quantitative yield.⁸ Nmr analysis of the coupled sulfone revealed lack of aliphatic methyl resonance, a consequence of coupling at the γ position and no terminal vinyl resonance. The new sulfone was reduced (Li-EtNH₂, -78°, 30 min) and the product chromatographed (hexane-ether, 10:1) on silica gel to yield pure ketal 14 in 82% overall yield from sulfone 12. Nmr analysis of 14 revealed an olefinic proton at δ 5.00 (t, J = 6.5 Hz), ketal absorption at 3.78 (m, 4 H), two olefinic methyl resonances (1.58 and 1.65), and a saturated methyl resonance at 1.18 (5, 3 H). Deketalization [acetic acid-water (3:7), 85°, 1.5 hr] produced a 97% yield of ketone 15 which was methylenated with methylene triphenylphosphorane in DMSO⁹ affording sesquifenchene identical by nmr, ir, glc, and tlc with a sample kindly provided by Professor Bessière-Chrétien and Dr. C. Grison. The nmr spectrum of synthetic 3 displayed a sharp singlet due to the C-8 methyl at δ 0.96, two broadened peaks due to C=C(CH₃)₂ at 1.60 and 1.67, two methylene protons $(=CH_2)$ at 4.58 and 4.77, and one olefinic proton at 5.05 (broadened triplet), in addition to a complex series of peaks in the region 1-2.5 due to remaining protons.

A particularly interesting feature of this synthesis of dlsesquifenchene is the efficiency and high stereoselectivity of the alkylation of ester 7 to provide C-8 methyl, C-9 functionalized bicyclo[2.2.1]heptane derivatives. In this connection, mention should be made of the possible utilization of 8 and derivatives thereof for construction of 12α -methylprostaglandins (e.g., 17) via a Corey-like intermediate (see Scheme I).



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Benzocrown Amino Ethers¹

Summary: Sixteen new multiheteromacrocycles are reported whose major rings contain O, NH, NTs, CH₂CH₂, and o- C₆H₄ units.

Sir: In the design of host molecules for particular complexing tasks, the placement of specific heteroatoms and rigid hydrocarbon groups in desired places in multiheteromacrocycles of different ring sizes provides an interesting synthetic challenge. Good synthetic methods for preparing benzocrown ethers,² crown ethers,³ and crown amino ethers⁴ without high dilution have been reported. Certain crown amino ethers have been synthesized with high dilution^{5a} or flow cell techniques,^{5b} and several benzo-15crown-5 and benzo-12-crown-4 amino ethers have been prepared from o-hydroxyaniline or o-phenylenediamine and appropriate dichloro polyethers.⁶ We report here simple syntheses of the listed benzocrown amino ethers and their derivatives.7

Preparation of 5, 6, and 9 from 1-4 involved potassium carbonate in dimethylformamide (DMF) at reflux for 5-16 hr.8 Reductions of 6 and 9 with hydrazine-palladium-carbon in ethanol gave 7 and 10, respectively. Tosyl or mesyl





chloride in pyridine sulfonated the amines. The important ring-closing steps involved either phenoxides² or sulfonylanilides^{4,9} with a variety of base-solvent combinations, such as K_2CO_3 -DMF at 80° for 12 hr (for 12, 16, 18, or 20) or KOC(CH₃)₃-(CH₃)₃COH at 82° for 24 hr (for 14). The yield of 16 was reduced by production of 22 as a competing product, and by the need for chromatographic separation. In these and other ring closures, guanidine in tertamyl alcohol at 100° gave poorer yields of monomers mixed with significant amounts of cyclic oligomers. Yields of 18membered rings decreased sharply with o-disulfonamidobenzene units in starting materials. For example, with pentaethylene glycol ditosylate (NaOH-BuOH at 118°, 24 hr), o-hydroxy-N-mesylanilide gave 32% 24 (mp 91-92°), but the dimesyl derivative of o-phenylenediamine gave after 64 hr only 5% 25 (mp 191-192°). Attempts to make dibenzo18-crown-6 compounds containing five or six sulfonamide groups failed. In DMF-NaH (80°, 24 hr.), tosylamide and the appropriate ditosylate gave 26. This ditosylate was prepared from catechol and the tetrahydropyranyl ether of monochlorodiethylene glycol as the primary starting materials. Mesylamides that led to crowded cycles gave higher yields than the corresponding tosylamides, but mesyl protecting groups were harder to remove. The best method^{7d} of removing these sulfonamide groups from nitrogen (e.g., from 14 or 18) involved glacial acetic acid saturated with HBr, 5 M in phenol at 80° for 2.5 hr. The small amounts of bromine introduced into the benzene rings of the crowns during this reaction were removed by reduction with hydrazine-palladium-carbon.

These cyclic amines serve as starting materials for syntheses of unusual polycyclic ligands. The conversion of 19 to 28 would be an example. Corey-Pauling-Koltun molecular models of 28 are assemblable only with all CH₂ groups



on one side, and all heteroatoms on the other, with their electron pairs "focused" on a single point. Attempts to make this and other host compounds from these multiheteromacrocycles are in progress.

References and Notes

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