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ONE STEP SYNTHESIS OF 3,8-METHANOAZA[10]ANNULENE DERIVATIVES[1]

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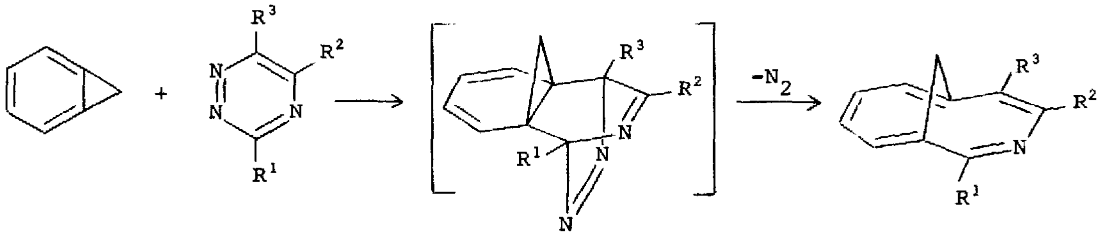
Abstract. The cycloaddition of benzocyclopropene with 1,2,4-triazines bearing one or more electron accepting substituents produces the corresponding substituted 3,8-methanoaza[10]annulene derivatives.

Recently the synthesis of some 10-alkoxy-3,8-methanoaza[10]annulenes was independently achieved by three groups of investigators[2]. Further study of these interesting substances was, however, hampered by the length of the synthetic routes and the low overall yields of the bridged heteroannulenes obtained thereby. This report describes a one step synthesis of the title compounds by a process which also has important implications for the preparation of other bridged annulenes.



(1) (2) (3) (4)

Inasmuch as benzocyclopropene was known[3] to participate in Diels-Alder type reactions with electron deficient dienes, it occurred to us to examine the reaction of this dieneophile with appropriately substituted 1,2,4-triazines[4]. Thus a 2:1 ethyl acetate-hexane solution of approximately equimolar amounts of benzocyclopropene[5] and tris(ethoxycarbonyl)-1,2,4-triazine (2a)[6] was heated at 55°, under nitrogen, for 26 h. to give the trisubstituted annulene (4a) as a stable yellow solid in ca. 70% yield (Table 1)[7]. The cyanoannulene (4b) was obtained in a similar manner from 3-cyano-5,6-bis(ethoxycarbonyl)-1,2,4-triazine (2b)[8]. The triazine di- and monocarboxylic acid esters (2c)[6] and (2d)[9] did not react with benzocyclopropene under the above conditions presumably because of the decreased reactivity of the esters and/or the modest dienophilicity of benzocyclopropene. The cycloadditions did, however, take place when the reactants were subjected to ultra high pressure[10]. In contrast, the analogous reaction between 1,2,4-triazine and benzocyclopropene has not yet been effected under any conditions.

The low field ^{1}H nmr spectral absorptions (Table 2) of the hydrogens about the 10-atom periphery, the upfield shift of the signals for the methano bridge protons, and the magnitude of the coupling constants for the perimeter and bridge protons in compounds (4a-d) are in accordance with those expected in molecules containing a delocalized π-system(see ref.2 and papers cited therein).

A full account of the synthesis, physical properties, and chemical transformations of the compounds described herein will be published in due course.

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Table 1. Conditions, Yields, Etc., for 3,8-Methanoaza[10]annulene Syntheses[a].

Cpd. No.	R^1	R^2	R^3	Pressure	Time,hr.	Yield	M.p. °C
(4a)	CO_2Et	CO_2Et	CO_2Et	1 atm.	26	67	108.5-.09.5[b]
(4b)	CN	CO_2Et	CO_2Et	1 atm.	17	70	97-98[b]
(4c)	H	CO_2Et	CO_2Et	15 kbar[c]	27	41	oil[d]
(4d)	CO_2Et	H	H	15 kbar[c]	27	33	oil[e]

[a] All reactions were conducted at 55°C.

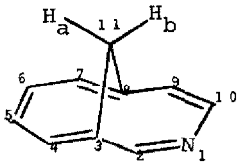
[b] Indefinitely stable at room temperature.

[c] Reaction effected in dichlormethane-hexane solution.

[d] Rapidly forms a hydrate, m.p. 107 - 109°C in moist air.

[e] Stable for ca. one month at 0°C.

Table 2. ^{1}H Nmr Spectra of 3,8-Methanoaza[10]annulenes[a].



Cpd.								H-11[b]						
No.	H-2	H-4	H-5	H-6	H-7	H-9	H-10	a	b	$J_{4,5}$	$J_{5,6}$	$J_{6,7}$	$J_{9,10}$	$J_{11a,b}$
(4a)		8.37	7.20	7.27	7.88			0.33	-0.33	10.8	8.92	10.02		9
(4b)[c]		7.9	7.4	7.4	7.9			0.50	-0.19	∿9	∿9	∿9		9.4
(4c)	8.37	7.58	7.10	7.24	7.81			0.18	-0.09	9.23	8.39	9.48		9.1
(4d)[d]		8.29	7.18	7.23	7.42	7.32	8.47	-0.11	-0.36	9.46	9.13	9.21	6.20	9

[a] Measured at 90 MHz, unless indicated otherwise, on a Bruker WH-90 Pulse Fourier Transform spectrometer, in $CDCl_3$ soln. containing TMS (intern.). Chemical shifts are δ values, coupling constants are in Hz (See also, refs. 11 and 12).

[b] $H\text{-}11_b$ coupled to H-4 and H-7 by ca. 1.5 Hz (see ref. 13).

[c] Spectra too complex for accurate simulation.

[d] Spectrum measured on a Nicolet 360 Pulse Fourier Transform Spectrometer at 360 MHz.

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