

of the vinyl groups become evident in the monolayer properties of the pimelic acids, it was thought possible that the structural differences would also lead to differences in elution behaviour in chromatography if the conditions were suitably chosen. It seemed probable that if the elution rates were different, it would be likely that the molecule (IDP) whose motion is retarded more at low temperatures would be also more strongly adsorbed on a column than the other molecule (DP). This proved to be the case.

Temperature regulation is often employed in gas chromatography to improve separations and this effect has also been proposed on the basis of theoretical considerations, but this possibility has seldom been taken advantage of in partition chromatography (see, e.g. Ref.<sup>11</sup>). As the results presented above show, different temperatures might be used more often than has been done previously when carrying out partition-chromatographic separations and analyses.

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1. Loeblich, V. M., Baldwin, D. E. and Lawrence, R. V. *J. Am. Chem. Soc.* **77** (1955) 2823.
2. Bruun, H. H. and Gåsland, S. *Acta Acad. Aboensis, Math. Phys.* **22** (1960) No. 1.
3. Bruun, H. H. *Ibid.* **19** (1954) No. 3.
4. Bruun, H. H., Ryhage, R. and Stenhagen, E. *Acta Chem. Scand.* **12** (1958) 789.
5. Bruun, H. H., Fischmeister, I. and Stenhagen, E. *Acta Chem. Scand.* **13** (1959) 379.
6. Bruun, H. H. and Stenhagen, E. *Acta Chem. Scand.* **13** (1959) 832.
7. Arya, V. P., Enzell, C. and Erdtman, H. *Acta Chem. Scand.* **15** (1961) 682.
8. Edwards, O. E. and Howe, R. *Can. J. Chem.* **37** (1959) 760.
9. Ireland, R. E. and Schiess, P. W. *Tetrahedron Letters* **24** (1960) No. 18, p. 37.
10. Milue, G. W. A. and Smith, H. *Chem. Ind. (London)* **1961** 1307.
11. Heftmann, E. (Ed.) *Chromatography*, New York 1961, p. 141.

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## Nicotinamide-Nucleotide Coenzymes or Nicotiniumamide-Nucleotide Coenzymes?

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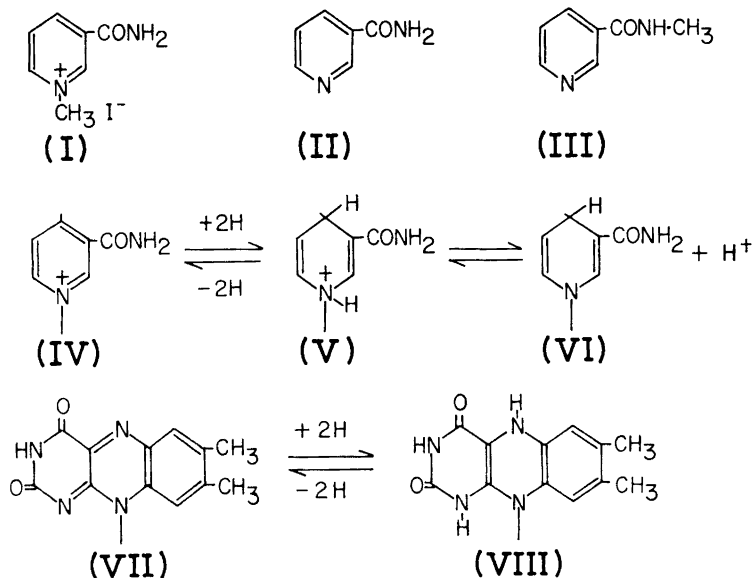
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Efforts to solve long-standing controversies over the nomenclature of so called *pyridine-nucleotide* coenzymes have led to a recent recommendation to call this group of coenzymes *nicotinamide-nucleotide* coenzymes<sup>1</sup>. Although the recommended nomenclature indicates the general structure of these coenzymes more adequately than before, an apparently minute but actually fundamental short-coming observed in the previous nomenclature is still uncorrected in this one.

1-Methyl-3-carbamyl pyridinium iodide (I) has been called N<sup>1</sup>-methyl nicotinamide iodide, nicotinamide methiodide, or even N-methyl nicotinamide. Although it is closely related to nicotinamide (II), this compound is quite different from nicotinamide in chemical reactivity. These conventional names fail to indicate the presence of a quaternary nitrogen in the compound. The last name, moreover, is definitely incorrect. It is the name of another compound, 3-(N-methylcarbamyl)-pyridine (III).

Radical (IV) is the functional group of the oxidized form of *pyridine-nucleotide* coenzymes. Upon reduction, this radical becomes radical (V), which subsequently changes to radical (VI) upon releasing a hydrogen ion. If a compound with radical (IV) is called a nicotinamide compound, as is recommended,<sup>1</sup> a compound with radical (V) must be called a dihydronicotinamide compound. Then, what should one name a compound with radical (VI)? The chemically proper name of radical (VI) is actually dihydronicotinamide radical. This dilemma comes from inadequately calling 3-carbamyl-pyridinium radical (IV) nicotinamide radical.

I would like to propose radicals (IV) and (V) to be called *nicotiniumamide* and *dihydronicotiniumamide* radicals, respectively, from the following reasons: (A) the presence of the quaternary nitrogen can be clearly indicated, (B) the chemical changes involved in oxidation-reduction and addition of these radicals can be



expressed more adequately than before, (C) a close relation of *pyridine-nucleotide* coenzymes to nicotinamide in biosynthesis can be indicated, and (D) no modification of the presently accepted or the recently recommended abbreviations of nicotinamide-related compounds is necessary. N<sup>1</sup>-Methyl nicotinamide iodide, nicotinamide mononucleotide, nicotinamide-adenine dinucleotide, and nicotinamide-adenine dinucleotide phosphate will be called 1-methyl nicotiniamamide iodide, nicotiniamamide mononucleotide (NMN<sup>+</sup>), nicotiniamamide-adenine dinucleotide (NAD<sup>+</sup>), and nicotiniamamide-adenine dinucleotide phosphate (NADP<sup>+</sup>), respectively. The reduction and addition products of these compounds are dihyronicotiniamamide (V)-compounds, which become dihyronicotinamide (VI)-compounds after releasing a hydrogen ion in neutral solution. It should be understood, therefore, that the interconversion, *nicotiniamamide* (IV)  $\rightleftharpoons$  *dihyronicotinamide* (VI) +  $H^+$ , is responsible for the oxidation-reduction of so called *pyridine-* or *nicotinamide-nucleotide* coenzymes. It is not appropriate to state that the oxidation-reduction of these coenzymes is accomplished by the interconversion, nicotinamide  $\rightleftharpoons$  dihyronicotinamide, as it has been conventionally described.

This nomenclature suggesting the name, *nicotiniamamide-nucleotide* coenzymes, is not only in harmony with the well-accepted one of *flavin-nucleotide* coenzymes, but also clearly illustrates the difference in oxidation and reduction between these two groups of coenzymes: the oxidized form of the latter coenzymes, an isoalloxazine (VII)-compound, is reduced to a dihydroisoalloxazine (VIII)-compound which does not liberate a hydrogen ion under similar conditions. In other words, the oxidation-reduction of the latter group of coenzymes accompanies no quaternary-tertiary interconversion of the nitrogen atom. On the other hand, it has been well recognized that the quaternary-tertiary interconversion of a nitrogen atom of *nicotiniamamide-nucleotide* coenzymes plays an important role in the apoenzyme-coenzyme interaction<sup>2,3</sup>.

1. Report of the Commission on Enzymes of the International Union of Biochemistry, Pergamon Press, London 1961, p. 16.
2. Theorell, H. *Discussions Faraday Soc.* **20** (1955) 224.
3. Shifrin, S. and Kaplan, N. O. *Advan. Enzymol.* **22** (1960) 337.

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