Removal of 1,3-Dithiolan Protecting Groups by Benzeneseleninic Anhydride

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Summary Benzeneseleninic anhydride smoothly regenerates ketones and aldehydes from their 1,3-dithiolan derivatives at room temperature in tetrahydrofuran (or CH_2Cl_2) in good yield and, in particular cases, where all other common procedures have failed.

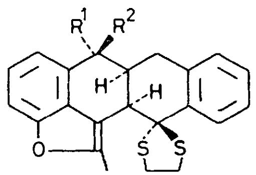
We report here a new procedure for the reformation of ketones (and aldehydes) from their corresponding dithioacetals using benzeneseleninic anhydride,[1] ($Ph_2Se_2O_3$) which shows advantages over existing methods.[2]

In a typical experiment the tetracyclic carbinol (**1**), which contains a sterically hindered 1,3-dithiolan unit, was treated with benzeneseleninic anhydride at room temperature in dry tetrahydrofuran (THF) to afford the deprotected carbinol (**2**) in high yield (Table). Under similar conditions the ketone (**3**) could be smoothly converted into the diketone (**4**).

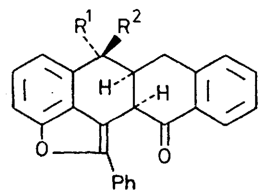
Table. Reactions of dithiolan derivatives with $Ph_2Se_2O_3$ to give the parent carbonyl compound.[a]

1,3-Dithiolan	Time	% Yield[b]
(**1**)[c]	50 h	78 [of (**2**)]
(**3**)[d]	3·5 h	63 [of (**4**)]
(**6**)	3 h	21 (59 by g.l.c.)
(**7**)	40 min	78 (DNP) (92 by g.l.c.)
(**8**)	1 h	93
(**9**)	30 min	65 (DNP) (70 by g.l.c.)
(**10**)	1 h	72
(**11**)[e]	18 h	(63 by g.l.c.)
(**12**)[f]	2 h	(78 by g.l.c.)

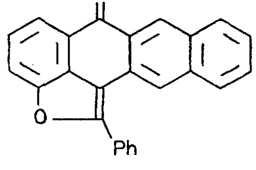
[a] In THF at room temperature unless otherwise noted. [b] Isolated yield of carbonyl compound [or 2,4-dinitrophenylhydrazone (DNP)] unless noted. [c] In THF–pyridine at 40 °C. [d] In CH_2Cl_2 at room temperature. [e] In refluxing THF. [f] In THF at 55 °C.



(**1**) $R^1 = Me$; $R^2 = OH$
(**3**) $R^1, R^2 = O$

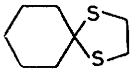


(**2**) $R^1 = Me$; $R^2 = OH$
(**4**) $R^1, R^2 = O$



(**5**)

In comparison, attempted deprotection of compound (**3**) with standard reagents [HgO, $HgCl_2$, $Hg(OAc)_2$, $AgNO_3$, $MeI–H_2O$, or $MeOSO_2F$]) gave none, or only small quantities, of the desired ketone (**4**). Indeed, the major product from the reaction of compound (**3**) with $MeOSO_2F$ was shown to be the tetracyclic ketone (**5**).[3] Other more vigorous conditions (particularly low pH) had to be avoided during the deprotection of the carbinol (**1**) owing to the easy loss of the hydroxy group by dehydration.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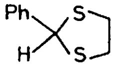
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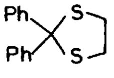
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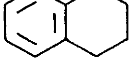
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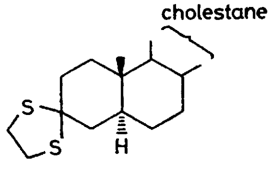

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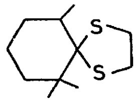
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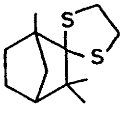
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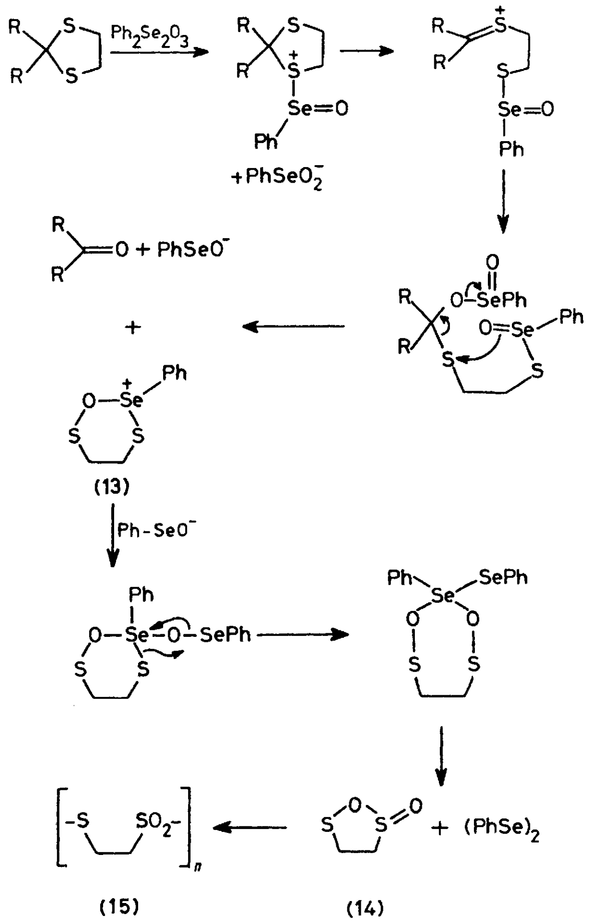
The 1,3-dithiolan analogues of cyclohexanone (**6**), 2,2,6-trimethylcyclohexanone (**11**), fenchone (**12**), benzaldehyde (**7**), benzophenone (**8**), α-tetralone (**9**), and 5α-cholestan-3-one (**10**) all reacted with the anhydride giving the parent carbonyl compounds in good yield (Table). Noticeably (**10**) was recovered in 72% yield from its ethylene dithioacetal. This yield equals or exceeds those for other reported procedures for this transformation.[4]†

1,3-Dithian derivatives can also be deprotected by the use of the anhydride. For example, the 1,3-dithian derivative of the cholestane system gave cholestanone in 73% yield after 16 h at room temperature.

In all the reactions studied, diphenyl diselenide was formed quantitatively and all three oxygen atoms of the reagent were consumed. Also, if the reactions were followed by n.m.r. or i.r. spectroscopy, rapid formation of the carbonyl products was observed even under scrupulously dry conditions. Hydrolytic work-up was not essential. Whilst the monosulphoxides of 1,3-dithiolans have been shown to enhance reconversion into ketones[5] the monosulphoxides of each dithioacetal in this study did not react with benzeneseleninic anhydride under normal conditions. In addition, attempts to generate diphenyl sulphoxide and dibenzyl sulphoxide from their sulphides with the anhydride failed (even after heating in THF for several days). We conclude that oxidation to a sulphoxide (and subsequent reaction) is not an intermediate step in the reaction.

Selenium dioxide reacts with dithioacetals at room temperature to give a complex mixture of products.

A possible mechanism for the reaction is summarised in the Scheme; there are, of course, plausible alternatives which we will discuss in more detail in a full paper. Apart from the carbonyl compound and $(PhSe)_2$, the other product was a polymer (**15**). This was identified by composition and by comparison with the per-acid oxidation product of polyethylene disulphide.[6] We tentatively consider it to be formed from (**13**) through the monomer (**14**).



SCHEME

No radicals could be detected by e.s.r. spectroscopy.

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† Use of MeI/H_2O and 'Magic Methyl' give the ketone in 21 and 90% yield, respectively.

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[2] *Cf.* B.-T. Gröbel and D. Seebach, *Synthesis*, 1977, 357 and references there cited.

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