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Cleavage of 2-(1,2,3,4-Tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithianes with HgO/BF_3

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Summary. The title compounds (**5**) were prepared by addition of 2-phenyl-1,3-dithiane anion (2-lithiated **10**) to adequately substituted N-alkyl-3,4-dihydroisoquinolinium salts (**7a–7g**). Cleavage of compounds **5** with HgO/BF_3 affords S-benzoyl-1,3-propanedithiol (**4a**) and the corresponding disulfide **4c**, benzaldehyde, and Hg(I) ions. In contrast to the title compounds, 2-(α-dialkylaminobenzyl)-2-phenyl-1,3-dithianes (**6**) yield benzil under these conditions.

Keywords. 2-(1,2,3,4-Tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithianes; 2-(α-Dialkylaminobenzyl)-2-phenyl-1,3-dithianes; Cleavage with HgO/BF_3; N-Alkyl-3,4-dihydroisoquinolinium salts.

Spaltung von 2-(1,2,3,4-Tetrahydroisochinolin-1-yl)-2-phenyl-1,3-dithianen mit HgO/BF_3

Zusammenfassung. Die Titelverbindungen (**5**) wurden durch Addition des 2-Phenyl-1,3-dithian-Anions (2-Lithio-**10**) an entsprechend substituierte N-Alkyl-3,4-dihydroisochinolinium-Salze (**7a–7g**) hergestellt. Die Spaltung der Dithianderivate **5** mit HgO/BF_3 führt zu S-Benzoyl-1,3-propandithiol (**4a**), seinem Disulfid **4c**, Benzaldehyd und Hg(I)-Ionen. Im Gegensatz zu den Titelverbindungen liefern 2-(α-Dialkylaminobenzyl)-2-phenyl-1,3-dithiane (**6**) unter diesen Bedingungen Benzil.

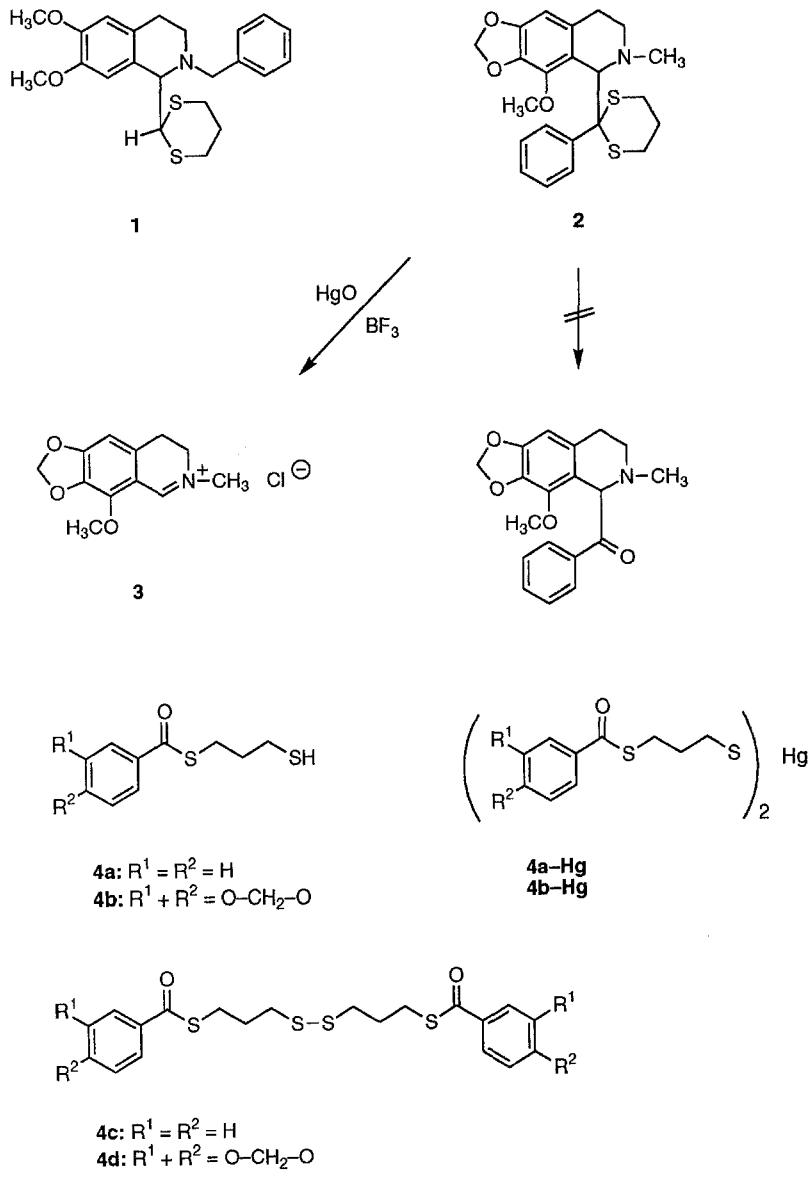
Introduction

In 1975, *Seebach et al.* [1] published stimulating results concerning the addition of C-2 lithiated 1,3-dithianes to 3,4-dihydroisoquinolinium ions, leading *inter alia* to 2-benzyl-1-(1,3-dithian-2-yl)-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinoline (**1**).

We used 2-phenyl-1,3-dithiane in order to prepare 1-benzoyl-1,2,3,4-tetrahydroisoquinolines which were considered to be useful intermediates in the synthesis of quettamine related alkaloids [2]. Various deprotection strategies for the 2-(tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane **2**, including those reported by *Gröbel* and *Seebach* [3] for ketone derived dithianes, failed, however, to produce the expected ketone [2]. Instead, we recovered cotarnine as its hydrochloride (**3**) after work-up with HCl; the 2-phenyldithiane increment was converted to S-benzoyl-1,3-propanedithiol (**4a**) [2] when red HgO/BF_3 was used, and Hg(II) was

[#] In commemoration of the late Prof. Dr. Dr. h.c. mult. *Horst Böhme*, Marburg/Germany, an outstanding representative of Pharmaceutical Chemistry

reduced to Hg(I). Most probably this reaction is triggered by the electron donating properties of the sp^3 hybridized N atom in 1,2,3,4-tetrahydroisoquinoline **2**, because 2-(isoquinolin-1-yl)-2-phenyl-1,3-dithianes (sp^2-N) were easily cleaved by HgO/BF_3 yielding the pertinent ketones [2].



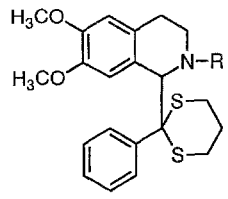
Scheme 1

Results and Discussion

Syntheses

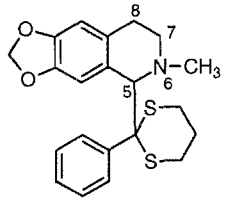
In order to determine scope and limitation of the aforementioned cleavage reaction, we prepared the tetrahydroisoquinolines **5** and the 2-(α-dialkylaminobenzyl)-2-

phenyl-1,3-dithianes **6** and treated them with HgO/BF_3 as described for compound **2** [2].

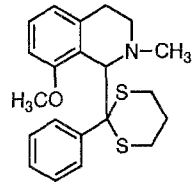


5

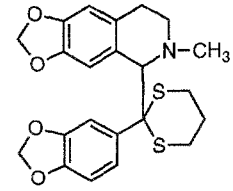
5	R
a	CH_3
b	C_2H_5
c	$n\text{-}C_3H_7$
d	$n\text{-}C_4H_9$
e	$CH_3\text{-}CH\text{-}CH_3$
f	$CH_2\text{-}CH{=}CH_2$
g	$CH_2\text{-}C_6H_5$



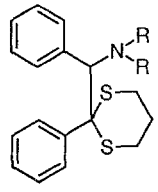
5h



5i

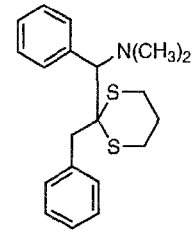


5k



6

6	R, R
a	CH_3, CH_3
b	
c	
d	



6e

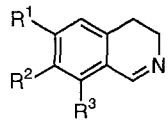
Scheme 2

6,7-Dimethoxy-3,4-dihydroisoquinoline (**7**) and 7,8-dihydro-1,3-dioxolo[4,5-*g*]isoquinoline (**8**) were prepared according to the *Bischler-Napieralski* protocol, whereas 8-methoxy-3,4-dihydroisoquinoline (**9**) was obtained from N-(2-(3-methoxyphenyl)ethyl)pivaloylamide *via* its *ortho*-lithiated derivative following the procedure of *Schlosser et al.* [4].

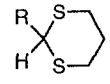
In order to study the influence of alkyl, allyl, and benzyl N-substituents, 3,4-dihydroisoquinoline **7** was quaternized with *R*-halides indicated as N-substituents in compounds **5a–5g**. The 3,4-dihydroisoquinolines **8** and **9** (Scheme 3) were reacted with CH_3I, affording the quaternary salts **8a** and **9a**. 2-Phenyl-1,3-dithiane (**10**), 2-benzyl-1,3-dithiane (**11**), and 2-(1,3-benzodioxol-5-yl)-1,3-dithiane (**12**) were prepared according to the protocols of *Seebach* [5] or *Seebach* and *Corey* [6], respectively, and were lithiated with *n*-butyl-Li in *THF* at −78°C under N_2 [5].

The lithiated dithianes were reacted with the dihydroisoquinolinium salts. In spite of our experience [2] and contrary to Ref. [5], the yields of the expected 2-

1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-dithianes **5** were low (3–5%) when we used our original procedure characterized by work-up with 0.1 *N* HCl [2]. With cotarnine (**3**), however, that protocol worked well again. When we used water for work-up instead of 0.1 *N* HCl [2], the tetrahydroisoquinolines **5** were obtained in fair yields. Interestingly, the isolated compounds proved to be stable when being boiled with 0.1 *N* HCl (91% recovery). Yields did not depend on the counterions: Br^- and I^- gave similar results (data not given).



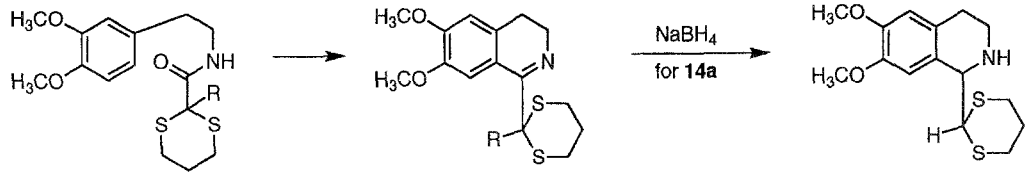
7: $R^1 = R^2 = OCH_3$, $R^3 = H$
7a - 7g: corresponding iminium salts as iodides or bromides, respectively (cf. Experimental)
8: $R^1 + R^2 = O\text{–}CH_2\text{–}O$, $R^3 = H$
9: $R^1 = R^2 = H$, $R^3 = OCH_3$
8a, 9a: N-methyl iodides of **8**, **9**



	R
10	C_6H_5
11	$CH_2\text{–}C_6H_5$
12	

Scheme 3

We tried various methods in order to obtain higher yields. Phase transfer conditions [7] proved to be unsuccessful; conversion of the N-methyl-3,4-dihydroisoquinolinium ions into the corresponding 1-cyano-2-methyl-1,2,3,4-tetrahydroisoquinolines (*cf. de Costa* [8]) and treatment with the lithiated dithiane **10** led to the recovery of the starting materials only. Formal exchange of the donor/acceptor reactivity of the educts, *i.e.* reaction of *Seebach*'s supernucleophile 2-*bis*(dimethylamino)phosphinoyl-1-lithio-1,2,3,4-tetrahydroisoquinoline [9], an N-stabilized carbanion [10, 11] (*cf. Reissert* compounds) with 1,3-dithienium salts (formyl cation equivalents as BF_4^- and Cl^-/HCl salts), prepared according to *Stahl*'s protocol [12, 13], led either to the starting tetrahydroisoquinoline and 2-phenyl-1,3-dithiane by an abnormal reduction (Cl^-/HCl salt) or to complete degradation of both molecules (BF_4^- salt). With benzoyl chloride, *Seebach*'s supernucleophile afforded benzoic acid only. *Seebach et al.* [1] have synthesized 2-(3,4-dihydroisoquinolin-1-yl)-1,3-dithiane **14a** starting from 1,3-dithian-2-yl-carboxylic acid and β-(3,4-dimethoxyphenyl)ethylamine, and subsequently reduced **14a** by $NaBH_4$ affording the pertinent 1,2,3,4-tetrahydroisoquinoline derivative **14a′** (Scheme 4). *Bischler-Napieralski* cyclization of **13b** afforded the 2-(3,4-dihydroisoquinolin-1-yl)-2-phenyl-dithiane **14b** which – in contrast to *Seebach*'s 3,4-dihydroisoquinoline **14a** [1] – is stable. All our efforts – including *Seebach*'s $NaBH_4$ reduction – to reduce imine **14b** to the pertinent tetrahydroisoquinoline failed: H_2/Pd, Raney-Ni/H_2, and Zn/HCl cleaved the dithiane group reductively, indicated by two triplets and a quintet in the ^1H NMR spectrum (the intact dithiane shows two characteristic multiplets). We did not try to quaternize **14b** in order to facilitate the imine reduction, because accompanying S-methylation [14] would lead to hydrolysis of the dithiane increment.



13a: R = H (Seebach)
13b: R = C_6H_5

14a: R = H *(Seebach)*
14b: R = C_6H_5

14a´

Scheme 4

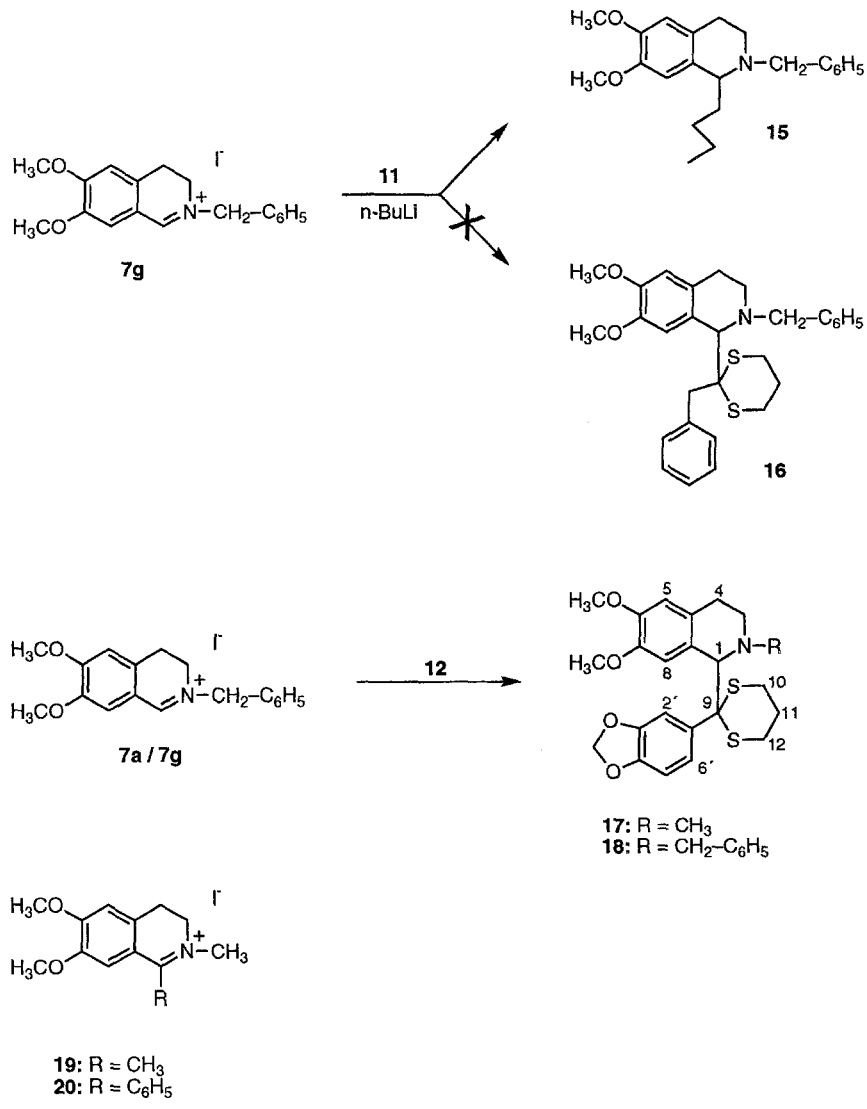
When we lithiated 2-benzyl-1,3-dithiane (**11**) with *n*-butyl lithium and tried to use the pertinent anion for nucleophilic attack at the 3,4-dihydroisoquinolinium iodide **7g**, we obtained – besides degradation procucts – 1-*n*-butyl-6,7-dimethoxy-2-benzyl-1,2,3,4-tetrahydroisoquinoline (**15**) in 25% yield instead of the 2-benzyldithianyl derivative **16** (Scheme 5). This can be explained on the basis of *Seebach*'s kinetic experiments concerning the lithiation of 2-substituted 1,3-dithianes [5], indicating a strong dependence on the substituents. When we lithiated 2-benzyl-1,3-dithiane (**11**) with *n*-BuLi under standard conditions (Experimental), we found that lithiation proceeds rapidly up to 48% during the first 10 min, reaching a plateau of about 70% after 1 h, followed by a steep decrease to 10% after 2 h. The reaction was controlled by ^1H NMR spectroscopy, determining the intensity of the 2-H triplet of **11** after Li/D-exchange with D_2O. As maximal lithiation of 70% at C-2 of **11** can be obtained with one equiv. of *n*-BuLi, 30% of *n*-BuLi remain unreacted; this result corresponds to the 25% yield of the 1-*n*-butyltetrahydroisoquinoline **15**.

The reaction of the iminium ions **7a** and **7g** with C-2 lithiated **12** (Scheme 5) proceeded smoothly, leading to the tetrahydroisoquinolines **17** and **18**. Our ^1H NMR data of compound **17** do not correspond in some aspects to those reported by *Brozda* [15], due to the higher field strength of our NMR spectrometer (250 *vs.* 60 MHz; Experimental).

In order to avoid confusion, the 2-(tetrahydroisoquinolin-1-yl)-dithiane **17** is numbered according to *Brozda* ("3,4-methylenedioxy" – nomenclature) [15], and *Brozda*'s assignments are given in square brackets. 2′-H resonates as a d ($J = 1.8$ Hz) at 7.36 ppm [7.13], 6′-H shows a dd ($J_1 = 8.3$ Hz; $J_2 = 1.8$ Hz) at 7.27 ppm [7.36]. As expected, 5′-H absorbs as a d at 6.73 ppm ($J = 8.3$ Hz) as indicated by *Brozda* [6.78]. *Brozda*'s assignments of 5-H, 8-H, and 1-H as well as those for OCH_3 and NCH_3 agree with ours. The signals of most of the CH_2 protons of the dithiane and the tetrahydroisoquinoline system could be correlated by two dimensional ^1H and ^{13}C NMR spectroscopy (Experimental).

The 1-substituted 3,4-dihydroisoquinolinium ions **19** and **20** did not react with 2-lithiated **10**: dithiane **10** was recovered quantitatively, and the dihydroisoquinolinium salts were destroyed. Probably the electrophilic reactivity of the iminium ions was overcompensated by steric hindrance.

Thus far we have reported on iminium ions being part of an isoquinoline skeleton. In the context of scope and limitations of the HgO/BF_3 induced cleavage

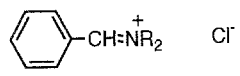


Scheme 5

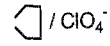
reaction we prepared the non-cyclic iminium salts **21** (Scheme 6) which were treated with **10**-anion, and the interference of HgO/BF_3 with the 2-(α-dialkylaminobenzyl)-2-phenyldithianes **6** so obtained was examined (*vide infra*).

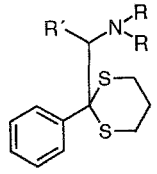
Synthesis and reactivity of iminium salts have been studied in depth by *Böhme* and coworkers [16] who treated aminals and α-dialkylamino ethers with chlorine, hydrogen halides, and acid chlorides [17–21], respectively. In addition, iminium salts are obtained by hydride abstraction from the α-position of tertiary amines [22] and by alkylation of enamines and imines [23–25].

We used the cleavage of pertinent aminals which in turn were prepared from secondary amines and the corresponding aldehydes and cleaved by acetyl chloride in absol. tetrahydrofuran instead of absol. Et_2O. The salts obtained in this way



21

	R, R
a	CH_3, CH_3
b	 / ClO_4^-
c	
d	



22a: R = CH_3, R′ = H

22b: R, R =  , R′ = H_3C–CH–CH_3

Scheme 6

could be directly reacted with the lithiated dithiane in absol. *THF*. The yields resulting from dry crystals or crystals moist of *THF* were identical.

Böhme has studied the reaction of N,N-dialkyl-α-chlorobenzylamines, potential precursors of iminium salts, with *Grignard* reagents [26]; other groups have used organolithium compounds for the conversion of azomethines [27]. The addition of the dithiane anion (2-lithiated **10**) to iminium salts **21a–d** worked well, the 2-(α-dialkylaminobenzyl)-2-phenyl-1,3-dithianes **6** were obtained after acidic work-up [2] which is far more convenient than working up under neutral conditions as is necessary in the case of the dithianyl-tetrahydroisoquinolines **5** (*vide supra*).

According to *Leonard* and *Paukstelis*, iminium perchlorates can be prepared directly from the perchlorates of secondary amines and benzaldehydes [28]; *Böhme et al.* have investigated the reaction of these salts with organolithium compounds [29]. We prepared N-benzylidenepyrrolidinium perchlorate **21b** by removal of the water formed during the reaction of pyrrolidinium perchlorate with benzaldehyde using a *Soxhlet* device filled with molecular sieve, the procedures recommended in Ref. [28] being not successful. As the addition of lithiated **10** to **21b** yielded only 5% of crude **6b**, which in addition could not be purified sufficiently, we stopped this approach (data not given).

As 2-(α-dialkylamino*benzyl*)-2-phenyldithianes **6** still contain the aromatic ring of the 1,2,3,4-tetrahydroisoquinoline moiety, we intended to incorporate 2-(α-dialkylamino*alkyl*)-2-phenyl-dithianes **22** into our examination of the title reaction. Therefore, we prepared aminals of formaldehyde not capable of forming enamines which impede the addition of the dithiane anion. *Bis*(dimethylamino)methane [30] was converted to N,N-dimethyl-methyleneammonium chloride or iodide, respectively [31–33]. Although two equiv. of the chloride were used, the addition of lithiated **10** afforded only 16% of 2-(dimethylaminomethyl)-2-phenyldithiane

(**22a**). Because non-reacted dithiane **10** could be recovered, this seems to be tolerable.

N-(Isobutylidene)pyrrolidinium perchlorate [28] was reacted with lithiated **10**, leading to crude **22b** in 2% yield only (data not given), most probably due to enamine formation as indicated by ^{1}H NMR data. *Böhme et al.* [29] were able to trap the enamines obtained from their experiments with *n*-BuLi. Therefore, we stopped further experiments with iminium salts capable of enamine formation due to α-CH increments.

Hydrolysis with HgO/BF$_3$

a) 2-(1,2,3,4-Tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithianes **5**

The 6,7-dimethoxy-2-methylderivative **5a** is similar to our cotarnine derivative **2** [2]. Treatment of **5a** with HgO/BF_3 according to the general procedure (Experimental) led to a 3,4-dihydroisoquinolinium salt which was recognized by its characteristic green-yellowish fluorescence. We isolated the white Hg containing solid **4a**-Hg, identified as the thiol ester **4a** after removing Hg(II) by H_2S. Moreover, in accordance with earlier results, we found Hg(I) ions [2]. In addition we detected benzaldehyde, probably resulting from a formal reverse of the synthesis, and a further white solid Hg free material which contains S and no N (I_2/NaN_3 and *Dragendorff* reagent, respectively). The ^{1}H NMR spectrum of the latter substance exhibits the quintet, characteristic for the S–CH_2–C*H*$_2$–CH_2-S increment of the thiol ester **4a**. FD-MS revealed $M^{+\cdot}$ at $m/z = 422$, thus proving the dimerized thiol ester **4c**. The additional NMR data (Experimental) agree with this structure which is probably generated by oxidative dimerization caused by Hg(II). The tetrahydroisoquinoline-dithianes **5b–g** were treated analogously, but the reaction conditions differed slightly: whereas **5a** and **5b** needed warming to 40–50°C, **5c–g** reacted already at room temperature. The counterion (I^-/Br^-) did not exert any influence. In all our experiments we realized the formation of the 3,4-dihydroisoquinolinium ion by its fluorescence; furthermore, we isolated benzaldehyde, the thiol ester **4a**, and its dimer **4c** together with Hg(I). This holds true also for 1,3-benzodioxolo- (**5h**) and for 8-methoxy- (**5i**) dithianyl-tetrahydroisoquinoline (Scheme 2). If C-2 of the dithiane moiety carries a benzo[1,3]dioxolo group (**5k**), piperonal is formed instead of benzaldehyde in addition to the analogously substituted thiol ester **4b** and its dimer **4d** (Scheme 1).

Corey and *Seebach* have obtained a mercapto-thiol ester analogous to **4a** (cited in Ref. 5) when the ketene thioacetal 2-cyclohexylidene-1,3-dithiane was hydrolyzed by formic acid.

b) 2-(α-Dialkylaminobenzyl)-2-phenyl-1,3-dithianes **6**

In order to clarify the function of the tertiary amine as being a part of the 1,2,3,4-tetrahydroisoquinoline system, we treated the ring opened analogues **6** (Scheme 2) with HgO/BF_3. In spite of the differently substituted N-atom, the crude products from all educts exhibited the same spots in their TLCs. One of these compounds

was free of N and S; it reacted with 2,4-dinitrophenylhydrazine, and spectra and direct comparison proved it to be benzil. The thiol ester **4a** and its dimer **4c** were not detectable.

We can only speculate upon the formation of benzil: oxidation of benzoin as an intermediate was excluded experimentally. Dehydrogenation of the C–N increment affording the pertinent iminium ion is unlikely if we consider *Duhamel*'s experiments [34] who obtained α-aminoaldehydes by oxidative cleavage of 2-(α-dialkylaminoalkyl)-1,3-dithianes using chloramine T. When we treated 2-(dimethylaminomethyl)-2-phenyl-1,3-dithiane (**22a**) and 2-benzyl-2-(α-dimethylaminobenzyl)-1,3-dithiane (**6e**) with HgO/BF_3 at room temperature, these compounds were completely destroyed (data not given).

Rozwadowska et al. [35] cleaved 2-(6,7-methylendioxy-2-methyl-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-(3,4-methylendioxyphenyl)-1,3-dithiane (**5k**, Scheme 2) with Br_2/HCl/acetic acid; they obtained the expected 1-benzoyl-1,2,3,4-tetrahydroisoquinoline. Unfortunately, this method led to complete degradation of our analogous compounds.

In conclusion, the HgO/BF_3 induced cleavage of 2-(1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithianes of type **5** to ω-mercaptothiol esters of type **4** seems to be characteristic for these 1,3-dithiane derivatives.

Experimental

Melting points: Büchi 5410, uncorrected; IR spectra: Nicolet 510M FT-IR; ^{1}H NMR spectra: Varian EM 390 (90 MHz), Bruker WM 250 (250 MHz), *TMS* as int. standard, 90 MHz spectra if not stated otherwise; MS: Varian MAT 311A EI-MS (70eV), Varian MAT 95 FD-MS; TLC: SiO_2 Merck no. 5554, Al-foils, Silica 60 F 254; CC SiO_2 Merck no. 7734 (silica 60; 70–230 mesh ASTM); solvents purified and dried as usual; drying Na_2SO_4; evaporation *in vacuo* at the rotary evaporator.

3,4-Dihydroisoquinolines and their N-alkylated derivatives

6,7-Dimethoxy-3,4-dihydroisoquinoline (**7**): Ref. [36]
6,7-Dimethoxy-2-methyl-3,4-dihydroisoquinolinium iodide (**7a**): Ref. [37]
2-Ethyl-6,7-dimethoxy-3,4-dihydroisoquinolinium iodide (**7b**): Ref. [38]
6,7-Dimethoxy-2-propyl-3,4-dihydroisoquinolinium iodide (**7c**): Ref. [38]
2-n-Butyl-6,7-dimethoxy-3,4-dihydroisoquinolinium iodide (**7d**): Ref. [38]
2-Isopropyl-6,7-dimethoxy-3,4-dihydroisoquinolinium iodide (**7e**): Ref. [38]
2-Allyl-6,7-dimethoxy-3,4-dihydroisoquinolinium bromide (**7f**): Ref. [39]
2-Benzyl-6,7-dimethoxy-3,4-dihydroisoquinolinium bromide (**7g**): Ref. [40]
6-Methyl-7,8-dihydro-1,3-dioxolo[4,5-g]isoquinolinium iodide (**8a**): Ref. [41]
8-Methoxy-2-methyl-3,4-dihydroisoquinolinium iodide (**9a**): Ref. [4]

1,3-Dithianes

2-Phenyl-1,3-dithiane (**10**): Ref. [5]
2-Benzyl-1,3-dithiane (**11**): Ref. [42]
1,3-Benzodioxol-5-yl-1,3-dithiane (**12**): Ref. [43]

2-Phenyl-2-(1,2,3,4-tetrahydroisoquinolin-1-yl)-1,3-dithianes
Lithiation of 1,3-dithianes (general procedure)

In a flame dried three necked bulb, flushed with dry N_2, 20 mmole of the pertinent 1,3-dithiane are dissolved in 120 ml of absol. *THF*. At −78°C, 13 ml of *n*-butyl lithium (1.6 molar, 15% in hexane)

are added within 3 min by a syringe *via* a septum. The solution becomes yellow to wine red (**10**), orange (**11**), or dark red (**12**) and is stirred for 1 h.

Reaction of lithiated 1,3-dithianes with 3,4-dihydroisoquinolinium salts (general procedure)

The finely ground iminium salts are added to the dithiane anions in portions. The suspension brightens up or becomes dark green. After the addition, stirring under N_2 at −60 – −40°C is continued for 2 h; then the mixture is allowed to reach room temp. within 18–20 h.

General work-up procedures

A) After hydrolysis with 70 ml of satrd. NH_4Cl solution *THF* is evaporated *in vacuo*, and the residue is extracted with 400 ml of dichloromethane in portions. After drying, evaporation *in vacuo* and CC (SiO_2 Merck no. 7734, Kieselgel 60; 70–230 mesh) with dichloromethane, the crude addition product is crystallized from EtOH.

B) Hydrolysis with 120 ml of water and three-fold extraction with Et_2O; then follow *A*.

C) Hydrolysis with 100 ml of 0.1 *N* HCl. After three-fold extraction with Et_2O (phase 1), the aqueous layer is made alkaline with Na_2CO_3 and extracted with Et_2O (phase 2). Phase 1 contains non-reacted 1,3-dithiane which is recovered after drying (Na_2SO_4), evaporation, and CC. Phase 2 is worked up as described under **A**.

(6,7-Dimethoxy-2-methyl-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5a**)

From **7a** and **10**; work-up procedure: *B*; yield: 63%; m.p.: 156–158°C; $C_{22}H_{27}NO_2S_2$ (401.58); calcd.: C 65.77, 6.77, 3.49; found: C 65.39, H 6.98, N 3.50; IR (KBr): ν = 2855, 2632 (OCH_3), 2792 (NCH_3), 1607, 1518, 864 (arom), 908 (dithiane), 739, 708 (arom) cm^{-1}; ^1H NMR (250 MHz): δ = 1.84–1.89 (m; 2H, CH_2–C*H*$_2$–CH_2), 2.09–2.18 (m; 1H, ArC*H*H), 2.42–2.62 (m; 5H, SCH_2, SC*H*H, NCHH, ArCH*H*), 2.58 (s; 3H, NCH_3), 2.70–2.80 (m; 1H, SCH*H*), 3.61 (s; 3H, OCH_3), 3.64–3.71 (m; 1H, NCH*H*), 3.83 (s; 3H, OCH_3), 3.98 (s; 1H, CHN), 6.08 (s; 1H, arom), 6.48 (s; 1H, arom), 7.23–7.34 (m; 3H, Ph), 7.77–7.81 (m; 2H, Ph) ppm; FD-MS (CH_2Cl_2): *m/z* (%) = 401 (0.8; $M^{+\cdot}$), 206 (100; dihydroisoquinolinium$^+$), 195 (59; 2-Ph-1,3-dithianyl$^+$).

(2-Ethyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5b**)

From **7b** and **10**; work-up procedure: *B*; yield: 22%; m.p.: 127–129°C; $C_{23}H_{29}NO_2S_2$ (415.61); calcd.: C 66.47, H 7.04; N 3.37 found: C 66.28, H 7.21, N 3.31; IR (KBr): ν = 2865, 2832 (OCH_3), 2797 (NCH_2), 1607, 1518, 863 (arom), 908 (dithane), 737, 708 (arom) cm^{-1}; ^1H NMR: δ = 1.14 (t; J = 7.5 Hz, 3H, CH_2–C*H*$_3$), 1.73–2.04 (m; 2H, CH_2–C*H*$_2$–CH_2), 2.32–2.91 (m; 9H, SCH_2, SC*H*H, $ArCH_2$, NC*H*$_2$–CH_2, N–C*H*$_2$–CH_3), 3.60 (s; 3H, OCH_3), 3.82 (s; 3H, OCH_3), 3.89–4.02 (m; 1H, SCH*H*), 4.10 (s; 1H, CHN), 6.12 (s; 1H, arom), 6.51 (s; 1H, arom), 7.22–7.53 (m; 3H, Ph), 7.81–7.97 (m; 2H, Ph) ppm.

(6,7-Dimethoxy-2-propyl-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5c**)

From **7c** and **10**; work-up procedure: *B*; yield: 25%; m.p.: 125–126°C; $C_{24}H_{31}NO_2S_2$ (429.64); calcd.: C 67.09, H 7.27; N 3.26 found: C 67.28, H 7.34, N 3.33; IR (KBr): ν = 2869, 2832 (OCH_3), 2801 (NCH_2), 1609, 1518, 864 (arom), 908 (dithiane), 742, 706 (arom) cm^{-1}; ^1H NMR (250 MHz): δ = 0.95 (t; J = 7.5 Hz, 3H, CH_2–C*H*$_3$), 1.54–1.61 (m; 2H, NCH_2–C*H*$_2$), 1.82–1.90 (m; 2H, C*H*$_2$–CH_2), 2.00–2.12 (m; 1H, ArC*H*H), 2.48–2.84 (m; 8H, 2 SCH_2, ArCH*H*, NC*H*H, NCH_2). 3.61

(s; 3H, OCH_3), 3.83 (m; 3H, OCH_3), 3.40–3.90 (m; 1H, NCH*H*), 4.04 (s; 1H, CHN), 6.05 (s; 1H, arom), 6.49 (s; 1H, arom), 7.31–7.38 (m; 3H, Ph), 7.83–7.89 (m; 2H, Ph) ppm.

(2-n-Butyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5d**)

From **7d** and **10**; work-up procedure: *B*; yield: 38%; m.p.: 129–130°C; $C_{25}H_{33}NO_2S_2$ (443.66); calcd.: C 67.68, H 7.50; N 3.16 found: C 67.76, H 7.56, N 3.60; IR (KBr): $\nu = 2861$, 2832 (OCH_3), 2801 (NCH_2), 1607, 1518, 864 (arom), 908 (dithiane), 739, 710 (arom), 721 (CH_2) cm^{-1}; ^1H NMR: $\delta = 0.90$ (t; 3H, $J = 7.5$ Hz, CH_2–C*H*$_3$), 1.25–1.6 (m; 4H, C*H*$_2$–C*H*$_2$–CH_3), 1.71–1.98 (m; 2H, SCH_2–C*H*$_2$–CH_2–S), 2.00–2.25 (m; 2H, NC*H*$_2$–CH_2), 2.30–2.80 (m, 8H, 2 SCH_2, $ArCH_2$, NCH_2), 3.55 (s; 3H, OCH_3), 3.78 (s; 3H, OCH_3), 4.03 (s; 1H, CHN), 6.03 (s; 1H, arom), 6.50 (s; 1H, arom), 7.20–7.50 (m; 3H, Ph), 7.72–7.92 (m; 2H, Ph) ppm.

(2-Isopropyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5e**)

From **7e** and **10**; work-up procedure: *B*; yield: 43%; m.p.: 112–113°C; $C_{24}H_{31}NO_2S_2$ (429.64); calcd.: C 67.09, H 7.27; N 3.26 found: C 66.79, H 7.25, N 3.63; IR (KBr): $\nu = 2830$ (OCH_3), 1609, 1518, 1391 , 1360, 1167, 1131 (isopropyl), 908 (dithiane), 866 (arom), 729, 706 (arom) cm^{-1}; ^1H NMR $\delta = 0.93$ (d; $J = 7.5$ Hz, 3H, CH–C*H*$_3$), 1.14 (d; $J = 7.5$ Hz, 3H, CH–C*H*$_3$), 1.70–2.00 (m; 2H, CH_2–C*H*$_2$–CH_2), 2.02–2.20 (m; 1H, ArC*H*H), 2.28–2.80 (m; 5H, SCH_2, SC*H*H, ArCH*H*, NC*H*H), 3.03–3.50 (m; 3H, SCH*H*, CH_3–C*H*–CH_3, NCH*H*) 3.65 (s; 3H, OCH_3), 3.80 (s; 3H, OCH_3), 3.89–4.04 (m; 1H, SCH*H*), 4.34 (s; 1H, CHN), 6.31 (s; 1H, arom), 6.41 (s; 1H, arom), 7.20–7.40 (m; 3H, Ph), 7.70–7.90 (m; 2H, Ph) ppm.

(2-Allyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5f**)

From **7f** and **10**; work-up procedure: *B*; yield: 32%; m.p.: 114–115°C; $C_{24}H_{29}NO_2S_2$ (427.62); calcd.: C 67.41, H 6.84; N 3.28 found: C 67.48, H 6.82, N 3.43; IR (KBr): $\nu = 2832$ (OCH_3); 2790 (NCH_2), 1642 (allyl), 1607, 1516 (arom), 986, 916 (allyl), 909 (dithiane), 866 (arom), 739, 706 (arom) cm^{-1}; ^1H NMR (250 MHz): $\delta = 1.85$–1.89 (m; 2H, CH_2–C*H*$_2$–CH_2), 2.06–2.16 (m; 1H, ArC*H*H), 2.36–2.80 (m; 6H, SC*H*H, SCH*H*, SCH_2, ArCH*H*, NC*H*H), 3.27 (d; $J = 7.2$ Hz, 2H, NC*H*$_2$–CH=CH_2), 3.60 (s; 3H, OCH_3), 3.83 (s; 3H, OCH_3), 3.87–3.97 (m; 1H, NCH*H*), 4.11 (s; 1H, CHN), 5.09–5.16 (m; 2H, CH=C*H*$_2$), 5.97–6.05 (m; 1H, C*H*=CH_2), 6.02 (s, 1H, arom), 6.49 (s; 1H, arom), 7.24–7.37 (m; 3H, Ph), 7.82–7.86 (m; 2H, Ph) ppm.

(2-Benzyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**5g**)

From **7g** and **10**; work-up procedure: *B*; yield: 40%; m.p.: 151–152°C; $C_{28}H_{31}NO_2S_2$ (477.68); calcd.: C 70.38, 6.54; N 2.93; found: C 70.08, H 6.54, N 2.97; IR (KBr): $\nu = 2834$ (OCH_3), 2783 (NCH_2), 1609, 1514, 861 (arom), 908 (dithiane), 733, 704 (arom) cm^{-1}; ^1H NMR: $\delta = 1.70$–2.00 (m, 2H, CH_2–C*H*$_2$–CH_2), 2.10–2.22 (m; 1H, ArC*H*H), 2.32–2.85 (m; 6H, 2 SCH_2, ArCH*H*, NCH*H*), 3.60 (s; 3H, OCH_3), 3.75 (s; 2H, NCH_2–Ar), 3.82 (s; 3H, OCH_3), 3.90–4.01 (m; 1H, NCH*H*), 4.10 (s; 1H, CHN), 6.00 (s; 1H, arom), 6.51 (s; 1H, arom), 7.13–7.54 (m; 3H, Ph), 7.68–7.85 (m; 2H, Ph) ppm.

(6-Methyl-5,6,7,8-tetrahydro-1,3-dioxolo[4,5-g]isoquinolin-5-yl)-2-phenyl-1,3-dithiane (**5h**)

From **8a** and **10**; work-up procedure: *B*; yield: 17% of a resinous material; $C_{21}H_{23}NO_2S_2$ (385.54); calcd.: 65.42, H 6.00, N 3.68; found: C 65. 10, H 6.24, N 3.58; IR (film): $\nu = 2796$ (OCH_2O, NCH_3),

735, 704 (arom) cm^{-1}; ^1H NMR: $\delta = 1.49–1.90$ (m; 3H, CH_2–CH_2–CH_2, ArC*H*H), 2.20–2.60 (m; 6H, ArCH*H*, NC*H*H, 2 SCH_2), 2.51 (s; 3H, NCH_3), 3.30–3.40 (m; 1H, NCH*H*), 3.91 (s; 1H, CHN), 5.81–5.84 (m; 2H, OCH_2O), 6.24 (s; 1H, arom), 6.38 (s; 1H, arom), 7.20–7.35 (m; 3H, Ph), 7.65–7.85 (m; 2H, Ph) ppm; FD-MS (Et_2O): m/z (%) = 385 (10; $M^{+\cdot}$), 195 (57; 2-Ph-1,3-dithianyl$^+$), 190 (100; dihydroisoquinolinium$^+$).

(8-Methoxy-2-methyl-1,2,3,4-tetrahydroisoquinolin-1-yl)-2-phenyl-1,3-dithian (**5i**)

From **9a** and **10**; work-up procedure: *B*; yield: 31% m.p.: 107–108°C; $C_{21}H_{25}NOS_2$ (371.56); calcd: C 67.88, H 6.78, N 3.79; found: C 67.87, H 6.71, N 3.96; IR: $\nu = 2843$ (OCH_3), 2798 (NCH_3), 740, 708 (arom) cm^{-1}; ^1H NMR: $\delta = 1.74–1.95$ (m; 2H, CH_2–CH_2–CH_2), 2.05–2.30 (m; 3H, SCH_2, ArC*H*H), 2.38–2.68 (m; 4H, ArCH*H*, NC*H*H, SCH_2), 2.54 (s; 3H, NCH_3), 3.30–3.42 (m; 1H, NCH*H*), 3.46 (s; 3H, OCH_3), 4.69 (s; 1H, CHN), 6.51–6.62 (m; 2H, arom), 6.80–6.95 (m; 1H, arom), 7.10–7.31 (m; 3H, Ph), 7.68–7.83 (m; 2H, Ph) ppm; FD-MS (CH_2Cl_2): m/z (%) = 371 (17; $M^{+\cdot}$), 195 (46; 2-Ph-1,3-dithiane$^+$), 176 (100; dihydroisoquinolinium$^+$).

1-Butyl-6,7-dimethoxy-2-benzyl-1,2,3,4-tetrahydroisoquinoline (**15**)

From **7g** and *n*-butyl lithium solution; work-up procedure: *B*; yield: 75%; wax; EI-MS: *m/z* (%) = 339 (0.7; $M^{+\cdot}$), 338 (1; M–H·)$^+$), 282 (100; dihydroisoquinolinium$^+$), 91 (87; $C_7H_7^+$); PI FD-MS (CH_2Cl_2): 679 (2M + H)$^+$ (weak), 339 ($M^{+\cdot}$).

2-(1,3-Benzodioxol-5-yl)-2-(6,7-dimethoxy-2-methyl-1,2,3,4-tetrahydroisoquinolin-1-yl)-1,3-dithiane (**17**)

From **7a** and **12**; work-up procedure: *B*; yield: 34%; m.p.: 149–150 °C; $C_{23}H_{27}NO_4S_2$ (445.58); calcd.: C 61.99, H 6.11, N 3.14; found: C 61.68, H 6.03, N 3.14; IR (KBr): $\nu = 2805$, 2803 (OCH_3, NCH_3, OCH_2O), 931, 918 (OCH_2O), 908 (dithiane), 891, 810 (arom), 868 (arom) cm^{-1}; ^1H NMR (250 MHz): $\delta = 1.84–1.89$ (m; 2H, CH_2–CH_2–CH_2), 2.13–2.23 (m; 1H, ArC*H*H), 2.43–2.63 (m; 5H, SCH_2, SC*H*H, ArC*H*H, NC*H*H), 2.54 (s; 3H, NCH_3), 2.70–2.82 (m; 1H, SCH*H*), 3.61–3.71 (m; 1H, NCH*H*), 3.69 (s; 3H, OCH_3), 3.84 (s; 3H, OCH_3), 3.94 (s; 1H, CHN), 5.97 (s; 2H, OCH_2O), 6.21 (s; 1H, arom 8-H), 6.50 (s; 1H, arom 5-H), 6.73 (d; $J = 8.3$ Hz, 1H, Ph), 7.27 (dd; $J_1 = 8.3$ Hz, $J_2 = 1.8$ Hz, 1H, Ph), 7.36 (d; $J = 1.8$ Hz, 1H, Ph) ppm; ^{13}C NMR (62 MHz): $\delta = 25.08$ ($ArCH_2$), 25.21 (CH_2–CH_2–CH_2), 27.72, 28.23 (2 SCH_2), 46.02 (NCH_3), 49.31 (NCH_2), 55.66, 55.74 (2 OCH_3), 68.87 (SCS), 74.11 (CHN), 101.14 (OCO), 107.27 (C-5′), 110.54 (C-5) 111.65 (C-2′), 113.66 (C-8), 123.12, 129.66, 134.64 (ArC; C-8a, C-4a, C-9), 125.19 (C-6′), 145.91, 146.45, 147.71, 148.21 (2 CH_3O-*C*; CH_2O-*C*) ppm; DEPT 135 (62 MHz): $\delta = 24.99$, 25.22, 27.72, 28.24, 45.99, 49.24, 55.61, 55.71, 74.01, 101.19, 107.30, 110.37, 111.62, 113.43, 125.20 ppm.

2-(1,3-Benzodioxol-5-yl)-2-(2-benzyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinolin-1-yl)-1,3-dithiane (**18**)

From **7g** and **12**; work-up procedure: *B*: yield: 36%; m.p.: 163–164°C; $C_{29}H_{31}NO_4S_2$ (521.67); calcd.: C 66.76, H 6.00, N 2.68; found; C 66.87, H 6.02, N 2.53; IR (KBr): $\nu = 2831$, 2806 (NCH_2, OCH_3, OCH_2O), 930, 720 (OCH_2O), 909 (dithiane), 876, 810 (arom), 8.58 cm^{-1} (arom) cm^{-1}; ^1H NMR: $\delta = 1.75–2.01$ (m; 2H, CH_2-CH_2-CH_2), 2.15–2.37 (m; 1H, ArC*H*H), 2.40–2.97 (m; 6H, 2 SCH_2, ArCH*H*, NC*H*H), 3.52–3.70 (m; 1H, NCH*H*), 3.66 (s; 3H, OCH_3), 3.76 (s; 2H, NCH_2-Ph) 3.88 (s; 3H, OCH_3), 4.10 (s; 1H, CHN), 5.95 (s; 2H, OCH_2O), 6.19 (s; 1H, arom), 6.57 (s; 1H, arom), 6.66–6.80 (m; 1H, Ph), 7.22–7.50 (m; 7H, Ph) ppm.

(6,7-Dimethoxy-3,4-dihydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**14b**)

a) N-(2-(3,4-Dimethoxyphenyl)ethyl-1,3-dithianyl-2-carboxamide (**13b**)

Under ice cooling, a solution of 8 g (31 mmole) 2-phenyl-1,3-dithianylic acid chloride [1] in 120 ml of benzene is slowly added to a solution of 6.5 g (35 mmole) 2-(3,4-dimethoxyphenyl)ethylamine in 30 ml of benzene. After 1 h of stirring at room temp., the mixture is heated to reflux for 1 h. After standing over night, the mixture is washed with water and the solvent is removed *in vacuo*, at last at the oil pump. CC (silica; dichloromethane) affords 53% of **13b** as a colourless, solid, non-crystalline mass.

$C_{21}H_{25}NO_3S_2$ (403.56); calcd.: C 62.50, H 6.24, N 3.47; found: C 62.46, H 6.29, N 3.46; IR (film): ν=3361 (NH), 2835 (OCH_3), 1609, 1570 (arom) 1671, 1515 (amide I, II), 909 (dithiane) cm^{-1}; ^1H NMR: δ=1.84–2.13 (m; 2H, CH_2–CH_2–CH_2), 2.65–2.96 (m, 6H, 2 SCH_2, $ArCH_2$), 3.50–3.72 (m; 2H, NCH_2), 3.80 (s; 3H, OCH_3), 3.81 (s; 3H, OCH_3), 6.62–6.68 (m; 3H, arom), 7.10 (br; 1H, NH), 7.23–7.29 (m; 3H, Ph), 7.55–7.61 (m; 2H, Ph) ppm; EI-MS (70 eV): *m/z* (%) = 403 (4.7; $M^{+\cdot}$), 195 (97; 2-Ph-1,3-dithianyl$^+$), 164 (34; *McLafferty*), 151 (35; benzylic cleavage), 121 (100; $PhCS^+$).

b) 2-(6-7-Dimethoxy-3,4-dihydroisoquinolin-1-yl)-2-phenyl-1,3-dithiane (**14b**)

A mixture of 3.4 g (8.4 mmole) **13b**, 20 ml of $POCl_3$, and 2 g of P_2O_5 is heated at 100°C for 3 h. Then the dark black solution is stirred at room temp. for 16 h, hydrolyzed with water/ice, alkalized with conc. NH_4OH, and extracted 4 times with dichloromethane. After drying and evaporation, **14b** can be detected by its yellowish-green fluorescence (UV light of 365 nm). The crude material is washed with MeOH and purified by CC (silica; dichloromethane).

Yield: 56%; m.p.: 158–160°C; $C_{21}H_{23}NO_2S_2$ (385.54); calcd.: C 65.42, H 6.01, N 3.63; found: C 65.46, H 6.02, N 3.58; IR (KBr): ν =2832 (OCH_3), 1609, 1571 (arom), 1484 (C=N), 909 (dithiane), 743, 702 (arom) cm^{-1}; ^1H NMR: δ =1.90–2.10 (m; 2H, CH_2–CH_2–CH_2), 2.65–2.82 (m; 4H, 2 SCH_2), 3.05–3.34 (m; 2H, $ArCH_2$), 3.44 (s; 3H, OCH_3), 3.78–4.05 (m; 2H, NCH_2), 3.97 (s; 3H, OCH_3), 6.58 (s; 1H, arom), 6.61 (s; 1H, arom), 7.22–7.38 (m; 3H, Ph), 7.65–7.88 (m; 2H, Ph) ppm; FD-MS (Et_2O) *m/z* (%) = 385 (100; $M^{+\cdot}$), 195 (0.8; 2-Ph-1,3-dithianyl$^+$).

6,7-Dimethoxy-1,2-dimethyl-3,4-dihydroisoquinolinium iodide (**19**): Ref. [44]

6,7-Dimethoxy-2-methyl-1-phenyl-3,4-dihydroisoquinolinium iodide (**20**): Ref. [45]

2-Phenyl-2-(α-dialkylaminobenzyl)-1,3-dithianes **6**

2-(α-Dimethylaminobenzyl)-2-phenyl-1,3-dithiane (**6a**)

From N-benzylidenedimethylammonium chloride (**21a**) [46] and dithiane **10** as described in general procedures *a)* and *b)*; work-up procedure: *C*; yield: 51%; m.p.: 99–100°C; $C_{19}H_{23}NS_2$ (329.53); calcd.: C 69.25, H 7.04, N 4.25; found: C 69.02, H 6.98, N 4.42; IR (KBr): ν =2825, 2784 (NCH_3), 909 (dithiane), 758, 710 (arom) cm^{-1}; ^1H NMR (250 MHz): δ = 1.83–1.94 (m; 2H, CH_2–CH_2–CH_2), 2.20 (s; 6H, 2 NCH_3), 2.53–2.67 (m; 4H, 2 SCH_2), 4.09 (s; 1H, CHN), 7.05–7.07 (m; 2H, arom), 7.20–7.35 (m; 6H, arom), 7.94–7.99 (m; 2H, arom) ppm; FD-MS (Et_2O): *m/z* (%) = 329 (100; $M^{+\cdot}$), 195 (51; 2-Ph-dithianyl$^+$), 134 (44; $PhCH{=}N(CH_3)_2^+$).

2-Phenyl-2-(α-pyrrolidin-1-yl)benzyl-1,3-dithiane (**6b**)

From N-benzylidenepyrrolidinium chloride (**21b**) [47] and dithiane **10** according to general procedures *a)* and *b)*; work-up procedure: *C*; yield: 64%; m.p.: 107–108°C; $C_{21}H_{25}NS_2$ (355.56);

calcd.: C 70.94, H 7.09, N 3.94; found: C 70.70, H 7.11, N 3.97; IR (KBr): $\nu = 2824$ (NCH_3), 909 (dithiane), 752, 712 (arom) cm^{-1}; ^1H NMR: $\delta = 1.50–1.67$ (m; 4H, 2 CH_2, pyrrolidine), 1.70–2.00 (m; 2H, CH_2–CH_2–CH_2), 2.30–2.67 (m; 8H, 2 NCH_2, 2 SCH_2), 4.10 (s; 1H, CHN), 7.10–7.40 (m; 8H, arom), 7.82–8.01 (m; 2H, arom) ppm; FD-MS CH_2Cl_2): m/z (%) = 355 (40; $M^{+\cdot}$), 195 (82; 2-Ph-1,3-dithianyl$^+$), 160 (100; $PhCH{=}N(CH_2)_4^+$).

2-(α-Piperidin-1-yl)benzyl-2-phenyl-1,3-dithiane (**6c**)

From N-benzylidenepiperidinium chloride (**21c**) and dithiane **10** according to general procedures *a*) and *b*); work-up procedure: *B*; yield: 42%; m.p.: 198–200°C (decomp.); **21c** was prepared from *bis*piperidinylphenylmethane [48] by treatment with acetyl chloride in absol. *THF* at room temperature.

$C_{22}H_{28}NS_2Cl$ (405.93); calcd.: C 65.09, H 6.95, N 3.45; found: C 64.82, H 6.91, N 3.47; IR (KBr): $\nu = 2857$ (NCH_2), 2473 (R_2N^+H), 910 (dithiane), 742, 698 (arom) cm^{-1}; ^1H NMR: $\delta = 1.10–1.60$ (m; 6H, 3 CH_2 piperidine), 1.62–2.20 (m; 6H, CH_2–CH_2–CH_2 dithiane, 2 NCH_2), 2.23–2.63 (m; 4H, 2 SCH_2), 4.10 (m; 1H, CHN), 7.00–7.40 (m; 8H, arom), 8.00–8.20 (m; 2H, arom) ppm.

2-(α-Morpholin-4-yl)benzyl-2-phenyl-1,3-dithiane (**6d**)

From N-benzylidenemorpholinium chloride (**21d**) [47] and dithiane **10** according to general procedures *a*) and *b*); work-up procedure: *C*; yield: 59%; m.p.: 125–126°C; $C_{21}H_{25}NOS_2$ (371.56); calcd.: C 67.88, H 6.78, N 3.77; found: C 67.77, H 6.75, N 3.81; IR (KBr): $\nu = 2821$, 2798 (OCH_2, NCH_2), 1109 (COC), 910 (dithiane), 735, 700 (arom) cm^{-1}; ^1H NMR: $\delta = 1.71–2.01$ (m; 2H, CH_2–CH_2–CH_2), 2.03–2.73 (m; 8H, 2 SCH_2, 2 NCH_2), 3.6 (t; $J = 5$ Hz, 4H, OCH_2–CH_2), 4.06 (s; 1H, CHN), 7.00–7.50 (m; 8H, arom), 8.00–8.20 (m; 2H, arom) ppm.

2-Benzyl-2-(α-dimethylaminobenzyl)-1,3-dithiane (**6e**)

From N-benzylidenedimethylammonium chloride (**21a**) [46] and dithiane **11** according to general procedures *a*) and *b*); work-up procedure: *B*; the crude material is worked-up once again according to procedure *C*; crystallization after 2–3 weeks in the refrigerator.

Yield: 4%; m.p.: 120–121°C; $C_{20}H_{25}NS_2$ (343.55); calcd.: C 69.92, H 7.34, N 4.07; found: C 69.91, H 7.11, N 3.90; IR (KBr): $\nu = 2782$ (NCH_3), 740, 702 (arom) cm^{-1}; ^1H NMR: (250 MHz): $\delta = 1.88–2.00$ (m; 2H, CH_2–CH_2–CH_2), 2.28 (s; 6H, 2 NCH_3), 2.67–3.05 (m; 4H, 2 SCH_2), 3.42 (d; AB, $J = 14$ Hz, 1H, ArCHH), 3.51 (s; 1H, CHN), 3.72 (d, AB; $J = 14$ Hz, 1H, 1 ArCHH), 7.22–7.32 (m; 8H, arom), 7.45–7.48 (m; 2H, arom); EI-MS: m/z (%) = 209 (2; 2-benzyl-1,3-dithianyl$^+$), 134 (100; $PhCH{=}N(CH_3)_2^+$), 91 (24; $C_7H_7^+$).

2-(N,N-Dimethylaminomethyl)-2-phenyl-1,3-dithiane hydrochloride (**22a**)

From dithiane **10** and 2 equiv. of N,N-dimethylmethyleneammonium chloride [32]; work-up procedure: *B*; the hydrochloride was precipitated by HCl gas in absol. Et_2O.

M.p.: 242–245°C; $C_{13}H_{20}NS_2Cl$ (289.89); calcd.: C 53.79, H 6.89, N 4.83; found: C 53.46, H 6.82, N 4.85; IR (KBr): $\nu = 2740$ (NCH_3), 2655 (N^+-H), 909 (dithiane), 739, 698 (arom) cm^{-1}; ^1H NMR (base): $\delta = 1.80–2.10$ (m; 2H, CH_2–CH_2–CH_2), 2.10 (s; 6H, 2 NCH_3), 2.50–2.77 (m; 4H, 2 SCH_2), 2.80 (s; 2H, CH_2N), 7.20–7.50 (m; 3H, arom), 7.90–8.10 (m; 2H, arom) ppm; liquid SI-MS (Et_2O, *m*-nitrobenzyl alcohol): m/z (%) = 254 (100; $M^{+\cdot}$), 209 (35, M – $(CH_3)_2NH)^{+\cdot}$, 195 (4.7; 2-Ph-1,3-dithianyl$^+$).

Cleavage with HgO/BF_3

Preparation of thiol esters **4**

a) Mercury-bis(3-(3-(benzoylmercapto)propylthiolates) (**4a**-Hg) *(general procedure)*

To a suspension of 2.2 g (10 mmole) of red HgO in 85 ml of *THF* and 15 ml of water, 5 mmole of the tetrahydroisoquinolin-1-yl-1,3-dithianes **2**, **5a–5i**, respectively, and then 2.5 ml (20 mmol) of BF_3/Et_2O are added. Stirring for 30 min at room temp. affords a clear solution. Addition of 200 ml of CH_2Cl_2 leads to a white precipitate which contains Hg^{1+} (identified by its disproportionation in contact with NH_3). The filtrate of this precipitate is washed with Na_2CO_3 solution and with brine, generating a second precipitate. After drying and evaporation of this filtrate, the residue is purified by CC (CH_2Cl_2).

4a-Hg [2] is obtained as a white, amorphous solid. $C_{20}H_{22}HgO_2S_4$ (623.24); IR (KBr): ν = 1669, 1661 (Ar–CO–S) cm^{-1}; ^1H NMR: δ = 1.87–2.23 (quint; J = 7 Hz, 4H, CH_2–CH_2–CH_2), 3.08–3.34 (m; 8H, 4 SCH_2), 7.30–7.69 (m; 6H, arom), 7.87–7.94 (m; 4H, arom) ppm; FD-MS (CH_2Cl_2): m/z (%) = 624 (18; $M^{+\cdot}$), 422 [100; $(Ph–CO–SCH_2–CH_2–CH_2S)_2^{+\cdot}$], 105 (63; $Ph–CO^+$).

The preparation of **4a**-Hg from **5a–i** needs small deviations from this general procedure. **5a**, **b**: no reaction at room temp., water bath (40–50°C), yields: 75% and 36%, resp.; **5c**: 4 h, room temp., 43%; **5d**: 14 h, room temp., 61%; **5e**: 6 h, room temp., 58%; **5f**: 2 h, room temp., 74%; **5g**: 4 h, room temp., 67%; **5h**: 2 h, room temp., 63%; **5i**: 1 h, room temp., 78%.

a') Mercury-bis(3-(piperonylmercapto)propylthiolate) (**4b**-Hg)

From **17** or **18** according to the general procedure (*vide supra*); **4b**-Hg is a soft, amorphous white solid.

$C_{22}H_{22}HgO_6S_4$ (711.24); calcd.: C 37.15, H 3.18; found: C 37.07, H 3.40; IR (film): ν = 1670, 1659 (Ar–CO–S) cm^{-1}; ^1H NMR (250 MHz): δ = 2.02 (quint; J = 8 Hz, 4H, 2 × CH_2–CH_2–CH_2), 3.18 (two overlapping t; $J_1 = J_2$ = 8 Hz, 8H, 4 × SCH_2–CH_2), 6.04 (s; 4H, 2 × O–CH_2–O), 6.83 (d; J = 8.2 Hz, 2H, arom), 7.40 (d; J = 1.8 Hz, 2H, arom), 7.59 (dd; J_1 = 8.2 Hz, J_2 = 1.8 Hz, 2H, arom) ppm.

b) S-Benzoyl-1,3-propanedithiol (**4a**)

200 mg **4a**-Hg are dissolved in 2 ml of $CDCl_3$. H_2S is fed into the solution. After standing for 15 min, HgS is filtered off, H_2S is removed by flushing with N_2, and the solution is directly used for IR and ^1H NMR measurements.

IR ($CDCl_3$): ν = 1667 (Ar–CO–S) cm^{-1}; ^1H NMR: δ = 1.46 (t; J = 7 Hz, SH), 1.82–2.20 (quint; J = 7 Hz, 2H, CH_2–CH_2–CH_2), 2.52–2.83 ("q"; J = 7 Hz, 2H, CH_2–CH_2–SH), 3.18 (t; J = 7 Hz, 2H, CO–SCH_2–CH_2), 7.32–7.71 (m; 3H arom), 7.94–8.03 (m; 2H arom) ppm; FD-MS (CH_2Cl_2): m/z (%) = 212 (8; $M^{+\cdot}$), 105 (100; $Ph–CO^+$), 77 (55; Ph).

b') S-Piperonyl-1,3-propandithiol (**4b**)

From **4b**-Hg as described for **4a**. Oil; $C_{11}H_{12}O_3S_2$ (256.33); IR ($CDCl_3$): ν = 1668 (Ar–CO–S) cm^{-1}; ^1H NMR: δ = 1.41 (t; J = 8 Hz, 1H, SH), 1.88–2.12 (quint; J = 8 Hz, 2H, CH_2–CH_2–CH_2), 2.54–2.90 ("q"; J = 8 Hz, 2H, HS–CH_2–CH_2), 3.20 (t; J = 8 Hz, 2H, CO–S–CH_2–CH_2), 6.00 (s; 2H, O–CH_2–O), 6.85 (d; J = 8 Hz, 1H arom), 7.45 ("s", 1H, arom), 7.64 ("d", J = 8 Hz, 1H, arom) ppm.

S,S'-Bis(3-(benzoylmercapto)propyl)disulfide (**4c**) *and S,S'-Bis(3-(piperonylmercapto)propyl)-disulfide* (**4d**)

Disulfide **4c** was obtained by CC as a side product of the HgO/BF_3 cleavage of **5a–i**, described for the preparation of **4a**-Hg; **4d** results from the analogous cleavage of **17** or **18**.

4c: White, amorphous, soft solid; $C_{20}H_{22}O_2S_4$ (422.63); ^1H NMR: $\delta = 1.83$–2.21 (quint; $J = 7$ Hz, 4H, CH_2–CH_2–CH_2), 2.65 (t; $J = 7$ Hz, 4H, CH_2–CH_2–S–S–CH_2–CH_2), 3.20 (t; $J = 7$ Hz, 4H, 2 $COSCH_2$–CH_2), 7.38–7.80 (m; 6H, arom), 7.98–8.10 (m; 4H, arom) ppm; FD-MS (CH_2Cl_2): $m/z = 422$ ($M^{+\cdot}$).

4d: White, amorphous, soft solid; $C_{22}H_{22}O_6S_4$ (510.65); ^1H NMR: $\delta = 1.82$–2.22 (quint; $J = 7$ Hz, 4H, $2 \times CH_2$–CH_2–CH_2), 2.70 (t; $J = 7$ Hz, 4H, CH_2–CH_2–S–S–CH_2–CH_2), 3.25 (t; $J = 7$ Hz, 4H, 2 $COSCH_2$–CH_2), 5.97 (s; 4H, $2 \times$ O–CH_2–O), 6.90 (d; $J = 8$ Hz, 2H, arom), 7.5 ("s"; 2H, arom), 7.71 ("d"; $J = 8$ Hz, 2H, arom); FD-MS (acetone): $m/z = 510$ ($M^{+\cdot}$).

HgO/BF_3 cleavages of **17** (1 h at room temp., cf. general procedure) and **18** (1.5 h at 50°C, cf. general procedure) afforded 50% **4b**-Hg and 15% piperonal (**17**) and 25% **4b**-Hg and 35% piperonal (**18**), respectively.

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