Anal. Calcd. for $C_{11}H_{12}ClNO_2$: C, 58.5; H, 5.30; Cl, 15.70; N, 6.20. Found: C, 58.41; H, 5.57; Cl, 15.82; N, 6.05.

The filtrate was acidified with cold dilute HCl whereby a colorless product separated out, was filtered off, and crystallized from petroleum ether (b.p. 100–120°) as colorless needles, m.p. 210°.

Action of Hydrazoic Acid on 2-Phenyl-4-cyclohexylidene-5-oxazolone.—The experiment was carried out as described above. The nonacidic fraction was crystallized from ethyl acetate, m.p. 157°, yield 73%.

Anal. Calcd. for $C_{14}H_{17}NO_2$: C, 72.70; H, 7.41; N, 6.06. Found: C, 72.26; H, 7.56; N, 6.32.

The acidic fraction was crystallized from ethyl acetate as colorless needles, m.p. 204–208°.

Action of Sodium Azide and Aluminum Chloride in Tetrahydrofuran on IVa.—A solution of aluminum chloride (12 g.) in anhydrous tetrahydrofuran (250 ml.) was added dropwise to a well-stirred solution of IVa (18 g.) in anhydrous tetrahydrofuran containing sodium azide (29 g.). The reaction mixture was stirred for 10 hr. on a water bath. The complex was decomposed with 125 ml. of 6 *N* HCl while stirring for 1 hr. The tetrahydrofuran layer was separated and dried over anhydrous sodium sulfate. Tetrahydrofuran was removed to give a solid product which was dissolved in ethyl acetate and, on addition of petroleum ether (b.p. 40–60°), a colorless material separated out which was filtered off and crystallized from ethyl acetate–petroleum ether (b.p. 40–60°) as colorless crystals (15 g.), m.p. 217°, shown to be α-benzamido-β,β′-dimethylacrylic acid by mixture melting point.

Action of Trichloroacetic Acid on IVa.—The experiment was carried out as described in the action of hydrazoic acid on IVa except that trichloroacetic acid was used instead of sodium azide. The product (1 g.) was crystallized from ethyl acetate–petroleum ether (b.p. 60–80°) and proved to be α-benzamido-β,β′-dimethylacrylic acid[16] by mixture melting point.

Acknowledgment.—The authors are indebted to Professor R. Raphael, Chemistry Department, The University, Glasgow, W.2, Scotland, for kindly carrying out the n.m.r. spectra in his department, and to S. Farid, Max Planck Institute, Abt. Strahlenchemie, Mülheim, Ruhr, Germany, for helpful discussions of the n.m.r. spectra.

2-Amino-5-aryl-2-oxazolines. Tautomerism, Stereochemistry, and an Unusual Reaction

JOHN R. CARSON, GEORGE I. POOS, AND HAROLD R. ALMOND, JR.

Department of Chemical Research, McNeil Laboratories, Fort Washington, Pennsylvania

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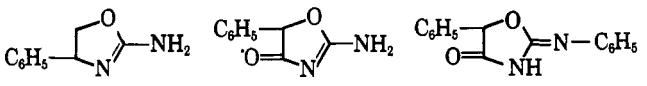
The double bond of the 2-amino-5-aryl-4-methyl-2-oxazolines has been shown by infrared and proton magnetic resonance spectra to be endocyclic, regardless of the substituent on the amino group. Determination of stereochemistry in this series by n.m.r. spectra is discussed. 3,4-Dimethyl-2-methylimino-5-phenyloxazolidine (VIIa) reacts with phenyl isothiocyanate to give 3,4-dimethyl-5-phenyl-2-phenylimino-2-oxazolidine (VIIb).

2-Amino-4-phenyl-2-oxazoline (I) has been reported[1] to exist as the amino tautomer on the basis of infrared spectra and dissociation constant. This is consistent with the generalization[2] that amino tautomers are almost always more stable than their corresponding imino tautomers. However, ultraviolet spectral studies of the 2-amino-5-aryl-2-oxazolin-4-ones have indicated that, while the unsubstituted 2-amino compound (II) exists as the amino tautomer,[3] the compound (III) bearing a phenyl group on the exocyclic nitrogen exists as the imino tautomer.[3a]



I II III

In the course of our study of the appetite suppressant activity of the 2-amino-5-aryl-2-oxazolines,[4] we have examined the spectra of a number of these compounds to gain insight into their tautomerism with particular reference to the effect of a substituent on the amino group.

(1) J. Pitha, J. Jonás, J. Kovár, and K. Bláha, *Collection Czech. Chem. Commun.*, **26**, 834 (1961).

(2) A. R. Katritzky and J. M. Lagowski, *Advan. Heterocyclic Chem.*, **2**, 66 (1963).

(3) (a) C. F. Howell, N. Q. Quinones, and R. H. Hardy, *J. Org. Chem.*, **27**, 1686 (1962); (b) H. Najer, R. Guidicelli, J. Menin, and J. Loiseau, *Compt. rend.*, **254**, 2173 (1962).

(4) G. I. Poos, J. R. Carson, J. D. Rosenau, A. P. Roszkowski, N. M. Kelley, and J. W. McGowen, *J. Med. Chem.*, **6**, 266 (1963).

Discussion and Results

Tautomerism.—The infrared spectral evidence cited[1] by Pitha, Jonás, Kovár, and Bláha for the existence of I in the amino form is the absorption at 2.84 and 2.92 μ assigned to the asymmetric and symmetric stretch of the unassociated amino group and the band at 6.21 μ assigned to the $-NH_2$ deformation absorption. Based on a study of model compounds, they felt that the N–H stretching bands of the alternative imino form would appear at higher wave lengths. They observed the apparently anomolous fact that the C=N stretching band of I appears at a wave length closer to that of the oxazoline locked in the imino form by a methyl group at the 3-position than to the C=N absorption of the compound locked in the amino form by two methyl groups on the amino nitrogen. They rationalized this fact on the grounds that the wave length should be highly dependent on the degree of substitution on nitrogen as is the carbonyl absorption of amides.

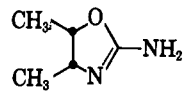
The infrared spectra of the 2-amino-4-methyl-5-phenyl-2-oxazolines closely resemble the reported spectra of the 2-amino-4-aryl-2-oxazolines (see Table I). Compound IV, in very dilute solution in deuteriochloroform, exhibits N–H stretching bands at 2.83 and 2.92 μ. In more concentrated solution in chloroform, IV shows a C=N stretching band at 5.90 μ and a band, presumably due to NH_2 deformation, at 6.27 μ. Since the alternative imino form should also show two NH stretching bands and since the band at 6.27 μ is only of moderate intensity and in a region where aromatic absorption is also found, we sought stronger confirmatory

TABLE I

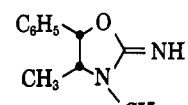
Compd.	Double-bond position	Stereochemistry	Infrared[a] C=N stretch	Infrared[a] NH_2 deformation	N.m.r.[b] 5-CH	N.m.r.[b] 4-CH	N.m.r.[b] 5-CH_3
IV	Endocyclic	*cis*	5.95	6.31	5.60, J = 10	4.37 (8)	0.70, J = 8
V	Exocyclic	*cis*	5.96	...	5.48, J = 8	3.92 (5)	0.75, J = 7
VIa	Endocyclic	*trans*	5.93	6.30	4.95, J = 7	3.98 (5)	1.36, J = 7
VIb	Endocyclic	*trans*	5.97	...	4.86	3.97 (5)	1.27, J = 7
VIc	Endocyclic	*trans*	6.02	...	4.78, J = 8	3.80 (5)	1.28, J = 7
VId	Endocyclic	*trans*	5.95	6.25[c]	5.00, J = 8	4.00 (5)	1.34, J = 7
VIe	Endocyclic	*trans*	6.09	6.26[c]	4.92, J = 7	4.06 (5)	1.41, J = 7
VIIa	Exocyclic	*trans*	5.90	...	4.80, J = 9.5	3.27 (8)	1.26, J = 7
VIIb	Exocyclic	*trans*	6.00	6.29[c]	4.85, J = 9	3.42 (8)	1.27, J = 7

[a] 4% solution in $CHCl_3$; maximum in μ. [b] 15% solution in $CDCl_3$; shifts in parts per million relative to internal tetramethylsilane, multiplicity in parentheses, coupling constants in cycles per seconds. [c] Aromatic absorption.

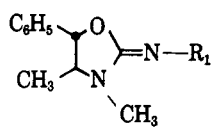
evidence that the bands at 2.83, 2.92, and 6.27 μ were due to a primary amino group. We applied the diagnostic test of Boulton and Katritzky[5] for the primary amino group. These authors observed a band at 2.90 μ which appeared between the asymmetric and symmetric stretching bands at 2.86 and 2.95 μ of 5-amino-3-methylisoxazole upon partial deuteration. They ascribe this band to the NH stretch of the NHD group. Upon partial deuteration of IV, a band appeared at 2.87 μ in addition to the bands at 2.83 and 2.92 μ. The band at 6.27 μ seemed to be diminished in intensity. This provides confirmation that these bands are indeed due to a primary amino group.



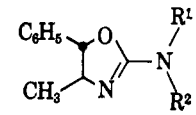
IV



V



VIa, R_1, R_2 = H
b, R_1 = H; R_2 = CH_3
c, R_1, R_2 = CH_3
d, R_1 = H; R_2 = C_6H_5
e, R_1 = CH_3; R_2 = C_6H_5



VIIa, R_1 = CH_3
b, R_1 = C_6H_5

Analysis of the n.m.r. spectra of the 2-amino-4-methyl-5-phenyl-2-oxazolines and the 3,4-dimethyl-2-imino-5-phenyloxazolidines gives additional proof that the former are correctly formulated as amino compounds. The NH band for IV or VIa occurs as a sharp singlet corresponding to two protons due to the expected rapid exchange of protons.

The methine proton on the 4-position of IV occurs at 4.37 p.p.m. while it occurs at 3.92 p.p.m. in the spectrum of 3,4-dimethyl-2-imino-5-phenyloxazolidine (V). A downfield shift of the methine proton of IV would be expected[6a] since it is adjacent to a double bond. The N-methyl group of V should have no influence on the chemical shift on the adjacent proton since the methylene protons adjacent to nitrogen of 2-pyrrolidone and 1-methyl-2-pyrrolidone both occur at 3.40 p.p.m.[6b]

When the methyl and phenyl groups are *trans* to one another on the oxazoline ring, the methine proton at the 4-position occurs at slightly higher field both for 2-amino-2-oxazolines and for 2-iminooxazolidines than the corresponding *cis* compound. The 4-methine resonance is again shifted downfield by about 0.5–0.6 p.p.m. when the double bond is endocyclic. Chemical shifts of 3.98 and 3.80 p.p.m. were observed for the 4-methine protons of VIa and VIc, *trans* compounds with endocyclic double bonds. For the compound VIIa, which has *trans* stereochemistry and an exocyclic double bond, a value of 3.27 p.p.m. was observed.

In sharp contrast to 5-phenyl-2-phenylimino-4-oxazolidinone (III),[3a] 2-anilino-4-methyl-5-phenyl-2-oxazoline (VId) exists in the amino form rather than the imino form. The 4-methine proton of VId appears at 4.00 p.p.m. while it is found at 3.42 p.p.m. in the spectrum of 3,4-dimethyl-5-phenyl-2-phenyliminooxazolidine (VIIb).

The 2-methylamino compound VIb also exists in the amino form since it exhibits this resonance at 3.97 p.p.m. *vs.* 3.27 p.p.m. for the corresponding imino compound VIIa.

The ultraviolet spectra of VId and the model compounds VIe and VIIb gave no useful information about the tautomerism of VId since the absorption maxima of all three fell within the range 245–247 mμ.

Chapman and King[7] have observed coupling of hydroxyl protons with protons on neighboring carbon in dimethyl sulfoxide solution. An attempt to observe coupling between the proton on nitrogen and the protons on the methyl group of the methylamino compound (VIb) in dimethyl sulfoxide solution was unsuccessful.

The coupling constant between the methine protons at the 4- and 5-positions is also dependent on the position of the double bond. When the substituents are *cis*, the coupling constant changes from 8 c.p.s. for the exocyclic to 10 c.p.s. for the endocyclic compound. When the substituents are *trans*, the exocyclic compounds have coupling constants of 9.0 to 9.5 c.p.s. while the endocyclic compounds range from 7 to 8 c.p.s. These changes probably represent a greater deviation from ring planarity in the exocyclic compounds. Application of the revised Karplus equation[8] would give dihedral angles between methine protons in the *cis* case of 0° for the endocyclic and 26° for the exocyclic compounds. In the *trans* case, the angles would vary from 131–134° for the endocyclic compounds to 138–140°

(5) A. J. Boulton and A. R. Katritzky, *Tetrahedron*, **12**, 51 (1961).

(6) (a) "NMR Spectra Catalog," Vol. II, N. S. Bhacca, D. P. Hollis, L. F. Johnson, and E. A. Pier, Ed., Varian Associates, Palo Alto, Calif., 1963, Spectra No. 572 and 673; (b) *ibid.*, Vol. I, N. S. Bhacca, L. F. Johnson, and J. N. Shoolery, Ed., Varian Associates, Palo Alto, Calif., 1962, Spectra No. 68 and 116.

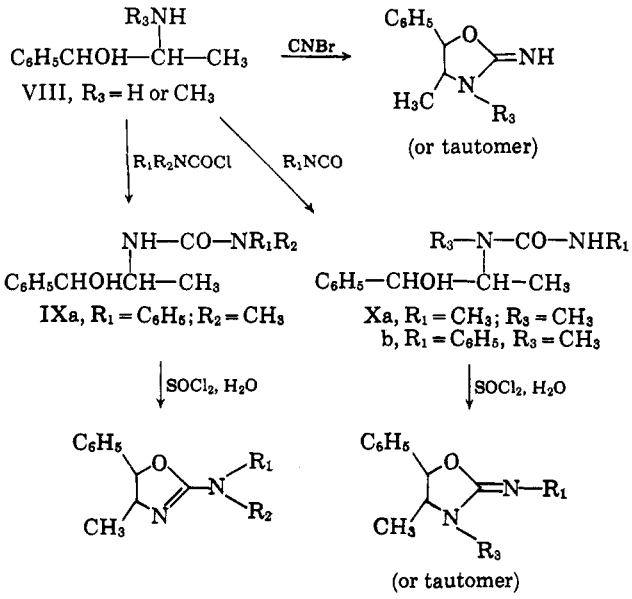
(7) O. L. Chapman and R. W. King, *J. Am. Chem. Soc.*, **86**, 1257 (1964).

(8) K. L. Williamson and W. S. Johnson, *ibid.*, **83**, 4623 (1961).

for the exocyclic compounds. While the magnitude of these angular variations may be subject to large error,[9] the direction of angular variations is probably correct.

The effect of these coupling constants on the patterns of the 4-methine protons is that, when coupling between 4- and 5-methine protons is close to the coupling (about 7 c.p.s.) between the 4-methine and methyl protons, a quintet is observed. When the coupling constants are dissimilar, an eight-line ARX_3 pattern is found. Thus the exocyclic *cis* compounds and the endocyclic *trans* compounds show a quintet, while the exocyclic *trans* compounds and endocyclic *cis* compounds show two overlapping quartets.

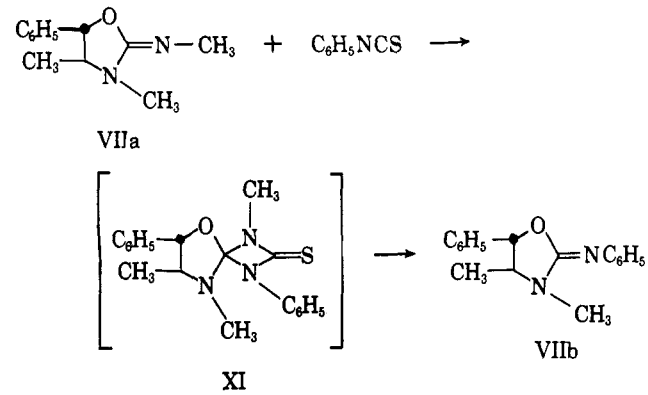
Stereochemistry.—The aminooxazolines and iminooxazolidines under discussion are prepared by two different routes.[4] An amino alcohol (VIII) can be cyclized directly with cyanogen bromide to give the aminooxazoline or iminooxazolidine with retention of configuration. Alternatively, the amino alcohol is converted to a hydroxyurea (IX or X) and the hydroxyurea is cyclized by the action of thionyl chloride and then boiling water, with net inversion of configuration.[1]



The n.m.r. spectra of *cis*- (IV) and *trans*-aminooxazoline (VIa) prepared from amino alcohols of known stereochemistry by the cyanogen bromide route were compared. The *trans* compound exhibited a methyl peak at 1.36 p.p.m. and 5-methine resonance at 4.95 p.p.m. In the *cis* compound these peaks were shifted to 0.70 and 5.60 p.p.m., respectively. The origin of these shifts probably arises from a steric interaction between the methyl and phenyl groups of the *cis* compound which causes the phenyl ring to prefer a conformation perpendicular to the plane best described by the methyl carbon, the carbons at positions 4 and 5, and the 1-carbon of the phenyl ring. Examination of a Dreiding model of IV in this conformation showed that the methyl group would be above the phenyl ring and the 5-methine proton would lie close to the plane of the phenyl ring. Qualitative evaluation of the expected shift using the "isoshielding plot" of Johnson and Bovey[10] showed that the methyl group would be in the region shielded, and the 5-methine proton in the region deshielded, by the phenyl group.

The n.m.r. spectra of the compounds (VIb–e, VIIa and b) prepared from *erythro* amino alcohols by the hydroxyurea route compared well with the *trans*-aminooxazoline VIa, prepared by the stereochemically unequivocal cyanogen bromide route. The chemical shifts of the C-methyl groups of compounds VIb–e and VIIa and b range from 1.26 to 1.41 p.p.m. and the 5-methine protons from 4.78 to 5.00 p.p.m. No traces of bands were found below 1 or above 5 p.p.m.; therefore, the thionyl chloride reaction and subsequent closure must be almost completely stereospecific in these cases.

Chemical Reaction.—In the course of the preparation of 3,4-dimethyl-2-methylimino-5-phenyloxazoline (VIIa), a band at 3.0 μ in the infrared spectrum of this material was observed. We now attribute this band to water since the substance is quite hygroscopic. In order to test for the presence of a secondary amine, VIIa was allowed to react with phenyl isothiocyanate. A substance was isolated in 55% yield which showed no absorption in the 3-μ region and which proved to be identical with the phenylimino compound VIIb. It is suggested that, in analogy to the cycloaddition reactions of enamines with ketenes,[11] the reaction may proceed through a 1,3-diazetidinethione intermediate (XI).



Experimental

General.—The infrared spectra in chloroform were obtained on a Perkin-Elmer Model 21 spectrophotometer. The high-resolution infrared spectra in deuteriochloroform were obtained with a Perkin-Elmer Model 521 spectrophotometer. The ultraviolet spectra were measured with a Cary Model 14 spectrophotometer. The n.m.r. spectra were observed in deuteriochloroform solution using a Varian A-60 instrument. The melting points are corrected. Compounds IV,[4] V,[12] VIa–d,[4] and VIIb[13] have been previously described.

***dl-trans*-4-Methyl-2-*N*-methylanilino-5-phenyl-2-oxazoline (VIe).**—A solution of 11.3 g. (0.067 mole) of methylphenylcarbamyl chloride[14] in 100 ml. of chloroform was added to the suspension made by adding 12.5 g. (0.067 mole) of norephedrine hydrochloride (Fisher Chemical Co.) to 67 ml. (0.20 mole) of 12% sodium hydroxide solution. The mixture was stirred at ice-bath temperature for 4 hr. The layers were separated and the aqueous layer was extracted with chloroform. The combined organic solutions were washed with saturated brine and dried over magnesium sulfate. The solvent was evaporated under reduced pressure and 17.8 g. (92%) of white crystalline *dl-erythro*-1-(β-hydroxy-α-methylphenethyl)-3-methyl-3-phenylurea

(9) M. Karplus, *J. Am. Chem. Soc.*, **85**, 2870 (1963).
(10) C. E. Johnson and R. E. Bovey, *J. Chem. Phys.*, **29**, 1012 (1958).
(11) R. H. Hasek and J. C. Martin, *J. Org. Chem.*, **28**, 1468 (1963).
(12) G. Fodor and K. Koczka, *J. Chem. Soc.*, 850 (1952).
(13) B. Adcock, A. Lawson, and D. H. Miles, *ibid.*, 5120 (1961).
(14) L. C. Raiford and K. Alexander, *J. Org. Chem.*, **5**, 306 (1940).

(IXa) remained. It melted at 114–115° after recrystallization from benzene.

The entire crop of IXa (17.8 g., 0.063 mole) was dissolved in 100 ml. of chloroform and a solution of 4.50 ml. (0.063 mole) of thionyl chloride in 50 ml. of chloroform was added. The resulting solution was heated for 3 hr. under reflux. The solvent was evaporated under reduced pressure leaving a semisolid mass. Boiling water was admitted to the flask and the mixture was agitated for a few seconds. The aqueous solution was decanted from the residual oil and quickly cooled. The solution was washed with ether and the ether was discarded. The solution was made basic by the addition of concentrated potassium carbonate solution and the mixture was extracted several times with methylene chloride. The methylene chloride solution was dried over magnesium sulfate and evaporated to a cloudy, colorless oil. The oil was distilled through a short Vigreux column; the material began to boil at 153° (0.30 mm.) and the fraction boiling at 155–156° (0.30 mm.) was collected, yield 8.0 g. (48%).

Anal. Calcd. for $C_{17}H_{18}N_2O$: C, 76.66; H, 6.81; N, 10.52. Found: C, 76.60; H, 7.11; N, 10.68.

***d-trans*-3,4-Dimethyl-2-methylimino-5-phenyloxazolidine Hydrochloride (VIIa).**—A solution of hydrous ephedrine alkaloid (Merck and Co., Inc.) in chloroform was dried over magnesium sulfate, and the solvent was evaporated leaving anhydrous ephedrine as a clear oil. A solution of 4.1 g. (0.072 mole) of methyl isocyanate in 25 ml. of chloroform was added to a solution of 11.9 g. (0.072 mole) of the anhydrous ephedrine in 50 ml. of chloroform. The reaction mixture was stirred at 0° for 30 min. and allowed to come to room temperature over a period of 2 hr. The solution was boiled briefly to remove excess methyl isocyanate. To the solution was added 5.2 g. (0.072 mole) of thionyl chloride. The mixture was stirred at room temperature for 1 hr. and heated under reflux for 2 hr. The solvent was evaporated and the white crystals which remained were slurried with ether and collected by filtration, yield 16.5 g. (95%), m.p. 195–196°. The analytical sample was obtained by dissolving the crystals in methanol and precipitating with ether, m.p. 198–199°.

Anal. Calcd. for $C_{12}H_{16}N_2O \cdot HCl$: C, 59.87; H, 7.12; N, 11.63. Found: C, 59.80; H, 7.34; N, 11.58.

The free base for spectral studies was obtained by the following procedure. A solution of 8.0 g. of *d-trans*-3,4-dimethyl-2-methylimino-5-phenyloxazoline hydrochloride in 25 ml. of water was made strongly basic by the addition of 50% sodium hydroxide solution. The mixture was extracted twice with ether, and the ether solution was washed with saturated brine, dried over magnesium sulfate, and concentrated *in vacuo* to give 6.5 g. of a yellow oil. Distillation of the oil through a short Vigreux column afforded 3.14 g. of a colorless, low-melting, hygroscopic solid, b.p. 102° (0.25 mm.), $[\alpha]^{27}D$ +12.1° (*c* 10.0, methanol).

***d-trans*-3,4-Dimethyl-5-phenyl-2-phenyliminooxazolidine (VIIb).**[13] **A. From Ephedrine.**—A solution of 14.3 g. (0.12 mole) of phenyl isocyanate in 50 ml. of chloroform was added to a solution of 20.0 g. (0.12 mole) of anhydrous *l*-ephedrine in 150 ml. of chloroform. The resulting solution was heated under reflux for 2 hr., and the solvent was evaporated under reduced pressure. The residual gum crystallized on standing and was recrystallized from benzene–hexane to give 26.8 g. (78%) of white crystalline *erythro*-1-(β-hydroxy-α-methylphenethyl)-3-methyl-1-phenylurea (Xb), m.p. 130–132°.

The cyclization of Xb (25.0 g., 0.088 mole) by the action of thionyl chloride (10.5 g., 0.088 mole) and boiling water was carried out as described for VIe. The product crystallized without need for distillation and was recrystallized twice from 2-propanol, yield 15.6 g. (68%), m.p. 94–95° (lit.[13] m.p. 187°), $[\alpha]^{27}D$ +46.2° (*c* 10.0, methanol).

Anal. Calcd. for $C_{17}H_{18}N_2O$: C, 76.66; H, 6.81; N, 10.52. Found: C, 76.62; H, 6.97; N, 10.30.

B. From VIIa.—A solution of 0.449 g. (0.0022 mole) of *d-trans*-3,4-dimethyl-2-methylimino-5-phenyloxazolidine (VIIa) and 0.239 g. (0.0022 mole) of phenyl isothiocyanate in 5 ml. of hexane was allowed to stand for 4 days at room temperature in a stoppered vessel. The solvent was distilled from the mixture on a steam bath. After several hours the resultant oil was induced to crystallize. The material was recrystallized from hexane, yield 0.319 g. (55%), m.p. 92–94°. Further recrystallization from hexane afforded crystals melting at 94–95°, identical by solid state infrared spectrum and mixture melting point with VIIb prepared by method A.

Deuteration of *dl-cis*-2-Amino-4-methyl-5-phenyl-2-oxazoline (IV).—A suspension of 200 mg. of freshly sublimed *dl-cis*-2-amino-4-methyl-5-phenyl-2-oxazoline (IV) in 2.0 ml. of deuterium oxide was agitated for 18 hr. at 40°. The solid was collected by filtration, dried *in vacuo*, and sublimed. All operations on this material were carried out in a drybox since it is hygroscopic. It was estimated that 79 ± 3% of the two exchangeable hydrogen atoms on nitrogen had been replaced by deuterium by averaging five n.m.r. integral runs measured on a digital voltmeter. A 9.84×10^{-4} *M* solution in deuteriochloroform of the deuterated IV was prepared for infrared analysis by dilution of the solution used for the n.m.r. determination. The infrared spectrum, determined in 1-cm. quartz cells, showed a band at 2.88 μ with only shoulders at 2.83 and 2.92 μ where the undeuterated IV absorbs.

Acknowledgment.—We are indebted to Professor Alan R. Katritzky for a helpful discussion of infrared spectra and to Mrs. M. C. Christie for many of the spectral determinations.

5,6-Dihydro-4H-1,3,4-thiadiazines[1]

D. L. TREPANIER,[2] W. REIFSCHNEIDER, W. SHUMAKER, AND D. S. THARPE

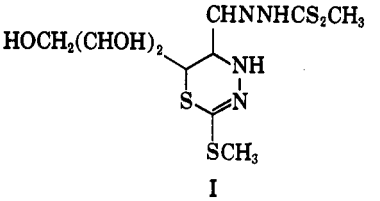
Chemistry Research Department, Pitman-Moore Division of The Dow Chemical Company, Indianapolis, Indiana, and Bioproducts Department, The Dow Chemical Company, Midland, Michigan

Received December 14, 1964

Treatment of 2-(β-hydroxyalkyl)carboxylic acid hydrazides with phosphorus pentasulfide gave substituted 5,6-dihydro-4H-1,3,4-thiadiazines. The scope of this reaction has been explored. *cis* and *trans* isomers have been synthesized and their conformation has been proposed on the basis of n.m.r. data. The mechanism of the reaction is discussed.

As part of a continuing program of exploratory research in heterocyclic chemistry, we turned our attention to the 5,6-dihydro-4H-1,3,4-thiadiazine system.

A survey of the literature showed that Hull, during an investigation of carbohydrate derivatives of alkyl dithiocarbazates, reported[3] that D-glucosamine and methyl dithiocarbazate reacted abnormally to give a product which, on the basis of elemental analysis, could be I.



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(2) To whom correspondence should be sent: Pitman-Moore Division Dow Chemical Co., Box 1656, Indianapolis, Ind.

(3) R. Hull, *J. Chem. Soc.*, 2959 (1952).