutero molecules have the D-label in p- and α-position, respectively.

The intensity ratios I¹²⁹/I¹²⁸ and I¹¹⁶/I¹¹⁵ are approximately identical with the I¹⁵³/I¹⁵² ratio which indicates that in the course of the formation of the m/e 128 and 115 ions the α-CH group is incorporated in both cases into the C_nH_n neutral fragment while the p-CH groups are retained in the resulting ions, and corroborates the result concerning the distribution of the D-label deduced from the value of I¹⁵³/I¹⁵².

All our observations are accommodated by the following mechanism of the reduction:



with $k_3 \gg k_2$, which incorporates the two limiting cases $k_2 = 0$ /first step irreversible/ and $k_3 \rightarrow \infty$ /concerted reaction/. Whether the deuterium distribution in monodeutero-2a is the result of only the operation of the H/D kinetic isotope effect or, in addition to the latter, of part of the α -deutero compound being formed by direct $D:^\ominus$ attack at the α -position of 1a is not clear at present. The hydrogen migration in the last step of the sequence, on the other hand, undoubtedly does not take place by a deprotonation-protonation mechanism.

Ionic abundances* in the mass spectra of 2a
and monodeutero-2a

<u>m/e</u>	unlabelled	labelled
240		36
239	40	1,5
168		<u>100</u>
167	<u>100</u>	10
166	5	31
165	30	4
153		11
152	12	6
129		2
128	2	1
116		3
115	4	1,5

*
Corrected for natural isotope abundances

If the reason of the hydride anion to attack mainly /or exclusively/ the p-position of one of the phenyl rings of 1a is steric crowding at the α -carbon atom, then it may be assumed that the attack of more bulky nucleophiles /such as amines and N-cyanoanilide anions/ at the p-position must be even more favoured and that the "normal" substitution products with such nucleophiles are also formed via p-attack and subsequent rearrangement.

References

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