Pteridines

Part CXVII[1])

Side-Chain Transformations of 6- and 7-Substituted 1,3-Dimethyllumazines (=1,3-Dimethylpteridine-2,4(1*H*,3*H*)-diones)

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A series of side chain reactions starting from the 6- and 7-styryl-substituted 1,3-dimethyllumazines **1** and **21** as well as from the 6- and 7-[2-(methoxycarbonyl)ethenyl]-substituted 1,3-dimethyllumazine **2** and **22** were performed first by addition of Br_2 to the C=C bond forming the 1′,2′-dibromo derivatives **3**, **4**, **24**, and **26** in high yields (*Schemes 1* and *3*) (lumazine = pteridine-2,4(1*H*,3*H*)-dione). Treatment of **3** with various nucleophiles gave rise to an unexpected tele-substitution in 7-position and elimination of the Br-atoms generating 7-alkoxy- (see **5** and **6**), 7-hydroxy- (see **7**) and 7-amino-6-styryl-1,3-dimethyllumazines (see **8**–**11**) (*Scheme 1*). On the other hand, **4** underwent, with dilute DBU (1,8-diazabicyclo[5.4.0]undec-2-ene), a normal HBr elimination in the side chain leading to **18**, whereas treatment with MeONa afforded a more severe structural change to **19**. Similarly, **24** and **26** reacted to **27**, **32**, and **33** under mild conditions, whereas in boiling NaOMe/MeOH, **24** gave 7-(2-dimethoxy-2-phenylethyl)-1,3-dimethyllumazine (**30**) which was hydrolyzed to give **31** (*Scheme 3*). From the reactions of **4** and **24** with DBU resulted the dark violet substance **20** and **25**, respectively, in which DBU was added to the side chain (*Scheme 2*). The styryl derivatives **1** and **21** could be converted, by a *Sharpless* dihydroxylation reaction, into the corresponding stereoisomeric 6- and 7-(1,2-dihydroxy-2-phenylethyl)-1,3-dimethyllumazines **34**–**37** (*Scheme 4*). The dihydroxy compounds **34** and **35** were also acetylated to **38** and **39** which, on catalytic reduction followed by formylation, yielded the diastereoisomer mixtures **40** and **41**. Deacetylation to **42** and **45** allowed the chromatographic separation of the diastereoisomers resulting in the isolation of **43** and **44** as well as **46** and **47**, respectively. Introduction of a 6- or 7-ethynyl side chains proceeded well by a *Sonogashira* reaction with 6- (**48**) or 7-chloro-1,3-dimethyllumazine (**55**) yielding **49**–**51** and **56**–**58** (*Scheme 5*). The direction of H_2O addition to the triple bond is depending on the substituents since the 6- (**49**) and 7-(phenylethynyl)-1,3-dimethyllumazine (**56**) showed attack at the 2′-position yielding **53** and **60**, in contrast to the 6- (**51**) and 7-ethynyl-1,3-dimethyllumazine (**58**) favoring attack at C(1′) and formation of 6- (**52**) and 7-acetyl-1,3-dimethyllumazine (**59**).

1. Introduction. – The synthesis of the pteridine molecular skeleton is mainly achieved by two major approaches which starts either from a suitably substituted pyrimidine derivative able to form on condensation the fused pyrazine ring or from an appropriately substituted pyrazine derivative forming the pyrimidine ring on cyclization [2][3]. It is interesting to note that the most common modifications at the pteridine molecular skeleton are dealing with nucleophilic displacement reactions of various functional groups attached to the molecular skeleton, but very little chemistry has been

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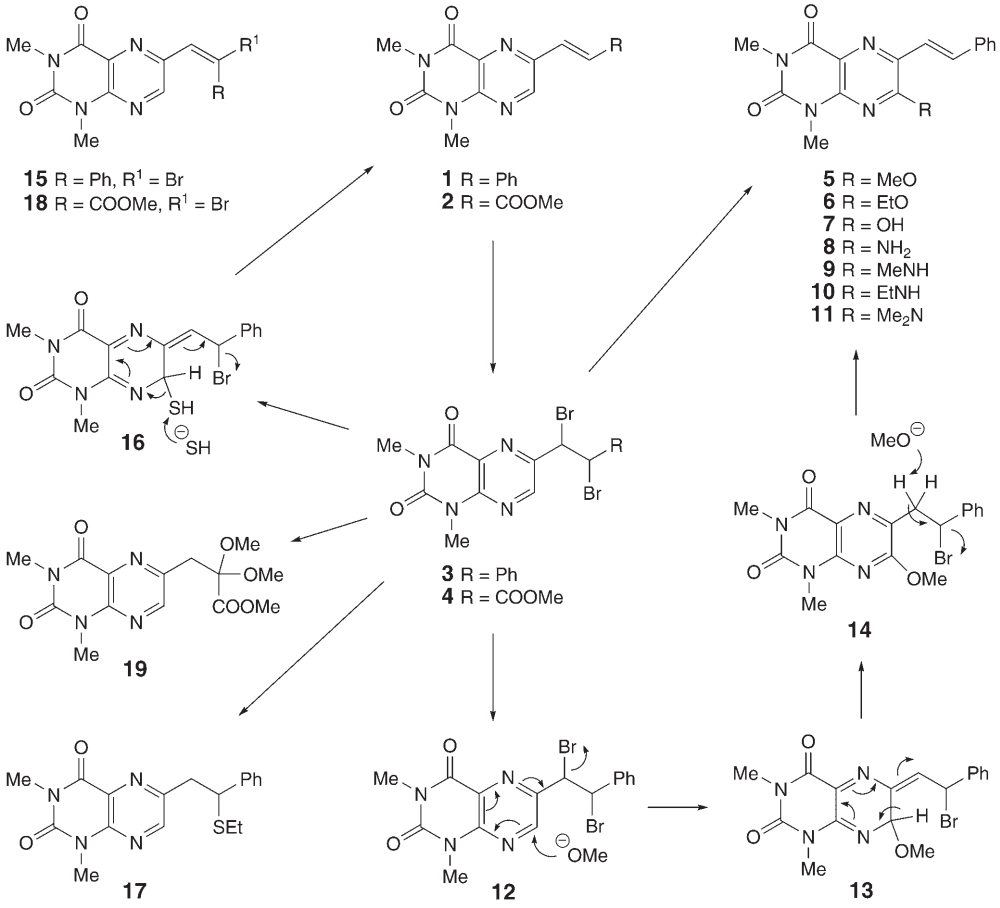
done in modifying side chains. Even since most naturally occurring pterins bear a C side chain in 6-position, their introduction is usually achieved directly through the condensation step during ring formation and not indirectly through subsequent chain transformations (pterin = 2-aminopteridin-4(1*H*)-one). In 1958, *Tschesche* and *Glaser* [4] showed that the C(6) side chain in 6-acetonylisoxanthopterin (acetonyl = 2-oxopropyl) can be brominated and oxidized, respectively, to give the corresponding 1′-hydroxy- and 1′-keto derivatives in reasonable yields. *Goto* and co-workers [5][6] applied a similar approach in their urothion synthesis by converting the 6-[3′,4′-bis(benzyloxy)-2′-oxobutyl] side chain into a fused thieno ring on treatment with P_4S_{10}. Also $Na_2S_2O_4$ treatment of D-*erythro*-neopterin [7] gave raise to a series of unexpected 6-substituted pterins indicating that the side chains bear a high potential for many transformations. Some reactions have also been performed with biopterin to modify the 6-(1,2-dihydroxypropyl) side chain [8]. A rare case is also the addition reaction at the side chain of 2,4-diamino-6-styrylpteridine 8-oxide leading to the corresponding 6-(1,2-dihydroxy-2-phenylethyl) derivative of sofar unknown configuration [9]. *Taylor* and co-workers [10–12] undertook several efforts to build-up the complex side chain of molybdopterin with only limited success. Recently, *Suckling* and co-workers [13][14] performed various side chain reactions with 6-substituted pteridines which are resembling our activities to some extent.

In this paper, we report about the reactivities of unsaturated side chains regarding addition, elimination, and transformation reactions leading to a broad variety of new lumazine derivatives (lumazine = pteridine-2,4(1*H*,3*H*)-dione).

2. Results and Discussion. – As suitable starting materials for our investigations 6- and 7-[(*E*)-styryl]-substituted 1,3-dimethyllumazines **1** and **21** as well as the 3-(1,3-dimethyllumazin-6-yl)- and 3-(1,3-dimethyllumazin-7-yl)-substituted (2*E*)-prop-2-enoic acid methyl esters **2** and **22** were considered which have been synthesized by an aldol-type condensation and *Wittig* reactions [15]. Analogously, 7-acetyl-1,3-dimethyllumazine (**59**; see below) [16] reacted with triphenylphosphoranylidene)acetic acid methyl ester to give the stereoisomers (2*E*)- and (2*Z*)-3-(1,3-dimethyllumazin-7-yl)but-2-enoic acid methyl ester (**23a** and **23b**, for formulas, see below) whose side chain structure was assigned by the ^{1}H-NMR chemical shifts of the MeC=CHCOOMe moiety (downfield-shifted signals in the (*E*)-isomer **23a** as compared to the (*Z*)-isomer **23b**, as predicted).

Bromine addition worked very well with **1** and **2** leading to the corresponding 6-(*erythro*-1,2-dibromoethyl) derivatives **3** and **4** (*Scheme 1*). Anticipated elimination reactions of **3** with various nucleophiles such as OH^- ions, alkoxide ions, ammonia, and primary and secondary amines proceeded, unexpectedly, by the formation of the 7-substituted 1,3-dimethyl-6-styryllumazines **5**–**11**. The most probable mechanism of these interesting transformations involves the initial nucleophilic attack at C(7), as exemplified by **12**, leading to a tele-substitution of the Br-atom at C(1′) of the side chain to give **13** which then tautomerizes to **14** and is followed by HBr elimination to give **5**. Treatment of **3** with dilute 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) in dioxane proceeded under HBr elimination giving rise to 6-[(1*E*)-2-bromo-2-phenylethenyl]-1,3-dimethyllumazine (**15**), the structure of which was established by 2D-NMR (NOE between H_o of Ph and H–C(7), and ^4J(H–C(7), H–C(1′)) observed). The assigned configuration of **15** is in agreement with a *trans*-coplanar E_2 mechanism. Treatment of **3**

Scheme 1

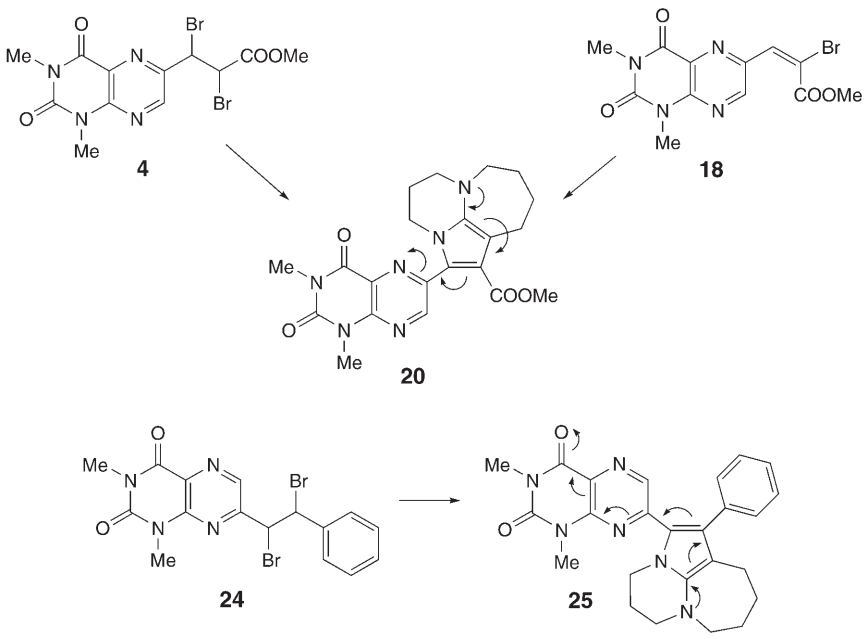


with an excess of DBU at 50° was associated with the elimination of 2 mol of HBr leading to the 1,3-dimethyl-6-(phenylethynyl)lumazine (**49**; see below) which can also been obtained by a *Sonogashira* reaction between 6-chloro-1,3-dimethyllumazine (**48**; see below) and phenylethyne, as already described in [17].

Another strange reaction was observed on treatment of **3** with sodium hydrogensulfide proceeding by formal reduction of both Br-atoms leading back to 1,3-dimethyl-6-styryllumazine (**1**) (*Scheme 1*). We assume that the mechanism is again initiated by a nucleophilic attack of the hydrogensulfide anion (HS^-) at C(7) and elimation of the Br-atom at C(1′) giving **16** as an intermediate which is then attacked at the HS–C(7) group with tele-substitution of the second Br-atom in the side chain. Reaction of **3** with ethanethiol in the presence of DBU resulted in the formation of 6-[2-(ethylthio)-2-phenylethyl)-1,3-dimethyllumazine (**17**) which followed most probably the preceeding mechanism to **1** with subsequent addition of ethanethiol. Methylhydrazine was also able to convert **3** into **1**.

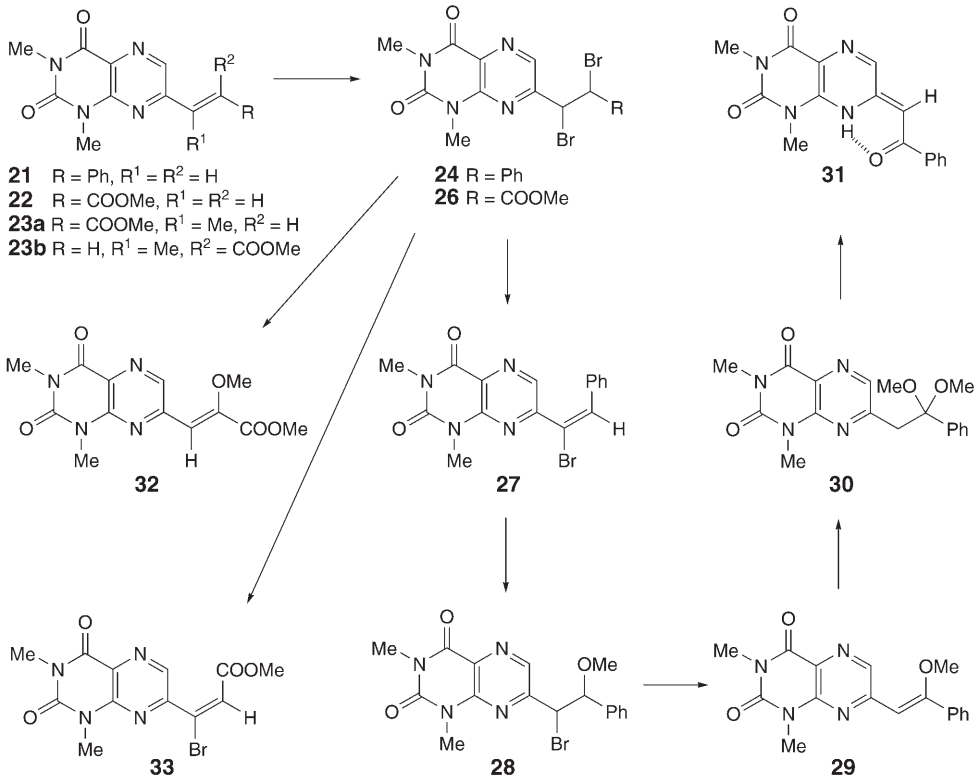
Side-chain reactions with 2,3-dibromo-3-(1,3-dimethyllumazin-6-yl)propanoic acid methyl ester (**4**) were more straightforward leading under mild treatment with diluted DBU in dioxane to (2*E*)-2-bromo-3-(1,3-dimethyllumazin-6-yl)prop-2-enoic acid methyl ester (**18**), and with MeONa to 2,2-dimethoxy-3-(1,3-dimethyllumazin-6-yl)propanoic acid methyl ester **19** (*Scheme 1*). Treatment of either **4** or **18** with excess of DBU resulted again in an unexpected reaction visualized by the appearance of a dark violet solution from which purple crystals separated after several hours stirring at room temperature. In these reactions, DBU was not only involved in the elimination process but was also a reactant forming the complex molecule **20** (*Scheme 2*), the structure of which was derived from its NMR and mass spectra as well as the elemental analysis. Its long-wavelength UV/VIS spectrum is explained by the built-in merocyanine chromophor.

Scheme 2



Analogous investigations were performed starting from 1,3-dimethyl-7-[(*E*)-styryl]lumazine (**21**) as well as from (2*E*)-3-(1,3-dimethyllumazin-7-yl)prop-2-enoic acid methyl ester (**22**) [15] (*Scheme 3*). Bromination proceeded in high yields to **24** and **26**. Heating of **24** to 90° in dioxane for 30 min in the presence of DBU led again to a violet precipitate **25**, structurally related to **20** (*Scheme 2*). Reaction of **24** with NaOMe in MeOH at room temperature led to 7-[(1*E*)-1-bromo-2-phenylethenyl]-1,3-dimethyllumazine (**27**), whereas heating under the same conditions gave 7-(2,2-dimethoxy-2-phenylethyl)-1,3-dimethyllumazine (**30**), probably *via* the intermediates **28** and **29** (*Scheme 3*). Workup under acidic conditions was associated with hydrolysis of the acetal function to the corresponding keto derivative which tautomerized right away to the thermodynamically more stable vinylogous amide **31**.

Scheme 3

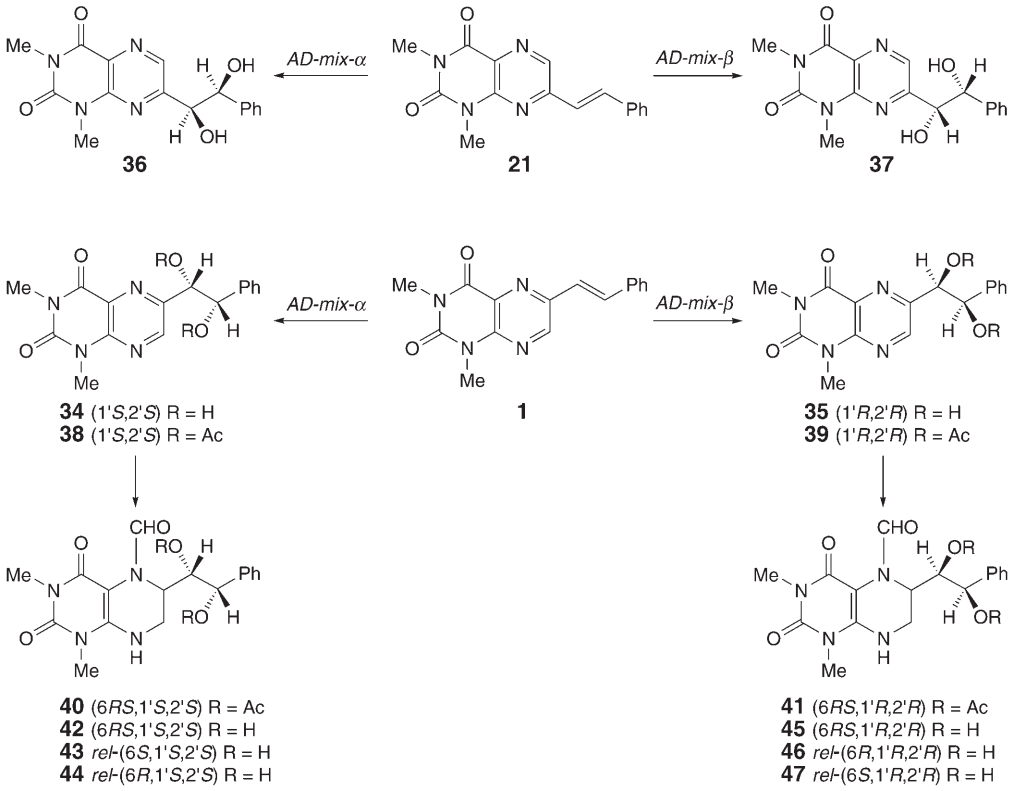


Mild treatment of **26** with NaOMe at room temperature resulted in the formation of (2*Z*)-2-methoxy-3-(1,3-dimethyllumazin-7-yl)prop-2-enoic acid methyl ester (**32**), and with triethylamine in MeOH, (2*E*)-3-bromo-3-(1,3-dimethyllumazin-7-yl)prop-2-enoic acid methyl ester (**33**) was obtained (*Scheme 3*).

The styryllumazine derivatives **1** and **21** were also prone to a *Sharpless* dihydroxylation reaction [18] applying the osmium-catalyzed asymmetric diol formation with *AD-mix-α* and *AD-mix-β* yielding **34** and **35** as well as **36** and **37**, respectively, according to *Sharpless*'s notation (*Scheme 4*). Acetylation of **34** and **35** led to the diacetyl derivatives **38** and **39** which were catalytically reduced and formylated to give the diastereoisomer mixtures of (6*RS*)-6-[(1*S*,2*S*)-bis(acetyloxy)-2-phenylethyl]-5-formyl-5,6,7,8-tetrahydro-1,3-dimethyllumazine (**40**) and (6*RS*)-6-[(1*R*,2*R*-bis(acetyloxy)-2-phenylethyl]-5-formyl-5,6,7,8-tetrahydro-1,3-dimethyllumazine (**41**). Deacetylation led to the diols **42** and **45** each of which could be separated into the two corresponding pure diastereoisomers **43** and **44**, and **46** and **47**, respectively. The absolute configurations of these isomers could not been assigned.

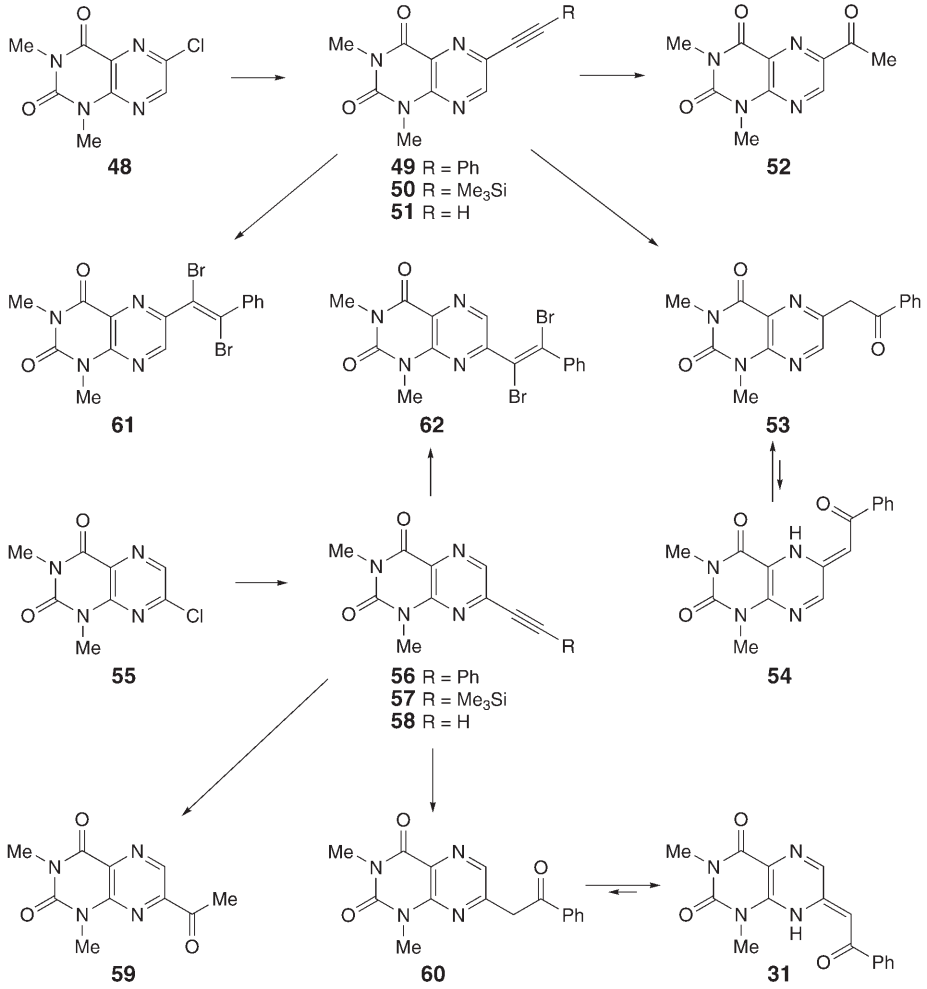
Another attractive approach for the introduction of C side chains in the lumazine molecular skeleton is the very efficient *Sonogashira* reaction. The 6-chloro- (**48**) [19] and 7-chloro-1,3-dimethyllumazine (**55**) [19] are valuable starting materials which react

Scheme 4



in the Pd-catalyzed reaction with phenylethyne and (trimethylsilyl)ethyne (=ethynyltrimethylsilane), respectively, in high yields to the corresponding 6- and 7-substituted ethynyl derivatives **49** [17], **50** [20], **56**, and **57** (*Scheme 5*), some of which have recently also been described by two other groups. Desilylation of **50** and **57** proceeded well by fluoride treatment to give 6- (**51**) and 7-ethynyl-1,3-dimethyllumazine (**58**). Modification of the triple bond by Hg-catalyzed H_2O addition was depending on the nature of the side chain since the phenylethynyl derivatives showed nucleophilic attack on the C(2′) atom to yield **53** and **60**, respectively, whereas the ethynyl derivatives **51** and **58** reacted at C(1′) to give 6-acetyl- (**52**) [21] and 7-acetyl-1,3-dimethyllumazine (**59**) [21], respectively. The isomeric 6- and 7-(2-oxo-2-phenylethyl) derivatives **53** and **60**, respectively, exist, according to the ^{1}H-NMR and UV spectra, as tautomeric mixtures in which the equilibrium of **53** ⇄ **54** is in favor of the 6-(2-oxo-2-phenylethyl) form **53**, whereas **60** tautomerizes to the thermodynamically more stable 7,8-dihydro-1,3-dimethyl-7-(2-oxo-2-phenylethylidene)lumazine (**31**). Finally, **49** and **56** reacted smoothly with Br_2 to form in high yield the 6- (**61**) and 7-[(1*E*)-1,2-dibromo-2-phenylethenyl]-1,3-dimethyllumazine (**62**).

Scheme 5



Experimental Part

General. TLC: precoated cellulose thin-layer sheets *F 1440b LS 254* and silica gel thin-layer sheets *F 1500 LS 254* from *Schleicher & Schüll*. Prep. TLC: silica gel *60 PF 254* from *Merck*. M.p.: *Büchi* apparatus, model Dr. *Tottoli*; no corrections. The pK_a measurements were performed by the spectrophotometric method [16]. UV: *Cary* recording spectrometer, model *15*; λ_{max} (log ε) in nm, sh = shoulder. ^{1}H-NMR: *Bruker WM-250* spectrometer; δ in ppm rel. to $SiMe_4$, *J* in Hz. MS: in *m*/*z*.

*1,3-Dimethyl-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H*,3*H*)-dione* (**1**) [15]. *a*) To a soln. of 6-(1,2-dibromo-2-phenylethyl)-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione (**3**; 0.1 g, 0.22 mmol) in dioxane (10 ml) was added a soln. of NaSH (0.13 g) in H_2O (3 ml), and the mixture was stirred at r.t. for 24 h. After evaporation, the residue was treated with H_2O and the precipitate collected and dried *in vacuo:* 63 mg (97%) of **1**. Pale yellow powder. M.p. 238° ([15]: 237–239°).

b) To a soln. of **3** (0.1 g, 0.22 mmol) in dioxane (10 ml) was added methylhydrazine (1 ml) and H_2O (2.5 ml), and the mixture was stirred at r.t. for 17 h. After evaporation, H_2O (5 ml) was added and the precipitate collected, washed with a small amount of H_2O, and dried *in vacuo:* 30 mg (46%) of **1**. Pale yellow powder. M.p. 239°.

*6-(1,2-Dibromo-2-phenylethyl)-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**3**). To a suspension of **1** (0.842 g, 2.86 mmol) in $CHCl_3$ (20 ml) was added 2M Br_2 in $CHCl_3$ (2.5 ml, 5 mmol), and the mixture was stirred at r.t. for 4 h. After evaporation, the residue was treated with MeOH and the precipitate collected and dried *in vacuo:* 1.22 g (94%) of **3**. Colorless powder. M.p. 176°. UV (MeOH): 245 (4.18), 260 (sh, 4.10), 341 (3.83). ^{1}H-NMR ($CDCl_3$): 8.78 (*s*, H–C(7)); 7.60–7.50 (*m*, 2 arom. H); 7.50–7.40 (*m*, 3 arom. H); 5.88 (*d*, H–C(1′)); 5.79 (*d*, H–C(2′)); 3.76 (*s*, Me–N(1)); 3.58 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{14}Br_2N_4O_2$ (454.1): C 42.32, H 3.11, N 12.34; found: C 42.09, H 3.12, N 12.33.

2,3-Dibromo-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-6-yl)propanoic Acid Methyl Ester (**4**). To a soln. of (2*E*)-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-6-yl)prop-2-enoic acid methyl ester [15] (**2**; 0.7 g, 2.53 mmol) in $CHCl_3$ (18 ml) was added a 2M Br_2 in $CHCl_3$ (1.5 ml, 3 mmol), and the mixture was stirred at r.t. for 4 h. Then more Br_2 soln. (0.5 ml, 1 mmol) was added and stirring continued for additional 2 h. The mixture was evaporated, the residue treated with MeOH, and the precipitate collected and dried *in vacuo:* 0.968 g (88%) of **4**. Colorless powder. M.p. 163–164°. UV (MeOH): 247 (4.16), 260 (sh, 4.08), 339 (3.88). ^{1}H-NMR ($CDCl_3$): 8.67 (*s*, H–C(7)); 5.62 (*d*, H–C(1′)); 5.33 (*d*, H–C(2′)); 3.91 (*s*, MeO); 3.73 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)). Anal. calc. for $C_{12}H_{12}Br_2N_4O_4$ (436.1): C 33.05, H 2.77, N 12.85; found: C 32.99, H 2.79, N 12.70.

*7-Methoxy-1,3-dimethyl-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H*,3*H*)-dione* (**5**). To a suspension of **3** (0.1 g, 0.22 mmol) in abs. MeOH (3 ml) was added DBU (0.1 ml, 0.67 mmol), and the mixture was stirred for 1.5 h at r.t. The precipitate was collected, washed with MeOH, and dried *in vacuo:* 67 mg (94%) of **5**. Pale yellow powder. M.p. 271–272°. UV (MeOH): 232 (sh, 4.11), 306 (4.36), 375 (4.38). ^{1}H-NMR ((D$_6$)DMSO): 7.96 (*d*, *J* = 16.2, 1 olef. H); 7.62 (*m*, 2 arom. H); 7.42 (*d*, *J* = 16.2, 1 olef. H); 7.45–7.30 (*m*, 3 arom. H); 4.18 (*s*, MeO); 3.69 (*s*, Me–N(1)); 3.53 (*s*, Me–N(3)). Anal. calc. for $C_{17}H_{16}N_4O_3$ (324.3): C 62.96, H 4.97, N 17.28; found: C 62.65, H 4.99, N 17.51.

*7-Ethoxy-1,3-dimethyl-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H*,3*H*)-dione* (**6**). To a suspension of **3** (0.1 g, 0.22 mmol) in abs. EtOH (3 ml) was added DBU (0.1 ml, 0.67 mmol) and stirred for 3 h at r.t. The precipitate was collected, washed with EtOH, and dried *in vacuo:* 50 mg (67%) of **6**. Pale yellow powder. M.p. 271–272° (DMF). UV (MeOH): 232 (sh, 4.10), 307 (4.36), 376 (4.38). ^{1}H-NMR ((D$_6$)DMSO): 7.98 (*d*, *J* = 16.1, 1 olef. H); 7.62 (*m*, 2 arom. H); 7.43 (*d*, *J* = 16.1, 1 olef. H); 7.42–7.30 (*m*, 3 arom. H); 4.61 (*q*, Me*CH*$_2$O); 3.67 (*s*, Me–N(1)); 3.53 (*s*, Me–N(3)), 1.56 (*t*, *Me*CH$_2$O). Anal. calc. for $C_{18}H_{18}N_4O_3$ (338.4): C 63.89, H 5.36, N 16.56; found: C 63.98, H 5.44, N 16.57.

*1,3-Dimethyl-7-hydroxy-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H*,3*H*)-dione* (**7**). *a*) Sodium salt Na(**7**-H): To a suspension of **3** (0.1 g, 0.22 mmol) in EtOH (3 ml) was added 2.5N NaOH (0.5 ml, 1.3 mmol), and the mixture was stirred for 30 min at r.t. The precipitate was collected and recrystallized fron EtOH/H_2O: 13 mg (17%) of Na(**7**-H). Pale orange crystals. M.p. > 350°. UV (MeOH): 222 (4.76), 264 (4.46), 303 (4.47), 383 (4.76), 412 (sh, 4.46). ^{1}H-NMR ((D$_6$)DMSO): 7.81 (*d*, *J* = 16.2, 1 olef. H); 7.55 (*m*, 2 arom. H); 7.39 (*d*, *J* = 16.2, 1 olef. H); 7.35 (*m*, 2 arom. H); 7.23 (*m*, 1 arom. H); 3.36 (*s*, Me–N(1)); 3.23 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{13}N_4O_3Na \cdot H_2O$ (350.3): C 54.86, H 4.31, N 15.99; found: C 54.93, H 4.03, N 15.88.

b) OH Form **7**: The crude sodium salt Na(**7**-H) was suspended in H_2O (5 ml) and acidified with 1N HCl to pH 1. The precipitate was collected and recrystallized from $CHCl_3$/MeOH/hexane: 20 mg (29%) of **7**. Yellow powder. M.p. 300–306°. ^{1}H-NMR ((D$_6$)DMSO): 7.69 (*d*, *J* = 16.5, 1 olef. H); 7.67 (*m*, 2 arom. H); 7.40 (*d*, *J* = 16.5, 1 olef. H); 7.44–7.29 (*m*, 3 arom. H); 3.49 (*s*, Me–N(1)); 3.30 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{14}N_4O_3$ (310.3): C 61.93, H 4.55, N 18.05; found: C 61.57, H 4.66, N 17.81.

*7-Amino-1,3-dimethyl-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H*,3*H*)-dione* (**8**). To a soln. of **3** (0.1 g, 0.22 mmol) in dioxane (10 ml) was added conc. ammonia (10 ml), and the mixture was stirred at r.t. for 15 h. The precipitate was collected, washed with H_2O, and dried *in vacuo:* 19 mg (27%) of **8**. Bright yellow powder. M.p. 308–310°. UV (MeOH): 226 (4.53), 262 (4.17), 307 (4.30), 389 (4.41). ^{1}H-NMR ((D$_6$)DMSO): 7.83 (br. *s*, NH_2); 7.73 (*m*, 2 arom. H); 7.57 (*s*, 2 olef. H); 7.44–7.37 (*m*, 2 arom.

H); 7.35 (*m*, 1 arom. H); 3.44 (*s*, Me–N(1)); 3.27 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{15}N_5O_2 \cdot 0.25\ H_2O$ (313.8): C 61.24, H 4.98, N 22.32; found: C 61.26, H 4.83, N 21.82.

*1,3-Dimethyl-7-(methylamino)-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H,*3*H*)-dione* (**9**). To a soln. of **3** (0.1 g, 0.22 mmol) in dioxane (10 ml) was added 33% $MeNH_2$/EtOH (5 ml), and the mixture was stirred at r.t. for 20 h. After concentration to 2 ml, the precipitate was collected, washed with H_2O, and dried *in vacuo:* 9 mg (12%) of **9**. Bright yellow powder. M.p. 282°. UV (MeOH): 234 (4.43), 264 (4.16), 310 (4.26), 394 (4.34). ^{1}H-NMR ((D_6)DMSO): 7.56 (*d*, *J* = 15.7, 1 olef. H); 7.40 (*m*, 2 arom. H); 7.32–7.25 (*m*, 3 arom. H); 6.93 (*d*, *J* = 15.7, 1 olef. H); 6.13 (br. *q*, MeN*H*); 3.55 (*s*, Me–N(1)); 3.49 (*s*, Me–N(3)); 3.16 (*d*, *Me*NH). Anal. calc. for $C_{17}H_{17}N_5O_2 \cdot 0.25\ H_2O$ (327.9): C 62.28, H 5.38, N 21.36; found: C 62.31, H 5.25, N 21.06.

*7-(Ethylamino)-1,3-dimethyl-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H,*3*H*)-dione* (**10**). To a soln. of **3** (0.1 g, 0.22 mmol) in dioxane (10 ml) was added a 50% aq. $EtNH_2$ soln. (5 ml), and the mixture was stirred at r.t. for 20 h. After concentration to 3 ml, H_2O (5 ml) was added and the precipitate collected and recrystallized from $CHCl_3$/hexane: 11 mg (15%) of **10**. Bright yellow powder. M.p. 222–224°. UV (MeOH): 235 (4.46), 264 (4.20), 311 (4.31), 395 (4.36). ^{1}H-NMR ((D_6)DMSO): 7.70 (*d*, *J* = 15.5, 1 olef. H); 7.52 (*m*, 2 arom. H); 7.40–7.30 (*m*, 3 arom. H); 6.97 (*d*, *J* = 15.5, 1 olef. H); 5.70 (br. *t*, EtN*H*); 3.70–3.58 (*m*, Me*C*H_2N); 3.61 (*s*, Me–N(1)); 3.50 (*s*, Me–N(3)); 1.37 (*t*, *Me*CH_2N). Anal. calc. for $C_{18}H_{19}N_5O_2 \cdot 0.25\ H_2O$ (341.9): C 63.24, H 5.75, N 20.48; found: C 63.47, H 5.74, N 20.22.

*7-(Dimethylamino)-1,3-dimethyl-6-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H,*3*H*)-dione* (**11**). To a soln. of **3** (0.1 g, 0.22 mmol) in dioxane (10 ml) was added a 40% aq. Me_2NH soln. (10 ml), and the mixture was stirred at r.t. for 19 h. After evaporation, the residue was treated with a small amount of H_2O and the precipitate collected and dried *in vacuo:* 30 mg (40%) of **11**. Bright yellow powder. M.p. 211°. UV (MeOH): 240 (4.55), 254 (sh, 4.52), 264 (sh, 4.51), 320 (4.48), 397 (4.46). ^{1}H-NMR ($CDCl_3$): 7.67 (*d*, *J* = 16, 1 olef. H); 7.57 (*m*, 2 arom. H); 7.41–7.30 (*m*, 3 arom. H); 7.16 (*d*, *J* = 16, 1 olef. H); 3.64 (*s*, Me–N(1)); 3.51 (*s*, Me–N(3)); 3.24 (*s*, Me_2N). Anal. calc. for $C_{18}H_{19}N_5O_2$ (337.4): C 64.08, H 5.68, N 20.76; found: C 63.91, H 5.55, N 20.83.

*6-[(1*E*)-2-Bromo-2-phenylethenyl]-1,3-dimethyl]pteridine-2,4(1*H,*3*H*)-dione* (**15**). A soln. of **3** (0.22 g, 0.5 mmol) in dry dioxane (20 ml) was treated with DBU (0.4 g) by stirring at r.t. for 1 h. The precipitate (DBU · HBr) was filtered off and the filtrate evaporated. The residue was separated by CC (silica gel, AcOEt/hexane 1:2): less polar **15** (0.06 g, 30%; m.p. 143–145°) and more polar **49** (0.1 g, 68%; m.p. 227°; see below). *Data of* **15**: UV(MeOH): 203 (4.36), 244 (4.39), 296 (sh, 3.91), 357 (4.00). ^{1}H-NMR ($CDCl_3$): 8.33 (*s*, H–C(7)); 7.55 (*s*, H–C(1′)); 7.21 (*m*, 3 arom. H); 7.02 (*m*, 2 arom. H); 3.66 (*s*, MeN(1)); 3.55 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{13}BrN_4O_2$ (373.2): C 51.49, H 3.51, N 15.01; found: C 51.40, H 3.49, N 15.06.

*6-[2-(Ethylthio)-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H,*3*H*)-dione* (**17**). To a suspension of **3** (0.1 g, 0.22 mmol) in ethanethiol (3 ml) was added DBU (0.1 ml, 0.67 mmol), and the mixture was stirred at r.t. for 2 h. After evaporation, the residue was dissolved in $CHCl_3$ (10 ml), the soln. washed with H_2O (5 ml), dried (Na_2SO_4), and concentrated, and the residue purified by CC (SiO_2, toluene). The residue of the product fractions was recrystallized from Et_2O/MeOH/hexane: 64 mg (82%) of **17**. Pale yellow crystals. M.p. 114–115°. UV (MeOH): 239 (4.26), 337 (3.85). ^{1}H-NMR ($CDCl_3$): 8.25 (*s*, H–C(7)); 7.40–7.20 (*m*, 5 arom. H); 4.35 (*t*, H–C(2′)); 3.66 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)); 3.47 (*dd*, 1 H–C(1′)); 3.40 (*dd*, 1 H–C(1′)); 2.29 (*q*, Me*C*H_2S); 1.08 (*t*, *Me*CH_2S). Anal. calc. for $C_{18}H_{20}N_4O_2S$ (356.4): C 60.65, H 5.66, N 15.72; found: C 60.41, H 5.67, N 15.71.

*(2*E*)-2-Bromo-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-6-yl)prop-2-enoic Acid Methyl Ester* (**18**). To a soln. of **4** (0.1 g, 0.23 mmol) in dioxane (20 ml) was added 0.67M DBU in dioxane (0.92 ml, 0.62 mmol), and the mixture was stirred for 2 h at r.t. After dilution with AcOEt (150 ml), the mixture was washed with H_2O (3 × 50 ml), the org. phase dried (Na_2SO_4) and concentrated, the residue treated with MeOH, and the solid collected and dried *in vacuo:* 55 mg (68%) of **18**. Pale orange powder. M.p. 204°. UV(MeOH): (254 (4.08)), 285 (4.25), 360 (4.01). ^{1}H-NMR ($CDCl_3$): 8.55 (*s*, H–C(7)); 7.26 (*s*, 1 olef. H); 4.02 (*s*, MeO); 3.70 (*s*, Me–N(1)); 3.52 (*s*, Me–N(3)). Anal. calc. for $C_{12}H_{11}BrN_4O_4$ (355.1): C 40.58, H 3.12, N 15.78; found: C 40.85, H 3.26, N 15.49.

2,2-Dimethoxy-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-6-yl)propanoic Acid Methyl Ester (**19**). In a soln. of Na (0.23 g, 10 mmol) in MeOH (10 ml), **4** (0.44 g, 1 mmol) was treated at r.t. for 2 h

with stirring. After neutralization with AcOH to pH 7 and evaporation, the residue was dissolved in H_2O (20 ml) and extracted with CH_2Cl_2 (2 × 20 ml), and the org. phase dried (Na_2SO_4) and concentrated: 0.26 g (77%) of **19**. Purification was achieved by prep. TLC (silica gel, 20 × 20 × 0.2 cm plate, Et_2O). The fastest moving band was eluted with CH_2Cl_2/MeOH 4:1 (R_f 0.66) and the eluent evaporated: 98 mg (29%) of pure **19**. M.p. 159°. UV (MeOH): 203 (4.06), 238 (4.22), 333 (3.53). ^{1}H-NMR ($CDCl_3$): 8.99 (*s*, H–C(7)); 3.74 (*s*, COOMe); 3.54 (*s*, Me–N(1)); 3.52 (*s*, Me–N(3)); 3.82 (*s*, CH_2); 3.23 (*s*, 2 MeO). Anal. calc. for $C_{14}H_{18}N_4O_6$ (338.3): C 49.71, H 5.36, N 16.56; found: C 50.03, H 5.41, N 16.48.

*4,5,6,7,8,9-Hexahydro-2-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-6-yl)-3*H*-2a,5a-diazabenzo[*cd*]azulene-1-carboxylic Acid Methyl Ester* (**20**). To a soln. of **4** (0.105 g, 0.23 mmol) in abs. dioxane (2 ml) was added DBU (0.1 ml, 0.67 mmol), and the mixture was stirred at r.t. for 2 h. After evaporation, the residue was treated with MeOH and the precipitate collected, washed with MeOH, and dried *in vacuo:* 33 mg (34%) of **20**. Dark purple powder. M.p. 223°. UV (MeOH): 245 (4.31), 258 (sh, 4.20), 310 (sh, 4.16), 330 (4.27), 373 (3.92), 415 (3.83), 473 (4.01), 496 (sh, 3.98), 536 (3.82). ^{1}H-NMR ($CDCl_3$): 6.58 (*s*, CH=); 3.85–3.73 (*m*, 1 CH_2); 3.70 (*s*, MeO); 3.65 (*s*, Me–N(1)); 3.60–3.50 (*m*, 1 CH_2); 3.49 (*s*, Me–N(3)); 3.40 (*t*, 1 CH_2); 2.91–2.85 (*m*, 1 CH_2); 2.40–2.20 (*m*, 1 CH_2); 2.00–1.80 (*m*, 2 CH_2). MS: 424. Anal. calc. for $C_{21}H_{24}N_6O_4 \cdot 0.5\ H_2O$ (433.5): C 58.18, H 5.81, N 19.39; found: C 58.43, H 5.71, N 19.18.

*(2*E*)-3-(1,2,3,4-Tetrahydro-1,3-dimethyl-2,4-dioxopteridin-7-yl)prop-2-enoic Acid Methyl Ester* (**22**) [15]. ^{1}H-NMR ($CDCl_3$): 8.63 (*s*, H–C(6)); 7.73 (*d*, *J* = 12, H–C(3′)); 7.15 (*d*, *J* = 12, H–C(2′)); 3.87 (*s*, MeO); 3.74 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)). ^{1}H-NMR ((D_6)DMSO): 8.89 (*s*, H–C(6)); 7.81 (*d*, *J* = 12, H–C(3′)); 7.18 (*d*, *J* = 12, H–C(2′)); 3.79 (*s*, MeO); 3.57 (*s*, Me–N(1)); 3.33 (*s*, Me–N(3)).

*(2*E*)-3-(1,2,3,4-Tetrahydro-1,3-dimethyl-2,4-dioxopteridin-7-yl)but-2-enoic Acid Methyl Ester* (**23a**) *and (2*Z*)-3-(1,2,3,4-Tetrahydro-1,3-dimethyl-2,4-dioxopteridin-7-yl)but-2-enoic Acid Methyl Ester* (**23b**). To a soln. of 7-acetyl-1,3-dimethylpteridine-2,4-(1*H*,3*H*)-dione [21] (**59**; 1.17 g, 5 mmol) in dioxane (50 ml) was added (triphenylphosphoranylidene)acetic acid methyl ester (2.0 g, 6 mmol), and the mixture was stirred at r.t. for 3 days. After evaporation, and the residue was crystallized twice from MeOH (60 ml) to give 1.1 g (76%) of **23b** as colorless needles. The combined filtrates were evaporated and analyzed by TLC (AcOEt): two close spots. Separation of 150 mg of crude material was achieved by prep. TLC (silica gel, 20 × 20 cm plate, AcOEt). Elution of the faster moving band gave, after evaporation, 50 mg of **23a** as a colorless crystal powder.

Data of **23a**: M.p. 194°. UV (MeOH): 206 (4.26), 237 (4.14), 340 (3.95). ^{1}H-NMR ((D_6)DMSO): 9.00 (*s*, H–C(6)); 7.00 (*s*, C*H*CO_2Me); 3.75 (*s*, MeO); 3.57 (*s*, Me–N(1)); 3.33 (*s*, Me–N(3)); 2.59 (*s*, MeC=CH). ^{1}H-NMR ($CDCl_3$): 8.77 (*s*, H–C(6)); 6.84 (*s*, *CH*CO_2Me); 3.79 (*s*, MeO); 3.71 (*s*, Me–N(1)); 3.51 (*s*, Me–N(3)); 2.64 (*s*, MeC=CH). Anal. calc. for $C_{13}H_{14}N_4O_4$ (290.3): C 53.78, H 4.86, N 19.30; found: C 53.98, H 4.87, N 19.12.

Data of **23b**: M.p. 185°. UV (MeOH): 205 (4.38), 228 (4.39), 256 (sh, 4.15), 354 (4.12). ^{1}H-NMR ((D_6)DMSO): 8.58 (*s*, H–C(6)); 6.38 (*s*, C*H*CO_2Me); 3.54 (*s*, MeO); 3.50 (*s*, Me–N(1)); 3.32 (*s*, Me–N(3)); 2.27 (*s*, *Me*C=CH). ^{1}H-NMR ($CDCl_3$): 8.48 (*s*, H–C(6)); 6.19 (*s*, C*H*CO_2Me); 3.69 (*s*, MeO); 3.61 (*s*, Me–N(1)); 3.54 (*s*, Me–N(3)); 2.28 (*s*, *Me*C=CH). Anal. calc. for $C_{13}H_{14}N_4O_4$ (290.3): C 53.78, H 4.86, N 19.30; found: C 53.68, H 4.82, N 18.90.

*7-(1,2-Dibromo-2-phenylethyl)-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**24**). To a suspension of 1,3-dimethyl-7-[(1*E*)-2-phenylethenyl]pteridine-2,4(1*H*,3*H*)-dione [15] (**21**; 0.6 g, 2.04 mmol) in $CHCl_3$ (15 ml) was added 2M Br_2 in $CHCl_3$ (1.5 ml, 3 mmol), and the mixture was stirred at r.t. for 3 h. After evaporation, the residue was treated with MeOH and the precipitate collected and dried *in vacuo:* 0.878 g (95%) of **24**. Colorless powder. M.p. 187–188°. UV (MeOH): 241 (4.25), 341 (4.06). ^{1}H-NMR ($CDCl_3$): 8.68 (*s*, H–C(6)); 7.60–7.50 (*m*, 2 arom. H); 7.50–7.40 (*m*, 3 arom. H); 5.75 (*d*, H–C(1′)); 5.67 (*d*, H–C(2′)); 3.81 (*s*, Me–N(1)); 3.57 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{14}Br_2N_4O_2$ (454.1): C 42.32, H 3.11, N 12.34; found: C 42.11, H 3.12, N 12.41.

*7-(4,5,6,7,8,9-Hexahydro-1-phenyl-3*H*-2a,5a-diazabenzo[*cd*]azulen-2-yl)-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**25**). To a suspension of **24** (0.105 g, 0.23 mmol) in abs. dioxane (3 ml) was added DBU (0.1 ml, 0.67 mmol), and the mixture was stirred at 90° for 30 min. After evaporation, the residue was treated with MeOH, the precipitate collected, washed with MeOH, and dried *in vacuo:* 24 mg (25%) of **25**. Dark green powder. M.p. 285–287° (dec.). UV (MeOH): 237 (4.36), 321 (3.69), 370 (3.56), 500 (4.48). ^{1}H-NMR ($CDCl_3$): 7.72 (*s*, CH=); 7.45–7.30 (*m*, 3 arom. H); 7.20–7.10 (*m*, 2 arom. H); 4.40 (*m*,

1 CH_2); 3.63 (*s*, Me–N(1)); 3.47 (*s*, Me–N(3)); 3.20–3.10 (*m*, 1 CH_2); 2.40–2.30 (*m*, 1 CH_2); 1.95–1.80 (*m*, 1 CH_2); 1.65–1.50 (*m*, 1 CH_2). MS: 442. Anal. calc. for $C_{25}H_{26}N_6O_2$ (442.5): C 67.86, H 5.92, N 18.99; found: C 67.40, H 5.89, N 18.85.

2,3-Dibromo-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-7-yl)propanoic Acid Methyl Ester (**26**). To a suspension of **22** [15] (1.79 g, 6.5 mmol) in $CHCl_3$ (70 ml) was added Br_2 (0.7 ml, 14 mmol), and the mixture was stirred at r.t. for 3 h. After evaporation, the residue was treated with MeOH and the precipitate collected, washed with MeOH, dried (2.34 g), and purified by recrystallization from AcOEt/hexane: 1.93 g (68%) of **26**. Colorless crystals. M.p. 144–145°. UV (MeOH): 240 (4.14), 343 (3.90). ^{1}H-NMR ($CDCl_3$): 8.56 (*s*, H–C(6)); 5.58 (*d*, H–C(2′)); 5.15 (*d*, H–C(1′)); 3.94 (*s*, MeO); 3.74 (*s*, Me–N(1)); 3.56 (*s*, Me–N(3)). Anal. calc. for $C_{12}H_{12}Br_2N_4O_4$ (436.1): C 33.05, H 2.77, N 12.85; found: C 33.17, H 2.80, N 12.87.

*7-[(1*E*)-1-Bromo-2-phenylethenyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**27**). To a suspension **24** (0.1 g, 0.22 mmol) in abs. MeOH (2 ml) was added 2.2M MeONa in MeOH (0.5 ml, 1.1 mmol), and the mixture was stirred at r.t. for 3 h. The precipitate was collected, washed with MeOH, and dried *in vacuo:* 58 mg (71%) of **27**. Pale yellow powder. M.p. 245–246° (from DMF). UV (MeOH): 243 (4.15), 372 (4.15). ^{1}H-NMR ($CDCl_3$): 9.11 (*s*, H–C(6)); 8.34 (*s*, CH=); 7.90–7.80 (*m*, 2 arom. H); 7.50–7.40 (*m*, 3 arom. H); 3.78 (*s*, Me–N(1)); 3.57 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{13}BrN_4O_2$ (373.2): C 51.49, H 3.51, N 15.01; found: C 51.35, H 3.56, N 15.15.

*7-(2,2-Dimethoxy-2-phenylethyl)-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**30**). To a suspension of **24** (0.1 g, 0.22 mmol) in abs. MeOH (2 ml) was added 2.2M MeONa in MeOH (0.5 ml, 1.1 mmol), and then the mixture was refluxed for 30 min. After cooling, the mixture was neutralized with dil. NH_4Cl soln. and extracted with AcOEt, the extract washed with H_2O, dried (Na_2SO_4), and concentrated. TLC Analysis showed two substances **30** and **31** which were separated by prep. TLC (silica gel, AcOEt/acetone 7:3). The faster running band was eluted with $CHCl_3$ and the eluent evaporated to give a syrup which became crystalline on treatment with Et_2O: 47 mg (60%) of **30**. M.p. 134–138°. UV (MeOH): 202 (4.35), 236 (4.36), 335 (4.09), 348 (sh, 4.00). ^{1}H-NMR ($CDCl_3$): 8.90 (*s*, H–C(6)); 7.60–7.40 (*m*, 5 arom. H); 3.70 (*s*, Me–N(1)); 3.66 (*s*, Me–N(3)); 3.48 (*s*, CH_2); 3.23 (*s*, 2 MeO). Anal. calc. for $C_{18}H_{20}N_4O_4$ (356.4): C 60.67, H 5.60, N 15.72; found: C 60.12, H 5.56, N 15.44.

*7,8-Dihydro-1,3-dimethyl-7-(2-oxo-2-phenylethylidene)pteridine-2,4(1*H*,3*H*)-dione* (**31**) *and 1,3-Dimethyl-7-(2-oxo-2-phenylethyl)pteridine-2,4(1*H*,3*H*)-dione* (**60**). *a*) To a suspension of **24** (0.1 g, 0.22 mmol) in abs. MeOH (2 ml) was added 2.2M MeONa in MeOH (0.5 ml, 1.1 mmol), and the mixture was refluxed for 30 min. After cooling, the mixture was neutralized with dil. HCl soln. and then concentrated to 1 ml, and the precipitate collected, washed with H_2O, and dried *in vacuo:* 58 mg (85%) of **31**. Yellow powder. M.p. 250–251°.

b) As described for **52**, with 1,3-dimethyl-7-(phenylethynyl)pteridine-2,4(1*H*,3*H*)-dione (**56**; 0.292 g, 1 mmol), CF_3COOH (15 ml), HgO (0.1 g), and H_2O (1.5 ml). Purification by CC (SiO_2, $CHCl_3$/AcOEt 3:1) gave 0.25 g (80%) of **31**. Yellow powder. M.p. 250–251°. Recrystallization from MeOH gave yellow needles. UV (MeOH): 203 (4.25), 237 (4.21), 313 (3.83), 411 (4.36), 428 (sh, 4.30). ^{1}H-NMR ($CDCl_3$): 13.65 (*s*, H–N(8)); 8.38 (*s*, H–C(6)); 7.91–7.48 (*m*, 5 arom. H); 6.35 (*s*, C*H*COPh); 3.75 (*s*, Me–N(1)); 3.54 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{14}N_4O_3$ (310.3): C 61.93, H 4.55, N 18.48; found: C 61.90, H 4.59, N 18.04.

*(2*Z*)-2-Methoxy-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-7-yl)prop-2-enoic Acid Methyl Ester* (**32**). To a suspension of **26** (0.1 g 0.23 mmol) in abs. MeOH (4 ml) was added 2.2M MeONa (0.5 ml, 1.1 mmol), and the mixture was stirred at r.t. for 15 min. NH_4Cl and H_2O (10 ml) were added. Then the mixture was extracted with $CHCl_3$ (2 × 25 ml), the org. phase dried (Na_2SO_4), and concentrated, and the resulting syrup crystallized from $CHCl_3$/hexane: 20 mg (28%) of **32**. Colorless powder. M.p. 192° (decomp.). UV (MeOH): 227 (4.22), 254 (sh, 3.92), 291 (sh, 3.68), 363 (4.31), 371 (sh, 4.30). ^{1}H-NMR ($CDCl_3$): 8.37 (*s*, H–C(6)); 5.92 (*s*, 1 olef. H); 3.90 (*s*, MeOOC); 3.87 (*s*, *Me*OC=CH); 3.61 (*s*, Me–N(1)); 3.52 (*s*, Me–N(3)). MS: 306. Anal. calc. for $C_{13}H_{14}N_4O_5$ (306.3): C 50.98, H 4.61, N 18.29; found: C 50.79, H 4.60, N 18.18.

*(2*E*)-3-Bromo-3-(1,2,3,4-tetrahydro-1,3-dimethyl-2,4-dioxopteridin-7-yl)prop-2-enoic Acid Methyl Ester* (**33**). To a soln. of **26** (0.15 g, 0.34 mmol) in dioxane (8 ml) was added Et_3N (0.1 ml, 0.72 mmol), and the mixture was stirred for 8 h at r.t. After addition of AcOEt (25 ml), the org. phase was washed

with H_2O (2×15 ml), dried (Na_2SO_4), and concentrated, the residue treated with Et_2O, and the solid collected and dried *in vacuo:* 66 mg (55%) of **33**. M.p. 141–142°. UV (MeOH): 206 (4.26), 226 (4.19), 353 (3.98). ^{1}H-NMR ($CDCl_3$): 8.61 (*s*, H–C(6)); 6.86 (*s*, 1 olef. H); 3.69 (*s*, MeO); 3.65 (*s*, Me–N(1)); 3.56 (*s*, Me–N(3)). Anal. calc. for $C_{12}H_{11}BrN_4O_4$ (355.2): C 40.58, H 3.12, N 15.78; found: C 40.78, H 3.17, N 15.83.

*6-[(1*S*,2*S*)-1,2-Dihydroxy-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**34**). A mixture of *AD-mix-α* (4.8 g) in H_2O (18 ml), *t*-BuOH (36 ml) and methanesulfonamide (0.323 g, 3.4 mmol) was cooled to 0°, and then **1** (1.0 g, 3.4 mmol) was added. The suspension was stirred at r.t. for 27 h, then Na_2SO_3 (5.1 g) was added and the mixture stirred for another hour. The precipitate was collected, washed with H_2O, and then dried in a vacuum desiccator over P_4O_{10} to give 0.89 g of a yellowish powder. The reaction filtrate was extracted with $CHCl_3$, the aq. layer again extracted with $CHCl_3$ (2×30 ml), the combined org. phase washed with 2N KOH, dried (Na_2SO_4), and concentrated, and the residue purified by CC (SiO_2, $CHCl_3$, then $CHCl_3$/MeOH 95:5): 0.96 g (86%) of **34**. Recrystallization from MeOH gave yellowish crystals. TLC ($CHCl_3$/MeOH 9:1): R_f 0.47. M.p. 239–240°. $[\alpha]_D = +40$ ($c = 0.8$, DMF). UV (MeOH): 204 (4.36), 240 (4.28), 249 (sh, 4.18), 336 (3.87), 347 (sh, 3.78). ^{1}H-NMR ((D_6)DMSO): 8.67 (*s*, H–C(7)); 7.36–7.20 (*m*, 5 arom. H); 5.78 (*d*, $J = 5.8$, OH–C(1′)); 5.45 (*d*, $J = 5.1$, OH–C(2′)); 4.91–4.83 (*m*, H–C(1′), H–C(2′)); 3.53 (*s*, Me–N(1)); 3.32 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{16}N_4O_4$ (328.3): C 58.53, H 4.91, N 17.06; found: C 58.66, H 5.05, N 17.24.

*6-[(1*R*,2*R*)-1,2-Dihydroxy-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**35**). As described for **34**, with *AD-mix-β* (4.8 g) and **1** (1.0 g): 0.97 g (87%) of **35**. Pale yellow crystals. TLC ($CHCl_3$/MeOH 9:1). M.p. 240–242°. R_f 0.50. $[\alpha]_D = -38$ ($c = 0.8$, DMF). UV (MeOH): 205 (4.33), 240 (4.30), 250 (sh, 4.15), 336 (3.88), 351 (sh, 3.72). ^{1}H-NMR ((D_6)DMSO): 8.65 (*s*, H–C(7)); 7.35–7.19 (*m*, 5 arom. H); 5.76 (*d*, $J = 5.8$, OH–C(1′)); 5.43 (*d*, $J = 5.2$, OH–C(2′)); 4.90–4.82 (*m*, H–C(1′), H–C(2′)); 3.52 (*s*, Me–N(1)); 3.31 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{16}N_4O_4$ (328.3): C 58.53, H 4.91, N 17.06; found: C 57.84, H 4.95, N 16.83.

*7-[(1*S*,2*S*)-1,2-Dihydroxy-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**36**). To a mixture of *AD-mix-α* (4.8 g) in H_2O (18 ml) and *t*-BuOH (36 ml) was added methanesulfonamide (0.325 g, 3.4 mmol), followed by **21** (1.0 g, 3.4 mmol). The suspension was stirred at r.t. for 24 h, then Na_2SO_3 (5.1 g) was added and the mixture stirred for 2 h. After dilution with AcOEt (50 ml), the aq. phase was extracted with AcOEt (2×25 ml), the combined org. phase dried (Na_2SO_4) and concentrated, and the residue recrystallized from MeOH: 0.4 g (36%) of **36**. Yellowish crystals. M.p. 138° (shrinking), 145–147°. UV (MeOH): 204 (4.22), 237 (4.04), 333 (3.85). ^{1}H-NMR ((D_6)DMSO): 8.55 (*s*, H–C(6)); 7.27 (*m*, 3 arom. H); 6.81 (*m*, 2 arom. H); 5.91 (*d*, OH–C(1′)); 5.53 (*d*, OH–C(2′)); 4.96 (*m*, H–C(1′)); 4.80 (*m*, H–C(2′)); 3.44 (*s*, Me–N(1)); 3.30 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{16}N_4O_4$ (328.3): C 58.53, H 4.91, N 17.06; found: C 58.35, H 4.78, N 17.21.

*7-[(1*R*,2*R*)-1,2-Dihydroxy-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**37**). As described for **36**, with *AD-mix-β* (4.8 g) and **21** (1.0 g, 3.4 mmol): 0.65 g (58%) of **37**. Yellowish crystals. M.p. 130–135° (shrinking), 145°. UV (MeOH): 204 (4.21), 237 (4.05), 333 (3.87). ^{1}H-NMR ((D_6)DMSO): 8.56 (*s*, H–C(6)); 7.27 (*m*, 5 arom. H); 5.91 (*d*, OH–C(1′)); 5.53 (*d*, OH–C(2′)); 4.93 ('*t*', H–C(1′)); 4.82 ('*t*', H–C(2′)); 3.46 (*s*, Me–N(1)); 3.31 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{16}N_4O_4 \cdot H_2O$ (346.3): C 55.81, H 5.27, N 16.27; found: C 56.06, H 5.10, N 16.08.

*6-[(1*S*,2*S*)-1,2-Bis(acetyloxy)-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**38**). To a suspension of **34** (0.66 g, 2.0 mmol) in CH_2Cl_2 (15 ml) was added pyridine (1 ml) and then, after cooling with ice, dropwise Ac_2O (4 ml). The mixture was stirred at r.t. for 24 h, then evaporated to a yellowish syrup. This residue was purified by CC (SiO_2, AcOEt/hexane 1:1): 0.794 g (96%) of **38**. Yellowish solid foam which was recrystallized from AcOEt/hexane. Yellowish crystals. M.p. 131–132°. UV (MeOH): 242 (4.40), 256 (sh, 4.19), 332 (3.98). ^{1}H-NMR ($CDCl_3$): 8.46 (*s*, H–C(7)); 7.37–7.27 (*m*, 5 arom. H); 6.39 (*d*, H–C(1′)); 6.29 (*d*, H–C(2′)); 3.67 (*s*, Me–N(1)); 3.54 (*s*, Me–N(3)); 2.10 (*s*, Ac); 2.08 (*s*, Ac). Anal. calc. for $C_{20}H_{20}N_4O_6$ (412.4): C 58.25, H 4.89, N 13.59; found: C 58.18, H 4.91, N 13.61.

*6-[(1*R*,2*R*)-1,2-Bis(acetyloxy)-2-phenylethyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**39**). As described for **38**, with **35** (0.66 g, 2.0 mmol). CC gave 0.81 g (98%) of **39**. Yellowish foam which was recrystallized from AcOEt/hexane. Yellowish crystals. M.p. 131–132°. UV (MeOH): 242 (4.38), 256 (sh, 4.16), 332 (3.97). ^{1}H-NMR ($CDCl_3$): 8.45 (*s*, H–C(7)); 7.37–7.27 (*m*, 5 arom. H); 6.39 (*d*, H–C(1′)); 6.29

(*d*, H–C(2′)); 3.67 (*s*, Me–N(1)); 3.54 (*s*, Me–N(3)); 2.10 (*s*, Ac); 2.08 (*s*, Ac). Anal. calc. for $C_{20}H_{20}N_4O_6$ (412.4): C 58.25, H 4.89, N 13.59; found: C 58.38, H 4.97, N 13.57.

*(6*RS*)-6-[(1*S*,2*S*)-1,2-Bis(acetyloxy)-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**40**). A soln. of **38** (2.35 g, 5.3 mmol) in MeOH (30 ml) was reduced under H_2 in the presence of PtO_2 in a shaking apparatus. After 24 h, the catalyst was filtered off and the filtrate evaporated to a syrup. Then a mixture of formic acid (20 ml) and Ac_2O (20 ml) was added and stirred for 2 h. After evaporation, the residue was purified by CC (SiO_2, $CHCl_3$, then $CHCl_3$/MeOH 98:2): 2.17 g (92%) of **40**. Yellowish solid. Recrystallization from AcOEt/hexane gave yellowish crystals. M.p. 199°. UV (MeOH): 255 (sh, 2.99), 285 (4.20). ^{1}H-NMR ((D$_6$)DMSO): 8.53, 8.49 (2*s*, CHO); 7.60, 7.53 (2*d*, H–N(8)); 7.30–7.10 (*m*, 5 arom. H); 5.96, 5.56 (2*d*, H–C(6)); 5.05–4.90 (*m*, H–C(1′), H–C(2′)); 3.50–3.31 (*m*, CH_2(7)); 3.34, 3.25 (2*s*, Me–N(1)); 3.24–3.20 (*m*, CH_2(7)); 3.22, 3.11 (2*s*, Me–N(3)); 2.20, 2.12 (2*s*, AcO–C(1′)); 1.88, 1.68 (2*s*, AcO–C(2′)). Anal. calc. for $C_{21}H_{24}N_4O_7 \cdot H_2O$ (462.4): C 54.54, H 5.67, N 12.11; found: C 54.55, H 5.77, N 12.08.

*(6*RS*)-6-[(1*R*,2*R*)-1,2-Bis(acetyloxy)-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**41**). As described for **40**, with **39** (2.35 g, 5.3 mmol): 2.05 g (87%) of **41**. Yellowish solid. M.p. 198°. UV (MeOH): 205 (4.31), 252 (sh, 3.79), 284 (4.10). ^{1}H-NMR ((D$_6$)DMSO): 8.53, 8.49 (2*s*, CHO); 7.62, 7.53 (2*d*, H–N(8)); 7.30–7.11 (*m*, 5 arom. H); 5.96, 5.56 (2*d*, H–C(6)); 5.07–4.97 (*m*, H–C(1′), H–C(2′)); 3.50–3.31 (*m*, CH_2(7)); 3.34, 3.25 (2*s*, Me–N(1)); 3.24–3.18 (*m*, CH_2(7)); 3.22, 3.11 (2*s*, Me–N(3)); 2.20, 2.12 (2*s*, AcO–C(1′)); 1.88, 1.68 (2*s*, AcO–C(2′)). Anal. calc. for $C_{21}H_{24}N_4O_7 \cdot H_2O$ (462.4): C 54.54, H 5.67, N 12.11; found: C 54.23, H 5.82, N 12.07.

*(6*RS*)-6-[(1*S*,2*S*)-1,2-Dihydroxy-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**42**). A soln. of **40** (0.2 g, 0.45 mmol) in abs. MeOH (30 ml) was treated with a 2.2M NaOMe in MeOH (0.5 ml) by stirring for 4 h. After neutralization by addition of *Amberlite IR-120*, the mixture was filtered, the filtrate concentrated, and the residue purified by CC (SiO_2, $CHCl_3$/MeOH 98:2, then $CHCl_3$/MeOH 95:5): 0.094 g (58%) of **42**. Colorless solid which was recrystallized from $CHCl_3$/MeOH 95:5. M.p. 145–146° (dec.). UV (MeOH): 252 (sh, 3.94), 285 (4.17). ^{1}H-NMR ((D$_6$)DMSO): 8.60, 8.55 (*s*, CHO); 7.60, 7.50 (br. *s*, H–N(8)); 7.36–7.10 (*m*, 5 arom. H); 5.41, 5.25 (*d*, OH–C(1′)); 4.80, 4.73 (*m*, H–C(6)); 4.70, 4.62 (*d*, H–C(1′)); 4.45, 4.25 (*d*, OH–C(2′)); 3.77, 3.70 (*dd*, 1 H–C(7)); 3.4–3.1 (*m*, 1 H–C(7), H–C(2′)); 3.31, 3.22 (*s*, Me–N(1)); 3.14, 3.13 (*s*, Me–N(3)). Anal. calc. for $C_{17}H_{20}N_4O_5 \cdot H_2O$ (378.4): C 53.96, H 5.86, N 14.81; found: C 54.22, H 5.79, N 14.85.

rel-*(6*S*)-6-[(1*S*,2*S*)-1,2-Dihydroxy-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**43**) *and* rel-*(6*R*)-6-[(1*S*,2*S*)-1,2-Dihydroxy-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**44**). The diastereoisomer mixture **42** (0.5 g) was separated by prep. TLC (silica gel, 0.1 g of **42** per 20 × 20 × 0.2 cm plate, developing twice with AcOEt/MeOH 4:1). The faster moving band was assigned to **43** and the slower moving band to **44**. Each band was extracted with $CHCl_3$/MeOH, the extract concentrated, and the residue dried under high vacuum.

Data of **43**: Yield 0.18 g. M.p. 130–135° (shrinking), 155–160°. R_f (AcOEt/MeOH 4:1) 0.30. UV (MeOH): 205 (4.29), 252 (sh, 3.75), 285 (4.09). ^{1}H-NMR ((D$_6$)DMSO): 8.52 (*s*, CHO); 7.61 (*d*, H–N(8)); 7.24–7.14 (*m*, 5 arom. H); 5.23 (*d*, OH–C(1′)); 4.81 (*dd*, H–C(6)); 4.71 (*d*, OH–C(2′)); 4.48 (*d*, H–C(1′)); 3.78 (*dd*, H–C(2′)); 3.26 (*s*, Me–N(1)); 3.21 (*s*, Me–N(3)); 3.13 (*m*, CH_2(7)). Anal. calc. for $C_{17}H_{20}N_4O_5 \cdot 0.5\ H_2O$ (369.4): C 55.27, H 5.73, N 15.17; found: C 55.31, H 5.76, N 14.70.

Data of **44**: Yield 0.15 g. M.p. 130–135° (shrinking), 185°. R_f (AcOEt/MeOH 4:1) 0.22. UV (MeOH): 205 (4.31), 252 (sh, 3.80), 285 (4.09). ^{1}H-NMR ((D$_6$)DMSO): 8.61 (*s*, CHO); 7.49 (*d*, H–N(8)); 7.36–7.20 (*m*, 5 arom. H); 5.41 (*d*, OH–C(1′)); 4.74 (*dd*, H–C(6)); 4.64 (*dd*, H–C(1′)); 4.26 (*d*, OH–C(2′)); 3.73 (*dd*, H–C(2′)); 3.40 (*m*, CH_2(7)); 3.31 (*s*, Me–N(1)); 3.15 (*s*, Me–N(3)). Anal. calc. for $C_{17}H_{20}N_4O_5 \cdot H_2O$ (378.4): C 53.96, H 5.86, N 14.81; found: C 53.76, H 6.13, N 14.55.

*(6*RS*)-6-[(1*R*,2*R*)-1,2-Dihydroxy-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**45**). As described for **42**, with **41**: 0.1 g (58%) of **45**. Colorless solid which was recrystallized from $CHCl_3$/MeOH 95:5. M.p. 115–135° (shrinking), 150°. UV (MeOH): UV (MeOH): 205 (4.33), 252 (sh, 3.80), 284 (4.11). ^{1}H-NMR ((D$_6$)DMSO): 8.61, 8.52 (2*s*, CHO); 7.61, 7.50 (2*d*, H–N(8)); 7.37–7.15 (*m*, 5 arom. H); 5.42, 5.21 (2*d*, OH–C(1′)); 4.84–4.4.64 (*m*, H–C(6), OH–C(2′)); 4.49, 4.26 (2*d*, H–C(1′)); 3.81–3.68 (*m*, H–C(2′)); 3.36, 3.31 (2*s*, Me–N(1)); 3.26, 3.15 (2*s*,

Me–N(3)); 3.35–3.15 (*m*, CH_2(7)). Anal. calc. for $C_{17}H_{20}N_4O_5 \cdot H_2O$ (378.4): C 53.96, H 5.86, N 14.81; found: C 54.08, H 5.74, N 14.66.

rel-*(6*R*)-6-[(1*R,*2*R*)-1,2-Dihydroxy-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**46**) *and* rel-*(6*S*)-6-[(1*R,*2*R*)-1,2-Dihydroxy-2-phenylethyl]-1,2,3,4,5,6,7,8-octahydro-1,3-dimethyl-2,4-dioxopteridine-5-carboxaldehyde* (**47**). As described for **43**/**44**, with the diastereoisomer mixture **45** (0.5 g), assigning the faster moving band to **46** and the slower moving band to **47**.

Data of **46**: Yield 0.16 g. M.p. 115–130° (shrinking), 152°. R_f (AcOEt/MeOH 4:1) 0.30. UV (MeOH): 205 (4.31), 252 (sh, 3.79), 284 (4.11). ^{1}H-NMR ((D$_6$)DMSO): 8.52 (*s*, CHO); 7.61 (*d*, H–N(8)); 7.27–7.15 (*m*, 5 arom. H); 5.21 (*d*, OH–C(1′)); 4.83 (*dd*, H–C(6)); 4.79 (*d*, OH–C(2′)); 4.49 (*d*, H–C(1′)); 3.78 (*dd*, H–C(2′)); 3.36 (*s*, Me–N(1)); 3.26 (*s*, Me–N(3)); 3.25–3.15 (*m*, CH_2(7)). Anal. calc. for $C_{17}H_{20}N_4O_5 \cdot 0.5\ H_2O$ (369.4): C 55.27, H 5.73, N 15.17; found: C 55.16, H 5.64, N 14.53.

Data of **47**: Yield 0.14 g. M.p. 130–135° (shrinking), 150°. R_f (AcOEt/MeOH 4:1) 0.22. UV (MeOH): 205 (4.30), 252 (sh, 3.77), 284 (4.10). ^{1}H-NMR ((D$_6$)DMSO): 8.61 (*s*, CHO); 7.50 (*d*, H–N(8)); 7.37–7.20 (*m*, 5 arom. H); 5.41 (*d*, OH–C(1′)); 4.74 (*dd*, H–C(6)); 4.65 (*d*, H–C(1′)); 4.26 (*d*, OH–C(2′)); 3.70 (*dd*, H–C(2′)); 3.40 (*m*, CH_2(7)); 3.36 (*s*, Me–N(1)); 3.15 (*s*, Me–N(3)). Anal. calc. for $C_{17}H_{20}N_4O_5 \cdot H_2O$ (378.4): C 53.96, H 5.86, N 14.81; found: C 53.81, H 6.24, N 14.54.

*1,3-Dimethyl-6-(phenylethynyl)pteridine-2,4(1*H*,2*H*)-dione* (**49**) [17]. *a*) To a soln. of **3** (0.1 g, 0.22 mmol) in dry dioxane (2 ml) was added DBU (0.1 ml, 0.67 mmol), and the mixture was stirred at 50° for 1 h. After evaporation, the residue was treated with MeOH and the precipitate collected, washed with MeOH, and dried *in vacuo:* 36 mg (56%) of **49**. Pale yellow powder. M.p. 227° ([17]: 221–223°).

b) A mixture of 6-chloro-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione (**48**; 0.13 g, 0.57 mmol), CuI (5 mg), [Pd(Ph_3P)$_4$] (10 mg), and Et_3N (0.3 ml) in dioxane (5 ml) was treated with phenylethyne (0.1 ml, 0.95 mmol) at 100° for 10 min. After dilution with AcOEt (20 ml), the mixture was extracted with H_2O (3 × 10 ml), the org. phase dried (Na_2SO_4) and concentrated, and the residue purified by CC ($CHCl_3$): 0.107 g (64%) of crude **49**. Recrystallization of the crystal powder from EtOH (25 ml)/H_2O (1 ml) gave 0.079 g (47%) of **49**. Yellowish crystals. M.p. 227°. UV (MeOH): 238 (sh, 4.02), 248 (sh, 4.10), 259 (sh, 4.13), 293 (4.45), 307 (sh, 4.41), 364 (4.16). ^{1}H-NMR ($CDCl_3$): 8.77 (*s*, H–C(7)); 7.62–7.43 (*m*, 5 arom. H); 3.74 (*s*, Me–N(1)); 3.56 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{12}N_4O_2$ (292.3): C 65.75, H 4.14, N 19.17; found: C 65.95, H 4.27, N 18.98.

*1,3-Dimethyl-6-[(trimethylsilyl)ethynyl]pteridine-2,4(1*H*,3*H*)-dione* (**50**) [20]. To a mixture of **48** [19] (0.26 g, 1.14 mmol), CuI (10 mg), [Pd(Ph_3P)$_4$] (20 mg), and Et_3N (0.6 ml) in dioxane (10 ml) was added (trimethylsilyl)ethyne (0.25 ml, 1.7 mmol) and then heated to 100° for 30 min. After dilution with AcOEt (40 ml), the mixture was extracted with H_2O (3 × 20 ml), the org. layer dried (Na_2SO_4) and concentrated, and the residue purified by CC (SiO_2, $CHCl_3$): 0.3 g (96%) of crude **50**. Recrystallization from a small amount of EtOH (8 ml) yielded 0.25 g (76%) of **50**. Colorless crystals. M.p. 129–130° ([20]: 131–131.5°). UV (MeOH): 260 (sh, 4.24), 282 (4.34), 354 (4.05), 368 (sh, 3.93). ^{1}H-NMR ($CDCl_3$): 8.68 (*s*, H–C(7)); 3.71 (*s*, Me–N(1)); 3.54 (*s*, Me–N(3)); 0.29 (*s*, Me_3Si). Anal. calc. for $C_{13}H_{16}N_4O_2Si$ (288.4): C 54.14, H 5.59, N 19.43; found: C 54.08, H 5.60, N 19.45.

*6-Ethynyl-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**51**). To a soln. of **50** (0.315 g, 1.09 mmol) in abs. MeOH (25 ml) was added K_2CO_3 (0.165 g), and the mixture was stirred at r.t. for 1 h. After evaporation, the residue was treated with sat. aq. $NaHCO_3$ soln. and extracted with $CHCl_3$ (3 × 50 ml). The org. layer was dried (Na_2SO_4) and concentrated and the residue purified by CC (SiO_2, $CHCl_3$/AcOEt 3:1): 0.134 g (57%) of **51**. Creamy powder. M.p. 236–237° (dec.). UV (MeOH): 205 (4.09), 253 (4.21), 271 (4.19), 349 (3.95). ^{1}H-NMR ($CDCl_3$): 8.73 (*s*, H–C(7)); 3.72 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)); 3.37 (*s*, CH≡C). Anal. calc. for $C_{10}H_8N_4O_2$ (216.2): C 55.56, H 3.73, N 25.91; found: C 55.41, H 3.79, N 25.41.

*6-Acetyl-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**52**) [21]. A soln. of **51** (0.233 g, 1.08 mmol) in CF_3COOH (12 ml) was treated with HgO (76 mg) and H_2O (1.2 ml) for 7 h at r.t. and subsequently for 30 min at 40°. After evaporation, some H_2O was added, the mixture neutralized with dil. NH_4OH soln. and then extracted with $CHCl_3$ (3 × 20 ml). The org. layer was dried (Na_2SO_4) and concentrated and the residue purified by CC (SiO_2, $CHCl_3$/AcOEt 3:1): 0.188 g (74%) of **52**. Pale yellow powder. M.p. 200–202° ([20]: 203–204°). UV (MeOH): 248 (4.11), 281 (4.04), 332 (4.00). ^{1}H-NMR ($CDCl_3$): 9.29 (*s*, H–C(7)); 3.77 (*s*, Me–N(1)); 3.57 (*s*, Me–N(3)); 2.82 (*s*, Ac).

*1,3-Dimethyl-6-(2-oxo-2-phenylethyl)pteridine-2,4(1*H*,3*H*)-dione* (**53**). As described for **52**, with **49** (0.2 g, 0.68 mmol), CF_3COOH (10 ml), HgO (65 mg), and H_2O (1 ml). Purification by CC (SiO_2, $CHCl_3$/AcOEt 3 :1) gave 0.114 g (54%) of **53**. Yellow powder. M.p. 191°. Recrystallization from AcOEt/hexane gave yellow needles. UV (MeOH): 202 (4.32), 243 (4.30), 333 (3.89). ^{1}H-NMR ($CDCl_3$): **54**: 13.47 (*s*, HN); 8.54 (*s*, H–C(7)); 8.05 (*m*, 2 arom. H); 7.55 (*m*, 3 arom. H); 6.26 (*s*, C*H*COPh); 3.74 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)); **53**: 8.68 (*s*, H–C(7)); 8.05 (*m*, 2 arom. H); 7.55 (*m*, 3 arom. H); 4.74 (*s*, CH_2COPh); 3.74 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{14}N_4O_3$ (310.3): C 61.93, H 4.55, N 18.06; found: C 61.96, H 4.59, N 17.55.

*1,3-Dimethyl-7-(phenylethynyl)pteridine-2,4(1*H*,3*H*)-dione* (**56**). A mixture of 7-chloro-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione [19] (**55**; 0.13 g, 0.57 mmol), CuI (5 mg), [$Pd(Ph_3P)_4$] (10 mg), and Et_3N (0.3 ml) in $CHCl_3$ (5 ml) was treated with phenylethyne (0.1 ml, 0.95 mmol) at r.t. for 3 d with stirring. After evaporation, the residue was purified by CC ($CHCl_3$): 0.156 g (93%) of crude **56**. Recrystallization of the crystal powder from EtOH (65 ml)/H_2O (9 ml) gave 0.099 g (59%) of **56**. Yellow crystals. M.p. 275–276°. UV (MeOH): 237 (4.38), 242 (sh, 4.36), 264 (sh, 4.08), 305 (4.01), 365 (4.43), 372 (sh, 4.41). ^{1}H-NMR ($CDCl_3$): 8.68 (*s*, H–C(6)); 7.74–7.36 (*m*, 5 arom. H); 3.74 (*s*, Me–N(1)); 3.55 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{12}N_4O_2$ (292.3): C 65.75, H 4.14, N 19.17; found: C 65.48, H 4.18, N 18.92.

*1,3-Dimethyl-7-[(trimethylsilyl)ethynyl]pteridine-2,4(1*H*,3*H*)-dione* (**57**). To a mixture of **55** [19] (0.5 g, 2.2 mmol), CuI (20 mg), [$Pd(Ph_3P)_4$] (40 mg), and Et_3N (1.0 ml) in dioxane (20 ml) was added (trimethylsilyl)ethyne (0.5 ml, 3.4 mmol) and then heated to 90° for 40 min. After dilution with AcOEt (40 ml), the mixture was extracted with H_2O (3 × 20 ml), the org. layer dried (Na_2SO_4) and concentrated, and the residue purified by CC (SiO_2, $CHCl_3$): 0.57 g (90%) of crude **57**. Recrystallization from a small amount of EtOH yielded 0.42 g (66%) of **57**. Yellowish crystals. M.p. 165°. UV (MeOH): 218 (4.19), 252 (4.18), 278 (sh, 3.82), 353 (4.11), 366 (sh, 4.04). ^{1}H-NMR ($CDCl_3$): 8.59 (*s*, H–C(6)); 3.70 (*s*, Me–N(1)); 3.54 (*s*, Me–N(3)); 0.33 (*s*, Me_3Si). Anal. calc. for $C_{13}H_{16}N_4O_2Si$ (288.4): C 54.14, H 5.59, N 19.43; found: C 53.84, H 5.41, N 19.42.

*7-Ethynyl-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**58**). As described for **51**, with **57** (0.235 g, 0.82 mmol), K_2CO_3 (0.125 g), and MeOH (20 ml): 0.095 g (54%) of **58**. Pale yellowish powder. M.p. 258–259° (dec.). UV (MeOH): 212 (4.24), 247 (4.25), 349 (4.05). ^{1}H-NMR ($CDCl_3$): 8.65 (*s*, H–C(6)); 3.71 (*s*, Me–N(1)); 3.58 (*s*, CH≡C); 3.55 (*s*, Me–N(3)). Anal. calc. for $C_{10}H_8N_4O_2$ (216.2): C 55.56, H 3.73, N 25.91; found: C 55.35, H 3.87, N 25.56.

*7-Acetyl-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**59**) [21]. As described for **52**, with **58** (0.216 g, 1.0 mmol), CF_3COOH (10 ml), HgO (75 mg), and H_2O (1.2 ml): 0.117 g (50%) of **59**. Colorless crystals. M.p. 175° ([21]: 177°). UV (MeOH): 248 (4.08), 348 (3.89). ^{1}H-NMR ($CDCl_3$): 9,17 (*s*, H–C(6)); 3.79 (*s*, Me–N(1)); 3.58 (*s*, Me–N(3)); 2.78 (*s*, Ac).

*6-[(1*E*)-1,2-Dibromo-2-phenylethenyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**61**). A soln. of **49** (0.584 g, 2 mmol) in $CHCl_3$ (15 ml) was treated with 1M Br_2 in $CHCl_3$ (3 ml) by dropwise addition under stirring. After 24 h the mixture was evaporated and the residue treated with Et_2O to give 0.765 g (85%) of crude material. Recrystallization from EtOH (200 ml) gave 0.49 g (54%) of **61**. Yellowish crystals. M.p. 226°. UV (MeOH): 203 (4.27), 248 (4.11), 268 (sh, 3.99), 344 (3.81). ^{1}H-NMR ($CDCl_3$): 8.80 (*s*, H–C(7)); 7.59 (*m*, 2 arom. H); 7.45 (*m*, 3 arom. H); 3.77 (*s*, Me–N(1)); 3.57 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{12}Br_2N_4O_2$ (452.1): C 42.51, H 2.68, N 12.39; found: C 42.72, H 2.71, N 12.34.

*7-[(1*E*)-1,2-Dibromo-2-phenylethenyl]-1,3-dimethylpteridine-2,4(1*H*,3*H*)-dione* (**62**). A soln. of **56** (0.37 g, 1.3 mmol) in $CHCl_3$ (10 ml) was heated to 40°, and then Br_2 in $CHCl_3$ was dropwise added under stirring till no decoloration took place. The mixture was stirred for another 30 min and then concentrated and the residue purified by CC ($CHCl_3$) to give 0.55 g (96%) of crude **56**. Recrystallization from EtOH (100 ml) yielded 0.29 g (51%) of **56**. Yellowish crystals. M.p. 217–219°. UV (MeOH): 238 (4.37), 354 (4.11). ^{1}H-NMR ($CDCl_3$): 8.85 (*s*, H–C(6)); 7.58–7.45 (*m*, 5 arom. H); 3.77 (*s*, Me–N(1)); 3.58 (*s*, Me–N(3)). Anal. calc. for $C_{16}H_{12}Br_2N_4O_2$ (452.1): C 42.51, H 2.68, N 12.39; found: C 42.80, H 2.75, N 12.30.

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Received February 7, 2007