Trichlorethylidenedi-p-tolamine gave with one molecule of bromine the hydrobromide of *p*-toluidine while two molecules gave a mixture of the hydrobromide of *p*-toluidine, hydrobromide of 3-brom-4-toluidine and the hydrobromide of 3,5-dibrom-4-toluidine.

Trichlorethylidenedi-o-tolamine gave chiefly the hydrobromide of 5-brom-2-toluidine, melting with decomposition at about 280°.

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[CONTRIBUTIONS FROM THE HAVEMEYER LABORATORIES OF COLUMBIA UNIVERSITY, No. 168.]

RESEARCHES ON QUINAZOLINES (TWENTY-SECOND PAPER). ON 2-METHYL-3-AMINO-4-QUINAZOLONE AND CERTAIN OF ITS DERIVATIVES.[1]

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The N-amino quinazolones present an interesting case of unsymmetrical secondary hydrazine structure. The first one described in the literature seems to be the 6-nitro-3-amino-4-quinazolone which Kratz[2] obtained by the action of glacial formic acid upon 5-nitro-2-aminobenzhydrazide. From a foot-note at the close of Kratz's article, it appears that Finger endeavored to prepare the simple 3-amino-4-quinazolone from *o*-aminobenzhydrazide, but Finger himself does not mention it in his paper on *o*-aminobenzhydrazide,[3] and it was not until 1904 that this unsubstituted N-amino-4-quinazolone was prepared by Thode[4] from the *o*-aminobenzhydrazide and glacial formic acid. From the phenylhydrazide, Thode obtained the 3-anilino-4-quinazolone. In 1902, Anschütz, Schmidt and Greiffenberg[5] produced the 2-methyl-3-anilino-4-quinazolone by condensing acetanthranil with phenylhydrazine. From the corresponding nitro acetanthranils and hydrazine hydrate, Bogert and his co-workers prepared the 5-nitro-,[6] 6-nitro-[7] and the 7-nitro-2-methyl-3-amino-4-quinazolone,[8] and various derivatives thereof.

Very closely related to these N-amino-4-quinazolones are the 3-amino benzoylene urea of Kunckell,[9] Spiegelberg[10] and Lederer,[11] and the 1-methyl-3-amino benzoylene urea of Spiegelberg.[12]

[1] Read at the meeting of the New York Section, March 5, 1909.

[2] *J. prakt. Chem.*, **53** [2], 224 (1896).

[3] *Ibid.*, **48**, 92 (1893).

[4] *Ibid.*, **69**, 100 (1904).

[5] *Ber.*, **35**, 3483 (1902).

[6] Bogert and Seil, THIS JOURNAL, **28**, 884 (1906).

[7] Bogert and Cook, *Ibid.*, **28**, 1449 (1906).

[8] Bogert and Klaber, *Ibid.*, **30**, 807 (1908).

[9] *Ber.*, **38**, 1212 (1905).

[10] *Inaug. Dissert.*, Rostock, 1905.

[11] *Inaug. Dissert.*, Rostock, 190 .

[12] *Loc. cit.*

Recently, the N-amino heterocyclic compounds have been studied by Franzen,[1] Bülow[2] and others, but so far as we are aware the investigations have not included the N-amino quinazolines.

In the following pages, the preparation and properties of the 2-methyl-3-amino-4-quinazolone are described. On the whole, its properties agree with those of other N-amino heterocyclic compounds. Thus, nitrous acid does not diazotize the amino group, but replaces it with hydrogen; with diacetosuccinic ester it condenses to a pyrrole derivative; with aromatic nitroso bodies it yields no azo compound; it is not oxidized by mercuric oxide. On the other hand, it does yield a phenyluramino body with phenyl isocyanate, and does not condense with ketones. In the elimination of the N-amino group by nitrous acid, there must be some unstable intermediate product formed, for if immediately after the addition of the nitrous acid the mixture be poured into an alkaline solution of α or β naphthol, dyestuffs are obtained of high tinctorial power, but fugitive. Their structure has not been ascertained.

Besides the free aminoquinazolone, its hydrochloride, picrate, formyl, acetyl, phenyluramino and benzal derivatives were prepared. The free aminoquinazolone is easily obtained by the action of hydrazine hydrate upon acetanthranil.

Experimental.

Acetanthranil is conveniently prepared by the action of acetic anhydride upon anthranilic acid.[3] Occasionally, beautiful, great, glassy prisms separate on concentrating the solution. These are composed of the acetanthranil with acetic anhydride of crystallization. They are not very stable, and lose their acetic anhydride when removed from the mother liquor, becoming opaque and crumbling to a colorless powder.

2-Methyl-3-amino-4-quinazolone, $C_6H_4\begin{cases} N = C.CH_3 \\ \quad\quad | \\ CO{-}N.NH_2 \end{cases}$.—Acetanthranil was added gradually, with stirring, to slightly more than an equimolecular amount of hydrazine hydrate (50 per cent. aqueous solution). Some heat was developed in the reaction and a colorless solid separated. On boiling the mixture, this solid dissolved and on cooling, long, colorless needles of the aminoquinazolone separated. These crystals contained a molecule of water of crystallization which was given off at 110°.

Found: H_2O, 9.50. Calculated for $C_9H_9ON_3$: H_2O, 9.32.

The anhydrous compound melts at 152° (corr.).

Found: N, 24.06. Calculated for $C_9H_9ON_3$: N, 24.0.

The yield of aminoquinazolone was nearly theoretical. Any di-quinazolonyl formed is easily removed by virtue of its insolubility in most solvents. The aminoquinazolone is easily soluble in most organic solvents, and crystallizes well from dilute alcohol. Attempts to condense the CO group with phenylhydrazine, hydroxylamine or aniline, all failed. Heating with alcoholic ammonia for six hours at 130° caused no change. Bülow and Klemann[4] found that N-amino heterocyclic compounds con-

[1] *J. prakt. Chem.*, **73** [2], 547 (1906); **77**, 193 (1908).

[2] *Ber.*, **40**, 4749 (1907).

[3] Bogert and Seil, THIS JOURNAL, **29**, 529 (1907).

[4] *Ber.*, **40**, 4755 (1907).

densed with ketones. When the above aminoquinazolone was heated with an absolute alcohol solution of acetophenone for six hours under a return condenser, or for nine hours at 180–200° in a sealed tube, no reaction occurred. The same result was recorded when the two substances were heated together dry at the boiling point of the acetophenone.

Hydrochloride.—A saturated aqueous solution of the aminoquinazolone is precipitated by concentrated hydrochloric acid as the hydrochloride. It is easily soluble in water and not hydrolyzed when boiled with it. Recrystallized from dilute hydrochloric acid, it forms long, colorless needles, m. p. 206.9° (corr.).

Picrate.—When solutions of the calculated amounts of the aminoquinazolone and picric acid in warm alcohol were mixed, a crystalline picrate was precipitated. It was washed with water and dried at 110°. The yield was 90 per cent. of the theoretical.

Found: N, 21.01. Calculated for $C_9H_9ON_3.C_6H_3O_7N_3$: N, 20.78.

It is sparingly soluble in water or alcohol, the solutions dyeing wool or silk a bright yellow. At 187° (corr.), it blackens.

2-Methyl-3-amino-4-quinazolone and Nitrous Acid.—Like other N-amino compounds,[1] nitrous acid replaces the amino group of this quinazoline by hydrogen, giving 2-methyl-4-quinazolone (m. p. 238°). We have found, however, that under certain conditions other substances may be obtained.

A gram and a half of the aminoquinazolone were dissolved in dilute hydrochloric acid, the solution cooled to 10° and an equimolecular amount of sodium nitrite added in dilute aqueous solution. Frothing began at once, and this frothing mixture was poured immediately into an alkaline solution of 1.2 grams β-naphthol. The solution turned deep red and a red, flocculent precipitate separated, which was filtered out and washed with cold water (in which it is but sparingly soluble). It was dissolved in concentrated sulphuric acid, giving a deep purple solution, and the free base precipitated by dilution with water. The precipitated base was washed with water, then with alcohol, redissolved in concentrated sulphuric acid, reprecipitated with water, the precipitate washed thoroughly with water, crystallized from alcohol and dried at 110°.

Found: C, 68.30, 68.25; H, 4.53, 4.38; N, 9.70.

The free base crystallizes from alcohol in bright red needles, which darken at 200–30° and decompose sharply at 266° (corr.). It is soluble in ethyl or amyl alcohol, glacial acetic acid or benzene; insoluble in water; soluble in concentrated hydrochloric or sulphuric acids, giving intensely colored solutions; and dissolves slightly in alkalies or in concentrated ammonium hydroxide solution, with formation of salts which are difficultly soluble in cold water (*e. g.*, the ammonium salt dissolves in about 15000 parts of cold water). But even in these dilute aqueous solutions of the salts, silk and wool are dyed a deep orange, which is fairly fast to acids or alkalies, but fugitive in sunlight. The tinctorial power of the substance is such that half a gram of it is sufficient to dye 100 grams silk the maximum depth of shade. Although no mordant is necessary, previous moistening of the fiber with alum solution materially hastens the dyeing.

Just what is the nature of this dyestuff, is still unrevealed. The analytical results do not correspond to any very simple empirical formula, $C_{41}H_{32}O_8N_5$ contains C, 68.14; H, 4.43; and N, 9.7.

In one experiment when, so far as we could tell, the conditions necessary for the formation of this dye were maintained, no dye at all was formed on adding the frothing

[1] von Pechmann and Mills, *Ber.*, **37**, 3838 (1904); Bülow and Klemann, *Loc. cit.*, *et al.*

mixture to the alkaline β-naphthol solution, but a mass of red crystals containing no alkali metal. Purified by solution in 95 per cent. alcohol and reprecipitation with water, it was obtained in bright orange needles, m. p. 144–5° (corr.), easily soluble in ethyl or amyl alcohol, acetone, benzene, acetic acid or caustic alkalies; slightly soluble in water or in dilute mineral acids.

Found: C, 75.32, 74.86; H, 5.11, 5.24; N, 9.22.

This corresponds to a combination of one molecule of the aminoquinazolone with one of the naphthol:

Calculated for $C_9H_8ON_3.C_{10}H_8O$: C, 75.0; H, 5.26; N, 9.21.

The compound had a strong odor of β-naphthol. Whether the naphthol is present as naphthol of crystallization, or is combined in some other way, has not been determined, as we could not get the compound again. It had no tinctorial power.

When α-naphthol was used instead of β, a dyestuff was obtained much like that from the latter. The free base is a brick-red powder, melting with decomposition at 245° (corr.), easily soluble in alcohol or acetic acid, insoluble in water, soluble in concentrated sulphuric acid to a deep purple solution. Its salts are much more soluble in water than those of the analogous compound from β-naphthol. In alkaline or acetic acid solution, they dye silk pink.

These dyestuffs were obtained only when the two solutions were mixed immediately after the addition of the sodium nitrite. If the hydrochloric acid solution of the aminoquinazolone was allowed to stand for many seconds after the addition of the sodium nitrite, no dye at all was obtained when this solution was added to the alkaline naphthol solution.

2-Methyl-3-formamino-4-quinazolone, $C_6H_4\begin{cases}N = C.CH_3\\ \quad\quad\ |\\ CO—N.NHCOH\end{cases}$. — The aminoquinazolone was dissolved in excess of glacial formic acid, the solution evaporated to dryness, the residue taken up with chloroform, and the formyl derivative precipitated by adding benzene. The crude product was purified by resolution in chloroform and reprecipitation with benzene. Yield, 50 per cent. the weight of the aminoquinazolone used.

Found: N, 20.52. Calculated for $C_{10}H_9O_2N_3$: N, 20.68.

Long, gray needles (from chloroform), softening at 185° and melting at 203–4° (corr.). The compound is easily soluble in water, alcohol or acetic acid; moderately soluble in chloroform, and but slightly soluble in benzene.

2-Methyl-3-acetamino-4-quinazolone, $C_6H_4\begin{cases}N = C.CH_3\\ \quad\quad\ |\\ CO—N.NHCOCH_3\end{cases}$, from the aminoquinazolone and acetic anhydride, crystallizes from benzene in short prisms carrying benzene of crystallization. This benzene is lost rapidly on exposure to the air and the crystals then disintegrate. Fresh crystals, carefully dried between filter papers and then heated to constant weight (10 minutes) at 100°, gave the following result:

Found: C_6H_6, 15.73. Calculated for $(C_{11}H_{11}O_2N_3)_2.C_6H_6$: C_6H_6, 15.23.

The pure benzene-free substance melts at 176.5° (corr.).

Found: N, 19.33. Calculated for $C_{11}H_{11}O_2N_3$: N, 19.35.

It is soluble in hot water, glacial acetic acid or alcohol, but separates from these solutions in a resinous condition.

2-Methyl-3-phenyluramino-4-quinazolone, $C_6H_4\begin{cases}N = C.CH_3\\ \quad\quad\ |\\ CO—N.NHCONHC_6H_5\end{cases}$.—The aminoquinazolone was heated for an hour at 150–60° with an excess of phenyl iso-

cyanate. After about 40 minutes' heating, a crystalline solid began to separate, and at the close of the hour the mixture was almost solid. When cold, the mass was washed thoroughly with ether, to remove unchanged isocyanate, then with hot alcohol, and dried at 110°. Yield, nearly theoretical.

Found: N, 18.84. Calculated for $C_{16}H_{14}O_2N_4$: N, 19.04.

The purified substance forms a colorless, micro-crystalline solid, infusible at 300°, and insoluble in water, ethyl or amyl alcohol, acetone, benzene or ether.

2-Methyl-3-benzalamino-4-quinazolone, $C_6H_4\begin{cases} N = C.CH_3 \\ \quad\quad | \\ CO—N.N:CHC_6H_5 \end{cases}$. — The amino-quinazolone was boiled for a few minutes with excess of benzaldehyde, until the water split off in the reaction was driven out. When cool, a considerable volume of alcohol was added to the mixture, and from this solution, on standing several hours, the benzal derivative slowly crystallized in stellate groups of needles. Recrystallized from alcohol, it melts at 183° (corr.).

Found: N, 16.08. Calculated for $C_{16}H_{13}ON_3$: N, 15.97.

It is insoluble in water, sparingly soluble in alcohol, and not readily soluble in mineral acids.

Acetanthranil and Unsym. Methylphenylhydrazine.—Acetanthranil was warmed with a slight excess of unsym. methylphenylhydrazine. Reaction occurred and heat was liberated. The product was recrystallized from alcohol, in which it is very easily soluble, although but slightly soluble in water. It melts at 106° (uncorr.) and contains 9.90 per cent. nitrogen. The expected quinazolone contains 15.85 N, and the intermediate amide 14.88. It has not been further examined.

When equimolecular amounts of 2-methyl-3-amino-4-quinazolone and *o*-benzoquinone[1] were brought together in chloroform solution, nothing definite could be isolated. With *p*-benzoquinone, an infusible, insoluble, black condensation product resulted.

m-Nitrobenzoylanthranil was boiled with excess of hydrazine hydrate solution, and the white solid obtained crystallized from 95 per cent. alcohol. Colorless needles, melting with effervescence at 196–7° (corr.). Not further investigated.

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NOTES.

A Simple Fat Extraction Apparatus. — It has come to be quite generally recognized that a considerable advantage is to be gained from the use of an extraction apparatus carrying a mercury seal instead of the more usual cork or ground glass joint. A very interesting note[2] on the use of such seals recently appeared, and the forms of a number of flasks which have been devised for this purpose were shown. Hitherto almost all efforts at improvement seem to have been expended on this flask, the condenser and tube for holding the sample being usually of the Knorr form. Certain difficulties are encountered in the use of this condenser, and to obviate these a form of apparatus was evolved by Mr. J. W. Ames, Chemist of this Station, by combining the desirable points

[1] McPherson and Lucas, THIS JOURNAL, 31, 283 (1909).

[2] *J. Ind. Eng. Chem.*, 1, 314 (1909).