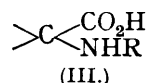
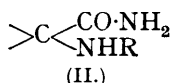
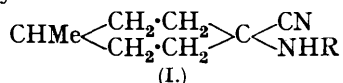


244. *Studies in the cycloHexane Series. Part II.* The Formation of Isomeric Arylamino-cyanomethylcyclohexanes in the Condensation of the Cyanohydrins of the Methylcyclohexanones with Arylamines.*

By M. WAHEED BUKHSH, R. D. DESAI, R. F. HUNTER, and MEHDI HUSSAIN.

QUDRAT-I-KHUDA'S claim (*J. Indian Chem. Soc.*, 1931, **8**, 277) to have isolated the four strainless forms of 1-carboxy-4-methylcyclohexane-1-acetic acid required by the Sasche-Mohr hypothesis led us to study the condensation of the cyanohydrins of the methylcyclohexanones with arylamines (cf. Walther and Hubner, *J. pr. Chem.*, 1916, **93**, 124). The reaction between the cyanohydrin of 4-methylcyclohexanone and aniline was studied by Betts and Plant from quite another point of view (*J.*, 1928, 2073), but fractional crystallisation of the product led to the isolation of a more easily fusible isomeride in addition to the 1-anilino-1-cyano-4-methylcyclohexane described by these authors. The condensation of this cyanohydrin with *p*-bromoaniline, *o*-, *m*-, and *p*-toluidine, and α - and β -naphthylamine led, with the exception of the case of *o*-toluidine, to the formation of pairs of isomeric arylaminocyanomethylcyclohexanes (I), which were characterised by the corresponding amides (II), and also in certain cases by the acids (III) obtained from the latter by hydrolysis.



3-Methylcyclohexanone behaved similarly towards aniline and gave rise to two isomeric varieties of 1-anilino-1-cyano-3-methylcyclohexane, and in the condensation with *p*-bromoaniline, traces of a second isomeride also appeared to be present. With *o*- and *p*-toluidine and with the naphthylamines, however, only one individual was detected.

2-Methylcyclohexanone gave rise to pairs of isomerides with aniline and with β -naphthylamine, and in the condensation of the cyanohydrin with *p*-bromoaniline traces of a second isomeride appeared to be present. In the reactions with the toluidines and α -naphthylamine, however, only one product was isolated.

The arylaminocyanomethylcyclohexanes derived from all three methylcyclohexanones are therefore isolable in certain cases in two, but never more than two, modifications and there is no indication of isomerism connected with multiplanar forms.

EXPERIMENTAL.

1-Anilino-1-cyano-4-methylcyclohexane.—When a solution of potassium cyanide (35 g.) in water (100 c.c.) was added to a mixture of 4-methylcyclohexanone (56 g.) and aniline (46 g.) in

* The paper of Desai, Hunter, Ghulam Khan, and Saharia (this vol., p. 416) is to be regarded as Part I.

glacial acetic acid (250 c.c.), heat was evolved. The product, which separated over-night, was collected; dilution of the filtrate with water gave a further quantity. On recrystallisation from benzene, the A form of the anilino-cyano-derivative separated in thick plates, m. p. 107° (Found : C, 78·2; H, 8·6. Calc. for C₁₄H₁₈N₂ : C, 78·5; H, 8·4%). The mother-liquor, on being kept, deposited a further quantity; the filtrate from this, on being evaporated to dryness, yielded a residue, m. p. 65—75°, which was extracted with hexane. The sparingly soluble residue consisted of the A form, but the hexane extract deposited two types of crystal consisting of the A form, m. p. 107°, and thin plates of the B form, which were separated with the help of a lens and recrystallised from hexane. This isomeride had m. p. 92—93°, depressed to 80° by the A form (Found : C, 78·3; H, 8·1%).

The amide of the A form was prepared by dissolving the nitrile in cold concentrated sulphuric acid and keeping the mixture over-night. On dilution with water and treatment with ammonia, a precipitate formed, which separated from alcohol in needles, m. p. 166° (Found : C, 72·3; H, 8·7. Calc. for C₁₄H₂₀ON₂ : C, 72·4; H, 8·6%). Betts and Plant (*loc. cit.*) recorded the m. p. as 161°. The B form, prepared in a similar manner from the B form of the nitrile, separated from alcohol in needles, m. p. 174° (Found : C, 72·1; H, 8·8%), depressed to 150—155° by the amide of the A form.

The A form of 1-anilino-4-methylcyclohexane-1-carboxylic acid was obtained by heating the A form of the amide with alcoholic hydrochloric acid for 20 hours, the residue obtained by removal of alcohol being treated with dilute aqueous sodium carbonate, and the acid recovered from the filtered solution by acidification with acetic acid. It separated from alcohol in needles, m. p. 186° [equiv., 235. Calc. for C₁₄H₁₉O₂N (monobasic) : equiv., 233]. Betts and Plant record m. p. 179°.

The details of the preparation of the compounds described below are similar, but the experiments were carried out on a smaller scale; e.g., the amount of ketone used for condensation in the 4-methyl series was 5·6 g., 11·2 g., and 5·6 g. in the cases of *p*-bromoaniline, *p*-toluidine, and β-naphthylamine respectively. (The theoretical percentages are given in parentheses.)

Compound.	Form.	M. p.	Analysis.	Remarks.
1- <i>p</i> -Bromoanilino-1-cyano-4-methylcyclohexane	A	126°	C, 57·5 (57·3); H, 5·7 (5·8)	Needles from hexane
	B	88—89	C, 57·4; H, 5·75	Nodules from hexane
1- <i>p</i> -Bromoanilino-4-methylcyclohexane-1-carboxamide	A	178	Br, 26·0 (25·7)	Needles from alcohol
	B	158	Br, 25·9	Needles from alcohol
1- <i>p</i> -Bromoanilino-4-methylcyclohexane-1-carboxylic acid	A	184	Br, 25·9 (25·7)	
1- <i>p</i> -Toluidino-1-cyano-4-methylcyclohexane	A	104	C, 78·9 (78·9); H, 9·0 (8·8)	Needles from benzene
	B	79	C, 78·9; H, 7·9	Six-sided plates from hexane
1- <i>p</i> -Toluidino-4-methylcyclohexane-1-carboxamide	A	155	C, 73·0 (73·2); H, 9·2 (9·0)	Needles from alcohol
	B	145	C, 72·9; H, 9·1	Needles
1- <i>m</i> -Toluidino-1-cyano-4-methylcyclohexane	A	115	C, 78·9; H, 9·0	Needles from benzene
	B	82—83	C, 79·0; H, 8·7	Hexagonal plates from benzene
1- <i>m</i> -Toluidino-4-methylcyclohexane-1-carboxamide	A	137—138	C, 73·0; H, 9·1	Obtained by keeping the nitrile in conc. H ₂ SO ₄ for 1 month
	B	117—118	C, 72·9; H, 9·0	
1- <i>o</i> -Toluidino-1-cyano-4-methylcyclohexane		100	C, 78·8; H, 8·9	Needles from benzene
1- <i>o</i> -Toluidino-4-methylcyclohexane-1-carboxamide		143	C, 73·0; H, 9·1	Plates from alcohol
1- <i>α</i> -Naphthylamino-1-cyano-4-methylcyclohexane	A	151—152	C, 81·8 (81·8); H, 7·6 (7·6)	Plates from benzene
	B	165	C, 81·6; H, 7·7	Soft needles from benzene
1- <i>α</i> -Naphthylamino-4-methylcyclohexane-1-carboxamide	A	138	C, 76·3 (76·6); H, 8·1 (7·8)	Plates from benzene-petrol
	B	204	C, 76·5; H, 7·9	
1-β-Naphthylamino-1-cyano-4-methylcyclohexane	A	152	C, 81·7; H, 7·8	Plates from benzene
	B	132	C, 81·5; H, 7·4	Needles from benzene
1-β-Naphthylamino-4-methylcyclohexane-1-carboxamide	A	270	C, 76·4; H, 8·0	Plates from benzene
	B	205	C, 76·5; H, 7·9	Minute plates from benzene
1- <i>α</i> -Nilino-1-cyano-3-methylcyclohexane.	A	75	C, 78·2 (78·5); H, 8·7 (8·4)	Needles from hexane
	B	95	C, 78·4; H, 8·4	Plates

Compound.	Form.	M. p.	Analysis.	Remarks.
1-Anilino-3-methylcyclohexane-1-carboxyamide	A	97	C, 72.2 (72.4); H, 8.8 (8.6)	Needles from alcohol
	B	92	C, 72.1; H, 8.7	Needles from benzene
1-p-Bromoanilino-1-cyano-3-methylcyclohexane		88—89	Br, 27.7 (27.3)	Needles from hexane
1-p-Bromoanilino-3-methylcyclohexane-1-carboxyamide		137	Br, 25.9 (25.7)	Needles from alcohol
1-p-Toluidino-1-cyano-3-methylcyclohexane		78	C, 78.8 (78.9); H, 8.9 (8.8)	Rhomboids from alcohol
1-p-Toluidino-3-methylcyclohexane-1-carboxyamide		165	C, 73.0 (73.2); H, 9.2 (9.0)	Needles from alcohol
1-o-Toluidino-1-cyano-3-methylcyclohexane		86	C, 78.9; H, 9.0	Recovered unchanged after being kept in conc. H ₂ SO ₄ for 4 months
1-α-Naphthylamino-1-cyano-3-methylcyclohexane		137	C, 81.6 (81.8); H, 7.8 (7.6)	Plates from benzene
1-α-Naphthylamino-3-methylcyclohexane-1-carboxyamide		169	C, 76.5 (76.6); H, 8.0 (7.8)	Small prisms from benzene
1-β-Naphthylamino-1-cyano-3-methylcyclohexane		136	C, 81.4; H, 7.9	Rhombic plates from benzene
1-β-Naphthylamino-3-methylcyclohexane-1-carboxyamide		186	C, 76.7; H, 7.9	Needles from alcohol
1-Anilino-1-cyano-2-methylcyclohexane	A	126	C, 78.3 (78.5); H, 8.6 (8.4)	Small plates from hexane containing a few drops of benzene
	B	88	C, 78.2; H, 8.3	Aggregates of soft needles
1-Anilino-2-methylcyclohexane-1-carboxyamide	A	128	C, 72.2 (72.4); H, 8.9 (8.6)	Obtained by keeping the nitrile in conc. H ₂ SO ₄ for 6 weeks
	B	147	C, 72.3; H, 8.8	Plates from alcohol
1-Anilino-2-methylcyclohexane-1-carboxylic acid	A	187	C, 71.9 (72.1); H, 8.4 (8.1); equiv., 234 (233)	
		99	Br, 27.6 (27.3)	Short needles from hexane
1-p-Bromoanilino-2-methylcyclohexane-1-carboxyamide		154	Br, 26.0 (25.7)	Needles from alcohol
1-p-Toluidino-1-cyano-2-methylcyclohexane		140	C, 78.6 (78.9); H, 9.0 (8.8)	Plates from benzene
1-p-Toluidino-2-methylcyclohexane-1-carboxyamide		185	C, 73.0 (73.2); H, 9.1 (9.0)	Rectangular plates from benzene
1-m-Toluidino-1-cyano-2-methylcyclohexane		101	C, 78.7; H, 8.9	Needles from benzene
1-m-Toluidino-2-methylcyclohexane-1-carboxyamide		112	C, 73.1; H, 9.2	Obtained by keeping the nitrile in conc. H ₂ SO ₄ for 4 months
1-o-Toluidino-1-cyano-2-methylcyclohexane		121	C, 78.8; H, 9.1	Needles from benzene. Recovered unchanged after keeping in conc. H ₂ SO ₄ for 4 months
1-α-Naphthylamino-1-cyano-2-methylcyclohexane		118	C, 81.5 (81.8); H, 7.9 (7.6)	
1-β-Naphthylamino-1-cyano-2-methylcyclohexane	A	110—111	C, 81.4; H, 7.8	Nodules from benzene
	B	105	C, 81.5; H, 7.7	Plates from hexane
1-β-Naphthylamino-2-methylcyclohexane-1-carboxyamide	A	178	C, 76.4 (76.6); H, 8.1 (7.8)	