A useful procedure for the reductive alkylation of ammonia, 1º-, & 2º-amines, in which formic acid or a derivative thereof serves as the reducing agent, is known as the **Leuckart Reaction**. Some examples of this reaction are shown below.

1. \[ \text{C}_{6}	ext{H}_{5}	ext{NH}_{2} + 	ext{HCOOH} \xrightarrow{\text{heat}} \text{C}_{6}	ext{H}_{5}	ext{CH}_{2}	ext{NH}_{2} + \text{H}_{2}	ext{O} + \text{CO}_{2} \]

2. \[ \text{C}_{6}	ext{H}_{5}	ext{NH}_{2} + \text{HCOOH} \xrightarrow{\text{heat}} \text{C}_{6}	ext{H}_{5}	ext{CH}_{2}	ext{NHCH}_{2}	ext{C}_{6}	ext{H}_{5} + \text{H}_{2}	ext{O} + \text{CO}_{2} \]

3. \[ \text{RNH}_{2} + 2\text{CH}_{2}\text{O} + 2\text{HCOOH} \xrightarrow{\text{heat}} \text{RNCH}_{2}	ext{CH}_{2}	ext{N}_{2} + 2\text{H}_{2}	ext{O} + 2\text{CO}_{2} \]

The manner in which a hydride moiety is transferred from formate to an iminium intermediate is a matter for speculation, but may be summarized roughly as below:

Both aldehydes and ketones may be used as the carbonyl reactant. By using ammonia as a reactant, this procedure may be used to prepare 1º-amines; however, care must be taken to avoid further alkylation to 2º & 3º-amines. Polyalkylation is sometimes desired, as in example #3 where dimethylation is accomplished with formaldehyde. This is sometimes referred to as the **Eschweiler-Clarke procedure**, and it has proven to be a useful method for converting 1º-amines to precursors for Hofmann or Cope elimination reactions.

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**Contributors**