502. *Mesitylurea and Mesitylsemicarbazide.*

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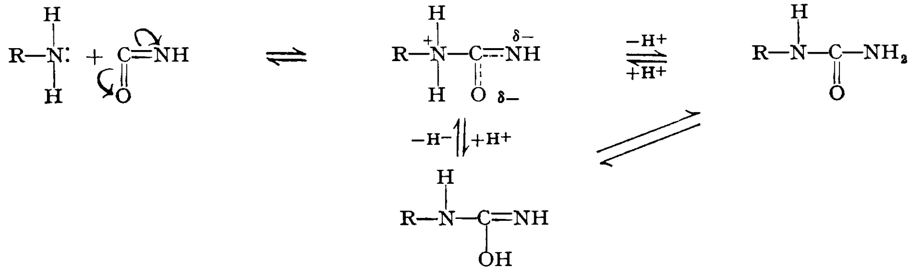
Mesitylurea and mesitylsemicarbazide have been prepared and the latter has been used for characterising several aldehydes and ketones. Comments are made on the mechanisms of the reactions involved in the two preparations.

THE reaction between a primary amine and nitrourea has been used by Davis and Blanchard (*J. Amer. Chem. Soc.*, 1929, **47**, 1790) and by Sah and his co-workers (*J. Chinese Chem. Soc.*, 1934—1939) for the preparation of several substituted ureas. It seems established that the reaction actually occurring is between the amine and the *iso*cyanic acid liberated from the nitrourea in aqueous solution. It may reasonably be assumed, particularly from the work of Davis and Blanchard, that the mechanism of the reaction is along the following lines :

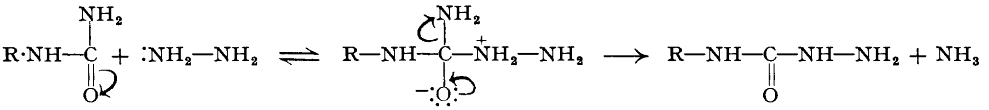


Aniline gives high yields of phenylurea by this method, and mesidine which is more basic should, if it may be assumed that the *ortho*-substituents cause no appreciable hindrance to reaction, readily form an addition complex with cyanic acid to give mesitylurea as the final product.

It has been found that mesitylurea can be readily prepared from mesidine in this way (65% yield) and with hydrazine gives high yields (>80%) of mesitylsemicarbazide. The hydrochloride of this semicarbazide has been used to form derivatives of several aldehydes and ketones : it is quite useful for characterisation of aldehydes and ketones of low molecular weight, but no more so than several other substituted semicarbazides. It gives a reasonable spread of melting points, and the solubility of the derivatives in water, either hot or cold, is extremely low.

The reaction between hydrazine and a substituted urea is open to more than one mechanistic interpretation. On the assumption that *iso*cyanate is formed by breakdown of the urea derivative, a semicarbazide could be produced through attack by hydrazine on the *iso*cyanate or on one of the products subsequently formed from it (*e.g.*, a carbamic ester by reaction of *iso*cyanate with solvent alcohol).

A simpler scheme would be one involving a nucleophilic replacement on the substituted urea itself :



For mesitylsemicarbazide formation the second mechanism appears much the more probable. Ready conversion into *iso*cyanate implies an instability of the mesitylurea molecule which is not confirmed by observations. Mesitylurea may be boiled with water, aqueous alcohol, or aqueous-alcoholic sodium hydroxide without any apparent release of ammonia. Furthermore the work of Naegeli, Tyabji, Conrad, and Litwan (*Helv. Chim. Acta*, 1938, **21**, 1100) indicates that under the conditions of our reaction some *sym*-disubstituted urea should have been obtained if an *iso*cyanate were formed as an intermediate. No side-products have been observed during several preparations, and high yields of pure semicarbazide support the assumed absence of appreciable side-reactions.

EXPERIMENTAL

M. p.s are corrected.

Mesidine.—This was obtained in good yield from mesitylene without purification of the intermediate nitromesitylene. Mesitylene (40 g.) was nitrated under conditions for mononitration (*Org. Synth.*, Coll. Vol. I, 2nd Edn., p. 442) and to the crude nitro-compound were added granulated zinc (50 g.), water (50 ml.), and ethyl alcohol (100 ml.). Subsequent addition of concentrated hydrochloric acid (200 ml.) was accompanied by vigorous shaking, and the rate of addition adjusted to maintain a temperature of 40—50°. The mixture was then gently warmed, to dissolve any remaining tin, and unchanged nitromesitylene removed by steam-distillation. After the reaction mixture had been made alkaline a further steam-distillation gave mesidine which was fractionated after ether-extraction. The yield was 77% (34·8 g.), and the b. p. 232—233°.

Mesitylurea.—Mesidine (20 g.) was added to an aqueous solution of nitrourea (25 g. in 1 l.) at 50°, and stirred continuously for 36 hours. After cooling, the *mesitylurea* (17·7 g., 67%) was collected, washed well with water, and dried at 110°. Repeated recrystallisation from alcohol gave bulky white needles which shrank visibly, without melting, at 258°; sublimation of the solid residue occurred at *ca.* 320° (Found: C, 67·2; H, 7·7; N, 15·6. $C_{10}H_{14}ON_2$ requires C, 67·4; H, 7·9; N, 15·7%). Mesitylurea dissolved in dioxan, methyl or ethyl alcohol, chloroform, or toluene. It is slightly soluble in hot water but insoluble in ether. N-*Acetyl*-N′-*mesitylurea* gave fine white needles, m. p. 212°, from aqueous alcohol (Found: N, 12·6; $C_{12}H_{16}O_2N_2$ requires N, 12·7%). Attempts to benzoylate and nitrosate mesitylurea were unsuccessful.

Mesitylsemicarbazide.—Mesitylurea (6 g.), hydrazine hydrate (15 ml. of 50% solution), and ethyl alcohol (30 ml.) were boiled under reflux until evolution of ammonia, which was apparent within 0·5 hour, ceased (*ca.* 72 hours). The reaction mixture was poured into water (200 ml.) and after filtration the solid *mesitylsemicarbazide* was washed with water. Purification was carried out by conversion, in alcohol, into the hydrochloride, dissolution of the salt in water, and reprecipitation of the base by careful neutralisation with sodium hydroxide solution. The semicarbazide was washed well with water and dried at 110° (yield, 5·5 g., 87%). For analysis the compound was crystallised from ethyl alcohol forming fine, white needles (Found: C, 62·3; H, 7·7; N, 21·6. $C_{10}H_{15}ON_3$ requires C, 62·2; H, 7·8; N, 21·8%). Mesitylsemicarbazide decomposes, without melting, at 220° and the solid residue melts with decomposition at 304°. The base dissolves in dioxan, methyl or ethyl alcohol, chloroform, or toluene. It is sparingly soluble in cold carbon tetrachloride but insoluble in cold water and ether. Mesitylsemicarbazide hydrochloride, prepared as above, forms white needles from aqueous alcohol (50%) and decomposes, without melting, at 300°. Potentiometric titration with standard sodium hydroxide showed it to be a monohydrochloride.

	M. p. of mesitylsemicarbazone	Formula	Found, N, %	Reqd., N, %
Acetone	189°	$C_{13}H_{19}ON_3$	17·6 [a]	18·0
Ethyl methyl ketone	139	$C_{14}H_{21}ON_3$	16·9	17·0
Acetophenone	203—204	$C_{18}H_{21}ON_3$	14·0	14·2
Benzil	182	$C_{24}H_{23}O_2N_3$	10·9	10·9 [b]
Formaldehyde	214—218 *	$C_{11}H_{15}ON_3$	20·4	20·5
Acetaldehyde	212 *	$C_{12}H_{17}ON_3$	18·6 [a]	19·2
Propaldehyde	175	$C_{13}H_{19}ON_3$	17·8	18·0
Benzaldehyde	214 *	$C_{17}H_{19}ON_3$	14·8	14·9
Cinnamaldehyde	237	$C_{19}H_{21}ON_3$	13·7	13·7
Acraldehyde	192	$C_{13}H_{17}ON_3$	17·8	18·1

[a] Analysed after repeated recrystallisation. [b] Calc. for monosemicarbazone.
* With decomp.

Preparation of Semicarbazones.—To a mixture of mesitylsemicarbazide hydrochloride (0·4 g.), alcohol (10 ml.), and water (10 ml.) was added sodium acetate (1 g.), to give eventually a solution buffered to a pH of *ca.* 4·5. The mixture was warmed on a steam-bath until all had dissolved, slightly more than one equivalent of the aldehyde or ketone was added, and the whole was heated under reflux, usually for 0·5 hour. With formaldehyde, acetaldehyde, propaldehyde, cinnamaldehyde, acraldehyde, acetone, and ethyl methyl ketone, precipitation occurred immediately or within a few minutes, but with acetophenone there was some delay. No apparent precipitation was noted with benzil after an hour; glacial acetic acid (10 ml.) was then added and heating continued for a further 3 hours. Cooling gave a deposit of the monosemicarbazone (see Table). Camphor gave, after 5 hours, only an extremely small quantity of presumed semicarbazone, m. p. 215° after recrystallisation (no analysis). Benzophenone was unaffected on prolonged boiling. Semicarbazones were recrystallised from aqueous alcohol, the water being omitted for those carbonyl compounds of higher molecular weights; they formed needles, all being colourless except those from benzil and cinnamaldehyde (yellow).

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