Metallation Reactions. XXXIV. Synthesis of 2-(1-Hydroxy-1-arylethyl)-1,3-benzoxathiol-3-oxide Derivatives

Salvatore Cabiddu (a)*, Enzo Cadoni (a)*, Stefana Melis (a), Alen Ianni (a), Angela M. Bernard (a), Maria G. Cabiddu (a), Stefania De Montis (a), Claudia Fattuoni (a) and Sandra Ianelli (b)

(a) Dipartimento di Scienze Chimiche, Università di Cagliari, Cittadella Universitaria di Monserrato, S.S. 554 Bivio per Sestu, I-09042 Monserrato, Italy
(b) Dipartimento di Chimica Generale ed Inorganica, Chimica Analitica e Chimica Fisica, Università di Parma, Parco Area delle Scienze 17A, I-43100 Parma, Italy

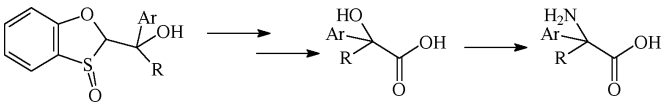
Received April 18, 2003

The reaction of benzoxathiole-3-oxide with lithiumdiisopropylamide in tetrahydrofuran gave an anion, which was reacted with various aryl-methyl-ketones to give 2-(1-hydroxy-1-arylethyl)-1,3-benzoxathiol-3-oxide derivatives. The reaction was carried out in different temperature conditions: at –88 °C the *trans* addition stereoisomers to the sulfoxide oxygen atom were the main products.

J. Heterocyclic Chem., **40**, 979 (2003).

The benzodioxole system is present in a great number of bioactive molecules and natural compounds [1-9] so it provoked our interest as synthetic target. This work, pursuing our previous researches [10,11], describes the preparation of the analogous 1,3-benzoxathiol-l,3-oxide derivatives bearing a 1-aryl substituted hydroxyethyl group in the 2 position, and their structure determination. These compounds can be considered as *O*,*S*-ketals of aldehydes and then precursors of *alpha*-hydroxyacids and *alpha*-aminoacids (Scheme 1).

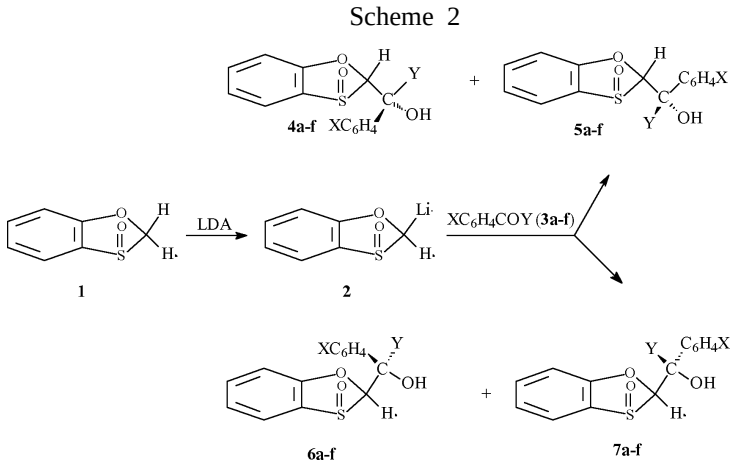
Scheme 1



All reactions were performed reacting the anion (**2**) derived from 1,3-benzoxathiol-3-oxide (**1**) with aryl alkyl ketones (**3a-f**). This anion was obtained using lithiumdiisopropylamide because literature reports that butyllithium cleaves the aryl-sulfoxide bond [12,13]. In this way (Scheme 2 and Table I) we prepared the 2-(1-hydroxy-1-arylethyl)-1,3-benzoxathiol-3-oxide derivatives **4a-f**, **5a-f**, **6a-f**, **7a-f** with moderate yields. The greater portion of isomers **4** was isolated with a purity of 95-96% by handling the reaction mixture with diethyl ether or a 3:1 solution of diethyl ether/methanol, in which the other diastereoisomers are soluble. The remaining part of isomers **4** and all the other diastereoisomers were isolated by flash-chromatography.

With the aim to improve the electrophile attack selectivity (*cis* or *trans* to the sulphoxide oxygen atom), the reactions were performed at different temperatures. The results (Table I) showed that decreasing the temperatures caused an increase of the attack selectivity on the carbon *alpha* to the sulfoxide moiety, giving a greater amount of **4** and **5** products: this is particularly evident for the ketone **3c**. These products are characterized by an absolute configuration *S* for the C-2 *i.e.* the hydrogen atom at position 2 is on the same side of the sulfoxide oxygen. The amount of diastereomers derived from an attack *trans* to the sulfoxide

Scheme 2



a: X = 4-OMe, Y = Me; **b**: X = 4-Me, Y = Me; **c**: X = H, Y = Me; **d**: X = 4-F, Y = Me; **e**: X = 4-CF_3, Y = Me; **f**: X = H, Y = CF_3

Table I

Product Distribution for the Reaction **2** + **3** in THF in the Range -88[]-20 °C. Lithiumdiisopropylamide/**1** = 2

Starting Material	Y	X	T (°C) **1**+**LDA** [a]	T (°C) **2**+**E** [b]	Molar fraction **4**	**5**	**6**	**7**	Total Yield (%)
3a	Me	4-MeO	-72	-72	0.41	0.30	0.15	0.14	36
3b	Me	4-Me	-81	-81	0.36	0.29	0.16	0.19	35
3b	Me	4-Me	-78	-78	0.35	0.24	0.16	0.25	45
3b	Me	4-Me	-78	60	0.34	0.28	0.17	0.21	44
3b	Me	4-Me	-78	-40	0.34	0.26	0.18	0.22	45
3b	Me	4-Me	-78	-20	0.28	0.23	0.20	0.29	54
3c	Me	H	-88	-88	0.45	0.43	0.05	0.07	12
3c	Me	H	-81	-81	0.40	0.38	0.09	0.13	16
3c	Me	H	-70	-70	0.29	0.20	0.22	0.29	32
3d	Me	4-F	-78	-78	0.35	0.30	0.17	0.18	53
3e	Me	4-CF_3	-78	-78	0.36	0.32	0.16	0.16	38
3f	CF_3	H	-78	-78	0.34	0.49	0.07	0.10	41

[a] LDA = lithiumdiisopropylamide; [b] E = ketonic compound.

oxygen atom is greater than from a *cis* attack even if the ratio *trans*/*cis* is not very high. This result can be due to competition between the steric effect favouring the *trans* attack, and the stabilization of the transition state given by the lithium atom bonded to both the carbonyl oxygen and the sulphoxide oxygen, favouring the *cis* attack (Figure 1).

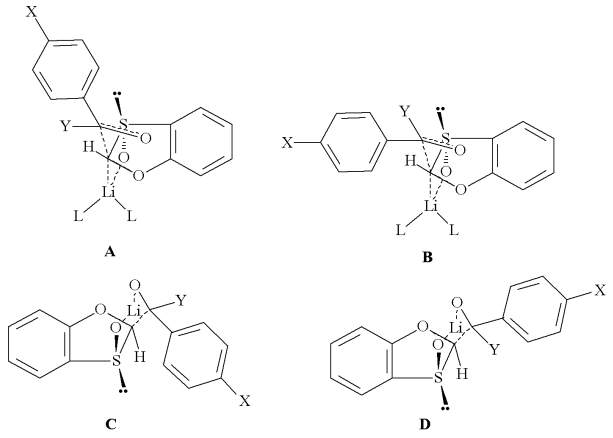


Figure 1. **A**, **B**: Transition States for *trans* Adducts. **C**, **D**: Transition States for *cis* Adducts.

The structures and the configuration of C-2 and C-8 stereogenic centres of **4b**, **5b** and **7b** were determined by X-ray analysis (Figure 2), and the assignment of the configuration to **6b** was made by default. The structures of compounds (**4**-**7**)(**a**, **c**-**e**) were assigned by comparison of their ^{1}H and ^{13}C nmr spectra with those of the analogous compounds (**4**-**7**)**b**. In fact, the chemical shifts, as summarised in Table II, are quite similar and attributable to an analogous chemical environment. The diastereomers **6** and **7** were distincted from **4** and **5** on the basis of their ^{13}C nmr spectrum: in fact **6** and **7**, bearing the H-2 *trans* to the sulfoxide oxygen atom, show the C-2 signal at values ranging from δ = 100.65 ppm and δ = 102.52 ppm; the *cis* isomers **4** and **5** have C-2 signals at values ranging from δ = 112.42 ppm and δ = 112.87 ppm. The distinction between **4** and **5** and between **6** and **7** was based on the comparison of ^{1}H environments.

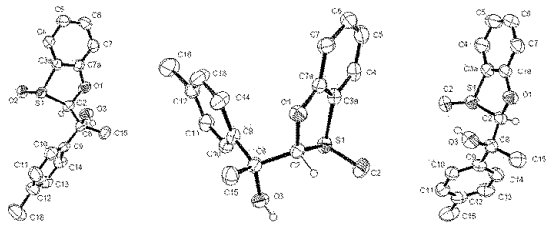
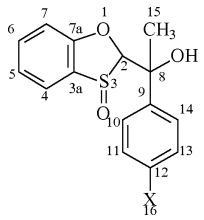


Figure 2

The structures of compounds (**4**-**7**)**f** were also determined by nmr spectra analysis. The relative configurations of C-2 relative to the sulfoxide group were assigned on the basis of the chemical shifts of the C-2 compared with those of (**4**-**7**)**a**-**e**: in fact these values were higher when the H-2 proton was *cis* relative to the sulfoxide oxygen [10,11] (see Table II). In (**4**-**7**)**f** the CF_3 group changed the chemical environment of the H-2 proton relative to the other derivatives, therefore their ^{1}H nmr spectra were no longer comparable with those of the other isomers (**4**-**7**)**a**-**e**. The relative stereochemistry of C-8 was determined by the deshielding effect of the fluorine atoms on the H-2 proton in the more stable conformation (compounds **6f** and **7f**) (Figure 3) calculated by PCMODEL 4.0 or determined

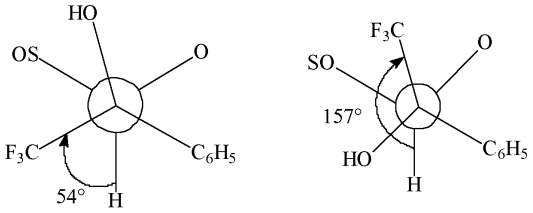
Table II

^{1}H and ^{13}C nmr Chemical Shift (δ ppm) of Diastereomers **4-7**.



	(**2S,8R,Ss + 2R,8S,Rs**)				(**2S,8S,Ss + 2R,8R,Rs**)		
Compound	H2	OH	C2	compound	H2	OH	C2
	δ	δ	δ		δ	δ	
4a	5.89	5.76	112.76	**5a**	5.56	6.11	112.59
4b	5.67	5.81	112.56	**5b**	5.59	6.09	112.57
4c	5.85	5.98	112.87	**5b**	5.62	6.19	112.55
4d	5.86	6.08	112.79	**5d**	5.62	6.27	112.63
4e	5.94	6.25	112.84	**5e**	5.86	6.44	112.42

	(**2R,8R,Ss + 2S,8S,Rs**)				(**2R,8S,Ss + 2S,8R,Rs**)		
Compound	H2	OH	C2	compound	H2	OH	C2
	δ	δ	δ		δ	δ	δ
6a	5.22	6.01	102.52	**7a**	5.34	6.05	101.08
6b	5.14	5.88	102.26	**7b**	5.25	5.92	100.65
6b	5.29	6.07	102.05	**7c**	5.38	6.13	100.90
6d	5.29	6.16	101.97	**7d**	5.34	6.25	100.88
6e	5.39	6.39	101.42	**7e**	5.41	6.49	100.74



6f **7f**

Figure 3 More Stable Conformation for the Bond C2-C8 in **6f** and **7f**

using molecular models (see Table III). Furthermore **6f** and **7f** were transformed in **4f** and **5f**, respectively by reaction with sodium hydroxide in dimethylsulfoxide at room temperature (configuration inversion at C-2).

Table III

^{1}H and ^{13}C nmr Chemical Shift (δ ppm) of Diastereomers (**4-7)f**.

Compound	C-2	H-2	OH	O_{SO}/H-2	Configuration
	δ	δ	δ		
4f	107.91	6.09	8.34	*cis*	2S,8S,Ss + 2R,8R,Rs
5f	108.25	6.51	-	*cis*	2S,8R,Ss + 2R,8S,Rs
6f	95.67	6.40	6.92	*trans*	2R,8S,Ss + 2S,8R,Rs
7f	94.52	5.77	7.81	*trans*	2R,8R,Ss + 2S,8S,Rs

EXPERIMENTAL

Melting points were determined with a Kofler hot stage microscope and are uncorrected. The ir spectra were recorded with a Nicolet FT-IR 210 spectrophotometer. Nmr spectra were recorded on a Varian VXR-300 spectrometer operating at 300 MHz for ^{1}H nmr and 75 MHz for ^{13}C nmr spectra. Chemical shifts are reported in ppm relative to tetramethylsilane and *J* values in Hz. The mass spectral data were recorded at 70 eV with a Hewlett-Packard 5989A MS spectrometer using the direct insertion probe method. Microanalyses were carried out on a Carlo Erba model 1106 Elemental Analyzer. Analytical thin layer chromatography plates and silica gel (230-400 mesh) were purchased from Merck. Flash chromatographies were performed on silica gel 60, 0.04-0.063 mm (Fluka).

In order to determine yields and molar fractions, HPLC analyses were performed by Waters 600 pump connect to Waters 996 photodiode array detector employing a Spherisorb-CN normal phase column of 250 mm length and 4.6 mm internal diameter, hexane/isopropanol (75:25) as eluent (1mL/min). The chromatogram was extracted at λ_{max}; all determinations were carried out on the basis of calibration plots on pure compounds.

Materials.

Reagent-grade reagents and solvents were used. All reagents were purchased from Aldrich Chemical Co. Solutions of butillithium in hexane were purchased from Aldrich Chemical Co. and were analyzed by the Gilman double titration method [14]. Solutions of lithiumdiisopropylamide in tetrahydrofuran were

prepared by literature methods [15]. All solvents were dried and purified using standard techniques. Petroleum ether (bp 40-60 °C) was used for chromatography.

X-Ray Structure Determination [16].

X-ray crystal structures of substituted aryl-methyl-ketone adducts **4b**, **5b** and **7b** were obtained and are shown in Figure 2.

The stereochemistry of chiral atoms of adducts obtained by the crystal structure determinations are referred to one of the enantiomers. Of course, the space groups all being centrosymmetric, the configurations of the other enantiomers are also present.

(±)1,3-Benzoxathiol-3(2*H*)-oxide (**1**).

This compound has been prepared as described in the literature [20].

General Method for the Condensation between 2-Lithiated-1,3-benzoxathiol-3(2*H*)-oxide (**1**) and Electrophiles.

To a stirred solution of lithiumdiisopropylamide (8.7 mmol) in dry tetrahydrofuran (15 mL) cooled at –88 °C, a solution of **1** (3.47 mmol) in dry tetrahydrofuran (12 mL) was added dropwise. After stirring for ten minutes at the same temperature, a solution of **3a-f** (4.20 mmol) in dry tetrahydrofuran (6 mL) was added. Stirring was continued for further 15 minutes and the reaction was quenched with aqueous saturated ammonium chloride, extracted with dichloromethane, dried with anhydrous sodium sulfate, filtered and the solvent removed *in vacuo*.

The reactions have been repeated at different temperatures as shown in Table I.

By addition of diethyl ether or a 3:1 solution of diethyl ether/methanol to the crude reaction mixtures the precipitated crystalline compound was isolated and then identified. The remaining products were separated by flash-chromatography on a Merck silica gel 43-60 μm. The reaction of **2** with **3a**, performed at the temperatures shown in Table I, gave **4a**, **5a**, **6a**, **7a** with the yield and molar fractions reported in Table I.

(2*S*,S_S)-2-[(1*R*)-1-(4-Methoxyphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**4a**).

The 85% of this product was obtained by handling the reaction mixture with a solution of 3:1 diethyl ether/methanol. The remaining 15% was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 178-179 °C; ir (Nujol): 3462 (OH), 1609, 1583, 1516, 1364, 1273, 1248, 1172, 1096, 1033 (S=O), 1002, 890, 831, 804, 761 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.70 (s, 3H, CH_3), 3.89 (s, 3H, OCH_3), 5.76 (s, 1H, OC*H*S), 5.89 (s, 1H, exchangeable with D_2O, OH), 7.08 (d, $^3J_{H-H}$ = 8.7 Hz, 2H, ArH), 7.24 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.38 (d, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.65-7.72 (m, 3H, ArH), 7.95 (d, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 26.47 (CH_3), 55.16 (OCH_3), 74.75 (COH), 112.76 (C_2), 113.32 (arom CH), 113.59 (arom CH), 122.17 (arom CH), 127.20 (arom CH), 129.42 (arom C), 134.45 (arom CH), 135.76 (arom C), 158.62 (arom C), 161.34 (arom C); ms: m/z (%) 287 (M^+-OH, 1), 286 (M^+-H_2O, 3), 163 (M^+-C_6H_4OHSO, 19), 151 ($CH_3OC_6H_4CCH_3OH^+$, 28), 150 ($CH_2OC_6H_4CCH_3OH^+$, 14), 137 ($C_6H_4OSCH^+$, 19), 135 ($CH_3OC_6H_4CO^+$, 54), 109 ($C_6H_4SH^+$, 6), 108 ($CH_3OC_6H_5^+$, 6), 107 ($CH_3OC_6H_4^+$, 10), 92 ($C_6H_4O^+$, 10), 91 ($C_7H_7^+$, 7), 77 ($C_6H_5^+$, 27), 45 (CHS^+, 78), 43 (CH_3CO^+, 100).

Anal. Calcd. for $C_{16}H_{16}O_4S$: C, 63.14; H, 5.30; S, 10.53. Found: C, 62,95; H, 5.22; S, 10.70.

(2*S*,S_S)-2-[(1*S*)-1-(4-Methoxyphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**5a**).

This compound was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 163-165 °C; ir (Nujol): 3340 (OH), 1614, 1580, 1515, 1304, 1251, 1178, 1153, 1128, 1103, 1066, 1035 (S=O), 1013, 839, 770 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.72 (s, 3H, CH_3), 3.65 (s, 3H, OCH_3), 5.56 (s, 1H, OC*H*S), 6.11 (s, 1H, exchangeable with D_2O, OH), 6.73 (d, $^3J_{H-H}$ = 8.4 Hz, 2H, ArH), 7.03 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.13 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.33 (d, $^3J_{H-H}$ = 8.4 Hz, 2H, ArH), 7.49 (t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.71 (d, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 27.09 (CH_3), 55.06 (OCH_3), 74.11 (COH), 112.59 (C_2), 112.97 (arom CH), 113.35 (arom CH), 122.30 (arom CH), 127.13 (arom CH), 127.27 (arom CH), 128.89 (arom C), 134.49 (arom CH), 134.62 (arom C), 158.31 (arom C), 160.63 (arom C); ms: m/z (%) 286 (M^+-H_2O, 2), 164 (M^+-C_6H_4OSO, 12), 163 (M^+-C_6H_4OHSO, 49), 151 ($CH_3OC_6H_4CCH_3OH^+$, 31), 150 ($CH_2OC_6H_4CCH_3OH^+$, 14), 137 ($C_6H_4OSCH^+$, 26), 135 ($CH_3OC_6H_4CO^+$, 84), 109 ($C_6H_4SH^+$, 9), 108 ($CH_3OC_6H_5^+$, 5), 107 ($CH_3OC_6H_4^+$, 12), 92 ($C_6H_4O^+$, 17), 91 ($C_7H_7^+$, 11), 77 ($C_6H_5^+$, 36), 65 ($C_5H_5^+$, 16), 43 (CH_3CO^+, 100).

Anal. Calcd. for $C_{16}H_{16}O_4S$: C, 63.14; H, 5.30; S, 10.53. Found: C, 62.90; H, 5.15; S, 10.71.

(2*R*,S_S)-2-[(1*R*)-1-(4-Methoxyphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**6a**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 153-154 °C; ir (Nujol): 3374 (OH), 1608, 1591, 1517, 1298, 1254, 1178, 1127, 1099, 1070, 1026 (S=O), 852, 834, 763, 738 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.94 (s, 3H, CH_3), 3.88 (s, 3H, OCH_3), 5.22 (s, 1H, OC*H*S), 6.01 (s, 1H, exchangeable with D_2O, OH), 7.07 (d, $^3J_{H-H}$ = 8.7 Hz, 2H, ArH), 7.32 (t, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH), 7.43 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.67-7.76 (m, 3H, ArH), 8.03 (d, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 24.51 (CH_3), 55.32 (OCH_3), 73.54 (COH), 102.52 (C_2), 113.41 (arom CH), 113.52 (arom CH), 123.40 (arom CH), 127.54 (arom CH), 127.96 (arom CH), 130.37 (arom C), 135.08 (arom CH), 136.37 (arom C), 158.93 (arom C), 159.87 (arom C); ms: m/z (%) 304 (M^+, 0.2), 287 (M^+-OH, 2), 164 (M^+-C_6H_4OSO, 7), 163 (M^+-C_6H_4OHSO, 27), 151 ($CH_3OC_6H_4CCH_3OH^+$, 20), 138 ($C_6H_4OSCH_2^+$, 11), 137 ($C_6H_4OSCH^+$, 100), 135 ($CH_3OC_6H_4CO^+$, 52), 121 ($CH_3OC_6H_4CH_2^+$, 10), 109 ($C_6H_4SH^+$, 9), 105 ($C_7H_5O^+$, 11), 92 ($C_6H_4O^+$, 9), 91 ($C_7H_7^+$, 9), 77 ($C_6H_5^+$, 24), 65 ($C_5H_5^+$, 13), 43 (CH_3CO^+, 69).

Anal. Calcd. for $C_{16}H_{16}O_4S$: C, 63.14; H, 5.30; S, 10.53. Found: C, 63.35; H, 5.22; S, 10.93.

(2*R*,S_S)-2-[(1*S*-1-(4-Methoxyphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**7a**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 142-144 °C; ir (Nujol): 3370 (OH), 1604, 1592, 1505, 1438, 1297, 1272, 1255, 1182, 1070, 1059, 1011 (S=O), 960, 853, 835, 776, 764, 738 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.86 (s, 3H, CH_3),

3.89 (s, 3H, OC*H*$_3$), 5.34 (s, 1H, OC*H*S), 6.05 (s, 1H, exchangeable with D_2O, OH), 7.09 (d, $^3J_{H-H}$ = 8.1 Hz, 2H, ArH), 7.34 (t, $^3J_{H-H}$ = 6.9 Hz, 1H, ArH), 7.46 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.69-7.72 (m, 3H, ArH), 8.08 (d, $^3J_{H-H}$ = 6.9 Hz, 1H, ArH); ^{13}C-nmr (deuteriodimethylsulfoxide-d_6): δ 25.74 (CH_3), 55.28 (OCH_3), 74.82 (COH), 101.09 (C_2), 112.68 (arom CH), 113.67 (arom CH), 123.30 (arom CH), 126.77(arom CH), 127.98 (arom CH), 130.36 (arom C), 135.00 (arom CH), 138.04 (arom C), 158.77 (arom C), 159.98 (arom C); ms: m/z (%) 304 (M^+, 2), 287 (M^+-OH, 10), 164 (M^+-C_6H_4OSO, 10), 163 (M^+-C_6H_4OHSO, 38), 151 ($CH_3OC_6H_4CCH_3OH^+$, 25), 138 ($C_6H_4OSCH_2^+$, 15), 137 ($C_6H_4OSCH^+$, 100), 135 ($CH_3OC_6H_4CO^+$, 50), 121 ($CH_3OC_6H_4CH_2^+$, 11), 109 ($C_6H_4SH^+$, 9), 105 ($C_7H_5O^+$, 10), 92 ($C_6H_4O^+$, 7), 91 ($C_7H_7^+$, 7), 77 ($C_6H_5^+$, 19), 65 ($C_5H_5^+$, 13), 43 (CH_3CO^+, 60).

Anal. Calcd. for $C_{16}H_{16}O_4S$: C, 63.14; H, 5.30; S, 10.53. Found: C, 62.89; H, 5.45; S, 10.31.

The reaction of **2** with **3b**, performed at the temperatures shown in Table I, gave **4b**, **5b**, **6b**, **7b** with the yield and molar fractions reported in Table I.

(2*S*,S_S)-2-[(1*R*)-1-(4-Methylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**4b**).

The 88% of this product was obtained by handling the reaction mixture with a solution of 3:1 diethyl ether/methanol. The remaining 12% was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 174-176 °C; ir (Nujol): 3298 (OH), 1585, 1510, 1454, 1274, 1247, 1233, 1157, 1090, 1028 (S=O), 1001, 844, 825, 767 cm^{-1}; ^{1}H nmr (deuteriodimethylsulfoxide-d_6): δ 1.59 (s, 3H, C*H*$_3$), 2.33 (s, 3H, C*H*$_3$), 5.67 (s, 1H, OC*H*S), 5.81 (s, 1H, exchangeable with D_2O, OH), 7.14 (t, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH), 7.23 (d, $^3J_{H-H}$ = 8.1Hz, 2H, ArH), 7.28 (d, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.51 (d, $^3J_{H-H}$ = 8.1 Hz, 2H, ArH), 7.59 (t, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.83 (d, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 20.54 (CH_3), 26.34 (CH_3), 74.78 (COH), 112.56 (C_2), 112.90 (arom CH), 122.00 (arom CH), 125.61 (arom CH), 127.00 (arom CH), 128.67 (arom CH), 129.19 (arom C), 134.30(arom CH), 136.46 (arom C), 140.68 (arom C), 161.17 (arom C); ms: m/z (%) 271 (M^+-OH, 3), 148 (M^+-C_6H_4OSO, 30), 147 (M^+-C_6H_4OHSO, 100), 138 ($C_6H_4OSCH_2^+$, 9), 137 ($C_6H_4OSCH^+$, 30), 135 ($CH_3C_6H_4CCH_3OH^+$, 18), 120 ($CH_3C_6H_4COH^+$, 9), 119 ($CH_2C_6H_4COH^+$, 65), 91 ($C_7H_7^+$, 22), 77 ($C_6H_5^+$, 8), 65 ($C_5H_5^+$, 10), 43 (CH_3CO^+, 58).

Anal. Calcd. for $C_{16}H_{16}O_3S$: C, 66.64; H, 5.59; S, 11.12. Found: C, 66.92; H, 5.37; S, 11.32.

(2*S*,S_S)-2-[(1*S*)-1-(4-Methylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**5b**).

This compound was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 193-194 °C; ir (Nujol): 3321 (OH), 1585, 1367, 1321, 1268, 1208, 1125, 1063, 1036 (S=O), 1008, 843, 820, 767 cm^{-1}; ^{1}H nmr (deuteriodimethylsulfoxide-d_6): δ 1.74 (s, 3H, C*H*$_3$), 2.19 (s, 3H, C*H*$_3$), 5.59 (s, 1H, OC*H*S), 6.09 (s, 1H, exchangeable with D_2O, OH), 6.98-7.06 (m, 3H, ArH), 7.12 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.31 (d, $^3J_{H-H}$ = 8.1 Hz, 2H, ArH), 7.50 (t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.72 (d, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 20.63 (CH_3), 27.10 (CH_3), 73.37 (COH), 112.57 (C_2), 113.30 (arom CH), 122.28 (arom CH), 125.76 (arom CH), 127.28 (arom CH), 128.26 (arom CH), 128.94 (arom C), 134.62 (arom CH), 136.19 (arom C), 139.78 (arom C), 160.65 (arom C); ms: m/z (%) 288 (M^+, 0.1), 271 (M^+-OH, 2), 148 (M^+-C_6H_4OSO, 27), 147 (M^+-C_6H_4OHSO, 100), 138 ($C_6H_4OSCH_2^+$, 10), 137 ($C_6H_4OSCH^+$, 30), 135 ($CH_3C_6H_4CCH_3OH^+$, 18), 120 ($CH_3C_6H_4COH^+$, 9), 119 ($CH_2C_6H_4COH^+$, 81), 91 ($C_7H_7^+$, 30), 77 ($C_6H_5^+$, 12), 65 ($C_5H_5^+$, 17), 43 (CH_3CO^+, 79).

Anal. Calcd. for $C_{16}H_{16}O_3S$: C, 66.64; H, 5.59; S, 11.12. Found: C, 66.85; H, 5.43; S, 11.01.

(2*R*,S_S)-2-[(1*R*)-1-(4-Methylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**6b**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 139-140 °C; ir (Nujol): 3383 (OH), 1588, 1513, 1269, 1241, 1215, 1126, 1098, 1072, 1025 (S=O), 1004, 848, 819, 751, 722 cm^{-1}; ^{1}H nmr (deuteriodimethylsulfoxide-d_6): δ 1.84 (s, 3H, C*H*$_3$), 2.37 (s, 3H, C*H*$_3$), 5.14 (s, 1H, OC*H*S), 5.88 (s, 1H, exchangeable with D_2O, OH), 7.21 (m, 3H, ArH), 7.31 (d, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.54 (d, $^3J_{H-H}$ = 7.8 Hz, 2H, ArH), 7.63 (t, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.94 (d, $^3J_{H-H}$ = 7.8 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 20.84 (CH_3), 24.71 (CH_3), 73.76 (COH), 102.26 (C_2), 113.30 (arom CH), 123.24 (arom CH), 126.04 (arom CH), 127.93 (arom CH), 128.72 (arom CH), 130.31 (arom C), 135.02 (arom CH), 136.92 (arom C), 141.40 (arom C), 159.79 (arom C); ms: m/z (%) 288 (M^+, 0.2), 271 (M^+-OH, 11), 270 (M^+-H_2O, 6), 260 (M^+-CO, 7), 148 (M^+-C_6H_4OSO, 15), 147 (M^+-C_6H_4OHSO, 52), 138 ($C_6H_4OSCH_2^+$, 29), 137 ($C_6H_4OSCH^+$, 100), 135 ($CH_3C_6H_4CCH_3OH^+$, 38), 134 ($CH_2C_6H_4CCH_3OH^+$, 16), 120 ($CH_3C_6H_4COH^+$, 10), 119 ($CH_2C_6H_4COH^+$, 87), 91 ($C_7H_7^+$, 56), 77 ($C_6H_5^+$, 13), 65 ($C_5H_5^+$, 30), 43 (CH_3CO^+, 91).

Anal. Calcd. for $C_{16}H_{16}O_3S$: C, 66.64; H, 5.59; S, 11.12. Found: C, 66.37; H, 5.41; S, 11.22.

(2*R*,S_S)-2-[(1*S*)-1-(4-Methylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**7b**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 130-132 °C; ir (Nujol): 3414 (OH), 1590, 1394, 1298, 1264, 1239, 1230, 1124, 1067, 1053, 1020 (S=O), 1002, 826, 753 cm^{-1}; ^{1}H nmr (deuteriodimethylsulfoxide-d_6): δ 1.74 (s, 3H, C*H*$_3$), 2.33 (s, 3H, C*H*$_3$), 5.25 (s, 1H, OC*H*S), 5.92 (s, 1H, exchangeable with D_2O, OH), 7.22 (m, 3H, ArH), 7.35 (d, $^3J_{H-H}$ = 8.7 Hz, 1H, ArH), 7.56 (d, $^3J_{H-H}$ = 8.1 Hz, 2H, ArH), 7.63 (t, $^3J_{H-H}$ = 8.7 Hz, 1H, ArH), 7.97 (d, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 20.52 (CH_3), 25.43 (CH_3), 74.67 (COH), 100.65 (C_2), 113.05 (arom CH), 122.97 (arom CH), 125.07 (arom CH), 127.70 (arom CH), 128.62 (arom CH), 130.08 (arom C), 134.68 (arom CH), 136.50 (arom C), 142.85 (arom C), 159.67 (arom C); ms: m/z (%) 288 (M^+, 0.3), 272 (M^+-O, 3), 271 (M^+-OH, 16), 148 (M^+-C_6H_4OSO, 13), 147 (M^+-C_6H_4OHSO, 40), 138 ($C_6H_4OSCH_2^+$, 14), 137 ($C_6H_4OSCH^+$, 100), 135 ($CH_3C_6H_4CCH_3OH^+$, 12), 120 ($CH_3C_6H_4COH^+$, 5), 119 ($CH_2C_6H_4COH^+$, 76), 91 ($C_7H_7^+$, 23), 77 ($C_6H_5^+$, 10), 65 ($C_5H_5^+$, 15), 43 (CH_3CO^+, 48).

Anal. Calcd. for $C_{16}H_{16}O_3S$: C, 66.64; H, 5.59; S, 11.12. Found: C, 66.78; H, 5.50; S, 11.35.

The reaction of **2** with **3c**, performed at the temperatures showed in Table I, gave **4c**, **5c**, **6c**, **7c** with the yield and molar fractions reported in Table I.

(2*S*,S_S)-2-[(1*R*)-1-Phenyl-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**4c**).

The 80% of this product was obtained by handling the reaction mixture with diethyl ether. The remaining 20% was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 192-194 °C; ir (Nujol): 3223 (OH), 1586, 1314, 1270, 1212, 1166, 1125, 1098, 1069, 1026 (S=O), 998, 767, 702 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.73 (s, 3H, CH_3), 5.85 (s, 1H, OC*H*S), 5.98 (s, 1H, exchangeable with D_2O, OH), 7.26 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.44 (m, 3H, ArH), 7.55 (t, $^3J_{H-H}$ = 7.2 Hz, 2H, ArH), 7.71 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.76 (d, $^3J_{H-H}$ = 7.2 Hz, 2H, ArH), 7.97 (d, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 26.61 (CH_3), 75.17 (COH), 112.87 (C_2), 113.06 (arom CH), 122.30 (arom CH), 125.98 (arom CH), 127.33 (arom CH), 127.62 (arom CH), 128.39 (arom CH), 129.57 (arom C), 134.59 (arom CH), 143.97 (arom C), 161.46 (arom C); ms: m/z (%) 274 (M^+, 0.4), 257 (M^+-OH, 3), 256 (M^+-H_2O, 5), 138 ($C_6H_4OSCH_2^+$, 13), 137 ($C_6H_4OSCH^+$, 51), 134 ($C_9H_{10}O^+$, 27), 133 ($C_9H_9O^+$, 65), 121 ($C_6H_5CCH_3OH^+$, 20), 106 ($C_6H_5COH^+$, 10), 105 ($C_6H_5CO^+$, 100), 91 ($C_7H_7^+$, 16), 77 ($C_6H_5^+$, 39), 65 ($C_5H_5^+$, 15), 43 (CH_3CO^+, 99).

Anal. Calcd. for $C_{15}H_{14}O_3S$: C, 65.67; H, 5.14; S, 11.69. Found: C, 65.91; H, 5.21; S, 11.82.

(2*S*,S_S)-2-[(1*S*)-1-Phenyl-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**5c**).

This compound was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 176-177 °C; ir (Nujol): 3264 (OH), 1582, 1302, 1270, 1212, 1147, 1127, 1072, 1035 (S=O), 1008, 756, 720 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.79 (s, 3H, CH_3), 5.62 (s, 1H, OC*H*S), 6.19 (s, 1H, exchangeable with D_2O, OH), 7.03 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.10-7.21 (m, 4H, ArH), 7.42-7.51 (m, 3H, ArH), 7.70 (d, $^3J_{H-H}$ = 7.8 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 27.09 (CH_3), 73.43 (COH), 112.55 (C_2), 113.06 (arom CH), 122.25 (arom CH), 125.79 (arom CH), 127.15 (arom CH), 127.16 (arom CH), 127.62 (arom CH), 129.90 (arom C), 134.57 (arom CH), 142.63 (arom C), 160.63 (arom C); ms: m/z (%) 274 (M^+, 0.4), 257 (M^+-OH, 6), 256 (M^+-H_2O, 7), 138 ($C_6H_4OSCH_2^+$, 11), 137 ($C_6H_4OSCH^+$, 45), 134 ($C_9H_{10}O^+$, 27), 133 ($C_9H_9O^+$, 63), 121 ($C_6H_5CCH_3OH^+$, 23), 105 ($C_6H_5CO^+$, 100), 91 ($C_7H_7^+$, 15), 77 ($C_6H_5^+$, 44), 65 ($C_5H_5^+$, 16), 43 (CH_3CO^+, 99).

Anal. Calcd. for $C_{15}H_{14}O_3S$: C, 65.67; H, 5.14; S, 11.69. Found: C, 65.49; H, 5.05; S, 11.83.

(2*R*,S_S)-2-[(1*R*)-1-Phenyl-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**6c**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 145-146 °C; ir (Nujol): 3407 (OH), 1589, 1491, 1305, 1268, 1218, 1135, 1045 (S=O), 1006, 981, 751, 715 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.99 (s, 3H, CH_3), 5.29 (s, 1H, OC*H*S), 6.07 (s, 1H, exchangeable with D_2O, OH), 7.33 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.41-7.57 (m, 4H, ArH), 7.71-7.87 (m, 3H, ArH), 8.06 (d, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 24.80 (CH_3), 73.85 (COH), 102.05 (C_2), 113.27 (arom CH), 123.25 (arom CH), 126.05 (arom CH), 127.75 (arom CH), 127.90 (arom CH), 128.14 (arom CH), 130.16 (arom C), 135.05 (arom CH), 144.25 (arom C), 159.71 (arom C); ms: m/z (%) 274 (M^+, 0.2), 258 (M^+-O, 2), 257 (M^+-OH, 11), 256 (M^+-H_2O, 1), 138 ($C_6H_4OSCH_2^+$, 15), 137 ($C_6H_4OSCH^+$, 100), 134 ($C_9H_{10}O^+$, 20), 133 ($C_9H_9O^+$, 50), 121 ($C_6H_5CCH_3OH^+$, 17), 105 ($C_6H_5CO^+$, 88), 91 ($C_7H_7^+$, 16), 77 ($C_6H_5^+$, 41), 65 ($C_5H_5^+$, 20), 43 (CH_3CO^+, 86).

Anal. Calcd. for $C_{15}H_{14}O_3S$: C, 65.67; H, 5.14; S, 11.69. Found: C, 65.52; H, 5.18; 11.51.

(2*R*,S_S)-2-[(1*S*)-1-Phenyl-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**7c**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 165-166 °C; ir (Nujol): 3387 (OH), 1591, 1494, 1271, 1231, 1126, 1064 (S=O), 997, 855, 754, 701 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.87 (s, 3H, CH_3), 5.38 (s, 1H, OC*H*S), 6.13 (s, 1H, exchangeable with D_2O, OH), 7.35 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.40-7.61 (m, 4H, ArH), 7.63-7.82 (m, 3H, ArH), 8.09 (d, $^3J_{H-H}$ = 7.8 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 25.57 (CH_3), 75.00 (COH), 100.90 (C_2), 113.33 (arom CH), 123.3 (arom CH), 125.42 (arom CH), 127.64 (arom CH), 127.95 (arom CH), 128.35 (arom CH), 130.21 (arom C), 134.97 (arom CH), 146.03 (arom C), 159.90 (arom C); ms: m/z (%) 274 (M^+, 0.1), 258 (M^+-O, 1), 257 (M^+-OH, 6), 256 (M^+-H_2O, 1), 138 ($C_6H_4OSCH_2^+$, 10), 137 ($C_6H_4OSCH^+$, 100), 134 ($C_9H_{10}O^+$, 14), 133 ($C_9H_9O^+$, 34), 121 ($C_6H_5CCH_3OH^+$, 10), 105 ($C_6H_5CO^+$, 58), 91 ($C_7H_7^+$, 10), 77 ($C_6H_5^+$, 27), 65 ($C_5H_5^+$, 12), 43 (CH_3CO^+, 45).

Anal. Calcd. for $C_{15}H_{14}O_3S$: C, 65.67; H, 5.14; S, 11.69. Found: C, 64.95; H, 5.29; S, 11.59.

The reaction of **2** with **3d**, performed at the temperatures shown in Table I, gave **4d**, **5d**, **6d**, **7d** with the yield and molar fractions reported in Table I.

(2*S*,S_S)-2-[(1*R*)-1-(4-Fluorophenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**4d**).

The 90% of this product was obtained by handling the reaction mixture with diethyl ether. The remaining 10% was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 193-195 °C; ir (Nujol): 3299 (OH), 1589, 1508, 1304, 1275, 1229, 1144, 1085, 1027 (S=O), 1014, 835, 752 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.73 (s, 3H, CH_3), 5.86 (s, 1H, OC*H*S), 6.08 (s, 1H, exchangeable with D_2O, OH), 7.26 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.34-7.43 (m, 3H, ArH), 7.71 (t, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.80 (dd, $^3J_{H-H}$ = 8.4 Hz, $^3J_{H-F}$ = 5.7 Hz, 2H, ArH), 7.98 (d, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 26.42 (CH_3), 74.82 (COH), 112.79 (C_2), 112.90 (arom CH), 114.99 (arom CH, $^2J_{C-F}$ = 20.7 Hz), 122.27 (arom CH), 127.27 (arom CH), 128.14 (arom CH, $^3J_{C-F}$ = 8.4 Hz), 129.34 (arom C), 134.53 (arom CH), 140.01 (arom C, $^4J_{C-F}$ = 3.0 Hz), 161.34 (arom C), 161.61 (arom C $^1J_{C-F}$ = 242.2 Hz); ms: m/z (%) 276 (M^+-O, 1), 274 (M^+-H_2O, 2), 152 ($C_9H_9FO^+$, 26), 151 ($C_9H_8FO^+$, 72), 139 ($FC_6H_4CCH_3OH^+$, 23), 138 ($C_6H_4OSCH_2^+$, 14), 137 ($C_6H_4OSCH^+$, 52), 123 ($FC_6H_4CO^+$, 81), 109 ($C_6H_4SH^+$, 20), 103 (25), 97 ($FC_6H_6^+$, 14), 96 ($FC_6H_5^+$, 17), 95 ($FC_6H_4^+$, 24), 77 ($C_6H_5^+$, 10), 59 (33), 43 (CH_3CO^+, 100).

Anal. Calcd. for $C_{15}H_{13}FO_3S$: C, 61.63; H, 4.48; F, 6.50; S, 10.97. Found: C, 61.91, H, 4.72; F, 6.36; S, 11.10.

(2*S*,S_S)-2-[(1*S*)-1-(4-Fluorophenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**5d**).

This compound was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl

ether/petroleum ether as eluents; white crystals, mp 175-176 °C; ir (Nujol): 3275 (OH), 1591, 1509, 1415, 1305, 1230, 1149, 1128, 1070, 1037 (S=O), 1009, 842, 756 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.78 (s, 3H, CH_3), 5.62 (s, 1H, OC*H*S), 6.27 (s, 1H, exchangeable with D_2O, OH), 6.96-7.11 (m, 3H, ArH), 7.12 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.45-7.50 (m, 3H, ArH), 7.98 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 27.08 (CH_3), 73.22 (COH), 112.63 (C_2), 112.88 (arom CH), 114.34 (arom CH, $^2J_{C-F}$ = 20.7 Hz), 122.41 (arom CH), 127.25 (arom CH), 128.05 (arom CH, $^3J_{C-F}$ = 7.8 Hz), 128.81 (arom C), 134.71 (arom CH), 138.741 (arom C, $^4J_{C-F}$ =3.1 Hz), 161.60 (arom C), 161.38 (arom C, $^1J_{C-F}$ =242.2 Hz); ms: m/z (%) 292 (M^+, 0.3), 275 (M^+-OH, 2), 274 (M^+-H_2O, 3), 152 ($C_9H_9FO^+$, 36), 151 ($C_9H_8FO^+$, 100), 139 ($FC_6H_4CCH_3OH^+$, 27), 138 ($C_6H_4OSCH_2^+$, 10), 137 ($C_6H_4OSCH^+$, 51), 123 ($FC_6H_4CO^+$, 84), 109 ($C_6H_4SH^+$, 21), 103 (27), 97 ($FC_6H_6^+$, 14), 96 ($FC_6H_5^+$, 13), 95 ($FC_6H_4^+$, 14), 77 ($C_6H_5^+$, 10), 65 ($C_5H_5^+$, 9), 43 (CH_3CO^+, 74).

Anal. Calcd. for $C_{15}H_{13}FO_3S$: C, 61.63; H, 4.48; F, 6.50; S, 10.97. Found: C, 61.51; H, 4.63; F, 6.72; S, 10.71.

(2*R*,S_S)-2-[(1*R*)-1-(4-Fluorophenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**6d**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 130-132 °C; ir (Nujol): 3387 (OH), 1603, 1589, 1513, 1302, 1272, 1234, 1165, 1120, 1093, 1019 (S=O), 837, 752, 724 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.96 (s, 3H, CH_3), 5.29 (s, 1H, OC*H*S), 6.16 (s, 1H, exchangeable with D_2O, OH), 7.30-7.60 (m, 3H, ArH), 7.44 (d, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.71-7.82 (m, 3H, ArH), 8.06 (d, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 25.11 (CH_3), 73.54 (COH), 101.97 (C_2), 113.32 (arom CH), 114.77 (arom CH, $^2J_{C-F}$ = 21.8 Hz), 123.30 (arom CH), 127.98 (arom CH), 128.41 (arom CH, $^3J_{C-F}$ = 8.5 Hz), 130.28 (arom C), 135.07 (arom CH), 140.44 (arom C, $^4J_{C-F}$ = 2.9 Hz), 159.71 (arom C), 161.77 (arom C, $^1J_{C-F}$ = 241.4 Hz); ms: m/z (%) 276 (M^+-O, 1), 275 (M^+-OH, 7), 152 ($C_9H_9FO^+$, 17), 151 ($C_9H_8FO^+$, 50), 139 ($FC_6H_4CCH_3OH^+$, 23), 138 ($C_6H_4OSCH_2^+$, 15), 137 ($C_6H_4OSCH^+$, 100), 123 ($FC_6H_4CO^+$, 73), 109 ($C_6H_4SH^+$, 25), 103 (26), 97 ($FC_6H_6^+$, 17), 96 ($FC_6H_5^+$, 17), 95 ($FC_6H_4^+$, 24), 77 ($C_6H_5^+$, 13), 43 (CH_3CO^+, 88).

Anal. Calcd. for $C_{15}H_{13}FO_3S$: C, 61.63; H, 4.48; F, 6.50; S, 10.97. Found: C, 61.85; H, 4.35; F, 6.42; S, 10.81.

(2*R*,S_S)-2-[(1*S*)-1-(4-Fluorophenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**7d**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 151-152 °C; ir (Nujol): 3408 (OH), 1602, 1589, 1509, 1405, 1304, 1270, 1228, 1162, 1066, 1020 (S=O), 1009, 837, 755 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.88 (s, 3H, CH_3), 5.34 (s, 1H, OC*H*S), 6.25 (s, 1H, exchangeable with D_2O, OH), 7.33-7.40 (m, 3H, ArH), 7.47 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.76 (t, $^3J_{H-H}$ = 7.5 Hz,1H, ArH), 7.83 (dd, $^3J_{H-H}$ = 8.7 Hz, $^3J_{H-F}$ = 5.4 Hz, 2H, ArH), 8.11 (d, $^3J_{H-H}$ = 7.5, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 25.28 (CH_3), 74.59 (COH), 100.88 (C_2), 113.33 (arom CH), 114.97 (arom CH, $^2J_{C-F}$ = 21.2 Hz), 123.34 (arom CH), 127.73 (arom CH, $^3J_{C-F}$ = 8.4 Hz), 127.98 (arom CH), 130.39 (arom C), 134.94 (arom CH), 142.29 (arom C, $^4J_{C-F}$ = 3.0 Hz), 159.80 (arom C), 161.64 (arom C, $^1J_{C-F}$ = 242.2 Hz); ms: m/z (%) 275 (M^+-OH, 3), 152 ($C_9H_9FO^+$, 14), 151 ($C_9H_8FO^+$, 36), 139 ($FC_6H_4CCH_3OH^+$, 18), 138 ($C_6H_4OSCH_2^+$, 14), 137 ($C_6H_4OSCH^+$, 100), 123 ($FC_6H_4CO^+$, 52), 109 ($C_6H_4SH^+$, 17), 103 (17), 97 ($FC_6H_6^+$, 12), 96 ($FC_6H_5^+$, 12), 95 ($FC_6H_4^+$, 17), 77 ($C_6H_5^+$, 10), 65 ($C_5H_5^+$, 11), 59 (18), 43 (CH_3CO^+, 65).

Anal. Calcd. for $C_{15}H_{13}FO_3S$: C, 61.63; H, 4.48; F, 6.50; S, 10.97. Found: C, 61.54; H, 4.59; F, 6.63; S, 11.10.

The reaction of **2** with **3e**, performed at the temperatures shown in Table I, gave **4e**, **5e**, **6e**, **7e** with the yield and molar fractions reported in Table I.

(2*S*,S_S)-2-[(1*R*)-1-(4-Trifluoromethylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**4e**).

The 78% of this product was obtained by handling the reaction mixture with a solution of 3:1 diethyl ether/methanol. The remaining 22% was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 182-184 °C; ir (Nujol): 3312 (OH), 1611, 1589, 1411, 1328, 1274, 1165, 1118, 1027 (S=O), 1002, 849, 749 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.76 (s, 3H, CH_3), 5.94 (s, 1H, OC*H*S), 6.25 (s, 1H, exchangeable with D_2O, OH), 7.27 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.43 (d, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.73 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.91-8.02 (m, 5H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 26.23 (CH_3), 76.00 (COH), 112.84 (C_2), 112.88 (arom CH), 122.38 (arom CH), 124.38 (CF_3, $^1J_{C-F}$ = 275.5 Hz), 125.27 (arom CH, $^3J_{C-F}$ = 3.7 Hz), 126.89 (arom CH), 127.30 (arom C), 128.24 (arom C, $^2J_{C-F}$ = 31.5 Hz), 129.31 (arom CH), 134.67 (arom CH), 148.62 (arom C), 161.34 (arom C); ms: m/z (%) 342 (M^+, 2), 325 (M^+-OH, 4), 324 (M^+-H_2O, 7), 323 (M^+-F, 5), 202 ($C_{10}H_9F_3O^+$, 32), 201 ($C_{10}H_8F_3O^+$, 32), 189 ($CF_3C_6H_4CCH_3OH^+$, 31), 173 ($CF_3C_6H_4CO^+$, 79), 153 (21), 145 ($CF_3C_6H_4^+$, 34), 142 ($C_6H_4OH_2SO^+$, 37), 141 ($C_6H_4OHSO^+$, 57), 137 ($C_6H_4OSCH^+$, 86), 133 (23), 126 (24), 125 (31), 113 (13), 109 ($C_6H_4SH^+$, 16), 97 ($FC_6H_6^+$, 21), 96 ($FC_6H_5^+$, 33), 95 ($FC_6H_4^+$, 14), 77 ($C_6H_5^+$, 10), 70 (CF_3H^+, 11), 69 (CF_3^+, 13), 65 ($C_5H_5^+$, 17), 43 (CH_3CO^+, 100).

Anal. Calcd. for $C_{16}H_{13}F_3O_3S$: C, 56.14; H, 3.83; F, 16.65; S, 9.37. Found: C, 56.01; H, 3.71; F, 16.49; S, 9.46.

(2*S*,S_S)-2-[(1*S*)-1-(4-Trifluoromethylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**5e**).

This compound was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then 8:2 diethyl ether/petroleum ether as eluents; white crystals, mp 180-182 °C; ir (Nujol): 3295 (OH), 1621, 1581, 1421, 1311, 1268, 1163, 1128, 1104, 1075, 1038 (S=O), 1013, 845, 763 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.95 (s, 3H, CH_3), 5.89 (s, 1H, OC*H*S), 6.44 (s, 1H, exchangeable with D_2O, OH), 7.17 (t, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH), 7.23 (d, $^3J_{H-H}$ = 8.7 Hz, 1H, ArH), 7.62 (t, $^3J_{H-H}$ = 8.4 Hz, 1H, ArH), 7.69 (d, $^3J_{H-H}$ = 8.7 Hz, 2H, ArH), 7.80 (d, $^3J_{H-H}$ = 8.7 Hz, 2H, ArH), 7.89 (d, $^3J_{H-H}$ = 7.4, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 26.83 (CH_3), 73.77 (COH), 112.42 (C_2), 112.62 (arom CH), 122.40 (arom CH), 124.45 (CF_3, $^1J_{C-F}$ = 274.3 Hz), 124.60 (arom CH, $^3J_{C-F}$ = 3.6 Hz), 126.75 (arom CH), 127.25 (arom CH), 127.82 (arom C, $^2J_{C-F}$ = 31.6 Hz), 128.95 (arom C), 134.70 (arom CH), 147.84 (arom C), 161.63 (arom C); ms: m/z (%) 342 (M^+, 1), 325 ((M^+-OH, 2), 324 (M^+-H_2O, 4), 202 ($C_{10}H_9F_3O^+$, 34), 201 ($C_{10}H_8F_3O^+$, 34), 189 ($CF_3C_6H_4CCH_3OH^+$, 33), 173 ($CF_3C_6H_4CO^+$, 69), 153 (24), 145 ($CF_3C_6H_4^+$, 28), 142 ($C_6H_4OH_2SO^+$, 37), 141 ($C_6H_4OHSO^+$, 60), 137 ($C_6H_4OSCH^+$,

73), 133 (28), 126 (24), 125 (31), 113 (15), 109 ($C_6H_4SH^+$, 16), 97 ($FC_6H_6^+$, 26), 96 ($FC_6H_5^+$, 36), 95 ($FC_6H_4^+$, 16), 77 ($C_6H_5^+$, 11), 70 (CF_3H^+, 13), 69 (CF_3^+, 14), 65 ($C_5H_5^+$, 19), 43 (CH_3CO^+, 100).

Anal. Calcd. for $C_{16}H_{13}F_3O_3S$: C, 56.14; H, 3.83; F, 16.65; S, 9.37. Found: C, 56.30; H, 3.71; F, 16.78; S, 9.49.

(2*R*,S_S)-2-[(1*R*)-1-(4-Trifluoromethylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**6e**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 138-140 °C; ir (Nujol): 3394 (OH), 1618, 1584, 1328, 1161, 1110, 1075, 1023 (S=O), 843, 760 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 2.06 (s, 3H, CH_3), 5.39 (s, 1H, OC*H*S), 6.39 (s, 1H, exchangeable with D_2O, OH), 7.33 (t, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH), 7.48 (d, $^3J_{H-H}$ = 8.2 Hz, 1H, ArH), 7.74(t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.89 (d, $^3J_{H-H}$ = 8.4 Hz, 2H, ArH), 8.03-8.09 (m, 3H, ArH); ^{13}Cuteriodimethylsulfoxide-d_6): δ 26.18 (CH_3), 73.90 (COH), 101.42 (C_2), 113.42 (arom CH), 123.25 (arom CH), 124.40 (CF_3, $^1J_{C-F}$ = 268.5 Hz), 124.83 (arom CH, $^3J_{C-F}$ = 3.1 Hz), 126.98 (arom CH), 127.90 (arom CH), 127.71 (arom C, $^2J_{C-F}$ = 32.8 Hz), 130.20 (arom C), 135.06 (arom CH), 148.81 (arom C), 159.63 (arom C); ms: m/z (%) 325 (M^+-OH, 0.2), 324 (M^+-H_2O, 0.4), 202 ($C_{10}H_9F_3O^+$, 3), 201 ($C_{10}H_8F_3O^+$, 3), 189 ($CF_3C_6H_4CCH_3OH^+$, 7), 173 ($CF_3C_6H_4CO^+$, 13), 153 (6), 145 ($CF_3C_6H_4^+$, 17), 141 ($C_6H_4OHSO^+$, 8), 137 ($C_6H_4OSCH^+$, 42), 133 (11), 127 (7), 126 (6), 109 ($C_6H_4SH^+$, 13), 97 ($FC_6H_6^+$, 20), 96 ($FC_6H_5^+$, 20), 95 ($FC_6H_4^+$, 14), 77 ($C_6H_5^+$, 11), 70 (CF_3H^+, 13), 69 (CF_3^+, 18), 66 (26), 65 ($C_5H_5^+$, 22), 43 (CH_3CO^+, 100).

Anal. Calcd. for $C_{16}H_{13}F_3O_3S$: C, 56.14; H, 3.83; F, 16.65; S, 9.37. Found: 56.20; H, 3.75; F, 16.69; S, 9.22.

(2*R*,S_S)-2-[(1*S*)-1-(4-Trifluoromethylphenyl)-1-hydroxyethyl]-1,3-benzoxathiol-3-(2*H*)-oxide (**7e**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether; white crystals, mp 179-181 °C; ir (Nujol): 3473 (OH), 1618, 1588, 1410, 1331, 1274, 1162, 1110, 1047 (S=O), 996, 842, 754 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 1.92 (s, 3H, CH_3), 5.41 (s, 1H, OC*H*S), 6.49 (s, 1H, exchangeable with D_2O, OH), 7.35 (t, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH), 7.46 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.75 (t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.91 (d, $^3J_{H-H}$ = 8.4 Hz, 2H, ArH), 8.03 (d, $^3J_{H-H}$ = 8.4 Hz, 2H, ArH), 8.09 (d, $^3J_{H-H}$ = 7.2, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 24.95 (CH_3), 74.79 (COH), 100.74 (C_2), 113.45 (arom CH), 123.53 (arom CH), 124.45 (CF_3, $^1J_{C-F}$ = 271.9 Hz), 125.34 (arom CH, $^3J_{C-F}$ = 4.5 Hz), 126.54 (arom CH), 128.05 (arom CH), 128.3 (arom C, $^2J_{C-F}$ = 31.6 Hz), 130.42 (arom C), 135.10 (arom CH), 150.66 (arom C), 159.82 (arom C); ms: m/z (%) 342 (M^+, 0.3), 325 (M^+-OH, 3), 324 (M^+-H_2O, 2), 202 ($C_{10}H_9F_3O^+$, 20), 201 ($C_{10}H_8F_3O^+$, 19), 189 ($CF_3C_6H_4CCH_3OH^+$, 26), 173 ($CF_3C_6H_4CO^+$, 64), 153 (13), 145 ($CF_3C_6H_4^+$, 37), 142 ($C_6H_4OH_2SO^+$, 16), 141 ($C_6H_4OHSO^+$, 26), 137 ($C_6H_4OSCH^+$, 100), 133 (11), 126 (15), 125 (31), 113 (5), 109 ($C_6H_4SH^+$, 8), 97 ($FC_6H_6^+$, 9), 96 ($FC_6H_5^+$, 10), 95 ($FC_6H_4^+$, 9), 77 ($C_6H_5^+$, 5), 70 (CF_3H^+, 4), 69 (CF_3^+, 7), 65 ($C_5H_5^+$, 5), 43 (CH_3CO^+, 37).

Anal. Calcd. for $C_{16}H_{13}F_3O_3S$: C, 56.14; H, 3.83; F, 16.65; S, 9.37. Found: C, 56.31; H, 3.65; F, 16.83; S, 9.19.

The reaction of **2** with **3f**, performed at the temperatures showed in Table I, gave **4f**, **5f**, **6f**, **7f** with the yield and molar fractions reported in Table I.

(2*S*,S_S)-2-[(1*S*)-2,2,2-Trifluoro-1-hydroxy-1-phenylethyl)-1,3-benzoxathiol-3-(2*H*)-oxide (**4f**).

The 83% of this product was obtained by handling the reaction mixture with a solution of 3:1 diethyl ether/methanol. The remaining 17% was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then diethyl ether; white crystals, mp 189-191 °C; ir (Nujol): 3360 br (OH), 1585, 1273, 1159, 1027 (S=O), 916, 838, 755, 721 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 6.01 (s, 1 H, OC*H*S), 7.18 (t, $^3J_{H-H}$ = 7.2 Hz, 1H, ArH), 7.29-7.36 (m, 4H, ArH), 7.84-7.91 (m, 3H, ArH), 8.00 (d, $^3J_{H-H}$ = 7.2 Hz, 2H, ArH), 8.34 (s, 1H, exchangeable with D_2O, OH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 75.60 (COH, $^2J_{C-F}$ = 27.9 Hz), 107.89 (C_2), 112.93 (arom CH), 123.06 (arom CH), 124.34 (CF_3, $^1J_{C-F}$ = 287.7 Hz), 126.67 (arom CH), 127.11 (arom CH), 128.03 (arom CH), 128.19 (arom C), 128.74 (arom CH), 129.24 (arom CH), 132.38 (arom C), 135.05 (arom CH), 160.24 (arom C); ms: m/z (%) 328 (M^+, 6), 310 (M^+-H_2O, 3), 188 ($C_9H_7F_3O^+$, 8), 187 ($C_9H_6F_3O^+$, 20), 175 ($C_6H_5CCF_3OH^+$, 23), 159 (15), 154 (10), 141 ($C_6H_4OHSO^+$, 100), 137 ($C_6H_4OSCH^+$, 58), 126 (30), 125 ($C_7H_6FO^+$, 34), 113 (21), 109 ($C_6H_4SH^+$, 32), 108 ($C_6H_4S^+$, 6), 105 ($C_6H_5CO^+$, 57), 97 (CF_3CO^+, 29), 96 (57), 95 (14), 77 ($C_6H_5^+$, 61), 69 (CF_3^+, 30), 65 ($C_5H_5^+$, 27), 51 (HCF_2^+, 43).

Anal. Calcd. for $C_{15}H_{11}F_3O_3S$: C, 54.86; H, 3.38; F, 17.36; S, 9.77. Found: C, 54.99; H, 3.47; F, 17.51; S, 9.89.

(2*S*,S_S)-2-[(1*R*)-2,2,2-Trifluoro-1-hydroxy-1-phenylethyl)-1,3-benzoxathiol-3-(2*H*)-oxide (**5f**).

This compound was obtained after flash-chromatography using first 3:7 diethyl ether/petroleum ether and then diethyl ether; white crystals, mp 200-202 °C dec.; ir (Nujol): 3276 br (OH), 1584, 1264, 1185, 1152, 1030 (S=O), 987, 937, 839, 752 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 6.50 (s, 1H, OC*H*S), 7.31 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.51 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.70-7.63 (m, 3H, ArH), 7.75 (t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.88 (d, $^3J_{H-H}$ = 6.6 Hz, 2H, ArH), 8.00 (d, $^3J_{H-H}$ = 7.5, 1H, ArH); ^{13}C nmr (deuteriodimethylsulfoxide-d_6): δ 77.95 (COH, $^2J_{C-F}$ = 27.9 Hz), 108.25 (C_2), 113.15 (arom CH), 122.85 (arom CH), 124.85 (CF_3, $^1J_{C-F}$ = 287.7 Hz), 126.78 (arom CH), 127.19 (arom CH), 127.78 (arom C), 128.60 (arom CH), 128.92 (arom CH), 129.74 (arom CH), 134.28 (arom C), 134.99 (arom CH), 161.52 (arom C); ms: m/z (%) 328 (M^+, 9), 310 (M^+-H_2O, 2), 188 ($C_9H_7F_3O^+$, 7), 187 ($C_9H_6F_3O^+$, 14), 175 ($C_6H_5CCF_3OH^+$, 35), 159 (16), 154 (10), 141 ($C_6H_4OHSO^+$, 100), 137 ($C_6H_4OSCH^+$, 64), 126 (33), 125 ($C_7H_6FO^+$, 34), 113 (21), 109 ($C_6H_4SH^+$, 34), 108 ($C_6H_4S^+$, 6), 105 ($C_6H_5CO^+$, 93), 97 (CF_3CO^+, 31), 96 (58), 95 (14), 77 ($C_6H_5^+$, 98), 69 (CF_3^+, 40), 65 ($C_5H_5^+$, 23), 51 (HCF_2^+, 14).

Anal. Calcd. for $C_{15}H_{11}F_3O_3S$: C, 54.86; H, 3.38; F, 17.36; S, 9.77. Found: C, 54.63; H, 3.39; F, 17.23; S, 9.85.

(2*R*,S_S)-2-[(1*S*)-2,2,2-trifluoro-1-hydroxy-1-phenylethyl)-1,3-benzoxathiol-3-(2*H*)-oxide (**6f**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether, white crystals, mp 146-147 °C; ir (Nujol): 3395, 3297 (OH), 1586, 1256, 1176, 1146, 1040 (S=O), 1005, 979, 930, 852, 754, 704 cm^{-1}; ^1H nmr (deuteriodimethylsulfoxide-d_6): δ 6.40 (s, 1H, OC*H*S), 6.90 (s, 1H, exchangeable with D_2O, OH), 7.39 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.58 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.67-7.64 (m, 3H, ArH), 7.82 (t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.94-7.45 (m, 2H, ArH), 8.11 (d,

$^3J_{H-H}$ = 7.5, 1H, ArH); ^{13}C(deuteriodimethylsulfoxide-d_6): δ 76.80 (COH, $^2J_{C-F}$ = 28.4 Hz), 95.56 (C_2), 113.51 (arom CH), 123.51 (arom CH), 125.40 (CF_3, $^1J_{C-F}$ = 271.0 Hz), 126.52 (arom CH), 127.71 (arom CH), 128.58 (arom C), 128.72 (arom CH), 129.29 (arom C), 129.73 (arom CH), 135.18 (arom C), 135.28 (arom CH), 160.31 (arom C); ms: *m/z* (%) 328 (M^+, 9), 310 (M^+-H_2O, 2), 188 ($C_9H_7F_3O^+$, 6), 187 ($C_9H_6F_3O^+$, 12), 175 ($C_6H_5CCF_3OH^+$, 17), 159 (12), 154 (9), 141 ($C_6H_4OHSO^+$, 100), 137 ($C_6H_4OSCH^+$, 74), 126 (30), 125 ($C_7H_6FO^+$, 35), 113 (22), 109 ($C_6H_4SH^+$, 31), 108 ($C_6H_4S^+$, 6), 105 ($C_6H_5CO^+$, 43), 97 (CF_3CO^+, 22), 96 (49), 95 (10), 77 ($C_6H_5^+$, 48), 69 (CF_3^+, 24), 65 ($C_5H_5^+$, 26), 51 (HCF_2^+, 33).

Anal. Calcd. for $C_{16}H_{13}F_3O_3S$: C, 54.86; H, 3.38; F, 17.36; S, 9.77. Found C, 54.71; H, 3.51; F, 17.29; S, 9.61.

A mixture of **6f** (50 mg), sodium hydroxide (125 mg) and dimethylsulfoxide (25 mL) was kept at room temperature for almost 20 minutes. The reaction was then quenched with aqueous saturated ammonium chloride, extracted with dichloromethane, dried with anhydrous sodium sulfate, filtered and the solvent removed *in vacuo* to afford a product which was identified as **4f** by comparison of its nmr and mass spectra with those of an authentic sample.

(2*R*,S_S)-2-[(1*R*)-2,2,2-trifluoro-1-hydroxy-1-phenylethyl)-1,3-benzoxathiol-3-(2*H*)-oxide (**7f**).

This compound was obtained after flash-chromatography using 3:7 diethyl ether/petroleum ether, white crystals, mp 165-167 °C; ir (Nujol): 3329 and 3285 (OH), 1593, 1585, 1275, 1120, 1165, 1068, 1041 (S=O), 979, 848, 751, 714 cm^{-1}; ^{1}H nmr (deuteriodimethylsulfoxide-d_6): δ 5.77 (s, 1H, OC*H*S), 7.27 (t, $^3J_{H-H}$ = 7.5 Hz, 1H, ArH), 7.36 (d, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.39-7.43 (m, 3H, ArH), 7.65 (t, $^3J_{H-H}$ = 8.1 Hz, 1H, ArH), 7.72-7.75 (m, 2H, ArH), 7.81 (s, 1H, exchangeable with D_2O, OH), 8.06 (d, $^3J_{H-H}$ = 7.5, 1H, ArH); ^{13}C(deuteriodimethylsulfoxide-d_6): δ 77.37 (COH, $^2J_{C-F}$ = 27.9 Hz), 94.52 (C_2), 113.52 (arom CH), 123.90 (arom CH), 129.56 (CF_3, $^1J_{C-F}$ = 271.0 Hz), 126.96 (arom CH), 127.91 (arom CH), 128.03 (arom CH), 129.33 (arom CH), 130.16 (arom C), 134.32 (arom C), 135.44 (arom CH), 159.03 (arom C); ms: *m/z* (%) 328 (M^+, 14), 310 (M^+-H_2O, 3), 188 ($C_9H_7F_3O^+$, 7), 187 ($C_9H_6F_3O^+$, 16), 175 ($C_6H_5CCF_3OH^+$, 20), 159 (15), 154 (13), 141 ($C_6H_4OHSO^+$, 100), 137 ($C_6H_4OSCH^+$, 75), 126 (34), 125 ($C_7H_6FO^+$, 38), 113 (25), 109 ($C_6H_4SH^+$, 36), 108 ($C_6H_4S^+$, 7), 105 ($C_6H_5CO^+$, 44), 97 (CF_3CO^+, 24), 96 (49), 95 (12), 77 ($C_6H_5^+$, 47), 69 (CF_3^+, 19), 65 ($C_5H_5^+$, 26), 51 (HCF_2^+, 30).

Anal. Calcd. for $C_{15}H_{11}F_3O_3S$: C, 54.86; H, 3.38; F, 17.36; S, 9.77. Found C, 54.67; H, 3.31; F, 17.54; S, 9.62.

A mixture of **7f** (50 mg), sodium hydroxide (125 mg) and dimethylsulfoxide (25 mL) was kept at room temperature for almost 20 minutes. The reaction was then quenched with aqueous saturated ammonium chloride, extracted with dichloromethane, dried with anhydrous sodium sulfate, filtered and the solvent removed *in vacuo* to afford a product which was identified as **5f** by comparison of its nmr and mass spectra with those of an authentic sample.

Acknowledgement.

Financial support from the Ministero dell'Università e della Ricerca Scientifica e Tecnologica, Rome, and by the University of Cagliari (National Project "Stereoselezione in Sintesi Organica. Metodologie ed Applicazioni") and from the C.N.R. (Italy) is gratefully acknowledged.

REFERENCES AND NOTES

[1] M. Beroza and M. Schechter, *J. Am. Chem. Soc*., **78**, 1242 (1956).

[2] M. Laubie, H. Schmitt and J. C. Le Douarec, *Eur. J. Pharmacol*, **6**, (1969).

[3] V. Snieckus, *Chem. Rev.*, **90**, 879 (1990), and references cited therein.

[4] L. Lajide, P. Escoubas and J. Mizutani, *J. Agric. Food Chem.*, **41**, 2426 (1993).

[5] M. Friedrich, W. Meichle, H. Bernhard, G. Rihs and H. H. Otto, *Arch. Pharm. Pharm. Med. Chem.*, **329**, 361 (1996).

[6] D. Venkata Rao, G. Omprakash and C. Subrahmanyam, *Indian J. Chem.*, **35B**, 1349 (1996).

[7] S.T. D'Arcangelis and D. O. Cowan, *Tetrahedron Lett.*, **37**, 2931 (1996).

[8] S. L. Majerus, N. Alibhai, S. Tripathy and T. Durst, *Can. J. Chem.*, **78**, 1345 (2000).

[9] B. Das, P. Madhusudhan and B. Venkataiah, *Synth. Commun*., **30**, 4001 (2000).

[10] S. Cabiddu, E. Cadoni, S. Melis, G. Gelli, M. G. Cabiddu, C. Fattuoni, S. De Montis and S. Ianelli, *Tetrahedron*, **57**, 10365 (2001).

[11] S. Cabiddu, E. Cadoni, A. Ianni, G. Gelli, S. Melis, A. M. Bernard, M. G. Cabiddu, S. De Montis and C. Fattuoni, *Eur. J. Org. Chem.*, 3393 (2002).

[12] G. Solladié, *Synthesis*, 185 (1981).

[13] T. Durst, M. J. Le Belle, E. Van Den Elzen, and K.C. Tin, *Can. J. Chem.*, **52**, 761 (1974).

[14] H. Gilman and A. H. Haubein *J. Am. Chem. Soc*., **66**, 1515 (1944).

[15] L. Brandsma, Preparative Polar Organometallic Chemistry, Vol. **1**, Springer-Verlag: Berlin, 1990.

[16] Crystallographic data have deposited at the CCDC, 12 Union Road, Cambridge CB IEZ, UK and copies can be obtained on request, free on charge, by quoting the publication citation and the deposition numbers CCDC 194872-194874.

[17] S. Cabiddu, A. Maccioni and M. Secci, *Synthesis*, 797 (1976).