Tetrahedron Vol 49, No 46, pp 10739-10748, 1993
Printed in Great Britain

0040-4020/93 $6 00+ 00

Bridged Octahomotetraoxacalix[4]arenes from Acyclic Precursors

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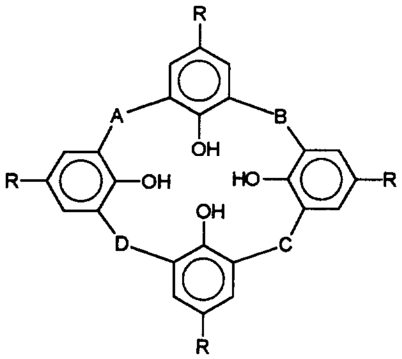
(*Received in UK* 28 *July* 1993, *accepted* 17 *September* 1993)

Abstract Diols and tetraols obtained by alkylation of the phenolic function of 2,6-bis(hydroxymethyl)-4-methylphenol with mono- or bifunctional electrophiles, when reacted with the corresponding polybromides in dioxane and heterogeneous KOH or NaOH, gave monocyclic, bicyclic or tricyclic ether derivatives of *p*-methyloctahomotetraoxacalix[4]arene in fairly good yields Template effects of the alkali metal ion probably operate in the formation of these macropolycyclic polyethers The obtained tricyclic compounds are flattened, due to the shortness of the bridging units, but the method allows in principle the synthesis of compounds with large cavities

The $[1_n]$metacyclophanes known as calixarenes are among the most interesting families of host compounds and in the last fifteen years their chemistry has significantly developed [1,2] Most of the work has been performed on calix[4]arenes whose parent structures are easily available by single step procedures or can be obtained by stepwise synthesis in more special cases Actually the cavity of calix[4]arenes is rather small and bridge moieties or other special functionalizations in the upper or lower rim are often used with the aim at extending the contact surface with possible guests, the aromatic moiety being in the limit but a platform Due to these limitations several research groups involved in calixarene chemistry are presently turning to larger homologues, namely calix[5]arenes and calix[6]arenes, which seem to be more suitable hosts for organic species Unfortunately these homologues are more conformationally flexible than calix[4]arenes and their selective functionalization is in general more difficult due to the increased number of phenolic rings,[3] moreover the basic structure of calix[5]arenes cannot be easily obtained by direct procedures Following an alternative strategy, we are presently investigating cyclophanic structures in which several features of calix[4]arenes are kept up but a larger cavity is obtained by spacing the aromatic nuclei with groups larger than CH_2 in one or more sites We report here on the preparation of macrocyclic and macropolycyclic ethers which are formally derived from the family of calix[4]arene analogues with the whole set of CH_2 groups replaced by CH_2OCH_2 groups, which can be called octahomotetraoxacalix[4]arenes according to the current nomenclature system introduced by Gutsche [1b,4a] A few homooxacalixarenes are known, namely compounds **2**, **3**, **4** and the homologue of **4** with three aromatic nuclei (R = *p*-methyl and/or *p-tert*-butyl) [4,1b] All these compounds have been obtained by thermal dehydration of bis(hydroxymethylated)phenols and in a very few cases the phenolic functions of homooxacalixarenes have been alkylated [5,4b]



1 $A = B = C = D = CH_2$
calix[4]arene

2 $A = B = C = CH_2$, $D = CH_2OCH_2$
dihomooxacalix[4]arene

3 $A = C = CH_2$, $B = D = CH_2OCH_2$
tetrahomodioxacalix[4]arene

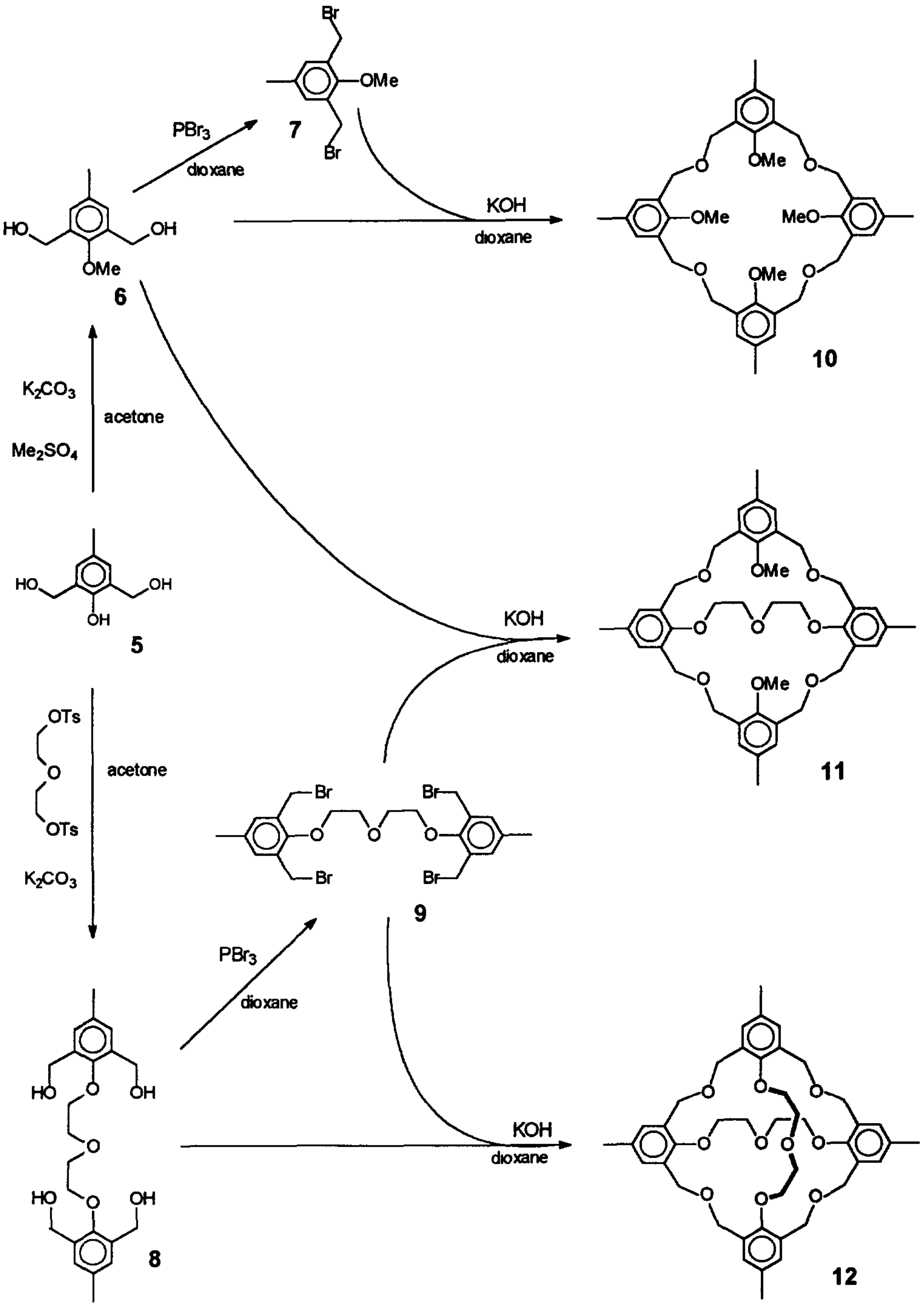
4 $A = B = C = D = CH_2OCH_2$
octahomotetraoxacalix[4]arene

RESULTS

At variance with the strategy followed in the preparation of the numerous known derivatives of calixarenes[1] and of the very few reported derivatives of homooxacalixarenes,[5,4b] we first alkylated the phenolic function of a bis(hydroxymethyl)phenol and then closed the calix[4]arene-like annulus by a Williamson reaction between polyols and the corresponding polybromides By the simple synthetic approach shown in Scheme 1 monocyclic, bicyclic, and tricyclic polyethers of the same octahomotetraoxacalix[4]arene system could be obtained According to the same strategy, alkylation of **5** with 1,5-dibromopentane and with 1,2-bis(bromomethyl)benzene yielded tetraols **13** and **14**, which when reacted with the corresponding tetrabromides **15** and **16**, formed the macrotricyclic polyethers **17** and **18**, respectively The preparation of the tetraols was carried out with K_2CO_3 in boiling acetone, recrystallized products being obtained in 36 to 60 % yield, while the tetrabromides were obtained in 76 to 86% yield by treatment with PBr_3 in dioxane The crucial Williamson reaction between polyols and polybromides which gives the final products could be run in very favourable conditions, namely with powdered KOH or NaOH in dioxane In preliminary experiments the yield of **10** was checked not to be significantly improved by the use of NaH in THF The use of powdered alkali metal hydroxides in apolar solvents to promote the alkylation of alcoholic functions is well documented with polyethylene glycols,[6] for which an increased acidity can be expected due to the occurrence of multichelated ion pairing [7,8,6b,6c] The structural similarity between our polyols and polyethylene glycols suggested heterogeneous metal hydroxides could be effective also in the present case The yields of the cyclization reactions are reported in Table 1 The cyclic products were purified by flash chromatography with $CHCl_3$ as eluent, repeated elution being needed in some cases to isolate all the product in pure form In no case pure monodisperse products other than the expected octahomotetraoxacalix[4]arene compounds could be isolated

Although an optimisation of the reaction conditions has not been carried out, the yields in Table 1 allow several comparisons to be made With KOH as the heterogeneous base and 1 h addition time the yields for the various macropolycyclic compounds were **10** $\approx$ **11** $\approx$ **12** > **18** > **17**, and about the same yield was obtained for **10**

Scheme 1


PBr3
dioxane
Br
OMe
Br
7
HO
OH
OMe
6
KOH
dioxane
OMe
O
O
OMe
MeO
O
O
OMe
10
K2CO3
acetone
Me2SO4
HO
OH
OH
5
KOH
dioxane
OMe
O
O
O
O
O
O
O
OMe
11
OTs
O
OTs
acetone
K2CO3
Br
Br
O
O
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9
PBr3
dioxane
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HO
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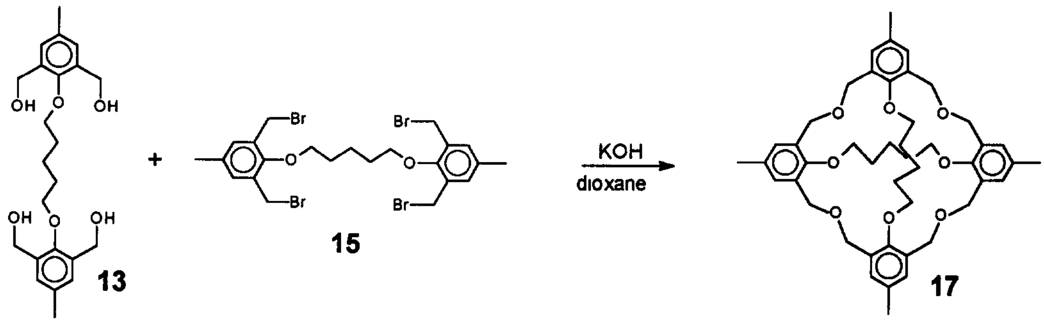
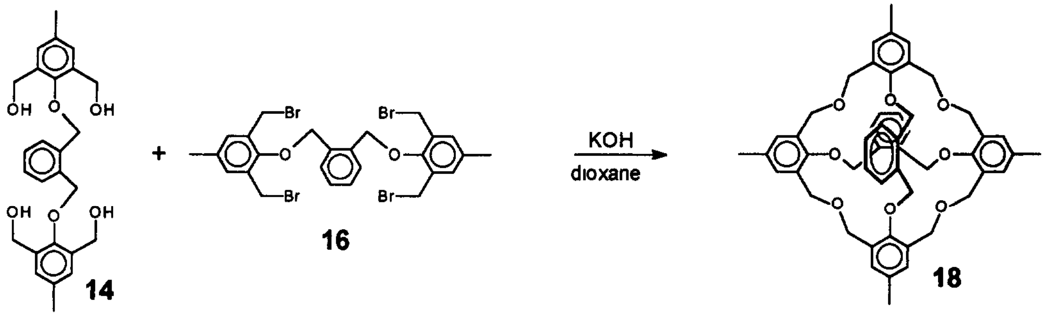
8
KOH
dioxane
12





when the reaction was carried out in NaH/THF For the same addition time the yields of compounds **12** and **18** were distinctly higher with NaOH than with KOH as the base Longer addition times, as used in the case of compounds **12**, increased the yields both with KOH and with NaOH, but the effect does not appear to be very large and a fairly good yield was obtained also in the batch-wise experiment (13 %)

In the ^{1}H NMR spectra the eight methylene groups of the octahomotetraoxacalix[4]arene ring showed one singlet for the monocyclic compound **10** and two singlets for the bicyclic compound **11**, thus indicating that the aromatic groups easily rotate through the annulus and that the bridge can easily cross the mean plane of the structure On the other hand these eight methylene groups give rise to an AB system in the spectra of the tricyclic compounds **12**, **17**, and **18**, namely a bridge cannot cross the other one and make equivalent the two protons in a set Conformational changes in the bridges of the tricyclic compounds **12**, **17**, and **18** appear to be fast according to the NMR spectra recorded at room temperature

Preliminary investigations on the complexing ability of the obtained polyethers towards alkali metal ions have been carried out in MeOH solution by monitoring the changes in the UV spectrum of the ligand on increasing metal ion concentration [8] Only for compound **12** the observed changes allowed an association constant to be determined ($K = 2\ 5\times10^2\ M^{-1}$ with KBr at 25 0 °C)

Table 1 Yields of Macropolycyclic Ether Derivatives of *p*-Methyloctahomotetraoxacalix[4]arene with Heterogeneous Base in Dioxane at 65 °C [a]

compound	KOH	NaOH
10 [b]	19 (1)	
11	21 (1)	
12	19 (1) 22 (4)	23 (1) 28 (4) 13 (-)[c]
17	7 (1)	
18	13 (1)	18 (1)

a) Addition time of the precursors in parentheses (h) Further reaction time 7 h

b) The yield was 20% with NaH as the base in refluxing THF , addition and further reaction times 1 +7 h

c) Batch-wise experiment at 0 03 M concentration of the two reagents

DISCUSSION

The yields reported in Table 1 are pretty good when allowance is made for the several inter- and intramolecular steps involved, the moderate dilution, and the comfortable base-solvent system used These yields should be compared with those of other reactions of formation of macropolycyclic polyethers from acyclic alcoholic precursors with NaH in THF For instance, on reacting diethylene glycol and compounds quite similar to **9** or **16** with NaH in THF under high dilution conditions, Stoddart et al [9] reported 27 and 31 % yields, respectively, for the obtained bicyclic products Actually macropolycyclic polyethers are seldom prepared directly from acyclic alcoholic precursors [10]

The octahomotetraoxacalix[4]arene annulus of the monocyclic, bicyclic or tricyclic compounds is formed from acyclic precursors by linking 4, 3, or 2 molecular fragments, respectively After the first intermolecular reaction three further alkylation steps are needed two inter- and one intramolecular reactions for monocyclic, one inter- and two intramolecular reactions for bicyclic, and three intramolecular reactions for tricyclic compounds In the reaction of **6** with **7** a ring closure could in principle occur after the first intermolecular step, but we had no evidence supporting the formation of the strained [3_2]metacyclophane system (tetrahomodioxacalix[2]arene according to the presently used nomenclature) Clearly further intermolecular reactions take place and the intermediate with four aromatic rings can cyclize to the unstrained macrocycle **10**

Higher cyclooligomers are probably formed but we did not isolate any monodisperse compound Interestingly in the related cases of thia-analogues[11] and of pyridocrowns[12] the $[3_2]$metacyclophanes are well known to be formed under high dilution conditions Also in the case of bicyclic and tricyclic compounds the strain of the rings with two aromatic nuclei should be the factor allowing the compounds with the octahomotetraoxacalix[4]arene ring to be easily formed It is worth noting that not only molecular mass, but also NMR spectra cannot *a priori* rule out structures with the strained $[3_2]$metacyclophane rings in the case of bicyclic and tricyclic systems, namely the same multiplicity of the signals is expected as for octahomotetraoxacalix[4]arene systems An X-ray investigation[13] on the product obtained from **8** and **9** unambiguously confirmed it has the structure represented in **12** and not the isomeric one with two tetrahomodioxacalix[2]arene systems connected by two dioxyethylene bridges The ambiguity holds in principle also for the bicyclic and the other tricyclic structures, but again these structures appear unlikely to be formed because of strain

The addition time affects the yields but the dependence appears to be a smooth one and a fairly good yield of compound **12** (13%) is obtained even in the batch-wise experiment at 0 03 M concentration of the tetrafunctional reagents On extrapolating to polycyclic systems our quantitative treatment of effective molarities and template effects in the formation of monocyclic compounds,[14 8,15] we suspect that template effects of the base counterion operate The higher yields obtained with NaOH than with KOH might also be indicative of a specific action of the cation on the ring closure steps A further support to this hypothesis can be found on comparing the yield of **12** with the yield of **17** which lacks the oxygen atoms in the middle of the bridges Actually compound **12** does not appear to be a strong complexing agent for alkali metal ions (at least in the tested MeOH solution), but significant effects in preparative conditions can be accounted for by relatively small differences in free energy We are aware of the fact that the present system, though simple from a preparative point of view, is a quite complex one for a quantitative interpretation of the yields, as several factors must be reckoned with Most importantly the cation not only can selectively influence the rate of one or more cyclization steps with respect to the rate of the competing intermolecular processes, in which strictly speaking consists the kinetic template effect, but also can affect the position of the various heterogeneous acid base preequilibria and the extent of side reactions other than Williamson alkylations These factors can play a role for instance in the relative effectiveness of NaOH and KOH bases The extension to different bridging groups and to different reaction conditions is planned both to obtain other interesting structures and to get a deeper insight into template and/or other effects which determine the yields

The prepared tricyclic structures do not appear (on inspection of CPK models) to be affected by significant strains, though some small effects can be present and possibly play a role in the observed yields The presence of the two bridges forces the aromatic nuclei to adopt structures which correspond to the 1,3 alternate conformations in calix[4]arenes, but due to the larger annulus and to the shortness of the bridges the structure of **12** and **17** is flattened, the CPK models looking like a pillow The structure of **18** is similar, apart from the aromatics in the bridges, for which both flattened and somewhat protruding arrangements are suggested by the molecular models At least for **12** and **17** sodium and potassium ions can apparently be accommodated within the cavity without severe strains, but the cavities do not appear to be significantly preorganized for complexation, and coordination with the oxygen atoms of both the $ArCH_2OCH_2Ar$ and the $OCH_2CH_2OCH_2CH_2O$ groups in compound **12** appears to be unlikely Systematic structural and complexation studies are planned, in particular on tricyclic compounds

CONCLUSIONS

We think that compounds with a somewhat enlarged cavity with respect to calix[4]arenes (besides homooxacalix[4]arenes homocalix[4]arenes,[11 16] homothiacalix[4]arenes,[11,17] homoazacalix[4]arenes[18] are known) can be useful structures for the complexation of organic guests, but the larger structures are also more conformationally mobile than calix[4]arenes, so that bridging is expected to be of fundamental importance to endow the structure with sufficient preorganisation[19,20] By the present approach as applied to octahomotetraoxacalix[4]arenes, 1,3 aromatic nuclei can be easily differentiated from 2,4 ones, both in the *para* substituent and in the alkoxy group In particular, when alkoxy groups link two aromatic nuclei in the precursors, also bicyclic and tricyclic structures have been obtained in a very few steps, in satisfactory yields, and under a strict control of the regiochemistry It is worth noting that three isomers (corresponding to *cone*, *1,2 alternate*, and *1,3 alternate* structures in the family of calix[4]arenes) should be expected to form if doubly bridged derivatives were to be synthesised from preformed octahomotetraoxacalix[4]arenes **4**

With such short bridges as those of compounds **12** , **17**, and **18** the molecule is rather flat and the cavity can hardly include metal ions without strain On increasing the length of the bridges an almost parallel arrangement of the 1 and 3, and of the 2 and 4 aromatic nuclei should be possible, and, at variance with the case of calix[4]arene compounds with the same bridging pattern,[21] large cavities should be available for an organic guest Work is in progress to tune the size and the shape of the cavity by changing the length and the rigidity of the bridging units

EXPERIMENTAL

Compound **5** (Aldrich), 1,5-dibromopentane (Janssen), 1,2-bis(bromomethyl)benzene (Fluka) were used as received Diethylene glycol ditosylate[22] and compound **6**[23] were prepared according to reported methods Dioxane was stirred for 3h with powdered KOH at 70 °C and filtered before use

Melting points are uncorrected Melting points of the final cyclic products could not be obtained under ordinary conditions, most compounds decomposing at high temperature On the other hand we checked in some cases that ^1H NMR spectra of products melted under vacuum did not show any alteration and we got melting points in sealed and evacuated capillary tubes, as previously reported by Gutsche[4a] for some homooxacalixarene compounds NMR spectra were recorded in $CDCl_3$ solution unless otherwise indicated ^1H NMR spectra of the polyols and of the polybromides were recorded on a Bruker WP-80 (80 MHz) instrument, while ^1H and ^{13}C NMR spectra of the final cyclic compounds were taken on either a Varian XL 300 or a Bruker AC 300 (300 MHz for ^1H) instrument Column chromatography was carried out on 230-400 mesh silica gel (Merck) The addition of the reagents in cyclization reactions was carried out with a perfusor

Tetraols Tetraols were prepared by stirring compound **5** (0 164 mol) with the bifunctional alkylating agent (0 082 mol) and anhydrous K_2CO_3 (0 328 mol) in boiling acetone (200 ml) under a nitrogen atmosphere for 4 days The low solubility of the obtained tetraols conditioned the purification procedures

Tetraol 8 The solvent was evaporated, the residue was extracted with $CHCl_3$-water and the $CHCl_3$ extracts were dried (Na_2SO_4) Solvent was removed under vacuum and the crude product was recrystallized from MeOH yield 36%, mp 118-120 °C Precipitation of the product was observed in some runs in $CHCl_3$

solution under the action of the dehydrating agent in these cases absolute EtOH was used to recover the product ^{1}H NMR, δ 7 10 (s, 4H, ArH), 4 68 (br s, 8H, $ArCH_2$), 3 80-4 25 (m, 8H, CH_2CH_2), 3 07 (br s, 4H, OH), 2 30 (s, 6H, CH_3) Anal Calcd for $C_{22}O_7H_{30}$ C, 65 01, H, 7 44 Found C, 64 72, H, 7 39

Tetraol 13 The residue obtained on removing acetone was ground in a mortar, treated with 7% NaOH under stirring, washed with water and dried by azeotropic distillation with EtOH The product was extracted with boiling absolute EtOH, the hot extracts were filtered and after partial evaporation deposited at room temperature the expected tetraol in 38% yield, mp 158 5-159 5 °C, ^{1}H NMR in CD_3SOCD_3, δ 7 11 (s, 4H, ArH), 4 95 (br t, J = 5 Hz, 4H, OH), 4 49 (br d, J = 5 Hz, 8H, $ArCH_2$), 3 75 (br t, 4 H, $ArOCH_2$), 2 25 (s, 6H, CH_3), 1 87-1 55 (m, 6H, $OCH_2\mathit{CH_2CH_2CH_2}$) Anal Calcd for $C_{23}H_{32}O_6$ C, 68 29, H, 7 97 Found C, 68 00, H, 8 05

Tetraol 14 Acetone was removed under vacuum and the ground residue was stirred with hot $CHCl_3$ The $CHCl_3$ extracts deposited on standing the product in 60% yield, mp 164-168 °C Further purification was carried out by recrystallization from benzene-EtOH mp 172 5-173 °C ^{1}H NMR in CD_3SOCD_3, δ 7 70-7 30 (m, 4H, ArH), 7 14 (s, 4H, ArH), 5 10-4 87 (m, 8H, OH superposed to $ArCH_2OAr$), 4 46 (br d, J = 5 Hz, 8H, $Ar\mathit{CH_2}OH$), 2 28 (s, 6H, CH_3) Anal Calcd for $C_{26}H_{30}O_6$ C, 71 21, H, 6 90 Found C, 71 00, H, 6 80

Tetrabromides To a solution stirred at room temperature of 22 5 mmol of tetraol in 100 ml of dioxane was added over a 30 min period a solution of PBr_3 (50 mmol) in 10 ml of dioxane After 20 h 15 ml of H_2O and 200 ml of $CHCl_3$ were added and the mixture was stirred for 5 min, then neutralised with saturated $NaHCO_3$ The $CHCl_3$ extracts were dried (Na_2SO_4) and after removal of the solvent the residue was recrystallized from acetone

Tetrabromide 9 86% yield, mp 148 5 - 150 °C, ^{1}H NMR, δ 7 17 (s, 4H, ArH), 4 62 (s, 8H, CH_2Br), 4 40 - 3 96 (m, 8H, CH_2CH_2), 2 28 (s, 6H, CH_3) Anal Calcd for $C_{12}H_{26}Br_4O_3$ C, 40 15, H, 3 98 Found C, 39 97, H, 3 96

Tetrabromide 15 76% yield, mp 124 -126 °C, ^{1}H NMR, δ 7 18 (s, 4H, ArH), 4 54 (s, 8H, CH_2Br), 4 15 (t, J = 5 5 Hz, 4H, OCH_2), 2 30 (s, 6H, CH_3), 2 11 - 1 85 (m, 6H, $OCH_2\mathit{CH_2CH_2CH_2}$) Anal Calcd for $\mathit{C_{23}H_{28}Br_4O_2}$ C, 42 10, H, 4 30 Found C, 41 73, H, 4 30

Tetrabromide 16 77% yield, mp 152 - 154 °C, ^{1}H NMR, δ 7 82 - 7 38 (m, 4H, ArH), 7 19 (s, 4H, ArH), 5 38 (s, 4H, $ArCH_2O$), 4 47 (s, 8H, CH_2Br), 2 31 (s, 6H, CH_3) Anal Calcd for $C_{26}H_{22}Br_4O_2$ 45 52, H, 3 23 Found C, 45 37, H, 3 77

Dibromide 7 [23] The same preparation procedure as described for tetrabromides was followed 78 % yield, mp 78-79 °C

_p_-Methyloctahomotetraoxacalix[4]arenes.

Monocyclic compound 10 364 mg (2 00 mmol) of compound **6** and 616 mg (2 00 mmol) of compound **7** in 20 ml of dioxane were added over a 1 h period to a stirred suspension of powdered KOH (11 mmol) in 10 ml of dioxane heated at 65 °C under a nitrogen atmosphere The mixture was heated and stirred for additional 7 h The solvent was removed and after a water-$CHCl_3$ work-up the product was purified by flash chromatography with $CHCl_3$ eluent to yield 124 mg (19%) of the expected product which for analytical purposes was sublimated at 205 °C under vacuum (0 02 mm Hg) mp 220-223 °C, ^{1}H NMR, δ 7 18 (s, 8H, ArH), 4 49 (s, 16H, CH_2), 3 39 (s, 12H, OCH_3), 2 30 (s, 12H, $ArCH_3$), ^{13}C NMR δ 155 3, 133 3, 131 3, 130 8, 66 9, 62 5, 20 8, MS (EI) 657 (M^+) Anal Calcd for $C_{40}H_{48}O_8$ C, 73 14, H, 7 36 Found C, 72 89, H, 7 16

Bicyclic compound 11 364 mg (2 00 mmol) of compound **6** and 658 mg (1 00 mmol) of compound **9** were reacted as described for compound **10** Chromatography yielded 147 mg (21%) of **11**, mp 214-216 °C (from CH_2ClCH_2Cl) , ^{1}H NMR δ 7 23 (s, 4H, ArH), 7 21 (s, 4H, ArH), 4 59 (s, 8H, $ArCH_2$), 4 44 (s, 8H, $ArCH_2$), 3 56 (t, *J* = 5 2 Hz, 4H, $ArOCH_2$) partly superposed to 3 54 (s, 6H, OCH_3), 3 24 (t, *J* = 5 2 Hz, 4H, $ArOCH_2CH_2$), 2 35 (s, 6H, $ArCH_3$), 2 34 (s, 6H, $ArCH_3$), ^{13}C NMR δ 155 4, 153 9, 133 6, 133 3, 131 4, 131 1, 130 9, 130 8, 73 9, 67 8, 66 8, 66 3, 62 7, 20 84, 20 79, MS (FAB) 700 (M^++1) Anal Calcd for $C_{42}H_{50}O_9$ 72 18, H, 7 21 Found C, 72 37, H, 7 51

Tricyclic compound 12 406 mg of compound **8** (1 00 mmol) and 658 mg (1 00 mmol) of compound **9** were reacted as described for compound **10**, column chromatography yielded compound **12**, 140 mg (19%), mp 245-247 (from benzene), ^{1}H NMR δ 7 27 (s, 8H, ArH), 4 80 (d, *J* = 12 3 Hz, 8H, ArC*H*HO), 4 26 (d, *J* = 12 3 Hz, 8H, ArCH*H*O), 3 65 (t, *J* = 5 5 Hz, 8H, $ArOCH_2$), 3 35 (t, *J* = 5 5 Hz, 8H, CH_2O), 2 39 (s, 12H, CH_3), ^{13}C NMR δ 154 1, 133 5, 131 2, 131 0, 73 4, 68 2, 66 0, 20 9, MS (EI) 741 (M^+) Anal Calcd for $C_{44}H_{52}O_{10}$ C, 71 33, H 7 07 Found C 71 22, H 7 13

See Table 1 for yields in different reaction conditions

Tricyclic compound 17 404 mg (1 00 mmol) of compound **13** and 656 mg (1 00 mmol) of compound **15** were reacted as reported for compound **10**, column chromatography yielded compound **17** 52 mg (7%), mp 238-240 °C (from benzene-hexane), ^{1}H NMR δ 7 23 (s, 8H, ArH), 4 82 (d, *J*=11 6 Hz, 8H, ArC*H*HO), 4 18 (d, *J*=11 6 Hz, 8H, ArCH*H*O), 3 54 (t, *J* = 6 8 Hz, 8H, $ArOCH_2$), 2 36 (s, 12H, CH_3), 1 29 (quin, *J* = 7 0 Hz, 8H, OCH_2CH_2), 0 93 (quin, *J* = 7 0 Hz, 4H, $OCH_2CH_2CH_2$), ^{13}C NMR δ 154 5, 133 0, 131 6, 131 0, 75 8, 66 6, 28 5, 22 3, 20 9, MS (FAB) 736 (M^+) Anal Calcd for $C_{46}C_{56}O_8$ C, 74 96, H, 7 66 Found C, 74 92, H, 7 46

Tricyclic compound 18 434 mg (1 00 mmol) of compound **14** and 686 mg (1 00 mmol) of compound **15** were reacted as reported for compound **10**, column chromatography yielded compound **18** 148 mg (18%), mp 312-314 °C (from benzene), ^{1}H NMR δ 7 19 (s, 8H, ArH), 7 17 (s, 8H, ArH), 4 80 (s, 8H, $ArCH_2OAr$), 4 53 (d, 8H, *J* = 12 0 Hz, ArC*H*HO), 3 99 (d, 8H, *J* = 12 0 Hz, ArCH*H*O), 2 34 (s, 12H, CH_3), ^{13}C NMR δ 154 5,135 3, 133 7, 131 8, 131 4, 127 49, 127 45, 74 1, 65 9, 20 8, MS (FAB) 805 (M^+) Anal Calcd for $C_{52}H_{52}O_8$ C, 77 59, H, 6 51 Found C, 77 37, H, 6 48

See Table 1 for yields in different reaction conditions

Complexation experiments Preliminary complexation experiments with alkali metal ions were carried out by the technique we previously reported [8] The changes in the absorbance at 280 nm were followed for a 6 0x10^{-5} M solution of **12** in MeOH at 25 0 °C on addition of known amounts of a 0 0100 M solution of KBr From the least squares treatment the value of the association constant was obtained $K = 2\ 5\times10^2\ M^{-1}$, corr coeff 0 992 The changes in the absorbance for the other ligand-cation pairs were too small for a quantitative treatment

ACKNOWLEDGEMENTS

Financial support by MURST is acknowledged We are grateful to Dr L Petrilli and Mr F Dianetti of the *Servizio Microanalisi del CNR, Area della Ricerca di Roma*, for providing elemental analytical data, and to Mr G D'Arcangelo, *Universita di Tor Vergata, Roma*, for FAB-MS experiments

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