COMMUNICATIONS TO THE EDITOR

PREPARATION OF PYRROLIDINES

Sir:

Löffler and Freytag [*Ber.*, **42,** 3427 (1909)] prepared 1-methylpyrrolidine by heating N-bromo-N-methyl-*n*-butylamine with concentrated sulfuric acid for three hours on the water-bath and finally for thirty minutes at 135°. Other substituted pyrrolidines [Löffler, *ibid.*, **43,** 2035 (1910)] were prepared by this method from bromoamines having a methyl group on the third carbon from the nitrogen atom. However, when N-bromo-N-methyl-*n*-amylamine was heated with concentrated sulfuric acid, neither methylpiperidine nor 1,2-dimethylpyrrolidine was formed.

Britton [U. S. Patent 1,607,605, Nov. 23, 1926; *C. A.*, **21,** 249 (1927)] prepared pyrrolidines by heating with concentrated sulfuric acid or other concentrated mineral acid N-halogen derivatives of secondary aliphatic amines containing a methyl group three carbons removed from the nitrogen atom. The preparation of 1-*n*-butylpyrrolidine and 1-isoamyl-3-methylpyrrolidine by heating the corresponding bromoamines with concentrated sulfuric acid is described.

Recently Löffler's method has been used by Menshikov [*Ber.*, **69,** 1802 (1936)] to synthesize a new bicyclic system consisting of two condensed pyrrolidine rings having a nitrogen and carbon in common. From 2-isobutylpyrrolidine he prepared the N-bromine derivative and heated it with concentrated sulfuric acid. A tertiary base $C_8H_{15}N$ which he called 2-methylpyrrolizidine was isolated. The yield in the form of the picrate was 34.1% of the theoretical amount. However, when he tried the same experiment with 2-*n*-butylpyrrolidine complete resinification of the starting material resulted.

We have found that N-chloroamines are better than N-bromoamines for the preparation of pyrrolidines, that a mixture of sulfuric acid and water is a better reagent than concentrated acid for effecting ring closures of this type, and that in general temperatures considerably below those used by previous workers are preferable. From di-*n*-butylamine, for example, using the N-chlorine derivative and a mixture of sulfuric acid and water, a 75% yield of 1-butylpyrrolidine, determined as the picrate, was formed.

Furthermore, by using a mixture of water and sulfuric acid and proper temperature control good yields of substituted pyrrolidines can also be obtained from N-halogen derivatives of amines other than those having a methyl group on the third carbon from the nitrogen atom. For example, 1,2-dimethylpyrrolidine was prepared in 73% yield from methyl-*n*-amylamine by heating the N-chlorine derivative with a mixture of sulfuric acid and water at 90° for thirty minutes. In this case eight parts of concentrated acid to three parts of water by volume was used.

The relative amounts of water and acid as well as the temperature required to produce the best yields have been found to vary with the different amines. The chloroamines and bromoamines were prepared by modifications of methods previously described [Coleman, THIS JOURNAL, **55,** 3001 (1933)]. Other solvents than ether may be used or the solvent omitted.

Work in this field is being continued.

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RECEIVED FEBRUARY 4, 1938

SYNTHESIS OF CO-CARBOXYLASE (VITAMIN B_1 PYROPHOSPHATE) FROM VITAMIN B_1

Sir:

Recently Stern and Hofer described the phosphorylation of vitamin B_1 by $POCl_3$. Their finding, while very interesting, results only in the phosphorylation of a minute amount of the vitamin [*Science*, **85,** 483 (1937)]. I have shown that vitamin B_1 may be phosphorylated by enzyme action [*Science*, **86,** 180 (1937); *Enzymologia*, **2,** 171 (1937)]. The isolation of the pure co-enzyme, however, owing to the presence of proteins and products of autolysis is not practical.

The following synthesis which is rapid and convenient yields fifty times more co-carboxylase than the phosphorus oxychloride method: 200 mg. sodium pyrophosphate is placed in a Pyrex test-tube and heated until all of the water of crystallization is removed. 0.5 cc. of orthophosphoric

acid (C. P. 85%) is placed in another tube and heated until a slight amount of solid deposit forms on the side of the tube. Then the pyrophosphate is added and the mixture gently heated until solution takes place. After cooling 200 mg. vitamin B_1·HCl is added. An oil (heavy mineral oil) bath is brought to 155° and the tube is immersed and kept at this temperature for fifteen minutes, mixing its contents occasionally. Then the tube is removed and allowed to cool. The solid mass is dissolved in 10 cc. of ice water and adjusted to *p*H 6.2 with cold *N* sodium hydroxide. Local excess of alkali must be avoided (thiochrome formation inactivates irreversibly the co-carboxylase). The mixture is then diluted to 20 cc. One cc. of this solution is further diluted 100 times with phosphate buffer of *p*H 6.2 (Sörensen). Both solutions are very stable. 0.4 cc. of the final solution containing an equivalent of 40 gamma of vitamin B_1·HCl formed 340 cmm. of carbon dioxide in thirty minutes under the conditions described by Lohmann and Schuster [*Biochem. Z.*, **294,** 188 (1937)] in their co-carboxylase test. Thus my synthetic product possesses about one-tenth the activity of that claimed by Lohmann and Schuster for the natural co-carboxylase isolated by them from yeast.

A sample of crystalline (natural) co-carboxylase, kindly furnished by Professor Lohmann, was slightly less active than my synthetic mixture. According to Professor Lohmann his preparation is one year old and may have lost some of its activity.

I am grateful to Merck and Company, through the kindness of Dr. R. T. Major, for generous supplies of their synthetic vitamin B_1.

RESEARCH LABORATORIES HENRY TAUBER
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RECEIVED JANUARY 31, 1938

THE ABSENCE OF NICOTINIC ACID IN THE URINE OF PELLAGRINS AND A METHOD FOR ITS QUANTITATIVE ESTIMATION

Sir:

The extraordinary curative effect of nicotinic acid and nicotinamide in human pellagra as reported on November 5, 1937, at the meeting of the Central Society for Clinical Research in Chicago by Spies, Cooper and Blankenhorn, made it highly desirable to know whether these substances were present in the urine of normal persons and were lacking in pellagrins. Since no method was available for this purpose, one was devised by one of us (Mrs. S. P. Vilter, Horton-Hallowell Fellow from Wellesley College, 1937–1938).

By means of it we have found in the urine of normal persons eating an average, well-balanced diet, a small amount of nicotinic acid, or a substance with a similar color reaction; but not in the urine of normal persons on a diet free from nicotinic acid; and not in persons having subclinical pellagra, or pellagra in relapse. When such negatively-reacting persons are given sufficient nicotinic acid or its amide by mouth, the urine then gives the nicotinic acid reaction.

These results confirm the curative action of nicotinic acid in pellagra, and show clearly that pellagrins are deficient in this substance in the urine. The method aids in the detection of a prepellagrous state and makes possible an earlier diagnosis of the condition than has hitherto been possible.

The method will soon be published in full. It requires only 3 cc. of decolorized urine. It is based on a reaction found and developed chiefly by E. Vongerichten [*Ber.*, **32,** 2571 (1899)] and T. Zincke [*Ann.*, **330,** 361 (1904)], but hitherto applied only to pyridine and piperidine bases. Our work has shown that similar colored products can be produced after the action of 2,4-dinitrochlorobenzene on nicotine, nicotinic acid and nicotinic amide. Essentially the reaction consists of the reaction of 2,4-dinitrochlorobenzene with the tertiary nitrogen of the pyridine ring, and the subsequent decomposition of the addition product with sodium hydroxide. These colored substances resemble that obtained from pyridine, which is related to glutaconic aldehyde, an aliphatic compound with conjugated double bonds. The pyridine derivative is a purple substance soluble in alcohol, that of nicotinic acid is purple-red, and the derivative of the amide is burgundy-red. In each case, the intensity of the color developed with the pure compounds is quantitative, as measured within the limits of 0.1 and 1.0 mg. Pyridine reacts readily, but with nicotinic acid and amide it is necessary to evaporate the respective solutions to dryness on the water-bath with the reagent, the reacting substances appearing to fuse. The residues redissolved in alcohol and treated with measured quantities of clear, 0.1% alcoholic sodium hydroxide develop strong but transient colors. Since trigonellin and methyl-

pyridiniumammonium hydrate also have been reported in normal human urine, it is possible that the color developed in normal urine may be due in part to compounds other than nicotinic acid or its methylated betaine, trigonellin. But all substances producing color by this reaction have been absent from the pellagrin urine thus far examined.

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NEW BOOKS

Ambix. The Journal of the Society for the Study of Alchemy and Early Chemistry. Vol. I. F. SHERWOOD TAYLOR, Editor. Taylor and Francis, Ltd., Red Lion Court, Fleet Street, London, E. C. 4, England, 1937. 18 × 25 cm. Published quarterly. No. 1, May, 1937, pp. 1–92; No. 2, Dec., 1937, pp. 93–141. Price for year, £1, 4s, 0.

This new journal will delight the heart of every chemist who is interested in the early history and cultural values of his science. The contributions that have appeared in the first two issues of this quarterly are not only of high quality but in their respective fields of historical inquiry they represent the product of most painstaking original research.

It is impossible in the present notice to review each separate article that has been published in the two numbers of *Ambix* that are now before us. The period covered in the twelve contributions extends from "Jofuku or Joshi, the earliest alchemist of historical record" (Tenney L. Davis and Rokuro Nakaseko, pp. 109–115), through the later "Origins of Greek Alchemy" (F. Sherwood Taylor, pp. 30–47) and the medieval writings of "Albertus Magnus on Alchemy" (J. R. Partington, pp. 3–20), down to the time when the first members of the Royal Society under the leadership of Boyle became interested in "Hooke's Theory of Combustion" (D. J. Lysaght, pp. 93–108). Within this immense range of nearly 2000 years (from approximately 250 B.C. to 1680 A.D.) occurred the rise and fall of alchemy. While only a few high spots in this long period are discussed in the first two numbers of *Ambix*, we may expect, from the excellence of the articles already published, that future issues of this journal will most worthily continue to fill in the gaps. The chemist, who begins his membership and subscription now, will have in his possession, as the years go by, a detailed history of early chemical and alchemical origins of gradually increasing completeness. Not only every teacher of chemistry should have access to this journal but those who are active in industrial applications may derive profit and enjoyment from its pages.

Fifteen years ago the late Edgar Fahs Smith attempted to arouse interest in the publication of a history of chemistry journal in the United States and, had he lived, the plan, under his inspiring leadership, would no doubt have succeeded, for promises of sufficient support had been almost gained. But alas! not only Smith, but Moore, Slosson, Coyle, Newell, Foster and other loyal members of his following have been called from our midst and the movement perished from the loss of so many of its leaders. We, who were sadly disappointed in that outcome, can well rejoice that our British cousins have now come so gallantly to the rescue. We should join most heartily by membership and if possible by contributed articles in helping to make so worthy an undertaking a success.

In addition to the scholarly translations of the Greek alchemists by Dr. Taylor and the other interesting contributions in each issue of *Ambix*, there are several pages of timely reviews that deal with recent works on the history of alchemy and chemistry. The typography of *Ambix* leaves nothing to be desired. Its bound volumes will be valuable additions to the library of every chemist.

C. A. BROWNE

Traité Élémentaire de Chimie de Lavoisier. (Lavoisier's Elementary Treatise on Chemistry.) With an Introduction by HENRY LE CHATELIER. Gauthier-Villars, Éditeur, 55 Quai des Grands-Augustins, Paris 6, France, 1937. xxxviii + 191 pp. 13.5 × 19 cm. Price, 21 francs.

This book is one of *Les Classiques de la Découverte Scientifique* (*Mémoires de Chimie*) published on the occasion of the exposition of 1937 and of the organization of the *Palais de la Découverte*. The series will appear under the general editorship of Le Chatelier, Béhal, Urbain, Bertrand, Perrin, Delépine, Lespieau, and Damiens.

Copies of the original edition of Lavoisier's famous *Traité* have become so scarce and so valuable that students will be very glad to have a reprint of it. A bookseller's catalog recently offered "a very nice copy of this extremely rare book," first edition, 2 volumes, 1789, for $110.00. Students will still be glad to learn of the future publication of a reprint of it, for the present one is incomplete and thereby fails to answer the needs of those who will want it most. The entire Second Part of the work has been suppressed "because it is devoted to the enumeration of the chemical combinations which were known in the time of Lavoisier. The number of combinations known today has become so considerable that the limited list of Lavoisier no longer presents any interest." The Third