

Research upon Joint Reaction and Transjointing. (II)

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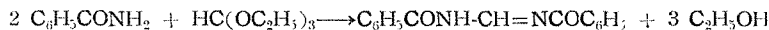
The authors have confirmed the following Joint Reaction and Transjointing Reactions.

1. Joint Reaction of orthoformic ester with benzamide or acetamide.
2. Transjointing between methylene-bis-benzamide and methylene-bis-acetamide.
3. Transjointing between 1, 3-Diphenyltetrahydro-imidazole and diethyl malonate, dimethyl aniline or β -naphthol.
4. Transjointing between dibenzylformal and diethylformal.
5. Transjointing between β -*n*-butoxypropionitrile and diethylamine or diethyl malonate.
6. Transjointing between methiodide of β -diethylamino-propionitrile and morpholine or diethyl malonate.
7. Transjointing between tetraethyl-methylene-diamine or diethylaminomethyl-*n*-butyl-ether and some Grignard's reagents or urea.

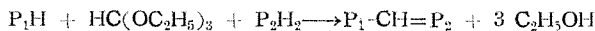
The authors reported in the previous paper about the Joint Reaction using isethionate and Transjointing Reaction between methylene-bis-malonate and methylene-bis-acetoacetic ester or methylenyl-bis-acetoacetic ester. Since then, the authors have further continued the investigations about the same item and obtained some new results. The reactions which the authors have newly found actually to occur are as follows :

1. Joint Reaction

Joint Reaction between benzamide or acetamide and orthoformic ester



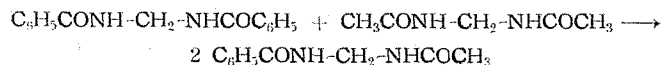
The orthoformic ester joints two various passive components as in the following manner :



But there is no example in the literature in which acid amides were selected as P_1H or P_2H_2 . The authors therefore have performed this investigation and found that the above two reactions actually occur.

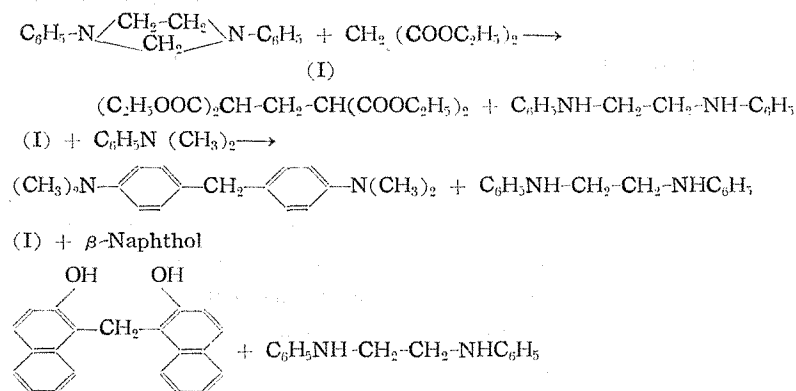
2. Transjointing

(a) Transjointing between methylene-bis-benzamide and methylene-bis-acetamide.

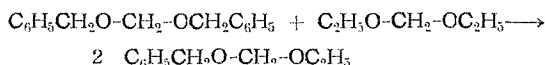


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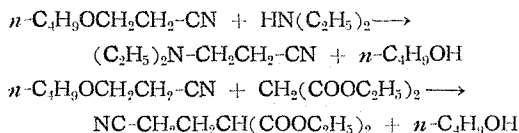
(b) Transjointing between 1, 3-biphenyltetrahydro-imidazole and diethyl malonate, dimethyl-aniline or β -naphthol.



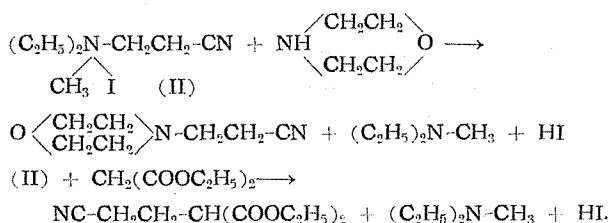
(c) Transjointing between dibenzylformal and diethylformal.



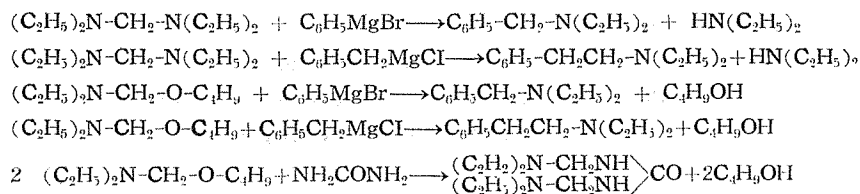
(d) Transjointing between β -*n*-butoxypropionitrile and diethylamine or diethyl malonate.



(e) Transjointing between methiodide of β -diethyl-aminopropio-nitrile and morpholine or diethyl malonate.

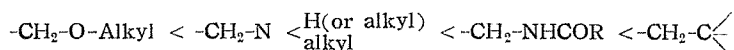


(f) Transjointing between tetraethyl- methylene-diamine (III) or diethylamino-methyl-*n*-butylether (IV) and some Grignard's reagents or urea.



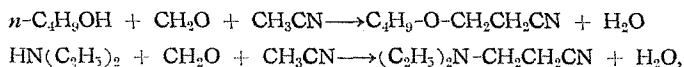
Research upon Joint Reaction and Transjointing. (II)

All of the above reactions are new reactions. The 1, 2-diphenyltetrahydroimidazole can be obtained by the reaction between N, N'-diphenyl ethylenediamine and formaldehyde and can be considered as a kind of jointed compound, i. e., cyclic jointed compound by formaldehyde, and this reaction is used as a characteristic identifying method for aldehydes. The authors have found that this compound releases the formaldehyde reversibly and the latter joints the other two passive components which exist at the same time in the reaction system. But there is distinctly a rule, which the authors have already pointed out, that the Transjointing takes place after the following series :



That is, in the above series the jointed alcohols can be most easily transjointed by other passive components, but the jointed amines can not be transjointed by alcohols and the jointed carbon components can neither be transjointed by alcohols nor by amino-components.

The β -butoxypropionitrile and β -diethylamino-propionitrile considered as kinds of jointed compounds by formaldehyde, as shown below :



though these compounds were prepared by the cyanoethylation of *n*-butanol or diethylamine by acrylonitrile. Therefore the above Transjointing reactions with these two compounds (d and e) are reasonable.

EXPERIMENTAL

(1) Joint Reaction of orthoformic ester with benzamide and acetamide.

A mixture of 27.0g. orthoformic ester and 12.0g. benzamide was refluxed for 12 hrs. The reaction mixture solidifies gradually after cooling. The mixture was washed with ether and then with hot water, in order to remove the unreacted orthoformic ester and benzamide, the yield of the crude product was 8.2g. This product was recrystallized twice from alcohol and analyzed.

m. p. 297~208°,

N : 11.39% (calc. 11.11%)

Similarly a mixture of 50g. orthoformic ester and 30g. acetamide was refluxed for 15 hrs. and the yield of the crude product was about 27 % (based on the acetamide). After recrystallization three times from alcohol the product was analyzed.

m. p. decomposes.

N : 22.16% (calc. 21.86%).

(2) Transjointing between methylene-bis-benzamide and methylene-bis-acetamide.

The methylene-bis-benzamide was prepared after the method of Pulvermacher¹⁾ and the methylene-bis-acetamide after the method of Brain²⁾.

A mixture of 50g. methylene-bis-benzamide (m. p. 220.5~221°) and 25g. methylene-bis acetamide (m. p. 196°) was heated gradually up to 270° under air condenser and kept refluxing for 9 hrs. During the refluxing the temperature dropped gradually down to 220°. The dark-brown reaction product was added to 250 cc. water and after extraction of the unreacted components with ether and chloroform the insoluble residue was collected. After recrystallization five times from water, it was analyzed. The yield was only 2.0g., m. p. 179.5~181°.

N : 14.69% (calc. 14.58%)

The yield of the aimed product was low, but this does not show the true yield, the major part was lost during the solvent purification.

(3) Transjointing between 1, 3-diphenyltetrahydro-imidazole and diethyl malonate, dimethylaniline or β -naphthol.

Without catalyzer this Transjointing does not occur at all. The authors have found that CaCl_2 or ZnCl_2 is a very suitable catalyzer for these reactions.

11.5g. 1, 3-diphenyltetrahydroimidazole (I), 16.0g. diethyl malonate and 2g CaCl_2 were dissolved in 70cc ethylalcohol and refluxed for 8 hrs. After cooling, almost no (I) was recognized, while it easily separates out as crystals when it remains if any. After removal of alcohol and unreacted diethyl malonate by vacuum distillation, the residue was saponified by refluxing with 4 % NaOH-solution for 3 hrs. The separated aqueous alkaline layer was acidified with HCl and extracted with ether. The ether solution was evaporated to dryness and the residue, crude propane-tetracarboxylic acid, was decarboxylated to glutaric acid. After recrystallization the product showed the m. p. 91~94° and no depression with an authentic sample of glutaric acid, the yield was about 53%. From the oily layer obtained by the alkaline saponification, N, N'-diphenyl-ethylenediamine was recovered as its hydrochloride with 95% yield.

Similarly 11.5g of (I), 12.1g. dimethylaniline and 4g ZnCl_2 were dissolved in 70 cc ethylalcohol and refluxed for 28 hrs, after this duration no (I) was recognized. After removal of solvent by distillation the residue was extracted with ether and the ether was again removed and the residue was distilled under vacuum.

Fraction 1 : 93~94°/22mm. 3g.

Fraction 2 : 230°/4 mm. 7g.

The first fraction was identified as the unchanged dimethylaniline and the second fraction as the tetramethyldiaminodiphenylmethane, after recrystallization and mixed melting point measurement with authentic sample.

Similarly 11.5g. (I), 14.5g. β -naphthol and 2g CaCl_2 were dissolved in 70cc ethyl alcohol and refluxed for 12hrs. After removal of solvent, the residue was made alkaline with NaOH-solution and the recovered N, N'-diphenylenethylenediamine was

eliminated. From the alkaline solution the methylene-bis- β -naphthol was obtained with 65% yield. After recrystallization it was identified comparing with an authentic sample.

(4). Transjointing between dibenzylformal and diethylformal.

The dibenzylformal was prepared after the method of M. Arnold³⁾ and purified and dried with CaCl_2 and metallic Na. The diethylformal was prepared after the method of E. Fischer⁴⁾ and E. W. Adams.⁵⁾ 38g. Dibenzylformal and 23g. diethylformal were mixed and after addition of 3g. ZnCl_2 as catalyser, the mixture was refluxed for 6 hrs. After the mixture was treated with excess water, in which NaHCO_3 was dissolved, and extracted with benzene. After drying the benzene solution with metallic Na, it was distilled and the following fraction was collected.

105~111°/24mm. 8.9g. (16%)

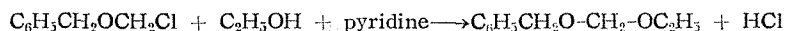
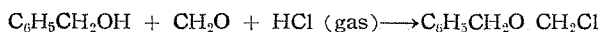
After rectification 4 times, the fraction, 68.5~69°/4mm, was analyzed and identified as the aimed benzylethylformal.

C : 72.10% (calc. 72.26%)

H : 8.72% (calc. 8.49%)

20g. Unchanged dibenzylformal was recovered as the second fraction.

On the other hand, the benzylethylformal was synthesized after the following course :



The benzylethylformal, thus obtained, is identical with the above product.

(5) Transjointing between β -butoxypropionitrile and diethylamine or diethyl malonate.

3g. Metallic sodium was dissolved in anhydrous ethylalcohol and the alcohol was evaporated. To this Na-ethylate 16.5g β -butoxypropionitrile and 9.5 g. diethylamine were added. The mixture was warmed for 4 hrs. at 40~50°. After standing overnight it was again heated up to 75° for a while and then neutralized with acetic acid. After removal of ethylalcohol and unchanged diethylamine (ca. 1g.) by distillation the residue was extracted with ether. The ether was removed and the residue was distilled in vacuum.

1. 40~53°/40 mm. 7 g.

2. 90~100°/30 mm. 6.7 (40%)

The fraction 1 was identified as butanol and the fraction 2 was identified as β -diethylaminopropionitrile. On redistillation it boils at 102°/35 mm and the neutralization value obtained by using N/5 HCl is 130 (calc. 126).

Similarly a mixture of 25.4 g. β -butoxy-propionitrile, 32 g diethyl malonate and 4.6 g. metallic sodium was refluxed for 2 hrs. at 120°. The sodium disappeared com-

pletely. After cooling, the mixture was neutralized with HCl and the separated oily layer was dried and fractionated.

1. 53~78°/70 mm. 5 g.
2. 91~120°/6 mm. 3 g.
3. 147~180°/4 mm, residue ca 4.5 g.

The first fraction was identified as *n*-butanol and the second fraction as the unreacted diethyl malonate. The last fraction, after redistillation, boiling 145~151°/5 mm, was identified as β -cyanoethylmalonic ester (yield, 16 g.) viz., this fraction was saponified and decarboxylated and the resulted glutaric acid was identified comparing with an authentic sample.

(6). Transjointing between the methiodide of β -diethylamino-propionitrile and morpholine or diethyl malonate.

14 g. Methiodide and 43.5g. morpholine were mixed and heated for 3 hrs. in an oil bath at 110°. After removal of the diethylmethylanine (ca, 2 g, 62~67°) and excess morpholine (65~71°/105 mm.) by distillation, the residue was made alkaline with NaOH and extracted with ether. The ether was removed and the fraction of the β -morpholino-propionitrile (130~133°/13 mm.) was collected. The yield was 3.5 g. (50%). The N-content was found as 19.58% (calc. 20.0%)

Similarly 1.2 g. metallic sodium was dissolved in 20 cc absolute ethylalcohol and to this solution 20 g. diethyl malonate was added and the alcohol was removed by distillation. To the residue 16 g. methiodide was added and heated under stirring up to 110° within 2 hrs. and maintained at this temperature for 6 hrs. After removal of the diethylmethylanine (3 g. as HCl salt) by distillation, the residue was mixed with 100 cc 10 % HCl and extracted several times with ether. The ether solution, washed and dried, was distilled and the following fractions were obtained.

1. 88~90°/17 mm. 5 g and 63°/6 mm. 5 g.
2. 138~140°/6 mm. 8.5 g. (yield 67 %).
3. 187~188°/6 mm. ca. 2 g.

The first fraction was identified as the unreacted diethyl malonate. The second fraction was identified as the aimed β -cyanoethylmalonic ester, deriving it into glutaric acid, as in the case (5).

The last fraction solidified, and melted at 57~60°. Further identification of this product was not undertaken.

(7) Transjointing between tetraethyl-methylene- diamine (III) or diethylamino-methyl-*n*-butylether (IV) and some Grignard's Reagents or urea.

The tetraethyl-methylene-diamine (III) was prepared by the Joint Reaction of diethylamine by formaldehyde and the diethylaminomethyl-*n*-butylether (IV) was prepared by the Joint Reaction of diethylamine and *n*-butanol by formaldehyde.

Research upon Joint Reaction and Transjoining. (II)

(a) 30g. Brombenzene was converted into the phenylmagnesium bromide as usual and to this solution 15g. (III) was added under stirring. Faint exothermic reaction occurred. After refluxing for 4 hrs., the reaction mixture was hydrolyzed with 25 % NH_4Cl -solution, fractionated and $87^\circ/15$ mm-fraction (4 g.) was collected. This fraction was identified as benzyldiethylamine, contaminated with small amount of biphenyl. No diphenylmethane was found, even when an excess of Grignard's reagent was used. The HCl -salt of the purified product melted at $192\sim 193^\circ$ and showed no melting point depression with authentic diethylbenzylamine.

Similarly from 25 g. (III) and $\text{C}_6\text{H}_5\text{CH}_2\text{MgCl}$ (from 20 g. benzylchloride), β -phenylethyldiethylamine was obtained in yield of 15, 3 %.

(b) 31.4 g. Brombenzene was converted into Grignard's solution and to this solution 16 g IV was added slowly. Immediately violent exothermic reaction occurred and the reaction mixture was cooled externally with ice-water. By distilling the extract the following fractions were obtained.

1. $50^\circ/50$ mm. 6 g.
2. $90.5\sim 91^\circ/15$ mm. 11.5 g.

The first fraction was the liberated *n*-butanol and the second fraction was identified as the benzyldiethylamine as above.

Similarly from IV and benzyl-MgCl the β -phenylethyl-diethylamine was obtained with excellent yield (91 %).

(c) 29 g. (IV) and 5.4 g. urea were mixed and heated on water bath for 20 minutes under stirring. The reaction mixture became homogeneous soon after the heating. By distilling the product, the following fractions were obtained.

1. $72\sim 75^\circ/117$ mm. 9.5 g.
2. $35\sim 42^\circ/6.5$ mm. 2.5 g.
3. Residue, 20 g.

The first fraction was *n*-butanol and the second fraction was the unreacted IV. The residue was converted into picrate and identified as N,N' -bis-(diethylamino-methyl)-urea with an authentic sample.

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