acting center of the base also cause deviations even within a series of the same charge type.[2]

In view of these facts, extreme interest attaches to the accompanying figure, in which catalytic constants[4,7] for the mutarotation of glucose at 18° are plotted logarithmically against the corresponding catalytic constants[2,3,5,6] for the decomposition of nitramide at 15°, both in aqueous solution. The figure includes all the bases whose behavior in both reactions has been studied. No statistical corrections are made. The straight line has a slope of 2.00.

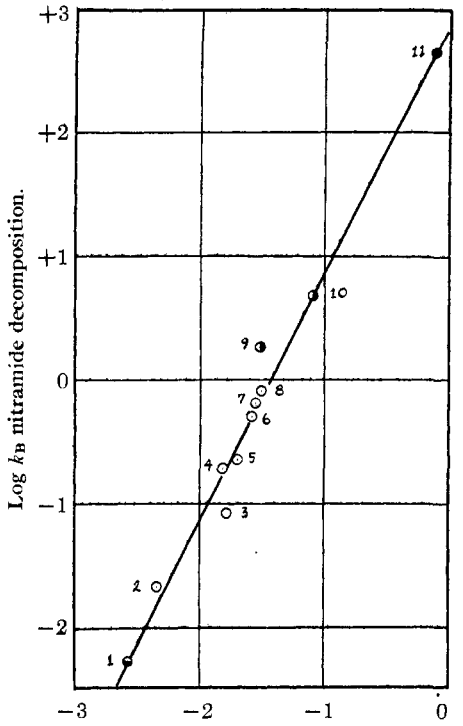

Fig. 1.—Plot of log k_B for nitramide decomposition against log k_B for glucose mutarotation: 1, betaine[3,7]; 2, salicylate[6,4]; 3, formiate[3,4]; 4, benzoate[3,4]; 5, phenylacetate[3,4]; 6, acetate[3,4]; 7, propionate[3,4]; 8, trimethylacetate[6,4]; 9, quinoline[2,7]; 10, pyridine[2,4]; 11, $Co(NH_3)_5OH^{++}$[5,4].

It is immediately apparent that all the points fall reasonably well on the same straight line and that betaine, pyridine, quinoline and even $Co(NH_3)_5OH^{++}$ follow the same relationship which holds for the negative bases such as acetate ion. This is particularly startling in the case of $Co(NH_3)_5OH^{++}$, which in the familiar k_B *vs.* K_B plot deviates from the carboxylate ion curve by as much as two logarithmic units.

It is therefore highly desirable that knowledge of these and other reactions susceptible to general base catalysis be extended to include more bases in common. If the uniqueness of Fig. 1 is upheld by further extension of the data, it implies that the relationship between two series of rate constants for association by bases of protons from two different substrates is more fundamental than the relationship of either series of rate constants to corresponding equilibrium constants. It follows further that deviations which occur in the k_B *vs.* K_B relationships must originate in deviations in the relationships between the rate constants for association and dissociation; this also can be submitted to experimental study.

In its amenability to experimental attack, such an empirical approach differs from the theoretical approach embodied in the transition-state method which assumes the fundamental relationship to be between equilibrium constants and then attempts to derive the connection between rate and equilibrium constants by postulating an equilibrium between initial and transition states, the constant for which can unfortunately not be measured.[8]

(8) See symposium in *Trans. Faraday Soc.*, **34**, 29ff. (1938).

SLATERSVILLE, R. I. HELMUTH L. PFLUGER

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(2) Work to be published by the writer.
(3) Brönsted and Pedersen, *Z. physik. Chem.*, **108**, 185 (1924).
(4) Brönsted and Guggenheim, THIS JOURNAL, **49**, 2554 (1927).
(5) Brönsted and Volqvartz, *Z. physik. Chem.*, **A155**, 211 (1931).
(6) Baughan and Bell, *Proc. Roy. Soc.* (London), **158A**, 464 (1937).
(7) Westheimer, *J. Org. Chem.*, **2**, 431 (1937).

INFLUENCE OF NICOTINIC ACID ON THE FERMENTATION METHOD FOR VITAMIN B_1 DETERMINATION

Sir:

Lohmann and Schuster[1] have shown that a vitamin B_1 pyrophosphate is identical with cocarboxylase. This coenzyme plays an essential part in the series of reactions which produce alcoholic fermentation and, in all probability, was present in the original Harden and Young extracts of cozymase. With regard to our fermentation method for vitamin B_1 determination,[2] it has been our working hypothesis that vitamin B_1, or the aminopyrimidine, is taken inside the

(1) K. Lohmann and Ph. Schuster, *Biochem. Z.*, **294**, 188 (1937).
(2) A. S. Schultz, L. Atkin and C. N. Frey, THIS JOURNAL, **59**, (a) 948, (b) 2457 (1937).

living cell and there transformed to cocarboxylase or its equivalent. We have considered the possibility that other substances might, on diffusion into the cell, be likewise converted into one of the elements of cozymase, *i. e.*, codehydrase, cophosphorylase or cocarboxylase. Adenylic acid, which is considered to be equivalent to cophosphorylase and which is contained in codehydrase, has been tested and found to be without action. Nicotinic acid which is present in the codehydrase molecule as the amide shows a certain stimulation.

TABLE I

Addition	Ml. gas per 3 hrs. (3 tests)			Av. diff. due to nicotinic acid	Possible error in a vit. B_1 assay
None (standard control mixture)	220	222	220		
1 mg. nicotinic acid	222	224	224	+2	
2 gamma vitamin B_1	296	295	300		
2 gamma vitamin B_1 plus 1 mg. nicotinic acid	306	308	305	+9	15%
4 gamma vitamin B_1	355	353	359		
4 gamma vitamin B_1 plus 1 mg. nicotinic acid	360	368	362	+7	7%

Table I shows how the effect was measured. The absolute values obtained cannot be compared with our previous data[2] but it will be observed that $\Delta_{4\gamma-0\gamma}$ and $\Delta_{4\gamma-2\gamma}$ correspond reasonably well. This is not at all surprising since relatively small variations in the vitamin and moisture content of the compressed yeast used will affect the rate of gas production of the controls. A single pair of measurements, either zero and 4 gamma or 2 and 4 gamma, will automatically correct for these variations, and from then on the same pound of yeast may be used until it is exhausted, with no more than a single control (2 or 4 gamma) in each run.

Increasing amounts of nicotinic acid up to 50 mg. did not show an increased effect. The amide of nicotinic acid was tested but did not show any greater activity. The effect of nicotinic acid though small is significant and the resulting possible error in a vitamin assay should be eliminated if possible. This is readily done by including nicotinic acid in all tests. Since large amounts show no further stimulation the addition of 1 mg. of nicotinic acid removes the possible source of error. The negligible effect of added nicotinic acid on the blank determination is interesting and may account for the general failure to observe this effect heretofore. Following our work on vitamin B_1 as a bios factor,[3] we tested nicotinic acid for bios activity but up to the present we have obtained no positive results.

(3) A. S. Schultz, L. Atkin and C. N. Frey, THIS JOURNAL, **60**, 490 (1938).

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RESTRICTED INTERNAL ROTATION IN HYDROCARBONS

Sir:

In the short time since we presented the first definite conclusion[1] in favor of the existence of a high potential restricting the internal rotation in ethane, considerable discussion and additional evidence[2] have appeared in the literature. Most recently Kistiakowsky and Wilson[2g] have satisfactorily summarized the general situation; however, certain of their statements appear to be misleading, particularly in view of new evidence obtained in this Laboratory.

A general though approximate method for conveniently relating thermodynamic functions and potential barriers for various molecules has been given.[2b] It of course should be realized that restricting potentials calculated by this method have exact meaning only in connection with the assumed shape of potential barrier. This, however, detracts little from their usefulness in correlating a large amount of thermodynamic data because the same assumed shape of potential barrier will have been used throughout. Indeed, such a correlation of the various thermodynamic data as yet available was made, which showed the general applicability and correctness of accurate entropies obtained through the third law of thermodynamics. Kistiakowsky and Wilson, however, assert that the selection of the magnitude of some of the potentials was "arbitrary" and that "without the knowledge of the laws of force responsible for the hindrance of internal rotation" calculations such as these are "rather meaningless. . . ." It is of course true that in a few cases potential barriers were estimated; however, the only assumption made was the almost axiomatic one that the restriction of rotation about a given C—C bond is related to the position and character of the groups

(1) Kemp and Pitzer, *J. Chem. Physics*, **4**, 749 (1936); THIS JOURNAL, **59**, 276 (1937).

(2) (a) Howard, *Phys. Rev.*, **51**, 53 (1937); *J. Chem. Physics*, **5**, 442, 451 (1937); (b) Pitzer, *ibid.*, **5**, 469, 473 (1937); (c) Bartholome and Karwill, *Naturwiss.*, **25**, 476 (1937); (d) Aston, Siller and Messerly, THIS JOURNAL, **59**, 1743 (1937); (e) Kassel, *ibid.*, **59**, 2745 (1937); (f) Kistiakowsky and Nazmi, *J. Chem. Physics*, **6**, 18 (1938); (g) Kistiakowsky and Wilson, THIS JOURNAL, **60**, 494 (1938).