

A New Synthesis of *s*-Triazoles from 1*H*-2,3-Benzoxazine 4-Hydrazones (I)

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Aliphatic and aromatic aldehydes react with 4-hydrazino-1*H*-2,3-benzoxazines (I) to form the corresponding 1*H*-2,3-benzoxazine hydrazones (II). Compounds II when heated in the presence of an acid catalyst rearrange to form substituted *s*-triazoles (III) in high yields. In particular, the hydrazones containing one imino hydrogen undergo the same rearrangement by refluxing in xylene. Structure III, in agreement with the analytical and spectroscopic data, was confirmed by univocal syntheses. The *N*-acylation and *N*-alkylation of some unsymmetrically 3,5-substituted *s*-triazoles were also investigated and the mechanism of formation of III is briefly discussed.

We have recently reported on the preparation of some 4-hydrazino-1*H*-2,3-benzoxazines (Ia...d) (3,4) from the nucleophilic displacement of 4-chloro- and 4,6-dichloro-1*H*-2,3-benzoxazine with hydrazine or methylhydrazine. The condensation of Ia...c with one equivalent of a suitable aliphatic or aromatic aldehyde in ethanol led to the substituted hydrazones of 1*H*-2,3-benzoxazine (IIa...g) (Table I). However, when IIa...d were heated with dilute hydrochloric acid, a novel rearrangement was found to take place instead of the expected hydrolysis and 3,5-substituted-1-methyl-1*H*-1,2,4-triazoles (IIIa...d) were obtained in very good yields (Scheme I).

A band at about  $3300\text{ cm}^{-1}$  in the infrared spectrum in the solid state and two absorptions in the nmr spectrum in dimethylsulfoxide solution at about  $5.4\ \tau$  ( $\text{CH}_2\text{-O}$  doublet) and  $4.7\ \tau$  (OH, triplet) indicated (5) the presence of a hydroxymethyl group in the rearranged products IIIa...d, arising from the cleavage of the weak N-O bond in the 2,3-benzoxazine ring. This was proved by reacting IIIc with acetic anhydride to give the expected ester IVa, and with hydrogen bromide to yield the bromo derivative IVb. Structure III was then confirmed by an alternative synthesis of the reduced compound V from IIIb, involving an univocal ring closure of 1-benzimidoyl-2-methylhydr-

SCHEME I

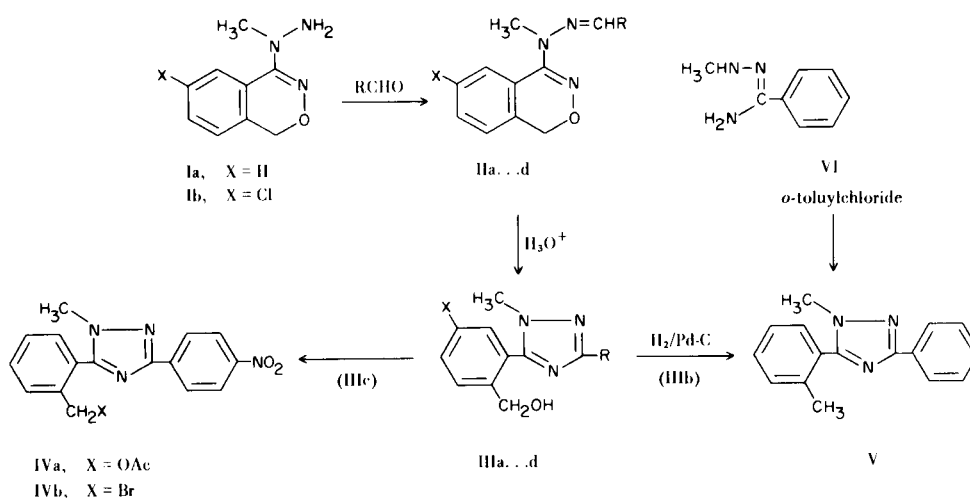


TABLE I  
1*H*-2,3-Benzoxazine Hydrazones (II)

No.	R	R <sub>1</sub>	X	M.P., °C (a)	Yield %	Formula	C%		H%		N%	
							Calcd.	Found	Calcd.	Found	Calcd.	Found
IIa	CH <sub>3</sub>	CH <sub>3</sub>	H	liquid	---	C <sub>11</sub> H <sub>13</sub> N <sub>3</sub> O	72.43	72.60	5.70	5.53	15.84	15.90
IIb	C <sub>6</sub> H <sub>5</sub>	CH <sub>3</sub>	H	133-135	91	C <sub>16</sub> H <sub>15</sub> N <sub>3</sub> O	72.43	72.60	5.70	5.53	15.84	15.90
IIc	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	CH <sub>3</sub>	H	210 dec.	98	C <sub>16</sub> H <sub>14</sub> N <sub>4</sub> O <sub>3</sub> (b)	---	---	---	---	---	---
IIId	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	CH <sub>3</sub>	Cl	251 dec.	75	C <sub>16</sub> H <sub>13</sub> ClN <sub>4</sub> O <sub>3</sub> (c)	55.74	55.80	3.80	4.03	16.25	16.12
IIe	CH <sub>3</sub>	H	H	128-129	83	C <sub>10</sub> H <sub>11</sub> N <sub>3</sub> O	63.47	63.56	5.86	5.81	22.21	22.00
IIIf	C <sub>6</sub> H <sub>5</sub>	H	H	155-156	98	C <sub>15</sub> H <sub>13</sub> N <sub>3</sub> O	71.69	71.28	5.21	4.92	16.72	17.00
IIIg	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	H	H	189-190	85	C <sub>15</sub> H <sub>12</sub> N <sub>4</sub> O <sub>3</sub>	60.80	60.21	4.08	4.28	18.91	19.20

(a) The solid products were crystallized from ethanol except for IIg which was purified from ethyl acetate. (b) This compound has been described (ref. 3). (c) *Anal.* Calcd.: Cl%, 10.28. Found: 9.95.

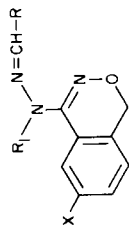


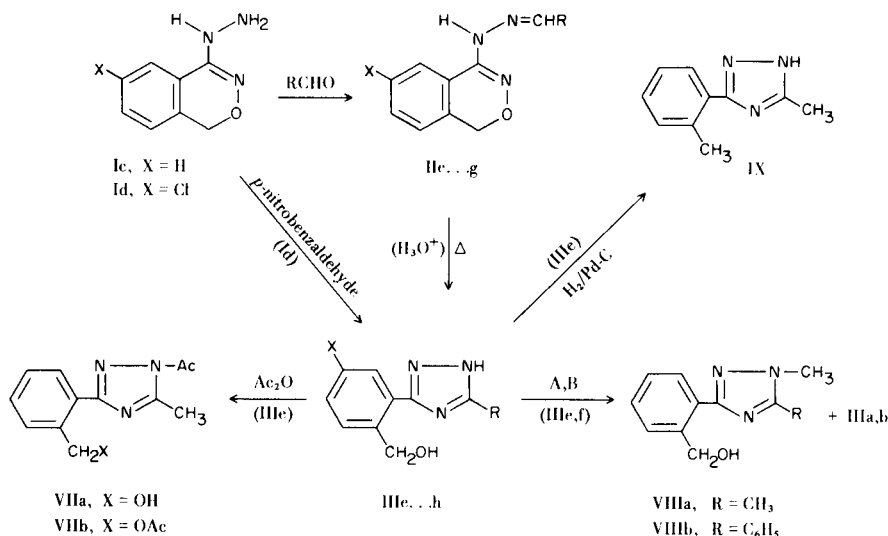
TABLE II

Substituted 1,2,4-Triazoles (III)

No.	R	R <sub>1</sub>	X	M.P. °C (cryst. solvent)	Yield %	Formula	C%		H%		N%	
							Calcd.	Found	Calcd.	Found	Calcd.	Found
IIIa	CH <sub>3</sub>	CH <sub>3</sub>	H	70-71 (isopr. ether)	86	C <sub>11</sub> H <sub>13</sub> N <sub>3</sub> O	65.00	64.93	6.45	6.62	20.68	20.65
IIIb	C <sub>6</sub> H <sub>5</sub>	CH <sub>3</sub>	H	122-123 (ethanol)	96	C <sub>16</sub> H <sub>15</sub> N <sub>3</sub> O	72.43	72.48	5.70	5.76	15.84	16.00
IIIc	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	CH <sub>3</sub>	H	175-176 (ethanol)	96	C <sub>16</sub> H <sub>14</sub> N <sub>4</sub> O <sub>3</sub>	61.93	61.30	4.55	4.68	18.06	18.50
IIId	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	CH <sub>3</sub>	Cl	209-210 (benzene)	95	C <sub>16</sub> H <sub>13</sub> ClN <sub>4</sub> O <sub>3</sub> (a)	55.74	55.37	3.80	3.88	16.25	16.10
IIIe	CH <sub>3</sub>	H	H	149-150 (ethylacet.)	94	C <sub>10</sub> H <sub>11</sub> N <sub>3</sub> O	63.47	63.45	5.86	5.92	22.21	22.40
IIIf	C <sub>6</sub> H <sub>5</sub>	H	H	195-196 (ethanol)	97	C <sub>15</sub> H <sub>13</sub> N <sub>3</sub> O	71.69	71.77	5.21	5.20	16.72	16.72
IIIg	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	H	H	282-283 (pyridine)	90	C <sub>15</sub> H <sub>12</sub> N <sub>4</sub> O <sub>3</sub>	60.80	60.63	4.08	4.03	18.91	18.80
IIIh	C <sub>6</sub> H <sub>4</sub> NO <sub>2-p</sub>	H	Cl	220 dec. (pyridine)	42 (b)	C <sub>15</sub> H <sub>11</sub> ClN <sub>4</sub> O <sub>3</sub> (c)	54.58	54.48	3.35	3.50	16.94	17.20

(a) *Anal.* Calcd.: Cl, 10.28%. Found: 10.16. (b) From Id. (c) *Anal.* Calcd.: Cl, 10.72%. Found: 10.95.

SCHEME II



azine (VI) and *o*-toluylchloride according to the procedure of Atkinson and Polya (6). The 3,5-disubstituted-1-methyl-1*H*-1,2,4-triazoles (IIIa...d) (Table II) are stable solid substances insoluble in water, with the exception of IIIa, and soluble in hydrochloric acid in concentrations increasing from 5 to 20% for IIIb-d; one basic nitrogen can be detected by potentiometric titration in acetic acid with perchloric acid also in IIIc-d, the less basic products for the presence of a nitro group.

A protonating medium was not necessary for the rearrangement of the hydrazones IIe...g containing one imino hydrogen in the molecule. These compounds thermally rearranged by simply refluxing derivatives IIe...g in xylene (Scheme II). In particular, the hydrazone IIIh could not be isolated because derivative Id reacted with *p*-nitrobenzaldehyde at room temperature to give directly 3-(5-chloro-2-hydroxymethylphenyl)-5-(4-nitrophenyl)-*s*-triazole (IIIh) (7). The presence of OH and NH stretching absorptions was not so evident in the ir spectra of IIIe...h in the solid state, particularly for compounds IIIg and IIIh, which showed a very broad band in the range 3200-2300  $\text{cm}^{-1}$ , probably due to highly associated forms (10). The nmr spectra of IIIe...h were taken in pyridine- $d_5$  and showed the presence of a two mobile protons broad band at about  $-0.5 \tau$ . Two active hydrogens per molecule were quantitatively confirmed by isotopic exchange (11). Additional evidence that the structure of class III is correct, was obtained by catalytic reduction of IIIe to the known triazole IX (12). The 3,5-substituted *s*-triazoles IIIe...h synthesized are amphoteric substances with a higher m.p. than the corresponding 1-methyl derivatives IIIa...d, and are reported with their analytical data in Table II.

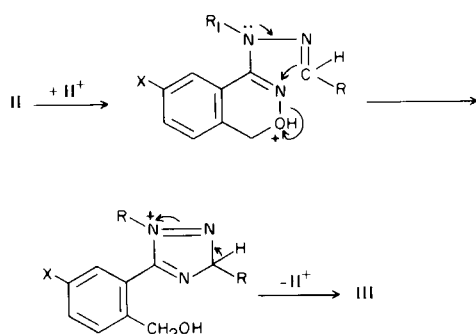
When the triazole IIIe was treated with about one equivalent of acetic anhydride at 80° in benzene, the *N*-acetyl-triazole (VIIa) was obtained which is insoluble in mineral acids and easily hydrolyzed by aqueous alkali at room temperature to the starting product. Evidence for a free hydroxymethyl group were the infrared band at 3300  $\text{cm}^{-1}$  and the two absorptions (5) (a doublet at 5.05  $\tau$  and a triplet at 4.75  $\tau$ ) in the nmr spectrum in dimethylsulfoxide solution. The high frequency of the infrared carbonyl peak at 1750  $\text{cm}^{-1}$  is characteristic for *N*-acyltriazoles (8,13). The proposed position of the acetyl group (14) in VIIa appears the most likely one considering that substitutions in 3,5-unsymmetrically substituted *s*-triazoles occur mainly at the "vicinal" nitrogen with increased  $\pi$ -electron density (6,15). Further treatment of VIIa with an excess of acetic anhydride at 140° gave the *O,N*-diacetyl derivative (VIIb).

Methylation of IIIe either with diazomethane (Method A) or with methyl iodide on its sodium salt (Method B) afforded the 1,5-dimethyltriazole VIIIa and smaller quantities of the 1,3-dimethyl isomer IIIa, identical (undepressed m.p. in admixture, infrared spectrum) with the sample obtained from the rearrangement of IIa. The composition of the isomeric mixture obtained by methylation of IIIe with diazomethane doesn't parallel the one obtained by Atkinson and Polya (6) starting from 3-methyl-5-phenyl-*s*-triazole. In order to ascertain the importance of the tautomeric composition of the starting triazoles in respect to the composition of the isomeric methylated mixture, studies are in progress.

Methylation of IIIf with Methods A and B gave a 1:1 mixture, chromatographically separated of 3-(2-hydroxymethylphenyl)-1-methyl-5-phenyl-1*H*-1,2,4-triazole (VIIIb)

and of the isomer IIIb, identified by its infrared spectrum and mixed m.p. with the sample obtained from IIb. The structure of the triazoles VIIIa and VIIIb were assigned on the basis of similar alkylations described for some 3,5-substituted *s*-triazoles (6,15) and on the comparison of their ultraviolet spectra with those of analogous triazoles reported by Potts (8), as the most closely related structures available.

As far as the mechanism is concerned, we observed that acidic, but not basic conditions promote the rearrangement of the hydrazones II. It is proposed that, by a Beckman-like protonation on oxygen, an oxonium salt is formed which is favourably arranged to transform irreversibly into the triazole III, as indicated. The syn-



thesis of other hydrazones, by condensation of derivatives Ia...d with ketones, and the study of their chemical behavior have been also investigated in our laboratories and will be the subject of a later communication.

#### EXPERIMENTAL (16)

General Procedure for the Preparation of 1*H*-2,3-Benzoxazine Hydrazones (IIa...g). Example: 4-(2-Benzyliden-1-methylhydrazino)-1*H*-2,3-benzoxazine (IIb).

To a solution of 4-(1-methylhydrazino)-1*H*-2,3-benzoxazine (3) (Ia; 0.89 g., 5 mmoles) in 13 ml. of ethanol, benzaldehyde (0.53 g., 5 mmoles) was added and the mixture was allowed to stand at room temperature for three hours. The precipitate was filtered, dried and recrystallized quickly from ethanol;  $\text{ir cm}^{-1}$ : 1540 (C=N), 990 (C=O), 780, 760, and 700 (aromatic CH).

The analytical properties of derivatives IIa...g, obtained from Ia...c (3,4) according to the above procedure, are reported in Table I, with the exception of IIa, an oily product which, after infrared control, was used without purification for the next reaction.

General Procedure for the Preparation of 3,5-Substituted-1-methyl-1,2,4-1*H*-triazoles (IIIa...d). Rearrangement in an Acidic Medium. Example: 5-(2-Hydroxymethylphenyl)-1-methyl-3-phenyl-1*H*-1,2,4-triazole (IIIb).

A suspension of 1.2 g. of 4-(2-benzyliden-1-methylhydrazino)-1*H*-2,3-benzoxazine (IIb) in 12 ml. of ethanol and 12 ml. of 5% hydrochloric acid was heated on a water bath for three hours. The ethanol was removed by distillation and the residue, neutralized

with a sodium bicarbonate solution, was cooled at 0°. The precipitate of IIIb was filtered and crystallized from ethanol;  $\text{ir cm}^{-1}$ : 3350 (OH), 1560 (C=N), 1025 ( $\tau$  OH), 760 and 705 aromatic CH; nmr (DMSO- $d_6$ ): 6.21  $\tau$  (s, 3H, CH<sub>3</sub>-N  $\curvearrowright$ ), 5.49  $\tau$  (d, 2H, CH<sub>2</sub>), 4.73  $\tau$  (t, 1H, OH), 2.7-1.8  $\tau$  (m, 9H, aromatic hydrogens).

The analytical data of compounds IIIa...d are reported in Table II.

5-(2-Acetoxyethylphenyl)-1-methyl-3-(4-nitrophenyl)-1*H*-1,2,4-triazole (IVa).

A solution of 0.5 g. of 5-(2-hydroxymethylphenyl)-1-methyl-3-(4-nitrophenyl)-1*H*-1,2,4-triazole (IIIc) in 5 ml. of acetic anhydride was heated on a water bath for 3 hours and then evaporated *in vacuo* to dryness. The solid residue was crystallized from ethanol to yield 0.5 g. (88%) of IVa, m.p. 126-127°;  $\text{ir cm}^{-1}$ : 1755 (C=O), 1530 (C=N), 1540 and 1340 (NO<sub>2</sub>), 860 and 730 (aromatic CH); nmr (deuteriochloroform): 7.98  $\tau$  (s, 3H, CH<sub>3</sub>CO), 6.06  $\tau$  (s, 3H, CH<sub>3</sub>-N  $\curvearrowright$ ), 4.78  $\tau$  (s, 2H, CH<sub>2</sub>), 2.6-2.2  $\tau$  (m, 4H, *o*-phenyl hydrogens), 1.63  $\tau$  (s, 4H, *p*-phenyl hydrogens).

Anal. Calcd. for C<sub>18</sub>H<sub>16</sub>N<sub>4</sub>O<sub>4</sub>: C, 61.36; H, 4.54; N, 15.92. Found: C, 61.60; H, 4.70; N, 16.10.

5-(2-Bromomethylphenyl)-1-methyl-3-(4-nitrophenyl)-1*H*-1,2,4-triazole (IVb).

To 5 ml. of glacial acetic acid saturated with gaseous hydrogen bromide at 10° was added a warm (40°) solution of 0.2 g. of 5-(2-hydroxymethylphenyl)-1-methyl-3-(4-nitrophenyl)-1*H*-1,2,4-triazole (IIIc) in 5 ml. of acetic acid. The solution was stirred at room temperature for 3 hours, then evaporated to dryness using a rotatory evaporator. The residue was taken up with water and was adjusted to pH 8 with 8% sodium bicarbonate solution. The solid was filtered, dried and recrystallized from benzene to give 0.11 g. (46%) of IVb, m.p. 258° dec.;  $\text{ir cm}^{-1}$ : 1540 (C=N), 1530 and 1350 (NO<sub>2</sub>), 860 and 740 (aromatic CH); nmr (DMSO- $d_6$ ): 6.12  $\tau$  (s, 3H, CH<sub>3</sub>-N  $\curvearrowright$ ), 5.19  $\tau$  (s, 2H, CH<sub>2</sub>), 2.5-2.2  $\tau$  (m, 4H, aromatic hydrogens), 1.60  $\tau$  (s, 4H, aromatic hydrogens).

Anal. Calcd. for C<sub>16</sub>H<sub>13</sub>BrN<sub>4</sub>O<sub>2</sub>: C, 51.47; H, 3.51; N, 15.02; Br, 21.41. Found: C, 51.69; H, 3.62; N, 15.20; Br, 21.23.

1-Methyl-3-phenyl-5-(*o*-tolyl)-1*H*-1,2,4-triazole (V) from IIIb.

A solution of 0.53 g. (2 mmoles) of 5-(2-hydroxymethylphenyl)-1-methyl-3-phenyl-1*H*-1,2,4-triazole (IIIb) in 20 ml. of ethanol containing 2 mmoles of hydrogen chloride, was hydrogenated at 25° and atmospheric pressure using 0.5 g. of palladium 10% on charcoal as catalyst. When the calculated quantity of hydrogen was absorbed (about 1 hour), the catalyst was filtered off and the filtrate was evaporated to dryness. The solid (crude V hydrochloride) was suspended in water, made basic with sodium bicarbonate solution and the product was extracted with ether. The solvent was evaporated and the residue distilled *in vacuo* to yield 0.4 g. (80%) of V, b.p. 155-160°/0.1 mm. Hg;  $\text{ir cm}^{-1}$ : 1540 (C=N), 770, 735 and 690 (aromatic CH); nmr (deuteriochloroform): 7.74  $\tau$  (s, 3H, CH<sub>3</sub>-C  $\curvearrowright$ ), 6.28  $\tau$  (s, 3H, CH<sub>3</sub>-N  $\curvearrowright$ ), 2.8-2.4 and 1.95-1.65  $\tau$  (m, 9H, aromatic hydrogens).

Anal. Calcd. for C<sub>16</sub>H<sub>15</sub>N<sub>3</sub>: C, 77.08; H, 6.06; N, 16.86. Found: C, 76.88; H, 6.20; N, 17.00.

1-Methyl-3-phenyl-5-(*o*-tolyl)-1*H*-1,2,4-triazole (V) from VI.

A mixture of 1-benzimidoyl-2-methylhydrazine hydrochloride (6) (VI; 0.56 g.) and 3.8 g. of *o*-toluylchloride was heated (oil bath at 120°) for 12 hours while stirring. On addition of ether to the cooled solution, crystals of crude V hydrochloride were ob-

tained. The product was treated with aqueous bicarbonate solution and the base was extracted with ether. The organic phase was washed with water, dried (sodium sulfate) and evaporated. The residue was distilled *in vacuo* to yield 0.63 g. (84%) of V, b.p. 155-160°/0.1 mm. Hg.

This compound was identical (comparison of analytical and spectroscopic data) with that obtained from IIIb.

General Procedure for the Preparation of 3,5-Disubstituted *s*-Triazoles (IIIe..g). Thermal Rearrangement. Example: 3-(2-Hydroxymethylphenyl)-5-methyl-*s*-triazole (IIIe).

4-(2-Ethylidenediazirino)-1*H*-2,3-benzoxazine (IIe; 0.75 g.) was refluxed in 7.5 ml. of xylene for 45 minutes and cooled in an ice bath. The solid was filtered and recrystallized from ethyl acetate;  $\text{ir cm}^{-1}$ : 3200-3000 (NH and OH), 1565 (C=N), 1040 ( $\tau$  OH), 730 (aromatic CH); nmr (pyridine- $d_5$ ): 7.53  $\tau$  (s, 3H, CH<sub>3</sub>), 4.78  $\tau$  (s, 2H, CH<sub>2</sub>), 2.75-2.05 and 1.7-1.4  $\tau$  (m, 4H, aromatic hydrogens), -0.5  $\tau$  (s, 2H, mobile hydrogens).

The triazole IIIh was obtained directly from the condensation of Id (4) and *p*-nitrobenzaldehyde at room temperature. Attempts to isolate the intermediate hydrazone were unsuccessful.

The rearrangement of IIe..g to triazoles IIIe..g was also achieved by using acidic conditions as for IIa..d. The 3,5-disubstituted-*s*-triazoles IIIe..h are reported with their analytical data in Table II.

1-Acetyl-3-(2-hydroxymethylphenyl)-5-methyl-1*H*-1,2,4-triazole (VIIa).

A solution of 0.38 g. (2 mmoles) of 3-(2-hydroxymethylphenyl)-5-methyl-*s*-triazole (IIIe) and 0.23 ml. (2.4 mmoles) of acetic anhydride in 6 ml. of benzene was refluxed for 0.5 hour. After cooling at room temperature, the precipitate was collected and recrystallized from ethanol, yield 0.19 g. (40%) of VIIa, m.p. 146-148°;  $\text{ir cm}^{-1}$ : 3300 (OH), 1750 (C=O), 1540 (C=N), 740 (aromatic CH); nmr (DMSO- $d_6$ ): 7.27  $\tau$  (s, 6H, CH<sub>3</sub>-C=O and CH<sub>3</sub>-C=O), 5.05  $\tau$  (d, 2H, CH<sub>2</sub>-O (H)), 4.75  $\tau$  (t, 1H, OH), 2.8-1.8  $\tau$  (m, 4H, aromatic hydrogens).

*Anal.* Calcd. for C<sub>12</sub>H<sub>13</sub>N<sub>3</sub>O<sub>2</sub>: C, 62.33; H, 5.67; N, 18.17. Found: C, 62.22; H, 5.61; N, 18.05.

1-Acetyl-3-(2-acetoxymethylphenyl)-5-methyl-1*H*-1,2,4-triazole (VIIb).

A solution of 0.1 g. of 1-acetyl-3-(2-hydroxymethylphenyl)-5-methyl-1*H*-1,2,4-triazole (VIIa) in 3 ml. of acetic anhydride was refluxed for 2 hours, then evaporated *in vacuo*. The residue was crystallized from isopropyl ether to give 0.09 g. (76%) of VIIb, m.p. 118-120°;  $\text{ir cm}^{-1}$ : 1750 (C=O amide), 1720 (C=O ester), 1540 and 1515 (C=N and C=C), 1245 and 1060 (C-O), 720  $\text{cm}^{-1}$  (aromatic CH); nmr (deuteriochloroform): 7.87  $\tau$  (s, 3H, CH<sub>3</sub>-COO), 7.23 and 7.17  $\tau$  (two s, 6H, CH<sub>3</sub>-C= and CH<sub>3</sub>-CO), 4.35  $\tau$  (s, 2H, CH<sub>2</sub>), 2.7-2.2 and 1.9-1.6  $\tau$  (m, 4H, aromatic hydrogens).

*Anal.* Calcd. for C<sub>14</sub>H<sub>15</sub>N<sub>3</sub>O<sub>3</sub>: C, 61.54; H, 5.53; N, 15.37. Found: C, 61.63; H, 5.80; N, 15.50.

1,5-Dimethyl-3-(2-hydroxymethylphenyl)-1*H*-1,2,4-triazole (VIIIa). Method A.

To a solution of IIIe (0.38 g.) in 5 ml. of methanol, an ether solution of diazomethane (generated from 3 g. of nitrosomethylurea) was slowly added and the reactants were kept at room temperature for 45 minutes. A few drops of acetic acid were added and the solvent was distilled *in vacuo*. The residue was treated with water and neutralized with a sodium bicarbonate solution. The solid was removed by filtration and crystallized

from ethanol to yield 0.23 g. (56%) of VIIIa, m.p. 150-152°;  $\text{ir cm}^{-1}$ : 3200 (OH), 1530 (C=N), 1040 (OH), 750 (aromatic CH);  $\text{uv } \lambda \text{ max } 243 \text{ m}\mu$  ( $\epsilon$  mol, max 13640); nmr (DMSO- $d_6$ ): 7.55  $\tau$  (s, 3H, CH<sub>3</sub>-C=O), 6.16  $\tau$  (s, 3H, CH<sub>3</sub>-N<), 5.20  $\tau$  (d, 2H, CH<sub>2</sub>), 4.55  $\tau$  (t, 1H, OH), 2.8-1.9  $\tau$  (m, 4H, aromatic hydrogens).

*Anal.* Calcd. for C<sub>11</sub>H<sub>13</sub>N<sub>3</sub>O: C, 65.00; H, 6.45; N, 20.68. Found: C, 65.20; H, 6.25; N, 20.88.

The aqueous filtrate was concentrated to dryness and the residue was extracted with warm isopropyl ether and filtered. The filtrate was evaporated and the residue was crystallized from hexane-isopropyl ether, yield 82 mg. (20%) of IIIa, m.p. 68-70°. The ir spectrum and melting point were identical with those described above.

The methylation of the sodium salt of IIIe by methyl iodide (see forward Method B) gave a mixture of VIIIa (60%) and IIIa (13%).

3-(2-Hydroxymethylphenyl)-1-methyl-5-phenyl-1*H*-1,2,4-triazole (VIIIb).

Method B.

3-(2-Hydroxymethylphenyl)-5-phenyl-*s*-triazole (IIIf) (0.75 g., 3 mmoles) was suspended in a solution of sodium (69 mg., 3 mmoles) in dry methanol (5 ml.) and refluxed for ten minutes. Methyl iodide (0.5 ml.) was added and the mixture was refluxed for one hour. Solvent was removed by distillation and the residue was dissolved in ether, washed with water and dried (sodium sulfate). After evaporation of ether, the oily residue was triturated with a little isopropyl ether and left in a refrigerator overnight. A solid separated on standing (0.55 g.) whose melting point (89-105°) remained unsharp despite numerous crystallizations.

A solution in chloroform of this product was chromatographed on 5 plates (20 x 20 cm; 1 mm. layer of silica gel HF) and 5-times developed with benzene-methanol (9:1). The separation was followed by examining the plates under uv light. The silica gel of the two main spots was separately collected from plates, combined and eluted with CHCl<sub>3</sub>-CH<sub>3</sub>OH (1:1). After removal of solvent, the residue of the spot with R<sub>f</sub> 0.75 was crystallized from ethanol to give 0.16 g. (20%) of VIIIb, m.p. 104-106°;  $\text{ir cm}^{-1}$ : 3300 (OH), 1550 (C=N), 1030 (OH), 785, 760 and 705 (aromatic CH);  $\text{uv } \lambda \text{ max } 247 \text{ m}\mu$  ( $\epsilon$  mol max 24,300); nmr (DMSO- $d_6$ ): 5.93  $\tau$  (s, 3H, CH<sub>3</sub>-N<), 5.08  $\tau$  (d, 2H, CH<sub>2</sub>), 4.58  $\tau$  (t, 1H, OH), 2.7-1.8  $\tau$  (m, 9H, aromatic hydrogens).

*Anal.* Calcd. for C<sub>16</sub>H<sub>15</sub>N<sub>3</sub>O: C, 72.43; H, 5.70; N, 15.84. Found: C, 72.53; H, 6.02; N, 16.00.

The residue from the spot with R<sub>f</sub> 0.66 was crystallized from ethanol, yielding 0.2 g. (25%) of IIIb, m.p. 121-123°, with ir spectrum and melting point identical with those described above.

The methylation of IIIf with diazomethane (Method A) afforded 27% of VIIIb and 34% of IIIb.

5-Methyl-3-(*o*-tolyl)-*s*-triazole (IX).

A suspension of 0.38 g. (2 mmoles) of 3-(2-hydroxymethylphenyl)-5-methyl-*s*-triazole (IIIe) in 17 ml. of ethanol containing ca. 2 mmoles of hydrogen chloride was hydrogenated at 25° and atmospheric pressure with 0.3 g. of palladium 10% on charcoal as catalyst. After the consumption of hydrogen stopped (ca. 30 minutes), the mixture was filtered and the filtrate evaporated. The residue was dissolved in water and made basic with a sodium bicarbonate solution. The precipitate was collected and recrystallized from benzene, yielding 0.3 g. (93%) of IX (12), m.p. 142-144°.

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