The heat of reaction was sufficient to keep the solution at reflux temperature. Upon cooling the addition compound crystallized out, yield 42 g. (98%). Piperazine-1,4-bis-(β-ethanol) crystallizes from amyl acetate in large prisms which melt at 135–135.5°.

Anal. Calcd. for $C_8H_{18}N_2O_2$: N, 16.09. Found: N, 16.07.

Di-*p*-nitrobenzoate of Piperazino-1,4-bis-(β-ethanol).—This compound is prepared in 50% yield from the above by treatment with *p*-nitrobenzoyl chloride in cold alkaline solution. Recrystallization from xylene gives small yellow granules which melt at 158–158.5°.

Anal. Calcd. for $C_{22}H_{24}N_4O_8$: N, 11.86. Found: N, 11.74.

Di-*p*-aminobenzoate of Piperazino-1,4-bis-(β-ethanol).—Reduction of the di-*p*-nitrobenzoate with a large excess of powdered iron[3] followed by extraction with hot xylene yields this compound. It is purified by solution in dilute hydrochloric acid followed by reprecipitation with dilute alkali and recrystallization from xylene as silky needles, m. p. 203–204°.

Anal. Calcd. for $C_{22}H_{28}N_4O_4$: N, 13.59. Found: N, 13.55.

The tetrahydrochloride of the di-*p*-aminobenzoate of piperazino-1,4-bis-(β-ethanol) is prepared by dissolving the free base in dilute acid and evaporating the solution *in vacuo* at room temperature. The crystals thus formed are very hygroscopic and must be oven-dried prior to analysis. The compound is stable in boiling water.

Anal. Calcd. for $C_{22}H_{32}N_4O_4Cl_4$: N, 10.04. Found: N, 9.83.

Summary

1. Piperazino-1,4-bis-(β-ethanol) has been prepared in good yield. From it have been synthesized the di-*p*-nitrobenzoate, the di-*p*-aminobenzoate and the tetrahydrochloride of the latter.

2. The therapeutic properties of the tetrahydrochloride of the di-*p*-aminobenzoate of piperazino-1,4-bis-(β-ethanol) will be investigated.

GAINESVILLE, FLORIDA RECEIVED AUGUST 17, 1935

[CONTRIBUTION FROM THE CHEMISTRY DEPARTMENT, VIRGINIA MILITARY INSTITUTE]

Normal Fatty Acid Amides of Ethylenediamine

BY N. BEVERLEY TUCKER[1]

The purpose of the work herein reported was to record the physical properties, chiefly the melting points, of the normal fatty acid diamides of ethylenediamine. The amides were all prepared alike, *i. e.*, the diamine was boiled for forty-eight hours with the calculated double molar quantity of the ethyl ester of the desired acid. The resulting solid product was recrystallized to constant melting point, the lower members to the butyric from a mixture of ethyl acetate and alcohol, others from absolute alcohol. The first six members of the series were examined under the polarizing microscope, and their solubilities in three solvents were measured. Results are summarized in the tables.

The diacetyl,[2] dipropionyl and dibutyryl[3] derivatives, as well as several related compounds, have been reported.[3,4]

TABLE I

MELTING POINTS AND SOLUBILITIES

(Melting points were measured with complete stem immersion to eliminate stem correction)

Derivative	M. p.	Solubility at 25°C. in g./100 cc. Water	Abs. EtOH	Et. acetate	N, % Calcd.	Found
C_2	173–173.5	68.3	13.1	0.25	19.4	...
C_3	189.0	40.8	13.8	.26	16.27	16.22
C_4	191–191.3	4.78	13.7	.28	14.00	13.69
C_5	183.0	0.35		.48	12.28	...
C_6	177–177.3	.02	6.48		10.94	11.18
C_7	171.5	Too small	2.49	.11	9.80	9.82

Melting points of higher members of the series: C_8, 169–169.5; C_{10}, 164.0; C_{11}, 160.5; C_{12}, 159.0; C_{13}, 156–156.4; C_{14}, 154.5; C_{15}, 153.0; C_{16}, 148.5; C_{17}. 149.5–150.

Results of Experiments

In the tables, derivatives of ethylenediamine of the general formula $C_2H_4(NHCOR)_2$, where R is straight chain, are designated as the C_n derivative, where n = the total number of carbon atoms in the acid.

Grateful acknowledgment is made of the assistance of Professor E. Emmet Reid. The writer also wishes to thank Professor Edward Steidtmann for assistance in measuring crystal properties.

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[1] Present address: Chemical Division, Proctor and Gamble Co., Ivorydale, Ohio.

[2] Hofmann, *Ber.*, **21**, 2332 (1888).

[3] Klingenstein, *ibid.*, **28**, 1173 (1895); Chattaway, *J. Chem. Soc.*, **87**, 381 (1905).

[4] Windaus, Dörries and Jensen, *Ber.*, **54**, 2745 (1921); Rosenmund, U. S. Patents 1,926,014 and 1,926,015.

TABLE II

APPEARANCE UNDER THE POLARIZING MICROSCOPE

Derivs.	Crystal system	Habit and extinction	Optical character, biaxial	Elongation	Observed *n*s[a] Low	High
C_2	Triclinic or monoclinic	Flat needles, 40–41°	Negative	Positive	1.53[b]	1.595[c]
C_3	Triclinic	Fibrous, 2–13°	Negative(?)	Positive	1.441–1.442	1.545–1.546
C_4	Triclinic	Flat, elongated, 3–6°	Positive	Positive	1.40–1.45	1.52–1.525
C_5	Triclinic	Flat, some rectangular	....	Positive in needles	1.46	1.52
C_6	Triclinic	Flat, elongated, 5–6°	Positive	Positive	1.46–1.475	1.515–1.520
C_7	Triclinic	Flat, elongated. Rectangular, 0–2°	Positive	Positive	1.48–1.485	1.52–1.530

[a] The *n*s given above represent those which are observed on the crystals as they lie on the slide in immersion liquids. Since the principal optical directions lie oblique to this surface, the actual minimum index alpha and maximum index gamma cannot be directly measured. [b] Beta. [c] Gamma.

Summary

1. The melting points of the normal fatty acid diamides of ethylenediamine are given, from acetyl to heptadecoyl, less C_9.

2. The solubilities and some crystallographic properties of the first six members of the series are recorded.

LEXINGTON, VIRGINIA RECEIVED JUNE 24, 1935

[CONTRIBUTION FROM SEVERANCE CHEMICAL LABORATORY, OBERLIN COLLEGE]

Preparation of a Potent Vitamin A Concentrate[1]

BY HARRY N. HOLMES, HAROLD CASSIDY, RICHARD S. MANLY AND EVA R. HARTZLER

Since Vitamin A has not yet been isolated, it is highly desirable that improved methods for the preparation of potent concentrates be developed.

Other workers in this field have obtained Vitamin A concentrates of very high values. Karrer, Morf and Schöpp[2] in 1931 succeeded in preparing a pale yellow oil of approximately 105,000 "blue value." (Values based upon the Carr–Price[3] color test and upon Karrer's own calculation that his standard cod-liver oil had a Vitamin A potency of 10 blue value). Heilbron, Heslop, Morton, Webster, Rea and Drummond[4] have published data on a concentrate of 65,000 blue value, while Carr and Jewell[5] have more recently obtained a concentrate of 78,000 blue value. The English workers, like Karrer, based their valuation upon the Carr–Price color test. Their concentrates were prepared by vacuum distillation.

The "blue value" signifies the number of blue units read with a Lovibond tintometer for 0.04 g. of solid dissolved in anhydrous chloroform immediately after reaction with the antimony trichloride reagent. It is obvious that "blue units per gram" could also be calculated by multiplying "blue value" by 25.

Concentration by Freezing.—The liver oil of halibut (Hippoglossus) was saponified in the Parke–Davis laboratories, the non-saponifiable portion removed by a solvent and most of the cholesterol frozen out. In our laboratory the first step was to transfer the concentrate from methyl alcohol to pentane by washing out the alcohol with water.

The pentane solution was next subjected to drastic freezing for a week or ten days in a bath of ethyl alcohol and carbon dioxide snow. To filter out the noticeable precipitate we employed in our earlier work an ultra-filter bomb of heavy metal which could be entirely surrounded by a bath of ethyl alcohol and carbon dioxide snow. Through this strong filter (Fig. 1) the filtrate could be forced by a pressure of 50–100 pounds of nitrogen. This method was very satisfactory when working with small quantities as it prevented any warming up of the mixture with annoying dissolving of the precipitate during filtration and also permitted the exclusion of air. With larger quantities, however, the filtration of such

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[1] This research was made possible through the cordial coöperation of Parke, Davis & Company, of Detroit, and the Abbott Laboratories, of North Chicago. Paper read at the New York Meeting of the A. C. S., Division of Biochemistry, April 22, 1935.

[2] Karrer, Morf and Schöpp, *Helv. Chim. Acta*, **14**, 1036 (1931).

[3] Carr and Price, *Biochem. J.*, **20**, 497 (1926).

[4] Heilbron, Heslop, Morton, Webster, Rea and Drummond, *ibid.*, **26**, 1178 (1932).

[5] Carr and Jewell, *Nature*, **131**, 92 (1933).