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CYCLIC SULFONES. VI.

4H-1,4-BENZOTHIAZINE-1,1-DIOXIDE

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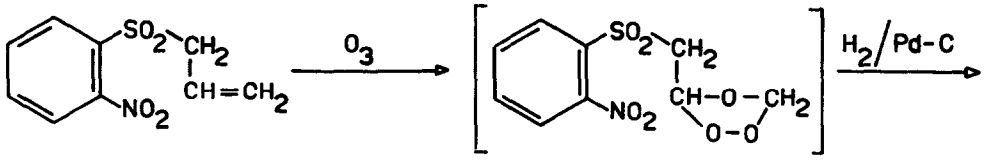
The present communication is mainly concerned with the behavior of 4H-1,4-benzothiazine-1,1-dioxide (II) and of 3-phenyl-4H-1,4-benzothiazine-1,1-dioxide (III)[1] toward a few reagents known to effect electrophilic substitution.

4H-1,4-Benzothiazine-1,1-dioxide (II), not yet described in the literature, has been prepared in 20% yield by ozonolysis of o.nitrophenyl allyl sulfone (I, m.p. 62-3°; obtained from sodium o.nitrobenzensulfinate and allyl bromide) followed by catalytic hydrogenation.



I

II

Compound (II) is very sensitive to cold mineral acids, but shows considerable thermal stability. The N.M.R. spectrum of (II) (in $DMSOd_6$ solution) shows that protons at position 2 and 3 give rise to an AB system (J = 9 cps): the former is present at 3.9 τ, while the latter is obscured by the aromatic protons present as a complex multiplet at 1.85-2.8 τ (see Table).

The electrophilic substitutions so far considered on 4H-1,4-benzothiazine-

1,1-dioxides (II) and (III) are: nitration with acetyl nitrate (HNO_3 + Ac_2O), bromination with bromine in $CHCl_3$ solution in the presence of $CaCO_3$, Vilsmeier formylation and Mannich reaction with morpholine and formaldehyde. In all cases substrates (II) and (III) undergo the electrophilic attack at the position 2 of the heterocycle; such a position clearly corresponds to the β position of the indole ring.

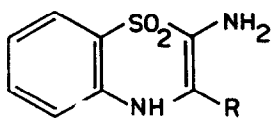
II: R=H; III: R=C_6H_5.

IIa: R=H; X=CHO.
IIb: R=H; X=Br.
IIc: R=H; X=CH_2-Morph.
IId: R=H; X=NO_2.

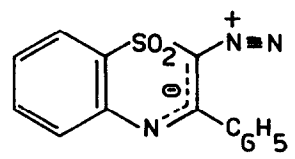
IIIa: R=C_6H_5; X=CHO.
IIIb: R=C_6H_5; X=Br.
IIIc: R=C_6H_5; X=CH_2-Morph.
IIId: R=C_6H_5; X=NO_2.

The assignement of the structures (II a-d) and (III a-d) to the reaction products is based on the absence in their N.M.R. spectra of the signal due to the proton at position 2 of the heterocycle: moreover in the spectra of benzothiazines (II a, b, d) the chemical shift of the proton at position 3 accounts for the deshielding effect of the corresponding substituent.

Nitro-derivatives (II d) and (III d) can be catalytically reduced to the corresponding amines (II e) and (III e). Analogously to 3-amino-2-phenyl-indole [2], 2-amino-3-phenyl-4H-1,4-benzothiazine-1,1-dioxide (III e) undergoes diazotization with $NaNO_2$ in acetic acid and HCl affording a diazo-betaine which has been identified as (III f), on the basis of analytical values and its I.R. spectrum ($\nu_{N\equiv N}$ 2115 cm^{-1}, no bands in the region of the NH stretching).



IIe: R=H; IIIe: R=C_6H_5.



IIIf

TABLE

Compound	m.p. °C	N.M.R. data (*)		
		Ring protons	substituent (**)	NH
II	195-6	1.85-2.8 (m,5H) aromatic+$H_{(3)}$; 3.9 (d,1H,J=9) $H_{(2)}$		-1 (s,1H)
III	276	2-2.8 (m,9H) aromatic; 3.7 (s,1H) $H_{(2)}$		-0.8 (s,1H)
IIa	266-7	1.75-2.6 (m,4H) aromatic; 1.65 (s,1H) $H_{(3)}$	0.4 (s,1H) CHO	-2.5 (bs,1H)
IIIa	277	1.7-2.5 (m,9H) aromatic;	0.7 (s,1H) CHO	-2 (bs,1H)
IIb	179-80	1.7-2.7 (m,5H) aromatic + $H_{(3)}$		-1.6 (d,1H)
IIIb	213-5	1.9-2.7 (m,9H) aromatic		-1.2 (bs,1H)
IIc	171-2	1.95-2.8 (m,5H) aromatic + $H_{(3)}$	6.6 (s,2H) CH_2; $\left.\begin{matrix}6.4\\7.5\end{matrix}\right\}$(m,8H)Morph.	-1.1 (bs,1H)
IIIc	170-1	2-2.8 (m,9H) aromatic	6.8 (s,2H) CH_2; $\left.\begin{matrix}6.5\\7.6\end{matrix}\right\}$(m,8H)Morph.	6.4 (s,1H)
IId	275-6	1.65-2.45 (m,4H) aromatic; 0.95 (s,1H) $H_{(3)}$		
IIId	280	1.8-2.6 (m) aromatic		
IIe	282	1.9-3.1 (m,5H) aromatic + $H_{(3)}$	6.35 (s,2H) NH_2	6.36 (s,1H)
IIIe	199	1.9-2.9 (m,9H) aromatic	6.4 (s,2H) NH_2	-0.1 (s,1H)
IIIf	138d	1.5-2.4 (m) aromatic		

(*) The spectra are recorded on a Perkin Elmer R 10 spectrometer in DMSO d_6 solution using TMS as internal standard. Chemical shifts are given in τ units.

(**) At position 2.

The physical and N.M.R. data of all the new compounds are summarized in the Table: all new products gave satisfactory analytical values.

The above results clearly indicate that the 4H-1,4-benzothiazine-1,1-dioxide system exhibits an indole-like aromatic behavior.

REFERENCES

(1) G.Pagani, Gazz.Chim.Ital., in press.

(2) S.Capuano, Gazz.Chim.Ital.,68, 733 (1938).