

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF TEXAS].

I. DIAZOAMINO COMPOUNDS FROM SEMICARBAZINO ACIDS. II. CHEMICAL BEHAVIOR OF THE DERIVATIVES OF CARBONAMIDOAZO-*i*-BUTYRIC ACID.

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Introduction

It has been shown by one of the authors in investigations, conducted in part conjointly with students, that the semicarbazino fatty acids show a close resemblance in chemical behavior to secondary amines. The α -hydrogen atom in these semicarbazino compounds is readily replaced by acyl radicals¹ and the α -imino group condenses with mustard oils.² As yet no work has been published on the behavior of these substances toward nitrous acid, although from the work of Thiele and Heuser on hydrazo-*i*-butyric acid³ and of O. Widman on phenyl-semicarbazine⁴, it is probable that the analogy in the chemical behavior of secondary amines and semicarbazino fatty acids will also hold here.

In this paper the behavior of the semicarbazino fatty acids toward the acid salts of diazonium compounds, more especially *m*-nitrophenylene-diazonium chloride is discussed. Probably all semicarbazine and hydrazine bodies react with diazonium bodies although the reactions are not always similar, and in many instances the instability of the substances formed make the isolation and purification of the reaction products difficult. The action of diazonium salts on hydrazine and phenylhydrazine has been shown by other investigators to result in the formation of azoimides.⁵ By working with the acetate of phenylhydrazine and diazobenzene acetate, Wohl⁶ succeeded in isolating the primary reaction product of diazobenzene on phenylhydrazine, a substance with the empirical formula $C_{12}H_{12}N_4$. Furthermore, Curtius obtained from hippurylhydrazine and diazobenzene sulphate hippurylphenylbutylene, to which he ascribed the constitution, $C_6H_5CONHCH_2CONHNHN = NC_6H_5$.⁷ Diazonium salts in solution with semicarbazine pass into aromatic diazoamino bodies, in which the semicarbazine radical is not found, and in some instances these products were found to result when diazonium salts react with semicarbazino acid derivatives, owing primarily to the strongly reducing action of the latter compounds. However, as concerns the semicarbazino acids and their derivatives, it is in most cases possible to prepare substances, which appear to be diazoamino bodies, in which the diazonium radical is coupled directly

¹ Ber., 33, 1520.

² This Journal, 26, 1006.

³ Ann. 290, 23.

⁴ Ber., 28, 1925.

⁵ Ibid., 26, 1263; 23, 3025.

⁶ Ibid., 26, 1587.

⁷ Ibid., 26, 1268.

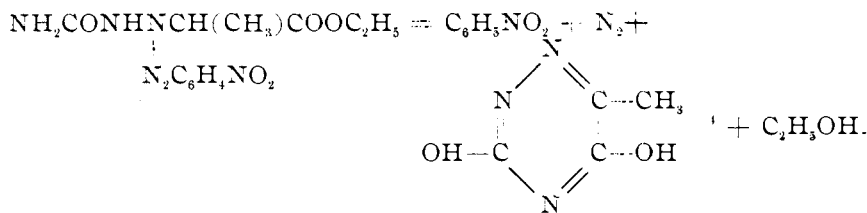
with the α -nitrogen of the semicarbazino compounds. Experiments instituted on another class of hydrazo bodies closely related to the semicarbazino acids, the hydrazo-*i*-butyric acid derivatives described by Thiele and Heuser¹, did not result in the isolation of diazoamino compounds, corresponding to those obtained in the semicarbazino series.

As typical for the constitution of the substances here described, the reaction product of phenyldiazonium chloride on semicarbazinopropionic acid ethyl ester may be selected. This substance is probably constituted as follows: $(\text{NH}_2\text{CONHN}(\text{N}_2\text{C}_6\text{H}_5)\text{CH}(\text{CH}_3)\text{COOC}_2\text{H}_5)$. The formula

$\text{NH}_2\text{CONHNH} \begin{array}{c} \text{C} \\ | \\ \text{CH}_3 \end{array} (\text{N}_2\text{C}_6\text{H}_5)\text{COOC}_2\text{H}_5$ is excluded, in view of the

fact that semicarbazino-*i*-butyric acid derivatives also couple with diazonium bodies. Here the α -carbon atom is not in union with hydrogen and, therefore, it is improbable that the diazo group is joined directly to carbon. Furthermore, phenylsemicarbazine exhibits a behavior toward diazonium salts, similar to that of the other semi-carbazino bodies. These facts indicate strongly that the semicarbazino compounds react with diazonium salts through the labile hydrogen of the α -imino group. As a negative proof that the hydrogen atom replaced in these reactions is on the α -nitrogen, may be cited the fact that the acyl derivatives of semicarbazinopropionic acid² do not react with diazonium salts.

The diazoamino bodies here described do not show the characteristic reaction of diazoamino bodies in general, *e. g.*, the resorcinol reaction suggested by Baeyer³ is not shown by the diazoamino compounds described in this article. In their behavior towards alcoholic potash, these diazoamino bodies show interesting differences. When α -*m*-nitrophenylenediazosemicarbazinopropionic acid ethyl ester is treated with alcoholic potash, two substances result; on the one hand, 6-methyl-3,5-dihydroxy-1,2,4-triazine, an oxidation product of semicarbazinopropionic acid, is formed and, on the other hand, nitrobenzene, a reduction product of the original diazonium salt is formed. This reaction may be interpreted as follows:



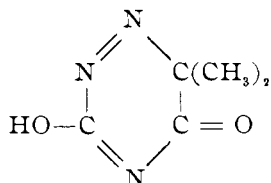
¹ Ann., 290, 1.

² loc. cit.

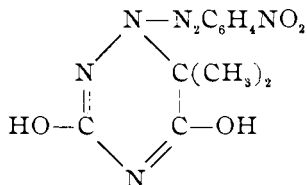
³ Ber. 8, 148.

⁴ Here and in similar compounds referred to in this article, no attempt is made to distinguish between the several tautomeric possibilities.

It was to be expected from the above that α -Ureido- α -*m*-nitrophenylenediazoamino-*i*-butyric acid ethyl ester would similarly yield with alcoholic potash, 5,6-dihydro-6-dimethyl-3-hydroxy-5-keto-1,2,4-triazine.



However, ring condensation results in this case without the elimination of the diazo radical 1,6-dihydro-6-dimethyl-3,5-dihydroxy-1-*m*-nitrophenylenediazo-1,2,4-triazine being formed.



Attempts to obtain 5,6-dihydro-6-dimethyl-3-hydroxy-5-keto-1,2,4-triazine in the above reaction and in other ways were without avail. Carbonamidoazo-*i*-butyric acid ethyl ester was prepared, in the hope that it, similarly to carbonamidehydrazo-*i*-butyric acid esters would condense with sodium alcoholate under ring formation¹ and yield the desired triazine. A further attempt to prepare it by oxidation of 1,6-dihydro-6-dimethyl-3,5-dihydroxy-1,2,4-triazine was without the desired result². In the experimental part of this article, it is shown that carbonamidoazo-*i*-butyric acid, as well as the corresponding triazine, breaks down spontaneously at the moment of its formation, giving off two atoms of nitrogen, a decomposition similar to that of azo-*i*-butyric acid³. Furthermore, carbonamidoazo-*i*-butyric acid ethyl ester decomposes at a few degrees above its melting point. These experiments go to confirm the observation of Thiele and Heuser that the azo compounds in the aliphatic series, in contrast to the aromatic azo compounds are not as a rule very stable and in many instances are incapable of existence⁴.

Experimental Part. Part I. Diazoamino Compounds from Semicarbazino Acids

Acetaldehydesemicarbazone—In the preparation of acetaldehydesemicarbazone, a slight modification of the method of Thiele and Bailey was

¹ Am. Ch. J. 28, 402.

² Compare Ann., 303, 82.

³ Ibid. 290, 8.

⁴ Ibid., 290, 12.

employed¹. It was found that acetaldehyde could be substituted for aldehydeammonia in making the semicarbazone and in this way an almost pure product is directly obtained, which yields with prussic acid semicarbazinopropionitrile of sufficient purity for direct conversion into other derivatives. 130 grams of hydrazine sulphate and 55 grams of sodium carbonate are made into a thin paste with 50 cc. of water and to this a solution of 85 grams of potassium cyanate in 60 cc. of water is added. After standing twelve hours, the mixture is acidified with acetic acid in order to precipitate the by-product, dicarbonamide. The filtered solution of semicarbazine thus prepared is cooled in ice water and 55 cc. of freshly prepared acetaldehyde is gradually added to this under constant stirring. The semicarbazone separates out almost pure in a yield of about 55% of the theoretical.

Semicarbazino Acid Esters.—The preparation of the semicarbazino acid esters has been studied by Thiele and Bailey² and by Bailey and Wesson³. In this work the following modification of the methods employed by these investigators was used. It was found that the yield of the ester is not materially affected by the purity of the semicarbazinopropionitrile employed, and, therefore, it is not necessary or even desirable to purify the latter substance. Furthermore, in saturating the alcoholic solution of this nitrile with hydrochloric acid gas, the regulation of the temperature does not materially affect the yield of ester. To prepare the ethyl or propyl ester of semicarbazinopropionic acid, the nitrile is dissolved in four times its weight of alcohol and, without cooling, hydrochloric acid gas is led in to saturation. After standing twelve hours, the alcoholic solution is neutralized with sodium carbonate, the alcohol is then distilled *in vacuo*, the residue is dissolved in water, and the ester is extracted from the aqueous solution with chloroform. The semicarbazinopropionic acid methyl ester cannot be prepared according to this method. Numerous attempts were also made to prepare semicarbazino-*i*-butyric acid ethyl ester, through the formation of the corresponding imino ether, but, although the ester, mixed with a larger amount of dimethyl triazine, was obtained in this way, this method of preparing it was finally abandoned for the method suggested by Bailey and Wesson⁴.

a-Ureido-a-phenyldiazoaminopropionic acid ethyl ester, $\text{NH}_2\text{CONHN}(\text{N}_2\text{C}_6\text{H}_5)\text{CH}(\text{CH}_3)\text{COOC}_2\text{H}_5$.—A diazo solution is prepared by dissolving 9.3 grams of aniline in 1,000 cc. of water, containing 3.6 grams of hydrochloric acid, and adding to this solution cooled to 0°, under constant stirring, a previously cooled solution of 6.9 grams of sodium nitrite in 250

¹ Ann., 303, 79.

² Ibid., 303, 83.

³ Am. Ch. J. 28, 396.

⁴ Ibid. 28, 402.

cc. of water. The diazo solution thus prepared is immediately added under stirring to a solution of 17.5 grams of semicarbazinopropionic acid ethyl ester in 1,500 cc. of water, also previously cooled to 0° . The substance begins to separate out at once and in half an hour the compound is filtered off. The yield obtained was 9 grams. This diazoamino compound is soluble in alcohol, acetic ester, and chloroform, very sparingly soluble in ether, and insoluble in benzene and petrolic ether. For purification, the substance is dissolved in alcohol and precipitated with water as a yellow-white crystalline mass. Recrystallized twice in this manner, the substance is colorless, melts under explosion to a dark-red liquid at $125^{\circ 1}$, and under the microscope it is seen to consist of clusters of long interlacing needles. On exposure to light, it rapidly turns yellow.

Calculated for $C_{12}H_{17}O_3N_3$: C, 51.61; H, 6.09; N, 25.09. Found: C, 51.71; H, 6.05; N, 24.92.

Wedekind has shown that by employing a nitrophenylenediazonium salt, instead of the simple phenyldiazonium salt, in effecting condensations of an analogous character to those described here, the formation of smeary substances is considerably avoided and the resulting compounds, as a rule, admit of ready crystallization². Similar observations have been made in this work.

*α -Ureido- α -*m*-nitrophenylenediazoaminopropionic acid ethyl ester*, $NH_2\text{-CONHN}(N_2C_6H_4NO_2)CH(CH_3)COOC_2H_5$.—The preparation of this substance may be taken as typical for the substances described in this article, which were obtained by the use of *m*-nitrophenylenediazonium chloride. A diazo solution is prepared by dissolving 8 grains of *m*-nitraniline in 200 cc. of dilute hydrochloric acid, containing 6.4 grams of HCl. To this solution, cooled to 0° , is added 4 grams of sodium nitrite, dissolved in 100 cc. of water, also cooled to 0° . The diazo solution thus prepared is added under constant stirring to a solution of 10 grams of semicarbazinopropionic acid ethyl ester in 300 cc. of water at 0° . The new diazoamino body separates out immediately as a bulky, cream-white precipitate and in about 30 minutes the reaction is complete. The yield is almost quantitative. The substance is soluble in alcohol and acetic ester, very soluble in cold chloroform, insoluble in ether, petrolic ether and water. Acetic ester is best adapted for purification of the compound. Crystallized once from this medium, the substance decomposes under explosion at 146° to a dark-red liquid.

¹ The melting points and explosion points given here are corrected. However, the explosion points depend in large measure on the rate of heating. It is characteristic of all the diazoamino compounds described in this article that they decompose under explosion at elevated temperatures without previously melting. Furthermore, they are all sensitive to light.

² Ann., 307, 283.

Calculated for $C_{12}H_{16}O_5N_8$: C, 44.44; H, 4.94; N, 25.93.

Found: C, 44.57; H, 5.06; N, 25.74.

The substance dissolves readily in the cold in bromine water, from which on the addition of ammonia there is precipitated a brick-red substance. Treatment of this diazoamino body in absolute alcohol solution with bromine yields a substance freely soluble in ether and alcohol and volatile with steam, which, after recrystallization from dilute alcohol, melts at $55-60^\circ$. This substance is undoubtedly *m*-nitrophenyleneazoimide. The diazoamino body is readily decomposed by acids, alkalis, and even boiling water.

Behavior of *α -ureido- α -m-nitrophenylenediazoaminopropionic acid ethyl ester toward alcoholic potassium hydroxide, potassium ethoxide and alcoholic ammonia*.—If to this diazoamino body in concentrated alcoholic solution, there be added alcoholic potassium hydroxide, containing one molecule of potassium hydroxide, and the mixture then be heated on the water-bath, the solution changes from a light yellow to a deep red color and a copious evolution of nitrogen takes place. At the same time a solid separates out of the solution in bright yellow flakes. The substance was obtained in silver-white flakes by boiling it in water with animal charcoal and after filtration precipitating the salt from its aqueous solution with an alcohol-ether mixture. An analysis of this substance proved it to be the potassium salt of 6-methyl-3,5-dihydroxy-1,2,4-triazine.

Calculated for $C_4H_4O_2N_3K$: K, 23.70. Found: K, 23.75.

When 1,6-dihydro-6-methyl-3,5-dihydroxy-1,2,4-triazine in concentrated alcoholic solution is treated with potassium ethoxide, a potassium salt separates out which is undoubtedly identical with the salt just described. Owing to a lack of material, the substance was not prepared in this way in an amount sufficient for analysis. The previously described potassium salt on treatment with hydrochloric acid yields the free triazine, a substance described by Thiele and Bailey¹. They found the melting point of this substance to be 209° (uncorrected), whereas we found the corrected melting point to be 217° . For identification of this substance the triazine was prepared according to the method of Thiele and Bailey by oxidizing the corresponding dihydrotriazine with bromine water. In the preparation of the triazine by this method, it is advantageous to neutralize the hydrobromic acid formed with ammonia before proceeding with the evaporation of the aqueous solution as directed. The substances obtained by the two methods proved in every respect identical, and their identity was further confirmed by an analysis of the triazine obtained from the potassium salt described above.

Calculated for $C_4H_5O_2N_3$: C, 37.80; H, 3.93; N, 33.07. Found: C, 37.81; H, 4.06; N, 33.09.

¹ *Ibid.* 303, 22.

The original alcoholic filtrate from the potassium salt of the triazine on evaporation yielded a red gummy substance and in small quantity an oil, volatile with steam and when quite pure of a bright yellow color. A sufficient quantity of this latter substance for analysis was not obtained. Its color, odor, and specific gravity indicated it to be nitrobenzene, which represents a reduction product of *m*-nitrophenylenediazonium chloride; whereas the triazine discussed above, represents an oxidation product of semicarbazinopropionic acid. Potassium or sodium ethoxide has an effect on the diazoamino body similar to alcoholic potassium hydroxide and alcoholic ammonia and decomposes the diazoamino body with direct formation of triazine. The sodium salt of the triazine, prepared by the action of sodium ethoxide on the diazoamino ester and purified in the same manner as that employed in the case of the potassium salt, was analyzed.

Calculated for $C_4H_6C_3N_3Na$: Na, 15.44. Found: Na, 15.04.

Behavior of acyl derivatives of semicarbazinopropionic acid ethyl ester toward m-nitrophenylenediazonium chloride.—As a negative proof that diazonium salts couple with the α -nitrogen of semicarbazino acid derivatives, may be cited the fact that, where this α -nitrogen contains no hydrogen atom bound to it, these semicarbazines do not react with diazonium salts. The acetyl and the benzenesulphonylsemicarbazinopropionic acid ethyl ester was treated in the usual way with diazonium salts and in no instance could a reaction product be isolated.

α -Ureido- α -m-nitrophenylenediazoaminopropionic acid propyl ester.—This diazoamino body was prepared similarly to the ethyl ester just discussed. After two crystallizations from acetic ester, the substance decomposed under explosion at 149° to a dark-red liquid.

Calculated for $C_{13}H_{18}O_2N_6$: C, 46.15; H, 5.33; N, 24.85. Found: C, 46.43; H, 5.46; N, 24.75.

α -Ureido- α -m-nitrophenylenediazoaminopropionitrile.—This substance was prepared analogously to the corresponding esters by using semicarbazinopropionitrile. This nitrile body does not immediately separate out on bringing together the nitrile and the diazonium salt, but after a few minutes the solution begins to cloud and in half an hour the diazoamino body has precipitated completely as a very bulky, faint yellow precipitate. The substance could not be recrystallized and was, therefore, analyzed without further purification. It decomposes at 133° under explosion to a dark-red liquid.

Calculated for $C_{10}H_{12}O_3N_7$: C, 43.32; H, 3.97; N, 35.38. Found: C, 43.32; H, 4.04; N, 35.22.

This diazoamino body in absolute alcohol saturated with dry hydrochloric acid gas yields a white crystalline substance. The yield, however, was too small to allow of further investigation of this substance. With hy-

droxylamine the nitrile reacts, probably passing to the corresponding amidoxime. The analytical data indicated that the amidoxime, if formed, was impure.

a-Ureido-a-m-nitrophenylenediazoaminopropionic acid.—This substance was prepared from semicarbazinopropionic acid in the usual way. It has about the same solubilities as the corresponding nitrile and like this substance was not recrystallized for analysis, as all attempts at further purification resulted in a partial decomposition of the substance. The sample used for analysis decomposed at 128° under explosion to a dark-red liquid.

Calculated for $C_{10}H_{12}O_5N_6$: C, 40.54; H, 4.05; N, 28.38. Found: C, 40.65; H, 4.04; N, 28.16.

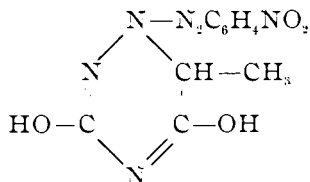
This diazoamino body shows a behavior toward alcoholic potash entirely different from the behavior of the corresponding ester toward this reagent. When an alcoholic solution of this acid is treated with alcoholic potash, a vermilion colored potassium salt crystallizes out. This salt freshly prepared explodes at 165° to a dark-brown gummy residue, but, if the pure dry substance be allowed to stand twenty-four hours, its explosion point rises to 184° and its color changes to creamy white. For analysis the latter modification of the salt was recrystallized from alcohol and well washed with ether.

Calculated for $C_{10}H_{11}O_5N_6K$: K, 11.68; N, 25.15. Found: K, 11.62; N, 23.96.

The free acid, prepared from the above salt by treatment with hydrochloric acid gave a substance corresponding in explosion point to the *a-ureido-a-m-nitrophenylenediazoaminopropionic acid*, but an analysis did not agree very closely with the percentage composition of this substance.

Calculated for $C_{10}H_{12}O_5N_6$: C, 40.54; H, 4.05. Found, C, 41.63; H, 4.88.

1-m-Nitrophenylenediazo-1,6-dihydro-6-methyl-3,5-dihydroxy-1,2,4-triazine:



Dihydromethyldihydroxytriazine couples with diazo compounds similarly to the semicarbazino acid derivatives. However, in preparing the diazoamino compound from this body, two molecules of hydrochloric acid instead of three were employed for each molecule of the triazine. With

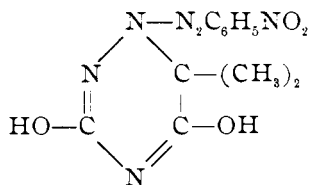
m-nitrophenylenediazonium chloride the triazine gives an almost quantitative yield of a diazoamino body of a cream white color. It explodes to a dark-red liquid at 121°. The substance is readily soluble in alcohol and acetic ester, difficultly soluble in benzene, ether and water. With alcoholic potash it forms a potassium salt of the original methyl-dihydroxy-triazine, a reaction similar to that described above for *α*-ureido-*α*-*m*-nitrophenylenediazoaminopropionic acid ethyl ester.

Calculated for C₁₀H₁₀O₄N₆: C, 43.17; H, 3.60. Found, C, 43.37; H, 3.71.

α-Ureido-*α*-*m*-nitrophenylenediazoamino-*i*-butyric acid ethyl ester NH₂CONHN(N₂C₆H₄NO₂)C(CH₃)₂COOC₂H₅.—When semicarbazino-*i*-butyric acid ethyl ester is treated with nitrophenylenediazonium chloride, according to the general method, precipitation of a cream white substance begins at once and in about thirty minutes the reaction is complete. The yield is almost quantitative. The new substance is readily soluble in alcohol and acetic ester and for purification is best crystallized from benzene. It explodes at 133°.

Calculated for C₁₈H₁₈O₅N₆: C, 46.15; H, 5.33; N, 24.85. Found: C, 46.32; H, 5.38; N, 25.09.

Behavior of α-ureido-α-m-nitrophenylenediazoamino-i-butyric acid ethyl ester toward potassium ethylate.—The ureidodiazoaminobutyric acid ester, when treated with alcoholic potash or with potassium ethoxide, similarly to the method employed in the case of the ureidodiazoaminopropionic acid ester, gives a bright vermilion colored potassium salt. Purified by recrystallization from alcohol, the salt is obtained in narrow thin prisms as seen under the microscope, which explode at 166° to a dark gummy residue. An analysis indicated that the salt was not obtained pure. The salt in aqueous solution was accordingly treated with dilute hydrochloric acid, whereupon a substance of a cream white color separated out. This was purified by recrystallization from dilute alcohol. It consists of flakes of a silvery luster and light lemon color, and explodes at 130°, leaving a yellow oil as a residue. An analysis indicated the substance to be 1,6-dihydro-6-dimethyl-3,5-dihydroxy-1-*m*-nitrophenylenediazo-1,2,4-triazine.



Calculated for C₁₁H₁₂O₄N₆: C, 45.21; H, 4.11; N, 28.77. Found: C, 45.48; H, 4.23; N, 28.37.

In order to confirm the constitution of the above compound, 1,6-dihydro-

6-dimethyl-3,5-dihydroxy-1,2,4-triazine was treated with nitrophenylene-diazonium chloride in the usual way and a substance obtained, which appeared identical with the compound described above. Its constitution was confirmed by an analysis. On treatment with alcoholic potash the triazine goes into a red potassium salt which has the same explosion point and crystalline form as the salt described above.

Calculated for $C_{11}H_{12}O_4N_6$: C, 45.21; H, 4.11; N, 28.77. Found: C, 45.33; H, 4.21; N, 28.18.

a-Urcido-a-m-nitrophenylenediazoaminobenzene, $NH_2CONHN(N_2C_6H_5NO_2)C_6H_5$.—This diazoamino body is obtained from phenylsemicarbazine in the usual way as a very bulky, orange colored, gelatinous substance resembling freshly precipitated ferric hydroxide. In its preparation no escape of gas or other indication of decomposition is observed. After being filtered and dried, the substance assumes a dark lemon yellow color and decomposes under violent explosion at 104° to a dark-red liquid. It is sparingly soluble in ether and chloroform, more soluble in alcohol and acetic ester, and insoluble in benzene and petroleic ether. Attempts to recrystallize the substance were fruitless.

Calculated for $C_{15}H_{12}O_3N_6$: C, 52.00; H, 4.00; N, 28.00. Found: C, 51.86; H, 4.07; N, 27.48.

Action of diazonium salts on semicarbazine.—It was found that semicarbazine itself acts as a reducing agent toward *m*-nitrophenylenediazonium chloride without condensing to a diazoamino body. The nitraniline thus formed couples with unchanged diazo compound, forming *m*-dinitrodiazoaminobenzene.

Part II. Chemical Behavior of Derivatives of Carbonamidoazo-*i*-Butyric Acid

*Carbonamidoazo-*i*-butyric acid ethyl ester*, $NH_2CON=NC(CH_3)_2COOC_2H_5$.—For the preparation of this azo body carbonamidohydrozo-*i*-butyric acid ethyl ester is dissolved in a little water and then bromine water is added in slight excess. The oxidation proceeds without gas evolution and the solution assumes a yellow color, due to the formation of the azo body. The solution of the azo ester is allowed to stand for about one-half hour, to insure complete oxidation, and then the excess of bromine is removed by the addition of sulphurous acid. Finally, after neutralization of the solution with ammonia, the ester is extracted with chloroform. On distilling off the chloroform, the azo ester remains as a yellow oil, which on stirring solidifies. The substance is readily soluble in the ordinary solvents, with the exception of petroleic ether, and may be purified by crystallization from water or benzene. It crystallizes beautifully from either of these solvents in golden yellow, glistening crystals, which begin to soften

at 81° and melt undecomposed at 83° to a clear liquid. When heated to 120° , the substance decomposes with gas evolution.

Calculated for $C_7H_{13}O_3N_3$: C, 44.92; H, 6.95; N, 22.46. Found: C, 45.18; H, 7.00; N, 22.79.

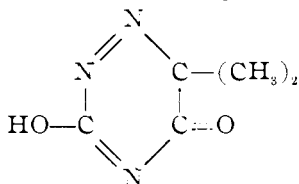
Action of heat on carbonamidoazo-i-butyric acid esters.—An attempt to prepare the azomethyl ester by the method employed for the corresponding ethyl ester yielded a yellow oil, which did not crystallize even after standing for several weeks. It was thought that possibly the desired triazine might be formed by heating the azo esters and, therefore, this oil, which was undoubtedly the azomethyl ester, was heated until there was a steady gas evolution. In this operation the temperature was kept between 135° and 160° . In addition to a small amount of a white sublimate, there remained in the vessel, in which the azo ester was heated, an oil. This latter substance was boiled with benzene, in which a large amount of it dissolved. On distilling off the benzene, there remained an oil, which differed from the original azo ester in that it was colorless and almost insoluble in water. This oil was next dissolved in ether, the ethereal solution dried with calcium chloride, and, after distilling off the ether, the oil was distilled under a pressure of 20 mm. A small amount of a colorless liquid distilled over but the greater part of the substance remained behind as a gum. In a boiling point tube this oil showed a corrected boiling point of 232° at 750 mm. However, it turned brown near its boiling point, owing to a partial decomposition. An analysis of this oil, which was undoubtedly impure, gave 49.06 per cent. C and 7.59 per cent. H. A lack of material prevented any further investigation of the substance.

Action of bromine water on 1,2-dihydro-6-dimethyl-3,5-dihydroxy-1,2,4-triazine.—When an aqueous solution of this triazine is treated with bromine water, even in the cold a steady gas evolution takes place. Evidently an unstable oxidation product is at first formed, as the solution with the first few drops of bromine water becomes yellow, but this color is not permanent for any length of time. In order to determine the amount of nitrogen given off in this reaction, the triazine, dissolved in a small amount of water was put in a flask connected with a carbon dioxide generator and a nitrometer. After expulsion of the air, a slight excess over one molecule of bromine in water solution was allowed to run in on the triazine through a dropping-funnel, and then a sulphurous acid solution was introduced to reduce any free bromine. With a slow stream of carbon dioxide passing through the flask the solution was now boiled as long as any gas collected in the nitrometer. Corrections were introduced for the dissolved gases in the water used. This experiment shows that two-thirds of the nitrogen in the triazine in this way escaped as a gas.

Calculated for one mol. N in one mol. triazine, 19.58 per cent. Found : N, 19.85.

In this connection it might be mentioned that carbonamidohydrazo-*i*-butyric acid, on treatment with bromine, evolved 17.47% N. Calculated for one mol. N in one mol. of acid, 17.39 per cent. This experiment makes it highly probable that carboamidoazo-*i*-butyric acid, $\text{NH}_2\text{CON}=\text{NC}(\text{CH}_3)_2\text{COOH}$, is also not capable of existence.

The preparation of 6-dimethyl-3-hydroxy-5-keto-1,2,4-triazine.



was attempted, because, from the formation of 6-methyl-3,5-dihydroxy-1,2,4-triazine from *α*-ureido-*α*-*m*-nitrophenylenediazoaminopropionic acid ethyl ester and alcoholic potash, it was to be expected that *α*-ureido-*α*-*m*-nitrophenylenediazoamino-*i*-butyric acid ethyl ester would show an analogous behavior. As has been described, the substance formed in this latter case is, however, in the main a potassium salt of the diazoamino body, minus alcohol. Two methods of preparation of the dihydroxy dimethyl-triazine in question suggested themselves from the work that one of the authors in connection with others has done on the corresponding methyl-triazine¹. First an attempt was made to oxidize with bromine water, 1,2-dihydro-6-dimethyl-3,5-dihydroxy-1,2,4-triazine. The experiments instituted in this connection are described above. In the second place an attempt was made to condense carbonamidoazo-*i*-butyric acid ethyl ester with sodium alcoholate to the desired triazine. This experiment was unsuccessful as the substances reacted violently with gas evolution, forming a colorless solution from which nothing was isolated.

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A PRELIMINARY COMMUNICATION ON THE TOXICITY OF SOME ANILINE DYESTUFFS.²

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Introduction.

Recent discussions concerning the use of various artificial organic dyes as food colorants made it seem very desirable to study the toxic effects of

¹loc. cit.

²Presented before the New York Section of the Am. Chem. Soc., Science, 25, 343 (1907). See also, Proc. sect. Biol. Chem. of Am. Chem. Soc. with sect. C., A. A. S., Science, 25, 457 (1907).