Azabenzocycloheptenones. Part IX.[1] A New Synthesis and some Reactions of the 5,6-Dihydrodibenz[*b*,*e*]azepin-11-one System

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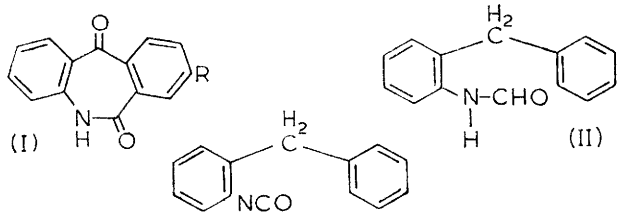
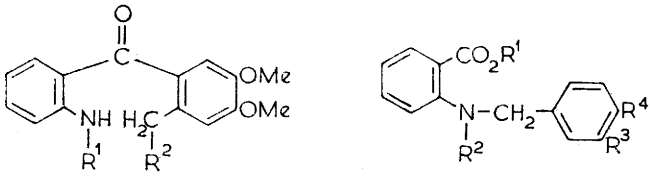
Cyclisation of *N*-(*m*-methoxybenzyl)-*N*-tosylanthraniloyl chloride with aluminium chloride at −20° yielded 5,6-dihydro-8-methoxy-5-tosyldibenz[*b*,*e*]azepine-11-one (70%), which could be detosylated with polyphosphoric acid. Some reactions of the dihydrodibenzazepinone system are described.

5,6-DIHYDRODIBENZ[*b*,*e*]AZEPINES have previously been made either from the so-called morphanthridinediones [2,3] [*e.g.* (I) obtained by ring-expansion of anthraquinones] or by cyclisation of compounds such as (II) [4] and (III) [5]; we have examined two other potential routes to derivatives with an 11-keto-group (VIII).

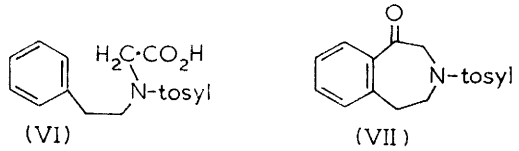


(I) (II) (III)

We first attempted to brominate certain 2-aminobenzophenones [*e.g.* (IV; R^1 = tosyl, R^2 = H)] in the hope that the products [*e.g.* (IV, R^1 = tosyl, R^2 = Br] might cyclise, perhaps spontaneously, to 5,6-dihydrodibenz[*b*,*e*]azepine derivatives. However, treatment with *N*-bromosuccinimide caused nuclear bromination of both the sulphonamide (IV; R^1 = tosyl, R^2 = H) and the base (IV; $R^1 = R^2$ = H); when excess of the reagent was employed, deep-coloured intractable products were found. Accordingly, we looked for an alternative method.

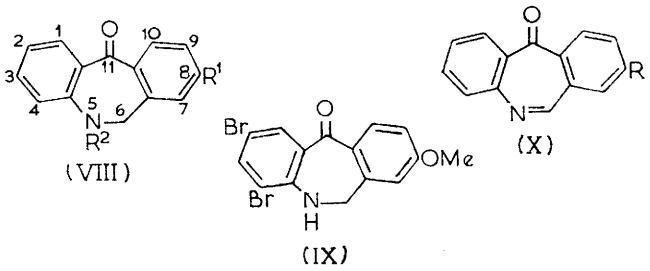


(IV) (V)



(VI) (VII)

N-Benzylanthranilic acid derivatives are reported [2,4] to be unsuitable substrates for cyclisation to 5,6-dihydrodibenz[*b*,*e*]azepin-11-ones, but our experiences with other systems,[1] particularly the tetrahydrobenz[*d*]-azepin-1-one [6] (VII) [obtained from the glycine (VII)], indicated that this route merited further exploration. The simplest member of this series, *N*-benzyl-*N*-tosylanthranilic acid (V; $R^1 = R^3 = R^4$ = H, R^2 = tosyl), was converted into the acid chloride and treated with anhydrous aluminium chloride in methylene dichloride at *ca.* −15° to give *N*-tosylanthranilic acid (>70%). However, the neutral fraction contained traces of a compound [7] $C_{21}H_{17}NO_3S$ which we believe to be 5,6-dihydro-*N*-tosyldibenz[*b*,*e*]azepin-11-one (VIII; R^1 = tosyl, R^2 = H) mainly on spectroscopic grounds (see Experimental section) including mass spectroscopy, which we have discussed elsewhere.[8] The mass spectrum shows an abundant $M - SO_2$ ion which relates this compound to benz[*f*]azepin-5-ones and tetrahydroquinolin-4-ones with a carbonyl group *ortho* to the *N*-tosyl linkage. Reduction with sodium borohydride gave the expected hydroxy-compound $C_{21}H_{19}NO_3S$, the n.m.r. spectrum (40 MHz) of which showed a quartet with centre at τ 5·0 (*J* 16 Hz) with further splitting (*J* *ca.* 1 Hz). We suggest that the quartet is due to two non-equivalent C-6 protons, and that the minor splitting is caused by long-range effects of aryl protons; the C-11 proton gives a multiplet at τ 4·2. Magnetic non-equivalence, presumably due to slow ring inversion, has been previously observed in azepines and dihydroazepines.[9]



(VIII) (IX) (X)

The major product from *N*-benzyl-*N*-tosylanthraniloyl chloride must be formed by benzylic cleavage; this might have been foreseen in the light of earlier work,[4,10]

[1] Part VIII, W. C. Peaston and G. R. Proctor, *J. Chem. Soc.* (*C*), 1968, 2481.
[2] L. H. Werner, S. Ricca, E. Mohacsi, A. Rossi, and J. P. Arya, *J. Medicin. Chem.*, 1965, **8**, 74.
[3] A. E. Drukker and C. I. Judd, *J. Heterocyclic Chem.*, 1965, **2**, 276.
[4] J. O. Jilek, J. Pomykacek, E. Svatek, V. Seidlova, M. Rajsner, K. Pelz, B. Hoch, and M. Protiva, *Coll. Czech. Chem. Comm.*, 1965, **30**, 445.
[5] J. Schmutz, F. Kunzle, F. Hunziker, and A. Burki, *Helv. Chim. Acta*, 1965, **38**, 336.
[6] M. A. Rehman and G. R. Proctor, *J. Chem. Soc.* (*C*), 1967, 58.
[7] E. D. Hannah, Ph.D., Thesis, Glasgow, 1965.
[8] S. Aftalion and G. R. Proctor, *Org. Mass Spectroscopy*, in the press.
[9] A. Mannschreck, G. Rissman, F. Vogtle, and D. Wild, *Chem. Ber.*, 1967, **100**, 335; A. Cromarty and G. R. Proctor, *Chem. Comm.*, 1968, 842.
[10] G. R. Proctor and R. H. Thomson, *J. Chem. Soc.*, 1957, 2302.

but the ease of this particular cleavage is surprising. We found further that the acid chloride from the acid (V; $R^1 = H$, $R^2 =$ tosyl, $R^3 = R^4 =$ OMe), which we had thought would cyclise more easily than the parent compound, gave at −70° no ketone but only *N*-tosylanthranilic acid (75%). Polyphosphoric acid caused essentially the same cleavage with each of the benzylanthranilic acids mentioned, and with the ester (V; $R^1 =$ Me, $R^2 =$ tosyl, $R^3 = R^4 =$ OMe) it gave a mixture of methyl *N*-tosylanthranilate (31%) and methyl anthranilate (50%).

We then examined some model compounds. *N*-Benzyl-*N*-tosylaniline was treated with anhydrous aluminium chloride in methylene dichloride at −70° and and gave *N*-tosylaniline (estimated 60%); under the same conditions *N*-(*p*-nitrobenzyl)-*N*-tosylaniline was unaffected. These results can be rationalised in terms of benzyl carbonium ion stability and suggest that the acid (V; $R^1 = H$, $R^2 =$ tosyl, $R^3 =$ OMe, $R^4 = NO_2$) might cyclise to a dibenz[*b*,*e*]azepinone without suffering benzylic cleavage. Unfortunately we were unable to obtain the desired acid; its ester could not be hydrolysed with mineral acid and with dilute alkali gave intractable materials, probably owing to elimination of the tosyl group, which is activated by the *p*-nitro-group.[11] The ester (V; $R^1 =$ Me, $R^2 =$ tosyl, $R^3 =$ OMe, $R^4 = NO_2$) reacted with polyphosphoric acid yielding the detosylated compound (V; $R^1 =$ Me, $R^2 = H$, $R^3 =$ OMe, $R^4 = NO_2$) (60%) along with methyl anthranilate (25%); polyphosphoric acid also detosylated methyl *N*-tosylanthranilate (88%) and ethyl *p*-*N*-tosylaminobenzoate (85%), so this reagent is very suitable for cleavage of aryl sulphonamides with an electron-attracting group in the *ortho* or *para* position. In the case of the *N*-acetyl acid (V; $R^1 = H$, $R^2 =$ Ac, $R^3 =$ OMe, $R^4 = NO_2$) attempted cyclisation was not promising but no adequate precedent exists for using the acetyl group for protection of the nitrogen atom in such reactions.

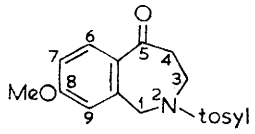
One final possibility was open. In the acid (V; $R^1 = R^4 = H$, $R^2 =$ tosyl, $R^3 =$ OMe), the energy of activation for cyclisation should be substantially lowered, while the energy of activation for benzylic cleavage should be no less than for the unsubstituted compound, since the *meta*-methoxy-group cannot further stabilise the developing benzyl carbonium ion. In fact the acid chloride from the acid (V; $R^1 = R^4 = H$, $R^2 =$ tosyl, $R^3 =$ OMe) cyclised at −20° in methylene dichloride (with aluminium chloride) to a colourless neutral solid (75%) $C_{22}H_{19}NO_3S$ which we formulate as the ketone (VIII; $R^1 =$ tosyl, $R^2 =$ OMe). This assertion is supported by spectroscopic evidence (see Experimental section), including mass spectrum [2] (strong $M - SO_2$ ion) and several chemical transformations described later.

During this work, we reinvestigated the low-temperature cyclisation of the glycine (II) and found that our published recipe [6] gave poor yields * of the expected ketone; however, with 3 equiv. of aluminium chloride, the reaction proceeded smoothly at −20°, giving the expected product (VII). We can suggest no satisfactory explanation for this requirement; the ketone (VIII; $R^1 =$ tosyl, $R^2 =$ OMe) was consistently obtained by use of 1·2 mol. of aluminium chloride, although evidence was obtained that the reaction is particularly sensitive to traces of thionyl chloride.

Reduction of the ketone (VIII; $R^1 =$ tosyl, $R^2 =$ OMe) with sodium borohydride in ethanol gave the 11-ethoxy-derivative rather than the expected alcohol; the n.m.r. spectrum was similar to that of the hydroxy-compound from the parent ketone (VIII; $R^1 =$ tosyl, $R^2 = H$), showing ring-fixation. The C-6 protons gave a quartet, centre τ 5·03 (*J* 16 Hz), with sub-splitting (*J* *ca.* 1 Hz), and the methylene protons of the C-11 ethoxy-group gave a blurred quartet, τ *ca.* 6·75.[9] Oximation of the ketone proceeded sluggishly, and we have not yet been able to make anils. This may be due to steric hindrance; the i.r. carbonyl absorption (1640 cm.$^{-1}$) is weak, as is typical for benzophenones. The ketone (VIII; $R^1 =$ tosyl, $R^2 =$ OMe) could not be brominated under mild conditions, but it was smoothly detosylated (85%) by polyphosphoric acid, yielding the amino-ketone (VIII; $R^1 = H$, $R^2 =$ OMe) which on bromination gave a dibromide, probably (IX).

The amino-group in the ketone (VIII; $R^1 = H$, $R^2 =$ OMe) can be acetylated with ease and dehydrogenation with manganese dioxide yielded the dibenzazatropone (X; R = OMe), identified by mass spectroscopy. This substance appears to share the reactivity at the C=N bond noted previously in similar molecules,[1,12] for it becomes converted into the 'morphanthridinedione' (I; R = OMe) during attempts to purify it. The parent compound (X = R = H) has been reported [13] but no details of its reactivity were given.

The present work led to the prediction that 8-methoxytetrahydrobenz[*c*]azepin-5-ones [*e.g.* (XI)] could be made by analogous processes. This proved to be true; the full results will be published later.



(XI)

EXPERIMENTAL

3,4-Dimethoxybenzylideneanthranilic Acid.[14]—Anthranilic acid (13·71 g.; 0·1 mole) and 3,4-dimethoxybenzaldehyde (16·61 g.; 0·1 mole) were heated under reflux in dry

* We thank Professor R. E. Partch, Potsdam College, New York, for pointing this out.

[11] W. Paterson and G. R. Proctor, *J. Chem. Soc.*, 1965, 485.
[12] E. D. Hannah, W. Peaston, and G. R. Proctor, *J. Chem. Soc.* (*C*), 1968, 1280.
[13] R. G. Cooke and I. M. Russel, *Tetrahedron Letters*, 1968, 4587.
[14] J. B. Ekeley, E. C. Rodgers, and M. Swisher, *J. Amer. Chem. Soc.*, 1922, **44**, 1756.

benzene (150 ml.) for 6 hr. with use of a Dean–Stark apparatus. The product crystallised when cool and gave yellow needles (21·04 g., 73%), m.p. 156—159° (from benzene) [lit.,[14] 169°], $\nu_{max.}$ (Nujol) 2860—2560 (acid OH) and 1695 (acid C=O) cm.$^{-1}$.

N-(3,4-*Dimethoxybenzyl*)*anthranilic Acid*.—3,4-Dimethoxybenzylideneanthranilic acid (5·89 g.; 0·02 mole) was hydrogenated in ethanol over palladised charcoal (10%; 200 mg.). The catalyst was filtered off and the solvent was evaporated *in vacuo*. The white solid gave *needles* (4·35 g., 73%), m.p. 186—189° (from chloroform) (Found: C, 66·85; H, 6·0; N, 4·95. $C_{16}H_{17}NO_4$ requires C, 66·9; H, 5·9; N, 4·85%), $\nu_{max.}$ (Nujol) 3390 (N–H), 2860—2500 (acid OH), and 1667 (C=O) cm.$^{-1}$.

Methyl N-3,4-*Dimethoxybenzyl*-N-p-*tolylsulphonylanthranilate*.—Methyl *N*-*p*-tolylsulphonylanthranilate (73·7 g., 0·24 mole) anhydrous potassium carbonate (40 g.), and 3,4-dimethoxybenzyl bromide [15] (62·1 g.; 0·27 mole) were heated under reflux for 6 hr. in anhydrous acetone (150 ml.). After filtration the solvent was removed *in vacuo*. The residual white solid gave *needles* (49·2 g., 43·7%), m.p. 130—131° (from methanol) (Found: C, 63·45; H, 5·6; N, 3·1. $C_{24}H_{25}NO_6S$ requires C, 63·3; H, 5·5; N, 3·1%), $\nu_{max.}$ (Nujol) 1725 cm.$^{-1}$ (ester C=O), τ 2·0—3·4 (11H, m), 5·19 (2H, s), and 6·2, 6·24, 6·26, and 7·58 (each 3H, s).

N-3,4-*Dimethoxybenzyl*-N-p-*tolylsulphonylanthranilic Acid*.—Methyl *N*-3,4-dimethoxybenzyl-*N*-*p*-tolylsulphonylanthranilate (31·5 g.; 0·69 mole) was heated under reflux in aqueous methanol (50%; 100 ml.) with sodium hydroxide solution (20%; 75 ml.) for 2·5 hr. The cooled solution was diluted with ice–water, extracted with benzene, and then acidified with dilute hydrochloric acid. The white precipitate gave *needles* (27·5 g., 89%), m.p. 156—159° (from ethanol) (Found: C, 62·15; H, 5·15; N, 3·0. $C_{23}H_{23}NO_6S$ requires C, 62·6; H, 5·25; N, 3·15%), $\nu_{max.}$ (Nujol) 2860—2380 (acid OH) and 1686 (C=O) cm.$^{-1}$.

N,3,4-*Dimethoxybenzyl*-N-p-*tolylsulphonylanthraniloyl Chloride*.—(*a*) *N*-3,4-Dimethoxybenzyl-*N*-*p*-tolylsulphonylanthranilic acid (2·2 g.; 0·005 mole) was dissolved in thionyl chloride (5 ml.; 0·07 mole). The solution was shaken for 2 hr. then hydrolysed with dilute sodium hydroxide (2N) and extracted with methylene dichloride. The aqueous layer was acidified to yield a white precipitate, m.p. 200—210° (0·62 g., 42%), of *N*-*p*-tolylsulphonylanthranilic acid.

(*b*) *N*-3,4-Dimethoxybenzyl-*N*-*p*-tolylsulphonylanthranilic acid (4·25 g.; 0·01 mole), thionyl chloride (1·1 ml.; 0·015 mole) and pyridine (5 drops) were left together overnight in methylene dichloride (75 ml.). The solvent was removed *in vacuo*. A portion of the acid chloride (2·29 g.; 0·005 mole) was dissolved in benzene and added to a solution of *p*-toluidine (1·02 g.; 0·01 mole) in benzene. The p-*toluidide* gave needles (2·42 g., 92%), m.p. 128—131° (from ethanol) [Found: C, 68·05; H, 5·7; N, 5·05%; *M*(mass spectroscopy), 530·1869. $C_{30}H_{30}N_2O_5S$ requires C, 67·9; H, 5·65; N, 5·3%; *M*, 530·1875], $\nu_{max.}$ (Nujol) 3279 (NH) and 1681 (C=O) cm.$^{-1}$.

Attempted Cyclisation of N-3,4-*Dimethoxybenzyl*-N-p-*tolsulphonylanthraniloyl Chloride*.—The anthraniloyl chloride (2·34 g.; 0·005 mole) was dissolved in dry methylene dichloride (150 ml.). Anhydrous aluminium chloride (0·75 g.; 0·006 mole) was added at −70° to the stirred solution, which became blue at −60°. The temperature was allowed to rise to 20° over 5 hr. The mixture was poured into ice–dilute hydrochloric acid (2N). The organic layer was separated, washed with dilute sodium hydroxide (2N), and water, and then dried (Na_2SO_4). The solvent was removed *in vacuo* to yield unidentifiable products (1·066 g.). The alkaline layer on acidification yielded *N*-*p*-tolylsulphonylanthranilic acid (75%).

Action of Polyphosphoric Acid on N-3,4-*Dimethoxybenzyl*-N-p-*tolylsulphonylanthranilic Acid*.—The anthranilic acid (2·0 g.; 0·005 mole) was added to polyphosphoric acid (50 g.) and stirred mechanically. The temperature was raised to 70° for 1 hr. and then the mixture was poured into ice–water. Work-up yielded *N*-*p*-tolylsulphonylanthranilic acid (68%).

Action of Aluminium Chloride on N-*Benzyl*-N-p-*tolylsulphonylaniline*.[11]—To a stirred solution of the aniline [11] (2·02 g.; 0·008 mole) in methylene dichloride (150 ml.) was added anhydrous aluminium chloride (0·9 g.; 0·007 mole) at −70°. The temperature was allowed to rise over 4 hr. to 0°. The mixture was poured into ice–dilute hydrochloric acid (2N). The organic layer was washed with water and dried (Na_2SO_4) to give a mixture (1·67 g.). T.l.c. showed the presence of *N*-*p*-tolylsulphonylaniline (*ca.* 60%), *N*-benzyl-*N*-*p*-tolylsulphonylaniline, and unidentifiable products. *N*-*p*-Nitrobenzyl-*N*-*p*-tolylsulphonylaniline [11] (1·35 g.; 0·0035M) in methylene dichloride (150 ml.) was unaffected by treatment with aluminium chloride (0·55 g.; 0·004 mole) for 5 hr. between −70° and +20°.

5-*Bromomethyl*-2-*nitroanisole*.[16]—5-Methyl-2-nitroanisole [17] (11·8 g.; 0·071 mole), dry carbon tetrachloride (100 ml.), *N*-bromosuccinimide (12·75 g.; 0·072 mole), and benzoyl peroxide (200 mg.) were heated under reflux for 5 hr. After cooling and filtration the solvent was removed *in vacuo*. The product (17·3 g.) was not further purified.

Methyl N-3-*Methoxy*-4-*nitrobenzyl*-N-p-*tolylsulphonylanthranilate*.—5-Bromomethyl-2-nitroanisole (17·3 g.; 0·07 mole), methyl *N*-*p*-tolylsulphonylanthranilate (19·35 g.; 0·063 mole) and sodium carbonate (7 g.) were heated under reflux in dry acetone (150 ml.) for 36 hr. The insoluble solids were filtered off and the acetone was removed *in vacuo*. The product gave *needles* (17·97 g., 60%), m.p. 139—141° (from methanol) (Found: C, 58·45; H, 4·75; N, 5·55. $C_{23}H_{22}N_2SO_7$ requires C, 58·75; H, 4·7; N, 5·95%), $\nu_{max.}$ (Nujol) 1730 cm.$^{-1}$ (ester C=O).

N-(3-*methoxy*-4-*nitrobenzyl*)*anthranilic Acid*.[18]—Anthranilic acid (6·8 g.; 0·05 mole) and 5-bromomethyl-2-nitroanisole (12 g.; 0·05 mole) were heated in ethanol for 4 hr. The product crystallised when cool and gave an amorphous solid (6·4 g., 42%), m.p. 220—240°, (from ethanol) $\nu_{max.}$ (Nujol) 3356 (NH), 2860—2500 (acid OH), and 1653 (C=O) cm.$^{-1}$.

N-*Acetyl*-N-(3-*methoxy*-4-*nitrobenzyl*)*anthranilic Acid*.—The preceding acid (2 g.) in pyridine (25 ml.) and acetic anhydride (1 g.) gave after 20 hr. at 20°, the *product*, prisms (1·9 g.), m.p. 193° [from chloroform–light petroleum (b.p. 40—60°)] (1·9 g.) (Found: C, 59·2; H, 5·0; N, 7·75. $C_{17}H_{16}N_2O_6$ requires C, 59·35; H, 4·7; N, 8·1%), ν_{max} (Nujol) 1724 (acid C=O) and 1639 (amide C=O) cm.$^{-1}$.

[15] R. D. Haworth, W. H. Perkin, and J. Rankin, *J. Chem. Soc.*, 1925, **122**, 1444; G. N. Walker, M. A. Moore, and B. N. Weaver, *J. Org. Chem.*, 1961, **26**, 2740.

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[17] P. Karrer and F. M. Strong, *Helv. Chim. Acta*, 1935, **18** 1343.

[18] B. Pawlewski, *Ber.*, 1904, **37**, 593.

3,4-*Dimethoxy*-6-*methyl*-2′-p-*tolylsulphonylaminobenzophenone*. (IV; R^1 = tosyl, R^2 = H).—Anhydrous aluminium chloride (4·5 g.) was added to a solution of *N*-*p*-tolylsulphonylanthraniloyl chloride,[19] 3,4-dimethoxytoluene [20] (3·5 g.), and dry methylene dichloride (100 ml.) at −70°. The stirred mixture was allowed to reach 20° in 5 hr. Work-up gave a neutral fraction (9 g.), from which the *product* crystallised (benzene) as a fine powder, m.p. 170° (Found: C, 64·55; H, 5·4; N, 3·2. $C_{23}H_{23}NO_5S$ requires C, 64·9; H, 5·4; N, 3·3%).

5′-*Bromo*-3,4-*dimethoxy*-6-*methyl*-2′-p-*tolylsulphonylaminobenzophenone*.—The preceding compound (1·28 g.), *N*-bromosuccinimide (1·7 g.), carbon tetrachloride (50 ml.), pyridine (2 ml.), and benzoyl peroxide (200 mg.) were heated under reflux for 2 hr. After cooling, filtration, and evaporation the *product* crystallised from ethanol as needles (45%) m.p. 148—150° (Found: C, 54·6; H, 4·45; Br, 15·6. $C_{23}H_{22}BrNO_5S$ requires C, 54·8; H, 4·4; Br, 15·85%), $\nu_{max.}$ (Nujol) 3205 (NH), 1639 (C=O) cm.$^{-1}$, τ −0·55 (1H, s), 2·1—3·5 (9H, m), and 6·08, 6·23, 7·68, and 7·9 (each 3H, s).

3,4-*Dimethoxy*-6-*methyl*-2′-*aminobenzophenone*. (IV; R^1 = R^2 = H).— 3,4-Dimethoxy-6-methyl-2′-*p*-tolylsulphonylaminobenzophenone (2 g.) and concentrated sulphuric acid were left together for 4 days with occasional shaking and then poured on ice. Basification yielded the *product* as yellow prisms, m.p. 181° (from benzene) (Found: C, 71·0; H, 6·4; N, 5·1. $C_{16}H_{15}NO_3$ requires C, 70·65; H, 6·25; N, 5·15%).

3′,5′-*Dibromo*-3,4-*dimethoxy*-6-*methyl*-2′-*aminobenzophenone*.—The preceding amine (0·5 g.), *N*-bromosuccinimide (0·98 g.), and benzoyl peroxide (20 mg.) were heated under reflux for 2 hr. in dry carbon tetrachloride (50 ml.). After filtration and evaporation, the product (0·58 g.) was purified by chromatography on silica gel and gave yellow *needles*, m.p. 115° (from ethanol) (Found: C, 44·95; H, 3·7; N, 3·2. $C_{16}H_{13}Br_2NO_3$ requires C, 44·7; H, 3·5; N, 3·25%), $\nu_{max.}$ (Nujol) 3500 and 3400 (NH) and 1640 (C=O) cm.$^{-1}$.

Reactions of Polyphosphoric acid with Some Sulphonamides.—Unless otherwise stated, mixtures were stirred for 1 hr. at 90°. In each case ratio (w/w) of polyphosphoric acid to sulphonamide was 50 : 1.

(*a*) *N*-(4-nitrobenzyl)-*N*-*p*-tolylsulphonylaniline [11] was unaffected. (*b*) *N*-*p*-Tolylsulphonylaniline [10] was unaffected. (*c*) Methyl *N*-*p*-tolylsulphonylanthranilate (1 g.) gave methyl anthranilate (0·44 g.). (*d*) 4-Ethoxycarbonyl-*N*-*p*-tolylsulphonylaniline (0·95 g.; m.p. 204—207°) at 110—120° gave 4-ethoxycarbonylaniline, m.p. 85—89° (0·56 g.). (*e*) Methyl *N*-3,4-dimethoxybenzyl-*N*-*p*-tolylsulphonylanthranilate (2 g.) at 50° gave methyl *N*-*p*-tolylsulphonylanthranilate (0·42 g.) by chromatography and methyl anthranilate (0·48 g.) after basification of the aqueous layer. (*f*) Methyl *N*-(3-methoxy-4-nitrobenzyl)-*N*-*p*-tolylsulphonyl anthranilate gave (after chromatography on silica gel M.F.C.), *methyl* N-(3-*methoxy*-4-*nitrobenzyl*)-*anthranilate* (59%), m.p. 105—106° [from light petroleum (b.p. 60—80°)] [Found: *M* (mass spectrum), 316·1068. $C_{16}H_{16}N_2O_5$ requires *M*, 316·1059], $\nu_{max.}$ (Nujol) 3320 (NH) and 1680 (C=O) cm.$^{-1}$, τ 1·6—3·6 (8H, m), 5·5 (2H, d), and 6·1 (6H, s). Methyl anthranilate (0·2 g.) was obtained by basification of the aqueous layer.

N-*Benzyl*-N-p-*tolylsulphonylanthraniloyl Chloride*.— The corresponding acid,[2,7] (31 g.) was heated under reflux with thionyl chloride (20 ml.) for 1 hr., and the mixture was then heated *in vacuo* to leave the *product* (33 g.). A portion was converted into the anilide, which gave yellow *prisms*, m.p. 132° (from ethanol) (Found: C, 70·7; H, 5·2; N, 6·2. $C_{27}H_{24}N_2O_3S$ requires C, 71·0; H, 5·3; N, 6·15%).

5,6-*Dihydro*-5-p-*tolylsulphonyldibenz*[b,e]*azepin*-11-*one*.—Finely powdered anhydrous aluminium chloride (25 g.) was added to a stirred solution of the preceding acid chloride (31·5 g.) in dry methylene dichloride (500 ml.) at −75°: the mixture was allowed to reach 20° in 5 hr. and then treated with ice and dilute hydrochloric acid. The organic layer was washed with dilute sodium hydroxide solution which removed *N*-*p*-tolylsulphonylanthranilic acid (16 g.), m.p. and mixed m.p. 225°. Chromatography of the neutral product on silica gel M.F.C. gave toluene-*p*-sulphonyl chloride (3·8 g.), m.p. and mixed m.p. 69°, followed by the desired *product* (1·2 g.) which gave needles, m.p. 171° (from ethanol) [Found: C, 69·2; H, 4·85; N, 3·95; S, 9·3%, *M*(mass spectrum), 363·09292. $C_{21}H_{17}NO_3S$ requires C, 69·4; H, 4·7; N, 3·9; S, 8·8%; *M* 363·09291], $\nu_{max.}$ (Nujol) 1634 cm.$^{-1}$ (C=O), τ 1·8—2·7 (8H, m, aryl), 3·22 (4H, s, aryl), 4·9 (2H, s, CH_2), and 7·78 (3H, s, Me).

5,6-*Dihydro*-5-p-*tolylsulphonyldibenz*[b,e]*azepin*-11-*ol*.—The preceding ketone (450 mg.) was reduced with sodium borohydride (in excess) in ethanol. Work-up gave the *product* (200 mg.) as prisms, m.p. 147—148° (from ethanol) (Found: C, 68·7; H, 5·1; N, 3·7. $C_{21}H_{19}NO_3S$ requires C, 69·0; H, 5·2; N, 3·8%), τ 2·3—3·0 (13H, m, 12 aromatic H and OH), 4·2 (1H, m H-11), 5·0 (2H, q, 6-H_2), and 7·62 (3H, s, Me).

Methyl N-m-*Methoxybenzyl*-N-p-*tolylsulphonylanthranilate*.—Methyl *N*-*p*-tolylsulphonylanthranilate (120 g., 0·39 mole), anhydrous potassium carbonate (100 g.), and *m*-methoxybenzyl bromide [21] (88 g., 0·44 mole) were heated under reflux for 24 hr. in acetone (1250 ml. AnalaR). After filtration, the solvent was removed *in vacuo* to yield a solid which gave *prisms*, m.p. 95—98° (from methanol) (159·5 g., 94·6%) (Found: C, 65·0; H, 5·3; N, 3·6. $C_{23}H_{23}NO_5S$ requires C, 65·0; H, 5·45; N, 3·3%), $\nu_{max.}$ (Nujol) 1709 cm.$^{-1}$ (C=O).

N-m-*Methoxybenzyl*-N-p-*tolylsulphonylanthranilic Acid*.—Methyl *N*-*m*-methoxybenzyl-*N*-*p*-tolylsulphonylanthranilate (80 g., 0·19 mole) was heated under reflux in aqueous methanol (50%; 800 ml.) with sodium hydroxide (20%; 100 ml.), for 7 hr. Work-up gave a white solid, which gave prisms (72·7 g , 96%), m.p. 168—171° (from ethanol) $\nu_{max.}$ (Nujol) 2882—2519 (acid OH) and 1689 (C=O) cm.$^{-1}$.

5,6-*Dihydro*-8-*methoxy*-5-p-*tolylsulphonyl*-*dibenz*[b,e]*azepin*-11-*one*.—*N*-*m*-Methoxybenzyl-*N*-*p*-tolylsulphonylanthranilic acid (15·7 g., 0·038 mole), thionyl chloride (2·9 ml., 0·04 mole) and pyridine (5 drops) were left overnight in methylene dichloride (300 ml.). Anhydrous aluminium chloride (5·6 g., 0·042 mole) was added to the stirred solution at −70°. The temperature was allowed to rise to 0° during 6 hr. before the mixture was poured into ice–dilute hydrochloric acid (2N). The organic layer was separated, washed with sodium hydrogen carbonate solution and water, and then dried (Na_2SO_4). Evaporation of solvent left a white solid which gave *prisms* (11·03 g., 73%), m.p. 198—200° (from ethyl acetate) [Found: C, 66·9; H,

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4·75; N, 3·45%; *M* (mass spectroscopy), 393·1043. $C_{22}H_{19}NO_4S$ requires C, 67·25; H, 4·85; N, 3·55%; *M*, 393·1034], $\nu_{max.}$ (Nujol) 1640 cm.$^{-1}$ (diaryl C=O), τ 1·6—2·8 (7H, m), 3·2 (4H, s), 5·0 (2H, s), 6·11 (3H, s), and 7·79 (3H, s).

11-*Ethoxy*-5,6-*dihydro*-8-*methoxy*-5-p-*tolylsulphonyldibenz*-[b,e]*azepine*.— 5,6-Dihydro-8-methoxy-5-*p*-tolylsulphonyldibenz[*b*,*e*]azepin-11-one (1·026 g., 0·0026 mole) in ethanol–dioxan was treated with sodium borohydride (0·34 g., 0·009 mole). After 6 days the solution was acidified with dilute hydrochloric acid (2N) and poured into water. The aqueous solution was extracted with ether. The ethereal layer was washed with sodium hydrogen carbonate and water and then dried (Na_2SO_4). The solvent was removed *in vacuo* to yield a solid which gave (from ethanol) *plates* (0·67 g., 60%), m.p. 146—148° [Found: C, 67·9; H, 5·75; N, 3·45%. *M*(mass spectroscopy), 423·1508. $C_{24}H_{25}NO_4S$ requires C, 68·15; H, 5·95; N, 3·3%; *M* 423·1504], τ 2·39—3·45 (11H, m), 5·03 (2H, q), τ 4·9 (1H, blurred s), 6·3 (3H, s), 6·45—7·0 (2H, q), 7·66 (3H, s), and 8·87 (3H, t).

5,6-*Dihydro*-8-*methoxydibenz*[b,e]*azepin*-11-*one*.— 5,6-Dihydro-8-methoxy-5-*p*-tolylsulphonyldibenz[*b*,*e*]azepin-11-one (16·02 g., 0·041 mole) was added to stirred polyphosphoric acid (200 g.) and heated to 100—110° for 5 hr. The cooled solution was poured into ice and the aqueous suspension was extracted with chloroform. The organic layer was washed with sodium hydrogen carbonate and water and dried (Na_2SO_4). The solvent was removed *in vacuo* to yield a yellow solid which gave *needles* (8·4 g.; 86%), m.p. 140—141° [from benzene–light petroleum (b.p. 40—60°)] [Found: C, 75·05; H, 5·4; N, 5·85%; *M*(mass spectroscopy), 239·0952. $C_{15}H_{13}NO_2$ requires C, 75·4; H, 5·5; N, 5·85% *M*, 239·0946], $\nu_{max.}$ (Nujol) 3311 (NH) and 1605 (C=O) cm.$^{-1}$ τ 1·6—3·45 (7H, m), 4·75br (1H, s), 5·8 (2H, d), and 6·19 (3H, s). On deuteriation the peak at τ 4·75 disappeared and the doublet at τ 5·8 collapsed to a singlet.

8-*Methoxydibenz*[b,e]*azepin*-11-*one*.—5,6-Dihydro-8-methoxydibenz[*b*,*e*]azepin-11-one (0·498 g.) and manganese dioxide (500 mg.) in dry benzene were heated under reflux overnight (Dean–Stark). After cooling and filtration through Kieselguhr the solvent was removed *in vacuo* to yield a white amorphous solid, m.p. 129—133° (0·389 g., 79%) [*M*(mass spectroscopy) 237·0788. $C_{15}H_{11}NO_2$ requires *M*, 237·0789], $\nu_{max.}$ (Nujol) 1647 (C=O) cm.$^{-1}$.

8-*Methoxydibenz*[b,e]*azepin*-6(5H),11-*dione*.— 8-Methoxydibenz[*b*,*e*]azepin-11-one, when recrystallised from ethanol or chloroform–benzene or dry benzene gave the *dione*, needles, m.p. 271—273° [Found: C, 71·0; H, 4·55; N, 5·65%; *M*(mass spectroscopy), 253·0722. $C_{15}H_{11}NO_3$ requires C, 71·2; H, 4·4; N, 5·55. *M*, 253·0738], $\nu_{max.}$ (Nujol) 1680 (amide C=O) and 1653 (aryl C=O) cm.$^{-1}$.

2,4-*Dibromo*-5,6-*dihydro*-8-*methoxydibenz*[b,e]*azepin*-11-*one*.— 5,6-Dihydro-8-methoxydibenz[*b*,*e*]azepin-11-one (7·79 g., 0·033 mole) in chloroform (250 ml.) was treated with bromine (18·2 g., 0·114 mole) overnight. The organic layer was poured into water, separated, washed with sodium hydrogen carbonate and water, and then dried (Na_2SO_4). Evaporation of solvent left a yellow solid which gave needles (4·7 g., 35%) m.p. 208—209° (from chloroform), [Found: C, 45·1; H, 2·75; N, 3·2; Br, 39·95%; *M*(mass spectroscopy), 398·9016, 396·9130, 394·9147. $C_{15}H_{11}Br_2NO_2$ requires C, 45·4; H, 2·8; N, 3·55; Br, 40·25%; *M*, 398·9116, 396·9136, 394·9156], $\nu_{max.}$ (KCl) 3448 (NH) 1647 cm.$^{-1}$ (C=O).

5-*Acetyl*-5,6-*dihydro*-8-*methoxydibenz*[b,e]*azepine*-11-*one*.—5,6-Dihydro-8-methoxydibenz[*b*,*e*]azepin-11-one (0·26 g., 0·001 mole) was treated for 5 min. in pyridine (50 ml.) with acetyl chloride (0·30 g., 0·004 mole). The solution was poured into ice and worked up to yield a white solid, which gave needles (0·11 g., 37%) m.p. 146—147° [from benzene–light petroleum (b.p. 40—60°)], (Found: C, 72·45; H, 5·7; N, 5·4. $C_{17}H_{15}NO_3$ requires C, 72·65; H, 5·4; N, 5·0%), $\nu_{max.}$ (KCl) 1695 (amide C=O) and 1647 (C=O) cm.$^{-1}$, τ 1·58—3·13 (7H, m), 5·02 (2H, s), 6·1 (3H, s), and 8·0 (3H, s).

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