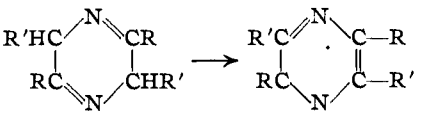
an α-naphthyl nucleus was substituted. Possibly the apparent discrepancies between Madinaveitia's and our findings may be traced to the effects of the —OH as compared to the —OCH_3 group. In any event the large differences between the activity of the α- and β-naphthyl isomers is most striking.

Addenda.—After all the above data had been assembled there appeared the paper by Machlis and Blanchard[10] on 1-xenyl-2-aminopropanol. The hydrochloride is described by these authors as melting with decomposition at 235°, and on alkalinization "the precipitated colorless base rapidly underwent oxidation, assuming a yellow color which quickly passed through orange to a deep red." Our hydrochloride of the same amino alcohol melted with decomposition at 228°, but we were able to isolate the free base by the usual alkalinization procedures, *i. e.*, with sodium carbonate or sodium hydroxide, and the base shows no evidence of instability on prolonged exposure or even at the melting point, 148.5–149° (corr.).

Machlis and Blanchard did not get complete hydrogenation—89% of calculated hydrogen being used (*cf.* footnote (c) Table III)—and in the light of our experience with numerous compounds of this type[11] these investigators had appreciable amounts of the amino ketone hydrochloride in their product. Amino ketones of this type are unstable when liberated from their salts, undergoing spontaneous condensation to dihydropyrazines

$$2RCOCHR'NH_2 \longrightarrow$$



which are readily oxidized to the more stable pyrazine derivatives.[12] The color sequences described are quite in agreement with those observed by Gabriel and by us with various analogs.

(10) Machlis and Blanchard, THIS JOURNAL, **57**, 176 (1935).

(11) Hartung, *ibid.*, **53**, 2248 (1931).

Summary

1. The synthesis of five additional amino alcohols is described; they are members of a series whose general structure is ARCHOHCH(NH_2)-CH_3, in which AR is *m*-tolyl, *p*-chlorophenyl, *p*-phenylphenyl (xenyl), α-naphthyl and β-naphthyl.

2. All of these compounds, substitution products of the parent substance in which AR is phenyl, are more toxic and less active than the parent substance, AR = phenyl, from which they may be considered as being derived.

(12) Gabriel, *Ber.*, **41**, 1148 (1908).

PHILADELPHIA, PA. RECEIVED MARCH 23, 1935

[CONTRIBUTION FROM THE DEPARTMENT OF PHYSIOLOGICAL CHEMISTRY, TEACHERS COLLEGE, COLUMBIA UNIVERSITY]

Studies of Crystalline Vitamin B_1. VIII. Sulfite Cleavage. II. Chemistry of the Acidic Product

BY ROBERT R. WILLIAMS, EDWIN R. BUCHMAN AND A. E. RUEHLE

In the third paper of this series[1] it was shown that crystalline vitamin B_1 is split on treatment with sulfite giving an acidic product, $C_6H_9N_3SO_3$ (I), in yields up to 97% of the theoretical. From its method of formation it may be inferred that this substance is a sulfonic acid and this view is confirmed by a study of its properties. The material chars slowly above 400° but does not melt up to 440°. It is almost insoluble in alcohol, very sparingly soluble in cold water, more freely in hot, but is easily soluble in dilute alkali or ammonia. It is also soluble unchanged in concentrated nitric or sulfuric acid. Recrystallization may be effected from hot water or by adding acetic acid to an ammoniacal solution; in either case characteristic small white needles are obtained. A solution of the substance either in ammonia or hydrochloric acid upon evaporation yields the original substance. The *p*H of a saturated aqueous solution is about 5.2. The sulfonic acid is not precipitated by phosphotungstic acid but is precipitated by silver nitrate at *p*H 8–9. In contrast to the vitamin it gives no color with diazotized sulfanilic acid[2] nor a nitroprusside reaction after heating with 20% alkali at 100°.

The action of hydrolytic agents was studied in some detail with a view to eliminating the sulfonic acid group. Heating with moist sodium hydroxide at 135° had little effect, 80% of the substance

(1) Paper III of this series, THIS JOURNAL, **57**, 536 (1935).

(2) Use was made of the technique of T. B. Johnson and S. H. Clapp, *J. Biol. Chem.*, **5**, 163 (1908).

being recovered unchanged, while after a half hour at 185° the major part of the sulfur was converted to alkali sulfite. When heated with water at 200° in a sealed tube for forty-eight hours, the substance yielded sulfuric acid in considerable amount. No recognizable organic fragment could be isolated from any of these hydrolytic reactions although the conditions were varied widely.

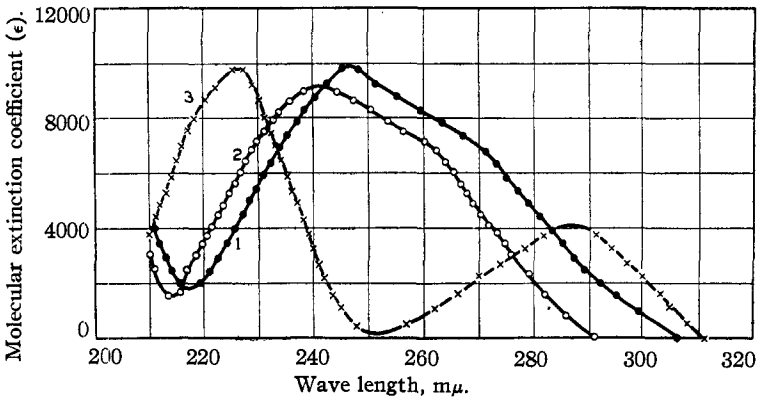


Fig. 1.—1, Amino sulfonic acid (I); 2, 2,4-dimethyl-6-aminopyrimidine; 3, 4,6-dimethyl-2-aminopyrimidine.

Treatment with concentrated hydrochloric acid gave important results. It was found that on refluxing with strong hydrochloric acid one mole of ammonia is split off and a new sulfonic acid is formed according to the reaction

$$C_6H_9N_3SO_3(I) + HOH \xrightarrow{HCl} C_6H_8N_2SO_4(III) + NH_3$$

Obviously an amino group is replaced by —OH. We will refer to the new compound (III) as "oxy sulfonic acid" and (I) as "amino sulfonic acid." The above reaction is conveniently carried out in the following manner: 302 mg. of (I) plus 6 cc. of concentrated hydrochloric acid were heated for three hours in a sealed tube at 150°. The contents of the cooled tube were evaporated to dryness and dissolved in 5 cc. of hot water. Absolute alcohol was added. Crystallization started immediately and was complete after a few hours of standing. The crystals were separated by centrifugation, washed with 95% alcohol and dried *in vacuo;* yield 290 mg. or 96%.

	Analyses, % C	H	N	S
Calcd. for $C_6H_8N_2SO_4$	35.27	3.95	13.73	15.69
Found (N, Dumas)	35.19	4.05	13.22	15.93

The splitting off of ammonia in the above reaction was confirmed by its isolation as the chloroplatinate and identification thereof by analysis and physical characteristics.

The oxysulfonic acid (III) does not melt up to 360°. It is moderately soluble in water, but is thrown out by addition of alcohol, in large well formed crystals. It gives no color with diazotized sulfanilic acid and the sulfonic group is as resistant to hydrolytic agents as is the parent substance, (I).

The presence of a pyrimidine nucleus in the vitamin has been suggested by numerous workers. The behavior of (I) with concentrated hydrochloric acid is consistent with that of 2-amino and 6-amino pyrimidines. The vitamin itself reacts slowly with nitrous acid to yield nitrogen[3] and yields ammonia on heating strongly with hydrochloric acid[4] but does not react with benzoyl chloride under mild conditions. These facts are suggestive of a 2- or 6-aminopyrimidine grouping in it. For purposes of comparison we have prepared 2-amino-4,6-dimethylpyrimidine and the corresponding 2-oxy compound, also 6-amino-2,4-dimethylpyrimidine and the corresponding 6-oxy compound. Both of these amino compounds react with hydrochloric acid as

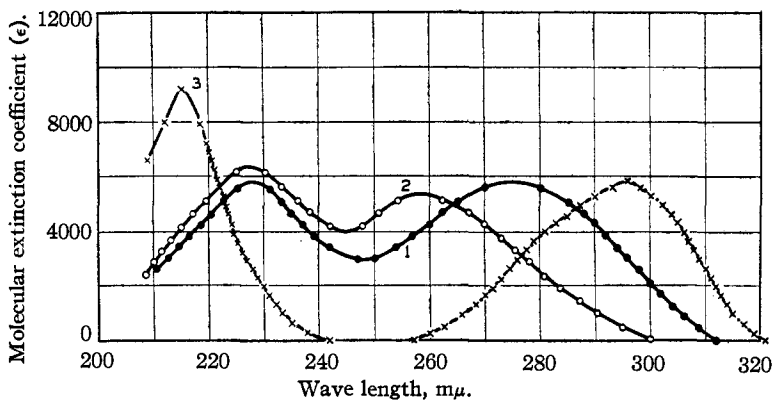


Fig. 2.—1, Oxy sulfonic acid (III); 2, 2,4-dimethyl-6-oxypyrimidine; 3, 4,6-dimethyl-2-oxypyrimidine.

does (I). (I) and (III) are like the 6-amino- and 6-oxypyrimidine, respectively, in giving no color with diazotized sulfanilic acid, but unlike the 2-amino and 2-oxy in that although the

(3) Unpublished work of R. R. Williams and S. Gurin.

(4) Paper IX of this series, E. R. Buchman and R. R. Williams, THIS JOURNAL, not yet published.

2-amino gives none the 2-oxy gives a strong color.

There is marked similarity in ultraviolet absorption of (I) and (III), respectively, to the 6-amino- and 6-oxypyrimidines. A correspondence of the ultraviolet absorption of one of Windaus' oxidation products of the vitamin to that of a 6-oxypyrimidine has been noted by Smakula.[5] This similarity does not extend to the 2-amino- and 2-oxypyrimidines (Figs. 1 and 2).

The authors are grateful to Dr. H. T. Clarke and Dr. Oskar Wintersteiner for microchemical and spectrographic facilities at the Department of Biochemistry of the College of Physicians and Surgeons. We are also indebted to the Carnegie Corporation for financial support through the Carnegie Institute of Washington.

(5) A. Smakula, *Z. physiol. Chem.*, **230**, 231 (1934).

Summary

The acidic product of sulfite cleavage, $C_6H_9N_3SO_3$ (I), has the chemical characteristics and ultraviolet absorption of a 6-aminopyrimidine.

Strong hydrochloric acid converts this product into a second substance, $C_6H_8N_2SO_4$ (III), having the properties of a 6-oxypyrimidine.

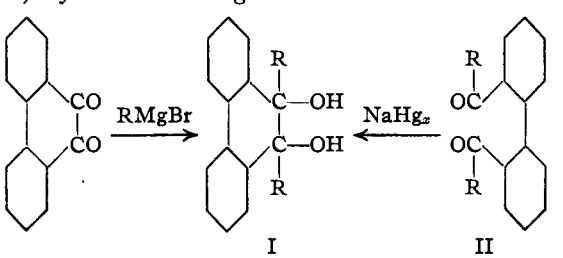
NEW YORK, N. Y. RECEIVED MARCH 28, 1935

[CONTRIBUTION FROM THE CHEMISTRY LABORATORY OF THE UNIVERSITY OF MICHIGAN]

The Pinacol–Pinacolone Rearrangement. VII. The Rearrangement of 9,10-Diaryldihydrophenanthrenediols[1]

BY W. E. BACHMANN AND EDITH JU-HWA CHU

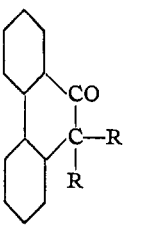
In a previous paper[2] of this series the preparation and rearrangement of three 9,10-diaryldihydrophenanthrenediols were described; in these pinacols the phenyl, *p*-tolyl and anisyl groups were the aryl radicals R (Formula I). We are now reporting the results obtained on six new pinacols of this type in which the aryl groups are *m*-tolyl, *p*-biphenyl, α-naphthyl, phenetyl, *p*-chlorophenyl and *p*-fluorophenyl. These compounds were prepared in two ways: by interaction of phenanthrenequinone and a Grignard reagent and by reduction of 2,2′-diacylbiphenyls (II) by sodium amalgam.



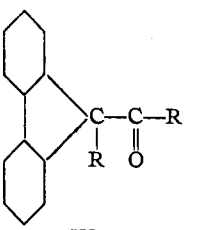
I II

Actually, the two methods yielded two different pinacols in each case; the products are probably diastereoisomers. The yields and properties of these pinacols are presented in Table I.

Rearrangement of the Pinacols.—By treatment with a hot solution of iodine in acetic acid, the diaryldihydrophenanthrenediols lost a molecule of water and were rearranged to 9,9-diarylphenanthrones (III) exclusively; in no instance was there any rearrangement to the isomeric pinacolone, acyl-aryl-fluorene (IV). The stereoisomeric pinacols gave the same diarylphenanthrone.



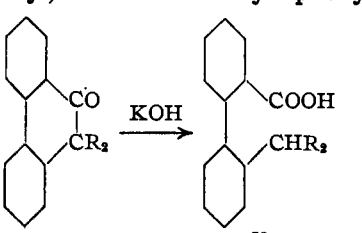
III



IV

In all, nine groups, phenyl, *m*-tolyl, *p*-tolyl, anisyl, phenetyl, *p*-chlorophenyl, *p*-fluorophenyl, *p*-biphenyl and α-naphthyl, have been found to migrate during the rearrangement of diaryldihydrophenanthrenediols in preference to a transformation taking place from a phenanthrene to a fluorene ring. The diarylphenanthrones are listed in Table II.

Scission of 9,9-Diarylphenanthrones to 2-(Diarylmethyl) - 2′ - carboxylbiphenyls.—By



V

(1) From part of the Ph.D. dissertation of Miss Chu.
(2) Bachmann, THIS JOURNAL, **54**, 1969 (1932).