

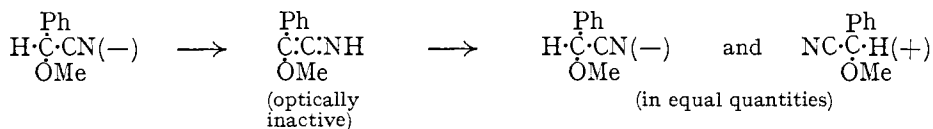
44. (–) *Phenylmethoxyacetonitrile*.

By ISOBEL AGNES SMITH.

IN continuance of previous work on optically active nitriles (Smith, *Ber.*, 1931, **64**, 427, 1115; 1934, **67**, 1307), a study has now been made of optically active phenylmethoxyacetonitrile.

The *r*-nitrile was obtained by Hess and Dorner (*Ber.*, 1917, **50**, 390) on the lines, $\text{Ph}\cdot\text{CH}(\text{OMe})\cdot\text{CO}\cdot\text{NH}_2 \xrightarrow{\text{SOCl}_2} \text{Ph}\cdot\text{CH}(\text{OMe})\cdot\text{CN}$. Several attempts were made by the author to obtain the pure optically active nitrile by this method, but the products did not give concordant values for specific rotatory power. As it was considered improbable that thionyl chloride would produce a racemising effect, its action on *r*-phenylmethoxyacetamide was investigated more fully. Two products were formed, and the separation of these by distillation was difficult. The lower-boiling fraction solidified in a freezing mixture, and was identified as benzoyl cyanide; *r*-phenylmethoxyacetonitrile was obtained as a liquid. In their description of the methoxy-nitrile Hess and Dorner made no reference to a low-boiling fraction, but in the dehydration of *r*-phenylethoxyacetamide with thionyl chloride they obtained, besides *r*-phenylethoxyacetonitrile, an unidentified low-boiling fraction with a sharp odour: doubtless this contained benzoyl cyanide.

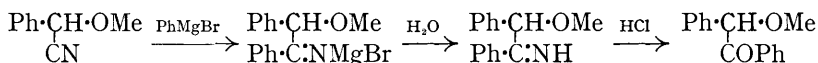
The action of phosphoric oxide on *r*-phenylmethoxyacetamide in the presence of toluene produced the *r*-nitrile, unaccompanied by benzoyl cyanide. When this method was applied to the (+)amide, (–) *phenylmethoxyacetonitrile* was obtained in a state of optical purity as an oil, giving $[\alpha]_{\text{D}}^{20} - 53\cdot0^\circ$ and $[\alpha]_{\text{D}461}^{20} - 63\cdot5^\circ$ (in acetone) before and after redistillation. As was to be expected, (–)phenylmethoxyacetonitrile was very susceptible to catalytic racemisation by alcoholic potash:



A methyl-alcoholic solution containing two drops of methyl-alcoholic potash became inactive in 2 hours, but 4 hours later acquired a constant dextrorotation, $\alpha_{5461}^{20} + 0.32^\circ$ ($l = 2$) (see Experimental). The quantity of potash was so small that it could scarcely cause the formation of any (+)phenylmethoxyacetamide before all the (–)nitrile had been converted into *r*-nitrile. Now, a trace of alcoholic potash is sufficient to racemise (+)mandelonitrile and also to convert it into benzaldehyde-bis-(α -cyanobenzyl)acetal (*Ber.*, 1931, 64, 427), and amygdalin with alcoholic potash, besides being racemised, undergoes methoxylation in the aglucone part of the molecule (*Ber.*, 1934, 67, 1307). It is possible that an action similar to the latter had occurred to a slight extent in the present reaction; the formation of a complex of the acetal type suggested above is less probable owing to the presence of the methoxy-group.

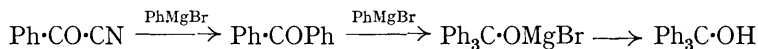
(–)Phenylmethoxyacetoneitrile in methyl-alcoholic solution underwent catalytic racemisation with water, the solution becoming optically inactive in 3 days; no small final dextrorotation was observed in this case. Under similar conditions with (+)mandelonitrile, 38 days elapsed before the solution had become inactive (*Ber.*, 1931, 64, 427). This was in keeping with the observation of McKenzie and Smith (*J.*, 1922, 121, 1348) that (–)phenylmethoxyacetamide was more rapidly catalytically racemised than (–)mandelamide.

The action of phenylmagnesium bromide on *r*-phenylmethoxyacetoneitrile gave benzoin methyl ether:



(cf. *Ber.*, 1931, 64, 427; McKenzie and Kelman, *J.*, 1934, 412). (–)Benzoin methyl ether was obtained by McKenzie, Martin, and Rule (*J.*, 1914, 105, 1583) from (–)phenylmethoxyacetamide and phenylmagnesium bromide.

The interaction of phenylmagnesium bromide and benzoyl cyanide gave triphenylcarbinol:



This displacement of the cyano- by an aryl group in the Grignard reaction recalls the formation of triphenylcarbinol by the action of phenylmagnesium bromide on oxamethane or ethyl cyanofornate (McKenzie and Duff, *Ber.*, 1927, 60, 1335).

EXPERIMENTAL.

The Interaction of Thionyl Chloride and (–)Phenylmethoxyacetamide.—6.5 G. of (–)phenylmethoxyacetamide ($[\alpha]_{5461}^{20} - 103.6^\circ$ in acetone; $c = 3.1465$) were heated with 20 g. of specially purified thionyl chloride (Meyer, *Monatsh.*, 1913, 34, 569) for 44 hours at 70–80°. The excess of thionyl chloride was removed under diminished pressure, the residual oil poured into water and extracted with ether, and the resulting oil distilled twice. The fraction, b. p. 95°/0.4 mm., gave with concentrated sulphuric acid the characteristic magenta coloration of the nitrile. In acetone ($l = 2$, $c = 1.842$): $\alpha_{5461}^{20} + 1.65^\circ$, $[\alpha]_{5461}^{20} + 44.8^\circ$. From another experiment with the (+)amide the product gave a higher value, *viz.*, $[\alpha]_{5461}^{20} - 57.2^\circ$ ($l = 2$, $c = 5.2505$).

The Interaction of Thionyl Chloride and r-Phenylmethoxyacetamide.—21.5 G. of *r*-phenylmethoxyacetamide (m. p. 111–112°) were heated for 48 hours at about 90° with 50 c.c. of purified thionyl chloride. The procedure was as above, but the extraction was carried out with benzene, since any unchanged amide would be less soluble in this solvent. The residual oil was distilled at 20 mm., three fractions being collected: (I) b. p. 102–110°, (II) b. p. 110–117°, (III) b. p. 117–118°. Fraction (I) contained some of the nitrile, since it gave the characteristic magenta coloration with concentrated sulphuric acid, but when cooled in a freezing mixture it deposited benzoyl cyanide, m. p. (after two recrystallisations from light petroleum) and mixed m. p. (with an authentic specimen) 31–32° (Found: C, 73.2; H, 3.8; N, 10.3. Calc. for $\text{C}_8\text{H}_5\text{ON}$: C, 73.3; H, 3.8; N, 10.7%).

Benzoyl cyanide was a product of an experiment in which the thionyl chloride (Kahlbaum) used was not specially purified, and also of another carried out at 70°.

Dehydration of r-Phenylmethoxyacetamide with Phosphoric Oxide in Presence of Toluene.—An intimate mixture of the amide (15.4 g.) and the oxide (21 g.) was heated in dry toluene at 110°

for 4 hours. The toluene was decanted, the residue washed with hot toluene, the solvent removed under diminished pressure, and the residual oil distilled; b. p. 120°/17 mm. Yield, 7.3 g. of *r*-nitrile.

Dehydration of (+)Phenylmethoxyacetamide with Phosphoric Oxide in Presence of Toluene.—12 G. of (+)phenylmethoxyacetamide, prepared from (+)phenylmethoxyacetic acid (Pirie and Smith, J., 1932, 338) and having m. p. 108—109° and $[\alpha]_D + 104.1^\circ$ in acetone, were treated with 16.5 g. of phosphoric oxide in presence of toluene as described above. (–)Phenylmethoxyacetoneitrile was obtained as a colourless oil (5.1 g.), b. p. 120°/17 mm. (Found: C, 73.0; H, 6.3; N, 9.7. C_9H_9ON requires C, 73.4; H, 6.1; N, 9.5%). In acetone ($l = 2, c = 4.936$): $\alpha_D^{20} - 5.23^\circ$, $[\alpha]_D^{20} - 53.0^\circ$; $\alpha_{5461}^{20} - 6.27^\circ$, $[\alpha]_{5461}^{20} - 63.5^\circ$.

Catalytic Racemisation of (–)Phenylmethoxyacetoneitrile with Methyl-alcoholic Potash.—The (–)nitrile (0.9843 g.) was made up to 20 c.c. with dry methyl alcohol ($l = 2, c = 4.9215$): $\alpha_D^{20} - 5.31^\circ$, $[\alpha]_D^{20} - 53.9^\circ$; $\alpha_{5461}^{20} - 6.31^\circ$, $[\alpha]_{5461}^{20} - 64.1^\circ$. Two drops of methyl-alcoholic potash (1.043N) were added to about 16 c.c. of the solution :

<i>t</i> , mins.	2	5	10	20	30	40	50	60	70
α_{5461}^{20}	–5.97°	–5.55°	–4.80°	–3.63°	–2.77°	–1.99°	–1.51°	–1.04°	–0.75°
<i>t</i> , mins.	80	90	99	110	119	4 hrs.	24 hrs.	4 days	
α_{5461}^{20}	–0.49°	–0.27°	–0.15°	–0.06°	0.00°	+0.33°	+0.32°	+0.32°	

The final dextrorotation was unexpected, and in case this was due to a trace of (+)phenylmethoxyacetamide present in the (–)nitrile the preparation of the latter was repeated, with the further precaution of carrying out the distillation of the nitrile under diminished pressure in presence of a small amount of phosphoric oxide. The (–)nitrile so obtained gave in methyl alcohol ($l = 2, c = 5.0535$): $\alpha_{5461}^{20} - 6.49^\circ$, $[\alpha]_{5461}^{20} - 64.2^\circ$. Two drops of methyl-alcoholic potash (1.043N) were added to about 18 c.c. of this solution; after 24 hours, $\alpha_{5461}^{20} + 0.28^\circ$ was observed.

Catalytic Racemisation of (–)Phenylmethoxyacetoneitrile with Water.—The (–)nitrile (0.7206 g.) was made up to 20 c.c. with dry methyl alcohol ($l = 2, c = 3.603$): $\alpha_{5461}^{20} - 4.56^\circ$, $[\alpha]_{5461}^{20} - 63.3^\circ$. 1 C.c. of water was added to this solution :

<i>t</i>	2 mins.	110 mins.	4.5 hrs.	28.5 hrs.	33 hrs.	46 hrs.	54 hrs.	3 days	6 days
α	–4.37°	–4.16°	–3.77°	–1.50°	–1.28°	–0.34°	–0.17°	+0.03°	+0.03°

Action of Phenylmagnesium Bromide on r-Phenylmethoxyacetoneitrile.—An ethereal solution of *r*-phenylmethoxyacetoneitrile (7.2 g.), prepared by dehydration of the *r*-amide with phosphoric oxide, was added within 3 minutes to the Grignard reagent, prepared from bromobenzene (23.2 g.). The mixture was heated for 15 minutes. After 1 hour at the ordinary temperature, the complex was decomposed with ice and concentrated hydrochloric acid and the ethereal layer was separated immediately. From the acid layer, *r*-benzoin methyl ether (1.4 g.), m. p. 48—49°, was obtained.

Action of Phenylmagnesium Bromide on Benzoyl Cyanide.—The Grignard reagent, prepared from bromobenzene (24 g.), was added at intervals to an ethereal solution of benzoyl cyanide (3.7 g., m. p. 32°). The mixture was heated for $\frac{1}{2}$ hour and then decomposed with ice and concentrated hydrochloric acid, and the ethereal layer was separated immediately. From the latter were obtained 2.8 g. of triphenylcarbinol, m. p. and mixed m. p. 161—162°.

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