[3,3]Sigmatropic Rearrangement of an *N*-Benzoyl-3,6-dihydro-1,2-oxazine Derived from Ergosteryl Acetate and Nitrosocarbonylbenzene

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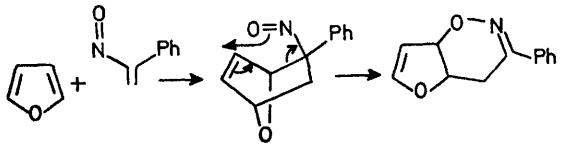
Summary Nitrosocarbonylbenzene reacts with ergosteryl acetate to give two, isomeric adducts by addition of the nitroso-group to the conjugated diene system; one adduct readily undergoes a [3,3]sigmatropic rearrangement to give a 3-phenyl-5,6-dihydro-1,4,2-dioxazine.

NITROSOCARBONYL-COMPOUNDS[1] and *C*-nitrosoimines[2] characteristically undergo [4 + 2]cycloaddition to conjugated dienes with the nitroso-group providing the 2π-electron component. Faragher and Gilchrist[3] have recently shown, in contrast, that α-nitrosostyrene gives with, for example, furan an adduct (**1**) in which the nitroso-compound



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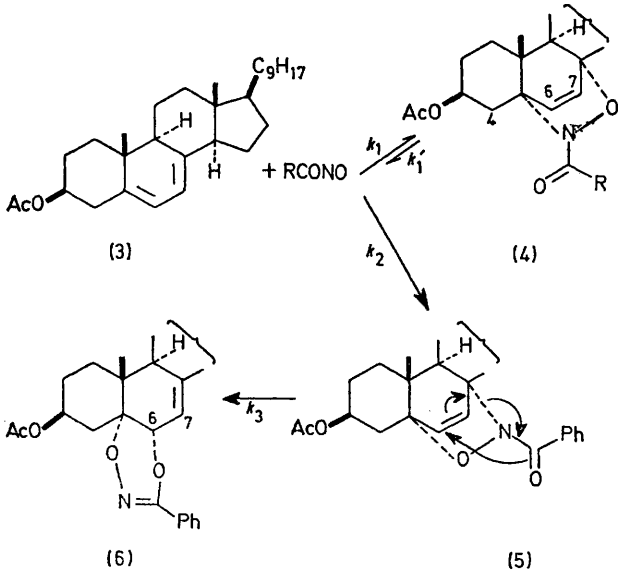
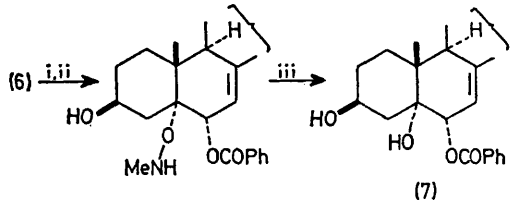
has provided, formally, the 4π-electron component. They believe (**1**) to be formed *via* a [3,3]sigmatropic rearrangement of the intermediate (**2**) which was, however, too labile to permit detection. We report here complementary findings for the cycloaddition of nitrosocarbonyl-compounds (RCONO) to ergosteryl acetate (**3**) (Scheme 1).



When R = Ph: $k_2 > k_1 \gg k_3 \gg k_1'$

SCHEME 1

Ergosteryl acetate (**3**) (0·5 mmol) and tetraethylammonium periodate (0·7 mmol) in dichloromethane were treated portionwise with stirring with acetohydroxamic acid (1·3 mmol) at 0° C to give the adduct (**4**; R=Me), m.p. 142—145 °C, in 84% yield [based on (**3**)]. This product arose, presumably, by 1,4-addition of transient nitrosocarbonylmethane,[1] generated by oxidation of the hydroxamic acid, to the diene system of (**3**). The spectroscopic properties of (**4**; R=Me) were in accord with this structure; in particular, in the n.m.r. spectrum, two doublets at τ ($CDCl_3$) 3·67 and 3·78 (J 9 Hz) could be assigned to the 6,7-olefinic protons and 1H double doublet (τ 6·53, J 14 and 5 Hz) to the equatorial, 4α-proton deshielded by the amido carbonyl-group. However, treatment of ergosteryl acetate (**3**) with nitrosocarbonylbenzene (generated *in situ* from benzohydroxamic acid, as before) gave, along with (**4**; R=Ph) (*ca.* 33%),† an adduct of a new type (**6**), m.p. 190—191 °C, τ ($CDCl_3$) 4·95 (br. s, 7-H) and 5·37 (br. s, 6-H), as the major (50—56% isolated) product. Analogous results



SCHEME 2. Reagents: i, $MeOSO_2F$, C_6H_6, room temp.; ii, H_2O–HCl, room temp.; iii, Zn–HOAc, room temp.

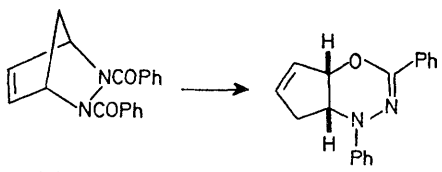
were obtained with ergosterol in place of ergosteryl acetate. The structure and stereochemistry of (**6**) were determined by conversion (Scheme 2) into the known[4] triol benzoate (**7**). The adducts (**4**; R=Ph) and (**6**) were produced in approximately the same (1:1·6) ratio when (**3**) was heated in benzene at 80 °C with the adduct of nitrosocarbonylbenzene and 9,10-dimethylanthracene, a known[1] source of PhCONO.

In principle, (**6**) might have arisen by direct [4 + 2]-cycloaddition of PhCONO, acting as the 4π-component, to the 5,6-double-bond of (**3**). However, we propose an alternative pathway, (**3**) → (**5**) → (**6**) (Scheme 1), for the following reasons. Ergosteryl acetate was treated with benzohydroxamic acid and periodate as before but the total reaction product was examined by n.m.r. spectroscopy after evaporation of solvent at 0 °C. No signals corresponding to (**6**) were observed. Instead, the two doublets due to the 6,7-olefinic system of (**4**; R=Ph), τ($CDCl_3$) 3·43 and 3·77 (J 9 Hz), were accompanied by a new pair of doublets, τ($CDCl_3$) 3·51 and 3·71 (J 8 Hz) attributed to (**5**). Moreover,

† The adduct (**4**; R = Ph) was isolated by preparative t.l.c.; it gave satisfactory spectroscopic data but did not crystallise. The corresponding adducts (**4**; R = 4-BrC_6H_4, 4-$MeOC_6H_4$, and 4-$NO_2C_6H_4$), obtained in analogous fashion, all crystallised and gave satisfactory spectroscopic and microanalytical data.

when the mixture‡ of (**4**; R=Ph) and (**5**) was heated in benzene at 60 °C complete conversion of (**5**) into (**6**) was observed (n.m.r. control), (**4**) remaining unchanged. Thus, in the original preparation of (**6**) isomerisation of the labile intermediate (**5**) had occurred during the normal operations of separation and crystallisation. The isomerisation, (**5**) to (**6**), might occur either by dissociation (retro Diels–Alder reaction) and recombination or by an intramolecular, [3,3]sigmatropic process. Evidence for the latter alternative came from experiments using triphenylphosphine, an efficient trapping agent[5] for PhCONO. When the mixture of (**4**; R=Ph) and (**5**) was heated in benzene at 60 °C with an excess of triphenylphosphine, the conversion of (**5**) into (**6**) was observed as before and at qualitatively the same rate. In contrast, when (**4**; R=Ph) was heated with triphenylphosphine in toluene at 111 °C, slow but efficient formation of (**3**) (78% isolated) occurred. In the absence of triphenylphosphine (**4**; R=Ph) isomerised slowly at this temperature to give (**6**), presumably *via* (**5**). The various reactions leading ultimately to the thermodynamically stable adduct (**6**) are summarised in Scheme 1.

The isomerisation of (**5**) to (**6**) appears to represent a new class of [3,3]sigmatropic rearrangement; to our knowledge the nearest literature[6] analogy is the rearrangement of the cyclopentadiene adduct (**8**) to the oxadiazine (**9**). The rearrangement of (**5**) may well be facilitated by relief of steric interactions associated with the *cis*-fused, B/C ring system. The corresponding rearrangement of (**4**) would lead to the sterically congested isomer (**10**) which, so far, has not been detected.



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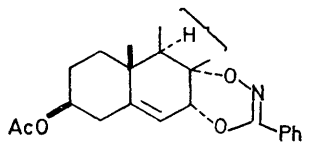

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‡ Attempts to separate this mixture by preparative t.l.c. lead to partial conversion of (**5**) into (**6**). The related adduct (**5**; 4-$NO_2C_6H_4$ in place of Ph) was obtained pure as judged by t.l.c. and n.m.r. spectroscopy; attempted crystallisation, however, gave (**6**; 4-$NO_2C_6H_4$ in place of Ph).

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