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INVESTIGATION OF THE REACTION BETWEEN ISOCYNATES AND ACID ANHYDRIDES WITH ^{14}C

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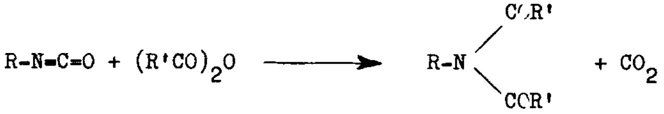
THE readiness of diacylamine derivatives for transfer of the acyl group is known long ago.[1] Recently this type of compounds has been used also in acylations from a preparative point of view.[2] Generally they are obtainable by making an anhydride react with an isocyanate.[3]



$$R\text{-}N{=}C{=}O + (R'CO)_2O \longrightarrow R\text{-}N\begin{cases}COR'\\COR'\end{cases} + CO_2$$

From this point of view and especially with regard to the synthesis of radioactive diacyl derivatives, it seemed of interest to investigate the reaction with ^{14}C. The carbon atom of the liberated carbon dioxide may come either from the C=O group of the isocyanate or from one of the

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[1] Brunner, *Ber.Dtsch.Chem.Ges.* **47**, 2676 (1914); *Monatshefte* **36**, 517 (1915).

[2] E.Taschner, M.Kocor and S.Meyer, *Rockniki Chem.* **26**, 692-694 (1952) *Chem.Abstr.* **49**, 2464 (1955).

[3] A.Wurtz, *Ann.Chim. No.3.* **42**, 54 (1884).

carbonyls of the anhydride. In the former case if 1-^{14}C anhydride is applied, the molar activity of the product has to agree with that of the anhydride, in the latter case it should be reduced to one half of it.

Phenyl and α -naphthyl isocyanate respectively and Di-1, 1'-^{14}C-acetic anhydride have been used with our experiments. The latter compound was prepared by a method [4] evolved in this Laboratory starting from barium-1-^{14}C-acetate and 1-^{14}C-acetyl chloride. The determinations of activity were carried out with an argon-methane proportional counter for $^{14}CO_2$ gas. The results obtained are given in Table 1.

TABLE 1

Compound	Activity, μc/mM
Acetic anhydride	6538
Diacetanilid	6534
N-diacetyl-α-naphtylamine	6540

The experiments prove that, with these compounds, the CO_2 originates from the isocyanate.

The mechanism of the reaction is probably analogous to that of the addition reaction [5] between isocyanates and carboxylic acids. According to this assumption, as a first step the mixed anhydride of an N-acetylated carbaminic acid and a carboxylic acid is formed

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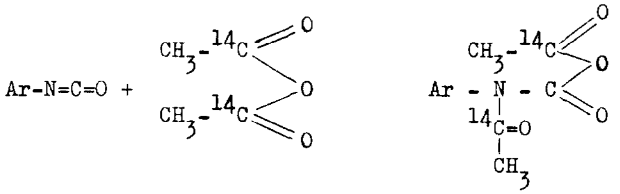
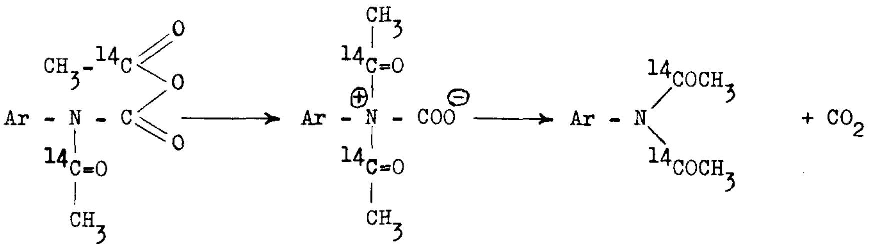
[4] L.Ötvös, J.Márton and Miesel Tiborné, KKKI Közlemenyei **3** (1959).

[5] C.Naegeli and A.Tyabji, Helv. Chim. Acta **18**, 142 (1935); A.Fry, J.Amer. Chem.Soc. **75**, 2686 (1953).



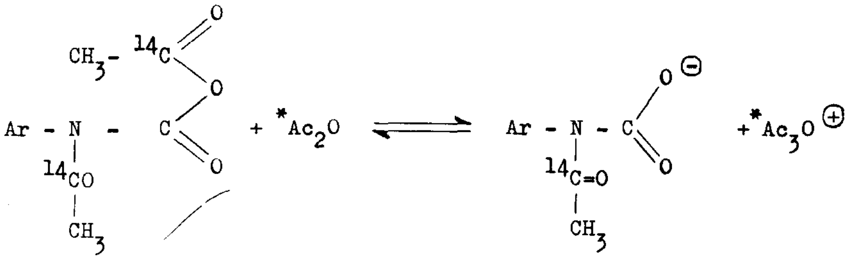
The further transformation of the intermediate product obtained may be achieved by an intramolecular (I) or intermolecular (II) transfer of the acyl group. In the latter case the compound of the anhydride type would be converted into N-acetyl carbaminic acid by acetylation of the isocyanate or more probably by a mechanism similar to that of the exchange reaction between acetic anhydride and acetyl chloride,[6] i.e. by the formation of a complex with the acetic anhydride furnishing the derivative of diacetamide by decarboxylation and acetylation.

I



or

II



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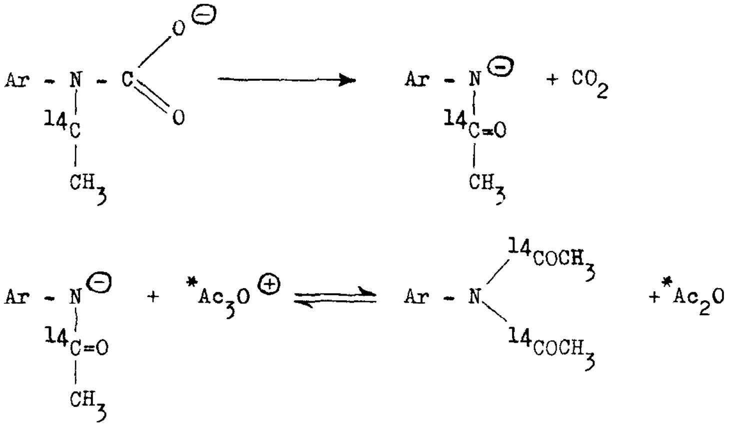
[6] E.A.Evans, J.L.Huston and T.M.Norris, J.Amer.Chem.Soc. 74, 4985 (1952).



When ethyl isocyanate is applied, the molar activity of the N-ethyldiacetamide obtained is essentially less than that of the acetic anhydride. The investigation of the reaction with other alkylisocyanates is in course.