

Novobiocin appears to be the first recorded example of the natural occurrence of a carbamate ester of a sugar derivative.

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THE COMBUSTION OF CARBON SUBNITRIDE, C_4N_2 , AND A CHEMICAL METHOD FOR THE PRODUCTION OF CONTINUOUS TEMPERATURES IN THE RANGE OF 5000-6000°K.¹

Sir:

A flame temperature of slightly over 5000°K. was reached by combusting cyanogen with oxygen under pressure.² The high temperature is due to the high endothermic heat of formation of cyanogen (-73.60 kcal./mole gas at 25°) and the great thermal stability of the combustion products, *i.e.*, CO and N₂.

It was obvious that if a compound existed with a still higher endothermic heat of formation than cyanogen, which also could be combusted to CO and N₂, higher flame temperatures could be attained. A whole series of such compounds exist. They are the dinitriles of acetylene-dicarboxylic and polyacetylene-dicarboxylic acids or dicyanoacetylene and dicyano-polyacetylenes. Their general structural formula is $N:C(C:C)_nC:N$.

The first member of the series ($n = 1$) or C_4N_2 was isolated by Charles Moureu and Jacques C. Bongrand³ and named carbon subnitride.

C_4N_2 is a water-white liquid with a b.p. 76.5°, m.p. 20.5° and d_{25}^{25} 0.9703. It has a high endothermic heat of formation, -149.81 kcal./mole gas at 25°, and can explode to carbon powder and nitrogen. The subsequent members have not been described in the literature, but the dicarboxylic acids, from which they are derived, have been known since A. v. Bayer's⁴ classical researches.

A still higher temperature can be obtained by combining an endothermic fuel with an endothermic oxidizer; in the above case the obvious substitute would be ozone for O₂. Dr. A. Streng recently succeeded in measuring flame velocities of pure O₃-O₂ mixtures in the range of 17-55 mole% O₃ and successfully burned such mixtures with H₂, CO and (CN)₂.

Since the calculated temperature of the (CN)₂-O₂ flame has been checked experimentally,⁵ the enthalpy data for CO and N₂ can be used with confidence to calculate⁶ the temperatures of $C_4N_2 +$

(1) This research was supported by the United States Air Force through the Air Force Office of Scientific Research of the Air Research and Development Command under Contract No. AF 18(600)-1475.

(2) J. B. Conway, W. F. R. Smith, W. J. Liddell and A. V. Grosse, *THIS JOURNAL*, **77**, 2026 (1955).

(3) C. Moureu and J. C. Bongrand, *Bull. soc. chim.*, [V], 846 (1909); *Ann. Chim.*, **14**, 5 (1920).

(4) A. v. Bayer, *Ber.*, **18**, 678, 1885, 2269 (1885).

(5) J. B. Conway, R. H. Wilson, Jr., and A. V. Grosse, *THIS JOURNAL* **75**, 499 (1953).

(6) Acknowledgment is due to Drs. Rapp and Irgon of Reaction Motors, Inc., for their accurate calculations. N.A.C.A. tables were used up to 6000°K.; above 6000°K. the data were extrapolated.

O₂ and +O₃ flames at various pressures. They are as follows, in °K. ($\pm 2^\circ$), for the reaction mixture specified:

Atm.	Temperature °K.		
	1.0	10	40.82 (= 600 psia)
$(C_4N_2)_g + 2O_2 \rightarrow 4CO + N_2;$ $\Delta H_{298}^\circ = +254.6$	5261	5573	5748
$(C_4N_2)_g + 4/3 O_3 \rightarrow 4CO + N_2;$ $\Delta H_{298}^\circ = +299.9$	5516	5936	6100

Temperature decrease due to ionization of the combustion products can be neglected completely even at 6000°K.

C_4N_2 was burned with oxygen in both a diffusion and premixed flame in the range of 2O₂-4O₂ per mole C_4N_2 . The nitride burns with a bright white-blue flame similar in many respects, but *not* identical, to the (CN)₂-O₂ flame. The $C_4N_2 + 2O_2$ flame burns to only CO and N₂ and has a calculated temperature, as outlined previously, of 5260°K. An oxygen-rich flame, of the composition $C_4N_2 + 2.40 O_2$ produced, in addition to CO, CO₂ and N₂, the nitrogen oxides, NO₂, N₂O₃ and mainly NO; calculated as NO, their amount equalled 0.6-0.9 mole% of the combustion products.⁷

(7) Our experimental combustion and analytical techniques and results are fully described in Technical Note No. 1 (A. V. Grosse and A. D. Kirshenbaum) Report Control No. AFOSR-TN-56-13, Contract No. AF 18(600)-1475, Project No. 7-7968, dated December 15, 1955. U. S. Air Force, Office of Scientific Research, Air Research & Development Command, P. O. Box 1395, Baltimore 3, Md.

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A NEW ATP-FORMING REACTION: THE REDUCTIVE DEAMINATION OF GLYCINE

Sir:

Extracts of the amino acid-fermenting organism, *Clostridium sticklandii* (strain HF), catalyze the formation of acetic acid and ammonia from glycine when 1,3-dithiolpropanol (DTP) is added as the reducing agent.¹ Decomposition of glycine-2-C¹⁴ in this system results in the formation of acetic acid labelled exclusively in the methylene carbon atom.² Aged preparations derived from extracts of alumina-ground dried cells exhibit dependencies on DPN and Mg⁺⁺ (Table I). There also appears to be a requirement for pyridoxal phosphate, particularly in the absence of added DPN, but this is somewhat variable. When more highly purified enzymes prepared from sonic extracts are employed, there is almost complete dependency on orthophosphate and an adenylate nucleotide (Table II). Since AMP, ADP and ATP are equally efficient in promoting the reaction, the preparation undoubtedly contains an adenylate kinase. Arsenate substitutes for phosphate and eliminates the need for an acceptor nucleotide.

The stoichiometry of the over-all process as determined by direct analysis of the reaction products

(1) T. C. Stadtman, *3rd Int. Congr. Biochem.*, Bruxelles, p. 53 (1955).

(2) C¹⁴-acetate was recovered by steam distillation, checked for purity by Duclaux distillation and degraded using the Schmidt reaction according to E. F. Phares, *Arch. Biochem. and Biophys.*, **33**, 173 (1951).