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QUINONE-IMIDES : REGIOSPECIFICITY OF NUCLEOPHILIC ATTACK ON N-ALKANESULPHONYL-N'-ALKANOYL 1,4-BENZOQUINONE-IMINES.

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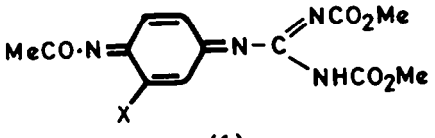
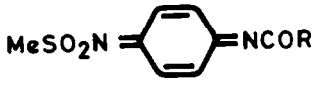
Abstract - Substrates such as (2) undergo regiospecific attack by azide and thiocyanate ions at the terminus of the C=C-C=N-CO system. In the case of addition of azide, this is proved by the detailed analysis of the ^{1}H and ^{13}C NMR spectra of the products (11) derived from the quinone-imides (8). The structure of the products obtained by the addition of thiocyanate to the quinone-imides (10) and (20) is proved by their facile cyclisation to the 2-aminobenzothiazoles (18) and (21) respectively.

We have previously reported our results on the intramolecular nucleophilic addition to quinone-imides[1]. In unsymmetrical quinone-imides such as (1) in which the nucleophile is the nitrogen atom bearing the carbomethoxy group, the direction of ring-closure seemed to depend primarily on the electronic properties of the substituent X, although steric effects might also have a role[2].



(1)



(2)

We now address ourselves to the question of regioselectivity of attack by an external nucleophile on a quinone-monocarboximide-monosulphonimide (2). In his pioneering work on quinone-imides[3], Adams had, in fact, shown that HCl adds preferentially to the C=C-C=N-COR system in the quinone-imide (3) leading to the product (4), which was synthesised unambiguously from 2-chloro-4-nitroaniline[4]. The explanation offered for this regioselectivity was preferential protonation of the =N-CO- as the first step; chloride ion would then be forced to attack the most electron-deficient carbon atom, leading to the product (4).

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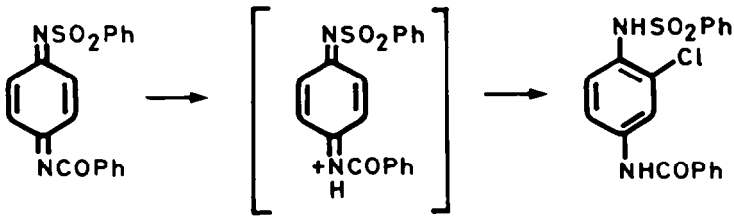


(3) (4)

In the present study, we have used two nucleophiles - azide ion and thiocyanate ion. Both can be regarded as soft nucleophiles (azide is a "borderline" case according to Fleming[5]). Under the reaction conditions employed - aqueous acetic acid at 28° - one would not expect protonation of the imide to occur as a preliminary step, as in the case of addition of HCl. We now find that even under these conditions, nucleophilic addition takes place at the terminus of the C=C-C=N-COR system; the product has the azide or thiocyanate attached to the carbon adjacent to the one carrying the sulphonamide.

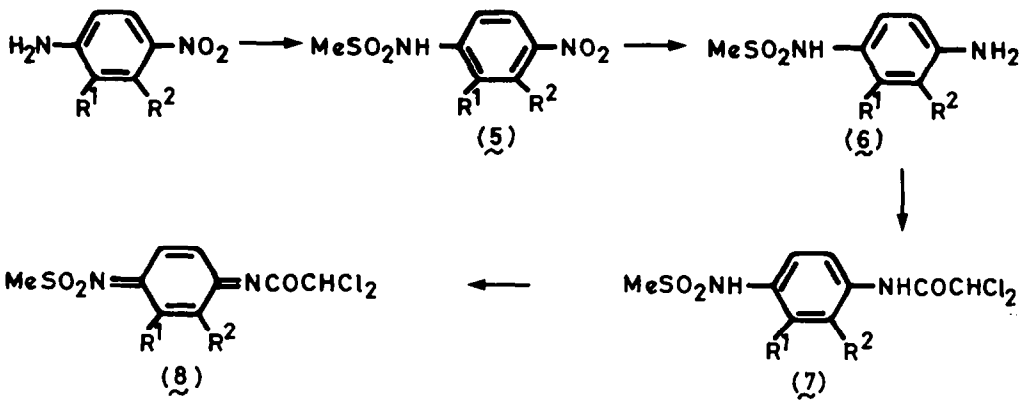
Synthesis of quinone-imides. These were prepared by lead tetraacetate (LTA) oxidation of the corresponding benzenoid precursors, which were themselves made by standard procedures as shown in Scheme 1. All the quinone-imides were unstable to a greater or lesser extent, being especially susceptible to hydrolysis by atmospheric moisture. It was best to use them for further reaction immediately after being synthesized.

Addition of azide. Azide was added to the three N-methanesulphonyl-N'-dichloroacetyl quinone-imines (8a, 8b and 8c) (Scheme 2). In each case only one product was isolated. The product from (8a) showed the following signals in the aromatic region of its ^{1}H NMR spectrum ($CDCl_3$ + CD_3SOCD_3): 7.83 (d, J 2 Hz); 7.40 (d, J 8.5 Hz); 7.20 (d,d, J 8.5, 2 Hz). However, a choice between structures (11a) and (12a) could not be made from the chemical shift data alone.

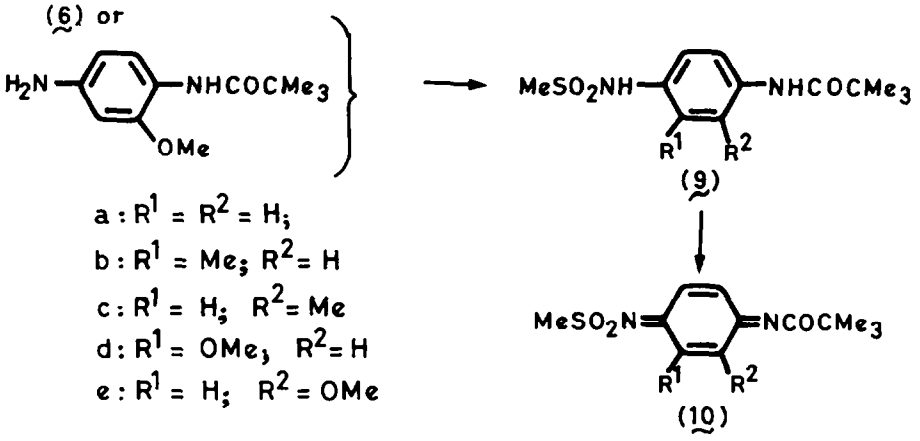
In order to resolve this problem, one of the available positions was blocked by a methyl group. The ^{1}H NMR data ($CDCl_3$ + CD_3SOCD_3) obtained for the product from (8b) clearly showed that it had the structure (11b) and not (12b): the two aromatic protons (H-3 and H-5) at 7.60 and 7.17 ppm exhibited long-range coupling (J 3 Hz; meta coupling) to each other. This assignment of structure (11b) to the product was further confirmed by ^{13}C NMR data (CD_3SOCD_3): 108.3 ppm (C-3) (d, J_{CH} 164 Hz; each further split into a quartet by long-range coupling to a CH and an NH; on addition of D_2O, the quartet collapsed to a doublet J_{CH} 6 Hz); and 118.3 ppm (C-5) (d, J_{CH} 164 Hz; each further split into a quintet after D_2O exchange due to long-range coupling with a CH_3 and a CH).

Addition of azide to (8c) similarly gave only (11c) as shown by the following NMR data. ^{1}H NMR ($CDCl_3$ + CD_3SOCD_3) : 7.42 (s), 7.17 (s). ^{13}C NMR (CD_3SOCD_3) : 116.0 ppm (C-3) (d, J_{CH} 162 Hz; long-range NH coupling, washed with D_2O); 128.8 ppm (C-6) (d, J_{CH} 162 Hz; further long-range coupling manifested as quartet after D_2O treatment).

Addition of thiocyanate : an unexpected reaction. In a pilot experiment, the bis-methanesulphonimide (13)[6] was treated in acetic acid with an aqueous solution of potassium thiocyanate. Within a short while, a white solid (14) had separated. However, on letting the mixture stir overnight at 28°, the solid redissolved to form a clear solution. Basification and extraction gave a crystalline solid (15), different from (14). In a subsequent experiment, the solid (14) was isolated immediately after its formation. Its IR spectrum (band at 2165 cm^{-1}) showed that it was indeed the expected thiocyanate addition product. This compound on stirring with acetic acid in aqueous methanol at 28° for 16 h, got converted to (15). The latter showed no SCN band in IR. Further, it had only one methyl group as seen in the ^{1}H NMR spectrum. Analytical values, coupled with the mass spectrum proved that it was the 2-aminobenzothiazole. This was confirmed by comparison with

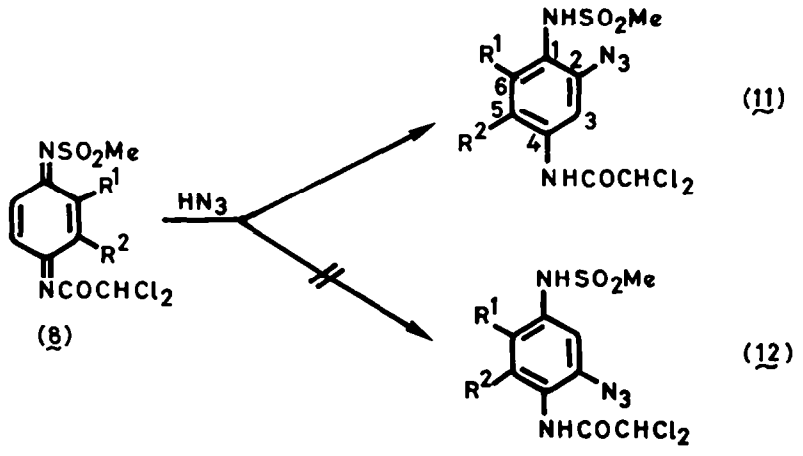


a : $R^1 = R^2 = H$
b : $R^1 = Me$; $R^2 = H$
c : $R^1 = H$; $R^2 = Me$
d : $R^1 = OMe$; $R^2 = H$



a : $R^1 = R^2 = H$;
b : $R^1 = Me$; $R^2 = H$
c : $R^1 = H$; $R^2 = Me$
d : $R^1 = OMe$; $R^2 = H$
e : $R^1 = H$; $R^2 = OMe$

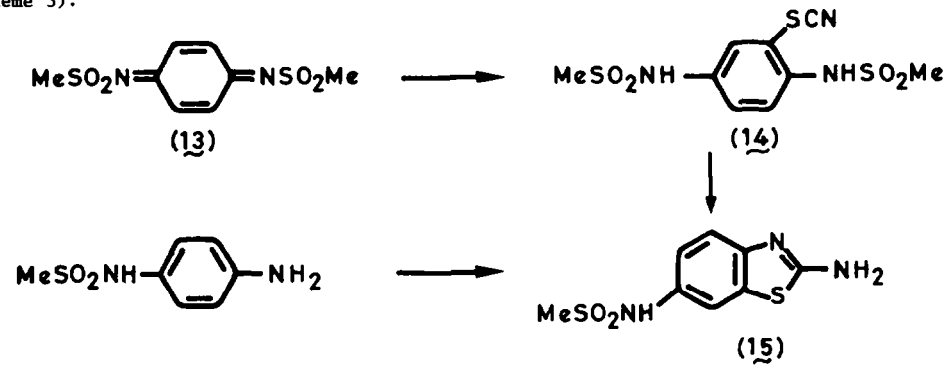
Scheme 1



a: $R^1 = R^2 = H$
b: $R^1 = Me$; $R^2 = H$
c: $R^1 = H$; $R^2 = Me$

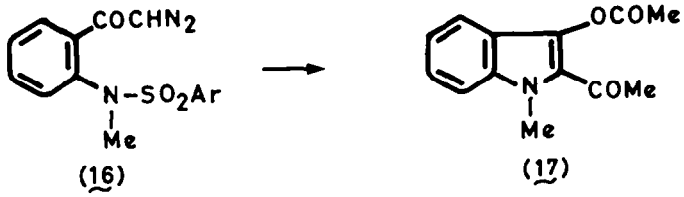
Scheme 2

a sample prepared in poor yield by conventional thiocyanation[7] of 4-methanesulphonamidoaniline (Scheme 3).

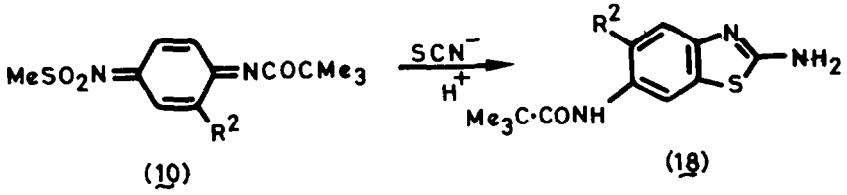


Scheme 3

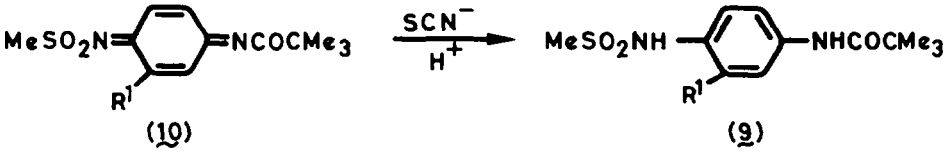
The extraordinary transformation of (14) to (15) has involved addition of NH to SCN, followed by desulphonation by acetic acid under very mild conditions. There are not too many precedents in literature for such a facile N-desulphonation. It has been shown that treatment of the diazoketone (16) with acetic acid and acetic anhydride at 20° for a few minutes, followed by aqueous work-up, leads to the indole (17) and p-toluenesulphonic acid[8].



The facile cyclisation of the 1-methanesulphonamido-2-thiocyanatobenzene system in (14) with subsequent loss of the methanesulphonyl group, gave us a ready chemical method of identifying the site of attack by thiocyanate ion on unsymmetrical systems such as in (2). The quinone-imide (10a) gave the product (18a), which lacked the $MeSO_2$ group. This proves that in this case also, as with the azide ion, addition of the nucleophile took place vicinal to the methanesulphonamide group; cyclisation followed by N-desulphonation has resulted in the formation of 2-aminobenzothiazole. With a



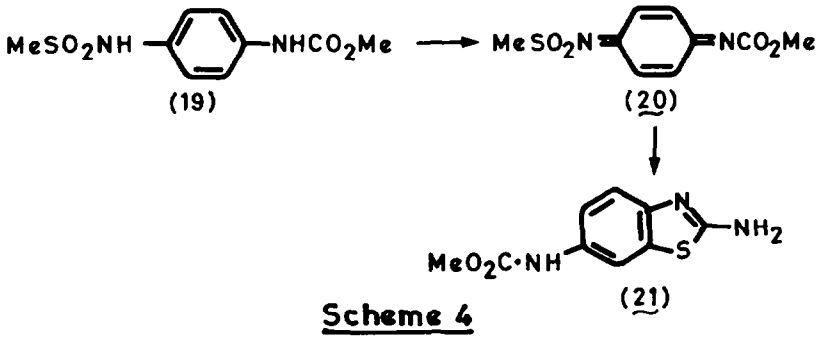
a: R^2 = H
c: R^2 = Me
e: R^2 = OMe



b: R^1 = Me
d: R^1 = OMe

further electron-releasing substituent on the ring as in (10e), addition is regiospecific in the expected sense to produce (18e) as shown by ^{1}H NMR (TFA) (two singlets for Ar-H at 8.57 and 7.23 ppm). Likewise (10c) gave (18c). An interesting finding is that when there is a substituent adjacent to the sulphonamide as in (10b) and (10d), then thiocyanate does not seem to add to the system; instead, a redox reaction intervenes to give back the benzenoid precursors (9b) and (9d) respectively. We suspect that this inability to add is due to steric overcrowding.

That the steric bulk of the pivaloyl group was not responsible for directing the nucleophile towards the position vicinal to the methanesulphonamido group, was proved by the fact that a 2-aminobenzothiazole (21) was also formed from the carbamate (20) (Scheme 4).



Scheme 4

EXPERIMENTAL

Melting points are uncorrected. ^{1}H NMR spectra were recorded either on a Varian EM-360 L instrument at 60 MHz or on a Bruker WH-90 FT spectrometer at 90 MHz. ^{13}C Spectra were recorded on the latter instrument at 22.63 MHz. Chemical shifts are quoted in ppm downfield from TMS internal reference. The nitroanilines used as starting materials are either available commercially, or known in the literature[2].

Preparation of the benzenoid precursors

1) The 4-nitroaniline (0.3 mole) in dry pyridine (150 ml) was treated dropwise with methanesulphonyl chloride (0.33 mole) with stirring and cooling (5° to 10°). After the addition was over, the mixture was stirred at 28° for 5 h and then poured over ice and water. The solid was filtered, washed with water and recrystallised from acetone-hexane.

4-Nitro-N-methanesulphonyl aniline (5a), m.p. 173-175°. (Found: C, 38.67; H, 3.96; N, 12.81. $C_7H_8N_2O_4S$ requires C, 38.89; H, 3.73; N, 12.96%).

2-Methyl-4-nitro-N-methanesulphonyl aniline (5b), m.p. 187-190°. (Found:: C, 42.08; H, 4.22; N, 12.05. $C_8H_{10}N_2O_4S$ requires C, 41.74; H, 4.38; N, 12.17%).

3-Methyl-4-nitro-N-methanesulphonyl aniline (5c), m.p. 146-148°. (Found: C, 41.56; H, 4.75; N, 12.44. $C_8H_{10}N_2O_4S$ requires C, 41.74; H, 4.38; N, 12.17%).

2-Methoxy-4-nitro-N-methanesulphonyl aniline (5d), m.p. 124-126° (from ethyl acetate-hexane). (Found: C, 39.20; H, 4.32; N, 11.67. $C_8H_{10}N_2O_5S$ requires C, 39.03; H, 4.09; N, 11.38%).

ii) The above nitro compound (5 g) was reduced catalytically in methanol (150 ml) in presence of Raney nickel (2.5 g) at 1 atm. pressure. After the reduction was over, the catalyst was filtered off, the filtrate evaporated in vacuo and the residue recrystallised from a suitable solvent.

4-Amino-N-methanesulphonyl aniline (6a), m.p. 106-108° (from methylene chloride - ether). (Found: C, 45.44; H, 5,58; N, 15.39. $C_7H_{10}N_2O_2S$ requires C, 45.16; H, 5.41; N, 15.05%).

4-Amino-2-methyl-N-methanesulphonyl aniline (6b), m.p. 125-127° (from ethyl acetate-hexane). (Found: C, 48.26; H, 6.24; N, 14.37. $C_8H_{12}N_2O_2S$ requires C, 47.99; H, 6.04; N, 13.99%).

4-Amino-3-methyl-N-methanesulphonyl aniline (6c) gum.

4-Amino-2-methoxy-N-methanesulphonyl aniline (6d), m.p. 189-192° (from methylene chloride-ether). (Found : C, 44.75; H, 5.85. $C_8H_{12}N_2O_3S$ requires C, 44.44; H, 5.60%. A satisfactory nitrogen analysis could not be obtained).

iii) Dichloroacetyl chloride (0.04 mole) in dry CH_2Cl_2 (5 ml) was added dropwise under stirring and cooling to a solution of the above amine (0.04 mole) in dry acetonitrile (50 ml). The mixture was stirred at 28° for 16 h and then diluted with water. The solid was filtered and recrystallised.

4-Dichloroacetamido-N-methanesulphonyl aniline (7a), m.p. 195-196° (from dioxane - CH_2Cl_2-hexane). (Found: C, 36.17; H, 3.61; N, 9.09. $C_9H_{10}Cl_2N_2O_3S$ requires C, 36.38; H, 3.39; N, 9.43%).

4-Dichloroacetamido-2-methyl-N-methanesulphonyl aniline (7b), m.p. 130-132° (from ethyl acetate - hexane). (Found: C, 38.95; H, 4.21; N, 9.25. $C_{10}H_{12}Cl_2N_2O_3S$ requires C, 38.60; H, 3.89; N, 9.00%).

4-Dichloroacetamido-3-methyl-N-methanesulphonyl aniline (7c), m.p. 158-160° (from CH_2Cl_2 - methanol - ether). (Found : C, 37.79; H, 4.23; N, 9.13. $C_{10}H_{12}Cl_2N_2O_3S$ requires C, 38.60; H, 3.89; N, 9.00%).

iv) The amine (25 mmole) from (ii) above in acetonitrile (40 ml) and N,N-dimethylaniline (3.1 g) was treated with pivaloyl chloride (3.1 g) in acetonitrile (5 ml) during 15-20 min. The reaction mixture was stirred at 28° for 16 h, diluted with cold water and the solid filtered.

4-Pivalamido-N-methanesulphonyl aniline (9a), m.p. 190-192° (from ethyl acetate - ether). (Found: C, 53.61; H, 6.67; N, 10.75. $C_{12}H_{18}N_2O_3S$ requires C, 53.32; H, 6.71; N, 10.37%).

2-Methyl-4-pivalamido-N-methanesulphonyl aniline (9b), m.p. 203-205° (from ethyl acetate - methanol). (Found: C, 55.62; H, 7.41. $C_{13}H_{20}N_2O_3S$ requires C, 54.92; H, 7.09%).

3-Methyl-4-pivalamido-N-methanesulphonyl aniline (9c), m.p. 183-185° (from ethyl acetate - methanol). (Found: C, 54.90; H, 7.08; N, 9.97. $C_{13}H_{20}N_2O_3S$ requires C, 54.92; H, 7.09; N, 9.85%).

2-Methoxy-4-pivalamido-N-methanesulphonyl aniline (9d), m.p. 150-152° (from ethyl acetate - ether - hexane). (Found: C, 52.50; H, 6.33; N, 10.27. $C_{13}H_{20}N_2O_4S$ requires C, 51.99; H, 6.71; N, 9.33%).

v) 2-Methoxy-4-nitroaniline was pivaloylated using pivaloyl chloride in acetonitrile and N,N-dimethyl aniline; m.p. 136-138° (from ethyl acetate - hexane). (Found: C, 57.48; H, 6.52; N, 11.46. $C_{12}H_{16}N_2O_4$ requires C, 57.13; H, 6.39; N, 11.11%).

Catalytic reduction of the above in presence of Raney nickel gave the amine, m.p. 141-144° (from ethyl acetate - hexane). (Found: C, 64.60; H, 7.99; N, 12.88. $C_{12}H_{18}N_2O_2$ requires C, 64.84; H, 8.16; N, 12.60%).

Treatment of the above amine in pyridine with methanesulphonyl chloride at 28° for 8 h gave 3-methoxy-4-pivalamido-N-methanesulphonyl aniline (9e), m.p. 152-154° (from ethyl acetate - methanol - ether). (Found : C, 51.90, H, 6.53; N, 9.45. $C_{13}H_{20}N_2O_4S$ requires C, 51.99; H, 6.71; N, 9.33%).

vi) Methyl chloroformate (2.5 g) was added dropwise with stirring to a solution of 4-methanesulphonamido aniline (4.65 g) and N,N-dimethylaniline (3.1 g) in dry acetonitrile (40 ml). The solution was stirred at 28° for 4 h, diluted with water, the solid filtered and recrystallised from ethyl acetate - methanol - ether to give (19), (3.8 g), m.p. 178-180°. (Found : C, 44.76; H, 5.13; N, 12.36. $C_9H_{12}N_2O_4S$ requires C, 44.26; H, 4.95; N, 11.47%).

Synthesis of the quinone-imides

The following general procedure was used for the oxidation of the benzenoid precursors. The 1,4-diaminobenzene derivative (10 mmol) in dry CH_2Cl_2 (200 ml) was stirred at 15° and treated with LTA (4.4 g). After stirring for 4 h at this temperature, the insoluble solid was filtered off, and the filtrate concentrated at < 40°. Addition of hexane and cooling caused the crystallisation of the quinone-imide. In some cases, filtration through a short silica gel column was resorted to in order to purify the product; elution with CH_2Cl_2 gave the required product.

N-Dichloroacetyl-N'-methanesulphonyl-1,4-benzoquinone-imine (8a), m.p. 128-130°. (Found: C, 36.88; H, 3.05; N, 9.09. $C_9H_8Cl_2N_2O_3S$ requires C, 36.63; H, 2.73; N, 9.49%).

(8b), m.p. 141-143°. (Found: C, 39.11; H, 3.43; N, 9.40. $C_{10}H_{10}Cl_2N_2O_3S$ requires C, 38.85; H, 3.26; N, 9.06%). ^1H NMR (MeOD) : 2.03 (s, Me); 3.25 (s, Me); 6.18 (s, CH); 6.73 (s, CH); 6.92 (d, J 2 Hz, 1H); 7.40 (d, J 2 Hz, 1H). IR(CH_2Cl_2) : 1712 cm^{-1}.

(8c), m.p. 78-80°. (Found : C, 39.69; H, 3.83; N, 9.09. $C_{10}H_{10}Cl_2N_2O_3S$ requires C, 38.85; H, 3.26; N, 9.06%).

N-Methanesulphonyl-N'-pivaloyl-1,4-benzoquinoneimine (10a), m.p. 115-118°. (Found: C, 53.53; H, 6.26; N, 10.39. $C_{12}H_{16}N_2O_3S$ requires C, 53.72; H, 6.01; N, 10.44%). ^1H NMR ($CDCl_3$) : 1.23 (s, 3Me); 3.20 (s, Me); 6.70 to 7.90 (m, 4H).

(10b), m.p. 103-105° (Found: C, 54.97; H, 6.55; N, 9.53. $C_{13}H_{18}N_2O_3S$ requires C, 55.31; H, 6.43; N, 9.92%).

(10c), m.p. 76-80° (Found: C, 55.47; H, 6.52; N, 10.10. $C_{13}H_{18}N_2O_3S$ requires C, 55.31; H, 6.43; N, 9.92%). ^1H NMR (MeOD) : 1.23 (s, 3Me); 2.25 (s, Me); 3.27 (s, Me); 6.83 (s, 2H); 7.67 (s, 1H). IR (CH_2Cl_2) : 1680 cm^{-1}.

(10d), m.p. 135-138° (Found : C, 52.15; H, 6.35; N, 9.43. $C_{13}H_{18}N_2O_4S$ requires C, 52.34; H, 6.08; N, 9.39%).

(10e), m.p. 114-115° (Found: C, 52.80; H, 6.31; N, 9.56. $C_{13}H_{18}N_2O_4S$ requires C, 52.34; H, 6.08; N, 9.39%).

(20), m.p. 74-76° (Found: C, 45.08; H, 4.22. $C_9H_{10}N_2O_4S$ requires C, 44.63; H, 4.16%. This quinone-imide tended to decompose even on standing for a short while. ^{1}H NMR ($CDCl_3$): 3.27 (s, Me); 3.93 (s, OMe); 6.70 to 7.90 (m, 4H).

Addition of azide ion to quinone-imides

To a suspension of the quinone-imide (1 g) in acetic acid (5 ml) was added dropwise a solution of sodium azide (0.35 g) in the minimum amount of water, with external cooling in ice-water. The dark red solution deposited a white precipitate within 5 min. After stirring for 1 h, the mixture was diluted with water, filtered and the solid washed with water.

2-Azido-4-dichloroacetamido-N-methanesulphonyl aniline (11a), m.p. 148-150° (from ethyl acetate-hexane). (Found : C, 32.26; H, 2.93; N, 20.37. $C_9H_9Cl_2N_5O_3S$ requires C, 31.96; H, 2.68; N, 20.71%).

2-Azido-4-dichloroacetamido-6-methyl-N-methanesulphonyl aniline (11b), m.p. 162-164° (from CH_2Cl_2, ethyl acetate - hexane). (Found : C, 34.27; H, 3.46; N, 19.54. $C_{10}H_{11}Cl_2N_5O_3S$ requires C, 34.10; H, 3.15; N, 19.89%).

2-Azido-4-dichloroacetamido-5-methyl-N-methanesulphonyl aniline (11c), m.p. 170-172° (d) (from ethyl acetate - hexane). (Found: C, 34.71; H, 3.45; N, 19.50. $C_{10}H_{11}Cl_2N_5O_3S$ requires C, 34.10; H, 3.15; N, 19.89%).

Addition of thiocyanate ion to quinone-imides

i) Without isolation of the intermediate : Potassium thiocyanate (3 g) in water (5 ml) was added to the quinone-imide (20 mmol) in acetic acid (15 ml) with stirring at 28°. A thick precipitate was formed in 5-10 min. After stirring for 1/2 h, more acetic acid (25 ml) was added and the temperature raised to 70-80°, when a clear solution resulted. The solution was maintained at this temperature for 2 hr, cooled and basified with $NaHCO_3$ solution. At this stage, if the product came out as a solid, it was filtered; if it was a gum, it was triturated (or extracted) with ethyl acetate to produce a solid.

2-Amino-6-methanesulphonamidobenzothiazole (15), m.p. 209-212° (from ethyl acetate-hexane) : yield 43% (Found : C, 39.99; H, 3.99; N, 16.51. $C_8H_9N_3O_2S_2$ requires C, 39.51; H, 3.73; N, 17.28%). ^{1}H NMR ($CDCl_3$ + CD_3SOCD_3) : 2.89 (s, Me); 7.13 (d,d, Ar-H, J 8.5 Hz, 2 Hz); 7.35 (d, Ar-H, J 8.5 Hz); 7.53 (d, Ar-H, J 2 Hz). MS: 243 (M^+).

2-Amino-6-pivalamidobenzothiazole (18a) (yield 51%), m.p. 225-228° (from ethyl acetate - methanol - ether). (Found : C, 58.03; H, 6.27; N, 17.17. $C_{12}H_{15}N_3OS$ requires C, 57.82; H, 6.07; N, 16.86%). ^{1}H NMR (TFA): 1.47 (s, 3 Me); 7.55 (s, 2 Ar-H); 8.07 (s, 1 Ar-H). MS : 249 (M^+).

2-Amino-5-methyl-6-pivalamidobenzothiazole (18c) (yield 14%), m.p. 292-294°(d) (from $CHCl_3$ - methanol). (Found : C, 57.35; H, 6.51; N, 15.12. $C_{13}H_{17}N_3OS.1/2\ H_2O$ requires C, 57.33; H, 6.66; N, 15.43%). ^{1}H NMR (TFA): 1.47 (s, 3 Me); 2.40 (s, Me); 7.47 (s, Ar-H); 7.70 (s, Ar-H). MS : 263 (M^+).

2-Amino-5-methoxy-6-pivalamidobenzothiazole (18e) (yield 71%), m.p. 285-288°(d) (from $CHCl_3$ - methanol - ether). (Found : C, 55.65; H, 6.37; N, 15.42. $C_{13}H_{17}N_3O_2S$ requires C, 55.90; H, 6.14; N, 15.05%). ^{1}H NMR (TFA): 1.47 (s, 3 Me); 4.07 (s, OMe); 7.23 (s, Ar-H); 8.57 (s, Ar-H). MS : 279 (M^+).

2-Amino-6-methoxycarbonylaminobenzothiazole (21), (yield 39.9%), m.p. 176-180°, resolidifying and decomposing at 300° (from ethyl acetate - methanol - ether). (Found : C, 48.61; H, 4.28; N, 19.15. $C_9H_9N_3O_2S$ requires C, 48.43; H, 4.06; N, 18.83%). ^{1}H NMR (TFA) : 3.98 (s, OMe); 7.48 (s, 2 Ar-H); 7.93 (s, 1 Ar-H). MS : 223 (M^+).

ii) In two steps, with isolation of the intermediate : N,N'-Bis-methanesulphonyl-1,4-benzoquinone-imine[6] (13) (0.5 g) was suspended in acetic acid (2 ml) and treated with stirring and cooling (15°) with a solution of potassium thiocyanate (0.3 g) in water (1 ml). A white solid separated in 5 min. After 25 min. at 15°, the mixture was diluted with water, the solid filtered and washed with cold methanol and ether. The IR spectrum of this solid showed a sharp band at 2165 cm-1.

This solid in methanol (5 ml), water (1 ml) and acetic acid (2 ml) was stirred for 16 h at 28°, basified with $NaHCO_3$ and extracted with ethyl acetate to give 2-amino-6-methanesulphonamidobenzothiazole (15),[3] (0.1 g), m.p. 203-205°, identical with the sample obtained above (mixed m.p., IR, TLC).

Synthesis of authentic 2-amino-6-methanesulphonamidobenzothiazole

A solution of bromine (1.6 g) in acetic acid (3 ml) was added dropwise with cooling and stirring to a mixture of 4-methanesulphonamido aniline (6a) (1.85 g) and potassium thiocyanate (2 g) in acetic acid (15 ml). The mixture was stirred for 1 h, the insoluble matter filtered off and the filtrate left at 28° for 72 h. The solid was filtered, dissolved in water, basified with $NaHCO_3$ solution, and extracted with ethyl acetate. Drying and evaporating the extract gave 2-amino-6-methanesulphonamidobenzothiazole (0.1 g), m.p. and mixed m.p. with the previous sample, 207-210°. The two samples had identical IR and NMR spectra.

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