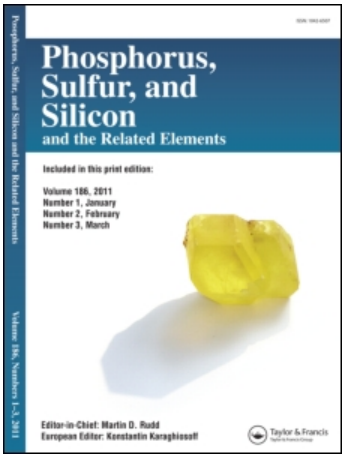


Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

UNUSUAL SYNTHESIS OF BICYCLO-[3,2,1]-2,7,8-TRIOXA-1-PHOSPHAOCTANE SYSTEM

E. E. Nifantyev[a]; D. A. Predvoditelev[a]; M. A. Malenkovskaya[a]; A. R. Bekker[a]; C. V. Meshkov[a]
[a] Chemistry Department, Moscow Lenin Pedagogical State University, Moscow, Russia

To cite this Article Nifantyev, E. E. , Predvoditelev, D. A. , Malenkovskaya, M. A. , Bekker, A. R. and Meshkov, C. V.(1994) 'UNUSUAL SYNTHESIS OF BICYCLO-[3,2,1]-2,7,8-TRIOXA-1-PHOSPHAOCTANE SYSTEM', Phosphorus, Sulfur, and Silicon and the Related Elements, 89: 1, 199 — 203
To link to this Article: DOI: 10.1080/10426509408020450
URL: http://dx.doi.org/10.1080/10426509408020450

Phosphorus, Sulfur, and Silicon, 1994, Vol. 89, pp. 199–203
Reprints available directly from the publisher
Photocopying permitted by license only

Communication

UNUSUAL SYNTHESIS OF BICYCLO-[3,2,1]-2,7,8-TRIOXA-1-PHOSPHAOCTANE SYSTEM

E. E. NIFANTYEV,* D. A. PREDVODITELEV,
M. A. MALENKOVSKAYA, A. R. BEKKER
and C. V. MESHKOV

Chemistry Department, Moscow Lenin Pedagogical State University, 119882 Moscow, Russia

(Received June 5, 1993; in final form March 3, 1994)

An unusual reaction leading to formation of bicyclo-[3,2,1]-2,7,8-trioxa-1-phosphaoctane framework by acylation of 2-thio(seleno)-2-dimethylamino-5,6-isopropylidene-1,3,2-dioxaphosphepanes was revealed.

Key words: Phosphepanes; framework; formation; acylation.

Previously it has been shown that the treatment of dioxolanes with two equivalents of acyl chlorides in the presence of Lewis acids affords 1,2-diol esters easily and in high yields.[1–5] The aim of the present work was to investigate the possibility of acylation of 2-thio(seleno)-2-dimethylamino-5,6-isopropylidene-1,3,2-dioxaphosphepanes **3** (**4**) containing a dioxolane ring. Such compounds are readily produced by phosphorylation of 2,3,-O-isopropylidene-D-threito **1** with phosphorous hexamethyltriamide **2** followed by sulfur or selenium treatment.

As it turned out compounds **3**, **4** reacted with stearoyl chloride to give compounds **5**, **6** which structures did not correspond to expected ones: their molecules contained only one acyl group (not two ones) and no dimethylamino group.

The structure of the molecules thus obtained was investigated by means of ^{1}H, ^{13}C and ^{31}P NMR spectroscopy (Tables I and II).

To make correct signal reference in ^{1}H and ^{13}C NMR spectra the synthesized compounds were studied by the methods of correlation 2D-spectroscopy COSY and HETCOR. ^{31}P NMR spectra were recorded with or without proton decoupling (at 162.0 MHz) to define the coupling constants J_{HP}.

The chemical shift examination for 6 protons and 4 carbons of the

$$\overset{4}{\text{—CH}_2\text{—}}\overset{5}{\text{CH}}\text{—}\overset{6}{\text{CH}}\text{—}\overset{7}{\text{CH}_2}\text{—}$$

moiety proved every carbon atom to be directly bonded to oxygen one. The couplings of five moiety protons with the phosphorus atom, which are absent in initial compound **3**, showed that the phosphorus atom is situated in bicyclic structure of bicyclo-[3,2,1]-2,7,8-trioxa-1-phosphaoctane.

Taking into account the structure of obtained compound, we assumed the re-

*To whom correspondence should be addressed.

TABLE I

^{1}H NMR spectra parameters of the compounds **3**, **5**, **7**

Assignment:	Compounds		
	3	**5**	**7**
	Chemical shifts (δ, ppm)		
$4H^a$	4.50	3.46	3.56
$4H^e$	3.71	3.83	3.75
5H	4.93	4.88	3.63
6H	3.81	3.96	3.95
$7H^a$	4.30	3.43	3.65
$7H^e$	4.07	3.66	3.99
	Coupling constants (J, Hz)		
$4H^a4H^e$	10.6	11.0	11.1
$4H^a5H$	6.4	10.4	10.3
$4H^e5H$	9.2	6.5	6.5
5H6H	9.1	5.3	3.9
$6H7H^a$	10.6	4.9	5.0
$6H7H^e$	3.4	0.6	0.4
$7H^a7H^e$	10.7	9.3	9.1
$4H^aP$	6.0	2.2	1.7
$4H^eP$	26.5	25.6	25.2
5HP	-	0	0
6HP	-	21.8	21.2
$7H^aP$	5.1	2.9	3.9
$7H^eP$	34.3	14.0	13.7

Note: The other protons chemical shifts (δ_H, ppm): compound **3** 1.22 and 1.28 (2 CH_3), 2.57 ($N(CH_3)_2$), $^3J_{HP}$ 11.7 Hz; compound **5** 0.96 (CH_3 fat-acid), 1.16–1.40 (CH_2 α-CH_2), 1.84 (β-CH_2).

action courses, as well as general principles of the acylation of cyclic acetales. A possible pathway is depicted in Scheme 1.

The reactions appear to start with the attack of carbonyl carbon of acyl halide at one of acetal oxygens to open the dioxolane ring. Thus, the initial intermediates are resonance-stabilized carbocations **A** with chloride anion as counter ion. Their interaction results in α-chloroethers (intermediates **B**) which can undergo repeated ionization either to initial species, or to new ionic intermediates—anion **C** and 2-chloropropyl cation. The subsequent cyclization of the intermediates **C** is due to the steric approach of the negatively charged oxygen atom to the phosphamide group.

Apparently, acylation of **3** occurred analogously and resulted in corresponding hydroxide **7** but not in acetyloxy framework (Scheme 2).

Compound **7** seems to be formed during the process of chromatographing, although its formation by dimethylaminolysis of primary product due to dimethylamino anion steric approach to ester carbonyl may be also assumed.

TABLE II

^{13}C NMR spectra parameters of the compounds **3**, **5**, **7**

Assignment:	Compounds		
	3	**5**	**7**
	Chemical shifts (δ, ppm)		
C^4	67.28	66.24	69.15
C^5	78.64	63.75	62.45
C^6	78.64	75.98	78.58
C^7	65.49	67.34	67.30
	Coupling constants ($^2J_{C-P}$, Hz)		
C^4-P	-	9.8	9.3
C^5-P	-	5.2	5.4
C^6-P	-	-	-
C^7-P	-	4.0	4.0

Note: The other carbons chemical shifts (δ_C, ppm): compound **3** 27.2 and 27.5 ($C^{9'}$ and $C^{9''}$), 111.3 (C^8), 37.24 (C^{10}); compound **5** 14.82 (CH_3 fat-acid), 23.57, 25.33, 30.32 (CH_2 fat-acid), 32.79 (α-CH_2), 34.01 (β-CH_2), 171.37 (C=O).

EXPERIMENTAL

NMR spectra were recorded on a Bruker AMX 400 spectrometer.

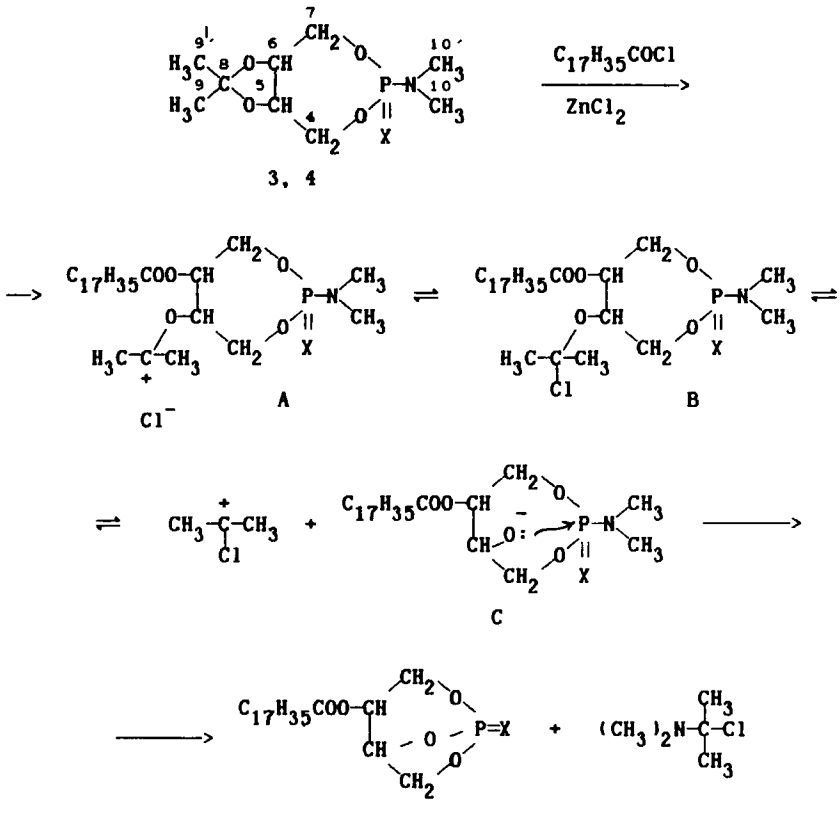
2-Thio-2-dimethylamino-5,6-O-isopropylidene-1,3,2-dioxaphosphepane (**3**): A mixture of 2,3-O-isopropylidene-D-threito **1** (0.5 g, 0.0031 mol) and phosphorous hexamethyltriamide **2** (0.5 g, 0.0031 mol) in absolute dioxane (50 ml) was heated at 75–80°C for 1 h. Sulfur (0.1 g, 0.0031 mol) was added to solution of amido phosphite, and the mixture was allowed to stand at 60°C for 1 h. The purification of amidothionphosphate **3** was performed on a column of silica gel (20 g) with eluating solution of hexane/dioxane (10:1).

Yield 0.40 g (69.5%); m.p. 85–86°C. δ_P (C_6H_6) 76.47; δ_H (400.13 MHz, C_6D_6) see Table I; δ_C (100.6 MHz, C_6D_6) see Table II.
Anal. calc. for $C_9H_{18}NO_4PS$: C, 40.44%; H, 6.79%; P, 11.59%; found: C, 40.58%; H, 6.85%; P, 11.52%.

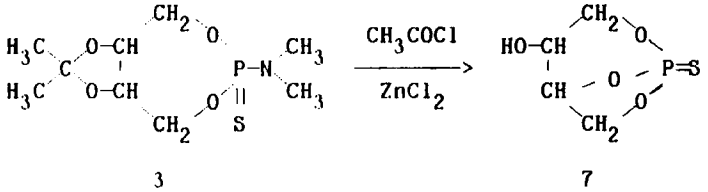
2-Seleno-2-dimethylamino-5,6-O-isopropylidene-1,3,2-dioxaphosphepane (**4**): Amidoselenonphosphate **4** was obtained from diol **1** (0.5 g, 0.0031 mol), amide **2** (0.5 g, 0.0031 mol) and selenium (0.2 g, 0.0031 mol) at 75°C for 1.5 h as it is described above.

Yield 0.44 g (65.3%); m.p. 71–72°C. δ_P (C_6H_6) 80.12; $^1J_{PSe}$ 935.87 Hz; δ_H (400.13 MHz, C_6D_6) and δ_C (100.6 MHz, C_6D_6) are analogous to those of compound **3**.
Anal. calc. for $C_9H_{18}NO_4PSe$: C, 34.39%; H, 5.77%; P, 9.86%; found: C, 34.48%; H, 5.63%; P, 9.72%.

Bicyclo-[3,2,1]-2,7,8-trioxa-1-thio-4-stearoyl-1-phosphaoctane (**5**): $ZnCl_2 \cdot 1.5\ H_2O$ (0.01 g, 0.00004 mol) and stearoyl chloride (0.23 g, 0.0008 mol) were added to the solution of amidothionphosphate **3** (0.1 g, 0.0004 mol) in chloroform (5 ml) at 0°C. Reaction mixture was kept under argon atmosphere at 0°C for 1 h and at 25°C for 12 h. The isolation of the compound **5** was carried out on a column of silica gel (10 g) with eluating solution of hexane/dioxane (10:1).



SCHEME 1



SCHEME 2

Yield 0.09 g (52%); m.p. 73–78°C. δ_P (C_6H_6) 74.99; δ_H (400.13 MHz, C_6D_6) see Table I; δ_C (100.6 MHz, C_6D_6) see Table II.
Anal. calc. for $C_{22}H_{41}O_5PS$: C, 58.90%; H, 9.21%; P, 6.91%; found: C, 58.98%; H, 9.24%; P, 6.84%.

Bicyclo-[3,2,1]-2,7,8-trioxa-1-seleno-4-stearoyl-1-phosphaoctane (**6**): The compound was obtained from amidoselenonphosphate **4** (0.05 g, 0.0002 mol), $ZnCl_2 \cdot 1.5\ H_2O$ (0.0096 g, 0.00002 mol) and stearoyl chloride (0.12 g, 0.0004 mol) at 25°C for 7 h as it is described above.

Yield 0.03 g (45%), m.p. 65–67°C. δ_P (C_6H_6) 77.77; $^1J_{PSe}$ 969.48 Hz; δ_H (400.13 MHz, C_6D_6) and δ_C (100.6 MHz, C_6D_6) are analogous to those of compound **5**.
Anal. calc. for $C_{22}H_{41}O_5PSe$: C, 53.33%; H, 8.34%; P, 6.25%; found: C, 53.37%; H, 8.38%; P, 6.30%.

Bicyclo [3,2,1]-2,7,8-trioxa-1-thio-4-hydroxy-1-phosphaoctane (**7**): The compound was obtained from amidothionphosphate **3** (0.14 g, 0.0005 mol), $ZnCl_2 \cdot 1.5\ H_2O$ (0.008 g, 0.00005 mol) and acetyl chloride (0.072 ml) for 3 h as it is described above for the bicyclothionphosphate **5**. The isolation of the compound **7** was carried out on a column of silica gel (10 g) with eluating solution of hexane/dioxane (10:1).

Yield 0.05 g (50%), m.p. 180–182°C. δ_P (C_6H_6) 75.09; δ_H (400.13 MHz, C_6D_6) see Table I; δ_C (100.6 MHz, C_6D_6) see Table II.
Anal. calc. for $C_4H_7O_4PS$: C, 26.38%; H, 3.87%; P, 17.01%; found: C, 26.42%; H, 3.98%; P, 17.12%.

REFERENCES

1. E. E. Nifantyev and D. A. Predvoditelev, *Bioorg. Chim.*, **7,** 1285 (1981).
2. E. E. Nifantyev, D. A. Predvoditelev, L. I. Smirnova and I. V. Fursenko, *Bioorg. Chim.*, **6,** 1346 (1980).
3. D. A. Predvoditelev, L. I. Smirnova, M. B. Smirnov and E. E. Nifantyev, *Dokl. AN SSSR*, **256,** 402 (1981).
4. D. A. Predvoditelev, M. A. Malenkovskaya and E. E. Nifantyev, *Bioorg. Chim.*, **17,** 1149 (1991).
5. D. A. Predvoditelev, M. A. Malenkovskaya, A. R. Bekker, L. K. Vasyanina and E. E. Nifantyev, *J. Org. Chim.*, **27,** 1655 (1991).