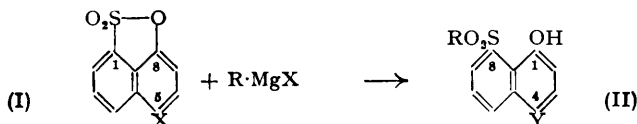


244. *Action of Grignard Reagents. Part IV.* Action of Grignard Reagents on Substituted Derivatives of Naphthasultone, N-Phenyl-o-sulphobenzoic Imide, 2-Phenyl-4 : 5-benzo-1 : 2-thiazolone, and 3-Chloro-4 : 5-benzo-1 : 2-thiazole 1 : 1-Dioxide.*

By AHMED MUSTAFA and MUSTAFA KAMAL HILMY.

The reactions named in the title occur as expected.

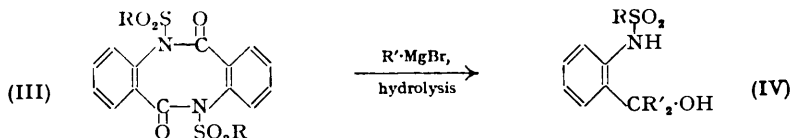
IN Parts I and III (Mustafa and Gad, *J.*, 1949, 384; Mustafa, *J.*, 1949, 2151), it was shown that the action of Grignard solutions on tolylene-3 : 4-sulphonylde and 1 : 8-naphthasultone (I; X = H), or its substitution products, provides a new method of preparing *o*- or *peri*-hydroxydiaryl sulphones respectively. Further examples are now reported.



When X in (I) is acetyl, the sultone ring is opened by reaction with methyl-, ethyl-, phenyl-, or α -naphthyl-magnesium halide, and (II) is obtained in which Y is $\text{CR}_2\cdot\text{OH}$ produced by reaction of the acetyl group with the Grignard reagent. 5-Benzoylnaphthasultone (I; X = $\text{CO}\cdot\text{C}_6\text{H}_5$) reacts similarly.

5-Chloromethyl-1 : 8-naphthasultone reacts with an excess of phenyl- or α -naphthyl-magnesium bromide to give 4-benzyl-8-benzenesulphonyl- and 4- α -naphthylmethyl-8- α -naphthalenesulphonyl-1-naphthol, respectively (cf. Table 1a).

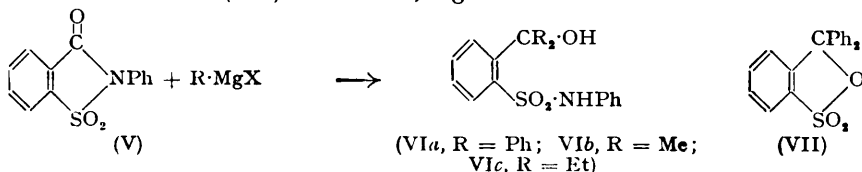
The constitutions of the products are deduced from the facts that they are colourless, form the corresponding methyl ethers with ethereal diazomethane in the absence of methyl alcohol (cf. Schönberg and Mustafa, *J.*, 1948, 605), dissolve in aqueous alkali, and contain active hydrogen.



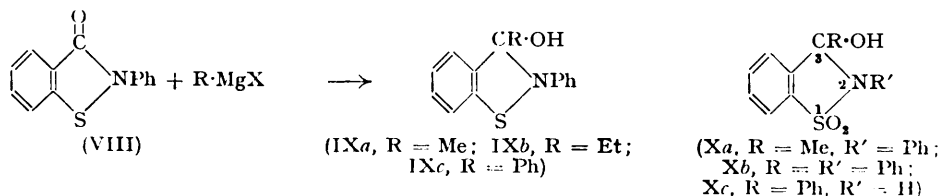
Mustafa and Gad (*loc. cit.*) have shown that Grignard reagents break the -C-N- linkage of *NN'*-diarylsulphonyldianthranilides (III), giving the corresponding *o*-arylsulphonyl-amidotriarylcarbinols (IV). *N*-Phenyl-*o*-sulphobenzoic imide (V) undergoes similar C-N cleavage, yielding the *N*-substituted *o*-sulphamyl-carbinols (VIa, b, and c) (cf. Sachs, Wolff, and Ludwig, *Ber.*, 1904, **37**, 3252; Sachs and Ludwig, *ibid.*, p. 389). The structure of *N*-phenyl-*o*-sulphamyltriphenylcarbinol (VIa) is inferred from the facts that it is colour-

* Part III, *J.*, 1949, 2151.

less, reacts with ethereal diazomethane (cf. Mustafa and Gad, *loc. cit.*), contains active hydrogen, gives the expected molecular weight, and is not identical with (X) (see below). Those of (VI*b* and *c*) are similarly deduced. When (VI*a*) is treated with concentrated sulphuric acid, the sultone (VII) is obtained, together with aniline.

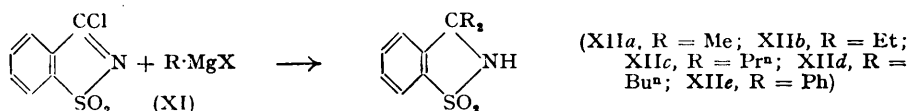


The carbonyl group of 2-phenyl-4:5-benzo-1:2-thiazolone (VIII) adds the Grignard reagent in the usual manner to give the corresponding hydroxy-compounds (IX*a*, *b*, and *c*)—compare the formation of (X*c*) by the action of phenylmagnesium bromide on saccharin (Oddo and Mingola, *Gazzetta*, 1927, **57**, 465), in contrast with the behaviour of (V) towards Grignard solutions. The constitution of the products (IX*a*—*c*) is elucidated from the facts



that they are colourless, contain active hydrogen, and are recovered unchanged when treated with ethereal diazomethane. When (IX*a*) and (IX*c*) are treated with hydrogen peroxide in acetic acid at 100°, they yield the 1:1-dioxides (X*a* and *b*).

The sultam (XII*e*) is obtained in poor yield together with the analogous sultim by the condensation of the chloride (XI) with benzene in the presence of aluminium chloride



(Fritzsche, *Ber.*, 1896, **29**, 2296). When (XI) has been treated with excess of phenylmagnesium bromide, hydrolysis gives (XII*e*) in almost quantitative yield. Methyl-, ethyl-, *n*-propyl-, and *n*-butyl-magnesium halides react analogously. This constitutes a new method for preparing these sultams.

EXPERIMENTAL

Action of Grignard Reagents on Substituted Naphthasultones (I).—The following exemplifies the procedure. 5-Acetyl-1:8-naphthasultone (I; X = Ac) (Schetty, *Helv. Chim. Acta*, 1947, **30**, 1650) (2 g.) in dry benzene (50 c.c.) was added to a solution of phenylmagnesium bromide [prepared from magnesium (1.8 g.), bromobenzene (18 g.), and dry ether (40 c.c.)], and the mixture was heated under reflux for 3 hours and then set aside overnight. The reaction mixture was decomposed with cold, dilute hydrochloric acid and extracted with ether. The ethereal solution was dried (Na₂SO₄), the solvent evaporated, and the residue washed twice with cold light petroleum (b. p. 30—50°). The 4- α -hydroxy- α -methylbenzyl-8-phenylsulphonyl-1-naphthol (2.5 g., 69%) obtained was filtered off and crystallised (cf. Table 1).

The naphthols listed in Table 1(*a*) were prepared similarly; except for methyl- and ethylmagnesium iodide the Grignard reagents used were bromides.

The naphthols dissolve in cold aqueous sodium hydroxide to give yellow solutions and their alcoholic solutions give an orange-red colour with ferric chloride; the same colour is given with concentrated sulphuric acid. In general, they dissolve in hot alcohol, benzene, and acetone, but are sparingly soluble in light petroleum (b. p. 40—60°).

Methylation was effected by ethereal diazomethane during 24 hours at 0°. The reaction mixture was evaporated; an ethereal solution of the residue was treated with aqueous potassium hydroxide (to remove unchanged naphthol), then with water, dried, and evaporated. The

TABLE 1a. 8-Hydroxy-1-naphthyl Sulphones (II).

R	M. p.	Solvent for crystn.	Found, %			Required, %			Colour in H ₂ SO ₄
			C	H	S	C	H	S	
CM _e , OH	176°	A	60.0	5.5	11.0	60.0	5.7	11.4	Yellow
CEtMe-OH	158	A or C	62.1	6.4	10.2	62.3	6.5	10.4	Orange-red
CPhMe-OH	168	C	71.0	4.8	7.8	71.3	4.9	7.9	Orange
1-C ₁₀ H ₇ , CM _e -OH	163	D	75.9	4.6	6.0	76.2	4.7	6.3	Orange-red
CPhMe-OH	170	C	66.4	5.3	9.1	66.7	5.2	9.4	Brown-red
CPhEt-OH	181	C	67.9	5.6	8.4	68.1	5.9	8.6	Red
CPh ₂ -OH	164	C	74.5	4.5	6.6	74.7	4.7	6.9	Orange-red
CH ₂ Ph	169	D	73.6	4.7	8.5	73.8	4.8	8.5	Purple
1-C ₁₀ H ₇ , CH ₂	232	D	78.4	4.4	6.5	78.5	4.6	6.8	Bluish-green

^a Found: M, 498. Req'd.: M, 452. Req'd.: M, 466. ^e Found: M, 460. Req'd.: M, 474.
¹ This experiment was carried out with A. F. A. Shalaby.
 Solvents (all Tables): A, Ethyl alcohol; B, methyl alcohol; C, benzene-light petroleum (b. p. 40—60°); D, benzene; E, light petroleum (b. p. 100—110°).

TABLE 1b. Methyl Ethers of (II).

R	M. p.	Solvent for crystn.	Found, %			Required, %			Colour in H ₂ SO ₄
			C	H	S	C	H	S	
CM _e , OH	120°	C	61.0	5.8	10.7	61.2	6.1	10.9	—
CEtMe-OH	135	B	63.4	6.9	9.7	63.3	6.8	9.9	—
CPhMe-OH	200	C	71.5	5.2	7.5	71.8	5.3	7.6	—
1-C ₁₀ H ₇ , CM _e -OH	157	B	76.3	4.8	5.9	76.4	5.0	6.2	—
CM _e Ph-OH	136	E	67.1	5.5	8.6	67.4	5.6	9.0	—
CEtPh-OH	142	E	68.5	6.2	8.1	68.8	6.2	8.3	—
CPh ₂ -OH	150	B	74.7	5.0	6.5	75.0	5.0	6.7	—
CH ₂ Ph	199	D	74.2	5.1	8.0	74.2	5.1	8.0	—
1-C ₁₀ H ₇ , CH ₂	244	D	78.5	4.8	6.3	78.7	4.9	6.5	—

^d Found, OMe, 7.2. Req'd.: OMe, 7.4%. ^e Found: OMe, 5.8. Req'd.: OMe, 5.98%. ^f Found: OMe, 6.2. Req'd.: OMe, 6.5%. ^g Found: OMe, 7.8. Req'd.: OMe, 8.0%.

TABLE 2. 3-Hydroxy-2-phenyl-4:5-benzo-1:2-thiazolines (IX).

R	M. p.	Solvent for crystn.	Yield, %	Found, %			Required, %		
				C	H	N	C	H	N
Me	150°	A	75	69.0	5.3	5.6	69.1	5.3	5.8
Et	103	C	62	69.9	5.6	5.6	70.0	5.8	5.4
Ph	170	A	70	74.5	4.6	4.4	74.7	4.9	4.6

^a Found: active H, 0.39. Req'd.: active H, 0.41%. [†] Found: active H, 0.35. Req'd.: active H, 0.39%.

TABLE 3. Substituted 4:5-benzo-1:2-thiazoline 1:1-dioxides (XII).

R	M. p.	Solvent for crystn.	Colour in H ₂ SO ₄	Yield, %	Found, %			Required, %		
					C	H	N	C	H	N
Me	114°	C	Pale yellow	60	54.6	5.5	6.9	54.8	5.6	7.1
Et	144	D	Red	75	58.4	6.5	6.0	58.6	6.7	6.2
Pr ⁿ	156	B	Yellow	65	61.5	7.3	5.5	61.7	7.5	5.5
Bu ⁿ	72	C	Red	72	63.8	7.9	4.9	64.0	8.2	5.0

others prepared are recorded in Table 1(b). They are rather more soluble in organic solvents than are the parent naphthols.

Action of Grignard Reagents on N-Phenyl-o-sulphobenzoic Imide (V).—(a) *Phenylmagnesium bromide*. The imide (2 g.) (McClelland and Gait, *J.*, 1926, 921) was treated with phenylmagnesium bromide as detailed above. *N-Phenyl-o-sulphamyltriphenylcarbinol (VIa)* was obtained in colourless crystals (from benzene) (*ca.* 70%), m. p. 205° [Found: C, 72.4; H, 4.9; N, 3.3; S, 7.5; active H, 0.44%; *M* (Rast), 414. $C_{25}H_{21}O_3NS$ requires C, 72.3; H, 5.0; N, 3.4; S, 7.7; active H, 0.48%; *M*, 415]. It gives a brown colour with concentrated sulphuric acid, is soluble in hot benzene and ethyl alcohol, but difficultly soluble in light petroleum (b. p. 50–70°). The carbinol (0.5 g.) and ethereal diazomethane, as above, gave the *N-methyl* derivative (82%) as colourless crystals, m. p. 168° (Found: C, 72.6; H, 5.2; N, 3.3; S, 7.4. $C_{26}H_{23}O_3NS$ requires C, 72.7; H, 5.4; N, 3.3; S, 7.5%). It is easily soluble in benzene and alcohol, and gives an orange colour with concentrated sulphuric acid.

The carbinol (1 g.) was dissolved in concentrated sulphuric acid (5 c.c.) and set aside for 1 hour at room temperature. The red solution was heated on a water-bath for 30 minutes, poured into ice-water, and extracted with ether. The ethereal layer was washed with water, dried, and evaporated; the colourless crystals obtained were recrystallised from alcohol, and had m. p. 162° (Found: C, 70.6; H, 4.3; S, 9.8. Calc. for $C_{19}H_{14}O_3S$: C, 70.8; H, 4.3; S, 9.9%). The sulphonylde (VII) was identified by m. p. and mixed m. p. with an authentic specimen (List and Stein, *Ber.*, 1898, 31, 1664). The aqueous layer was neutralised with sodium carbonate, extracted with ether, dried, and evaporated, and the oily residue was treated with benzoyl chloride in the presence of aqueous sodium hydroxide (10%). Benzanilide was obtained, m. p. and mixed m. p. 163°.

(b) *Methylmagnesium iodide*. The imide (V) (1 g.) was treated with methylmagnesium iodide (from magnesium, 0.6 g., methyl iodide, 3.6 g., and dry ether, 40 c.c.) as described previously. The oily residual α -dimethyl-o-N-phenylsulphamylbenzyl alcohol (VIb) (75%) was washed several times with light petroleum (b. p. <50°) and crystallised from dilute alcohol as colourless crystals, m. p. 113–114° [Found: C, 61.6; H, 5.7; N, 4.6; S, 10.7%; *M* (Rast), 287. $C_{15}H_{17}O_3NS$ requires C, 61.9; H, 5.8; N, 4.8; S, 10.9%; *M*, 291]. The product is easily soluble in most organic solvents.

(c) *Ethylmagnesium iodide*. α -Diethyl-o-N-phenylsulphamylbenzyl alcohol (VIc) (0.6 g.) was obtained similarly, by the action of ethylmagnesium iodide on (V) (1 g.), as colourless crystals (from ethyl alcohol), m. p. 117° (Found: C, 63.8; H, 6.5; N, 4.2; S, 9.8. $C_{17}H_{21}O_3NS$ requires C, 63.9; H, 6.6; N, 4.4; S, 10.0%). It is easily soluble in benzene, but difficultly soluble in light petroleum (b. p. <40°).

Action of Grignard Reagents on 2-Phenyl-4:5-benzo-1:2-thiazolone (VIII).—The results are given in Table 2.

3-Hydroxy-3-methyl-2-phenyl-4:5-benzo-1:2-thiazoline 1:1-Dioxide (Xa).—To a solution of (IXa) (0.5 g.) in acetic acid (3 c.c.), hydrogen peroxide (1.5 c.c.) was added, and the reaction mixture was heated on a water-bath for 1 hour. On cooling, the colourless crystals that separated were recrystallised from alcohol; the dioxide had m. p. 155° (Found: C, 60.8; H, 4.6; N, 4.9; S, 11.5. $C_{14}H_{13}O_3NS$ requires C, 61.1; H, 4.7; N, 5.1; S, 11.6%). Yield *ca.* 88%.

The 2:3-diphenyl analogue (Xb) was similarly obtained (79%) as colourless crystals (from acetic acid), m. p. 182° (Found: C, 67.3; H, 4.5; N, 3.9; S, 9.3. $C_{19}H_{15}O_3NS$ requires C, 67.6; H, 4.4; N, 4.2; S, 9.5%).

Action of Grignard Reagents on the Chloride (XI).—The chloride (2 g.) (Fritzsche, *loc. cit.*) was treated with phenylmagnesium bromide as detailed previously. 3:3-Diphenyl-4:5-benzo-1:2-thiazoline 1:1-dioxide (XIIe) was obtained in colourless crystals (82%) (from benzene), m. p. 210° (Found: C, 71.0; H, 4.4; N, 4.3; S, 9.6. Calc. for $C_{19}H_{15}O_2NS$: C, 71.0; H, 4.7; N, 4.4; S, 9.9%). It was identified by the m. p. and mixed m. p. with an authentic specimen, prepared according to Fritzsche (*loc. cit.*). It gives a reddish-brown colour with concentrated sulphuric acid and dissolves in aqueous sodium hydroxide.

The dioxide (0.5 g.) and ethereal diazomethane give the 2-methyl derivative, m. p. 205° (from benzene) (Found: C, 71.5; H, 5.0; N, 3.9; S, 9.5. $C_{20}H_{17}O_2NS$ requires C, 71.6; H, 5.1; N, 4.2; S, 9.6%). This is easily soluble in hot benzene and alcohol, but difficultly soluble in light petroleum (b. p. 40–60°).

For analogues see Table 3.