A mixed melting point with the hydrochloride of morpholinylacetonitrile was 135-140°; a mixed melting point with the hydrochloride of the following compound was 173°. The yield was quantitative. *Anal.* Calcd. for $C_8H_{16}O_3NCl$: N, 6.68. Found: N, 6.69.

Ethyl α-(4-Morpholinyl)-acetate.—A solution of 5.5 g. of ethyl bromoacetate and 5.5 g. of morpholine in 20 ml. of benzene was refluxed for thirty minutes. After the solution was cold, 5.4 g. of morpholine hydrobromide (representing a 98% conversion) was removed by filtration, and the filtrate fractionated. The boiling point of the colorless ester was 227-228° at 767 mm. *Anal.* Calcd. for $C_8H_{15}O_3N$: N, 8.09. Found: N, 8.00.

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Miscellaneous Derivatives of Morpholine

Diphenylcarbamyl Morpholide.—One-hundredth molar quantities of diphenylcarbamyl chloride and morpholine were mixed without benefit of dilution. When the mixture was cold, 20 ml. of water and 1.0 g. of sodium bicarbonate were added and the solution heated to boiling. The precipitated morpholide was removed by filtration and recrystallized twice from ethyl alcohol; large monoclinic prisms, m. p. 110-111°.[1] *Anal.* Calcd. for $C_{17}H_{13}O_2N_2$: N, 9.92. Found: N, 9.82.

Morpholine with Isothiocyanates.—The following thioureas were prepared by heating equivalent quantities of morpholine and the indicated isothiocyanate, and recrystallizing the product from aqueous ethyl alcohol or acetone.

TABLE I

RNCS (R =)	Formula of derivative	M. p. of derivative, °C.	N Analyses, % Calcd.	Found
Phenyl	$C_{11}H_{14}ON_2S$	130.5	12.60	12.62
o-Tolyl	$C_{12}H_{16}ON_2S$	144.5–145.5	11.86	11.79
p-Tolyl	$C_{12}H_{16}ON_2S$	151–151.5	11.86	11.84
Allyl	$C_8H_{14}ON_2S$	56–57	15.04	15.03

4-(Picryl)-morpholine.—To a hot solution of 5.0 g. of picryl chloride in 20 ml. of ethyl alcohol was added 3.4 g. of morpholine in 10 ml. of alcohol. The solution was refluxed for thirty minutes, then poured into 50 ml. of water. The precipitate was removed by filtration and washed carefully with water. The yield was 5.4 g., or 90%; m. p. 160-161°. Recrystallization from ethyl alcohol gave orange-yellow needles exhibiting two melting points. If heated rapidly, the compound melted at 147.5-148.5°, then resolidified and melted a second time at 166-166.5°. If heated slowly only the second melting point was observed. *Anal.* Calcd. for $C_{10}H_{10}O_7N_4$: N, 18.79. Found: N, 18.45.

4-(Picramyl)-morpholine.—This compound was prepared by the reduction of 4-(picryl)-morpholine with hydrogen sulfide in ammoniacal ethyl alcohol; dark red, fern-like crystals from 95% ethyl alcohol, decomposing at 256°. *Anal.* Calcd. for $C_{10}H_{12}O_5N_3$: N, 20.89. Found: N, 20.80.

(4-Morpholinyl)-thiocarbonic Acid Amide.—A solution of 2.1 g. of morpholine hydrochloride, 1.6 g. of potassium thiocyanate, and 10 ml. of water was evaporated to dryness on the water-bath. The amide was separated from the potassium chloride by extraction with absolute ethyl alcohol; partial evaporation of the alcohol and cooling gave needles, which melted at 111.5-112.5° after a second crystallization from absolute alcohol.

Anal. Calcd. for $C_5H_{10}ON_2S$: N, 19.2. Found: N, 19.3.

N,N,N′,N′-Bis-(oxydiethylene)-thiuram Sulfide, $O(C_4H_8(N\underset{\underset{S}{\|}}{C}S\underset{\underset{S}{\|}}{C}N(C_4H_8)O$.—A solution of 3.2 g. of N,N,N′-bis-oxydiethylene thiuram disulfide,[2] 0.7 g. of potassium cyanide, 40 ml. of 95% ethyl alcohol, and 10 ml. of water was refluxed for thirty minutes. The precipitate that formed when 50 ml. of water was added was removed by filtration and washed with water. One recrystallization from alcohol gave bright yellow prismatic needles; m. p. 126-126.5°. *Anal.* Calcd. for $C_{10}H_{16}O_2N_2S_3$: N, 9.21. Found: N, 9.21.

N,N,N′,N′-Bis-(oxydiethylene)-thiourea, $O(C_4H_8)N\overset{\overset{S}{\|}}{C}N(C_4H_8)O$.—The melt obtained by heating 2.7 g. of the thiuram disulfide[2] with 1.5 g. of morpholine for four hours at 120° was extracted with 10 ml. of water. The residue consisted of sulfur. The filtrate upon partial evaporation yielded a compound melting at 85 to 90°; two recrystallizations from water gave colorless, hexagonal plates of the monohydrate; m. p. 89.5-90°. *Anal.* Calcd. for $C_9H_{18}O_3N_2S$: N, 11.93. Found: N, 11.92, 11.94.

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[1] All melting points are corrected.

[2] Prepared by Schupe, *J. Assoc. Off. Agr. Chem.*, **23**, 824 (1940), by the action of potassium ferricyanide on morpholinium (4-morpholinyl)-dithiocarbamate.

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Some Derivatives of the 3- and 5-Nitro-2-aminopicolines[1]

In connection with our work on the cyclization of 2-aminopyridine derivatives it became of interest to prepare the following compounds derived from the 3- and 5-nitro-2-aminopicolines.

3- and 5-Nitro-2-aminopicolines.—These were prepared by the nitration of the 2-aminopicolines. All except 3-nitro-2-amino-5-methylpyridine have been previously reported.[2,3,4] This compound was prepared by the nitration of 10 g. (0.093 mole) of 2-amino-5-methylpyridine at 0° in sulfuric acid following the method of Seide.[3] The yield of pale yellow crystals was 8.5 g. (60%), m. p. after recrystallization from water, 190-191°. *Anal.*[5] Calcd. for $C_6H_7O_2N_3$: N, 27.45. Found: N, 27.38.

2,3-Diaminopicolines.—These were prepared by low pressure catalytic hydrogenation of the corresponding 3-nitro-2-aminopicolines in ethanol solution using a palladium-on-charcoal catalyst. In each case the reaction required twenty-four hours for completion when 7.7 g. (0.05 mole) of the starting material was used. The products were purified by recrystallization from benzene-hexane mixture. The purified diaminopicolines darkened rapidly on exposure to air and eventually became tars. When this procedure was applied to the 5-nitro-2-aminopicolines only tars could be isolated from the hydrogenation.

2,3-Diamino-4-methylpyridine.—Yield 4.3 g. (70%), m. p. 115-116°. *Anal.*[5] Calcd. for $C_6H_9N_3$: N, 34.15. Found: N, 34.06.

2,3-Diamino-5-methylpyridine.—Yield 2.0 g. (32%), m. p. 85-86°. *Anal.*[5] Calcd. for $C_6H_9N_3$: N, 34.15. Found: N, 34.24.

2,3-Diamino-6-methylpyridine.—Yield 3.6 g. (54%), m. p. 69-70°. *Anal.*[5] Calcd. for $C_6H_9N_3$: N, 34.15. Found: N, 34.00.

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[1] The work described in this paper was carried out under a Frederick Gardner Cottrell Special Grant-in-Aid from the Research Corporation.

[2] Seide, *Ber.*, **57**, 791 (1924).

[3] Seide, *ibid.*, **57**, 1802 (1924).

[4] Seide, *J. Russ. Phys.-Chem. Soc.*, **50**, 534 (1924).

[5] Microanalysis by the Clark Microanalytical Laboratory, Urbana, Ill.

2,3-Diphenyl-X-methylpyrido(2,3)pyrazines.—These were prepared by the condensation of the above 2,3-diaminopicolines with benzil following the procedure of Chichibabin and Kirsanow.[6] The yields of pure product after recrystallization from ethanol were about 30%.

2,3-Diphenyl-8-methylpyrido(2,3)pyrazine.—M. p. 143–144°. *Anal.*[5] Calcd. for $C_{20}H_{15}N_3$: N, 14.14. Found: N, 14.00.

2,3-Diphenyl-7-methylpyrido(2,3)pyrazine.—M. p. 160–161°. *Anal.*[5] Calcd. for $C_{20}H_{15}N_3$: N, 14.14. Found: N, 14.15.

2,3-Diphenyl-6-methylpyrido(2,3)pyrazine.—M. p. 169–170°. *Anal.*[5] Calcd. for $C_{20}H_{15}N_3$: N, 14.14. Found: N, 14.00.

3- and 5-Nitro-2-picolinols.—These were prepared by the reaction of the corresponding nitro-2-aminopicolines with nitrous acid at 0° following the usual procedure. The products were purified by recrystallization from water to give nearly quantitative yields.

TABLE I

3- AND 5-NITRO-X-METHYL-2-PYRIDINOLS

Nitro	Methyl	M. p., °C.	N Anal.,[5] % Calcd. for $C_6H_6O_3N_2$	N Anal.,[5] % Found
5	3	234–235	18.18	18.26
5	4	189–190	18.18	18.17
5	6	235–236	18.18	18.20
3	4	234–235	18.18	18.09
3	5	253–255	18.18	18.11
3	6	223–224	18.18	18.21

3-Amino-5-methyl-2-pyridinol.—Low pressure catalytic reduction of 5.0 g. (0.033 mole) of 3-nitro-5-methyl-2-pyridinol dissolved in 100 ml. of ethanol using palladium-on-charcoal catalyst gave 3.8 g. (80%) of this compound, m. p., after recrystallization from benzene, 119–120°. *Anal.*[5] Calcd. for $C_6H_8ON_2$: N, 22.58. Found: N, 22.63.

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[6] Chichibabin and Kirsanow, *Ber.*, **60**, 766 (1927).

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Oxonium Salts of Khellin

New compounds believed to be oxonium salts have been prepared by direct treatment of khellin[1] with sulfuric and hydrochloric acids.

Khellin Sulfate.—Powdered khellin (0.5 g.) in 1 cc. 98% sulfuric acid turned orange and then formed an orange-red viscous solution. On the addition of 50 cc. of ethyl acetate an orange solid separated which was filtered off, washed and dried; yield 0.7 g. Crystallization from ethyl acetate gave orange plates which melted at 210° with decomposition to a violet liquid. The solid was stable for a long time but decomposed almost quantitatively in aqueous solution or in dilute ammonia at room temperature to give khellin. This oxonium compound is practically insoluble in dry organic solvents, *e.g.*, benzene and toluene.

Anal. Calcd. for $C_{14}H_{12}O_5$, H_2SO_4: C, 46.9; H, 3.9; S, 8.9. Found: C, 46.7; H, 4.01; S, 8.9.

Khellin Hydrochloride.—Powdered khellin (0.5 g.) was dissolved in hot absolute alcohol and after cooling externally with ice, hydrogen chloride was passed into the solution. An orange color immediately developed, followed by the precipitation of yellow needles which were filtered off, washed with a little absolute alcohol, saturated with hydrogen chloride and then dried at room temperature. This substance melted at 98° decomposing to a red liquid. In aqueous solution it decomposed to khellin; yield, 0.4 g.

Anal. Calcd. for $C_{14}H_{12}O_5$, HCl; Cl, 11.9. Found: Cl, 12.1.

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[1] Khellin has been isolated from *Ami Visnaga* (*cf.* Späth and Gruber, *Ber.*, **71B**, 106–113 (1938).

3-Amino-4-ethyl-, 3-Amino-4-*t*-butylbenzoic Acids and 4-Bromo-3-*t*-butylaniline

The two amino acids were prepared from *p*-ethyl and *p*-*t*-butylbenzoic acids by nitration and reduction. 3-Nitro-4-ethylbenzoic acid so obtained[1] (90.5%) melted at 157.5–158.3° (lit.,[2] 155–156°), the *t*-butyl analog (90.7%) at 162.7–163.2° (lit.,[3] 161°).

Reduction was carried out according to the general procedure of Jacobs and Heidelberger.[4] A solution of 0.40 mole of the 3-nitro-4-alkylbenzoic acid in dilute ammonium hydroxide was added dropwise during a few minutes to a vigorously stirred, boiling solution of 780 g. (2.8 moles) of ferrous sulfate crystals in 1 l. of water. The mixture was then immediately treated with concentrated ammonium hydroxide, added dropwise at the rate of about 200 ml. an hour, while heating and vigorous stirring was maintained. Water lost by evaporation was made up from time to time by washing down the sides of the beaker with water. Addition of ammonium hydroxide was continued until the boiling solution became strongly ammoniacal and the mixture was then filtered hot. The cake was washed thoroughly by removing it from the filter, heating and stirring it with about 500 ml. of water containing 100 ml. of concentrated ammonium hydroxide, and then refiltering. The combined filtrates, which were dark in color, were concentrated to about 1 l., boiled with decolorizing charcoal, and refiltered. The warm filtrate was made barely acidic with acetic acid, resulting in the immediate separation of a solid precipitate or of an oil which solidified upon stirring. After cooling, this amino-acid was removed by filtration and dried at 105°. The amino-acids were purified further by recrystallization from boiling water. 3-Amino-4-ethylbenzoic acid was obtained in 73% yield, m. p. 149.4–149.7°.

Anal. Calcd. for $C_9H_{11}O_2N$: C, 65.43; H, 6.71; N, 8.48. Found: C, 65.78; H, 6.66; N, 8.66.

The *t*-butyl analog (75%) melted at 154–155°.

Anal. Calcd. for $C_{11}H_{15}O_2N$: C, 68.37; H, 7.82; N, 7.25. Found: C, 68.50; H, 7.64; N, 7.47.

4-Bromo-3-*t*-butylaniline.—*t*-Butylbenzene was converted to the 2,4-dinitro derivative (72%) m. p. 62.3–63.0° (lit.,[5] 61–62°), which was partially reduced to 4-amino-2-nitro-*t*-butylbenzene (97%), m. p. 56.6–57.7° (lit.,[5] 55°) and deaminated by diazotization and hypophosphorus acid to *o*-nitro-*t*-butylbenzene, b. p. 118° (12 mm.) (lit.,[5] 114–115° 10 mm.). Reduction gave 78% of *o*-*t*-butylaniline, b. p. 103–105° (11 mm.) (lit.,[5] 102° (10 mm.)). This material (34.5 g.) was boiled in 100 ml. of glacial acetic acid for three hours to convert it to *o*-*t*-butyl-acetanilide. After cooling, an equivalent of bromine was added dropwise over half-an-hour with shaking at room temperature. After standing an additional half-hour, the mixture was poured into a liter of water containing enough bisulfite to destroy any excess bromine. The precipitate of crude 2-*t*-butyl-4-bromoacetanilide was collected and hydrolyzed without further purification by

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[1] Kloeppel, *Ber.*, **26**, 1733 (1893).

[2] Aschenbrandt, *Ann.*, **216**, 221 (1882).

[3] Kelbe and Pfeiffer, *Ber.*, **19**, 1726 (1886).

[4] Jacobs and Heidelberger, THIS JOURNAL, **39**, 1435 (1917).

[5] Shoesmith and Mackay, *J. Chem. Soc.*, 2336 (1928).