165. Synthesis of 4′-*C*-Acylated Thymidines

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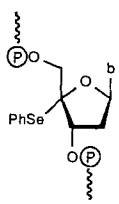
Two synthetic pathways towards 4′-*C*-acylthymidines are presented. These modified mononucleosides are precursors of the 2′-deoxyribonucleotide 4′-*C*-radical. They were converted into their corresponding 3′-*O*-[(2-cyanoethyl) *N*,*N*-diisopropylphosphoramidites] **3a–c** and incorporated in oligonucleotides by solid-phase synthesis. The structure of some modified nucleosides was revealed by X-ray crystal-structure analysis.

Introduction. – Antibiotics from the ene-diyne family like neocarzinostatin [1] and esperamycin [2] as well as metal complexes of bleomycin glycopeptides [3] induce the oxidative cleavage of DNA by generation of highly reactive DNA radicals. In a similar way, chemical nucleases and drugs can generate oxidative stress by damage of DNA *via* radicals [4]. The research in this area is focused on the development of new selective DNA cleavers and on the elucidation of the mechanism of action of these compounds. Whereas hydroxyl radicals react rather unselectively [5], several agents whose active center is bound to the minor groove preferentially abstract H-atoms from the 4′- and/or 5′-position of the deoxyribose [1–4]. Recently, we have demonstrated that 2′-deoxyribonucleotide 4′-*C* radicals can be generated selectively from selenide **1** or ketone **2** by photolysis [6]. These artificial oligonucleotides could be synthesized by solid-phase synthesis with suitably substituted mononucleotides. We have now worked out two different synthetic strategies towards 4′-*C*-acyl-2′-deoxyribonucleotides[1]) **3**.



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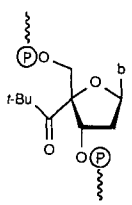

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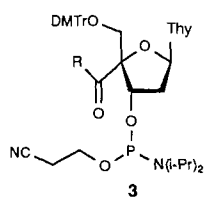

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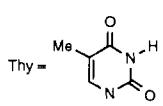
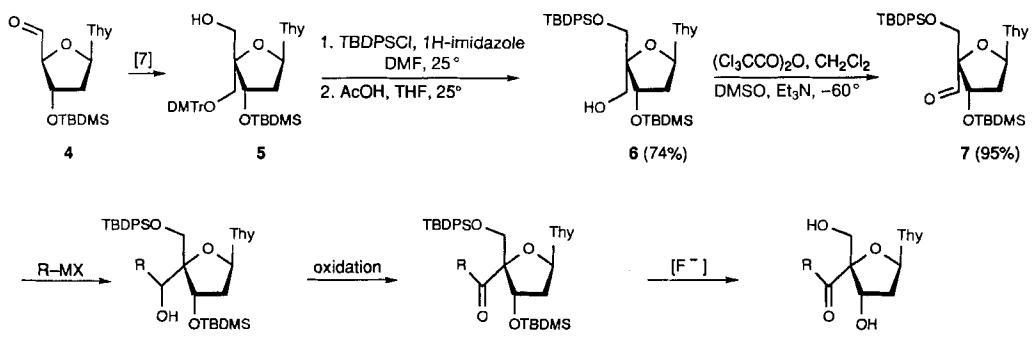


[1]) For convenience, all compounds described in this work are named as 4′-*C*-substituted pentose derivatives although pentose is not always the parent monosaccharide.

Results and Discussion. – 1. *4′-C-Acylthymidines*[1]) **10a–d**. The first route towards the thymidylyl 4′-*C* radical precursors **10a–d** starts from compound **5** [7] which was easily obtained from aldehyde **4** [8] (*Scheme 1*). After a protection/deprotection sequence using (*tert*-butyl)chlorodiphenylsilane in the presence of 1*H*-imidazole in DMF, followed by treatment with 80% AcOH in THF, compound **5** was converted to the bis-silylated derivative **6** in 74% yield. *Swern* oxidation [9] of **6** gave aldehyde **7** in 95% yield. The addition of MeMgCl (4 equiv.), EtMgCl (4.5 equiv.), or PhMgCl (6 equiv. and 0.2 equiv. CuI) in THF afforded the corresponding alkylated or arylated alcohols **8a–c** in 97, 63, and 79% yield, respectively. Oxidation of **8a–c** was achieved using the *Dess-Martin* reagent [10] in CH_2Cl_2 and afforded the protected 4′-*C*-acetylthymidine **9a**, 4′-*C*-propanoylthymidine **9b**, and 4′-*C*-benzoylthymidine **9c** in 75, 78, and 99% yield, respectively. Treatment of **7** with *t*-BuLi (5 equiv.) in Et_2O (−78°, 2 min) gave only poor yields of the desired pivaloyl alcohol **8d**. The reaction was incomplete, and longer reaction times, higher temperatures, or higher *t*-BuLi concentrations did not improve the yield of **8d**, but led to by-products. The crude reaction mixture was directly oxidized under *Swern* conditions. Bis-silylated 4′-*C*-pivaloylthymidine **9d** was obtained in 45% yield (from **7**) together with 19% of the starting aldehyde **7**. The last step of the synthesis consisted in the deprotection of the two silylated OH groups. Deprotection of **9a** (R = Me) and **9b** (R = Et) was achieved easily with tetrabutylammonium fluoride (Bu_4NF) in THF and gave **10a** in 84 and **10b** in 67% yield. Treatment of **9c** (R = Ph) with 2 equiv. of Bu_4NF in THF led to a complex mixture due to the instability of the free alcohol **10c** under basic conditions. Using 1 equiv. of Bu_4NF in THF at 0° led to mono-desilylation. Complete deprotection was then achieved by treatment with pyridinium poly(hydrogen fluoride) ($Py \cdot (HF)_n$) in THF (25°) [11]. The deprotected thymidine **10c** was obtained in 18% yield. Attempts to deprotect **9d** (R = *t*-Bu) with Bu_4NF in THF were unsuccessful. However, reaction of **9d** with CsF (10 equiv.) in DMF (45°) afforded 4′-*C*-pivaloylthymidine **10d** in 67% yield.

Scheme 1



8a R=Me (97%, MeMgCl, THF, 0°)
b R=Et (63%, EtMgBr, THF, −78°)
c R=Ph (79%, PhMgBr, CuI, THF, 0°)
d R=*t*-Bu (*t*-BuLi, Et_2O, −78°)

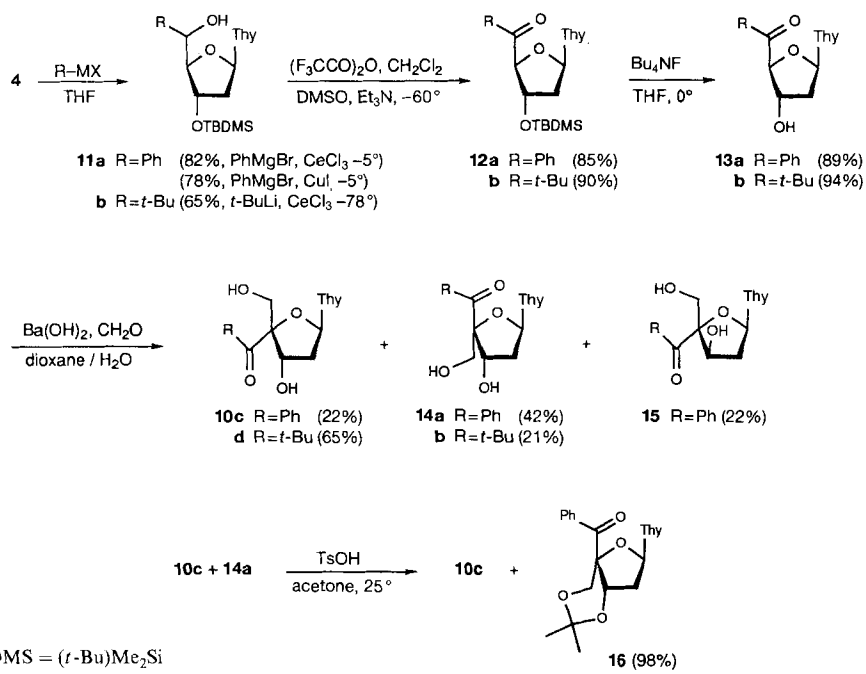
9a R=Me (75%, *Dess-Martin*, 25°)
b R=Et (78%, *Dess-Martin*, 25°)
c R=Ph (99%, *Dess-Martin*, 25°)
d R=*t*-Bu (45%, from **7** *Swern*, −70°)

10a R=Me (84%, Bu_4NF, THF, 25°)
b R=Et (67%, Bu_4NF, THF, 25°)
c R=Ph (18%, TBAF, Bu_4NF, then $Py \cdot (HF)_n$, THF, 25°)
d R=*t*-Bu (67%, CsF, DMF, 45°)

TBDMS = (*t*-Bu)Me_2Si, TBDPS = (*t*-Bu)Ph_2Si, DMTr = 4,4′-dimethoxytrityl

The second pathway towards compounds **10** turned out to be more efficient (*Scheme 2*), but it is limited to 4′-*C*-acylthymidines which do not possess H-atoms in α-position to the carbonyl function. The strategy consists in generating the 4′-*C*-acyl function in the first steps starting from aldehyde **4**, then performing a 4′-*C*-(hydroxymethyl)ation. The *t*-Bu and Ph groups were introduced by 1,2-addition of organolithium [12] or organomagnesium [13] compounds to the 5′-aldehyde function of nucleoside **4** in the presence of $CeCl_3$. Alcohol **11b** (R = *t*-Bu) was obtained in 65% yield (1:1 diastereoisomer mixture) by treatment of **4** with *t*-BuLi (11 equiv.) and $CeCl_3$ (12 equiv.) in THF at −78°. Under similar conditions, nucleoside **4** was treated with PhMgBr (3 equiv.) and $CeCl_3$ (3 equiv., −5°) to give compound **11a** (R = Ph) in 82% yield as a 1:1 diastereoisomer mixture. Alternatively, **11a** could also be obtained (78% yield, isomer ratio 3:1) by treatment of **4** with PhMgBr (6 equiv.) in the presence of CuI (2 equiv.). *Swern* oxidation of the diastereoisomeric alcohols **11a, b** led to the corresponding ketones **12a** (85%) and **12b** (90%). Deprotection of the 3′-silyl ethers was performed using Bu_4NF in THF at 0° and yielded alcohols **13a** (89%) and **13b** (94%), respectively. The hydroxymethylation step was hoped to occur *via* an aldol reaction with formaldehyde under basic conditions. However, the reaction of both **13a** and **13b** with lithium diisopropylamide and gaseous formaldehyde failed. Attempts to perform the aldol reaction with aqueous formaldehyde in the presence of other bases (KOH, NaOH, LiOH, and $Ca(OH)_2$) led to complex reaction mixtures or decomposition. Acceptable results were obtained by using $Ba(OH)_2$. Treatment of alcohol **13b** (R = *t*-Bu) with $Ba(OH)_2$ (0.6 equiv.) in dioxane/H_2O 7:1 and addition of aqueous formaldehyde (9 equiv.) led to **10d** (65%) and **14b** (21%) as sole

Scheme 2



TBDMS = (*t*-Bu)Me_2Si

reaction products. When the phenyl ketone **13a** was treated with $Ba(OH)_2$ (0.6 equiv.) in the presence of formaldehyde (5 equiv.) in dioxane/H_2O 10:1, three products were formed. Two of them were the *β*-D-*erythro* and *α*-L-*threo* derivatives **10c** and **14a**, respectively, which were obtained in 73% yield as a 1:2.5 mixture, besides 22% of **15**. Separation of the isomers turned out to be very difficult. Attempts to separate **10c** and **14a** by flash chromatography (FC), MPLC, or reversed-phase MPLC failed, and separation by HPLC was of low efficiency. However, treatment of a mixture **10c**/**14a** with toluene-4-sulfonic acid in acetone led to the selective formation of the 3′,5′-isopropylidene ketal **16** of the *α*-L-*threo* isomer which could be easily separated from **10c** by FC.

The *β*-D-*erythro* configuration of **10d** was assigned by an X-ray crystal-structure analysis (*Fig. 1*) and by comparison with the NMR data of the compound obtained by desilylation of **9d** (→ **10d**). The unit cell contained four molecules of **10d**, all with southern conformation phase angles [14] and '*anti*' orientation of the base (pseudorotation phase angle $P_A = 168°$, $P_B = 168°$, $P_C = 200°$, $P_D = 158°$; ring conformations: $^2T_3$, $^2T_3$, $_3E$, and ^2E; glycosyl torsion angle $\chi_A = -129.1°$, $\chi_B = -148.3°$, $\chi_C = -171.8°$, $\chi_D = -132.3°$; C(4′)–C(5′) torsion angle $\gamma_A = 57.2°$, $\gamma_B = 51.6°$, $\gamma_C = 172.6°$, $\gamma_D = 52.3°$). These structures are very similar to the solid-state conformation of thymidine ($P = 188°$; $_3T^2$; $\chi = -144°$; $\gamma = 172.8°$) [15]. The large J(H–C(1′),$H_{pro\text{-}S}$–C(2′)) of **10d** (10.1 Hz) in D_2O, as well as the undetectable small J($H_{pro\text{-}R}$–C(2′),H–C(3′)) showed that the southern conformation is also highly preferred in solution [16]. The other acylated thymidines **10a–c** have also large J(H–C(1′),$H_{pro\text{-}S}$–C(2′)) (9.0, 9.1, and 9.6 Hz, resp.), thus strongly preferring the southern conformation, whereas thymidine exists as a 2:1 mixture of the southern and northern conformation [17]. The structure of the *α*-L-*threo* derivative **14b** was assigned by X-ray analysis ($_4E$ envelope, pseudorotation phase angle $P = 52°$, *Fig. 1*).

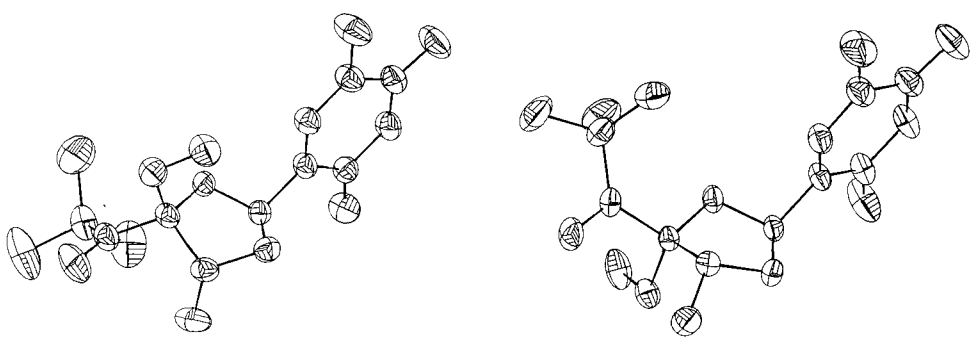


Fig. 1. *X-Ray crystal structures of compounds* **10d** (molecule A) *and* **14b**. C–H Bonds are not represented.

The configuration of **10c** could be assigned by a ^{1}H-NOESY experiment as well as by comparison with the NMR data of the compound obtained after desilylation of **9c** (→ **10c**). NOE Experiments confirmed also the *α*-L-*threo* configuration of nucleoside **14a**. A medium NOE effect was observed between the H_{ortho}-atoms of the Ph group and H–C(6) of the thymine moiety. A much weaker interaction was also observed between H–C(1′) and the hydroxymethyl group. To the third product, the structure of the

β-D-*threo* derivative **15** was assigned by an X-ray crystal-structure analysis (twisted ${}_4T^3$ conformation, pseudorotation phase angle $P = 48°$, *Fig. 2*) as well as by NOE experiments.

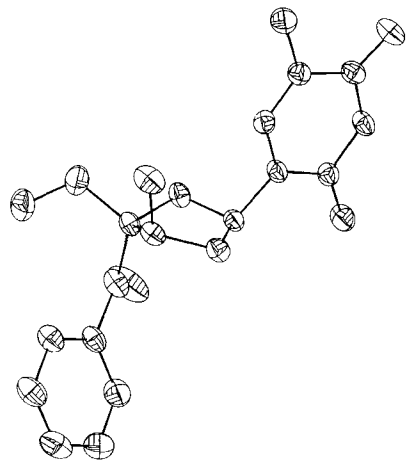
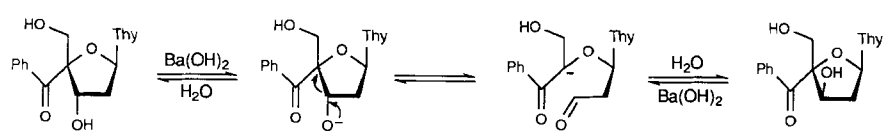


Fig. 2. *X-Ray crystal structure of compound* **15**. C–H Bonds are not represented.

The formation of **15** can be explained by a ring opening/ring closing sequence (*Scheme 3*). Indeed, we could show that compound **10c** interconverts with the β-D-*threo* derivative **15** and the α-L-*threo* derivative **14a** under the basic reaction conditions ($Ba(OH)_2$, 10% H_2O in dioxane). This *retro*-aldol reaction was only observed in the case of the 4′-*C*-benzoylnucleoside. It is favoured by a more effective stabilization of the intermediate anion by the benzoyl group compared with the pivaloyl function [18].

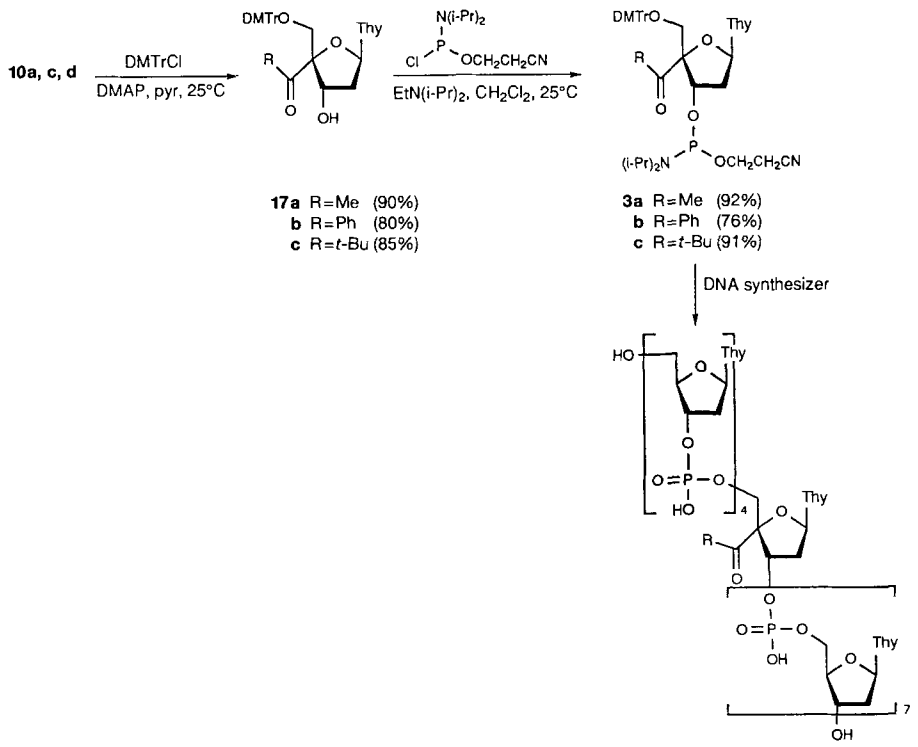
Scheme 3



10c **15**

2. *Modified Oligonucleotides*[1]) **17a–c**. In order to become suitable building blocks for the solid-phase synthesis of modified oligonucleotides, **10a, c, d** were converted into the corresponding 3′-phosphoramidites **3a–c** (*Scheme 4*) [19]. Tritylation of the primary OH group was achieved by treatment of **10a, c, d** with 4,4′-dimethoxytrityl chloride (2 equiv.) in pyridine in the presence of a catalytic amount of 4-(dimethylamino)pyridine to give **17a–c** in 90, 80, and 85% yield, respectively. Phosphitylation [20] of the secondary OH group in **17a–c** with 2-cyanoethyl *N,N*-diisopropylphosphorochloridamidite (2.3 equiv.) and *N,N*-diisopropylethylamine in CH_2Cl_2 led to **3a** (92%), **3b** (76%), and **3c** (91%).

Scheme 4



DMTr = 4,4′-dimethoxytrityl, DMAP = 4-(dimethylamino)pyridine

The modified oligonucleotides **18a–c** were synthesized following the solid-phase phosphoramidite method [21] on an automated DNA synthesizer using **3a–c**, respectively, and commercially available 2′-deoxynucleoside [(2-cyanoethyl)phosphoramidites]. The coupling efficiency of the modified phosphoramidites **3a–c** was *ca.* 98%, as monitored by the release of the dimethoxytrityl cation during deprotection in the coupling cycle. The dimethoxytritylated oligonucleotides were removed from the solid support by treatment with concentrated ammonia at 55° for 8 h. After detritylation, desalting, and purification by HPLC, the relative molecular masses of the modified oligonucleotides **18a–c** were determined by MALDI-TOF mass spectrometry.

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Experimental Part

General. All temp. quoted are uncorrected. All reagents are commercially available and used without further purification. The solvents were purified and dried according to standard procedures. The reactions were carried out in carefully dried apparatus and under Ar. Thin layer chromatography (TLC): precoated plates, silica gel F_{254},

Merck. Flash chromatography (FC): *Merck* silica gel *60* (0.040–0.063 mm). MPLC: *Büchi* chromatograph; *Macherey-Nagel* silica-gel column (*Polygosyl-60*, 15–25 μm). HPLC: *Kontron* chromatograph with UV detector (254 nm); anal. HPLC on *Merck RP-18 LiChrosorb* column and prep. HPLC on *Knauer RP-18* column. M.p.: *Büchi 530*; uncorrected. $[\alpha]_D$: *Perkin-Elmer-141* polarimeter (concentrations in g/ml). IR Spectra: *Perkin-Elmer-1600-FTIR* spectrophotometer (wavelengths in cm^{-1}). NMR Spectra: *Varian Gemini 300* (^1H at 300 MHz, ^{13}C at 75.5 MHz, ^{31}P at 121 MHz); chemical shifts δ in ppm rel. to internal $SiMe_4$ for ^1H (= 0.0 ppm), $CDCl_3$ for ^{13}C (= 77.0 ppm), CD_3OD for ^{13}C (= 49.0 ppm), and $OP(OPh)_3$ for ^{31}P (= −18.0 ppm), coupling constants J in Hz. NOE: irradiated H → affected H; ++ = strong, + = medium, (+) = weak. MS: *VG 70-250* for fast-atom bombardment (FAB) ionization (3-nitrobenzyl alcohol (NBA) and NBA + KCl); *Vestec*, *Benchtop II* for matrix-assisted laser-desorption ionization (time-of-flight) (MALDI-TOF), matrix 2,4,6-trihydroxyacetophenone, laser wavelength 337 nm, acceleration voltage 15 kV. Microanalyses were performed at the Mikroanalytisches Labor, University of Basel.

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-(hydroxymethyl)thymidine* (**6**). To a soln. of **5** (2.71 g, 3.93 mmol) and 1*H*-imidazole (0.80 g, 11.8 mmol) in DMF (7 ml), (*t*-Bu)Ph_2SiCl (1.11 ml, 4.33 mmol) was added at 25°. After stirring for 24 h at 25°, the mixture was poured onto H_2O (60 ml), extracted with CH_2Cl_2 (3 × 80 ml), dried ($MgSO_4$), and evaporated. To the resulting yellow foam in THF (5 ml), 80% AcOH/H_2O (17 ml) was added. After stirring at 25° for 24 h, the mixture was cooled to 0°, neutralized with 25% aq. NH_3 soln. (20 ml), poured onto H_2O (80 ml), and extracted with CH_2Cl_2 (2 × 50 ml). The combined org. phases were washed with sat. aq. $NaHCO_3$ soln. (100 ml), dried ($MgSO_4$), and evaporated. Flash chromatography (AcOEt/pentane 1:2) gave 1.82 g (74%) of **6**. Pale yellow foam. IR (KBr): 3433, 3200, 3071, 2955, 2930, 2892, 2857, 1690, 1472, 1428, 1259, 1114, 835, 778, 703. ^1H-NMR ($CDCl_3$): 0.07 (*s*, MeSi); 0.11 (*s*, MeSi); 0.91 (*s*, *t*-BuSi); 1.10 (*s*, *t*-BuSi); 1.62 (*s*, Me–C(5)); 2.27 (*m*, H_a–C(2′), OH); 2.36 (*ddd*, *J* = 3.0, 6.0, 13.4, H_b–C(2′)); 3.63 (*dd*, *J* = 8.7, 12.1, 1 H, HOCH_2–C(4′)); 3.77 (*dd*, *J* = 5.0, 12.1, 1 H, HOCH_2–C(4′)); 3.80 (*d*, *J* = 11.1, H_a–C(5′)); 3.88 (*d*, *J* = 11.1, H_b–C(5′)); 4.67 (*dd*, *J* = 3.0, 6.4, H–C(3′)); 6.41 (*dd*, *J* = 6.0, 7.8, H–C(1′)); 7.42 (*m*, arom. H, H–C(6)); 7.66 (*m*, arom. H); 9.15 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.2 (MeSi); −5.0 (MeSi); 12.0 (*Me*–C(5)); 17.9 (Me_3CSi); 19.3 (Me_3CSi); 25.6 (Me_3CSi); 27.0 (Me_3CSi); 41.8 (C(2′)); 63.6 (HOCH_2–C(4′)); 65.6 (C(5′)); 73.6 (C(3′)); 84.2 (C(1′)); 89.0 (C(4′)); 111.1 (C(5)); 127.9–135.5 (arom. C, C(6)); 150.3 (C(2)); 163.8 (C(4)). FAB-MS: 625 (2, $[M + 1]^+$). Anal. calc. for $C_{33}H_{48}N_2O_6Si_2$ (624.93): C 63.43, H 7.74, N 4.48; found: C 63.31, H 7.83, N 4.49.

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-formylthymidine* (**7**). To a soln. of trichloroacetic anhydride (0.40 ml, 2.14 mmol) in CH_2Cl_2 (6 ml), DMSO (0.20 ml, 2.98 mol) was added at −70°. After stirring for 15 min at −70°, a soln. of **6** (0.92 g, 1.46 mmol) in CH_2Cl_2 (2 ml) was added. After stirring for another 30 min at −70°, Et_3N (0.99 ml, 7.01 mmol) was added and the mixture warmed to 25° within 30 min. The mixture was poured onto H_2O (60 ml), extracted with CH_2Cl_2 (3 × 40 ml), dried ($MgSO_4$), and evaporated. Flash chromatography (AcOEt/pentane 1:1) gave 0.86 g (95%) of **7**. Pale yellow foam. IR (NaCl dissolved in CH_2Cl_2): 3187, 3071, 2931, 2858, 1694, 1472, 1428, 1363, 1281, 1263, 1114, 829. ^1H-NMR ($CDCl_3$): 0.02 (*s*, MeSi); 0.04 (*s*, MeSi); 0.85 (*s*, *t*-BuSi); 1.10 (*s*, *t*-BuSi); 1.64 (*d*, *J* = 1.2, Me–C(5)); 2.31 (*m*, H–C(2′)); 3.91 (*d*, *J* = 11.5, H_a–C(5′)); 4.11 (*d*, *J* = 11.5, H_b–C(5′)); 4.66 (*m*, H–C(3′)); 6.70 (*dd*, *J* = 6.3, 8.2, H–C(1′)); 7.43 (*m*, arom. H); 7.53 (*d*, *J* = 1.2, H–C(6)); 7.64 (*m*, arom. H); 9.09 (*s*, NH); 9.53 (*s*, C(O)H). ^{13}C-NMR ($CDCl_3$): −5.4 (MeSi); −4.9 (MeSi); 12.0 (*Me*–C(5)); 17.9 (Me_3CSi); 19.3 (Me_3CSi); 25.5 (Me_3CSi); 41.3 (C(2′)); 64.5 (C(5′)); 76.2 (C(3′)); 86.1 (C(1′)); 92.8 (C(4′)); 111.5 (C(5)); 127.9–135.5 (arom. C, C(6)); 150.3 (C(2)); 163.7 (C(4)); 200.2 (CHO). FAB-MS: 623 (2, $[M + 1]^+$). Anal. calc. for $C_{33}H_{46}N_2O_6Si_2$ (622.91): C 63.63, H 7.44, N 4.50; found: C 63.28, H 7.40, N 4.39.

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-(1-hydroxyethyl)thymidine* (**8a**). To a soln. of **7** (0.60 g, 0.96 mmol) in THF (10 ml), 3M MeMgCl in THF (1.20 ml, 3.60 mmol) was added at 0°. After stirring for 2 h at 0°, a sat. aq. NH_4Cl soln. (20 ml) was added and extracted with CH_2Cl_2 (3 × 100 ml). The combined org. phases were washed with H_2O (100 ml), dried ($MgSO_4$), and evaporated: 0.60 g (97%) of **8a** as a 3:1 diastereoisomer mixture which was used in the next step without further purification. IR (KBr): 3448, 3071, 2954, 2931, 1744, 1686, 1472, 1252, 1228, 703. ^1H-NMR ($CDCl_3$): major diastereoisomer: 0.13 (*s*, MeSi); 0.17 (*s*, MeSi); 0.93 (*s*, *t*-BuSi); 1.12 (*s*, *t*-BuSi); 1.17 (*d*, *J* = 6.7, *Me*CH(OH)); 1.54 (*d*, *J* = 1.1, Me–C(5)); 2.35 (*m*, H–C(2′)); 2.87 (*s*, OH); 4.00 (*d*, *J* = 11.5, H_a–C(5′)); 4.10 (*d*, *J* = 11.5, H_b–C(5′)); 4.14 (*d*, *J* = 6.7, MeC*H*(OH)); 4.84 (*dd*, *J* = 3.8, 6.7, H–C(3′)); 6.33 (*t*, *J* = 7.2, H–C(1′)); 7.44 (*m*, arom. H, H–C(6)); 7.66 (*m*, arom. H); 8.52 (*s*, NH); minor diastereoisomer: 0.11 (*s*, MeSi); 0.15 (*s*, MeSi); 0.93 (*s*, *t*-BuSi); 1.00 (*s*, *t*-BuSi); 1.25 (*d*, *J* = 4.7, *Me*CH(OH)); 1.61 (*d*, *J* = 1.2, Me–C(5)); 2.36 (*m*, H–C(2′)); 3.38 (*s*, OH); 3.60 (*d*, *J* = 11.2, H_a–C(5′)); 3.80 (*d*, *J* = 11.2, H_b–C(5′)); 3.84 (*d*, *J* = 4.7, MeC*H*(OH)); 4.84 (*dd*, *J* = 2.4, 6.9, H–C(3′)); 6.49 (*dd*, *J* = 6.0, 8.2, H–C(1′)); 7.44 (*m*, arom. H, H–C(6)); 7.66 (*m*, arom. H); 8.52 (*s*, NH). ^{13}C-NMR ($CDCl_3$): major diastereoisomer: −5.1 (MeSi); −4.3 (MeSi); 12.0 (*Me*–C(5)); 17.1 (*Me*CH(OH)); 17.9 (Me_3CSi); 19.5 (Me_3CSi); 25.7 (Me_3CSi); 27.2 (Me_3CSi); 41.6 (C(2′)); 63.6 (C(5′)); 68.2 (MeCH(OH)); 73.6 (C(3′)); 83.6 (C(1′)); 89.3 (C(4′));

111.3 (C(5)); 128.0–135.5 (arom. C, C(6)); 150.3 (C(2)); 163.7 (C(4)); minor diastereoisomer: −5.1 (MeSi); −4.5 (MeSi); 12.1 (*Me*−C(5)); 16.8 (*Me*CH(OH)); 18.8 (Me_3CSi); 19.4 (Me_3CSi); 27.1 (Me_3CSi); 27.2 (Me_3CSi); 42.7 (C(2′)); 65.1 (C(5′)); 69.0 (Me*C*H(OH)); 74.5 (C(3′)); 84.6 (C(1′)); 90.8 (C(4′)); 111.1 (C(5)); 128.0–135.6 (arom. C, C(6)); 150.2 (C(2)); 163.9 (C(4)). FAB-MS: 639 (1, $[M + 1]^+$). Anal. calc. for $C_{34}H_{50}N_2O_6Si_2$ (638.96): C 63.91, H 7.89, N 4.38; found: C 63.74, H 8.04, N 4.23.

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-(1-hydroxypropyl)thymidine* (**8b**). To a soln. of **7** (62 mg, 0.10 mmol) in THF (2 ml), 1.5M EtMgBr (0.3 ml, 0.45 mmol) in Et_2O was added at −78°. After stirring for 1.5 h at −78°, a sat. aq. NH_4Cl soln. (20 ml) was added and the mixture extracted with CH_2Cl_2 (50, 20, and 20 ml). The combined org. phases were washed with H_2O (20 ml), dried ($MgSO_4$), and evaporated. FC (pentane/acetone 3:1) yielded 41 mg (63%) of **8b** (major diastereoisomer). The minor diastereoisomer could not be isolated as a pure compound. Additionally 8 mg (13%) of the reduction product **6** were obtained. Major diastereoisomer: IR (KBr): 3323, 3233, 3074, 2954, 2931, 2893, 2857, 1718, 1702, 1683, 1472, 1428, 1273, 1205, 1086, 1036, 832, 778, 710, 700, 505. ^{1}H-NMR ($CDCl_3$): 0.12 (*s*, MeSi); 0.16 (*s*, MeSi); 0.93 (*s*, *t*-BuSi); 0.96 (*t*, J = 7.2, Me); 1.10 (*s*, *t*-BuSi); 1.20 (*m*, 1 H, CH_2CH(OH)); 1.54 (*d*, J = 1.2, Me−C(5)); 1.66 (*m*, 1H, CH_2CH(OH)); 2.30 (*m*, H_a−C(2′)); 2.38 (*ddd*, J = 3.9, 6.3, 13.4, H_b−C(2′)); 2.80 (*dd*, ^4J = 1.2, J = 4.1, OH); 3.78 (*ddd*, J = 2.0, 4.1, 10.8, CH_2CH(OH)); 3.96 (*d*, J = 11.4, H_a−C(5′)); 4.10 (*d*, J = 11.4, H_b−C(5′)); 4.81 (*dd*, J = 3.9, 6.3, H−C(3′)); 6.31 (*dd*, J = 6.3, 7.3, H−C(1′)); 7.42 (*m*, arom. H, H−C(6)); 7.65 (*m*, arom. H); 8.96 (*s*, NH); minor diastereoisomer: 0.09 (*s*, MeSi); 0.13 (*s*, MeSi); 0.91 (*s*, *t*-BuSi); 0.94 (*t*, J = 7.2, Me); 1.09 (*s*, *t*-BuSi); 1.40 (*m*, CH_2CH(OH)); 1.57 (*s*, Me−C(5)); 2.30 (*m*, H−C(2′)); 3.03 (*dd*, J = 1.5, 2.9, OH); 3.67 (*d*, J = 11.0, H_a−C(5′)); 3.85 (*d*, J = 11.2, H_b−C(5′)); 3.95 (*m*, CH_2CH(OH)); 4.75 (*dd*, J = 2.7, 6.8, H−C(3′)); 6.45 (*dd*, J = 6.1, 8.1, H−C(1′)); 7.40 (*m*, arom. H, H−C(6)); 7.64 (*m*, arom. H); 8.46 (*s*, NH). ^{13}C-NMR ($CDCl_3$): major diastereoisomer: −5.1 (MeSi); −4.4 (MeSi); 11.3 (*Me*CH_2); 11.9 (*Me*−C(5)); 17.8 (Me_3CSi); 19.4 (Me_3CSi); 23.7 (CH_2CH(OH)); 25.7 (Me_3CSi); 27.1 (Me_3CSi); 41.5 (C(2′)); 63.6 (C(5′)); 73.5, 73.8 (CH_2CH(OH), C(3′)); 83.4 (C(1′)); 89.4 (C(4′)); 111.3 (C(5)); 127.9, 128.0 (C_m); 130.0, 130.2 (C_p); 132.3, 132.9 (C_{ipso}); 135.1 (C(6)); 135.2, 135.4 (C_o); 150.3 (C(2)); 163.7 (C(4)). FAB-MS: 653 (3, $[M + 1]^+$).

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-[hydroxy(phenyl)methyl]thymidine* (**8c**). CuI (0.04 g, 0.20 mmol) was suspended in a soln. of **7** (0.70 g, 1.12 mmol) in THF (50 ml) at −5°, and 1M PhMgBr (6.00 ml, 6.00 mmol) was added slowly. The mixture was stirred for 2 h at −5° and for 1 h at 0°. Sat. aq. NH_4Cl soln. (20 ml) was added and the aq. phase extracted with Et_2O (7 × 50 ml). The org. phase was dried ($MgSO_4$) and evaporated. FC (AcOEt/pentane 1:2) yielded 0.62 g (79%) of **8c**. Colourless foam of one single diastereoisomer. ^{1}H-NMR ($CDCl_3$): 0.17 (*s*, MeSi); 0.18 (*s*, MeSi); 0.97 (*s*, *t*-BuSi); 1.07 (*s*, *t*-BuSi); 1.57 (*d*, J = 1.2, Me−C(5)); 2.15 (*m*, H_a−C(2′)); 2.34 (*m*, H_b−C(2′)); 3.26 (*d*, J = 11.1, H_a−C(5′)); 3.46 (*d*, J = 11.1, H_b−C(5′)); 4.04 (*d*, J = 2.5, OH); 4.82 (*d*, J = 2.9, H−C(3′)); 4.94 (*dd*, J = 2.5, 7.5, PhC*H*(OH)); 6.59 (*dd*, J = 6.3, 7.8, H−C(1′)); 7.40 (*m*, Ph, H−C(6)); 8.6 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −4.7 (MeSi); −4.2 (MeSi); 12.3 (*Me*−C(5)); 18.2 (Me_3CSi); 19.9 (Me_3CSi); 26.0 (Me_3CSi); 27.4 (Me_3CSi); 42.5 (C(2′)); 66.4 (C(5′)); 75.6 (C(5′)); 75.9 (C(3′)); 85.5 (C(1′)); 90.5 (C(4′)); 111.3 (C(5)); 128.2–139.0 (C(6), arom. C); 150.2 (C(2)); 163.6 (C(4)). FAB-MS: 701 (5, $[M + 1]^+$). Anal. calc. for $C_{39}H_{52}N_2O_5Si_2$ (700.01): C 66.82, H 7.48, N 4.00; found: C 66.82, H 7.47, N 3.84.

*4′-C-Acetyl-3′-O-[(*tert*-butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]thymidine* (**9a**). To a soln. of 1,1,1-triacetoxy-1,1-dihydro-1,2-benziodoxol-3(1*H*)-one (0.43 g, 1.02 mmol) in CH_2Cl_2 (7 ml), a soln. of **8a** (0.32 g, 0.51 mmol) in CH_2Cl_2 (3 ml) was added at 25°. After stirring for 1 h, the mixture was poured in sat. aq. $NaHCO_3$ soln./sat. aq. $Na_2S_2O_3$ soln. 1:1 (50 ml, *v*/*v*), extracted with Et_2O (3 × 100 ml), dried ($MgSO_4$), and evaporated. FC (AcOEt/pentane 1:3) gave 0.24 g (75%) of **9a**. Colourless foam. ^{1}H-NMR ($CDCl_3$): 0.01 (*s*, MeSi); 0.04 (*s*, MeSi); 0.86 (*s*, *t*-BuSi); 1.10 (*s*, *t*-BuSi); 1.59 (*s*, Me−C(5)); 2.28 (*m*, H−C(2′), MeCO); 3.95 (*d*, J = 11.3, H_a−C(5′)); 4.14 (*d*, J = 11.2, H_b−C(5′)); 4.50 (*m*, H−C(3′)); 6.66 (*dd*, J = 6.3, 8.7, H−C(1′)); 7.42 (*m*, arom. H); 7.61 (*m*, H−C(6), arom. H); 8.98 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.4 (MeSi); −5.1 (MeSi); 12.0 (Me−C(5)); 17.9 (Me_3CSi); 19.5 (Me_3CSi); 25.7 (Me_3CSi); 27.1 (Me_3CSi); 28.7 (*Me*CO); 41.6 (C(2′)); 66.7 (C(5′)); 76.2 (C(3′)); 86.3 (C(1′)); 96.3 (C(4′)); 111.4 (C(5)); 128.0–135.5 (arom. C, C(6)); 150.4 (C(2)); 163.8 (C(4)); 208.8 (Me*C*O). FAB-MS: 637 (3, $[M + 1]^+$). Anal. calc. for $C_{34}H_{48}N_2O_6Si_2$ (636.94): C 64.11, H 7.60, N 4.40; found: C 64.12, H 7.78, N 4.24.

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-propanoylthymidine* (**9b**). A soln. of 1,1,1-triacetoxy-1,1-dihydro-1,2-benziodoxol-3(1*H*)-one (156 mg, 2.12 mmol) and **8b** (major diastereoisomer; 96 mg, 0.15 mmol) in CH_2Cl_2 (5 ml) at 25° was stirred for 1 h. Then the mixture was poured in sat. aq. $NaHCO_3$ soln. (10 ml) and sat. aq. $Na_2S_2O_3$ soln. (10 ml), extracted with *t*-BuOMe (3 × 20 ml), dried ($MgSO_4$), and evaporated. FC (acetone/pentane 1:3) gave 75 mg (78%) of **9b**. Colourless foam. IR (KBr): 3414, 3192, 3072, 2955, 2931, 2886, 2858, 1718, 1700, 1472, 1428, 1279, 1254, 1114, 1076, 1035, 958, 834, 779, 703, 505. ^{1}H-NMR ($CDCl_3$): −0.03 (*s*, MeSi); 0.03 (MeSi); 0.84 (*s*, *t*-BuSi); 0.96 (*t*, J = 7.1, *Me*CH_2O); 1.10 (*s*, *t*-BuSi); 1.59 (*s*, Me−C(5)); 2.28 (*m*, H−C(2′)); 2.58 (*qd*, J = 7.1, 19.4, 1 H, MeCH_2CO); 2.82 (*qd*, J = 7.1, 19.4, 1 H, MeCH_2CO);

3.94 (*d*, *J* = 11.2, H_a–C(5′)); 4.11 (*d*, *J* = 11.2, H_b–C(5′)); 4.49 (*d*, *J* = 3.6, H–C(3′)); 6.65 (*dd*, *J* = 5.7, 8.9, H–C(1′)); 7.42 (*m*, arom. H); 7.63 (*m*, H–C(6), arom. H); 9.05 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.3 (MeSi); −5.2 (MeSi); 6.6 (*Me*CH_2CO); 12.0 (*Me*–C(5)); 17.9 (Me_3*C*Si); 19.4 (Me_3*C*Si); 25.6 (*Me*$_3$CSi); 27.0 (*Me*$_3$CSi); 33.6 (Me*C*H_2CO); 41.6 (C(2′)); 67.0 (C(5′)); 76.0 (C(3′)); 86.2 (C(1′)); 96.5 (C(4′)); 111.3 (C(5)); 128.0, 128.1 (C_m); 130.1, 130.3 (C_p); 132.0, 132.6 (C_{ipso}); 135.26 (C(6)); 135.31, 135.5 (C_o); 150.3 (C(2)); 163.8 (C(4)); 210.8 (MeCH_2*C*O). FAB-MS: 651 (3, $[M + 1]^+$). Anal. calc. for $C_{35}H_{50}N_2O_6Si_2$ (650.97): C 64.58, H 7.74, N 4.30; found: C 64.46, H 7.61, N 4.11.

*4′-C-Benzoyl-3′-O-[(*tert*-butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]thymidine* (**9c**). To a soln. of 1,1,1-triacetoxy-1,1-dihydro-1,2-benziodoxol-3(1*H*)-one (0.43 g, 1.02 mmol) in CH_2Cl_2 (10 ml), a soln. of **8c** (0.46 g, 0.66 mmol) in CH_2Cl_2 (5 ml) was added at 25°. After stirring for 1 h, the mixture was poured in sat. aq. $NaHCO_3$ soln./sat. aq. $Na_2S_2O_3$ soln. 1:1 (60 ml; *v*/*v*), extracted with Et_2O (3 × 100 ml), dried ($MgSO_4$), and evaporated: 0.45 g (99%) of **9c**. Colourless foam which was used in the next step without further purification. ^{1}H-NMR ($CDCl_3$): −0.06 (*s*, MeSi); 0.06 (*s*, MeSi); 0.74 (*s*, *t*-BuSi); 1.61 (*d*, *J* = 1.2, Me–C(5)); 2.33 (*m*, H_a–C(2′)); 2.40 (*m*, H_b–C(2′)); 4.21 (*d*, *J* = 11.1, H_a–C(5′)); 4.22 (*d*, *J* = 11.1, H_b–C(5′)); 4.64 (*d*, *J* = 4.8, H–C(3′)); 6.64 (*dd*, *J* = 6.3, 9.3, H–C(1′)); 7.59 (*m*, H–C(6), arom. H); 8.16 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.2 (MeSi); −4.9 (MeSi); 12.0 (*Me*–C(5)); 17.9 (Me_3*C*Si); 19.4 (Me_3*C*Si); 25.6 (*Me*$_3$CSi); 27.0 (*Me*$_3$CSi); 41.7 (C(2′)); 68.4 (C(5′)); 77.2 (C(3′)); 86.5 (C(1′)); 98.5 (C(4′)); 110.9 (C(5)); 127.9–135.6 (C(6), arom. C); 150.0 (C(2)); 163.4 (C(4)); 201.4 (C(5′)). FAB-MS: 699 (2.6, $[M + 1]^+$).

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-O-[(*tert*-butyl)diphenylsilyl]-4′-C-(1,1-dimethylpropanoyl)thymidine* (**9d**). To a soln. of 7 (4.00 g, 6.42 mmol) in Et_2O (180 ml) at −78°, 1.6M *t*-BuLi (20.0 ml, 32.0 mmol) in pentane was added. After stirring for 2 min, sat. aq. NH_4Cl soln. (12 ml) was added and the mixture warmed to 25°. The mixture was poured onto H_2O (200 ml), extracted with CH_2Cl_2 (4 × 400 ml), dried ($MgSO_4$), and evaporated to yield a colourless foam. A soln. of the crude product in CH_2Cl_2 (10 ml) was added to a soln. of trichloroacetic anhydride (2.10 ml, 10.8 mmol) and DMSO (1.00 ml, 15.1 mmol) in CH_2Cl_2 (30 ml) at −70°. After stirring for 30 min at −70°, Et_3N (5.20 ml, 35.9 mmol) was added and stirring continued for additional 5 min before warming up to 25°. The mixture was poured onto H_2O, extracted with CH_2Cl_2 (3 × 50 ml), dried ($MgSO_4$), and evaporated. FC (AcOEt/pentane 1:3) gave 1.96 g (45%) of **9d** and 0.82 g (19%) of 7. ^{1}H-NMR ($CDCl_3$): 0.01 (*s*, MeSi); 0.07 (*s*, MeSi); 0.87 (*s*, *t*-BuSi); 1.10 (*s*, *t*-BuSi); 1.20 (*s*, *t*-BuC); 1.56 (*s*, Me–C(5)); 2.26 (*dd*, *J* = 5.2, 12.4, H_a–C(2′)); 2.35 (*ddd*, *J* = 4.2, 9.8, 12.4, H_b–C(2′)); 3.97 (*d*, *J* = 11.1, H_a–C(5′)); 4.03 (*d*, *J* = 11.1, H_b–C(5′)); 4.50 (*d*, *J* = 4.2, H–C(3′)); 6.64 (*dd*, *J* = 5.2, 9.8, H–C(1′)); 7.44 (*m*, arom. H); 7.63 (*m*, H–C(6), arom. H); 8.23 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.2 (MeSi); −5.0 (MeSi); 11.9 (*Me*–C(5)); 18.0 (Me_3*C*Si); 19.5 (Me_3*C*Si); 25.8 (*Me*$_3$CSi); 25.9 (*Me*$_3$CSi); 27.2 (*Me*$_3$C); 41.2 (C(2′)); 45.2 (Me_3*C*); 70.0 (C(5′)); 77.2 (C(3′)); 85.8 (C(1′)); 99.6 (C(4′)); 111.2 (C(5)); 128.0–135.6 (arom. C, C(6)); 150.1 (C(2)); 163.4 (C(4)); 213.4 (*t*-Bu*C*O). FAB-MS: 718 (2, $[M + 1]^+$).

4′-C-Acetylthymidine (**10a**). To a soln. of **9a** (0.48 g, 0.75 mmol) in THF (15 ml), 1M Bu_4NF (1.92 ml, 1.92 mmol) was added at 25° and stirred for 3 h. Silica gel (2 g) was added and the solvent evaporated. FC (AcOEt/MeCN 4:1) gave 0.18 g (84%) of **10a**. Colourless foam. IR (KBr): 3420, 3062, 1701, 1474, 1413, 1357, 1275, 1102, 1054, 1010. ^{1}H-NMR (CD_3OD): 1.88 (*d*, *J* = 1.0, Me–C(5)); 2.25 (*s*, MeCO); 2.30 (*m*, H–C(2′)); 3.86 (*s*, H–C(5′)); 4.46 (*m*, H–C(3′)); 6.58 (*dd*, *J* = 5.9, 9.0, H–C(1′)); 7.86 (*q*, *J* = 1.0, H–C(6)). ^{13}C-NMR (CD_3OD): 12.5 (*Me*–C(5)); 28.9 (*Me*CO); 41.3 (C(2′)); 65.5 (C(5′)); 75.5 (C(3′)); 87.8 (C(1′)); 97.8 (C(4′)); 111.8 (C(5)); 138.2 (C(6)); 152.4 (C(2)); 166.4 (C(4)); 211.7 (Me*C*O). FAB-MS: 285 (46, $[M + 1]^+$). Anal. calc. for $C_{12}H_{16}N_2O_2 \cdot 0.8\ H_2O$ (298.69): C 48.21, H 5.95, N 9.48; found: C 48.18, H 5.90, N 9.12.

4′-C-Propanoylthymidine (**10b**). To a soln. of **9b** (0.23 g, 0.35 mmol) in THF (15 ml), 1M Bu_4NF (0.9 ml, 0.9 mmol) was added at 25° and stirred for 5 h. Silica gel (3 g) was added and the solvent evaporated. FC (AcOEt/MeCN 4:1), removal of the solvent *in vacuo*, dissolution in H_2O and lyophilization gave 72 mg (67%) of **10b**. Colourless foam. IR (KBr): 3412, 3063, 2979, 2939, 1700, 1474, 1406, 1376, 1115, 1047, 962, 779, 572. ^{1}H-NMR (CD_3OD): 0.99 (*t*, *J* = 7.2, *Me*CH_2CO); 1.89 (*d*, *J* = 1.2, Me–C(5)); 2.30 (*m*, H–C(2′)); 2.68 (*m*, MeCH_2CO); 3.84 (*d*, *J* = 11.7, H_a–C(5′)); 3.89 (*d*, *J* = 11.7, H_b–C(5′)); 4.46 (*m*, H–C(3′)); 6.57 (*dd*, *J* = 5.7, 8.9, H–C(1′)); 7.85 (*q*, *J* = 1.2, H–C(6)). ^{13}C-NMR (CD_3OD): 7.3 (*Me*CH_2CO); 12.5 (*Me*–C(5)); 34.8 (Me*C*H_2CO); 41.2 (C(2′)); 65.6 (C(5′)); 75.5 (C(3′)); 87.8 (C(1′)); 98.0 (C(4′)); 112.0 (C(5)); 138.2 (C(6)); 152.5 (C(2)); 166.6 (C(4)); 214.3 (MeCH_2*C*O). FAB-MS: 299 (31, $[M + 1]^+$). Anal. calc. for $C_{13}H_{18}N_2O_6 \cdot 0.35\ H_2O$ (304.61): C 51.26, H 6.19, N 9.20, O 33.35; found: C 51.13, H 6.24, N 9.05, O 33.05.

4′-C-Benzoylthymidine (**10c**). To a soln. of **9c** (6.5 mg, 0.01 mmol) in THF (2 ml), 1M Bu_4NF (0.01 ml, 0.01 mmol) was added at 0°. After stirring for 1 h at 0°, the mixture was directly chromatographed (CH_2Cl_2/MeOH 16:1) to remove Bu_4NF. After evaporation *in vacuo*, the residue was dissolved in THF (2 ml), and pyridinium poly(hydrogen fluoride) (0.07 ml, 70% HF) was added at 25°. After stirring for 2 d, the mixture was poured onto sat. aq. $NaHCO_3$ soln. (25 ml), extracted with AcOEt (4 × 50 ml), dried ($MgSO_4$), and evaporated. FC (CH_2Cl_2/MeOH 16:1) gave 0.6 mg (18%) of **10c**. For data, see below.

4′-C-(1,1-Dimethylpropanoyl)thymidine (**10d**). A suspension of **9d** (0.17 g, 0.25 mmol) and CsF (0.38 g, 2.52 mmol) in DMF (1.5 ml) was stirred for 15 h at 45°. The solvent was evaporated, the residue suspended in AcOEt (10 ml) and washed with H_2O (10 ml), and the phase extracted with AcOEt (5 × 10 ml). The combined org. phase was dried ($MgSO_4$) and evaporated. FC (AcOEt/pentane 4:1) gave 0.06 g (67%) of **10d**. Colourless solid. M.p. 192–194°. $[\alpha]_D^{25} = +11.3$ ($c = 0.011$, MeOH). IR (KBr): 3440, 3060, 2970, 1690, 1470, 1270, 1100, 1050. ^{1}H-NMR (CD_3OD): 1.21 (*s*, *t*-BuC); 1.89 (*d*, $J = 1.2$, Me–C(5)); 2.19 (*dd*, $J = 5.2$, 13.0, H_a–C(2′)); 2.37 (*ddd*, $J = 4.8$, 10.1, 13.0, H_b–C(2′)); 3.78 (*d*, $J = 11.5$, H_a–C(5′)); 3.83 (*d*, $J = 11.5$, H_b–C(5′)); 4.46 (*d*, $J = 4.8$, H–C(3′)); 6.63 (*dd*, $J = 5.2$, 10.1, H–C(1′)); 7.99 (*q*, $J = 1.2$, H–C(6)). ^{13}C-NMR (CD_3OD): 12.5 (*Me*–C(5)); 26.5 (*Me*$_3$C); 40.6 (C(2′)); 46.1 (Me$_3$*C*); 68.4 (C(5′)); 76.9 (C(3′)); 87.3 (C(1′)); 101.3 (C(4′)); 111.9 (C(5)); 138.3 (C(6)); 152.6 (C(2)); 166.4 (C(4)); 216.9 (*t*-Bu*C*O). FAB-MS: 327 (30, $[M + 1]^+$). Anal. calc. for $C_{15}H_{22}N_2O_6 \cdot 0.2\ H_2O$ (329.95): C 54.55, H 6.80, N8.49; found: C 54.59, H 7.18, N 8.44.

*3′-O-[(*tert*-Butyl)dimethylsilyl]-5′-C-phenylthymidine* (**11a**). a) $CeCl_3 \cdot 7\ H_2O$ (0.63 g, 1.70 mmol) was heated under stirring at 140° *in vacuo* (0.1 Torr) for 10 h (100-ml three-necked flask). After cooling to 0°, THF (10 ml) was added, and stirring was continued for 15 h. The mixture was then agitated at −5° for 10 min, and a soln. of aldehyde **4** (0.20 g, 0.56 mmol) in THF (10 ml) was added. Stirring at −5° was continued for 15 min. To the resulting suspension, 1M PhMgBr in THF (1.7 ml, 1.70 mmol) was added slowly (white → yellow). After 2 h at −5° and 1 h at 0°, the mixture was quenched with sat. aq. NH_4Cl soln. (25 ml), the resulting pale yellow suspension poured onto H_2O (100 ml), extracted with Et_2O (3 × 100 ml), dried ($MgSO_4$), and evaporated. FC (CH_2Cl_2/EtOH 20:1) gave 0.20 g (82%) of **11a** as a 1:1 diastereoisomer mixture. Colourless foam.

b) To a soln. of **4** (2.00 g, 5.60 mmol) in THF (80 ml) at −5°, CuI (0.21 g, 1.10 mmol) was added, the mixture agitated for 10 min, and 1M PhMgBr in THF (3.40 ml, 3.40 mmol) added. After stirring for 2 h at −5°, the mixture was hydrolyzed with sat. NH_4Cl soln. (100 ml) and extracted with Et_2O (8 × 100 ml), dried ($MgSO_4$), and evaporated. FC (CH_2Cl_2/EtOH 20:1) gave 1.90 g (78%) of **11a** as a 2.5:1 diastereoisomer mixture. Colourless foam. IR (KBr): 3397, 3211, 3063, 2929, 2856, 1695, 1472, 1276, 1105, 1072, 836, 777, 702. ^{1}H-NMR ($CDCl_3$): major diastereoisomer: 0.02 (*s*, MeSi); 0.86 (*s*, *t*-BuSi); 1.92 (*s*, Me–C(5)); 2.17 (*ddd*, $J = 2.8$, 5.1, 10.3, H_a–C(2′)); 2.35 (*m*, H_b–C(2′)); 3.43 (*d*, $J = 4.9$, OH–C(5′)); 4.08 (*dd*, $J = 3.3$, 3.5, H–C(4′)); 4.52 (*m*, H–C(3′)); 4.81 (*dd*, $J = 3.5$, 4.9, H–C(5′)); 6.11 (*dd*, $J = 5.1$, 8.0, H–C(1′)); 7.28–7.52 (*m*, arom. H, H–C(6)); 9.24 (*s*, NH); minor diastereoisomer: 0.02 (*s*, MeSi); 0.72 (*s*, *t*-BuSi); 1.93 (*s*, Me–C(5)); 2.04 (*m*, H_a–C(2′)); 2.42 (*m*, H_b–C(2′)); 4.03 (*d*, $J = 2.2$, OH–C(5′)); 4.12 (*dd*, $J = 1.3$, 2.3, H–C(4′)); 4.44 (*m*, H–C(3′)); 5.03 (*dd*, $J = 1.3$, 2.3, H–C(5′)); 6.16 (*dd*, $J = 5.5$, 9.6, H–C(1′)); 7.31–7.67 (*m*, arom. H, H–C(6)); 9.00 (*s*, NH). ^{13}C-NMR ($CDCl_3$): major diastereoisomer: −4.7 (MeSi); −4.6 (MeSi); 12.5 (*Me*–C(5)); 17.9 (Me$_3$*C*Si); 25.8 (*Me*$_3$CSi); 39.9 (C(2′)); 70.6 (C(5′)); 72.6 (C(3′)); 87.6 (C(1′)); 90.9 (C(4′)); 110.8 (C(5)); 125.9–128.8 (arom. C); 137.3 (C(6)); 150.3 (C(2)); 163.8 (C(4)); minor diastereoisomer: −4.9 (MeSi); −4.8 (MeSi); 12.4 (*Me*–C(5)); 17.9 (Me$_3$*C*Si); 25.7 (*Me*$_3$CSi); 40.0 (C(2′)); 70.4 (C(5′)); 73.2 (C(3′)); 87.5 (C(1′)); 90.4 (C(4′)); 111.0 (C(5)); 125.9–128.8 (arom. C); 137.2 (C(6)); 150.3 (C(2)); 164.4 (C(4)). FAB-MS: 433 (11, $[M + 1]^+$). Anal. calc. for $C_{22}H_{32}N_2O_5Si$ (432.60): C 61.08, H 7.46, N 6.48; found: C 60.76, H 7.70, N 6.48.

*1-{3′-O-[(*tert*-Butyl)dimethylsilyl]-2′,6′,7′-trideoxy-6′,6′-di-C-methyl-β-*D*-ribo/α-*L*-lyxo-heptofuranosyl}-thymine* (**11b**). $CeCl_3 \cdot 7\ H_2O$ (63.2 g, 170 mmol) was heated under stirring at 140° *in vacuo* (0.1 Torr) for 7 h (1-l three-necked flask). After cooling to 0°, THF (440 ml) was added and stirring continued for 15 h. The resulting suspension was cooled to −78° and 1.6M *t*-BuLi in pentane (99 ml, 158 mmol) added slowly (white → orange). After stirring at −78° for 1 h, a soln. of aldehyde **4** (5.02 g, 14.1 mmol) in THF (44 ml) was added slowly and stirring at −78° continued for 15 h. The mixture was quenched at −78° with 80% AcOH/H_2O (22 ml). The resulting pale yellow suspension was poured onto H_2O (500 ml) and extracted with AcOEt (3 × 600 ml), dried ($MgSO_4$), and evaporated. FC (AcOEt/pentane 1:1) gave 3.76 g (65%) of **11b** as a 1:1 diastereoisomer mixture. Colourless foam. IR (KBr): 3470, 2960, 2860, 1690, 1470, 1360, 1280, 1250, 1200, 1100, 1060, 970, 840, 780. ^{1}H-NMR ($CDCl_3$): diastereoisomer a: 0.08 (*s*, MeSi); 0.09 (*s*, MeSi); 0.90 (*s*, *t*-BuSi); 1.00 (*s*, *t*-BuC); 1.93 (*d*, $J = 1.2$, Me–C(5)); 2.15 (*ddd*, $J = 3.9$, 6.8, 13.4, H_a–C(2′)); 2.36 (*ddd*, $J = 6.7$, 6.8, 13.4, H_b–C(2′)); 2.72 (*d*, $J = 8.0$, OH–C(5′)); 3.33 (*d*, $J = 8.0$, H–C(5′)); 3.98 (*d*, $J = 3.8$, H–C(4′)); 4.44 (*dt*, $J = 4.0$, 6.7, H–C(3′)); 6.10 (*t*, $J = 6.8$, H–C(1′)); 7.43 (*q*, $J = 1.2$, H–C(6)); 8.26 (*s*, NH); diastereoisomer b: 0.09 (*s*, MeSi); 0.10 (*s*, MeSi); 0.90 (*s*, *t*-BuSi); 1.01 (*s*, *t*-BuC); 1.93 (*d*, $J = 1.2$, Me–C(5)); 2.14 (*m*, H_a–C(2′)); 2.37 (*m*, H_b–C(2′)); 2.83 (*d*, $J = 3.8$, OH–C(5′)); 3.50 (*m*, H–C(5′)); 4.07 (*t*, $J = 2.2$, H–C(4′)); 4.61 (*td*, $J = 2.1$, 5.7, H–C(3′)); 6.09 (*dd*, $J = 5.8$, 8.7, H–C(1′)); 7.32 (*d*, $J = 1.2$, H–C(6)); 8.22 (*s*, NH). ^{13}C-NMR ($CDCl_3$): diastereoisomer a: −4.7 (MeSi); −4.6 (MeSi); 12.5 (*Me*–C(5)); 18.0 (Me$_3$*C*Si); 25.8, 26.5 (*Me*$_3$CSi, *Me*$_3$CC); 35.2 (Me$_3$*C*); 39.7 (C(2′)); 74.3 (C(5′)); 78.3 (C(3′)); 86.2 (C(1′)); 87.1 (C(4′)); 111.0 (C(5)); 137.4 (C(6)); 150.6 (C(2)); 164.1 (C(4)); diastereoisomer b: −4.9 (MeSi); −4.0 (MeSi); 12.4 (*Me*–C(5)); 17.9 (Me$_3$*C*Si); 25.7, 26.4 (*Me*$_3$CSi, *Me*$_3$CC); 34.3 (Me$_3$*C*); 40.7 (C(2′)); 72.4 (C(5′)); 80.5 (C(3′)); 86.0 (C(1′)); 88.7 (C(4′)); 110.9 (C(5)); 136.9 (C(6)); 150.4 (C(2)); 164.0 (C(4)). FAB-MS: 413 (14, $[M + 1]^+$). Anal. calc. for $C_{20}H_{36}N_2O_5Si$ (412.61): C 58.22, H 8.79, N 6.79; found: C 57.86, H 8.78, N 6.79.

*1-{3'-O-[(*tert*-Butyl)dimethylsilyl]-2'-deoxy-5'-C-phenyl-β-*D-erythro-*pentos-5'-ulofuranosyl}thymine* (**12a**). To a soln. of trifluoroacetic anhydride (0.30 ml, 2.23 mmol) in CH_2Cl_2 (5 ml), DMSO (0.30 ml, 4.14 mmol) in CH_2Cl_2 (4 ml) was added dropwise at −60°. The mixture was stirred for 30 min at −60°. A soln. of **11a** (0.27 g, 0.62 mmol) in CH_2Cl_2 (10 ml) was added slowly. Agitation for 1 h at −60° was followed by the addition of Et_3N (0.5 ml, 165 mmol). The mixture was diluted with CH_2Cl_2 (20 ml), hydrolyzed with sat. aq. $NaHCO_3$ soln. (50 ml), extracted with CH_2Cl_2 (4 × 75 ml), dried ($MgSO_4$), and evaporated. FC (pentane/Et_2O/CH_2Cl_2 3:3:4) yielded 0.23 g (85%) of **12a**. Colourless foam. IR (KBr): 3326, 3185, 3065, 2954, 2923, 2855, 1695, 1472, 1278, 1218, 1133, 1085, 982, 837, 777, 692. ^{1}H-NMR ($CDCl_3$): 0.08 (*s*, MeSi); 0.95 (*s*, *t*-BuSi); 2.02 (*s*, Me–C(5)); 2.11 (*ddd*, *J* = 3.5, 8.8, 11.6, H_a–C(2')); 2.35 (*dd*, *J* = 5.4, 11.6, H_b–C(2')); 4.57 (*m*, H–C(3')); 5.45 (*d*, *J* = 1.4, H–C(4')); 6.59 (*dd*, *J* = 5.4, 8.8, H–C(1')); 7.55 (*t*, *J* = 7.7, H_m); 7.68 (*t*, *J* = 7.1, H_p); 8.02 (*d*, *J* = 7.2, H_o); 8.23 (*s*, H–C(6)); 9.24 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.0 (MeSi); −4.6 (MeSi); 12.7 (*Me*–C(5)); 17.8 (Me_3*C*Si); 25.6 (*Me*$_3$CSi); 40.0 (C(2')); 74.6 (C(3')); 86.1, 87.6 (C(1'), C(4')); 111.2 (C(5)); 128.5–134.5 (arom. C); 136.2 (C(6)); 150.4 (C(2)); 163.8 (C(4)); 197.0 (Ph*C*O). FAB-MS: 431 (31, $[M + 1]^+$). Anal. calc. for $C_{22}H_{30}N_2O_5Si$ (430.59): C 61.37, H 7.02, N 6.51; found: C 61.05, H 7.12, N 6.36.

*1-{3'-O-[(*tert*-Butyl)dimethylsilyl]-2',6',7'-trideoxy-6',6'-di-*C*-methyl-β-*D-erythro-*heptos-5'-ulofuranosyl}-thymine* (**12b**). To a soln. of trifluoroacetic anhydride (4.22 ml, 30.0 mmol) in CH_2Cl_2 (200 ml), DMSO (3.63 ml, 50.3 mmol) was added dropwise at −65°. The mixture was stirred for 45 min at −65°. A soln. of **11b** (3.76 g, 9.10 mmol) in CH_2Cl_2 (150 ml) was added slowly. After stirring for another 4 h at −65°, Et_3N (15 ml, 165 mmol) was added. The mixture was diluted with CH_2Cl_2 (500 ml), poured onto 5% aq. tartaric acid soln. (500 ml), extracted with CH_2Cl_2 (2 × 500 ml), dried ($MgSO_4$), and evaporated. FC (*t*-BuOMe/hexane 1:1) gave 3.35 g (90%) of **12b**. Colourless foam. $[\alpha]_D^{25}$ = +85.2 (*c* = 0.011, $CHCl_3$). IR (KBr): 3180, 3064, 2960, 2930, 2860, 1710, 1470, 1280, 1080, 1050, 830, 780. ^{1}H-NMR ($CDCl_3$): 0.07 (*s*, MeSi); 0.09 (*s*, MeSi); 0.90 (*s*, *t*-BuSi); 1.21 (*s*, *t*-BuC); 1.96 (*d*, *J* = 1.1, Me–C(5)); 2.07 (*ddd*, *J* = 4.5, 8.8, 13.3, H_a–C(2')); 2.23 (*ddd*, *J* = 1.9, 5.2, 13.3, H_b–C(2')); 4.33–5.35 (*m*, H–C(3')); 4.84 (*d*, *J* = 1.6, H–C(4')); 6.51 (*dd*, *J* = 5.2, 8.8, H–C(1')); 7.96 (*q*, *J* = 1.1, H–C(6)); 9.31 (*s*, NH). ^{13}C-NMR ($CDCl_3$): −5.0 (MeSi); −4.9 (MeSi); 12.7 (*Me*–C(5)); 17.7 (Me_3*C*Si); 25.6, 25.7 (*Me*$_3$CSi, *Me*$_3$C); 39.8 (C(2')); 43.8 (Me_3*C*); 74.3 (C(3')); 85.0, 85.4 (C(1'), C(4')); 111.3 (C(5)); 136.1 (C(6)); 150.6 (C(2)); 164.0 (C(4)); 213.6 (*t*-Bu*C*O). FAB-MS: 411 (13, $[M + 1]^+$). Anal. calc. for $C_{20}H_{34}N_2O_5Si$ (410.59): C 58.51, H 8.35, N 6.82; found: C 58.59, H 8.33, N 6.46.

*1-(2'-Deoxy-5'-C-phenyl-β-*D-erythro-*pentos-5'-ulofuranosyl)thymine* (**13a**). A soln. of **12a** (0.15 g, 0.36 mmol) in THF (10 ml) was treated with 1M Bu_4NF (0.40 ml, 0.40 mmol) in THF at 0°. After stirring for 45 min at 0°, the mixture was directly chromatographed without previous workup. FC (CH_2Cl_2/MeOH 20:1) gave 0.10 g (89%) of **13a**. Colourless foam. IR (KBr): 3378, 3229, 3063, 2926, 1692, 1664, 1474, 1275, 848, 778, 695. ^{1}H-NMR ($CDCl_3$ + 10% CD_3OD): 1.93 (*s*, Me–C(5)); 2.01 (*ddd*, *J* = 2.8, 5.0, 13.6, H_a–C(2')); 2.46 (*dd*, *J* = 9.3, 13.6, H_b–C(2')); 4.59 (*m*, H–C(3')); 5.52 (*d*, *J* = 1.1, H–C(4')); 6.58 (*dd*, *J* = 5.0, 9.3, H–C(1')); 7.55 (*dd*, *J* = 7.3, 7.6, H_m); 7.68 (*t*, *J* = 7.4, H_p); 8.02 (*d*, *J* = 7.2, H_o); 8.37 (*s*, H–C(6)). ^{13}C-NMR ($CDCl_3$ + 10% CD_3OD): 12.3 (*Me*–C(5)); 39.0 (C(2')); 73.5 (C(3')); 86.0, 87.5 (C(1'), C(4')); 111.0 (C(5)); 128.1–134.3 (arom. C); 136.6 (C(6)); 150.8 (C(2)); 164.5 (C(4)); 197.1 (Ph*C*O). FAB-MS: 317 (15, $[M + 1]^+$). Anal. calc. for $C_{16}H_{16}N_2O_5$ (316.32): C 60.75, H 5.10, N 8.86; found: C 61.19, H 5.48, N 8.55.

*1-(2',6',7'-Trideoxy-6',6'-di-*C*-methyl-β-*D-erythro-*heptos-5'-ulofuranosyl)thymine* (**13b**). A soln. of **12b** (0.40 g, 0.98 mmol) in THF (4 ml) was treated with 1M Bu_4NF (1.20 ml, 1.20 mmol) in THF at 0°. After stirring for 30 min at 0°, the mixture was directly chromatographed without previous workup. FC (CH_2Cl_2/MeOH 19:1) gave 0.27 g (94%) of **13b**. Colourless foam. $[\alpha]_D^{25}$ = +76.0 (*c* = 0.011, MeOH). IR (KBr): 3410, 3230, 3080, 2970, 1720, 1660, 1470, 1300, 1270, 1050. ^{1}H-NMR (CD_3OD): 1.23 (*s*, *t*-BuC); 1.92 (*d*, *J* = 1.2, Me–C(5)); 2.04 (*ddd*, *J* = 5.0, 9.2, 13.5, H_a–C(2')); 2.26 (*ddd*, *J* = 1.4, 5.2, 13.5, H_b–C(2')); 4.39 (*m*, H–C(3')); 4.96 (*d*, *J* = 1.3, H–C(4')); 6.47 (*dd*, *J* = 5.2, 9.3, H–C(1')); 8.28 (*q*, *J* = 1.2, H–C(6)). ^{13}C-NMR (CD_3OD): 12.7 (*Me*–C(5)); 26.2 (*Me*$_3$C); 40.0 (C(2')); 44.8 (Me_3*C*); 74.4 (C(3')); 86.8, 86.9 (C(1'), C(4')); 111.7 (C(5)); 138.4 (C(6)); 152.5 (C(2)); 166.3 (C(4)); 215.5 (*t*-Bu*C*O). FAB-MS: 297 (37, $[M + 1]^+$). Anal. calc. for $C_{14}H_{20}N_2O_5$ (296.33): C 56.75, H 6.80, N 9.45; found: C 56.17, H 6.88, N 9.02.

4'-C-Benzoylthymidine (**10c**), *1-(4'-C-Benzoyl-2'-deoxy-α-*L-threo-*pentofuranosyl)thymine* (**14a**), *and 1-(4'-C-Benzoyl-2'-deoxy-β-*D-threo-*pentofuranosyl)thymine* (**15**). $Ba(OH)_2 \cdot 8\,H_2O$ (0.12 g, 0.68 mmol) was suspended in a soln. of **13a** (0.18 g, 0.56 mmol) in dioxane/H_2O 10:1 (3.6 ml). After addition of 36% aq. formaldehyde soln. (0.30 ml, 3.60 mmol), the mixture was sonicated for 30 s (sonication bath). Stirring at 25° was continued for 1 h. The mixture was frozen with liquid N_2 and lyophilized *in vacuo*. FC (CH_2Cl_2/MeOH 2:1) of the white residue gave 38 mg (22%) of **15** and 126 mg (73%) of **14a**/**10c** (2.5:1). Prep. HPLC (*Knauer*; *RP-18*, 7 μm; column 250 × 15 mm; flow 6 ml/min; H_2O/MeCN 81:19) gave 38 mg (22%) of **10c** and 72 mg (42%) of **14a** as a colourless solid.

Data for **10c**: IR (KBr): 3442, 3065, 2935, 1692, 1633, 1512, 1469, 1282, 1256, 1141, 1042, 953, 752. ^{1}H-NMR ((D_6)DMSO): 1.78 (*d*, *J* = 1.0, Me–C(5)); 2.16 (*dd*, *J* = 5.5, 12.9, H_a–C(2′)); 2.29 (*ddd*, *J* = 4.9, 9.6, 13.0, H_b–C(2′)); 3.85 (*dd*, *J* = 5.5, 11.6, H_a–C(5′)); 3.86 (*dd*, *J* = 5.5, H_b–C(5′)); 4.55 (*t*, *J* = 4.5, H–C(3′)); 5.35 (*t*, *J* = 5.4, OH–C(5′)); 5.70 (*d*, *J* = 4.4, OH–C(3′)); 6.44 (*dd*, *J* = 5.3, 9.6, H–C(1′)); 7.44 (*t*, *J* = 7.9, H_m); 7.52 (*tt*, *J* = 1.3, 7.4, H_p); 7.76 (*dd*, *J* = 1.3, 7.2, H_o); 7.80 (*q*, *J* = 1.2, H–C(6)); 11.32 (*s*, NH); NOE H–C(6) → H–C(5′) (+), H–C(1′) (++); H_o → H–C(5′) (+), H–C(1′) ((+)); H–C(1′) → H_o (+), H–C(6) (+); H–C(3′) → H–C(5′) (+); H–C(5′) → H_o (+), H–C(6) (+), H–C(3′) (+); H_a–C(2′) → H–C(6) (+). ^{13}C-NMR ((D_6)DMSO): 12.3 (*Me*–C(5)); 40.1 (C(2′)); 65.3 (C(5′)); 74.2 (C(3′)); 85.1 (C(1′)); 97.6 (C(4′)); 109.5 (C(5)); 127.8 (C_m); 128.4 (C_o); 131.5 (C_p); 136.0 (C(6)); 138.3 (C_{ipso}); 150.5 (C(2)); 163.7 (C(4)); 202.3 (Ph*C*O). FAB-MS: 347 (33, $[M + 1]^+$). Anal. calc. for $C_{17}H_{18}N_2O_6 \cdot 0.75\ H_2O$ (359.85); C 56.67, H 5.60, N 7.78; found: C 56.61, H 5.54, N 7.74.

Data for **14a**: IR (KBr): 3454, 3041, 2899, 1701, 1687, 1537, 1470, 1460, 1285, 1049, 953, 752, 672. ^{1}H-NMR ((D_6)DMSO): 1.36 (*s*, Me–C(5)); 1.99 (*ddd*, *J* = 5.1, 9.0, 13.5, H_a–C(2′)); 2.04 (*ddd*, *J* = 2.1, 5.8, 13.5, H_b–C(2′)); 3.84 (*dd*, *J* = 4.1, 11.6, H_a–C(5′)); 4.00 (*dd*, *J* = 5.7, 11.6, H_b–C(5′)); 4.75 (*m*, H–C(3′)); 5.13 (*m*, OH); 5.75 (*m*, OH); 6.39 (*dd*, *J* = 5.8, 9.0, H–C(1′)); 6.59 (*s*, H–C(6)); 7.44 (*t*, *J* = 6.9, H_m); 7.56 (*t*, *J* = 7.3, H_p); 7.92 (*d*, *J* = 7.1, H_o); 11.2 (*s*, NH); NOE H_o → H–C(6) (+); H–C(6) → H–C(3′) (+), H_o ((+)), H–C(1′) (++); H–C(1′) → H–C(5′) ((+)); H–C(3′) → H–C(6) ((+)); H–C(5′) → H_o (+), H–C(1′) ((+)), OH–C(3′) (+). ^{13}C-NMR ((D_6)DMSO): 12.1 (*Me*–C(5)); 38.2 (C(2′)); 64.7 (C(5′)); 74.5 (C(3′)); 84.9 (C(1′)); 97.0 (C(4′)); 108.9 (C(5)); 127.7–135.7 (arom. C); 135.6 (C(6)); 150.5 (C(2)); 163.4 (C(4)); 203.7 (Ph*C*O). FAB-MS: 347 (32, $[M + 1]^+$). Anal. calc. for $C_{17}H_{18}N_2O_6 \cdot 0.75\ H_2O$ (359.85): C 56.67, H 5.60, N 7.78; found: C 56.55, H 5.68, N 7.71.

Data for **15**: IR (KBr): 3418, 3066, 2929, 1685, 1473, 1285, 1104, 1052, 786, 693. ^{1}H-NMR ($CDCl_3$ + 10% CD_3OD): 1.95 (*s*, Me–C(5)); 2.06 (*ddd*, *J* = 2.6, 3.9, 14.8, H_a–C(2′)); 2.49 (*ddd*, *J* = 5.8, 8.0, 14.8, H_b–C(2′)); 4.21 (*d*, *J* = 11.8, H_a–C(5′)); 4.29 (*d*, *J* = 11.8, H_b–C(5′)); 4.94 (*dd*, *J* = 2.6, 5.8, H–C(3′)); 6.07 (*dd*, *J* = 3.9, 8.0, H–C(1′)); 7.45 (*dd*, *J* = 7.7, 8.0, H_m); 7.56 (*t*, *J* = 7.5, H_p); 7.95 (*s*, H–C(6)); 8.12 (*d*, *J* = 7.2, H_o); NOE H_o → H–C(5′) (+), H–C(1′) ((+)); H–C(6) → H–C(5′) (+), H–C(1′) (++); H–C(1′) → H_o (+), H–C(6) (+); H–C(3′) → H_o ((+)), H–C(1′) ((+)); H–C(5′) → H_o (+), H–C(6) ((+)); H_b–C(2′) → H–C(5′) (+). ^{13}C-NMR ($CDCl_3$ + 10% CD_3OD): 12.5 (*Me*–C(5)); 40.1 (C(2′)); 63.9 (C(5′)); 72.4 (C(3′)); 83.2 (C(1′)); 98.2 (C(4′)); 109.3 (C(5)); 128.1–136.2 (arom. C); 136.8 (C(6)); 150.4 (C(2)); 163.6 (C(4)); 195.3 (Ph*C*O). FAB-MS: 347 (59, $[M + 1]^+$). Anal. calc. for $C_{17}H_{18}N_2O_6 \cdot 1\ H_2O$ (364.35): C 57.64, H 5.39, N 7.88; found: C 57.13, H 5.85, N 7.21.

4′-C-(2,2-Dimethylpropanoyl)thymidine (**10d**) *and 1-(2′-Deoxy-4′-C-(2,2-dimethylpropanoyl)-*α*-*L*-threo-pentofuranosyl)thymine* (**14b**). $Ba(OH)_2 \cdot 8\ H_2O$ (0.18 g, 0.57 mmol) was suspended in a soln. of **13b** (0.32 g, 1.10 mmol) in dioxane (7 ml). After addition of H_2O (1 ml), a 36% aq. formaldehyde soln. (0.40 ml, 5.20 mmol) was added. Stirring at 25° was continued for 12 h. The mixture was quenched with a sat. aq. NH_4Cl soln. (15 ml), extracted with AcOEt (3 × 10 ml), dried ($MgSO_4$), and evaporated. MPLC (AcOEt/pentane/MeOH 15:3:0.4) gave 0.23 g (65%) of **10d** as a colourless solid (see above) and 0.07 g (21%) of **14b**. **14b**: M.p. 221–223°. ^{1}H-NMR (CD_3OD): 1.17 (*s*, *t*-BuC); 1.89 (*d*, *J* = 1.2, Me–C(5)); 2.44 (*m*, H–C(2′)); 3.85 (*d*, *J* = 12.1, H_a–C(5′)); 3.97 (*d*, *J* = 12.1, H_b–C(5′)); 4.68 (*t*, *J* = 7.7, H–C(3′)); 6.28 (*dd*, *J* = 5.1, 8.0, H–C(1′)); 7.55 (*q*, *J* = 1.2, H–C(6)). ^{13}C-NMR (CD_3OD): 12.4 (*Me*–C(5)); 27.0 (*Me*$_3$C); 37.6 (C(2′)); 46.1 (Me$_3$*C*); 64.6 (C(5′)); 74.6 (C(3′)); 85.8 (C(1′)); 96.8 (C(4′)); 112.1 (C(5)); 139.5 (C(6)); 152.8 (C(2)); 166.8 (C(4)); 217.3 (*t*-Bu*C*O). Anal. calc. for $C_{15}H_{22}N_2O_6 \cdot 1.0\ H_2O$ (344.35): C 52.27, H 7.02, N 8.13; found: C 52.48, H 6.64, N 7.89.

X-Ray Structure Analyses of **10d**, **14b**, *and* **15** (see *Figs. 1* and *2*). Unit-cell parameters were determined by accurate centering of 25 strong independent reflections by the least-squares method. Reflection intensities were collected at r.t. on a four-circle diffractometer *Enraf-Nonius CAD4* equipped with a graphite monochromator and using CuK_α radiation. Three standard reflections monitored every 2 h during data collection showed no significant loss in intensity. The absorption profiles were measured for the correction of the absorptions. The usual corrections were applied and the structures solved by direct-method strategies using the program SIR92 [22]. Anisotropic least-squares refinement was carried out on all non-H-atoms using the program CRYSTALS [23]. Scattering factors were taken from the International Tables of Crystallography, Vol. IV [24]. The H-atoms attached to N/O atoms (N–H and O–H) were fixed at a distance of 0.96 Å and were isotropically refined. Fractional coordinates are deposited in the *Cambridge Crystallographic Data Base*. In the unit-cell of structure **10d**, one finds 4 symmetry-dependent units and 1 H_2O molecule. This H_2O molecule makes higher symmetry impossible. There is a considerable number of H-bondings between molecules **10d** themselves and with the H_2O molecule.

Separation of **10c**/**14a**: *1-(4′-C-benzoyl-2′-deoxy-3′,5′-O-isopropylidene-*α*-*L*-threo-pentofuranosyl)thymine* (**16**). A 3:1 diastereoisomer mixture **14a**/**10c** (100 mg, 0.29 mmol) and $TsOH \cdot H_2O$ (50 mg, 0.26 mmol) were dissolved in acetone (20 ml) and stirred 16 h at r.t. The mixture was concentrated to 5 ml *in vacuo*. FC (pentane/acetone 1:1) yielded 71 mg (98%) of **16** and 31.5 mg (90%) of unreacted **10c** as colourless glasses. **16**: IR (KBr): 3422, 3051, 2931, 1685, 1475, 1386, 1142, 1105, 1055, 771, 695. ^{1}H-NMR ($CDCl_3$): 1.43 (*s*, 3 H, Me_2C); 1.46

(*s*, 3 H, Me_2C); 1.53 (*s*, Me–C(5)); 1.94 (*m*, H–C(2')); 4.15 (*d*, J = 11.8, H_a–C(5')); 4.23 (*d*, J = 11.8, H_b–C(5')); 5.19 (*d*, J = 4.1, H–C(3')); 6.43 (*s*, H–C(6)); 6.68 (*dd*, J = 4.0, 5.2, H–C(1')); 7.48 (*t*, J = 6.5, H_m); 7.56 (*t*, J = 6.1, H_p); 8.12 (*d*, J = 6.2, H_o). ^{13}C-NMR ($CDCl_3$): 12.2 (*Me*–C(5)); 20.7, 26.9 (Me_2C); 37.1 (C(2')); 64.6 (C(5')); 72.8 (C(3')); 87.7 (C(1')); 89.0, 98.7 (Me_2C, C(4')); 111.1 (C(5)); 128.4, 128.7 (C_o, C_m); 130.0 (C_p); 133.9 (C(6)); 137.1 (C_{ipso}); 150.1 (C(2)); 163.7 (C(4)); 199.0 (Ph*C*O). FAB-MS: 387 (22, $[M + 1]^+$). Anal. calc. for $C_{20}H_{22}N_2O_6$ (386.38): C 62.01, H 5.98, N 7.22; found: C 61.70, H 5.91, N 7.02.

Isomerization of **15**. $Ba(OH)_2 \cdot 8\ H_2O$ (3.1 mg, 0.016 mmol) was suspended in a soln. of **15** (5 mg, 0.014 mmol) in dioxane/H_2O 10:1 (1.0 ml), and the mixture was sonicated for 30 s. Stirring at 25° was continued for 1 h. The mixture was diluted with acetone/H_2O 1:1 (1.0 ml) and analyzed by HPLC (*Merck RP-18*, 5 µm; column 250 × 4 mm; flow 1 ml/min; H_2O/MeCN 95:5 → 40:60). Comparison with authentic material showed that the mixture contained isomers **10c**, **14a**, and **15**. A quantitative analysis was not carried out.

General Procedure for the Preparation of the 4'-C-Acyl-5'-O-(4,4'-dimethoxytrityl)thymidines (**17**). A mixture of **10**, 4,4'-dimethoxytrityl chloride (2 equiv.) and a catal. amount of 4-(dimethylamino)pyridine was stirred (4 ml/mmol **10**) at 25° for 24 h. After the reaction was completed, MeOH (1 ml/mmol) was added. The mixture was poured onto sat. aq. $NaHCO_3$ soln. (100 ml/mmol) and extracted with CH_2Cl_2 (3 × 50 ml), dried ($MgSO_4$), and evaporated. FC gave **17** as a pale yellow foam.

4'-C-Acetyl-5'-O-(4,4'-dimethoxytrityl)thymidine (**17a**). Compound **10a** (0.70 g, 2.46 mmol) was converted into 1.47 g (90%) **17a**, after FC (AcOEt/pentane/Et_3N 1:1:0.01). IR (KBr): 3447, 3064, 2955, 1688, 1607, 1509, 1465, 1297, 1177, 1092, 1034, 830. ^{1}H-NMR ($CDCl_3$): 1.42 (*s*, Me–C(5)); 2.30 (MeCO); 2.43 (*m*, H–C(2')); 3.12 (*s*, OH–C(3')); 3.42 (*d*, J = 9.9, H_a–C(5')); 3.55 (*d*, J = 9.9, H_b–C(5')); 3.79 (*s*, MeO); 4.65 (*d*, J = 3.8, H–C(3')); 6.68 (*dd*, J = 5.7, 8.9, H–C(1')); 6.84 (*m*, arom. H); 7.30 (*m*, arom. H); 7.56 (*s*, H–C(6)); 9.20 (*s*, NH). ^{13}C-NMR ($CDCl_3$): 11.7 (*Me*–C(5)); 28.7 (*Me*CO); 40.1 (C(2')); 55.3 (MeO); 66.4 (C(5')); 75.0 (C(3')); 86.0 (C(1')); 87.6 (Ar_3C); 95.7 (C(4')); 111.7 (C(5)); 113.4 (C_m of $MeOC_6H_4$); 127.3–144.0 (arom. C, C(6)); 150.5 (C(2)); 158.9 (C_p of $MeOC_6H_4$); 163.8 (C(4)); 211.6 (MeCO). FAB-MS: 587 (2, $[M + 1]^+$). Anal. calc. for $C_{33}H_{34}N_2O_8$ (586.65): C 67.56, H 5.84, N 4.78; found: C 67.22, H 6.37, N 4.29.

4'-C-Benzoyl-5'-O-(4,4'-dimethoxytrityl)thymidine (**17b**). Compound **10c** (38 mg, 0.109 mmol) was converted into 56 mg (80%) of **17b**, after FC (AcOEt/pentane/Et_3N 1:3:0.01). IR (KBr): 3392, 3059, 2954, 2835, 1685, 1607, 1508, 1465, 1446, 1278, 1251, 1177, 1074, 1033, 829, 696. ^{1}H-NMR ($CDCl_3$): 1.50 (*s*, Me–C(5)); 2.40 (*m*, H–C(2')); 3.55 (*d*, J = 9.9, H_a–C(5')); 3.69 (*d*, J = 9.9, H_b–C(5')); 3.78 (*s*, MeO); 4.75 (*dd*, J = 1.9, 3.6, H–C(3')); 6.51 (*dd*, J = 5.7, 8.8, H–C(1')); 6.79–7.45 (*m*, arom. H); 7.50 (*s*, H–C(6)); 7.96 (*d*, J = 6.2, H_o). ^{13}C-NMR ($CDCl_3$): 11.9 (*Me*–C(5)); 39.1 (C(2')); 55.2 (MeO); 67.6 (C(5')); 75.6 (C(3')); 85.8 (C(1')); 87.9 (Ar_3C); 95.9 (C(4')); 111.4 (C(5)); 113.3 (C_m of $MeOC_6H_4$); 127.2–143.8 (arom. C); 135.4 (C(6)); 150.2 (C(2)); 158.7 (C_p of $MeOC_6H_4$); 163.6 (C(4)); 202.8 (Ph*C*O). FAB-MS: 648 (1.7, $[M + 1]^+$). Anal. calc. for $C_{38}H_{36}N_2O_8 \cdot 0.5\ H_2O$ (657.72): C 69.12, H 5.62, N 4.26; found: C 69.02, H 5.55, N 4.18.

5'-O-(4,4'-Dimethoxytrityl)-4'-C-(2,2-dimethylpropanoyl)thymidine (**17c**). Compound **10d** (0.48 g, 1.46 mmol) was converted into 0.77 g (85%) of **17c**, after FC (AcOEt/pentane/Et_3N 1:3:0.01). $[\alpha]_D^{25} = -2.0$ (c = 0.011, $CHCl_3$). IR (KBr): 3450, 3060, 2960, 2930, 1690, 1610, 1510, 1470, 1250, 1180, 1110, 1030, 830. ^{1}H-NMR ($CDCl_3$): 1.16 (*s*, *t*-BuC); 1.26 (*d*, J = 1.2, Me–C(5)); 2.43 (*m*, H–C(2')); 2.83 (br. *s*, OH–C(3')); 3.44 (*m*, H–C(5')); 3.79 (*s*, MeO); 4.67 (*d*, J = 4.2, H–C(3')); 6.70 (*dd*, J = 5.4, 9.7, H–C(1')); 6.83 (*m*, arom. H); 7.29 (*m*, arom. H); 7.64 (*s*, H–C(6)); 9.21 (*s*, NH). ^{13}C-NMR ($CDCl_3$): 11.3 (*Me*–C(5)); 25.9 (Me_3C); 38.8 (C(2')); 45.7 (Me_3C); 55.2 (MeO); 68.2 (C(5')); 76.1 (C(3')); 85.4 (C(1')); 88.0 (Ar_3C); 98.7 (C(4')); 111.4 (C(5)); 113.3 (C_m of $MeOC_6H_4$); 127.4–143.6 (arom. C); 135.8 (C(6)); 150.5 (C(2)); 158.8 (C_p of $MeOC_6H_4$); 163.9 (C(4)); 217.1 (*t*-Bu*C*O). FAB-MS: 629 (2, $[M + 1]^+$). Anal. calc. for $C_{36}H_{40}N_2O_8$ (628.42): C 68.77, H 6.41, N 4.46; found: C 68.41, H 6.67, N 4.74.

General Procedure for the Preparation of the 3'-O-Phosphoramidites **3**. Compound **17**, $(i\text{-Pr})_2EtN$ (5.5 equiv.), and 2-cyanoethyl *N,N*-diisopropylphosphorochloridamidite (2.3 equiv.) were dissolved in CH_2Cl_2 (4 ml/mmol **17**) and stirred for 2 h at 25°. The mixture was diluted with CH_2Cl_2 (20 ml), hydrolyzed with sat. aq. $NaHCO_3$ soln. (100 ml/mmol), extracted with CH_2Cl_2 (2 × 50 ml), dried ($MgSO_4$), and evaporated. FC gave the **3** as a pale yellow foam.

4'-C-Acetyl-5'-O-(4,4'-dimethoxytrityl)thymidine 3'-O-[(2-Cyanoethyl) N,N-Diisopropylphosphoramidite] (**3a**). Compound **17a** (0.50 g, 0.85 mmol) was converted into 0.62 g (92%) of **3a**, after FC (AcOEt/pentane/Et_3N 2:1:0.01). IR (KBr): 3447, 3059, 2967, 2931, 1700, 1654, 1509, 1509, 1466, 1252, 1179, 1032, 831. ^{1}H-NMR ($CDCl_3$; diastereoisomer mixture): 1.25 (*m*, Me_2CH, Me–C(5)); 2.45 (*m*, H–C(2'), CH_2CN, MeCO); 3.60 (*m*, CH_2OP, Me_2CH, H–C(5'), 2 MeO); 4.76 (*m*, H–C(3')); 6.66 (*m*, H–C(1')); 6.85 (*m*, arom. H); 7.31 (*m*, arom. H); 7.58, 7.60 (2*q*, J = 1.0, H–C(6)). ^{13}C-NMR ($CDCl_3$; diastereoisomer mixture): 11.7 (*Me*–C(5)); 20.3–20.5 (CH_2CN); 24.3–24.7 (Me_2CH); 28.6 (*Me*CO); 39.7 (C(2')); 43.4, 43.6 (2*d*, J = 12.4(a), 12.5(b), Me_2CH); 55.3 (MeO); 58.0, 58.66 (2*d*, J = 20.4(a), 19.0(b), CH_2OP); 65.9, 66.0 (C(5')); 76.8 (C(3')); 86.0, 86.1 (C(1')); 87.6 (Ar_3C); 94.4

(*d*, *J* = 5.8, C(4′)); 111.5 (C(5)); 113.4 (C_m of $MeOC_6H_4$); 117.5 (CN); 127.3–144.0 (arom. C, C(6)); 150.3 (C(2)); 158.9 (C_p of $MeOC_6H_4$); 163.8 (C(4)); 208.0, 208.2 (Me*C*O). ^{31}P-NMR ($CDCl_3$): 150.1 (diastereoisomer a); 150.0 (diastereoisomer b). FAB-MS: 787 (2, $[M+1]^+$). Anal. calc. for $C_{42}H_{51}N_4O_9P \cdot 0.5\,H_2O$ (795.87): C 63.32, H 6.52, N 7.00; found: C 62.97, H 6.50, N 6.85.

4′-C-Benzoyl-5′-O-[4,4′-dimethoxytrityl]thymidine 3′-O-[(2-Cyanoethyl) N,N-*Diisopropylphosphoramidite]* (**3b**). Compound **17b** (50 mg, 0.077 mmol) was converted into 50 mg (76%) **3b**, after FC (AcOEt/pentane/Et_3N 2:1:0.01). IR (KBr; diastereoisomer mixture): 3177, 3066, 2966, 1686, 1605, 1511, 1466, 1250, 1177, 1122, 1072, 1033, 828, 755, 700. ^{1}H-NMR ($CDCl_3$): diastereoisomer a: 1.17 (*m*, *Me*$_2$CH); 1.48 (*s*, Me–C(5)); 2.42 (*m*, CH_2CN); 2.65 (*dd*, *J* = 5.0, 13.2, H_a–C(2′)); 2.78 (*dd*, *J* = 3.7, 13.2, H_b–C(2′)); 3.45 (*m*, CH_2OP, Me$_2$C*H*, H–C(5′), MeO); 4.90 (*dd*, *J* = 4.6, 8.8, H–C(3′)); 6.60 (*dd*, *J* = 3.7, 5.0, H–C(1′)); 6.83 (*m*, arom. H); 7.12–7.52 (*m*, arom. H); 7.66 (*s*, H–C(6)); 7.82 (*d*, *J* = 6.2, H_o); 8.67 (*s*, NH); diastereoisomer b: 1.17 (*m*, *Me*$_2$CH); 1.55 (*s*, Me–C(5)); 2.37 (*m*, CH_2CN, H–C(2′)); 3.61 (*m*, CH_2OP, Me$_2$C*H*, H–C(5′), MeO); 5.00 (*dd*, *J* = 4.1, 11.9, H–C(3′)); 6.48 (*dd*, *J* = 2.3, 7.7, H–C(1′)); 6.75 (*m*, arom. H); 7.14–7.61 (*m*, arom. H); 7.62 (*s*, H–C(6)); 8.09 (*d*, *J* = 7.3, H_o); 8.67 (*s*, NH). ^{13}C-NMR ($CDCl_3$): diastereoisomer a: 11.7 (*Me*–C(5)); 20.2 (*d*, *J* = 7.1, *C*H$_2$CN); 24.1 (*d*, *J* = 7.0, *Me*$_2$CH); 24.4 (*d*, *J* = 7.0, *Me*$_2$CH); 39.3 (br. C(2′)); 43.5 (*d*, *J* = 12.5, Me$_2$*C*H); 55.2 (MeO); 58.5 (*d*, *J* = 18.9, CH_2OP); 67.3 (C(5′)); 77.5 (*d*, *J* = 18.9, C(3′)); 85.8 (C(1′)); 87.7 (Ar$_3$*C*); 96.2 (*d*, *J* = 6.1, C(4′)); 112.9 (C(5)); 113.3 (C_m of $MeOC_6H_4$); 117.5 (CN); 127.1–143.9 (arom. C); 135.7 (C(6)); 150.2 (C(2)); 158.7 (C_p of $MeOC_6H_4$); 163.7 (C(4)); 195.5 (Ph*C*O); diastereoisomer b: 12.4 (*Me*–C(5)); 19.9 (*d*, *J* = 7.8, *C*H$_2$CN); 24.2 (*d*, *J* = 7.2, *Me*$_2$CH); 24.4 (*d*, *J* = 7.2, *Me*$_2$CH); 39.7 (br., C(2′)); 43.5 (*d*, *J* = 12.9, Me$_2$*C*H); 55.2 (MeO); 58.4 (*d*, *J* = 19.1, CH_2OP); 67.3 (C(5′)); 77.5 (*d*, *J* = 19.2, C(3′)); 85.6 (C(1′)); 87.7 (Ar$_3$*C*); 96.5 (*d*, *J* = 6.3, C(4′)); 111.1 (C(5)); 113.3 (C_m of $MeOC_6H_4$); 117.5 (CN); 127.1–143.9 (arom. C); 135.6 (C(6)); 150.1 (C(2)); 158.4 (C_p of $MeOC_6H_4$); 163.8 (C(4)); 200.1 (Ph*C*O). ^{31}P-NMR ($CDCl_3$): 149.8 (diastereoisomer a); 149.4 (diastereoisomer b). FAB-MS (diastereoisomer mixture): 849 (1.1, $[M+1]^+$). Anal. calc. for diastereoisomer mixture $C_{47}H_{53}N_4O_9P \cdot H_2O$ (866.49): C 65.60, H 6.39, N 6.46; found: C 65.57, H 6.42, N 6.61.

5′-O-[4,4′-Dimethoxytrityl]-4′-C-[2,2-dimethylpropanoyl]thymidine 3′-O-[(2-Cyanoethyl) N,N-*Diisopropylphosphoramidite]* (**3c**). Compound **10d** (0.66 g, 1.05 mmol) was converted into 0.80 g (91%) of **3c**, after FC (AcOEt/pentane/Et_3N 2:3:0.01). IR (KBr): 3420, 3200, 2970, 2930, 1700, 1610, 1510, 1470, 1250, 1180, 1110, 1030, 980, 830, 730. ^{1}H-NMR ($CDCl_3$): diastereoisomer a: 1.18 (*s*, *t*-BuC); 1.20 (*m*, *Me*$_2$CH); 1.28 (*s*, Me–C(5)); 2.37 (*ddd*, *J* = 4.4, 10.3, 12.8, H_a–C(2′)); 2.51 (*dd*, *J* = 4.9, 12.9, H_b–C(2′)); 2.58 (*t*, *J* = 6.2, CH_2CN); 3.50 (*m*, H–C(5′)); 3.58 (*m*, Me$_2$C*H*); 3.74 (*m*, CH_2OP); 3.80 (*s*, MeO); 4.71 (*dd*, *J* = 4.2, *J*(P,H) = 8.6, H–C(3′)); 6.61 (*dd*, *J* = 4.8, 10.0, H–C(1′)); 6.83 (*m*, arom. H); 7.29 (*m*, arom. H); 7.67 (*q*, *J* = 1.2, H–C(6)); diastereoisomer b: 1.16 (*s*, *t*-BuC); 1.16 (*d*, *J* = 6.6, *Me*$_2$CH); 1.23 (*d*, *J* = 1.2, Me–C(5)); 2.57 (*m*, H–C(2′)); 2.62 (*t*, *J* = 6.0, CH_2CN); 3.57 (*m*, CH_2OP, Me$_2$C*H*, H–C(5′)); 3.79 (*s*, MeO); 4.66 (*dd*, *J* = 2.8, 8.8, H–C(3′)); 6.66 (*dd*, *J* = 6.1, 9.9, H–C(1′)); 6.82 (*d*, *J* = 8.6, arom. H); 7.28 (*m*, arom. H); 7.64 (*q*, *J* = 1.1, H–C(6)). ^{13}C-NMR ($CDCl_3$): diastereoisomer a: 11.3 (*Me*–C(5)); 20.3–20.4 (*C*H$_2$CN); 24.2–24.7 (*Me*$_2$CH); 26.0 (*Me*$_3$C); 39.2 (C(2′)); 43.6 (*d*, *J* = 12.5, Me$_2$*C*H); 45.3 (Me$_3$*C*); 55.2 (MeO); 59.0 (*d*, *J* = 19.5, CH_2OP); 68.9 (C(5′)); 78.7 (*d*, *J* = 24.8, C(3′)); 85.6 (C(1′)); 88.1 (Ar$_3$*C*); 97.5 (*d*, *J* = 8.5, C(4′)); 111.2 (C(5)); 113.3 (C_m of $MeOC_6H_4$); 117.6 (CN); 127.3–143.7 (arom. C); 135.8 (C(6)); 150.3 (C(2)); 158.8 (C_p of $MeOC_6H_4$); 163.7 (C(4)); 213.3 (*t*-Bu*C*O); diastereoisomer b: 11.2 (Me–C(5)); 20.4–20.5 (*C*H$_2$CN); 24.4–24.7 (*Me*$_2$CH); 26.0 (*Me*$_3$C); 39.4 (C(2′)); 43.2 (*d*, *J* = 12.5, Me$_2$*C*H); 45.2 (Me$_3$*C*); 55.2 (MeO); 57.9 (*d*, *J* = 24.4, CH_2OP); 68.8 (C(5′)); 78.4 (*d*, *J* = 12.7, C(3′)); 85.3 (C(1′)); 88.0 (Ar$_3$*C*); 97.3 (*d*, *J* = 8.0, C(4′)); 111.3 (C(5)); 113.3 (C_m of $MeOC_6H_4$); 117.5 (CN); 127.3–143.6 (arom. C); 136.0 (C(6)); 150.5 (C(2)); 158.8 (C_p of $MeOC_6H_4$); 163.7 (C(4)); 213.1 (*t*-Bu*C*O). ^{31}P-NMR ($CDCl_3$): 149.9 (*sext.*, *J* = 8.2, diastereoisomer a); 151.8 (*sext.*, *J* = 8.3, diastereoisomer b). FAB-MS: 829 (2, $[M+1]^+$). Anal. calc. for $C_{45}H_{57}N_4O_9P$ (828.37): C 65.21, H 6.93, N 6.76; found: C 64.63, H 7.19, N 6.69.

General Procedure for the Solid-Phase Synthesis of the 4′-Modified Oligonucleotides (5′–3′)d(T$_4$*-T*-T*$_7$*)* (**18a–c**). The synthesis of the oligonucleotides **18** was carried out on an *ABI 392 DNA/RNA* synthesizer in a 1-μmol scale (20 mol-equiv. of phosphoramidite per cycle, 500 Å controlled-pore glass (CPG) support). A standard procedure for 2-cyanoethyl phosphoramidites was used, except that the coupling time of the modified nucleoside **3** was extended to 30 min. The coupling efficiencies of the modified building blocks **3** were similar to those of the commercially available amidites (98%, assigned by conductivity measurements of the trityl salt released on each cycle). Conc. NH_3 soln. was used to remove the oligonucleotides from the solid support (55°, 8 h). The crude oligonucleotides were detritylated and desalted on oligonucleotide cartridges (*OPC*, *MWG-Biotech*). Prep. HPLC (*RP-18*, linear gradient of 5–40% MeCN (20 min) in 0.1% (Et_3NH)OAc soln. of pH 7.0) led, after lyophilization, to the oligonucleotides **18**. MALDI-TOF-MS: 3629.2 ($[M-H]^-$ for **18a**, calc. 3929.6). MALDI-TOF-MS: 3691.8 ($[M-H]^-$ for **18b**, calc. 3691.6). MALDI-TOF-MS: 3671.8 ($[M-H]^-$ for **18c**, calc. 3671.6).

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