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**Dedicated to Prof. Wiegrobe on the occasion of his 68th birthday**

The synthesis of a novel class of macrocyclic bis(indolylmaleimides) is reported. The key step involves the intermolecular connection of 2,2'-bridged indoles with 3,4-dibromo-2,5-dihydro-1*H*-2,5-pyrroledione (dibromomaleimide) derivatives. The bis(indolylmaleimides) afforded by this method were further processed by intramolecular nucleophilic substitution of the remaining bromo substituents forming flexible *N*-substituted macrocycles (**9a-9j**, **10a-10e**) and, by connecting both maleimides, semi rigid macrocycles (**7a-7xx**).

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The bis(indolylmaleimide) ring system is present in several biologically active molecules, such as the arcyriaflavins (**A**) and the potent antitumor agent rebeccamycin (**B**) [1], isolated from *Nocardia aerocoligenes* in 1985 [2,3]. For example, arcyriaflavin derivatives (**A**) have antimicrobial activity against *Bacillus cereus* [4], antitumor activity against P388 leukemia cells [4], and inhibit protein kinase A (PKA), protein kinase C (PKC) [4-6], topoisomerases I and II [4] as well as tyrosine and serine kinases [5]. Arcyriaflavin analogs are currently evaluated in human clinical trials as anti-cancer drugs [1]. Apart from the biologically active compounds mentioned above, bisindolylmaleimides which are bridged *via* their indole nitrogens (**C**) in order to suppress free rotation of the indole substituents are found in the patent literature [7-11]. These compounds are also potent and selective PKC-inhibitors.

Our group has prepared a group of compounds comparable with the homo-arcyriaflavins (**D**) [12]. Starting from the experience with the homo-arcyriaflavins, we synthesized the 2,2'-alkyl bridged bis(indolemaleimides). Depending on the substitution of the maleimide ring, flexible macrocycles with a wide variety of substituents (mono- and di-substitution) and semi rigid macrocycles with distinct lengths of the connecting chains are easily accessible.

**Results and Discussion.**

The methods for the synthesis of bis(indolylmaleimide) macrocycles are similar to those reported for homoarcyriaflavins [12]. The starting materials, (2,2'-bis-indolyl)alkanes and dibromopyrrolediones, were prepared according to literature procedures [12-15] (*vide infra*). Depending on the length of the alkyl bridge, the route affording the bisindole derivatives had to be varied. According to the procedure of Mahboobi [12], compound **2a** ( $n = 3$ ) was prepared. Longer alkyl bridges were obtained following the route of Julia [13]. For  $n > 3$  this synthesis is performed according to Figure 2.

The bis-amides **1a-1g** were obtained by reacting *o*-methylaniline (or its methoxy derivatives) with the corresponding alkandioyl chloride in toluene/pyridine (Table 1). These bis-amides were cyclized under the influence of sodium amide at 240-250° (Madelung reaction) affording the bis(1*H*-2-indolyl)alkanes **2a-2f** (Table 1). By heating **1d** to 240° the methoxy group was replaced by a hydroxy group. Under these conditions, compound **1e** gave no cyclized product (disintegration to tar).

When bis(1*H*-2-indole)alkanes **2a-g** were reacted with 3,4-dibromo-2,5-dihydro-1*H*-2,5-pyrrolediones **3a** [14] or **3b** [15] in the presence of ethylmagnesium bromide, cyclization resulted (Figure 3) [12]. However, the forma-

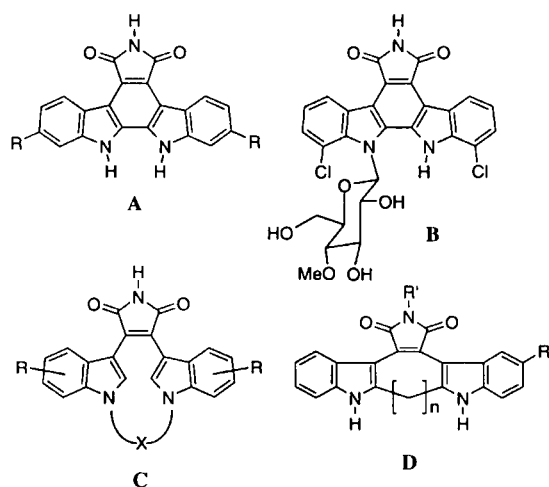


Figure 1.

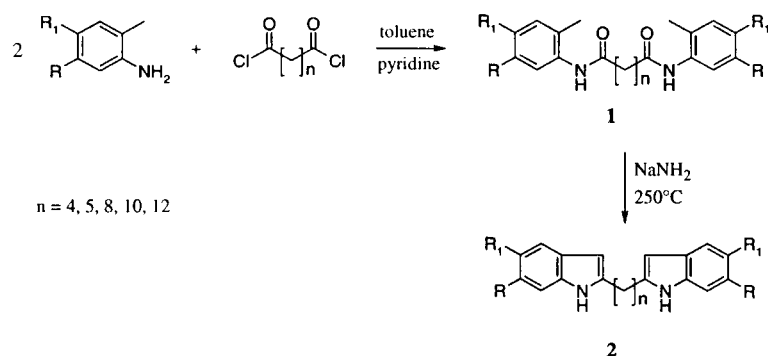


Figure 2.

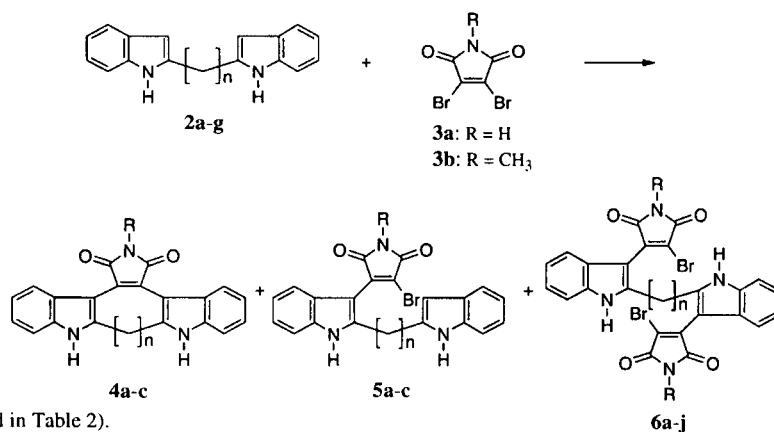
Compound	Table 1			Yield (%)
	n	R	R <sup>1</sup>	
<b>1a</b>	4	H	H	74 [13]
<b>1b</b>	5	H	H	73 [13]
<b>1c</b>	8	H	H	66 [13]
<b>1d</b>	8	H	OCH <sub>3</sub>	84
<b>1e</b>	8	OCH <sub>3</sub>	H	70
<b>1f</b>	10	H	H	69
<b>1g</b>	12	H	H	70
<b>2a</b>	4	H	H	22 [12]
<b>2b</b>	5	H	H	18 [13]
<b>2c</b>	5	H	H	53 [13]
<b>2d</b>	8	H	OH	32 [13]
<b>2e</b>	10	H	H	10
<b>2f</b>	10	H	H	44
<b>2g</b>	12	H	H	98

tion of the products depended on the length of the bisindole-alkane bridge. We found that for  $n = 1$ , which affords a 7-membered ring **4a**, only the cyclized product could be isolated. For  $n = 2$  (**4b**) and  $n = 3$  (**4c**), apart from cyclized products, mono-substituted (**5a-c**) and disubstituted (**6a-j**) products were obtained in poor yields (Figure 3). For  $n > 4$  no ring formation took place due to the unfavorable formation of the central 10-membered carbocycle. If

*n*-butyllithium was used instead of ethylmagnesium bromide ( $R = \text{CH}_3$ ), disubstituted products (**6a-j**) could be prepared in better yields (Table 2). For  $R = \text{H}$ , no increase of yields was observed.

Figure 4 summarizes the syntheses of macrocycles with 15 to 34 atoms in the central ring. These cyclizations were achieved by reacting **6a-j** and the appropriate bis-amines (**A-I**) which either are commercially available (**A-H**) or were prepared by literature methods (**I**) (Table 3) [16], on treatment with triethylamine in dimethylformamide at 80°. Nucleophilic substitution of the vinylic Br-atoms of **6a-j** by the amine groups afforded macrocycles in moderate yields (Table 3). In a side reaction, the dimethylamine moiety of the solvent dimethylformamide also reacted with the vinylic bromide in poor yields [17]. These by-products were only isolated in the case of **8a** and **8b** (Figure 5). If dimethylsulfoxide was used as a solvent the products were formed as well, but the yields decreased on account of the non-extractibility from dimethylsulfoxide/water mixtures.

The three dimensional structures of compounds **7c**, **7d**, **7h** and **7bb** (Figure 8, Tables 4-8) were established by X-ray crystallographic analysis. The X-ray crystallographic analysis shows an decreasing conformational strain when the alkyl bridge is longer. For **7c** the piperazine moiety is

Figure 3. ( $n$  and  $R$  are defined in Table 2).

Compound	Table 2		
	n	R	Yield (%)
5a	4	CH <sub>3</sub>	13
5b	5	CH <sub>3</sub>	39
5c	12	H	3
6a	3	H	19 [12]
6b	3	CH <sub>3</sub>	72
6c	4	CH <sub>3</sub>	50 [12]
6d	5	H	21
6e	5	CH <sub>3</sub>	73
6f	8	H	8
6g	8	CH <sub>3</sub>	23
6h	10	CH <sub>3</sub>	29
6i	12	H	13
6j	12	CH <sub>3</sub>	68

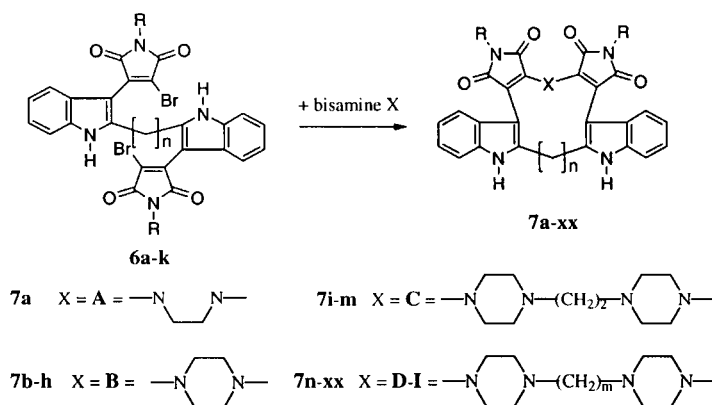


Figure 4. (n, m and R are defined in Table 3).

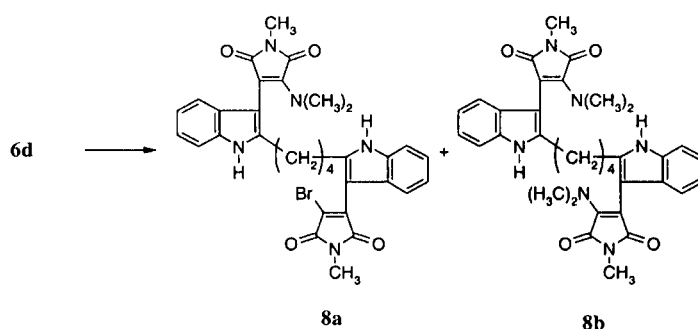


Figure 5. Solvent derived by-products.

forced to a boat-like conformation. For **7b** the X-ray analysis shows only torsion angle deformations within the piperazine moiety, which resulted in a twisted-like partial structure. In the conformationally relaxed compound **7h** the piperazine-ring can adopt a low-energy chair conformation. Nevertheless, some sterical strain was found for many other macrocycles by their <sup>1</sup>H nmr spectra, as indicated by some fractional numbers for the nmr integrals

(experimental section). Figure 6 shows the <sup>1</sup>H nmr spectra at 400 MHz of compound **7f** at temperatures varying from 21 to 160°. The spectra of compound **7f** showed two distinct signals for the indole NH-protons at 100° and lower temperatures, although the chemical environment of these protons is identical. The difference in chemical shift (21°) is 0.14 ppm (55.4 Hz). At 110° the signals coalesced, above this temperature the line width narrowed, and at 160° one singlet for the indole protons at  $\delta = 10.39$  ppm is found.

Figure 7 shows the <sup>1</sup>H nmr spectra at 400 MHz of compound **7bb** at 21° and at 100°; these two spectra are identical with reference to the indole protons (contrary to the spectra of compound **7f**). The indole NH-protons of compound **7f**, however, resonate at two different chemical shifts in spite of formally the same chemical surrounding.

The two singlets at 10.98 and 11.12 ppm at 21° belong to two distinct conformers of this indole-derivative **7f**. By heating to 100° (coalescence temperature) and 160° (last spectrum) we could not differentiate between the two conformers (indices A and B), because the converting process is so fast ( $k_A, k_B$  at coalescence temperature) that we could not see two conformers in the nmr-spectrum (the time-scale is too slow). The free energy of activation for

Table 3

Reactants	Compound	n	m	R	Yield (%)	
6c	A	7a	4	CH <sub>3</sub>	5	
6a	B	7b	3	H	30	
6b	B	7c	3	CH <sub>3</sub>	56	
6c	B	7d	4	CH <sub>3</sub>	33	
6d	B	7e	5	H	24	
6e	B	7f	5	CH <sub>3</sub>	38	
6i	B	7g	12	H	16	
6j	B	7h	12	CH <sub>3</sub>	26	
6a	C	7i	3	H	4	
6d	C	7j	5	H	7	
6e	C	7k	5	CH <sub>3</sub>	7	
6i	C	7l	12	H	16	
6j	C	7m	12	CH <sub>3</sub>	34	
6a	D	7n	3	0	H	6
6b	D	7o	3	0	CH <sub>3</sub>	32
6a	E	7p	3	1	H	4
6b	E	7q	3	1	CH <sub>3</sub>	17
6a	F	7r	3	2	H	5
6b	F	7s	3	2	CH <sub>3</sub>	20
6a	G	7t	3	3	H	5
6b	G	7u	3	3	CH <sub>3</sub>	21
6a	H	7v	3	5	H	4
6b	H	7w	3	5	CH <sub>3</sub>	35
6a	I	7x	3	6	H	4
6b	I	7y	3	6	CH <sub>3</sub>	38
6c	D	7z	4	0	CH <sub>3</sub>	12
6d	D	7aa	5	0	H	13
6e	D	7bb	5	0	CH <sub>3</sub>	39
6d	E	7cc	5	1	H	17
6e	E	7dd	5	1	CH <sub>3</sub>	35
6d	F	7ee	5	2	H	15
6e	F	7ff	5	2	CH <sub>3</sub>	36
6d	G	7gg	5	3	H	20
6e	G	7hh	5	3	CH <sub>3</sub>	36
6d	H	7ii	5	5	H	11
6e	H	7jj	5	5	CH <sub>3</sub>	39
6d	I	7kk	5	6	H	15
6e	I	7ll	5	6	CH <sub>3</sub>	38
6i	D	7mm	12	0	H	45
6j	D	7nn	12	0	CH <sub>3</sub>	34
6i	E	7oo	12	1	H	17
6j	E	7pp	12	1	CH <sub>3</sub>	28
6i	F	7qq	12	2	H	33
6j	F	7rr	12	2	CH <sub>3</sub>	37
6i	G	7ss	12	3	H	44
6j	G	7tt	12	3	CH <sub>3</sub>	40
6i	H	7uu	12	5	H	41
6j	H	7vv	12	5	CH <sub>3</sub>	36
6i	I	7ww	12	6	H	55
6j	I	7xx	12	6	CH <sub>3</sub>	53

this process shown in Figure 6 was calculated on the basis of Eyring's theory [18,19].

$$\Delta G_{A,B}^{\ddagger} = -R \cdot T_c \cdot \ln \frac{h \cdot N_A \cdot k_{A,B}}{R \cdot T_c}$$

$$k_A = 77.6 \text{ s}^{-1}; \Delta G_A^{\ddagger} = 80.7 \text{ KJ/mol};$$

$$k_B = K \cdot k_A = 54.3 \text{ s}^{-1}; \Delta G_B^{\ddagger} = 81.9 \text{ KJ/mol}$$

$$R = 8.314 \text{ J/mol K}, N_A = 6.022 \cdot 10^{23}, h = 6.626 \cdot 10^{-34} \text{ Js},$$

$$T_c = 110^\circ, K = 0.7$$

A: 1,2-ethylenediamine; B: piperazine; C: 1,2-dipiperazinoethane; D: 4,4'-bispiperidine; E: dipiperidin-4-yl-methane; F: 1,2-dipiperidin-4-yl-ethane; G: 1,3-dipiperidin-4-yl-propane; H: 1,5-dipiperidin-4-yl-pentane; I: 1,6-dipiperidin-4-yl-hexane.

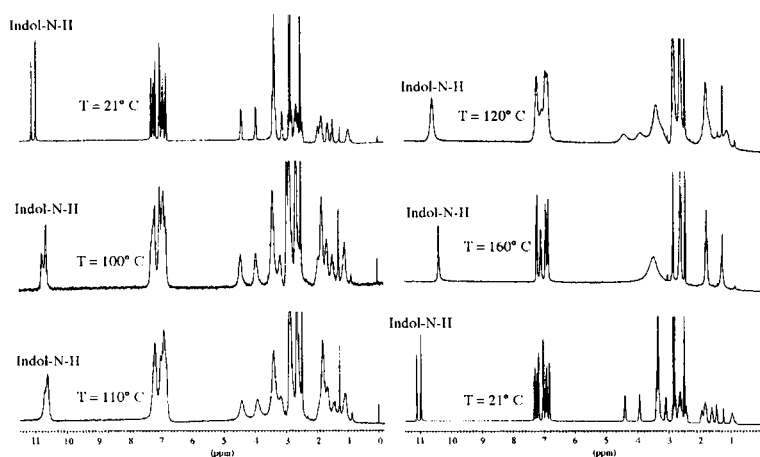
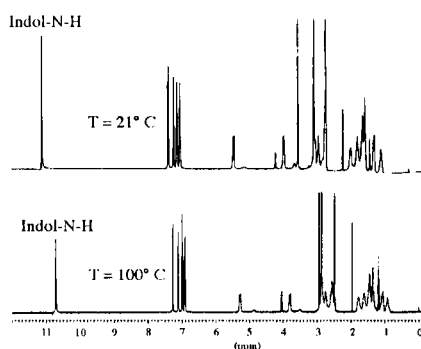
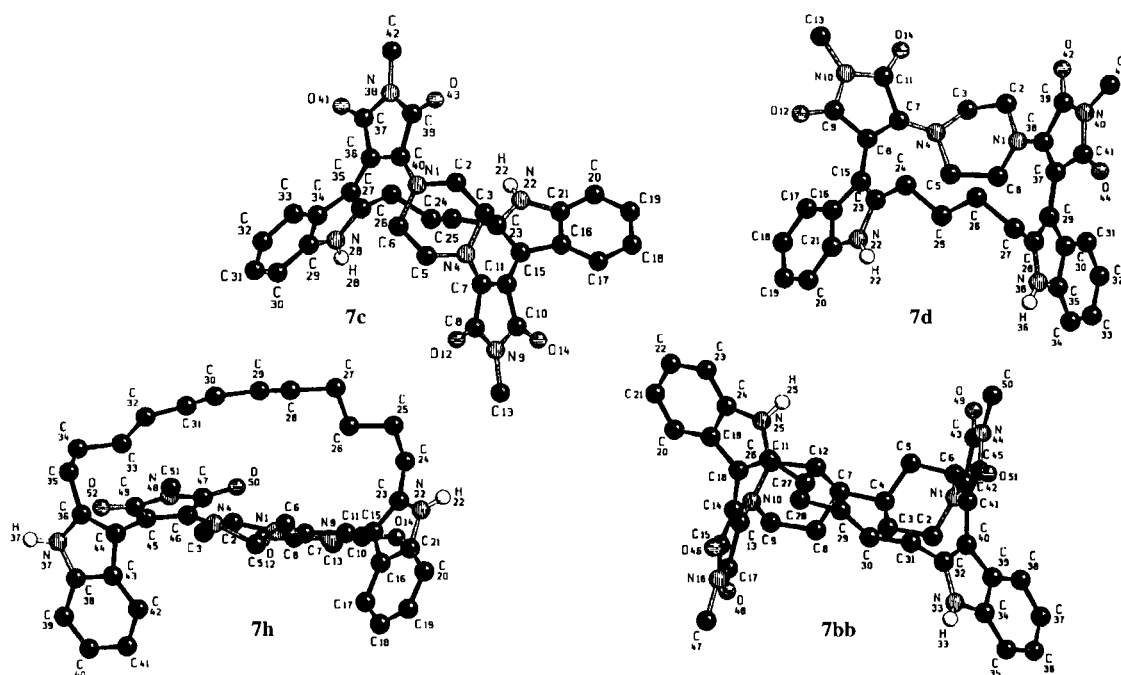
Figure 6.  $^1\text{H}$  nmr-spectrum of **7f** (400 MHz, dimethyl- $d_6$  sulfoxide).Figure 7.  $^1\text{H}$  nmr-spectrum of **7bb** (400 MHz, dimethyl- $d_6$  sulfoxide).Figure 8. SCHAKAL-plots [20] of **7c**, **7d**, **7h** and **7bb**.

Table 4

Crystal data for	7c	7d	7h	7bb
Formula	C <sub>33</sub> H <sub>30</sub> N <sub>6</sub> O <sub>4</sub> x 2DMSO x H <sub>2</sub> O	C <sub>34</sub> H <sub>32</sub> N <sub>6</sub> O <sub>4</sub> x 1.5 THF	C <sub>42</sub> H <sub>48</sub> N <sub>6</sub> O <sub>4</sub> [a]	C <sub>41</sub> H <sub>44</sub> N <sub>6</sub> O <sub>4</sub>
Crystal dimensions (mm)	0.064 x 0.160 x 0.576	0.22 x 0.19 x 0.13	0.224 x 0.576 x 0.576	0.032 x 0.224 x 0.256
Formula weight (g mol <sup>-1</sup> )	748.9	696.81	700.89	684.82
Space group	P ca2 <sub>1</sub> (orthorhombic)	C 2 <sub>1</sub> /c (monoclinic)	C 2/c (monoclinic)	P -1 (triclinic)
a (Å)	11.5651(4)	18.887(3)	29.805(5)	9.8670(7)
b (Å)	22.5741(9)	28.030(2)	9.560(6)	9.8863(7)
c (Å)	14.4109(5)	14.126(4)	32.430(2)	20.661(2)
α (degree)				82.217(6)
β (degree)		103.139(9)	119.42(6)	80.815(6)
γ (degree)				64.814(6)
V (Å <sup>3</sup> )	3762.3(2)	7282(2)	8049(8)	1795.3(2)
Z	4	8	8	2
D <sub>c</sub> (g cm <sup>-3</sup> )	1.322	1.271	1.157	1.267
μ (mm <sup>-1</sup> )	1.75	0.70	0.60	0.66
F (000)	1584	2960	2992	728
Radiation	Cu-K <sub>α</sub> graphite monochromatized	λ = 1.5418 Å		
Diffractometer		CAD4 (Enraf-Nonius)		
T (K)	298(2)	298(2)	298(2)	298(2)
Scan method		ω/2θ		
Data collection range		1.5° ≤ Θ ≤ 75.0°		
No. unique reflections	5503	13755	7638	7400
No. of observed reflections	4034	3903	4489	4051
Correction	Lorentz- and polarization correction variation of standard reflections corrected with a cubic spline function			
Solution	Program: SIR-92, SHELXS-97 (direct methods)			
Refinement	Program: SHELXL-97 (full-matrix least-squares)			
wR2 for unique reflections [b]	0.2255	0.4750	0.4571	0.2067
R1 for observed reflections [c]	0.0722	0.1387	0.1484	0.0711
Largest positive peak (e Å <sup>-3</sup> )	0.81	0.57	1.51	0.30
Largest negative peak (e Å <sup>-3</sup> )	-0.52	-0.60	-0.61	-0.30

[a] Structure contains solvent, which could not be localized; [b] wR1 =  $[\sum(w(F_o^2 - F_c^2)^2)/\sum(w(F_o^2)^2)]^{1/2}$ ; [c] R1 =  $[\sum||F_o| - |F_c||/\sum|F_o|]$ ; Weighting scheme:  $w = 1/[\sigma^2(F_o^2) + (a*P)^2 + b*P]$  with  $P = (\text{Max}(F_o^2, 0) + 2*F_c^2)/3$ .

Table 5

Positional Parameters and Equivalent Displacement Parameters (Å)<sup>2</sup> of 7c with Estimated Standard Deviation in Parenthesis

$$U_{eq} = (1/3) * \sum \sum U_{ij} * a_i * a_j$$

Atom	X	Y	Z	U <sub>eq</sub>
N1	7250(4)	2917(2)	2042(3)	44(1)
C2	6966(5)	2352(2)	2472(3)	47(1)
C3	7100(5)	1862(2)	1766(3)	46(1)
N4	6438(4)	2006(2)	910(3)	44(1)
C5	5765(4)	2552(2)	965(3)	42(1)
C6	6536(5)	3061(2)	1198(3)	45(1)
C7	6639(4)	1709(2)	115(3)	37(1)
C8	5661(5)	1655(2)	-600(4)	45(1)
N9	6079(4)	1306(2)	-1280(3)	52(1)
C10	7202(5)	1100(3)	-1067(4)	48(1)
C11	7555(5)	1374(2)	-181(3)	40(1)
O12	4705(3)	1855(2)	-566(3)	59(1)
C13	5423(7)	1099(4)	-2086(5)	72(2)
O14	7735(4)	767(2)	-1565(3)	65(1)
C15	8718(4)	1294(2)	173(3)	39(1)
C16	9308(5)	738(2)	339(3)	43(1)

Table 5 (cont.)

Atom	X	Y	Z	U <sub>eq</sub>
C17	8984(6)	144(2)	269(4)	56(1)
C18	9786(7)	-281(3)	512(6)	72(2)
C19	10861(7)	-132(3)	838(6)	70(2)
C20	11215(6)	446(3)	910(4)	57(1)
C21	10420(4)	877(2)	650(3)	41(1)
N22	10508(4)	1487(2)	670(3)	46(1)
C23	9497(4)	1735(2)	372(3)	42(1)
C24	9365(5)	2399(2)	347(5)	60(2)
C25	10262(5)	2730(3)	-209(5)	55(1)
C26	10389(5)	3370(2)	148(4)	47(1)
C27	9322(5)	3738(2)	117(3)	39(1)
N28	8980(4)	4011(2)	-688(3)	42(1)
C29	8042(5)	4355(2)	-509(3)	45(1)
C30	7388(7)	4710(3)	-1107(4)	61(2)
C31	6469(7)	5014(3)	-737(5)	72(2)
C32	6170(6)	4969(3)	204(5)	63(2)
C33	6820(5)	4614(2)	787(4)	51(1)
C34	7757(5)	4301(2)	437(3)	42(1)

Table 5 (cont.)

Atom	X	Y	Z	$U_{eq}$
C35	8595(5)	3901(2)	835(3)	41(1)
C36	8694(5)	3707(2)	1805(3)	45(1)
C37	9610(6)	3940(3)	2408(4)	54(1)
N38	9560(5)	3621(2)	3248(3)	59(1)
C39	8689(5)	3225(2)	3241(3)	47(1)
C40	8141(5)	3262(2)	2279(3)	40(1)
O41	10322(5)	4317(3)	2250(3)	79(2)
C42	10278(7)	3739(4)	4057(4)	74(2)
O43	8394(4)	2917(2)	3884(3)	64(1)

Bond Length (Å) of 7c

N1-C40	1.337(7)	N22-C23	1.367(7)
N1-C2	1.454(6)	C23-C24	1.506(8)
N1-C6	1.506(6)	C24-C25	1.509(8)
C2-C3	1.512(7)	C25-C26	1.542(8)
C3-N4	1.488(6)	C26-C27	1.489(7)
N4-C7	1.347(6)	C27-N28	1.371(6)
N4-C5	1.459(6)	C27-C35	1.382(7)
C5-C6	1.493(8)	N28-C29	1.359(7)
C7-C11	1.370(7)	C29-C30	1.400(8)
C7-C8	1.535(7)	C29-C34	1.407(7)
C8-O12	1.194(7)	C30-C31	1.373(10)
C8-N9	1.347(7)	C31-C32	1.403(10)
N9-C10	1.413(8)	C32-C33	1.384(9)
N9-C13	1.464(8)	C33-C34	1.389(8)
C10-O14	1.207(7)	C34-C35	1.443(7)
C10-C11	1.477(7)	C35-C36	1.469(7)
C11-C15	1.450(7)	C36-C40	1.372(8)
C15-C23	1.373(7)	C36-C37	1.468(8)
C15-C16	1.450(7)	C37-O41	1.207(7)
C16-C17	1.396(8)	C37-N38	1.410(8)
C16-C21	1.398(8)	N38-C39	1.347(8)
C17-C18	1.380(10)	N38-C42	1.456(8)
C18-C19	1.370(12)	C39-O43	1.208(7)
C19-C20	1.372(10)	C39-C40	1.527(6)
C20-C21	1.391(8)	C21-N22	1.380(7)

Bond Angles (°) of 7c

C40-N1-C2	125.2(4)	N22-C23-C24	120.2(5)
C40-N1-C6	120.2(4)	C15-C23-C24	130.5(5)
C2-N1-C6	114.2(4)	C23-C24-C25	115.8(5)
N1-C2-C3	109.4(4)	C24-C25-C26	110.6(5)
N4-C3-C2	110.1(4)	C27-C26-C25	115.8(5)
C7-N4-C5	123.9(4)	N28-C27-C35	109.8(4)
C7-N4-C3	120.5(4)	N28-C27-C26	121.0(4)
C5-N4-C3	114.5(4)	C35-C27-C26	129.0(5)
N4-C5-C6	110.1(4)	C29-N28-C27	109.0(4)
C5-C6-N1	110.0(4)	N28-C29-C30	129.9(5)
N4-C7-C11	132.3(4)	N28-C29-C34	108.8(4)
N4-C7-C8	118.9(4)	C30-C29-C34	121.3(6)
C11-C7-C8	108.5(4)	C31-C30-C29	117.7(6)
O12-C8-N9	125.6(5)	C30-C31-C32	122.0(6)
O12-C8-C7	128.6(5)	C33-C32-C31	119.6(6)
N9-C8-C7	105.7(5)	C32-C33-C34	119.9(5)
C8-N9-C10	111.4(4)	C33-C34-C29	119.4(5)
C8-N9-C13	125.3(5)	C33-C34-C35	134.2(5)
C10-N9-C13	122.9(5)	C29-C34-C35	106.4(5)
O14-C10-N9	123.1(5)	C27-C35-C34	106.1(4)
O14-C10-C11	129.2(5)	C27-C35-C36	125.8(5)
N9-C10-C11	107.7(5)	C34-C35-C36	128.1(5)
C7-C11-C15	132.6(4)	C40-C36-C37	107.7(4)
C7-C11-C10	106.7(5)	C40-C36-C35	131.0(5)

Table 5 (cont.)

C15-C11-C10	120.6(5)	C37-C36-C35	120.8(5)
C23-C15-C16	106.6(4)	O41-C37-N38	123.4(5)
C23-C15-C11	126.3(4)	O41-C37-C36	129.4(5)
C16-C15-C11	127.0(4)	N38-C37-C36	107.2(5)
C17-C16-C21	119.2(5)	C39-N38-C37	111.3(5)
C17-C16-C15	133.9(5)	C39-N38-C42	123.6(5)
C21-C16-C15	106.9(4)	C37-N38-C42	124.9(5)
C18-C17-C16	117.9(6)	O43-C39-N38	126.0(5)
C19-C18-C17	121.8(6)	O43-C39-C40	127.7(5)
C18-C19-C20	122.0(6)	N38-C39-C40	106.3(4)
C19-C20-C21	116.6(6)	N1-C40-C36	131.2(4)
N22-C21-C20	130.1(5)	N1-C40-C39	121.3(4)
N22-C21-C16	107.4(4)	C36-C40-C39	107.4(5)
C20-C21-C16	122.4(5)	C23-N22-C21	109.8(4)

Table 6  
Positional Parameters and Equivalent Displacement  
Parameters (Å)<sup>2</sup> of 7d with Estimated Standard Deviations  
in Parenthesis  $U_{eq} = (1/3) \sum \sum U_{ij} a_i^* a_j^* a_i a_j$

Atom	X	Y	Z	$U_{eq}$
N1	5137(4)	6899(3)	1319(6)	65(2)
C2	5561(6)	6732(4)	2283(8)	79(3)
C3	5069(5)	6566(4)	2909(7)	72(3)
N4	4463(4)	6282(3)	2338(6)	62(2)
C5	3988(5)	6573(4)	1572(8)	69(3)
C6	4396(5)	7005(4)	1335(8)	73(3)
C7	4310(5)	5833(3)	2453(6)	54(2)
C8	3760(5)	5539(3)	1992(7)	60(3)
C9	3877(6)	5074(4)	2411(8)	70(3)
N10	4511(4)	5085(3)	3167(6)	71(2)
C11	4805(5)	5524(4)	3247(7)	61(3)
O12	3527(4)	4708(3)	2236(5)	89(2)
C13	4837(6)	4667(4)	3718(9)	101(4)
O14	5340(4)	5639(3)	3835(5)	80(2)
C15	3083(4)	5625(3)	1224(7)	58(3)
C16	2366(5)	5622(3)	1403(8)	61(3)
C17	2097(6)	5585(4)	2249(9)	82(3)
C18	1360(6)	5594(4)	2163(11)	95(4)
C19	880(6)	5656(4)	1260(12)	104(5)
C20	1131(5)	5682(4)	420(9)	77(3)
C21	1861(5)	5665(3)	484(8)	65(3)
N22	2266(4)	5679(3)	-198(6)	63(2)
C23	3000(5)	5652(3)	244(7)	56(2)
C24	3546(5)	5663(3)	-382(7)	60(3)
C25	3447(5)	6089(4)	-1065(7)	72(3)
C26	4079(6)	6153(4)	-1558(8)	78(3)
C27	3990(6)	6608(4)	-2211(8)	92(4)
C28	3933(6)	7067(4)	-1686(8)	73(3)
C29	4395(5)	7251(4)	-862(7)	65(3)
C30	4080(5)	7699(4)	-709(8)	66(3)
C31	4292(5)	8074(4)	-39(8)	77(3)
C32	3889(7)	8474(4)	-106(9)	96(4)
C33	3255(7)	8522(5)	-839(11)	102(4)
C34	3009(6)	8172(6)	-1475(9)	93(4)
C35	3428(6)	7762(5)	-1432(9)	80(3)
N36	3357(5)	7367(4)	-1991(7)	84(3)
C37	5114(5)	7066(3)	-405(8)	62(3)
C38	5415(5)	6942(3)	525(8)	64(3)
C39	6215(6)	6831(3)	609(10)	74(3)

Table 6 (cont.)

Atom	X	Y	Z	U <sub>eq</sub>
N40	6319(4)	6873(3)	-324(7)	74(2)
C41	5685(6)	7041(4)	-953(10)	80(3)
O42	6687(4)	6726(3)	1309(6)	87(2)
C43	7008(6)	6815(4)	-603(9)	101(4)
O44	5630(4)	7119(3)	-1812(6)	96(3)

## Bond Length (Å) of 7d

N1-C38	1.347(12)	C20-C21	1.363(12)
N1-C6	1.435(11)	C21-N22	1.359(12)
N1-C2	1.491(12)	N22-C23	1.387(10)
C2-C3	1.495(13)	C23-C24	1.504(12)
C3-N4	1.473(11)	C24-C25	1.520(12)
N4-C7	1.309(11)	C25-C26	1.523(12)
N4-C5	1.485(11)	C26-C27	1.562(14)
C5-C6	1.511(13)	C27-C28	1.501(15)
C7-C8	1.368(12)	C28-N36	1.364(13)
C7-C11	1.553(13)	C28-C29	1.386(13)
C8-C9	1.428(13)	C29-C30	1.425(13)
C8-C15	1.498(12)	C29-C37	1.461(13)
C9-O12	1.215(11)	C30-C31	1.411(14)
C9-N10	1.412(12)	C30-C35	1.421(14)
N10-C11	1.343(11)	C31-C32	1.346(14)
N10-C13	1.464(12)	C32-C33	1.40(2)
C11-O14	1.198(10)	C33-C34	1.34(2)
C15-C23	1.360(12)	C34-C35	1.39(2)
C15-C16	1.432(12)	C35-N36	1.351(14)
C16-C17	1.404(14)	C37-C38	1.353(13)
C16-C21	1.431(13)	C37-C41	1.465(14)
C17-C18	1.370(14)	C38-C39	1.521(13)
C18-C19	1.40(2)	C39-O42	1.208(11)
C19-C20	1.38(2)	C39-N40	1.380(14)

## Bond Angles (°) of 7d

C38-N1-C6	124.2(8)	C21-N22-C23	110.2(8)
C38-N1-C2	123.9(8)	C15-C23-N22	109.5(8)
C6-N1-C2	111.9(8)	C15-C23-C24	131.6(8)
N1-C2-C3	111.1(8)	N22-C23-C24	118.9(9)
N4-C3-C2	110.8(8)	C23-C24-C25	112.8(8)
C7-N4-C3	128.2(8)	C24-C25-C26	112.7(8)
C7-N4-C5	120.3(8)	C25-C26-C27	112.1(9)
C3-N4-C5	111.5(8)	C28-C27-C26	114.7(9)
N4-C5-C6	110.3(8)	N36-C28-C29	109.9(10)
N1-C6-C5	112.8(8)	N36-C28-C27	120.9(11)
N4-C7-C8	133.3(9)	C29-C28-C27	129.2(11)
N4-C7-C11	120.8(8)	C28-C29-C30	104.5(10)
C8-C7-C11	105.9(8)	C28-C29-C37	125.7(10)
C7-C8-C9	108.9(9)	C30-C29-C37	128.6(10)
C7-C8-C15	132.8(9)	C31-C30-C35	117.1(11)
C9-C8-C15	118.2(9)	C31-C30-C29	133.9(10)
O12-C9-N10	120.0(10)	C35-C30-C29	109.0(11)
O12-C9-C8	131.4(10)	C32-C31-C30	120.3(11)
N10-C9-C8	108.5(9)	C31-C32-C33	120.4(13)
C11-N10-C9	110.3(8)	C34-C33-C32	122.2(12)
C11-N10-C13	125.0(9)	C33-C34-C35	118.0(11)
C9-N10-C13	124.5(9)	N36-C35-C34	132.4(12)
O14-C11-N10	125.0(10)	N36-C35-C30	105.7(11)
O14-C11-C7	128.6(9)	C34-C35-C30	121.8(13)
N10-C11-C7	106.3(8)	C35-N36-C28	110.8(10)
C23-C15-C16	106.6(8)	C38-C37-C29	131.6(9)
C23-C15-C8	128.9(8)	C38-C37-C41	107.7(9)
C16-C15-C8	123.9(9)	C29-C37-C41	120.4(10)

Table 6 (cont.)

C17-C16-C21	118.9(9)	N1-C38-C37	132.4(9)
C17-C16-C15	133.6(10)	N1-C38-C39	119.1(10)
C21-C16-C15	107.5(9)	C37-C38-C39	108.5(10)
C18-C17-C16	118.7(12)	O42-C39-N40	124.3(11)
C17-C18-C19	121.2(12)	O42-C39-C38	130.4(12)
C20-C19-C18	121.0(11)	N40-C39-C38	105.3(9)
C21-C20-C19	118.9(12)	C39-N40-C41	110.3(9)
N22-C21-C20	132.6(11)	C39-N40-C43	125.4(10)
N22-C21-C16	106.2(8)	C41-N40-C43	123.7(10)
C20-C21-C16	121.2(11)	O44-C41-N40	124.2(11)

Table 7

Positional Parameters and Equivalent Displacement  
Parameters (Å)<sup>2</sup> of 7h with Estimated Standard  
Deviations in Parenthesis U<sub>eq</sub> = (1/3)\*ΣΣU<sub>ij</sub>a<sub>i</sub>\*a<sub>j</sub>

Atom	X	Y	Z	U <sub>eq</sub>
N1	3728(2)	4427(8)	1758(2)	105(2)
C2	4185(5)	4418(19)	1707(5)	247(10)
C3	4153(2)	4370(8)	1290(2)	85(2)
N4	3753(2)	5275(8)	949(2)	103(2)
C5	3252(3)	4896(16)	953(3)	164(6)
C6	3327(2)	5293(9)	1404(2)	94(2)
C7	3735(2)	4055(8)	2162(2)	81(2)
C8	4179(3)	3260(9)	2548(3)	100(2)
N9	4068(2)	3049(6)	2900(2)	81(1)
C10	3590(2)	3622(6)	2775(2)	69(1)
C11	3378(2)	4268(6)	2304(2)	65(1)
O12	4573(2)	2859(10)	2573(3)	168(4)
C13	4394(3)	2316(10)	3334(3)	111(3)
O14	3401(2)	3571(5)	3026(2)	89(1)
C15	2869(2)	4891(7)	2078(2)	69(2)
C16	2410(2)	4377(7)	1682(2)	73(2)
C17	2293(3)	3198(9)	1393(3)	90(2)
C18	1784(4)	3041(11)	1026(3)	112(3)
C19	1405(3)	3990(14)	944(3)	120(3)
C20	1505(3)	5121(12)	1227(3)	103(3)
C21	2012(2)	5308(9)	1594(2)	85(2)
N22	2220(2)	6364(7)	1929(2)	91(2)
C23	2740(2)	6080(7)	2226(2)	74(2)
C24	3056(3)	7072(9)	2619(3)	101(2)
C25	3113(4)	8526(11)	2469(4)	125(3)
C26	3366(4)	8525(10)	2163(4)	121(3)
C27	3489(5)	9975(12)	2063(4)	138(3)
C28	3723(5)	9920(15)	1729(5)	154(4)
C29	4223(5)	9374(13)	1902(4)	138(3)
C30	4445(5)	9207(16)	1571(4)	153(4)
C31	4898(5)	8351(11)	1732(4)	130(3)
C32	5061(4)	8034(11)	1388(3)	123(3)
C33	5381(3)	6659(10)	1484(3)	110(3)
C34	5621(3)	6476(9)	1180(3)	99(2)
C35	5234(2)	6275(8)	642(2)	84(2)
C36	4944(2)	4936(6)	540(2)	66(1)
N37	5176(2)	3699(6)	539(2)	78(2)
C38	4859(3)	2637(8)	461(2)	77(2)
C39	4914(4)	1176(10)	420(3)	103(3)



Table 7 (cont.)

Atom	X	Y	Z	Ueq
C40	4521(6)	344(10)	349(3)	127(4)
C41	4055(4)	844(9)	311(3)	110(3)
C42	4003(3)	2261(8)	345(2)	86(2)
C43	4397(2)	3148(7)	416(2)	69(2)
C44	4461(2)	4656(6)	465(2)	59(1)
C45	4046(2)	5649(6)	370(2)	60(1)
C46	3751(2)	5861(7)	575(2)	68(2)
C47	3371(2)	7051(7)	304(2)	70(2)
N48	3434(2)	7318(6)	-73(2)	75(1)
C49	3839(2)	6559(7)	-46(2)	74(2)
O50	3075(2)	7634(6)	398(2)	97(2)
C51	3090(2)	8217(8)	-472(3)	96(2)
O52	3973(2)	6628(6)	-345(2)	109(2)

Bond Length (Å) of 7h

N(1)-C(7)	1.347(7)	C(15)-C(23)	1.360(9)
N(1)-C(6)	1.444(8)	C(15)-C(16)	1.426(8)
N(1)-C(2)	1.450(9)	C(16)-C(21)	1.396(9)
C(2)-C(3)	1.308(12)	C(16)-C(17)	1.397(10)
C(3)-N(4)	1.449(8)	C(17)-C(18)	1.403(11)
N(4)-C(46)	1.334(7)	C(18)-C(19)	1.369(13)
N(4)-C(5)	1.543(9)	C(19)-C(20)	1.352(13)
C(5)-C(6)	1.417(12)	C(20)-C(21)	1.402(10)
C(7)-C(11)	1.366(7)	C(21)-N(22)	1.387(10)
C(7)-C(8)	1.506(9)	N(22)-C(23)	1.391(8)
C(8)-O(12)	1.199(8)	C(23)-C(24)	1.494(10)
C(8)-N(9)	1.351(8)	C(24)-C(25)	1.510(13)
N(9)-C(10)	1.390(8)	C(25)-C(26)	1.515(12)
N(9)-C(13)	1.439(9)	C(26)-C(27)	1.508(13)
C(10)-O(14)	1.197(6)	C(27)-C(28)	1.551(15)
C(10)-C(11)	1.473(8)	C(28)-C(29)	1.409(14)
C(11)-C(15)	1.451(7)	C(29)-C(30)	1.519(14)
C(30)-C(31)	1.44(2)	C(41)-C(42)	1.375(11)
C(31)-C(32)	1.451(13)	C(42)-C(43)	1.374(9)
C(32)-C(33)	1.561(13)	C(43)-C(44)	1.452(8)
C(33)-C(34)	1.486(11)	C(44)-C(45)	1.466(7)
C(34)-C(35)	1.561(10)	C(45)-C(46)	1.355(6)
C(35)-C(36)	1.488(9)	C(45)-C(49)	1.463(8)
C(36)-C(44)	1.364(7)	C(46)-C(47)	1.540(8)
C(36)-N(37)	1.371(7)	C(47)-O(50)	1.201(6)
N(37)-C(38)	1.324(9)	C(47)-N(48)	1.351(7)
C(38)-C(43)	1.400(8)	N(48)-C(49)	1.374(7)
C(38)-C(39)	1.420(11)	N(48)-C(51)	1.470(8)
C(39)-C(40)	1.339(14)	C(49)-O(52)	1.216(6)
C(40)-C(41)	1.415(14)		

Bond Angles (°) of 7h

C41-C42	1.375(11)	O12-C8-C7	130.4(6)
C42-C43	1.374(9)	N9-C8-C7	107.3(5)
C43-C44	1.452(8)	C8-N9-C10	109.7(5)
C44-C45	1.466(7)	C8-N9-C13	124.8(6)
C45-C46	1.355(6)	C10-N9-C13	125.4(6)
C45-C49	1.463(8)	O14-C10-N9	123.0(6)
C46-C47	1.540(8)	O14-C10-C11	128.2(6)
C47-O50	1.201(6)	N9-C10-C11	108.8(4)
C47-N48	1.351(7)	C7-C11-C15	133.3(5)
N48-C49	1.374(7)	C7-C11-C10	106.2(5)
N48-C51	1.470(8)	C15-C11-C10	120.3(4)
C49-O52	1.216(6)	C23-C15-C16	107.1(5)
C7-N1-C6	122.4(4)	C23-C15-C11	124.8(6)
C7-N1-C2	122.9(6)	C16-C15-C11	128.0(6)

Table 7 (cont.)

C6-N1-C2	111.6(5)	C21-C16-C17	118.1(6)
C3-C2-N1	121.5(11)	C21-C16-C15	107.9(6)
C2-C3-N4	112.5(6)	C17-C16-C15	134.0(6)
C46-N4-C3	125.4(4)	C16-C17-C18	117.7(8)
C46-N4-C5	122.3(5)	C19-C18-C17	122.6(9)
C3-N4-C5	106.9(6)	C20-C19-C18	120.9(8)
C6-C5-N4	106.4(8)	C19-C20-C21	117.6(8)
C5-C6-N1	108.5(6)	N22-C21-C16	107.1(6)
N1-C7-C11	130.2(5)	N22-C21-C20	129.8(7)
N1-C7-C8	121.9(5)	C16-C21-C20	123.1(8)
C11-C7-C8	107.9(5)	C21-N22-C23	108.6(5)
O12-C8-N9	122.2(7)	C15-C23-N22	109.2(6)
C23-C15-C11	126.3(4)	O41-C37-C36	129.4(5)
C16-C15-C11	127.0(4)	N38-C37-C36	107.2(5)
C17-C16-C21	119.2(5)	C39-N38-C37	111.3(5)
C17-C16-C15	133.9(5)	C39-N38-C42	123.6(5)
C21-C16-C15	106.9(4)	C37-N38-C42	124.9(5)
C18-C17-C16	117.9(6)	O43-C39-N38	126.0(5)
C19-C18-C17	121.8(6)	O43-C39-C40	127.7(5)
C18-C19-C20	122.0(6)	N38-C39-C40	106.3(4)
C19-C20-C21	116.6(6)	N1-C40-C36	131.2(4)
N22-C21-C20	130.1(5)	N1-C40-C39	121.3(4)
N22-C21-C16	107.4(4)	C36-C40-C39	107.4(5)
C20-C21-C16	122.4(5)	C23-N22-C21	109.8(4)
C15-C23-C24	131.6(6)	C36-C35-C34	112.5(5)
N22-C23-C24	119.2(6)	C44-C36-N37	108.7(5)
C23-C24-C25	115.7(7)	C44-C36-C35	131.0(5)
C24-C25-C26	112.5(7)	N37-C36-C35	120.2(5)
C27-C26-C25	113.0(8)	C38-N37-C36	110.4(5)
C26-C27-C28	111.0(9)	N37-C38-C43	109.0(6)
C29-C28-C27	119.1(10)	N37-C38-C39	132.0(7)
C28-C29-C30	120.0(10)	C43-C38-C39	119.0(8)
C31-C30-C29	117.3(10)	C40-C39-C38	118.0(8)
C30-C31-C32	116.7(10)	C39-C40-C41	123.6(8)
C31-C32-C33	115.2(8)	C42-C41-C40	118.0(9)
C34-C33-C32	114.4(7)	C43-C42-C41	120.1(8)
C33-C34-C35	115.1(6)	C42-C43-C38	121.2(6)

Table 8

Positional Parameters and Equivalent Displacement  
Parameters (Å)<sup>2</sup> of 7bb with Estimated Standard  
Deviations in Parenthesis  $U_{eq} = (1/3) \sum \sum U_{ij} a_i a_j$

Atom	X	Y	Z	U <sub>eq</sub>
O46	5222(3)	-935(3)	6712(2)	65(1)
O48	3392(3)	2292(3)	4975(1)	57(1)
O49	-5364(4)	3712(4)	8614(2)	68(2)
O51	-2478(3)	3627(3)	10124(1)	54(1)
N1	-3548(3)	5379(3)	7912(1)	41(1)
N10	1043(3)	1078(3)	5448(1)	40(1)
N16	4591(3)	799(4)	5831(2)	45(1)
N25	1546(3)	-2400(3)	7557(2)	45(1)
N33	484(3)	5768(3)	9172(1)	40(1)
N44	-4044(3)	3444(3)	9463(2)	44(1)
C2	-2325(4)	5717(4)	7527(2)	43(2)

Table 8 (cont.)

Atom	X	Y	Z	U <sub>eq</sub>
C3	-1495(4)	4576(4)	7015(2)	44(2)
C4	-2561(4)	4509(4)	6563(2)	38(1)
C5	-3878(4)	4275(4)	6988(2)	41(1)
C6	-4638(4)	5447(4)	7488(2)	44(1)
C7	-1753(4)	3341(4)	6053(2)	36(1)
C8	-608(4)	3734(4)	5564(2)	42(1)
C9	315(4)	2541(4)	5083(2)	48(2)
C11	-127(4)	638(4)	5822(2)	41(1)
C12	-1022(4)	1727(4)	6347(2)	38(1)
C13	2329(4)	7078(4)	0.5720(2)	34(1)
C14	2935(4)	-299(4)	6229(2)	36(1)
C15	4360(4)	-257(4)	6310(2)	45(2)
C17	3452(4)	1404(4)	5441(2)	40(1)
C18	2421(4)	-1335(4)	6665(2)	36(1)
C19	2490(4)	-2732(4)	6499(2)	37(1)
C20	2981(4)	-3515(4)	5936(2)	46(2)
C21	2908(5)	-4871(4)	5950(2)	56(2)
C22	2367(5)	-5495(5)	6525(2)	57(2)
C23	1872(4)	-4749(4)	7087(2)	53(2)
C24	1926(4)	-3374(4)	7074(2)	40(1)
C26	1842(4)	-1177(4)	7314(2)	40(1)
C27	1574(4)	30(4)	7742(2)	44(2)
C28	2760(5)	-381(5)	8208(2)	56(2)
C29	2231(5)	569(4)	8800(2)	54(2)
C30	1548(4)	2244(4)	8648(2)	47(2)
C31	921(4)	3073(4)	9272(2)	41(1)
C32	-49(4)	4697(4)	9155(2)	37(1)
C34	-612(4)	7163(4)	9027(2)	39(1)
C35	-616(5)	8571(4)	9020(2)	50(2)
C36	-1878(5)	9786(5)	8843(2)	62(2)
C37	-3118(5)	9620(5)	8684(2)	61(2)
C38	-3133(4)	8235(4)	8714(2)	49(2)
C39	-1874(4)	6974(4)	8896(2)	37(1)
C40	-1502(4)	5388(4)	8991(2)	34(1)
C41	-2538(4)	4674(4)	8987(2)	36(1)
C42	-3453(4)	4756(4)	8528(2)	35(1)
C43	-4444(4)	3947(4)	8845(2)	43(1)
C45	-2935(4)	3885(4)	9583(2)	39(1)
C47	5895(5)	1153(5)	5770(2)	64(2)
C50	-4698(5)	0.2599(5)	9940(2)	55(2)

Bond Length (Å) of **7bb**

N1-C42	1.336(4)	C23-C24	1.379(5)
N1-C6	1.467(4)	C24-N25	1.378(5)
N1-C2	1.472(4)	N25-C26	1.375(4)
C2-C3	1.525(5)	C26-C27	1.489(5)
C3-C4	1.540(4)	C27-C28	1.521(5)
C4-C5	1.533(5)	C28-C29	1.530(5)
C4-C7	1.536(5)	C29-C30	1.507(5)
C5-C6	1.520(5)	C30-C31	1.522(5)
C7-C12	1.528(4)	C31-C32	1.487(5)
C7-C8	1.532(5)	C32-N33	1.375(4)
C8-C9	1.524(5)	C32-C40	1.377(5)
C9-N10	1.474(4)	N33-C34	1.372(4)
N10-C13	1.356(4)	C34-C35	1.388(5)
N10-C11	1.473(4)	C34-C39	1.407(5)
C11-C12	1.524(5)	C35-C36	1.372(6)
C13-C14	1.364(4)	C36-C37	1.394(6)
C13-C17	1.540(5)	C37-C38	1.368(5)
C14-C15	1.461(5)	C38-C39	1.395(5)
C14-C18	1.472(5)	C39-C40	1.442(4)

Table 8 (cont.)

C15-O46	1.205(4)	C40-C41	1.471(4)
C15-N16	1.404(5)	C41-C42	1.382(4)
N16-C17	1.362(4)	C41-C45	1.458(5)
N16-C47	1.453(4)	C42-C43	1.530(5)
C17-O48	1.203(4)	C43-O49	1.207(4)
C18-C26	1.373(5)	C43-N44	1.362(4)
C18-C19	1.440(4)	N44-C45	1.403(4)
C19-C20	1.389(5)	N44-C50	1.455(4)
C19-C24	1.417(5)	C45-O51	1.226(4)

Bond Angles (°) of **7bb**

C42-N1-C6	124.8(3)	N10-C13-C14	131.3(3)
C42-N1-C2	122.3(3)	N10-C13-C17	121.5(3)
C6-N1-C2	111.1(3)	C14-C13-C17	107.1(3)
N1-C2-C3	109.7(3)	C13-C14-C15	108.3(3)
C2-C3-C4	112.3(3)	C13-C14-C18	132.3(3)
C5-C4-C7	112.7(3)	C15-C14-C18	119.4(3)
C5-C4-C3	109.1(3)	O46-C15-N16	122.6(3)
C7-C4-C3	113.2(3)	O46-C15-C14	129.5(4)
C6-C5-C4	110.9(3)	N16-C15-C14	107.8(3)
N1-C6-C5	110.3(3)	C17-N16-C15	110.8(3)
C12-C7-C8	110.6(3)	C17-N16-C47	126.1(3)
C12-C7-C4	114.3(3)	C15-N16-C47	123.2(3)
C8-C7-C4	111.9(3)	O48-C17-N16	125.0(3)
C13-N10-C9	121.4(3)	C26-C18-C14	126.3(3)
C11-N10-C9	109.2(3)	C19-C18-C14	126.4(3)
N25-C24-C19	106.9(3)	C21-C20-C19	119.7(4)
C23-C24-C19	121.7(4)	C20-C21-C22	121.1(4)
C26-N25-C24	110.2(3)	C23-C22-C21	120.6(4)
C18-C26-N25	108.8(3)	C22-C23-C24	118.6(4)
C18-C26-C27	130.0(3)	C27-C28-C29	114.0(3)
N25-C26-C27	121.2(3)	C30-C29-C28	116.1(3)
C26-C27-C28	114.2(3)	C29-C30-C31	111.6(3)
C32-C31-C30	114.0(3)	C38-C39-C34	118.8(3)
N33-C32-C40	109.0(3)	C38-C39-C40	134.5(3)
N33-C32-C31	121.4(3)	C34-C39-C40	106.7(3)
C40-C32-C31	129.5(3)	C32-C40-C39	106.8(3)
C34-N33-C32	109.7(3)	C32-C40-C41	126.6(3)
N33-C34-C35	130.1(3)	C39-C40-C41	126.2(3)
N33-C34-C39	107.8(3)	C42-C41-C45	107.2(3)
C35-C34-C39	122.1(3)	C42-C41-C40	131.8(3)
C36-C35-C34	117.3(4)	C45-C41-C40	120.2(3)
C35-C36-C37	121.5(4)	N1-C42-C41	130.8(3)
C38-C37-C36	121.1(4)	N1-C42-C43	121.9(3)

Figure 9 shows the nucleophilic substitution of vinylic bromine atoms of **6e** with cyclic amines and one primary aliphatic amine. For **9a-f** the cyclic amine is used as a solvent (20-fold excess), for **9g-j** and **10a-d** a 2-fold excess of secondary cyclic amine is used. Here, a mono-substituted main product and a disubstituted by-product were isolated. For the synthesis of **9j** and **10d**, dimethylsulfoxide was used as a solvent instead of dimethylformamide because in dimethylformamide, the side reaction forming dimethylamino substituted maleinimides (*vide infra*) became the exclusive one. Where a primary amine was used, only the mono-substituted product (**10e**) was formed and in low yield.

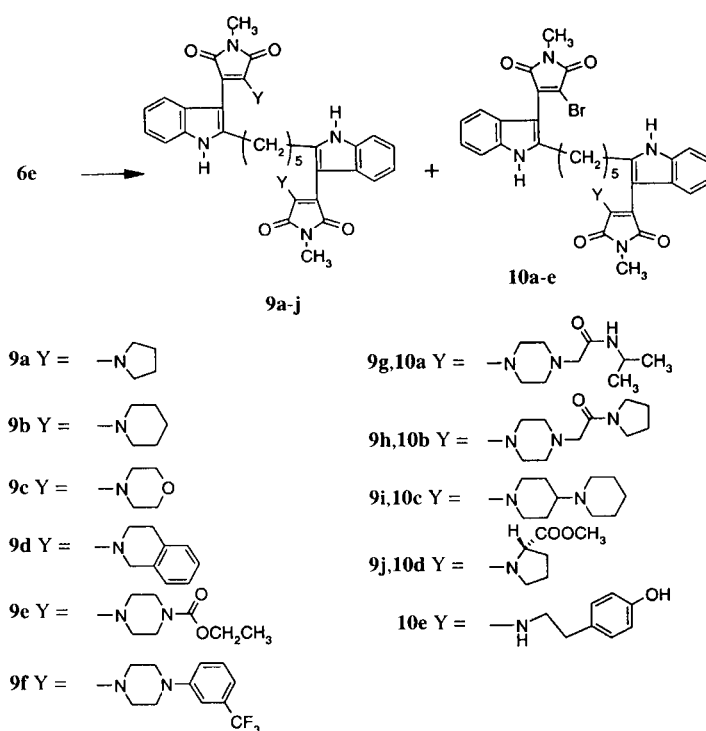


Figure 9.

## EXPERIMENTAL

Melting points were recorded on a Reichert Thermovar 300419 microscope heating stage and are not corrected. Proton nuclear magnetic resonance spectra were recorded on a Bruker AC250 (250 MHz) or a Varian EM 390 (90 MHz) spectrometer. All chemical shifts are quoted on the  $\delta$ -scale. FT-IR spectroscopy was performed on a Nicolet 510 FT-IR spectrometer. Mass spectra were recorded on a Varian MAT 311 A, 70 eV, using electron impact ionization (ei) or on a Finnigan MAT 95 for fast atomic bombardment (fab), field desorption (fd) and chemical ionization (ci). Microanalyses were performed by Analytisches Labor, Univ. of Regensburg. Thin layer chromatography (tlc) was carried out on aluminium sheets coated with 60F<sub>245</sub> silica. Compounds were detected using sprays of 3% w/v vanillin in 96% ethanol, followed by 5% w/v sulfuric acid in 96% ethanol. Column chromatography was carried out using Merck 60 (70-230 mesh ASTM) silica. Solvents and commercially available reagents were dried and purified before use according to standard procedures. All reactions were carried out under a dried nitrogen atmosphere in flame- or oven-dried vessels. Many maleimides crystallize with solvents, which could not be removed in spite of prolonged heating of the ground materials *in vacuo*. The presence of these solvents was assured by <sup>1</sup>H nmr spectra. If not otherwise stated, the crystals are colorless.

*N,N'*-*o*-Tolyldodecanediamide (**1f**).

The solution of *o*-methylaniline (120.0 mmoles) and pyridine (126.0 mmoles) in 50 ml of toluene was cooled to 0°, and dode-

candioyl dichloride (60.0 mmoles) was added slowly. After standing for 20 hours at room temperature the precipitate was filtered, washed with ethanol-water (1:1) and diethyl ether. Recrystallization from ethanol/methanol (1:1) afforded **1f** as crystals (69%), mp 170-172°; ir (potassium bromide):  $\nu$  3280, 2932, 2865, 1675, 1600, 1532 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethylformamide-d<sub>7</sub>):  $\delta$  1.25-1.42 (m, 12H), 1.62-1.75 (m, 4H), 2.28 (s, 6H), 2.42 (t, J = 7.4 Hz, 4H), 7.59-7.05 (m, 8H), 9.22 (s, 2H); ei-ms: m/z (%) 408 (39) [M<sup>+</sup>], 302 (48), 260 (21), 107 (100).

*Anal.* Calcd. for C<sub>26</sub>H<sub>36</sub>N<sub>2</sub>O<sub>2</sub> (408.58): C, 76.43; H, 8.88; N, 6.85. Found: C, 76.28; H, 9.05; N, 6.78.

*N,N'*-(4-Methoxy-2-methylphenyl)decandiamide (**1d**).

Compound **1d** was obtained as crystals (84%) as above for **1f** from 2-methyl-4-methoxyaniline and decandioyl dichloride; mp 206-208°; ir (potassium bromide):  $\nu$  3286, 2920, 2855, 1667, 1520 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethylformamide-d<sub>7</sub>):  $\delta$  1.27-1.45 (m, 8H), 1.60-1.76 (m, 4H), 2.23 (s, 6H), 2.40 (t, J = 3.0 Hz, 4H), 3.77 (s, 6H), 6.82-6.73 (m, 4H), 7.33 (d, J = 3.5 Hz, 2H), 9.14 (s, 2H); ei-ms: m/z (%) 440 (28) [M<sup>+</sup>], 304 (12), 179 (11), 137 (100).

*Anal.* Calcd. for C<sub>26</sub>H<sub>36</sub>N<sub>2</sub>O<sub>4</sub> (440.58): C, 70.88; H, 8.23; N, 6.36. Found: C, 70.85; H, 8.33; N, 6.32.

*N,N'*-(5-Methoxy-2-methylphenyl)decandiamide (**1e**).

Compound **1e** was obtained as above for **1f** from 2-methyl-5-methoxyaniline and decandioyl dichloride (70%); mp 143-145°; ir (potassium bromide):  $\nu$  3283, 2918, 2848, 1670, 1525 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethylformamide-d<sub>7</sub>):  $\delta$  1.29-1.42 (m,

8H), 1.64-1.78 (m, 4H), 2.20 (s, 6H), 2.43 (t,  $J = 2.9$  Hz, 4H), 3.77 (s, 6H), 6.64-6.69 (m, 2H), 7.12 (d,  $J = 3.4$  Hz, 2H), 7.33 (d,  $J = 1.0$  Hz, 2H), 9.14 (s, 2H); ei-ms:  $m/z$  (%) 440 (28) [M<sup>+</sup>], 304 (12), 179 (11), 137 (100).

*Anal.* Calcd. for C<sub>26</sub>H<sub>36</sub>N<sub>2</sub>O<sub>4</sub> (440.58): C, 70.88; H, 8.23; N, 6.36. Found: C, 70.61; H, 8.12; N, 6.27.

#### *N,N'*-*o*-Tolyltetradecanediamide (**1g**).

Compound **1g** was obtained as above for **1f** from tetradecan-diyl dichloride and *o*-methylaniline; (96%), mp 174-175°; ir (potassium bromide):  $\nu$  3278, 3027, 2921, 2852, 1661, 1588, 1526 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethyl-d<sub>6</sub>-sulfoxide):  $\delta$  1.27 (br s, 16H), 1.59 (quint,  $J = 7.3$  Hz, 4H), 2.17 (s, 6H), 2.31 (t,  $J = 7.3$  Hz, 4H), 7.02-7.21 (m, 6H), 7.34 (d,  $J = 7.4$  Hz, 2H), 9.21 (s, 2H); ei-ms:  $m/z$  (%) 436 (10) [M<sup>+</sup>], 330 (30), 106 (100).

*Anal.* Calcd. for C<sub>28</sub>H<sub>40</sub>N<sub>2</sub>O<sub>2</sub> (436.64): C, 77.02; H, 9.23; N, 6.42. Found: C, 76.92; H, 9.24; N, 6.35.

#### 1,10-Bis(1*H*-2-indolyl)decane (**2e**).

A mixture of **1f** (10.0 mmoles) and sodium amide (120.0 mmoles) was ground in a mortar and heated under nitrogen for 2 hours at 240°. After cooling to room temperature 50 ml of water was added, and the mixture was extracted with ethyl acetate (3 x 50 ml). The organic layer was dried over sodium sulfate, and the solvent was removed under reduced pressure. Recrystallization from ethanol afforded **2e** as crystals: (21%), mp 133-135°; ir (potassium bromide):  $\nu$  3390, 3095, 2950, 1630, 1535 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethyl-d<sub>6</sub>-sulfoxide):  $\delta$  1.15-1.40 (m, 12H), 1.55-1.73 (m, 4H), 2.68 (t,  $J = 3.0$  Hz, 4H), 6.10 (s, 2H), 6.86-7.00 (m, 4H), 7.25 (d,  $J = 8.0$  Hz, 2H), 7.38 (d,  $J = 8.2$  Hz, 2H), 10.84 (s, 2H); ei-ms:  $m/z$  (%) 372 (49) [M<sup>+</sup>], 144 (46), 131 (84), 130 (100).

*Anal.* Calcd. for C<sub>26</sub>H<sub>32</sub>N<sub>2</sub> (372.55): C, 83.82; H, 8.66; N, 7.52. Found: C, 83.67; H, 8.46; N, 7.49.

#### 1,8-Bis(1*H*-5-hydroxyindol-2-yl)octane (**2d**).

Compound **2d** was obtained as above for **2e** from **1d** to give crystals (10%); mp 209-210°; ir (potassium bromide):  $\nu$  3520, 3390, 2934, 2872, 1675 1600, 1495 cm<sup>-1</sup>; <sup>1</sup>H nmr (dimethyl-d<sub>6</sub>-sulfoxide):  $\delta$  1.21 (bs, 8H), 1.61-1.66 (m, 4H), 2.78 (t,  $J = 8.4$  Hz, 4H), 5.91 (s, 2H), 6.45-6.50 (dd,  $J = 3.4, 1.0$  Hz, 2H), 6.74 (d,  $J = 1.0$  Hz, 2H), 7.04 (d,  $J = 3.4$  Hz, 2H), 8.45 (s, 2H), 10.50 (s, 2H); ei-ms:  $m/z$  (%) 376 (67) [M<sup>+</sup>], 360 (17), 160 (66), 146 (100).

*Anal.* Calcd. for C<sub>24</sub>H<sub>28</sub>N<sub>2</sub>O<sub>2</sub> (376.49): C, 76.56; H, 7.50; N, 7.44. Found: C, 76.33; H, 7.36; N, 7.29.

#### 1,12-Bis(1*H*-2-indolyl)decane (**2f**).

Compound **2f**: Crystals (98%), mp 126-129°; ir (potassium bromide):  $\nu$  3381, 3053, 2919, 2850, 1549, 1472, 1457 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethyl-d<sub>6</sub>-sulfoxide):  $\delta$  1.20-1.36 (m, 16H), 1.66 (m, 4H), 2.68 (t,  $J = 7.5$  Hz, 4H), 6.10 (dd,  $J = 2.1, 0.9$  Hz, 2H), 6.85-7.01 (m, 4H), 7.25 (d,  $J = 7.6$  Hz, 2H), 7.37 (d,  $J = 7.6$  Hz, 2H), 10.85 (s, 2H); ei-ms:  $m/z$  (%) 400 (100) [M<sup>+</sup>].

*Anal.* Calcd. for C<sub>28</sub>H<sub>36</sub>N<sub>2</sub> (400.61): C, 83.95; H, 9.06; N, 6.99. Found: C, 83.95; H, 9.14; N, 6.76.

#### 3-Bromo-4-[2-[4-(1*H*-2-indolyl)butyl]-1*H*-3-indolyl]-2,5-dihydro-1-methylpyrrole-2,5-dione (**5a**).

1,4-Bis(1*H*-2-indolyl)butane (**2a**) (1.15 g, 4.00 mmoles) was dissolved in 20 ml of anhydrous tetrahydrofuran. Under nitro-

gen, butyllithium (3.00 ml, 4.80 mmoles) in hexane was added dropwise at 0°. After 2 hours at 25°, a solution of 3,4-dibromo-2,5-dihydro-1-methyl-2,5-pyrroledione (**3b**) [15] (1.08 g, 4.00 mmoles) in 100 ml of tetrahydrofuran was added dropwise. After 16 hours at room temperature, the dark solution was acidified with 100 ml of dilute hydrochloric acid, and the product was extracted with ethyl acetate (total volume 75 ml). After drying the organic phase over sodium sulfate, the solvent was removed *in vacuo*, and the residue was purified on a column of silica gel. Elution with dichloromethane afforded 0.24 g (13%) of **5a** as dark red crystals, mp 165-167° (ethyl acetate, dec.); ir (potassium bromide):  $\nu$  3394, 3313, 1771, 1705 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethyl-d<sub>6</sub>-sulfoxide):  $\delta$  1.69-1.77 (m, 4H), 2.68-2.82 (m, 4H), 2.99 (s, 3H), 6.07 (s, 1H), 6.86-7.38 (m, 8H), 10.85 (s, 1H), 11.71 (s, 1H); ei-ms:  $m/z$  (%) 393 (4.3) [M-Br]<sup>+</sup>, 143 (100).

*Anal.* Calcd. for C<sub>25</sub>H<sub>22</sub>BrN<sub>3</sub>O<sub>2</sub> x 1/2 ethyl acetate (520.42): C, 62.31; H, 5.04; N, 8.07. Found: C, 62.05; H, 4.94; N, 8.16.

#### 3-Bromo-4-[2-[5-(1*H*-2-indolyl)pentyl]-1*H*-3-indolyl]-2,5-dihydro-1-methylpyrrole-2,5-dione (**5b**).

Compound **5b** was obtained as above for **5a** from **2b** as an orange solid (39%), mp 125° (dec); ir (potassium bromide):  $\nu$  3384, 3054, 2929-2856, 1773, 1705 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dichloromethane-d<sub>2</sub>):  $\delta$  1.31-1.41 (m, 2H), 1.42-1.85 (m, 4H), 2.63-2.84 (m, 4H), 3.12 (s, 3H), 6.18-6.20 (m, 1H), 6.93-7.50 (m, 8H), 8.02 (s, 1H), 8.43 (s, 1H); ei-ms:  $m/z$  (%) 491 (4.8), 489 (5.5) [M<sup>+</sup>], 130 (100), 144 (51), 81 (60), 79 (59).

*Anal.* Calcd. for C<sub>26</sub>H<sub>24</sub>BrN<sub>3</sub>O<sub>2</sub> (490.39): C, 63.68; H, 4.93; N, 8.57. Found: C, 63.44; H, 5.04; N, 8.40.

#### 3-Bromo-4-[2-[12-(1*H*-2-indolyl)dodecyl]-1*H*-3-indolyl]-2,5-dihydro-1*H*-pyrrole-2,5-dione (**5c**).

Magnesium shavings (2.00 g, 76.0 mmoles) and ethyl bromide (3.00 ml, 39.2 mmoles) were added to dry tetrahydrofuran (32 ml). When the reaction started, further ethyl bromide (3.00 ml, 39.2 mmoles) was added dropwise so that the solution was refluxing gently. Then the solution was heated to reflux until all the magnesium was dissolved (*ca.* 30 minutes). After cooling to room temperature, compound **2g** (16.0 g, 0.04 mole), dissolved in dry toluene (200 ml), was added slowly, and the mixture was stirred for 45 minutes at 45°. When the mixture has cooled, a solution of **3a** [14] (10.2 g, 0.04 mole) in dry toluene (260 ml) and tetrahydrofuran (50 ml) was added dropwise during 1 hour, and the resulting dark solution was refluxed overnight. Then ice (200 g) and 20% citric acid (200 ml) were added, the organic layer was separated, and the aqueous phase was extracted with ethyl acetate (3 x 200 ml). The combined organic phases were washed with water, dried over sodium sulfate, and the solvent was evaporated. The crude product was separated from the remaining starting material and by-products by column chromatography (SiO<sub>2</sub>, dichloromethane) affording **5c** as red crystals (0.69 g, 1.20 mmoles, 3%); mp 117-119°; ir (potassium bromide):  $\nu$  3394, 3228, 2925, 2852, 1771, 1721, 1707 cm<sup>-1</sup>; <sup>1</sup>H nmr (250 MHz, dimethyl-d<sub>6</sub>-sulfoxide):  $\delta$  1.12-1.34 (m, 16H), 1.58-1.73 (m, 4H), 2.63-2.78 (m, 4H), 6.10 (dd,  $J = 2.1, 0.9$  Hz, 1H), 6.84-7.14 (m, 4H), 7.21-7.40 (m, 4H), 10.84 (s, 1H), 11.37 (s, 1H), 11.67 (s, 1H); ei-ms:  $m/z$  573, 575 (18, 18) [M<sup>+</sup>].

*Anal.* Calcd. for C<sub>32</sub>H<sub>36</sub>BrN<sub>3</sub>O<sub>2</sub> (574.57): C, 66.90; H, 6.32; N, 7.31. Found: C, 66.46; H, 6.35; N, 7.10.

3-Bromo-4-{2-[3-(3-[4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)propyl]-1H-3-indolyl}-1-methyl-2,5-dihydro-1H-pyrrole-2,5-dione (**6b**).

Compound **6b** was obtained as above for **6a** from **2a** as a red powder (21%); mp 160° (dec); ir (potassium bromide):  $\nu$  3381, 3058, 2948, 1773, 1708  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  2.09 (quint,  $J = 7.4$  Hz, 2H), 2.78 (t,  $J = 7.4$  Hz, 4H), 2.95 (s, 6H), 6.99-7.16 (m, 4H), 7.32-7.39 (m, 4H), 11.72 (s, 2H); ei-ms:  $m/z$  650 (0.2) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{29}\text{H}_{22}\text{Br}_2\text{N}_4\text{O}_4$  (650.33): C, 53.56; H, 3.41; N, 8.62. Found: C, 53.47; H, 3.38; N, 8.60.

3-Bromo-4-{2-[4-(3-[4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)butyl]-1H-3-indolyl}-1-methyl-2,5-dihydro-1H-pyrrole-2,5-dione (**6c**).

Compound **6c** was obtained as above for **6a** from **2a** as a red solid (50%); mp 190-193° (dec); ir (potassium bromide):  $\nu$  3398, 1769, 1709  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.68-1.83 (m, 4H), 2.66-2.82 (m, 4H), 3.00 (s, 6H), 6.99-7.38 (m, 8H), 11.70 (s, 2H); ei-ms:  $m/z$  (%) 504 (20) [ $\text{M}-2\text{Br}^+$ ], 156 (100).

*Anal.* Calcd. for  $\text{C}_{30}\text{H}_{24}\text{Br}_2\text{N}_4\text{O}_4$  (664.34): C, 54.24; H, 3.64; N, 8.43. Found: C, 54.46; H, 3.82; N, 8.20.

3-Bromo-4-{2-[5-(3-[4-bromo-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-2,5-dihydro-1H-pyrrole-2,5-dione (**6d**).

Compound **6d** was obtained as above for **6a** from **2b** as a red powder (21%); mp > 350°; ir (potassium bromide):  $\nu$  3340, 3220, 2932, 2860, 1755, 1719  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.19-1.39 (m, 2H), 1.59-1.82 (m, 4H), 2.61-2.83 (m, 4H), 6.96-7.17 (m, 4H), 7.26-7.42 (m, 4H), 11.34 (br s, 2H), 11.66 (s, 2H); fab-ms:  $m/z$  649, 651, 653 [ $\text{M}+\text{H}^+$ ].

*Anal.* Calcd. for  $\text{C}_{29}\text{H}_{22}\text{Br}_2\text{N}_4\text{O}_4 \times 1/2$  ethyl acetate (694.38): C, 53.62; H, 3.77; N, 8.07. Found: C, 53.67; H, 3.78; N, 8.00.

3-Bromo-4-{2-[5-(3-[4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-1-methyl-2,5-dihydro-1H-pyrrole-2,5-dione (**6e**).

Compound **6e** was obtained as above for **6a** from **2b** as an orange solid (73%); mp 137° (dec); ir (potassium bromide):  $\nu$  3375, 3353, 3060, 2935-2853, 1773, 1711  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, chloroform- $d$ ):  $\delta$  1.62-1.82 (m, 6H), 2.77 (t,  $J = 7.5$  Hz, 4H), 3.17 (s, 6H), 7.12-7.37 (m, 6H), 7.39-7.44 (m, 2H), 8.51 (s, 2H); ei-ms:  $m/z$  (%) 678 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{31}\text{H}_{26}\text{Br}_2\text{N}_4\text{O}_4$  (678.37): C, 54.89; H, 3.86; N, 8.26. Found: C, 54.64; H, 4.29; N, 8.07.

3-Bromo-4-{2-[8-(3-[4-bromo-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)octyl]-1H-3-indolyl}-2,5-dihydro-1H-pyrrole-2,5-dione (**6f**).

Compound **6f** was obtained as above for **6a** from **2c** as a red solid (8%); mp 180-183° (tetrahydrofuran/benzene, dec); ir (potassium bromide):  $\nu$  3343, 3228, 1755, 1721  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.13-1.29 (m, 8H), 1.65-1.73 (m, 4H), 2.68-2.77 (m, 4H), 6.99-7.38 (m, 8H), 11.36 (s, 2H), 11.65 (s, 2H); fd-ms:  $m/z$ : 692 [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{32}\text{H}_{28}\text{Br}_2\text{N}_4\text{O}_4 \times 1$  tetrahydrofuran (764.50): C, 56.56; H, 4.75; N, 7.33. Found: C, 56.85; H, 5.04; N, 7.51.

3-Bromo-4-{2-[8-(3-[4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)octyl]-1H-3-indolyl}-1-methyl-2,5-dihydro-1H-pyrrole-2,5-dione (**6g**).

Compound **6g** was obtained as above for **6a** from **2c** as a red solid (23%); mp 185-188° (tetrahydrofuran/benzene, dec); ir (potassium bromide):  $\nu$  3363, 1773, 1703  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.14-1.20 (m, 8H), 1.65-1.73 (m, 4H), 2.52-2.74 (m, 4H), 2.99 (s, 6H), 6.99-7.38 (m, 8H), 11.68 (s, 2H); fd-ms:  $m/z$  720 [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{34}\text{H}_{32}\text{Br}_2\text{N}_4\text{O}_4 \times 1$  tetrahydrofuran (792.56): C, 57.59; H, 5.09; N, 7.07. Found: C, 57.85; H, 4.96; N, 7.16.

3-Bromo-4-{2-[10-(3-[4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)decyl]-1H-3-indolyl}-1-methyl-2,5-dihydro-1H-pyrrole-2,5-dione (**6h**).

Compound **6h** was obtained as above for **6a** from **2e** as orange crystals (29%); mp > 220°; ir (potassium bromide):  $\nu$  3365, 2925, 2870, 1705, 1600, 1432  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.13-1.30 (m, 12H), 1.65-1.75 (m, 4H), 2.75 (t,  $J = 2.9$  Hz, 4H), 3.00 (s, 6H), 6.99-7.38 (m, 8H), 11.68 (s, 2H); fd-ms:  $m/z$  (%) 748 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{36}\text{H}_{36}\text{Br}_2\text{N}_4\text{O}_4$  (748.50): C, 57.77; H, 4.85; N, 7.49. Found: C, 57.43; H, 5.19; N, 7.23.

3-Bromo-4-{2-[12-(3-[4-bromo-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)dodecyl]-1H-3-indolyl}-2,5-dihydro-1H-pyrrole-2,5-dione (**6i**).

Compound **6i** was obtained as above for **6a** from **2f**. Column chromatography of the crude product afforded **6i** as deep red crystals (13%); mp 185°; ir (potassium bromide):  $\nu$  3346, 2927, 2854, 1771, 1721  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.15-1.27 (m, 16H), 1.58-1.73 (m, 4H), 2.67-2.78 (m, 4H), 7.02 (ddd,  $J = 7.9, 7.0, 1.2$  Hz, 2H), 7.11 (ddd,  $J = 7.9, 7.0, 1.4$  Hz, 2H), 7.30-7.39 (m, 4H), 11.37 (br s, 2H), 11.66 (s, 2H); fab-ms:  $m/z$  747 [ $\text{M}+\text{H}^+$ ].

*Anal.* Calcd. for  $\text{C}_{36}\text{H}_{36}\text{Br}_2\text{N}_4\text{O}_2$  (748.52): C, 57.77; H, 4.85; N, 7.49. Found: C, 57.52; H, 4.87; N, 7.32.

3-Bromo-4-{2-[12-(3-[4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)dodecyl]-1H-3-indolyl}-1-methyl-2,5-dihydro-1-methylpyrrole-2,5-dione (**6j**).

Compound **6j** was obtained as above for **6a** from **2f** as red crystals (68%); mp 126-129°; ir (potassium bromide):  $\nu$  3365, 3056, 2925, 2851, 1773, 1705, 1609  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.15-1.30 (m, 16H), 1.59-1.74 (m, 4H), 2.73 (t,  $J = 8.1$  Hz, 4H), 3.01 (s, 6H), 6.98-7.16 (m, 4H), 7.31-7.40 (m, 4H), 11.69 (s, 2H); fab-ms:  $m/z$  776 [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{38}\text{H}_{40}\text{Br}_2\text{N}_4\text{O}_4$  (776.57): C, 58.77; H, 7.19; N, 7.21. Found: C, 59.05; H, 7.23; N, 7.36.

General Procedure for the Preparation of Macrocycles **7a-7xx** by the Reaction of Bisamines **A-I** with 2,2'-Bisindolomaleimides **6a-6j**.

To a stirred solution of bisindol derivatives **6a-6j** (2.72 mmoles), triethylamine (2.00 ml) and *N,N*-dimethylformamide (250 ml) 3.35 mmoles of the appropriate bisamine (**A-I**) (see Table 3) were added at room temperature. After 72 hours at 60°, the solution was acidified with 200 ml of dilute hydrochloric acid and the product was extracted with ethyl acetate (total volume 150 ml). After drying of the organic phase over sodium sulfate, the solvent was removed under reduced pressure.

Compounds **7a**, **8a** and **8b** were prepared from **6c** and diamine **A**. Column chromatography (dichloromethane/ethyl acetate 20:1) of the crude product afforded **7a** as an orange solid (0.07 g, 5%), **8a** as a red solid (0.15 g, 9%) and **8b** as an orange solid (0.10 g, 6%).

6,13-Dimethyl-5,6,7,8,9,10,11,12,13,14,19,20,21,22,23,24-hexadecahydrodipyrrolo[3',4':15,16:3',4':5,6]indolo[2',3':13,14][1,4]-diazacyclohexadecino[7,8-*b*]indole-5,7,12,14-tetraone (**7a**).

Compound **7a** exhibited the following properties: mp > 240° (tetrahydrofuran/benzene); ir (potassium bromide):  $\nu$  3318, 1757, 1701  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.47-1.49 (m, 4H), 2.58-2.65 (m, 4H), 2.70-2.76 (b, 2H), 2.81 (s, 4H), 2.88 (s, 6H), 6.92-7.27 (m, 8H), 11.04 (s, 2H); ei-ms:  $m/z$  (%) 562 (100) [ $\text{M}^+$ ].

*Anal.* Calcd.  $\text{C}_{32}\text{H}_{30}\text{N}_6\text{O}_4 \times 1$  tetrahydrofuran (634.72): C, 68.12; H, 6.03; N, 13.24. Found: C, 67.83; H, 6.21; N, 12.71.

3-Bromo-4-{2-[4-(3-[4-(*N,N*-dimethylamino)-1-methyl-2,5-dioxo-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)butyl]-1*H*-3-indolyl]-1-methyl-2,5-dihydro-1*H*-pyrrole-2,5-dione (**8a**).

Compound **8a** exhibited the following properties: mp 180-183° (dec); ir (potassium bromide):  $\nu$  3380, 3310, 1775, 1748, 1709  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.67-1.68 (m, 4H), 2.56-2.81 (m, 4H), 2.87 (s, 3H), 2.88 (s, 6H), 2.99 (s, 3H), 6.91-7.36 (m, 8H), 11.06 (s, 1H), 11.66 (s, 1H); fab-ms:  $m/z$  629 [ $\text{M}+\text{H}$ ]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{32}\text{H}_{30}\text{BrN}_5\text{O}_4$  (628.52): C, 61.90; H, 4.81; N, 11.14. Found: C, 61.58; H, 4.99; N, 10.85.

3-(*N,N*-Dimethylamino)-4-{2-[4-(3-[4-(*N,N*-dimethylamino)-1-methyl-2,5-dioxo-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)butyl]-1*H*-3-indolyl]-1-methyl-2,5-dihydro-1*H*-pyrrole-2,5-dione (**8b**).

Compound **8b** exhibited the following properties: mp > 240° (dec); ir (potassium bromide):  $\nu$  3316, 1748, 1690  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (400 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.62-1.63 (m, 4H), 2.55-2.68 (m, 4H), 2.87 (s, 6H), 2.89 (s, 12H), 6.91-7.27 (m, 8H), 11.04 (s, 2H); fab-ms:  $m/z$  592 [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{34}\text{H}_{36}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (636.74): C, 67.91; H, 6.33; N, 13.20. Found: C, 67.95; H, 6.13; N, 13.83.

1,4,14,20,30,33-Hexaazaocyclo[31.2.2.0(2,6).0(7,15).0(8,13).0(19,27).0(21,26).0(28,32)]heptatriaconta-2(6),7(15),-8(13),9,11,19(27),21(26),22,24,28(32)-decaene-3,5,29,31-tetraone (**7b**).

Compound **7b** was prepared from **6a** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7b** as orange crystals (30%), mp 350° (dec); ir (potassium bromide):  $\nu$  3271, 2925, 2875, 1754, 1698  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  2.10-2.27 (m, 2H), 2.55-2.86 (m, 6H), 3.01-3.14 (m, 1H), 3.46-3.87 (m, 4H), 3.97-4.56 (m, 1H), 7.79-7.33 (m, 8H), 10.49 (s, 2H), 10.98, 11.21 (2 s, 0.7+1.3H); ei-ms:  $m/z$  (%) 546 (38) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{31}\text{H}_{26}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (590.64): C, 67.11; H, 5.12; N, 14.23. Found: C, 66.80; H, 4.96; N, 14.44.

4,30-Dimethyl-1,4,14,20,30,33-hexaazaocyclo[31.2.2.0(2,6).0(7,15).0(8,13).0(19,27).0(21,26).0(28,32)]heptatriaconta-2(6),7(15),8(13),9,11,19(27),21(26),22,24,28(32)-decaene-3,5,29,31-tetraone (**7c**).

Compound **7c** was prepared from **6b** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 5:1) of

the crude product afforded **7c** as orange crystals (56%); mp 314-318°; ir (potassium bromide):  $\nu$  3372, 3338, 2933, 1752, 1698  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  2.07-2.26 (m, 2H), 2.54-2.94 (m, 12H), 3.02-3.17 (m, 1H), 3.34-3.49 (m, 1H), 3.54-3.75 (m, 2H), 3.80-3.94 (m, 1H), 4.39-4.56 (m, 1H), 7.76-7.38 (m, 8H), 10.99, 11.21 (2 s, 0.7+1.3H); ei-ms:  $m/z$  574 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{33}\text{H}_{30}\text{N}_6\text{O}_4$  (574.64): C, 68.98; H, 5.26; N, 14.62. Found: C, 68.71; H, 5.34; N, 14.40.

4,31-Dimethyl-1,4,14,21,31,34-hexaazaocyclo[32.2.2.0(2,6).0(7,15).0(8,13).0(20,28).0(22,27).0(29,33)]octatriaconta-2(6),7(15),8(13),9,11,20(28),22(27),23,25,29(33)-decaene-3,5,30,32-tetraone (**7d**).

Compound **7d** was prepared from **6c** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 4:1) of the crude product afforded **7d** as orange solid (33%); mp > 240° (tetrahydrofuran/benzene); ir (potassium bromide):  $\nu$  3386, 1753, 1694  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (400 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.36-1.71 (m, 4H), 2.51-2.74 (m, 4H), 2.81-2.88 (m, 2H), 2.88 (s, 6H), 3.18-3.28 (m, 2H), 3.64-3.71 (m, 2H), 4.69-4.78 (m, 2H), 6.83-7.28 (m, 8H), 11.03 (s, 2H);  $^{13}\text{C}$  nmr (400 MHz, DEPT, dimethyl- $d_6$ -sulfoxide)  $\delta$  23.5, 26.3, 28.3, 44.5, 45.4, 95.9, 100.8, 110.7, 118.0, 119.0, 120.4, 129.5, 134.7, 139.3, 144.7, 167.7, 171.2; fd-ms:  $m/z$  588 [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{34}\text{H}_{32}\text{N}_6\text{O}_4 \times 1/2$  tetrahydrofuran (624.71): C, 69.21; H, 5.81; N, 13.45. Found: C, 69.34; H, 5.89; N, 13.42.

1,4,14,22,32,35-Hexaazaocyclo[33.2.2.0(2,6).0(7,15).0(8,13).0(21,29).0(23,28).0(30,34)]nonatriaconta-2(6),7(15),-8(13),9,11,21(29),23(28),24,26,30(34)-decaene-3,5,31,33-tetraone (**7e**).

Compound **7e** was prepared from **6d** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7e** as orange crystals (24%); mp 314-318°; ir (potassium bromide):  $\nu$  3375, 2929, 2858, 1754, 1701  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.85-1.07 (m, 1H), 1.41-2.06 (m, 5H), 2.38-2.83 (m, 8H), 2.98-3.13 (m, 1.2H), 3.21-3.46 (m, 0.8H), 3.83-3.99 (m, 0.8H), 4.25-4.41 (m, 1.2H), 6.77-7.07 (m, 5H), 7.12-7.34 (m, 3H), 10.35, 10.45 (2 s, 0.8+1.2H), 10.95, 11.10 (2 s, 1.2+0.8H); fab-ms:  $m/z$  575 [ $\text{M}+\text{H}$ ]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{33}\text{H}_{30}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (618.69): C, 67.95; H, 5.54; N, 13.58. Found: C, 68.00; H, 5.69; N, 13.62.

4,32-Dimethyl-1,4,14,22,32,35-hexaazaocyclo[33.2.2.0(2,6).0(7,15).0(8,13).0(21,29).0(23,28).0(30,34)]nonatriaconta-2(6),7(15),8(13),9,11,21(29),23(28),24,26,30(34)-decaene-3,5,31,33-tetraone (**7f**).

Compound **7f** was prepared from **6e** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7f** as orange solid (38%); mp > 350° (benzene, dec); ir (potassium bromide):  $\nu$  3373, 3056, 2929-2859, 1697, 1632, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (400 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.84-1.00, 1.33-1.45, 1.53-1.66, 1.71-1.92 (m, 6H), 2.39-2.71 (m, 4H), 2.72-2.83 (m, 1H), 2.82, 2.86 (2 s, 6H), 3.07-3.012 (m, 1H), 3.28-3.40 (m, 4H), 3.91-3.97 (m, 1H), 4.38-4.43 (m, 1H), 6.80-7.51 (m, 5H), 7.16-7.31 (m, 3H), 10.98, 11.12 (2 s, 2H); fab-ms:  $m/z$  602 [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{35}\text{H}_{34}\text{N}_6\text{O}_4 \times 1/2$  benzene (641.74): C, 71.10; H, 5.81; N, 13.10. Found: C, 70.69; H, 5.91; N, 12.67.

1,4,14,29,39,42-Hexaazaocyclo[40.2.2.0(2,6).0(7,15).0(8,13).0(28,36).0(30,35).0(37,41)]hexatetraconta-2(6),7(15),-8(13),9,11,28(36),30(35),31,33,37(41)-decaene-3,5,38,40-tetraone (**7g**).

Compound **7g** was prepared from **6i** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7g** as orange crystals (16%); mp 298° (dec); ir (potassium bromide):  $\nu$  3355, 3042, 2925, 2854, 1758, 1703  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.93-1.74 (m, 22H), 2.55-2.74 (m, 4H), 3.35-3.56 (m, 6H), 6.83-7.16 (m, 5H), 7.22-7.35 (m, 3H), 10.42 (s, 2H), 11.01, 11.19 (2 s, 0.4+1.6H); fab-ms:  $m/z$  673 [M+H]<sup>+</sup>, 1345 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{40}\text{H}_{44}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (716.88): C, 70.37; H, 6.75; N, 11.72. Found: C, 70.12; H, 6.55; N, 11.86.

4,39-Dimethyl-1,4,14,29,39,42-hexaazaocyclo[40.2.2.0(2,6).0(7,15).0(8,13).0(28,36).0(30,35).0(37,41)]hexatetraconta-2(6),7(15),8(13),9,11,28(36),30(35),31,33,37(41)-decaene-3,5,38,40-tetraone (**7h**).

Compound **7h** was prepared from **6j** and diamine **B**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5) of the crude product afforded **7h** as orange crystals (26%); mp 194-195°; ir (potassium bromide):  $\nu$  3321, 2925, 2854, 1754, 1690  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.94-1.28 (m, 16H), 1.37-1.50 (m, 1H), 1.52-1.73 (m, 3H), 2.53-2.72 (m, 4H), 2.84, 2.87 (2 s, 6H), 3.36-3.59 (m, 8H), 6.82-7.17 (m, 5H), 7.22-7.36 (m, 3H), 11.07, 11.21 (2 s, 1H); fab-ms:  $m/z$  701 [M+H]<sup>+</sup>, 1401 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{42}\text{H}_{48}\text{N}_6\text{O}_4$  (700.89): C, 71.98; H, 6.90; N, 11.99. Found: C, 71.87; H, 7.02; N, 11.83.

1,4,7,10,20,26,36,39-Octaazanacyclo[37.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(25,33).0(27,32).0(34,38)]pentatetraconta-8(12),13(21),14(19),15,17,25(33),27(32),28,30,34(38)-decaene-9,11,35,37-tetraone (**7i**).

Compound **7i** was prepared from **6a** and diamine **C**. Column chromatography (dichloromethane/ethyl acetate/methanol 4:4:1) of the crude product afforded **7i** as orange crystals (4%); mp 264-267°; ir (potassium bromide):  $\nu$  3423, 2929, 2854, 1754, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.89-2.47 (m, 8H), 2.53-2.82 (m, 10H), 3.22-3.61 (m, 8H), 6.90-7.12 (m, 4H), 7.14-7.22 (m, 2H), 7.27-7.41 (m, 2H), 10.42 (s, 2H), 10.99, 11.12 (2s, 1.6+0.4H); ci-ms ( $\text{NH}_3$ ):  $m/z$  659 [M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{37}\text{H}_{38}\text{N}_8\text{O}_4 \times 1/2$  ethyl acetate (702.81): C, 66.65; H, 6.02; N, 15.94. Found: C, 66.91; H, 6.22; N, 16.01.

1,4,7,10,20,28,38,41-Octaazanacyclo[39.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(27,35).0(29,34).0(36,40)]heptatetraconta-8(12),13(21),14(19),15,17,27(35),29(34),30,32,36(40)-decaen-9,11,37,39-tetraone (**7j**).

Compound **7j** was prepared from **6d** and diamine **C**. Column chromatography (dichloromethane/ethyl acetate/methanol 4:4:1) of the crude product afforded **7j** as orange crystals (7%); mp 258-261°; ir (potassium bromide):  $\nu$  3400, 3051, 2933, 1754, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.21-1.44 (m, 2H), 1.50-1.80 (m, 4H), 2.20-2.72 (m, 16H), 3.20-3.55 (m, 8H), 6.88-7.08 (m, 4H), 7.11-7.20 (m, 2H), 7.25-7.33 (m, 2H), 10.39, 10.41 (2 s, 2H), 11.10 (s, 2H); fab-ms:  $m/z$  687 [M+H]<sup>+</sup>, 1373 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{39}\text{H}_{42}\text{N}_8\text{O}_4 \times 1$  dichloromethane (761.65): C, 63.08; H, 4.50; N, 14.71. Found: C, 62.86; H, 4.76; N, 14.60.

10,38-Dimethyl-1,4,7,10,20,28,38,41-octaazanacyclo[39.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(27,35).0(29,34).0(36,40)]heptatetraconta-8(12),13(21),14(19),15,17,27(35),29(34),30,32,36(40)-decaene-9,11,37,39-tetraone (**7k**).

Compound **7k** was prepared from **6e** and diamine **C**. Column chromatography (dichloromethane/ethyl acetate/methanol 4:4:1) of the crude product afforded **7k** as orange crystals (38%); mp 305-308°; ir (potassium bromide):  $\nu$  3338, 2929, 2854, 1750, 1692  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.18-1.39 (m, 2H), 1.51-1.79 (m, 4H), 2.19-2.76 (m, 12H), 2.81-3.00 (m, 8H), 3.21-3.59 (m, 10H), 6.87-7.09 (m, 4H), 7.12-7.22 (m, 2H), 7.25-7.35 (m, 2H), 11.12, 11.13 (2 s, 2H); fab-ms:  $m/z$  715 [M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{41}\text{H}_{46}\text{N}_8\text{O}_4 \times 1/2$  ethyl acetate (758.92): C, 68.05; H, 6.64; N, 14.76. Found: C, 68.13; H, 6.63; N, 14.31.

1,4,7,10,20,35,45,48-Octaazanacyclo[46.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(34,42).0(36,41).0(43,47)]tetrapentaconta-8(12),13(21),14(19),15,17,34(42),36(41),37,39,43(47)-decaen-9,11,44,46-tetraone (**7l**).

Compound **7l** was prepared from **6i** and diamine **C**. Column chromatography (dichloromethane/ethyl acetate/methanol 4:4:0.5) of the crude product afforded **7l** as orange crystals (16%); mp 211-214°; ir (potassium bromide):  $\nu$  3340, 2927, 2854, 1752, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.91-1.26 (m, 16H), 1.46-1.70 (m, 4H), 2.10-2.36 (m, 12H), 2.54-2.80 (m, 4H), 3.18-3.29 (m, 4H), 3.50-3.71 (m, 4H), 6.87-7.06 (m, 4H), 7.12-7.22 (m, 2H), 7.22-7.31 (m, 2H), 10.37 (s, 2H), 11.07, 11.09 (2 s, 2H); fab-ms:  $m/z$  785 [M+H]<sup>+</sup>, 1569 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{46}\text{H}_{56}\text{N}_8\text{O}_4 \times 1/2$  ethyl acetate (829.04): C, 69.54; H, 7.29; N, 13.52. Found: C, 69.23; H, 7.13; N, 13.82.

10,45-Dimethyl-1,4,7,10,20,35,45,48-octaazanacyclo[46.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(34,42).0(36,41).0(43,47)]tetrapentaconta-8(12),13(21),14(19),15,17,34(42),36(41),37,39,43(47)-decaene-9,11,44,46-tetraone (**7m**).

Compound **7m** was prepared from **6j** and diamine **C**. Column chromatography (dichloromethane/ethyl acetate/methanol 4:4:0.5) of the crude product afforded **7m** as orange crystals (34%); mp 186-190°; ir (potassium bromide):  $\nu$  3388, 2925, 2854, 1750, 1698  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.87-1.21 (m, 16H), 1.42-1.70 (m, 4H), 2.09-2.36 (m, 12H), 2.53-2.78 (m, 4H), 2.79-2.91 (m, 6H), 3.21-3.40 (m, 4H), 3.49-3.79 (m, 4H), 6.85-7.07 (m, 4H), 7.12-7.22 (m, 2H), 7.22-7.32 (m, 2H), 11.09, 11.11 (2s, 2H); fab-ms:  $m/z$  813 [M+H]<sup>+</sup>, 1625 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{48}\text{H}_{62}\text{N}_8\text{O}_4 \times 1/2$  ethyl acetate (857.09): C, 70.07; H, 7.53; N, 13.07. Found: C, 69.67; H, 7.43; N, 13.25.

5,8,18,24,34,37-Hexaazanacyclo[35.2.2.2(2,5).0(6,10).0(11,19).0(12,17).0(23,31).0(25,30).0(32,36)]tritetraconta-6(10),11(19),12(17),13,15,23(31),25(30),26,28,32(36)-decaen-7,9,33,35-tetraone (**7n**).

Compound **7n** was prepared from **6a** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7n** as orange crystals (6%); mp 285° (dec); ir (potassium bromide):  $\nu$  3390, 2939, 2860, 1754, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.84-1.11 (m, 4H), 1.21-1.38 (m, 3H), 1.41-1.58 (m, 2H), 2.00-2.17 (m, 2H), 2.53-2.92 (m, 9H), 3.36-3.83 (m, 2H), 4.80-5.29 (m, 2H),

6.89-7.07 (m, 4H), 7.09-7.17 (m, 2H), 7.26-7.36 (m, 2H), 10.36 (s, 2H), 10.96-11.19 (m, 2H); ei-ms:  $m/z$  (%) 628 (13)  $[M^+]$ .

*Anal.* Calcd. for  $C_{37}H_{36}N_6O_4 \times 1/2$  dichloromethane (671.19): C, 67.11; H, 5.56; N, 12.52. Found: C, 66.99; H, 5.52; N, 12.10.

8,34-Dimethyl-5,8,18,24,34,37-hexaazanonacyclo[35.2.2.2(2,5).0(6,10).0(11,19).0(12,17).0(23,31).0(25,30).0(32,36)]tritetraconta-6(10),11(19),12(17),13,15,23(31),-25(30),26,28,32(36)-decaene-7,9,33,35-tetraone (**7o**).

Compound **7o** was prepared from **6b** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7o** as orange crystals (32%); mp 197-200°; ir (potassium bromide):  $\nu$  3372, 3338, 2933, 1752, 1698  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.76-1.88 (m, 10H), 2.01-2.17 (m, 2H), 2.52-3.12 (m, 14H), 3.68-3.83 (m, 2H), 4.76-5.32 (m, 2H), 6.88-7.09 (m, 4H), 7.10-7.37 (m, 4H), 11.04, 11.18 (2 s, 2H); fab-ms:  $m/z$  657  $[M+H]^+$ , 1313  $[2M+H]^+$ .

*Anal.* Calcd. for  $C_{39}H_{40}N_6O_4 \times 1/2$  ethyl acetate (700.84): C, 70.27; H, 6.33; N, 11.99. Found: C, 70.29; H, 6.26; N, 12.29.

6,9,19,25,35,38-Hexaazanonacyclo[36.2.2.2(3,6).0(7,11).0(12,20).0(13,18).0(24,32).0(26,31).0(33,37)]tetratetraconta-7(11),12(20),13(18),14,16,24(32),26(31),27,29,33(37)-decaene-8,10,34,36-tetraone (**7p**).

Compound **7p** was prepared from **6a** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7p** as orange crystals (4%); mp 215° (dec); ir (potassium bromide):  $\nu$  3381, 2921, 1752, 1702  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.77-1.73 (m, 13H), 1.95-2.27 (m, 2H), 2.58-3.03 (m, 7H), 3.47-3.71 (m, 2H), 4.60-5.20 (m, 2H), 6.88-7.10 (m, 5H), 7.12-7.18 (m, 1H), 7.27-7.37 (m, 2H), 10.24, 10.33 (2 s, 1.2+0.8H), 10.92, 11.15 (2 s, 0.8+1.2H); ei-ms:  $m/z$  (%) 642 (5)  $[M^+]$ .

*Anal.* Calcd. for  $C_{38}H_{38}N_6O_4 \times 1/2$  dichloromethane (685.21): C, 67.48; H, 5.74; N, 12.26. Found: C, 67.69; H, 5.78; N, 12.44.

9,35-Dimethyl-6,9,19,25,35,38-hexaazanonacyclo[36.2.2.2(3,6).0(7,11).0(12,20).0(13,18).0(24,32).0(26,31).0(33,37)]tetratetraconta-7(11),12(20),13(18),14,16,24(32),26(31),27,29,33(37)-decaene-8,10,34,36-tetraone (**7q**).

Compound **7q** was prepared from **6b** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7q** as orange crystals (17%); mp 337° (dec); ir (potassium bromide):  $\nu$  3317, 2917, 1746, 1686  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.00-1.76 (m, 12H), 2.01-2.31 (m, 2H), 2.54-3.09 (m, 14H), 3.46-3.58 (m, 0.8H), 3.61-3.73 (m, 1.2H), 4.61-4.98 (m, 0.8H), 5.08-5.22 (m, 1.2H), 6.88-7.10 (m, 5H), 7.12-7.19 (m, 1H), 7.28-7.37 (m, 2H), 10.94, 11.15 (2 s, 0.8+1.2H); fab-ms:  $m/z$  671  $[M+H]^+$ , 1341  $[2M+H]^+$ .

*Anal.* Calcd. for  $C_{40}H_{42}N_6O_4 \times 1/2$  ethyl acetate (714.86): C, 70.57; H, 6.49; N, 11.76. Found: C, 70.88; H, 6.43; N, 12.04.

7,10,20,26,36,39-Hexaazanonacyclo[37.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(25,33).0(27,32).0(34,38)]pentatetraconta-8(12),13(21),14(19),15,17,25(33),27(32),28,30,34(38)-decaene-9,11,35,37-tetraone (**7r**).

Compound **7r** was prepared from **6a** and diamine **F**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the

crude product afforded **7r** as orange crystals (52%); mp 330° (dec); ir (potassium bromide):  $\nu$  3388, 2927, 2854, 1752, 1698  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.79-1.65 (m, 14H), 1.90-2.11 (m, 2H), 2.56-2.98 (m, 8H), 3.48-3.71 (m, 2H), 4.60-4.76 (m, 0.7H), 4.98-5.14 (m, 1.3H), 6.88-7.23 (m, 6H), 7.25-7.39 (m, 2H), 10.31, 10.36 (2 s, 2H), 10.98, 11.08 (s, 2H); fab-ms:  $m/z$  657  $[M+H]^+$ , 1313  $[2M+H]^+$ .

*Anal.* Calcd. for  $C_{39}H_{40}N_6O_4 \times 1/2$  dichloromethane (720.47): C, 66.27; H, 5.81; N, 11.66. Found: C, 66.53; H, 5.92; N, 11.38.

10,36-Dimethyl-7,10,20,26,36,39-hexaazanonacyclo[37.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(25,33).0(27,32).0(34,38)]pentatetraconta-8(12),13(21),14(19),15,17,25(33),27(32),28,30,34(38)-decaene-9,11,35,37-tetraone (**7s**).

Compound **7s** was prepared from **6b** and diamine **F**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7s** as orange crystals (20%); mp 245° (dec); ir (potassium bromide):  $\nu$  3371, 2925, 2856, 1748, 1694  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.81-1.56 (m, 14H), 1.88-2.35 (m, 2H), 2.53-3.00 (m, 14H), 3.59-3.73 (m, 2H), 5.07-5.21 (m, 2H), 6.90-7.09 (m, 4H), 7.11-7.18 (m, 2H), 7.30-7.38 (m, 2H), 11.00 (s, 2H); fab-ms:  $m/z$  685  $[M+H]^+$ , 1369  $[2M+H]^+$ .

*Anal.* Calcd. for  $C_{41}H_{44}N_6O_4 \times 1/2$  ethyl acetate (728.88): C, 70.86; H, 6.64; N, 11.53. Found: C, 70.56; H, 6.68; N, 11.43.

8,11,21,27,37,40-Hexaazanonacyclo[38.2.2.2(5,8).0(9,13).0(14,22).0(15,20).0(26,34).0(28,33).0(35,39)]hexatetraconta-9(13),14(22),15(20),16,18,26(34),28(33),29,31,35(39)-decaene-10,12,36,38-tetraone (**7t**).

Compound **7t** was prepared from **6a** and diamine **G**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7t** as orange crystals (5%); mp 335° (dec); ir (potassium bromide):  $\nu$  3400, 2929, 2854, 1752, 1702  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.85-1.61 (m, 16H), 2.05-2.24 (m, 2H), 2.55-2.79 (m, 6H), 2.81-3.02 (m, 2H), 3.52-3.77 (m, 2H), 4.59-4.74 (m, 0.7H), 4.88-5.06 (m, 1.3H), 6.89-7.10 (m, 4H), 7.13-7.22 (m, 2H), 7.26-7.40 (m, 2H), 10.33 (s, 2H), 10.95, 11.00 (2 s, 1.3H+0.7H); fab-ms:  $m/z$  671  $[M+H]^+$ , 1341  $[2M+H]^+$ .

*Anal.* Calcd. for  $C_{40}H_{42}N_6O_4 \times 1$  ethyl acetate (758.92): C, 69.64; H, 6.64; N, 11.07. Found: C, 69.33; H, 6.57; N, 11.57.

11,37-Dimethyl-8,11,21,27,37,40-hexaazanonacyclo[38.2.2.2(5,8).0(9,13).0(14,22).0(15,20).0(26,34).0(28,33).0(35,39)]hexatetraconta-9(13),14(22),15(20),16,18,26(34),28(33),29,31,35(39)-decaene-10,12,36,38-tetraone (**7u**).

Compound **7u** was prepared from **6b** and diamine **G**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7u** as orange crystals (21%); mp 325° (dec); ir (potassium bromide):  $\nu$  3458, 2925, 1750, 1694  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.84-1.62 (m, 16H), 2.02-2.26 (m, 2H), 2.53-2.81 (m, 6H), 2.83-3.09 (m, 8H), 3.54-3.79 (m, 2H), 4.63-5.11 (m, 2H), 6.89-7.10 (m, 4H), 7.14-7.23 (m, 2H), 7.26-7.39 (m, 2H), 10.97, 11.04 (2 s, 1.4H+0.6H); ei-ms:  $m/z$  (%) 698 (100)  $[M^+]$ , 349 (11)  $[M^2+]$ .

*Anal.* Calcd. for  $C_{42}H_{46}N_6O_4$  (698.87): C, 72.18; H, 6.63; N, 12.03. Found: C, 71.99; H, 6.62; N, 11.76.



10,13,23,29,39,42-Hexaazanonacyclo[40.2.2(7,10).0(11,15).0(16,24).0(17,22).0(28,36).0(30,35).0(37,41)]octatetraconta-11(15),16(24),17(22),18,20,28(36),30(35),31,33,37(41)-decaene-12,14,38,40-tetraone (**7v**).

Compound **7v** was prepared from **6a** and diamine **H**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7v** as orange crystals (4%); mp 243-245°; ir (potassium bromide):  $\nu$  3406, 2929, 2854, 1754, 1702  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.70-1.58 (m, 20H), 1.79-1.97 (m, 1.4H), 2.01-2.12 (m, 0.6H), 2.54-2.97 (m, 8H), 3.63-3.88 (m, 2H), 4.02-4.18 (m, 1.4H), 4.50-4.64 (m, 0.6H), 6.89-7.10 (m, 4H), 7.16-7.39 (m, 4H), 10.95, 10.33 (2 s, 0.6+1.4H), 10.93, 11.10 (2 s, 0.6+1.4H); fab-ms:  $m/z$  699  $[\text{M}+\text{H}]^+$ , 1397  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{42}\text{H}_{46}\text{N}_6\text{O}_4 \times 1/3$  dichloromethane (727.16): C, 69.92; H, 6.47; N, 11.56. Found: C, 69.60; H, 6.57; N, 11.18.

13,39-Dimethyl-10,13,23,29,39,42-hexaazanonacyclo[40.2.2(7,10).0(11,15).0(16,24).0(17,22).0(28,36).0(30,35).0(37,41)]octatetraconta-11(15),16(24),17(22),18,20,28(36),30(35),31,33,37(41)-decaene-12,14,38,40-tetraone (**7w**).

Compound **7w** was prepared from **6b** and diamine **H**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7w** as orange crystals (35%); mp 245° (dec); ir (potassium bromide):  $\nu$  3357, 2929, 2846, 1744, 1692  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.73-1.61 (m, 20H), 1.82-2.14 (m, 2H), 2.54-2.83 (m, 7H), 2.84-3.02 (m, 7H), 3.65-3.74 (m, 0.7H), 3.79-3.97 (m, 1.3H), 3.99-4.19 (m, 1.3H), 4.56-4.71 (m, 0.7H), 6.88-7.10 (m, 4H), 7.16-7.40 (m, 4H), 10.95, 11.10 (2 s, 0.7+1.3H); ei-ms:  $m/z$  (%) 726 (100)  $[\text{M}^+]$ , 711 (1), 697 (1), 363 (5).

*Anal.* Calcd. for  $\text{C}_{44}\text{H}_{50}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (770.97): C, 71.66; H, 7.06; N, 10.90. Found: C, 71.64; H, 7.40; N, 10.35.

11,14,24,30,40,43-Hexaazanonacyclo[41.2.2(8,11).0(12,16).0(17,25).0(18,23).0(29,37).0(31,36).0(38,42)]nonatetraconta-12(16),17(25),18(23),19,21,29(37),31(36),32,34,38(42)-decaene-13,15,39,41-tetraone (**7x**).

Compound **7x** was prepared from **6a** and diamine **I**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7x** as orange crystals (4%); mp 258-260°; ir (potassium bromide):  $\nu$  3382, 2927, 2854, 1753, 1702  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.70-1.53 (m, 22H), 1.88-2.16 (m, 2H), 2.53-2.92 (m, 8H), 3.61-3.87 (m, 2H), 4.03-4.18 (m, 1.2H), 4.41-4.55 (m, 0.8H), 6.89-7.10 (m, 4H), 7.15-7.39 (m, 4H), 10.32, 10.40 (2 s, 0.8+1.2H), 10.92, 10.99 (2 s, 0.8+1.2H); ci-ms:  $m/z$  713  $[\text{M}+\text{H}]^+$ , 730  $[\text{M}+\text{NH}_4]^+$ .

*Anal.* Calcd. for  $\text{C}_{43}\text{H}_{48}\text{N}_6\text{O}_4 \times 1/2$  dichloromethane (755.34): C, 69.17; H, 6.54; N, 11.13. Found: C, 69.89; H, 6.77; N, 11.19.

14,40-Dimethyl-11,14,24,30,40,43-hexaazanonacyclo[41.2.2(8,11).0(12,16).0(17,25).0(18,23).0(29,37).0(31,36).0(38,42)]nonatetraconta-12(16),17(25),18(23),19,21,29(37),31(36),32,34,38(42)-decaene-13,15,39,41-tetraone (**7y**).

Compound **7y** was prepared from **6b** and diamine **I**. Column chromatography (dichloromethane/ethyl acetate 5:1) of the crude product afforded **7y** as orange crystals (38%); mp 325° (dec); ir (potassium bromide):  $\nu$  3390, 2927, 2856, 1750, 1694  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.69-1.62

(m, 22H), 1.87-2.19 (m, 2H), 2.53-2.83 (m, 7H), 2.83-3.00 (m, 7H), 3.60-3.73 (m, 0.9H), 3.76-3.90 (m, 1.1H), 3.99-4.14 (m, 1.1H), 4.44-4.60 (m, 0.9H), 6.88-7.10 (m, 4H), 7.16-7.39 (m, 4H), 10.95, 11.05 (2 s, 0.9+1.1H); ei-ms:  $m/z$  (%) 740 (100)  $[\text{M}^+]$ , 370 (5)  $[\text{M}^{2+}]$ .

*Anal.* Calcd. for  $\text{C}_{45}\text{H}_{52}\text{N}_6\text{O}_4 \times 1/4$  ethyl acetate (762.97): C, 72.41; H, 7.13; N, 11.01. Found: C, 72.28; H, 7.04; N, 11.13.

8,35-Dimethyl-5,8,18,25,35,38-Hexaazanonacyclo[36.2.2(2,5).0(6,10).0(11,19).0(12,17).0(24,32).0(26,31).0(33,37)]tetraconta-6(10),11(19),12(17),13,15,24(32),26(31),27,29,33(37)-decaen-7,9,34,36-tetraone (**7z**).

Compound **7z** was prepared from **6c** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 4:1) of the crude product afforded **7z** as orange needles (12%); mp >240°; ir (potassium bromide):  $\nu$  3307, 1748, 1690, 1630, 1609  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.88-0.92 (m, 2H), 1.15-1.20 (m, 2H), 1.39-1.46 (m, 8H), 2.18-2.30 (m, 2H), 2.47-2.56 (m, 2H), 2.56-2.76 (m, 4H), 2.81-2.88 (m, 2H), 2.86 (s, 6H), 3.73-3.77 (m, 2H), 5.39-5.43 (m, 2H), 6.88-7.32 (m, 8H), 11.08 (s, 2H); ei-ms:  $m/z$  (%) 670 (100)  $[\text{M}^+]$ .

*Anal.* Calcd.  $\text{C}_{40}\text{H}_{42}\text{N}_6\text{O}_4$  (670.80): C, 71.62; H, 6.31; N, 12.53. Found: C, 71.29; H, 6.52; N, 12.40.

5,8,18,26,36,39-Hexaazanonacyclo[37.2.2(2,5).0(6,10).0(11,19).0(12,17).0(25,33).0(27,32).0(34,38)]pentatetraconta-6(10),11(19),12(17),13,15,25(33),27(32),28,30,34(38)-decaen-7,9,35,37-tetraone (**7aa**).

Compound **7aa** was prepared from **6d** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7aa** as orange crystals (13%); mp 197-200°; ir (potassium bromide):  $\nu$  3396, 3048, 2932, 1752, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.67-1.82 (m, 18H), 2.53-2.80 (m, 4H), 2.83-3.06 (m, 2H), 3.45-3.65 (m, 2H), 3.96-4.27 (m, 0.4H), 4.76-5.00 (m, 1.6H), 6.86-7.07 (m, 4H), 7.10-7.17 (m, 2H), 7.22-7.33 (m, 2H), 10.33 (br s, 2H), 11.07, 11.09 (2 s, 2H); fab-ms:  $m/z$  657  $[\text{M}+\text{H}]^+$ , 1313  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{39}\text{H}_{40}\text{N}_6\text{O}_4$  (656.79): C, 71.32; H, 6.14; N, 12.80. Found: C, 71.10; H, 6.19; N, 12.68.

8,36-Dimethyl-5,8,18,26,36,39-Hexaazanonacyclo[37.2.2(2,5).0(6,10).0(11,19).0(12,17).0(25,33).0(27,32).0(34,38)]pentatetraconta-6(10),11(19),12(17),13,15,25(33),27(32),28,30,34(38)-decaen-7,9,35,37-tetraone (**7bb**).

Compound **7bb** was prepared from **6e** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7bb** as orange solid (39%); mp 310° (dec); ir (potassium bromide)  $\nu$  3400, 2932, 1692, 1630, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (400 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.72-0.88 (m, 2H), 1.03-1.12 (m, 2H), 1.23-1.61 (m, 10H), 1.65-1.86 (m, 2H), 2.49-2.62 (m, 4H), 2.66-2.77 (m, 2H), 2.85 (s, 6H), 2.71-2.79 (m, 2H), 3.73-3.82 (m, 2H), 5.21-5.36 (m, 2H), 6.88-6.95 (m, 2H), 6.97-7.04 (m, 2H), 7.10-7.15 (m, 2H), 7.26-7.30 (m, 2H), 11.09 (s, 2H); fd-ms:  $m/z$  684  $[\text{M}^+]$ .

*Anal.* Calcd. for  $\text{C}_{41}\text{H}_{44}\text{N}_6\text{O}_4$  (684.83): C, 71.91; H, 6.48; N, 12.27. Found: C, 71.46; H, 6.80; N, 12.00.

5,8,18,26,36,39-Hexaazanonacyclo[37.2.2(2,5).0(6,10).0(11,19).0(12,17).0(25,33).0(27,32).0(34,38)]pentatetraconta-6(10),11(19),12(17),13,15,25(33),27(32),28,30,34(38)-decaen-7,9,35,37-tetraone (**7cc**).

Compound **7cc** was prepared from **6d** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 2:1) of

the crude product afforded **7cc** as orange crystals (17%); mp 245-249°; ir (potassium bromide):  $\nu$  3386, 2927, 2856, 1752, 1702 (C=O)  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.89-1.70 (m, 18H), 2.53-3.01 (m, 8H), 3.50-3.70 (m, 2H), 4.42-4.59 (m, 0.3H), 4.86-5.04 (m, 1.7H), 6.87-7.06 (m, 4H), 7.07-7.16 (m, 2H), 7.23-7.33 (m, 2H), 10.20, 10.36 (2 s, 1.7+0.3H), 11.04, 11.08 (2 s, 2H); fab-ms:  $m/z$  672 [M+H]<sup>+</sup>, 1343 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{40}\text{H}_{42}\text{N}_6\text{O}_4 \times 3/4$  ethyl acetate (736.89): C, 70.09; H, 6.57; N, 11.40. Found: C, 69.96; H, 6.73; N, 11.61.

9,37-Dimethyl-6,9,19,27,37,40-hexaazanonacyclo-[38.2.2.2(3,6).0(7,11).0(12,20).0(13,18).0(26,34).0(28,33).0(35,39)]hexatetraconta-7(11),12(20),13(18),14,16,26(34),28(33),29,31,35(39)-decaen-8,10,36,38-tetraone (**7dd**).

Compound **7dd** was prepared from **6e** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 6:1) of the crude product afforded **7dd** as orange crystals (35%); mp >350°; ir (potassium bromide):  $\nu$  3400, 2925, 1748, 1692  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.80-1.89 (m, 19H), 2.54-2.75 (m, 5H), 2.75-2.97 (m, 8H), 3.53-3.71 (m, 2H), 4.48-4.64 (m, 0.3H), 4.92-5.12 (m, 1.7H), 6.86-7.06 (m, 4H), 7.07-7.18 (m, 2H), 7.23-7.34 (m, 2H), 11.06, 11.10 (2 s, 2H); fab-ms:  $m/z$  699 [M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{42}\text{H}_{46}\text{N}_6\text{O}_4 \times 1/4$  dichloromethane (720.10): C, 70.47; H, 6.51; N, 11.67. Found: C, 69.90; H, 6.66; N, 11.24.

7,10,20,28,38,41-Hexaazanonacyclo[39.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(27,35).0(29,34).0(36,40)]heptatetraconta-8(12),13(21),14(19),15,17,27(35),29(34),30,32,36(40)-decaene-9,11,37,39-tetraone (**7ee**).

Compound **7ee** was prepared from **6d** and diamine **F**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7ee** as orange crystals (15%); mp 290-292°; ir (potassium bromide):  $\nu$  3361, 3048, 2925, 1750, 1700  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.70-1.81 (m, 18H), 2.54-2.70 (m, 4H), 2.75-2.87 (m, 2H), 3.15-3.62 (m, 4.8H), 3.69-3.84 (m, 1.2H), 3.95-4.33 (m, 1.2H), 5.16-5.33 (m, 0.8H), 6.86-7.07 (m, 4H), 7.07-7.23 (m, 2H), 7.23-7.34 (m, 2H), 10.31 (br s, 2H), 11.08 (s, 2H); fab-ms:  $m/z$  685 [M+H]<sup>+</sup>, 1369 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{41}\text{H}_{44}\text{N}_6\text{O}_4 \times 1$  ethyl acetate (772.95): C, 69.93; H, 6.78; N, 10.87. Found: C, 69.79; H, 6.87; N, 11.09.

10,38-Dimethyl-7,10,20,28,38,41-hexaazanonacyclo-[39.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(27,35).0(29,34).0(36,40)]heptatetraconta-8(12),13(21),14(19),15,17,27(35),29(34),30,32,36(40)-decaene-9,11,37,39-tetraone (**7ff**).

Compound **7ff** was prepared from **6e** and diamine **F**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7ff** as orange solid (36%); mp 280° (dec); ir (potassium bromide):  $\nu$  3400, 2927, 1696, 1630, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, chloroform- $d$ ):  $\delta$  0.61-1.71 (m, 20H), 2.23-2.79 (m, 6H), 2.81-3.03 (m, 2H), 3.04, 3.05 (2 s, 6H), 3.64-3.76 (m, 2H), 5.07-5.16 (m, 2H), 6.95-7.13 (m, 4H), 7.16-7.28 (m, 4H), 8.35, 8.40 (2 s, 2H); fd-ms:  $m/z$  712 [M<sup>+</sup>].

*Anal.* Calcd. for  $\text{C}_{43}\text{H}_{48}\text{N}_6\text{O}_4$  (712.88): C, 72.45; H, 6.79; N, 11.79. Found: C, 72.41; H, 7.01; N, 11.79.

8,11,21,29,39,42-Hexaazanonacyclo[40.2.2.2(5,8).0(9,13).0(14,22).0(15,20).0(28,36).0(30,35).0(37,41)]octatetraconta-9(13),14(22),15(20),16,18,28(36),30(35),31,33,37(41)-decaen-10,12,38,40-tetraone (**7gg**).

Compound **7gg** was prepared from **6dc** and diamine **G**. Column chromatography (dichloromethane/ethyl acetate 1:1) of the crude product afforded **7gg** as orange crystals (20%); mp 197-200°; ir (potassium bromide):  $\nu$  3404, 2933, 2856, 1754, 1698  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.75-1.83 (m, 22H), 2.53-2.95 (m, 8H), 3.53-3.71 (m, 2H), 4.49-5.03 (m, 2H), 6.87-7.06 (m, 4H), 7.09-7.20 (m, 2H), 7.22-7.32 (m, 2H), 10.27, 10.31 (2 s, 2H), 11.01, 11.05 (2 s, 2H); ci-ms:  $m/z$  699 [M+H]<sup>+</sup>, 716 [M+NH<sub>4</sub>]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{42}\text{H}_{46}\text{N}_6\text{O}_4 \times 3/4$  ethyl acetate (764.94): C, 70.66; H, 6.85; N, 10.99. Found: C, 70.50; H, 6.80; N, 11.55.

11,39-Dimethyl-8,11,21,29,39,42-hexaazanonacyclo-[40.2.2.2(5,8).0(9,13).0(14,22).0(15,20).0(28,36).0(30,35).0(37,41)]octatetraconta-9(13),14(22),15(20),16,18,28(36),30(35),31,33,37(41)-decaen-10,12,38,40-tetraone (**7hh**).

Compound **7hh** was prepared from **6e** and diamine **G**. Column chromatography (dichloromethane/ethyl acetate 2:1) of the crude product afforded **7hh** as orange solid (36%); mp >350° (dec); ir (potassium bromide):  $\nu$  3392, 2929-2853, 1694, 1630, 1611  $\text{cm}^{-1}$ ; (250 MHz, chloroform- $d$ ):  $\delta$  0.75-1.92 (m, 22H), 2.43-2.70 (m, 6H), 2.86, 2.88 (2 s, 6H), 2.78-2.96 (m, 2H), 3.57-3.70 (m, 2H), 4.85-5.06 (m, 2H), 7.86-7.04 (m, 4H), 7.08-7.20 (m, 2H), 7.34-7.39 (m, 2H), 11.04, 11.07 (2 s, 2H); ei-ms:  $m/z$  (%) 726 (100) [M<sup>+</sup>], 130 (43).

*Anal.* Calcd. for  $\text{C}_{44}\text{H}_{50}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (770.96): C, 71.66; H, 7.06; N, 10.90. Found: C, 71.82; H, 7.11; N, 11.33.

10,13,23,31,41,44-Hexaazanonacyclo[42.2.2.2(7,10).0(11,15).0(16,24).0(17,22).0(30,38).0(32,37).0(39,43)]pentaconta-11(15),16(24),17(22),18,20,30(38),32(37),33,35,39(43)-decaen-12,14,40,42-tetraone (**7ii**).

Compound **7ii** was prepared from **6d** and diamine **H**. Column chromatography (dichloromethane/ethyl acetate 1:1) of the crude product afforded **7ii** as orange crystals (11%); mp 209-212°; ir (potassium bromide):  $\nu$  3394, 2927, 2856, 1754, 1702  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.71-1.74 (m, 26H), 2.54-2.98 (m, 8H), 3.55-3.67 (m, 0.9H), 3.68-3.82 (m, 1.1H), 4.44-4.60 (m, 1.1H), 4.65-4.79 (m, 0.9H), 6.88-7.08 (m, 4H), 7.13-7.23 (m, 2H), 7.24-7.34 (m, 2H), 10.32 (s, 2H), 11.04, 11.06 (2 s, 2H); ci-ms:  $m/z$  727 [M+H]<sup>+</sup>, 744 [M+NH<sub>4</sub>]<sup>+</sup>.

*Anal.* Calcd. for  $\text{C}_{44}\text{H}_{50}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (770.97): C, 71.66; H, 7.06; N, 10.90. Found: C, 71.39; H, 7.05; N, 11.16.

13,41-Dimethyl-10,13,23,31,41,44-hexaazanonacyclo-[42.2.2.2(7,10).0(11,15).0(16,24).0(17,22).0(30,38).0(32,37).0(39,43)]pentaconta-11(15),16(24),17(22),18,20,30(38),32(37),-33,35,39(43)-decaen-12,14,40,42-tetraone (**7jj**).

Compound **7jj** was prepared from **6e** and diamine **H**. Column chromatography (dichloromethane/ethyl acetate 6:1) of the crude product afforded **7jj** as orange crystals (39%); mp >310° (dec); ir (potassium bromide):  $\nu$  3338, 2927, 2856, 1750, 1692  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.71-1.78 (m, 27H), 2.55-2.70 (m, 5H), 2.79-2.99 (m, 8H), 3.56-3.69 (m, 1H), 3.70-3.83 (m, 1H), 4.50-4.65 (m, 1H), 4.68-4.83 (m, 1H), 6.88-7.07 (m, 4H), 7.13-7.23 (m, 2H), 7.25-7.33 (m, 2H), 11.07, 11.08 (2 s, 2H); fab-ms:  $m/z$  755 [M+H]<sup>+</sup>, 1509 [2M+H]<sup>+</sup>.

1700  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.68-1.38 (m, 28H), 1.46-1.69 (m, 6H), 2.53-2.63 (m, 4H), 2.67-2.93 (m, 10H), 3.58-3.73 (m, 2H), 4.70-4.97 (m, 2H), 6.86-7.07 (m, 4H), 7.11-7.20 (m, 2H), 7.21-7.31 (m, 2H), 11.08 (m, 2H); fab-ms:  $m/z$  811  $[\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{50}\text{H}_{62}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (855.13): C, 73.03; H, 7.78; N, 9.83. Found: C, 73.05; H, 7.83; N, 9.74.

8,11,21,36,46,49-Hexaazanonacyclo[47.2.2.2(5,8).0(9,13).0(14,22).0(15,20).0(35,43).0(37,42).0(44,48)]pentapentaconta-9(13),14(22),15(20),16,18,35(43),37(42),38,40,44(48)-decaene-10,12,45,47-tetraone (**7ss**).

Compound **7ss** was prepared from **6i** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7ss** as orange crystals (44%); mp 282-284°; ir (potassium bromide):  $\nu$  3352, 2923, 2852, 1754, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.73-1.41 (m, 32H), 1.45-1.70 (m, 6H), 2.53-2.90 (m, 6H), 3.63-3.78 (m, 2H), 4.51-4.69 (m, 2H), 6.86-7.06 (m, 4H), 7.11-7.20 (m, 2H), 7.21-7.31 (m, 2H), 10.32 (s, 2H), 11.05, 11.06 (2 s, 2H); fab-ms:  $m/z$  797  $[\text{M}+\text{H}]^+$ , 1593  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{49}\text{H}_{60}\text{N}_6\text{O}_4 \times 1/4$  ethyl acetate (819.08): C, 73.32; H, 7.63; N, 10.26. Found: C, 73.32; H, 7.60; N, 10.38.

11,46-Dimethyl-8,11,21,36,46,49-hexaazanonacyclo[47.2.2.2(5,8).0(9,13).0(14,22).0(15,20).0(35,43).0(37,42).0(44,48)]pentapentaconta-9(13),14(22),15(20),16,18,35(43),37(42),38,40,44(48)-decaene-10,12,45,47-tetraone (**7tt**).

Compound **7tt** was prepared from **6j** and diamine **G**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5) of the crude product afforded **7tt** as orange crystals (40%); mp 276° (dec); ir (potassium bromide):  $\nu$  3371, 2925, 2852, 1748, 1690  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.75-1.42 (m, 32H), 1.45-1.72 (m, 6H), 2.53-2.74 (m, 6H), 2.87 (m, 6H), 3.65-3.81 (m, 2H), 4.56-4.73 (m, 2H), 6.85-7.06 (m, 4H), 7.12-7.21 (m, 2H), 7.22-7.31 (m, 2H), 11.08 (m, 2H); fab-ms:  $m/z$  825  $[\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{51}\text{H}_{64}\text{N}_6\text{O}_4 \times 1/4$  ethyl acetate (847.11): C, 73.72; H, 7.85; N, 9.92. Found: C, 73.35; H, 7.84; N, 9.95.

10,13,23,38,48,51-Hexaazanonacyclo[49.2.2.2(7,10).0(11,15).0(16,24).0(17,22).0(37,45).0(39,44).0(46,50)]heptapentaconta-11(15),16(24),17(22),18,20,37(45),39(44),40,42,46(50)-decaene-12,14,47,49-tetraone (**7uu**).

Compound **7uu** was prepared from **6i** and diamine **H**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7uu** as orange crystals (41%); mp 176-179°; ir (potassium bromide):  $\nu$  3386, 2959, 2854, 1754, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.72-1.41 (m, 36H), 1.47-1.70 (m, 6H), 2.54-2.92 (m, 6H), 3.60-3.75 (m, 2H), 4.64-4.81 (m, 2H), 6.88-7.06 (m, 4H), 7.11-7.20 (m, 2H), 7.22-7.31 (m, 2H), 10.31 (s, 2H), 11.05-11.06 (m, 2H); fab-ms:  $m/z$  825  $[\text{M}+\text{H}]^+$ , 1649  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{51}\text{H}_{64}\text{N}_6\text{O}_4 \times 1/2$  ethyl acetate (869.16): C, 73.24; H, 7.89; N, 9.67. Found: C, 72.99; H, 7.72; N, 9.97.

13,48-Dimethyl-10,13,23,38,48,51-hexaazanonacyclo[49.2.2.2(7,10).0(11,15).0(16,24).0(17,22).0(37,45).0(39,44).0(46,50)]heptapentaconta-11(15),16(24),17(22),18,20,37(45),39(44),40,42,46(50)-decaene-12,14,47,49-tetraone (**7vv**).

Compound **7vv** was prepared from **6j** and diamine **H**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5)

of the crude product afforded **7vv** as orange crystals (36%); mp 245° (dec); ir (potassium bromide):  $\nu$  3338, 2925, 2854, 1750, 1688  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.71-1.43 (m, 34H), 1.45-1.73 (m, 6H), 2.54-2.77 (m, 6H), 2.79-3.00 (m, 8H), 3.62-3.78 (m, 2H), 4.66-4.87 (m, 2H), 6.87-7.07 (m, 4H), 7.12-7.21 (m, 2H), 7.23-7.32 (m, 2H), 11.07-11.08 (m, 2H); fab-ms:  $m/z$  853  $[\text{M}+\text{H}]^+$ , 1705  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{53}\text{H}_{68}\text{N}_6\text{O}_4$  (853.17): C, 74.61; H, 8.03; N, 9.85. Found: C, 74.40; H, 8.13; N, 9.66.

11,14,24,39,49,52-Hexaazanonacyclo[50.2.2.2(8,11).0(12,16).0(17,25).0(18,23).0(38,46).0(40,45).0(47,51)]octapentaconta-12(16),17(25),18(23),19,21,38(46),40(45),41,43,47(51)-decaene-13,15,48,50-tetraone (**7ww**).

Compound **7ww** was prepared from **6i** and diamine **I**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7ww** as orange crystals (55%); mp 147-150°; ir (potassium bromide):  $\nu$  3382, 2925, 2852, 1754, 1704  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.73-1.43 (m, 38H), 1.45-1.73 (m, 6H), 2.53-2.92 (m, 6H), 3.63-3.81 (m, 2H), 4.65-4.84 (m, 2H), 6.88-7.06 (m, 4H), 7.12-7.21 (m, 2H), 7.22-7.32 (m, 2H), 10.32 (s, 2H), 11.04, 11.06 (2 s, 2H); fab-ms:  $m/z$  839  $[\text{M}+\text{H}]^+$ , 1677  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{52}\text{H}_{66}\text{N}_6\text{O}_4 \times 1/4$  ethyl acetate (861.16): C, 73.92; H, 7.96; N, 9.75. Found: C, 74.16; H, 7.59; N, 9.59.

14,49-Dimethyl-11,14,24,39,49,52-hexaazanonacyclo[50.2.2.2(8,11).0(12,16).0(17,25).0(18,23).0(38,46).0(40,45).0(47,51)]octapentaconta-12(16),17(25),18(23),19,21,38(46),40(45),41,43,47(51)-decaene-13,15,48,50-tetraone (**7xx**).

Compound **7xx** was prepared from **6j** and diamine **I**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5) of the crude product afforded **7xx** as orange crystals (53%); mp 325° (dec); ir (potassium bromide):  $\nu$  3320, 2927, 2854, 1750, 1688  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.78-1.38 (m, 36H), 1.50-1.68 (m, 6H), 2.53-2.75 (m, 6H), 2.79-2.95 (m, 8H), 3.74 (d,  $J = 12.3$  Hz, 2H), 4.80 (d,  $J = 12.3$  Hz, 2H), 6.88-7.06 (m, 4H), 7.12-7.20 (m, 2H), 7.23-7.31 (m, 2H), 11.02-11.12 (m, 2H); fab-ms:  $m/z$  868  $[\text{M}+\text{H}]^+$ , 1735  $[2\text{M}+\text{H}]^+$ .

*Anal.* Calcd. for  $\text{C}_{54}\text{H}_{70}\text{N}_6\text{O}_4$  (867.20): C, 74.79; H, 8.14; N, 9.69. Found: C, 74.57; H, 8.21; N, 9.53.

1-Methyl-4-[2-[5-(3-[1-methyl-2,5-dioxo-4-pyrrolidin-1-yl]-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl]-3-pyrrolidin-1-yl-2,5-dihydro-1H-pyrrole-2,5-dione (**9a**).

Compound **6e** (1.5 mmole) was dissolved in 5 ml (60.6 mmoles) of pyrrolidine. After stirring at room temperature (16 hours), the solvent was removed under reduced pressure. The residue was purified on silica. Elution with dichloromethane/ethyl acetate (95:5) afforded **9a** as orange solid (49%); mp 298°; ir (potassium bromide):  $\nu$  3352, 2937, 1669, 1634, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.14-1.36 (m, 2H), 1.48-1.72 (m, 12H), 2.54-2.61 (m, 4H), 2.88 (s, 6H), 3.32 (br s, 8H), 7.04-7.17 (m, 4H), 7.18 (d,  $J = 7.6$  Hz, 2H), 7.26 (d,  $J = 7.5$  Hz, 2H), 10.97 (s, 2H); ei-ms:  $m/z$  (%) 658 (100)  $[\text{M}^+]$ , 294 (26).

*Anal.* Calcd. for  $\text{C}_{39}\text{H}_{42}\text{N}_6\text{O}_4$  (658.79): C, 71.10; H, 6.43; N, 12.76. Found: C, 70.90; H, 6.58; N, 12.61.

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*Anal.* Calcd. for  $C_{46}H_{54}N_6O_4 \times 1/4$  ethyl acetate (776.99): C, 72.65; H, 7.26; N, 10.82. Found: C, 72.41; H, 7.26; N, 10.68.

11,14,24,32,42,45-Hexaazanonacyclo[43.2.2.2(8,11).0(12,16).0(17,25).0(18,23).0(31,39).0(33,38).0(40,44)]unpentaconta-12(16),17(25),18(23),19,21,31(39),33(38),34,36,40(44)-decaene-13,15,41,43-tetraone (**7kk**).

Compound **7kk** was prepared from **6d** and diamine **I**. Column chromatography (dichloromethane/ethyl acetate 1:1) of the crude product afforded **7kk** as orange crystals (15%); mp 304-306°; ir (potassium bromide):  $\nu$  3400, 2927, 2854, 1756, 1702  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.67-1.73 (m, 28H), 2.53-2.88 (m, 8H), 3.70-3.85 (m, 0.9H), 3.90-4.09 (m, 2.2H), 4.41-4.55 (m, 0.9H), 6.84-7.07 (m, 4H), 7.10-7.21 (m, 2H), 7.22-7.32 (m, 2H), 10.30, 10.33 (2 s, 2H), 11.02, 11.04 (2 s, 2H); ci-ms:  $m/z$  741 [M+H]<sup>+</sup>, 758 [M+NH<sub>4</sub>]<sup>+</sup>.

*Anal.* Calcd. for  $C_{45}H_{52}N_6O_4 \times 1/2$  ethyl acetate (784.99): C, 71.91; H, 7.19; N, 10.71. Found: C, 72.20; H, 7.16; N, 10.98.

14,42-Dimethyl-11,14,24,32,42,45-hexaazanonacyclo[43.2.2.2(8,11).0(12,16).0(17,25).0(18,23).0(31,39).0(33,38).0(40,44)]unpentaconta-12(16),17(25),18(23),19,21,31(39),33(38),34,36,40(44)-decaene-13,15,41,43-tetraone (**7ll**).

Compound **7ll** was prepared from **6e** and diamine **I**. Column chromatography (dichloromethane/ethyl acetate 6:1) of the crude product afforded **7ll** as orange crystals (38%); mp 321-324°; ir (potassium bromide):  $\nu$  3394, 2927, 2856, 1750, 1694  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.71-1.74 (m, 28H), 2.54-2.80 (m, 7H), 2.81-2.95 (m, 7H), 3.73-3.87 (m, 0.8H), 3.93-4.15 (m, 2.4H), 4.42-4.57 (m, 0.8H), 6.83-7.07 (m, 4H), 7.10-7.22 (m, 2H), 7.22-7.32 (m, 2H), 11.03, 11.06 (2 s, 2H); fab-ms:  $m/z$  769 [M+H]<sup>+</sup>, 1537 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $C_{47}H_{56}N_6O_4 \times 1/4$  ethyl acetate (791.02): C, 72.88; H, 7.39; N, 10.62. Found: C, 72.46; H, 7.30; N, 10.63.

5,8,18,33,43,46-Hexaazanonacyclo[44.2.2.2(2,5).0(6,10).0(11,19).0(12,17).0(32,40).0(34,39).0(41,45)]dopentaconta-6(10),11(19),12(17),13,15,32(40),34(39),35,37,41(45)-decaene-7,9,42,44-tetraone (**7mm**).

Compound **7mm** was prepared from **6i** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7mm** as orange crystals (45%); mp 236-238°; ir (potassium bromide):  $\nu$  3390, 2925, 2852, 1717  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.93-1.74 (m, 22H), 2.55-2.74 (m, 4H), 3.35-3.56 (m, 6H), 6.83-7.16 (m, 5H), 7.22-7.35 (m, 3H), 10.42 (s, 2H), 11.01, 11.19 (2 s, 0.4+1.6H); fab-ms:  $m/z$  755 [M+H]<sup>+</sup>, 1509 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $C_{46}H_{54}N_6O_4 \times 1/4$  ethyl acetate (777.00): C, 72.65; H, 7.26; N, 10.82. Found: C, 72.53; H, 7.29; N, 10.97.

8,43-Dimethyl-5,8,18,33,43,46-hexaazanonacyclo[44.2.2.2(2,5).0(6,10).0(11,19).0(12,17).0(32,40).0(34,39).0(41,45)]dopentaconta-6(10),11(19),12(17),13,15,32(40),34(39),-35,37,41(45)-decaene-7,9,42,44-tetraone (**7nn**).

Compound **7nn** was prepared from **6j** and diamine **D**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5) of the crude product afforded **7nn** as orange crystals (50%); mp >250°; ir (potassium bromide):  $\nu$  3381, 2927, 2854, 1735, 1700  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.70-1.38 (m, 26H), 1.46-1.70 (m, 6H), 2.54-2.65 (m, 2H), 2.66-2.83 (m, 4H), 2.83-2.90 (m, 6H), 3.59-3.74 (m, 2H), 4.71-4.96 (m, 2H),

6.87-7.06 (m, 4H), 7.11-7.20 (m, 2H), 7.22-7.31 (m, 2H), 11.07 (s, 1H), 11.08 (s, 1H); fab-ms:  $m/z$  783 [M+H]<sup>+</sup>.

*Anal.* Calcd. for  $C_{48}H_{58}N_6O_4$  (783.04): C, 73.63; H, 7.47; N, 10.73. Found: C, 73.47; H, 7.74; N, 9.89.

6,9,19,34,44,47-Hexaazanonacyclo[45.2.2.2(3,6).0(7,11).0(12,20).0(15,18).0(33,412).0(35,40).0(42,46)]tripentaconta-7(11),12(20),13(18),14,16,33(41),35(40),36,38,42(46)-decaene-8,10,43,45-tetraone (**7oo**).

Compound **7oo** was prepared from **6i** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7oo** as orange crystals (17%); mp 231-233°; ir (potassium bromide):  $\nu$  3369, 2925, 2852, 1717  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.73-1.71 (m, 34H), 2.53-2.85 (m, 6H), 3.79-3.94 (m, 2H), 4.30-4.45 (m, 0.9H), 4.46-4.62 (m, 1.1H), 6.86-7.06 (m, 4H), 7.09-7.20 (m, 2H), 7.21-7.32 (m, 2H), 10.30, 10.32 (2 s, 2H), 11.02, 11.04 (2 s, 2H); fab-ms:  $m/z$  769 [M+H]<sup>+</sup>, 1537 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $C_{47}H_{56}N_6O_4 \times 1$  ethyl acetate (857.11): C, 71.47; H, 7.53; N, 9.81. Found: C, 71.30; H, 7.47; N, 9.85.

9,44-Dimethyl-6,9,19,34,44,47-hexaazanonacyclo[45.2.2.2(3,6).0(7,11).0(12,20).0(15,18).0(33,412).0(35,40).0(42,46)]tripentaconta-7(11),12(20),13(18),14,16,33(41),35(40),36,38,42(46)-decaene-8,10,43,45-tetraone (**7pp**).

Compound **7pp** was prepared from **6j** and diamine **E**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5) of the crude product afforded **7pp** as orange crystals (28%); mp 286° (dec); ir (potassium bromide):  $\nu$  3396, 2927, 2854, 1739, 1696  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.75-1.70 (m, 34H), 2.53-2.90 (m, 12H), 3.80-3.97 (m, 2H), 4.34-4.65 (m, 2H), 6.85-7.06 (m, 4H), 7.10-7.20 (m, 2H), 7.21-7.31 (m, 2H), 11.04, 11.06 (2 s, 2H); fab-ms:  $m/z$  797 [M+H]<sup>+</sup>, 1593 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $C_{49}H_{60}N_6O_4 \times 1$  ethyl acetate (885.14): C, 71.92; H, 7.74; N, 9.49. Found: C, 71.60; H, 7.74; N, 9.52.

7,10,20,35,45,48-Hexaazanonacyclo[46.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(34,42).0(36,41).0(43,47)]tetrapentaconta-8(12),13(21),14(19),15,17,34(42),36(41),37,39,43(47)-decaene-9,11,44,46-tetraone (**7qq**).

Compound **7qq** was prepared from **6i** and diamine **F**. Column chromatography (dichloromethane/ethyl acetate 9:1) of the crude product afforded **7qq** as orange crystals (33%); mp 209-211°; ir (potassium bromide):  $\nu$  3363, 2925, 2852, 1719 3363  $cm^{-1}$ ;  $^1H$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  0.67-1.39 (m, 30H), 1.44-1.70 (m, 6H), 2.54-2.64 (m, 2H), 2.66-2.95 (m, 4H), 3.54-3.71 (m, 2H), 4.68-4.91 (m, 2H), 6.87-7.06 (m, 4H), 7.11-7.21 (m, 2H), 7.21-7.31 (m, 2H), 10.30 (s, 2H), 11.05, 11.06 (2 s, 2H); fab-ms:  $m/z$  783 [M+H]<sup>+</sup>, 1565 [2M+H]<sup>+</sup>.

*Anal.* Calcd. for  $C_{47}H_{58}N_6O_4 \times 1/2$  ethyl acetate (815.05): C, 72.21; H, 7.68; N, 10.31. Found: C, 72.43; H, 7.39; N, 10.24.

10,45-Dimethyl-7,10,20,35,45,48-hexaazanonacyclo[46.2.2.2(4,7).0(8,12).0(13,21).0(14,19).0(34,42).0(36,41).0(43,47)]tetrapentaconta-8(12),13(21),14(19),15,17,34(42),36(41),37,39,43(47)-decaene-9,11,44,46-tetraone (**7rr**).

Compound **7rr** was prepared from **6j** and diamine **F**. Column chromatography (dichloromethane/ethyl acetate 9.5:0.5) of the crude product afforded **7rr** as orange crystals (37%); mp >250°; ir (potassium bromide):  $\nu$  3381, 2927, 2852, 1734,

1-Methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-piperidin-1-yl]-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-3-piperidin-1-yl-2,5-dihydro-1*H*-pyrrole-2,5-dione (**9b**).

Compound **9b** was obtained as above for **9a** from **6e** and piperidine as an orange solid (69%); mp 262°; ir (potassium bromide):  $\nu$  3343, 2936-2855, 1686, 1632, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.25-1.70 (m, 18H), 2.60-2.72 (m, 4H), 3.04, 3.05 (2 s, 6H), 3.32-3.65 (m; 8H), 6.88-7.21 (m, 6H), 7.26-7.35 (m, 2H), 8.51, 8.49 (2s, 2H); ei-ms:  $m/z$  (%) 686 (100) [ $\text{M}^+$ ]; 492 (30); 308 (54).

*Anal.* Calcd. for  $\text{C}_{41}\text{H}_{46}\text{N}_6\text{O}_4$  (686.85): C, 71.70; H, 6.75; N, 12.29. Found: C, 71.32; H, 7.12; N, 11.91.

1-Methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-morpholin-1-yl]-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-3-morpholin-1-yl-2,5-dihydro-1*H*-pyrrole-2,5-dione (**9c**).

Compound **9c** was obtained as above for **9a** from **6e** and morpholine. Compound **9c** was purified on silica. Elution with dichloromethane/ethyl acetate (4:1) afforded **9c** as an orange solid (81%); mp 168-170° (benzene); ir (potassium bromide):  $\nu$  3371, 2944, 1692, 1636, 1613  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.15-1.31 (m, 2H), 1.64 (tt,  $J = 7.3$  Hz, 4H), 2.69-2.54 (m, 4H), 2.87, 2.88 (2 s, 6H), 2.99-3.15 (m, 8H), 3.67-3.80 (m, 8H), 6.86-7.13 (m, 4H), 7.28-7.36 (m, 4H), 11.14 (s, 2H); ei-ms:  $m/z$  (%) 690 (100) [ $\text{M}^+$ ], 338 (24), 310 (27).

*Anal.* Calcd. for  $\text{C}_{39}\text{H}_{42}\text{N}_6\text{O}_6$  x 1/4 benzene (710.32): C, 68.48; H, 6.17; N, 11.83. Found: C, 68.31; H, 6.37; N, 11.48.

1-Methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-(1,2,3,4-tetrahydro-2-isoquinolyl)]-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-3-(1,2,3,4-tetrahydro-2-isoquinolyl)-2,5-dihydro-1*H*-pyrrole-2,5-dione (**9d**).

Compound **6e** (1.5 mmoles) was dissolved in 4 ml (24.0 mmoles) of 1,2,3,4-tetrahydroisoquinoline. After stirring at room temperature (16 hours), the solvent was removed under reduced pressure. The residue was suspended in 100 ml of water and extracted with dichloromethane. The organic layer was dried over sodium sulfate, and the solvent was removed *in vacuo*. The residue was purified on silica. Elution with dichloromethane/ethyl acetate (95:5) afforded **9d** as an orange solid (69%); mp 141-142°; ir (potassium bromide):  $\nu$  3350, 3027, 2931-2856, 1694, 1634, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.26 (t,  $J = 7.1$  Hz, 2H), 1.41-1.66 (m, 4H), 2.42-2.64 (m, 4H), 2.66-2.92 (m, 4H); 3.06 (s, 6H); 3.60-3.73 (m, 2H), 3.96-4.18 (m, 2H), 4.65 (s, 4 H), 6.66-6.77 (m, 2H); 6.92-7.14 (m, 12H), 7.28-7.36 (m, 2H), 8.48 (2s, 2H); ei-ms:  $m/z$  (%) 782 (17) [ $\text{M}^+$ ], 132 (43), 130 (100).

*Anal.* Calcd. for  $\text{C}_{49}\text{H}_{46}\text{N}_6\text{O}_4$  (782.93): C, 75.17; H, 5.92; N, 10.73. Found: C, 74.76; H, 6.15; N, 10.59.

1-Methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-(4-ethoxycarbonylpiperazin-1-yl)]-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-3-(4-ethoxycarbonylpiperazin-1-yl)-2,5-dihydro-1*H*-pyrrole-2,5-dione (**9e**).

Compound **9e** was obtained as above for **9a** from **6e** and piperazine-*N*-carbonic acid ethylester as an orange solid (69%); mp 149-150°; ir (potassium bromide):  $\nu$  3342, 2981-2860, 1752, 1699, 1634, 1613  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.20 (t,  $J = 7.1$  Hz, 6H), 1.25-1.38 (m, 2H), 1.54-1.75 (m, 4H), 2.66 (t, 4H), 3.07 (s, 6H), 3.32-3.41 (m, 8H), 3.42-3.59 (m,

8H), 4.07 (q,  $J = 7.1$  Hz, 4H), 6.98-7.20 (m, 6H), 7.22-7.31 (m, 2H), 8.64, 8.68 (2 s, 2H); fd-ms:  $m/z$  (%) 832 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{45}\text{H}_{52}\text{N}_8\text{O}_8$  x 1/2 ethyl acetate (877.00): C, 64.37; H, 6.44; N, 12.78. Found: C, 64.13; H, 6.49; N, 13.23.

1-Methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-((3-trifluoromethylphenyl)piperazin-1-yl)]-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-3-((3-trifluoromethylphenyl)piperazin-1-yl)-2,5-dihydro-1*H*-pyrrole-2,5-dione (**9f**).

Compound **9f** was obtained as above for **9d** from **6e** and *N*-(3-trifluoromethylphenyl)piperazine as an orange solid (78%); mp 140-141°; ir (potassium bromide):  $\nu$  3386, 3044, 2930-2856, 1699, 1636, 1613  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.21-1.50 (m, 2H); 1.52-1.75 (m, 4H), 2.61-2.74 (m, 4H), 3.02-3.12 (m, 14H), 3.60-3.85 (m, 8H), 6.82-7.20 (m, 12H); 7.23-7.37 (m, 4H), 8.53, 8.54 (2 s, 2H); fd-ms:  $m/z$  (%) 976 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{53}\text{H}_{50}\text{F}_6\text{N}_8\text{O}_4$  (977.02): C, 65.16; H, 5.16; N, 11.47. Found: C, 64.90; H, 5.09; N, 11.28.

3-Bromo-1-methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-(4-isopropylaminocarbonylmethylpiperazin-1-yl)]-2,5-dihydro-1*H*-3-pyrrolyl]-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-2,5-dihydro-1*H*-pyrrole-2,5-dione (**10a**) and 3-(Isopropylaminocarbonylmethylpiperazin-1-yl)-1-methyl-4-{2-[5-(3-[4-isopropylaminocarbonylmethylpiperazin-1-yl]-1-methyl-2,5-dioxo-4-(2,5-dihydro-1*H*-3-pyrrolyl)-1*H*-2-indolyl)pentyl]-1*H*-3-indolyl}-2,5-dihydro-1*H*-pyrrole-2,5-dione (**9g**).

To a stirred solution of **6e** (1.5 mmoles) in 7 ml of dimethylformamide were added 560 mg (303 mmoles) of *N*-isopropylpiperazin-1-ylacetamide and 1 ml of triethylamine. After stirring at room temperature (16 hours), the solvent was removed *in vacuo*. The residue was suspended in water and extracted with dichloromethane. The organic layer was dried over sodium sulfate, and the solvent was removed under reduced pressure. The residue was purified on silica. Elution with dichloromethane/ethyl acetate (2:1) afforded **10a** as an orange solid (45%); mp 156°; ir (potassium bromide):  $\nu$  3369, 2933-2858, 1713, 1694, 1632, 1613  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.10, 1.12 (2d,  $J = 6.6$  Hz, 6H), 1.22-1.40 (m, 2H), 1.51-1.78 (m, 4H), 2.31-2.48 (m, 4H), 2.62-2.78 (m, 4H), 2.89, 2.92 (2 s, 2H), 3.06, 3.16 (2 s, 6H), 3.46-3.80 (m, 4H), 4.03 (dq,  $J = 14.7$  Hz,  $J = 6.6$  Hz, 1H), 6.71 (br s, 1H), 7.05-7.23 (m, 6H), 7.28-7.43 (m, 2H), 8.28, 9.42 (2 s, 2H); fd-ms:  $m/z$  (%) 783 (100) [ $\text{M}^+$ ]; 781 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{40}\text{H}_{44}\text{BrN}_7\text{O}_5$  (782.72): C, 61.38; H, 5.67; N, 12.53. Found: C, 61.00; H, 5.97; N, 12.11.

Compound **9g** was also obtained and purified on silica. Continued elution with dichloromethane/ethyl acetate/methanol (1:1:0.2) afforded **9g** as an orange solid (34%); mp 126-128°; ir (potassium bromide):  $\nu$  3340, 3060, 2934, 1752, 1694, 1636, 1613  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.08-1.18 (m, 12H), 1.23-1.42 (m, 2H), 1.51-1.99 (m, 4H), 2.29-2.60 (m, 8H), 2.65 (t,  $J = 7.0$  Hz, 4H), 2.89, 2.95 (2 s, 4H); 3.04, 3.06 (2 s, 6H), 3.45-3.82 (m, 8H), 3.91-4.14 (m, 2H), 6.79 (br s, 2H), 7.03-7.11 (m, 6H), 7.17-7.32 (m, 2H), 9.05 (br s, 2H); ei-ms:  $m/z$  (%) 886 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{49}\text{H}_{62}\text{N}_{10}\text{O}_6$  x 3/4 ethyl acetate (931.13): C, 65.52; H, 7.19; N, 14.69. Found: C, 65.17; H, 7.24; N, 15.03.

3-Bromo-1-methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-(4-[pyrrolidinylcarbonylmethyl]piperazin-1-yl)-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-2,5-dihydro-1H-pyrrole-2,5-dione (**10b**) and 1-Methyl-4-{2-[5-(3-[1-methyl-2,5-dioxo-4-(4-[pyrrolidinylcarbonylmethyl]piperazin-1-yl)-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-3-[4-(pyrrolidinylcarbonylmethyl)piperazin-1-yl]-2,5-dihydro-1H-pyrrole-2,5-dione (**9h**).

Compound **10b** was obtained as above for **10a** from **6e** and *N*-(1-piperazinomethylcarbonyl)pyrrolidine and purified on silica. Elution with dichloromethane/ethyl acetate/methanol (1:1:0.2) afforded **10b** as an orange solid (40%); mp 158-159°; ir (potassium bromide)  $\nu$  3382, 3058, 2934, 1715, 1632  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.19-1.37 (m, 2H), 1.75-1.51 (m, 4H); 2.01-1.76 (m, 4H), 2.50 (t,  $J = 7.0$  Hz, 4H), 2.59-2.85 (m, 4H), 2.89, 2.96 (2 s, 2H), 3.05, 3.17 (2 s, 6H), 3.31-3.85 (m, 8H), 7.00-7.21 (m, 6H), 7.27-7.46 (m, 2H), 8.33, 10.05 (2 s, 2H); fd-ms:  $m/z$  (%): 795 (100) [ $\text{M}^+$ ]; 793 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{41}\text{H}_{44}\text{BrN}_7\text{O}_5$  (794.74): C, 61.96; H, 5.58; N, 12.34. Found: C, 61.65; H, 6.10; N, 12.34.

Compound **9h** was also obtained and purified on silica. Further elution with dichloromethane/ethyl acetate/methanol (1:1:0.2) afforded **9h** as an orange solid (30%); mp 185° (dec); ir (potassium bromide)  $\nu$  3272, 2932-2875, 1696, 1632, 1613  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.21-1.39 (m, 2H), 1.51-2.10 (m, 12H), 2.40-2.77 (m, 12H), 3.03, 3.05 (2 s, 6H), 3.85-2.28 (m, 4H), 3.29-3.52 (m, 8H), 3.66 (br s, 8H), 6.91-7.04 (m, 4H), 7.06-7.39 (m, 4H), 9.43 (br s, 2H); fd-ms:  $m/z$  (%) 910 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{51}\text{H}_{62}\text{N}_{10}\text{O}_6 \times 1$  ethyl acetate (999.21): C, 66.11; H, 7.06; N, 14.02. Found: C, 65.87; H, 7.29; N, 14.07.

3-Bromo-1-methyl-4-{2-[5-(3-[1-methyl-4-(1-[4-piperidino-piperidinyl])-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-2,5-dihydro-1H-pyrrole-2,5-dione (**10c**) and 1-Methyl-4-{2-[5-(3-[1-methyl-4-(1-[4-piperidino-piperidinyl])-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-3-[1-(4-piperidinopiperidinyl)]-2,5-dihydro-1H-pyrrole-2,5-dione (**9i**).

Compound **10c** was obtained as above for **10a** from **6e** and 4-(1-piperidino)piperidine and was purified on silica. Elution with dichloromethane/ethyl acetate/methanol (1:1:0.5) afforded **10c** as an orange solid (38%); mp 162-164°, ir (potassium bromide):  $\nu$  3382, 3224, 2936-2859, 1713, 1694, 1632, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.20-1.41 (m, 2H), 1.41-1.79 (m, 10H), 1.80-2.02 (m, 4H), 2.54-2.97 (m, 9H), 3.04, 3.17 (2 s, 6H), 4.06-4.18 (m, 2H), 4.63-4.79 (m, 2H Pip.), 7.01-7.10 (m, 4H), 7.12-7.79 (m, 4H), 8.55 (s, 1H), 10.20 (br s, 1H); fd-ms:  $m/z$  (%) 764 (100) [ $\text{M}^+$ ], 766 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{41}\text{H}_{45}\text{BrN}_6\text{O}_4$  (765.74): C, 64.31; H, 5.92; N, 10.98. Found: C, 64.67; H, 6.19; N, 10.67.

Compound **9i** was also obtained and was purified on silica. Continued elution with dichloromethane/ethyl acetate/methanol (1:1:0.5) afforded **9i** as an orange solid (20%); mp 230-232°; ir (potassium bromide):  $\nu$  3423, 2938-2859, 1694, 1634, 1611  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform):  $\delta$  1.17-2.20 (m, 54H), 2.51-3.10 (m, 24H), 3.03, 3.04 (2 s, 6H), 4.07-4.23 (m, 2H), 4.51-4.75 (m, 2H), 6.95-7.11 (m, 4H), 7.13-7.28 (m, 4H), 8.98, 9.29 (2 s, 2H); fd-ms:  $m/z$  (%) 852 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{51}\text{H}_{64}\text{N}_8\text{O}_4 \times 1$  ethyl acetate (941.21): C, 70.18; H, 7.71; N, 11.91. Found: C, 69.86; H, 7.52; N, 11.69.

Methyl 1-{4-[2-(5-[3-(4-bromo-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl)-1H-2-indolyl]pentyl)-1H-3-indolyl]-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrole}-(2*S*)-2-pyrrolidinedicarboxylate (**10d**) and Methyl 1-{4-[2-(5-[3-(4-[2-methoxycarbonyl-(2*S*)-1-pyrrolidinyl]-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl)-1H-2-indolyl]pentyl)-1H-3-indolyl]-1-methyl-2,5-dioxo-2,5-dihydro-1H-3-pyrrole}-(2*S*)-2-pyrrolidinedicarboxylate (**9j**).

Compound **10d** was prepared as above for **10a** from **6f** and ethyl 2-pyrrolidinedicarboxylate. Column chromatography (dichloromethane/ethyl acetate 1:1) of the crude product afforded **10d** as red crystals (2%); mp 151-155°; ir (potassium bromide):  $\nu$  3381, 2948, 1748, 1713  $\text{cm}^{-1}$ ;  $[\alpha]_{\text{D}}^{20} = -56.0^\circ$  ( $c = 1.02$ , MeOH);  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.21-1.38 (m, 2H), 1.45-1.90 (m, 7H), 2.03-2.25 (m, 1H), 2.54-2.80 (m, 4H), 2.81-2.91 (m, 3H), 2.93-3.22 (m, 5H), 3.39-3.77 (m, 3H), 4.75-5.19 (m, 1H), 6.87-7.41 (m, 8H), 11.00-11.12 (m, 1H), 11.61-11.72 (m, 1H); fab-ms:  $m/z$  727 [ $\text{M}+\text{H}$ ] $^+$ .

*Anal.* Calcd. for  $\text{C}_{37}\text{H}_{36}\text{BrN}_5\text{O}_6$  (726.63): C, 61.16; H, 4.99; N, 9.64. Found: C, 61.20; H, 5.30; N, 9.31.

Continued column chromatography (dichloromethane/ethyl acetate 1:1) of the crude product afforded **9j** as red crystals (2%); mp 153-155°; ir (potassium bromide):  $\nu$  3384 (N-H); 2950, 1748, 1696  $\text{cm}^{-1}$ ;  $[\alpha]_{\text{D}}^{20} = -58.3^\circ$  ( $c = 0.98$ , methanol);  $^1\text{H}$  nmr (250 MHz, dimethyl- $d_6$ -sulfoxide):  $\delta$  1.19-1.37 (m, 2H), 1.45-1.92 (m, 10H), 1.99-2.27 (m, 2H), 2.54-2.80 (m, 4H), 2.82-3.21 (m, 10H), 3.39-3.79 (m, 6H), 4.70-5.32 (m, 2H), 6.86-7.07 (m, 4H), 7.14-7.36 (m, 4H), 10.98-11.10 (m, 2H); fab-ms:  $m/z$  775 [ $\text{M}+\text{H}$ ] $^+$ .

*Anal.* Calcd. for  $\text{C}_{43}\text{H}_{46}\text{N}_6\text{O}_8$  (774.88): C, 66.65; H, 5.98; N, 10.85. Found: C, 66.33; H, 6.25; N, 10.61.

3-[1-[4-(4-Hydroxyphenyl)ethylamino]]-1-methyl-4-{2-[5-(3-[1-methyl-4-bromo-2,5-dioxo-2,5-dihydro-1H-3-pyrrolyl]-1H-2-indolyl)pentyl]-1H-3-indolyl}-2,5-dihydro-1H-pyrrole-2,5-dione (**10e**).

Compound **10e** was obtained as above for **10a** from **6f** and tyramine and was purified on silica. Elution with dichloromethane/ethyl acetate (4:0.5) afforded **10e** as an orange solid (18%); mp 120-122°; ir (potassium bromide):  $\nu$  3370, 3060, 2932-2857, 1707, 1655, 1616  $\text{cm}^{-1}$ ;  $^1\text{H}$  nmr (250 MHz, deuteriochloroform)  $\delta$  1.21-1.37 (m, 2H); 1.45-1.73 (m, 4H), 2.43 (t,  $J = 7.2$  Hz, 2H), 2.57-2.75 (m, 4H), 3.08, 3.15 (2 s, 6H), 3.03-3.23 (m, 2H), 5.12 (s, 1H), 5.38 (t,  $J = 6.5$  Hz, 1H), 6.56, 6.46 (AA'BB',  $J = 8.5$  Hz, 4H), 6.98-7.27 (m, 6H), 7.31-7.48 (m, 2H), 8.17, 9.14 (2 s, 2H); fd-ms:  $m/z$  (%) 733 (100) [ $\text{M}^+$ ], 735 (100) [ $\text{M}^+$ ].

*Anal.* Calcd. for  $\text{C}_{39}\text{H}_{36}\text{BrN}_5\text{O}_5 \times 1$  ethyl acetate (822.74): C, 62.77; H, 5.39; N, 8.51. Found: C, 62.77; H, 5.23; N, 8.89.

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