fluxed for 1.5 hours, cooled, filtered, and made acid to congo red with 15% hydrochloric acid. The N-(2-hydroxyethyl)-*p*-aminosalicylic acid was filtered and dried in a vacuum desiccator; yield 0.14 g. (25%); m.p. 126°.

Anal. Calcd. for $C_9H_{11}NO_4$: N, 7.11. Found: N, 6.89.

The filtrate was made alkaline and saturated with carbon dioxide yielding 0.11 g. of methyl N-(2-hydroxyethyl)-*p*-aminosalicylate.

Hydrolysis of methyl *p*-aminosalicylate under identical conditions gave a 61% yield of *p*-aminosalicylic acid.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF KENTUCKY REEDUS RAY ESTES
LEXINGTON, KENTUCKY E. KENNETH BRAKEBILL

RECEIVED FEBRUARY 4, 1952

Vanadium Monoboride

A vanadium boride of the composition VB was prepared by simultaneous reduction of V_2O_5 and B_2O_3 with carbon. The reaction was carried out under a protective atmosphere of hydrogen by heating the well mixed and pelleted ingredients in a graphite crucible at 3000°F.

Anal. V, 77.6; B, 16.7; C, 0.07. V/(V + B) ratio found 17.7; calcd., 17.5.

Crystal Structure.—Using X-ray diffraction, the compound was found to be isomorphous with CrB[1]. The X-ray techniques employed were the same as those used by J. T. Norton and co-workers[2].

The VB structure is orthorhombic with four molecules per unit cell. The lattice constants were calculated to be for *a* 3.10 Å., *b* 8.17 Å., *c* 2.98 Å., the calculated density is 5.44 g./cc.

Electrical Resistivity.—65.5 microhm-cm. for a hot pressed piece of 65% of the theoretical density. The resistivity of a dense specimen would probably be between 35 and 40 microhm-cm., making VB a metallic conductor.

Work done under Contract with the Office of Naval Research.

(1) S. J. Sindeband, *Transactions of A.I.M.E.*, 185, 198 (1949).

(2) J. T. Norton, H. Blumenthal and S. J. Sindeband, *ibid.*, **185**, 749 (1949).

AMERICAN ELECTRO METAL CORPORATION
YONKERS, NEW YORK H. BLUMENTHAL

RECEIVED JANUARY 24, 1952

COMMUNICATIONS TO THE EDITOR

THE NATURE OF THE ACTIVE METHYL DONOR FORMED ENZYMATICALLY FROM L-METHIONINE AND ADENOSINETRIPHOSPHATE[1,2]

Sir:

The participation of ATP in the enzymatic transmethylation reaction in which methionine is the methyl donor is well established.[3-5] As has been shown earlier, the role of ATP in such reactions is related to the activation of methionine,[6] as described by equation 1.

L-Methionine + ATP ⟶
Active methionine + orthophosphate (1)

The enzyme catalyzing this reaction has been partially purified, using rabbit liver as its source. The most significant property of active methionine is its ability to function as a methyl donor, even in the absence of ATP. Originally it had been assumed that the role of ATP in the activation reaction was to serve as a source of phosphate bond energy. However, the elucidation of the chemical nature of active methionine which is described below suggests that, regardless of the intermediate steps involved, ATP functions in the activation process in a novel and unexpected way as a donor of its adenosine moiety.

Active methionine, prepared enzymatically, has been purified from the deproteinized reaction mixture by (a) removal of Mg^{++} as Mg pyrophosphate at *p*H 7.0; (b) precipitation of organic and inorganic phosphates with barium and 80% ethanol, *p*H 7.8; (c) paper chromatography with 80% ethanol–5% acetic acid. The location of active methionine on the paper has been greatly facilitated by the observation that when methionine-S^{35} was used for the enzymatic reaction, the intermediate was labeled with S^{35}. Methionine-2-C^{14} also yielded labeled active methionine. After elution from the paper, active methionine exhibited an ultraviolet absorption spectrum nearly identical to that of adenylic acid. On the assumption that the extinction coefficient of active methionine is equal to that of adenylic acid it was found that preparations of active methionine, obtained as above, contained, for each mole of adenine, the equivalent of 0.78 mole of pentose[7] and 0.8 mole of labile methyl groups.[8] Three fragments have been recognized after hydrolysis in 0.5 *N* HCl at 100° for 2 hours. Adenine has been identified conclusively as one of them by chromatography on paper, by ion exchange chromatography on Dowex 1[9] and by oxidation of 2,8-dihydroxyadenine with xanthine oxidase.[10] An amino acid which when chromatographed on paper with different solvents appears to be identical with homoserine is another one of the products of hydrolysis. The nature of a third fragment has not been ascertained as yet; it is a sulfur-

(1) This investigation was aided by grants from the Williams Waterman Fund for the Combat of Dietary Diseases of the Research Corporation of New York and from the American Cancer Society (recommended by the Committee on Growth of the National Research Council).

(2) Adenosinetriphosphate = ATP.

(3) H. Borsook and J. W. Dubnoff, *J. Biol. Chem.*, **171**, 363 (1947).

(4) G. L. Cantoni, *ibid.*, **189**, 203 (1951).

(5) S. Cohen, *ibid.*, **193**, 851 (1951).

(6) G. L. Cantoni, *ibid.*, **189**, 745 (1951); and in "Phosphorus Metabolism," Vol. I, Johns Hopkins Press, Baltimore, Md., 1951, p. 641.

(7) Determined by the Bial-orcinol reaction with heating for 45 minutes at 100°.

(8) The latter were determined enzymatically by guanidoacetate methylpherase, an enzyme catalyzing the reaction

(2) Active methionine + guanidoacetate ⟶ creatine + X

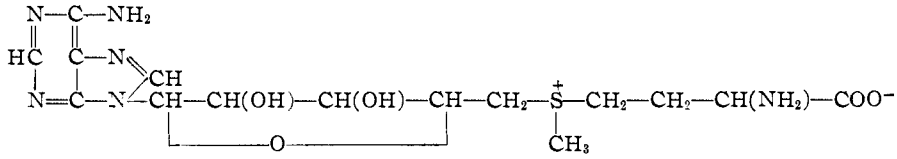
P. J. Vignos, Jr., and G. L. Cantoni, to be published.

(9) W. E. Cohn, *Science*, **109**, 377 (1950).

(10) H. Klenow, *Biochem. J.*, **50**, 404 (1952).

containing compound, presumably thiolribose or thiomethylribose.

On the basis of this evidence active methionine has been assigned the structure shown below.



Active methionine can be considered as an addition product of methionine and the adenosine portion of ATP, with the elimination of the inorganic tripolyphosphate chain. It should be noted also that the sulfur of methionine acquires an additional covalent bond and it is thought that formation of the positively charged sulfonium compound confers lability upon the methyl group. It is suggested that the compound formed from L-methionine and ATP by the action of the methionine-activating enzyme, which has been designated heretofore as active methionine, might more properly be referred to as S-adenosyl-methionine. On the basis of the data given above the preparation obtained by paper chromatography is at least 80% pure with relation to adenine compounds.

DEPARTMENT OF PHARMACOLOGY
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RECEIVED MAY 9, 1952

IDENTIFICATION OF DROSOPHILIN A AS *p*-METHOXYTETRACHLOROPHENOL[1]

Sir:

Drosophilin A, an antibiotic compound recently isolated in this Laboratory[2] has been identified as *p*-methoxytetrachlorophenol.

Drosophilin A was isolated as previously described, and further purified by sublimation under reduced pressure. Analytical values[3] for a sample resublimed four times agreed with the expected for a compound of formula $C_7H_4O_2Cl_4$. Found: C, 32.19; H, 1.50; Cl, 54.05; OCH_3, 11.88. Calcd. for $C_7H_4O_2Cl_4$ (261.93) C, 32.10; H, 1.54; Cl, 54.15; OCH_3, 11.85.

Demethylation of Drosophilin A with boiling 70% hydriodic acid yielded a crystalline compound which melted at 232°,[4] and gave no melting point depression on admixture with an authentic sample of tetrachlorohydroquinone.

Methylation of Drosophilin A with ethereal diazomethane yielded a crystalline product which melted at 160° and gave no depression on admixture with an authentic sample of 1,4-dimethoxytetrachlorobenzene prepared by methylation of the Eastman-Kodak preparation of tetrachlorohydroquinone.

(1) This investigation was supported in part by a research grant from the National Microbiological Institute of the National Institutes of Health, Public Health Service.

(2) F. Kavanagh, A. Hervey and W. J. Robbins, *Proc. Nat. Acad. Sci.*, in press.

(3) Microanalyses were performed by the Huffman Microanalytical Laboratories, Denver, Colorado.

(4) All melting points are uncorrected.

The melting point of the dimethyl ether agrees with that reported in the literature.[5] The monomethyl ether, as far as can be ascertained, has been described only once in the literature,[6] and the melting point reported is 103°, instead of 116° as found for Drosophilin A. Difference in the state of purity of the two samples may account for this discrepancy.

A sample of the monomethyl ether was prepared by removal of one methyl group from the dimethyl ether by treatment with warm concentrated sulfuric acid and melted at 114° alone or when mixed with Drosophilin A.

Drosophilin A is believed to be the first antibiotic compound isolated, which contains a halogenated benzene ring. The chlorine atoms of chloramphenicol, the first halogenated antibiotic compound reported, are in a side chain.

(5) A. Binz and C. Räth, *Ber.*, **58**, 309 (1925).

(6) E. Burès and J. Hutter, *Časopis Českoslov. Lékárnictva*, **11**, 29, 57 (1931) (*C. A.*, **25**, 5153 (1931)).

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RECEIVED MAY 9, 1952

DISSOCIATION MECHANISM FOR THE AQUATION OF SOME COBALT(III) COMPLEX IONS[1]

Sir:

Based on the published observations on substitution reactions of complex ions, it has not been possible to designate whether any of these reactions proceed by a displacement (S_N2) or dissociation (S_N1) mechanism. It may appear that these reactions of cobalt(III) complexes should proceed by a dissociation mechanism since the complex has an invert gas configuration which means there are no low-lying orbitals available for attack by the incoming group. However displacement reactions are known to occur with carbon compounds which likewise have an inert gas configuration.

The aquation rates of several substituted ethylenediamine complexes of the type $[Co(AA)_2Cl_2]^{+1}$ have recently been determined by us and some preliminary results are shown in Table I. It is apparent that the complex ions which contain C-substituted ethylenediamine aquate more rapidly than the corresponding ethylenediamine ion. The fact that increased crowding around the central ion does not decrease the rate suggests that these reactions

TABLE I

RATES OF AQUATION OF SOME *trans*-$[Co(AA)_2Cl_2]^{+1}$ IONS
First chlorine only, temperature 25°, *p*H 1

(AA) Diamine	$k \times 10^3$ (min.$^{-1}$)
$NH_2—CH_2—CH_2—NH_2$	1.9
$NH_2—CH_2—CH(CH_3)NH_2$	3.7
dl-$NH_2—CH(CH_3)—CH(CH_3)—NH_2$	8.4
meso	250
$NH_2—C(CH_3)_2—C(CH_3)_2—NH_2$	Very rapid

(1) This investigation was supported by a grant from the United States Atomic Energy Commission under contract AT(11-1)-89-Project No. 2.