crystallized was recrystallized from benzene-hexane to yield 9.2 g. (74%) of 2-phenyl-2,3-dihydrobenzo-1,4-thiazine, m.p. 131.2–132.4°, depressed upon admixture with either VI or VII. The infrared spectrum of the product showed only one band in the N—H and none in the O—H stretching region.

Anal. Calcd. for $C_{14}H_{13}NS$: C, 74.0; H, 5.77. Found: C, 73.7; H, 5.98.

Reaction of 2-aminothiophenol with trans-1,2-dibromocyclohexane. To a cooled solution of 12.5 g. (0.10 mole) of 2-aminobenzenethiol and 5.60 g. (0.10 mole) of potassium hydroxide in 50 ml. of ethanol, 12.1 g. (0.050 mole) of *trans*-1,2-dibromocyclohexane in 50 ml. of ethanol was added dropwise with stirring. The mixture was heated under reflux for 1 hr. and the ethanol then removed by distillation.

The residue was washed with water and crystallized from ethanol to give 12.0 g. (96%) of 2,2′-diaaminodiphenyl disulfide, m.p. 90.8–91.5° (reported[14] 89–91°). The aqueous washes upon evaporation afforded 10.8 g. (91%) of potassium bromide.

The ethanol distillate was added to 750 ml. of water and twice extracted with 200-ml. portions of ether. The ether extracts were combined, washed with water, and dried over magnesium sulfate, and the ether was removed. Distillation of the residue yielded 4.0 g. (95%) of cyclohexene, b.p. 81–83°, identified as the 2,4-dinitrobenzenesulfenyl chloride adduct, m.p. 117.2–118.4° (reported[15] 117–118°).

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[CONTRIBUTION FROM THE CLAYTON FOUNDATION BIOCHEMICAL INSTITUTE AND THE DEPARTMENT OF CHEMISTRY, THE UNIVERSITY OF TEXAS]

Synthesis of Some Heterocyclic Derivatives of α-Keto Acids

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Hippuric acid was condensed with several alicyclic, aliphatic, and aromatic aldehydes to yield the corresponding 4-(substituted)-2-phenyl-2-oxazoline-5-ones. Using acid hydrolysis, several of these compounds were converted to the corresponding α-keto acid derivative. Cyclohexane- and cyclopentane-glyoxylic acids were condensed with *o*-phenylenediamine to form the corresponding 2-(cycloalkyl)-3-hydroxyquinoxalines, and the latter two keto acids were also allowed to react with 4,5,6-triaminopyrimidine to form the corresponding cycloalkyl-hydroxy-4-amino pteridine derivatives.

For the purpose of study of the biological properties of keto acids which are structurally related to certain naturally occurring keto acids, several derivatives have been prepared in this and a previous investigation.[2] The chemistry of certain of these keto acids was further examined to the extent of preparing the corresponding quinoxaline and pteridine derivatives.

2-Oxo-3-(3-cyclohexene)propionic acid, the keto acid analog corresponding to the leucine antagonist, 3-cyclohexenealanine,[3] was prepared by the interaction of 3-cyclohexene-1-carboxaldehyde with hippuric acid to form the corresponding 2-oxazoline-5-one derivative. Acid hydrolysis of the latter compound yielded the desired keto acid analogue.[4] In the preparation of 4-(3-cyclohexene-1-methylidene)-2-phenyl-2-oxazoline-5-one, the use of sodium acetate as the condensing agent gave a low yield of the intermediate; however, a much superior yield was obtained later by carrying out the reaction in tetrahydrofuran using lead acetate as the condensing agent.[5] Alkaline hydrolysis of the 2-oxazoline-5-one condensation product described above gave 2-benzamido-3-(3-cyclohexene)-acrylic acid. The sequence of these reactions is indicated in the accompanying equations.

The yield of the corresponding 2-oxazoline-5-one derivative through the above reaction is found to be much better in the case of aromatic aldehydes than in the case of aliphatic aldehydes and ketones[4]; however, using the appropriate conditions, cyclopentanone, which has been reported to fail to condense with hippuric acid,[5,6] has recently been converted to the desired derivative, 4-cyclopentylidene-2-phenyl-2-oxazoline-5-one,[2] although in poor yield. Using the above described preparative procedure, tiglic aldehyde was condensed with both hippuric acid and *N*-acetylglycine to yield

(1) Rosalie B. Hite pre-doctoral fellow 1957–1959.

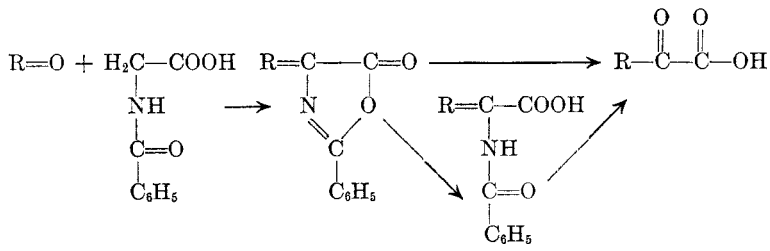
(2) J. D. Fissekis, C. G. Skinner, and W. Shive, *J. Am. Chem. Soc.*, **81**, 2715 (1959).

(3) J. Edelson, C. G. Skinner, J. M. Ravel, and W. Shive, *Arch. Biochem. Biophys.*, **80**, 416 (1959).

(4) Patterned after the procedure of G. R. Ramage and J. L. Simonsen, *J. Chem. Soc.*, 532 (1935); and R. Neher, M. Spillman, L. H. Werner, A. Wettstein, and K. Miescher, *Helv. chim. Acta*, **29**, 1874 (1946).

(5) E. Baltazzi and R. Robinson, *Chem. & Ind. (London)*, **1954**, 191.

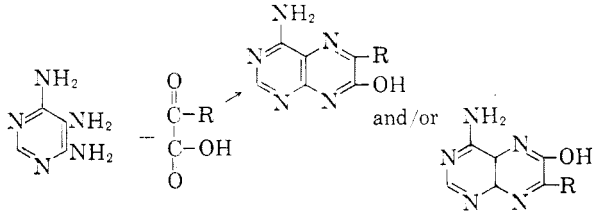
(6) V. Boekelheide and L. M. Schramm, *J. Org. Chem.*, **14**, 298 (1948).



4-(2-methyl-2-butenylidene)-2-phenyl-2-oxazoline-5-one and the 2-methyl-2-oxazoline-5-one, respectively. Hydrolysis of either of these derivatives gave a reaction mixture from which the desired keto acid analog could not be easily recovered.

In addition to the above described oxazolone derivatives, salicylaldehyde and 2,4-dihydroxybenzaldehyde were both converted to the corresponding heterocyclic analogs; however, in the latter instance the product isolated contained one acetylated hydroxyl group. In view of the fact that both of these latter aldehydes contain an *o*-hydroxy grouping, and that only the second one was acetylated by the acetic anhydride present in the reaction mixture, it appears that the product isolated from the 2,4-dihydroxy compound was 4-(4-acetoxy-2-hydroxybenzylidene)-2-phenyl-2-oxazoline-5-one.

The alicyclic keto acid derivatives undergo the typical reactions of α-keto acids; for example, both the cyclopentane- and cyclohexane-glyoxylic acids readily condense with *o*-phenylenediamine to form the corresponding 2-cycloalkyl-3-hydroxyquinoxalines in good yield. In contrast to the unambiguous structure of the latter two condensation products, the material isolated from the interaction of 4,5,6-triaminopyrimidine with each of the above glyoxylic acids may yield two isomeric pteridines, as indicated in the accompanying equations. Accordingly, utilizing cyclohexaneglyoxylic acid, the two anticipated isomeric products would be the 6-cyclohexane-7-hydroxy- and 7-cyclohexane-6-hydroxy- derivatives of 4-aminopteridine. Since the mode of condensation may be directed by carrying out the reaction under the proper conditions of *p*H,[7] both isomers were prepared and characterized. The two isomeric products were purified by recrystallization until a constant ultraviolet absorption spectrum was obtained at the most intense λ_{max}.[8]



The ultraviolet spectrum of the product isolated from the condensation of cyclohexaneglyoxylic acid and 4,5,6-triaminopyrimidine in the presence of strong acid (compound A) was qualitatively similar to the spectra of xanthopterin and 7-methylxanthopterin[9]; and the isomeric product isolated from the "*p*H 5" reaction mixture (compound B) was comparable to the reported spectra of isoxanthopterin and 6-methylisoxanthopterin.[9] Compound A is appreciably more soluble in water than compound B which is comparable to the reported greater solubility of 6-hydroxypteridine over that of the 7-hydroxy-isomer.[9] Finally, compound A possesses a strong fluorescence under a 365 mμ lamp; whereas, compound B has a very weak bluish fluorescence under this ultraviolet light source. After compound B is exposed to the 365 mμ light for several minutes, it then fluoresces very strongly as does compound A. This latter property is comparable to the fluorescent characteristics observed with 7-hydroxypteridine.[10] All of the above data supports the view that compound A (which was prepared by condensing in the presence of strong acid) is 4-amino-7-cyclohexyl-6-hydroxypteridine and that compound B (which was prepared by condensation at *p*H 5) is 4-amino-6-cyclohexyl-7-hydroxypteridine.

The interaction of cyclopentaneglyoxylic acid with 4,5,6-triaminopyrimidine under strongly acidic conditions yielded a reaction product which had an ultraviolet absorption spectrum similar to that of the 4-amino-7-cyclohexyl-6-hydroxypteridine described above. Its solubility properties and appearance under a 365 mμ ultraviolet light source was also comparable, and, since it was prepared by the "strong acid" technique which normally produces a 6-hydroxypteridine derivative, it was concluded that the isolated material from the above reaction mixture is 4-amino-7-cyclopentyl-6-hydroxypteridine.

A preliminary microbiological study of these compounds suggests that they do not have a wide spectrum of inhibitory properties; however, the two 4-amino-7-(cycloalkyl)-6-hydroxypteridines do inhibit the growth of *Streptococcus faecalis* 8043 and *Leuconostoc citrovorum* 8081 in a previously

(7) R. R. Purrmann, *Ann.*, **548**, 284 (1941); G. B. Elion, G. H. Hitchings, and P. B. Russell, *J. Am. Chem. Soc.*, **72**, 78 (1950).

(8) A. Albert, *Quart. Rev. Chem. Soc.*, VI, No. 3, p. 198.

(9) G. B. Elion and G. H. Hitchings, *J. Am. Chem. Soc.*, **69**, 2554 (1947).

(10) A. Albert, D. J. Brown and G. Cheeseman, *J. Chem. Soc.*, 1620 (1952).

described medium[11] using a paper disk assay technique. Since the corresponding 6-cyclohexyl-7-hydroxy- derivative was not inhibitory to growth under these conditions, these results offer further evidence for the identical substitution of the hydroxy group in the 6-position of the two active pteridines.

EXPERIMENTAL[12]

4-(3-Cyclohexene-1-methylidene)-2-phenyl-2-oxazoline-5-one. Method A: A mixture of 40 g. of dry hippuric acid, 18.5 g. of freshly fused sodium acetate, 100 ml. of acetic anhydride, and 27 g. of 3-cyclohexene-1-carboxaldehyde was heated on a steam cone for about 1 hr. to yield a dark pink solution. After cooling, the reaction mixture was added slowly, with vigorous stirring, to 3 l. of ice cold water; and then, stirred an additional 8 hr. while the temperature was kept between 0 and 5°. The resulting semisolid precipitate was recovered, washed thoroughly with ice cold water, and taken up in hot ethyl alcohol. The alcohol solution was then reduced in volume, and cooled overnight in an isopropyl alcohol–dry ice bath to yield 9.0 g. of orange-yellow needles, m.p. 104–105°. A sample was recrystallized twice from ethyl alcohol for elemental analysis, m.p. 109–110°.

Anal. Calcd. for $C_{16}H_{15}NO_2$: C, 75.86; H, 5.97; N, 5.53. Found: C, 76.12; H, 6.23; N, 5.60.

Method B: A much improved procedure consisted of mixing 35 g. of 3-cyclohexene-1-carboxaldehyde, 53 g. of hippuric acid, 100 ml. of acetic anhydride, 19 g. of lead acetate,[13] and 500 g. of freshly distilled tetrahydrofurane, and heating to reflux for about 5 hr. to yield a pink solution. The tetrahydrofurane was removed by distillation *in vacuo*, and the residue was cooled and added to about 3.5 l. of ice cold water with efficient stirring. After stirring an additional 5 hr. in the cold, the precipitated material was recovered, washed with ice water, and dried *in vacuo* over phosphorus pentoxide to yield 71 g. of crude product, *m.p.* 92–97°; which, after recrystallization from ethyl alcohol, had a melting range of 106–108°, and was identical with the analyzed material described above.

2-Benzamido-3-(3-cyclohexene)acrylic acid. A 10-g. sample of 4-(3-cyclohexene-1-methylidene)-2-phenyl-2-oxazoline-5-one was heated on a steam cone in the presence of 100 ml. of 10% potassium hydroxide for about 15 min. to yield a clear yellow solution. After cooling, the reaction mixture was washed twice with ether, the aqueous phase was diluted two-fold, and then acidified to *p*H 2 with 2*N* hydrochloric acid. The semisolid material which ultimately separated was taken up in ethyl alcohol, and the solution was treated with Norit. The resulting yellow solution was reduced *in vacuo* to yield an oil residue which was then taken up in benzene. Reduction in volume of the benzene phase followed by cooling overnight in the refrigerator yielded 3.6 g. of product, m.p. 163–165°. An analytical sample was recrystallized from chloroform–Skellysolve B, m.p. 164–166°.

Anal. Calcd. for $C_{16}H_{17}NO_3$: C, 70.83; H, 6.32; N, 5.16. Found: C, 71.03; H, 6.46; N, 5.14.

2-Oxo-3-(3-cyclohexene)propionic acid. A mixture of 15 g. of 4-(3-cyclohexene-1-methylidene)-2-phenyl-2-oxazoline-5-one and 300 ml. of 8*N* hydrochloric acid was heated on a steam bath for 20 hr. The precipitated benzoic acid which separated upon cooling was removed, and the filtrate was continuously extracted with ether for about 15 hr. The ether extract was dried over sodium sulfate, and the solvent was removed to yield an oily residue, which was purified by heating to 60° under 0.04 to 0.01 mm. pressure and there was collected 2.0 g. of a waxy-like distillate on a cold finger. After crystallization from ether–Skellysolve B the product melted 225–227°.

Anal. Calcd. for $C_9H_{12}O_3$: C, 64.27; H, 7.19. Found: C, 64.33; H, 7.24.

Using the procedure of Metzler and Snell,[14] a sample of the keto acid was treated with pyridoxamine, and the reaction mixture was examined by paper chromatographic techniques. There was observed only a single ninhydrin active spot which was identical with 2-amino-3-(3-cyclohexene)propionic acid in several solvent systems.

The 2,4-dinitrophenylhydrazone derivative of this keto acid was prepared by the usual method, m.p. 190°.

Anal. Calcd. for $C_{15}H_{15}N_4O_6$: N, 16.13. Found: N, 15.91.

4-(2-Methyl-2-butenylidene)-2-phenyl-2-oxazoline-5-one. Using the general procedure A described above for the corresponding 4-(3-cyclohexene-1-methylidene)- derivative, 40 g. of hippuric acid, 18.5 g. of sodium acetate, 100 ml. of acetic anhydride, and 37 g. of tiglic aldehyde were allowed to react; and, after precipitating with cold water, the reaction mixture yielded 18.3 g. of light yellow needles, m.p. 143°. Recrystallization from ethyl alcohol, followed by Skellysolve B, gave a product which melted 147–148°.

Anal. Calcd. for $C_{14}H_{13}NO_2$: C, 73.99; H, 5.77; N, 6.16. Found: C, 73.86; H, 5.63; N, 6.17.

2-Benzamido-4-methylhexa-2,4-dieneoic acid. A mixture of 8 g. of 4-(2-methyl-2-butenylidene)-2-phenyl-2-oxazoline-5-one and 80 ml. of 10% potassium hydroxide was heated over a steam cone for about 15 min. to yield a clear yellow solution. The reaction mixture was cooled, diluted with 160 ml. of water, and the resulting aqueous phase was washed with ether, and finally, acidified to *p*H 2 with 2*N* hydrochloric acid. Upon cooling, a precipitate formed which was filtered, washed with cold water, and then taken up in hot ethyl alcohol and decolorized with Norit. After standing in the refrigerator there was recovered 5.0 g. of yellow needles, m.p. 181–183°. An analytical sample was obtained by recrystallizing from ethyl alcohol–water to yield colorless needles, m.p. 184–186°.

Anal. Calcd. for $C_{14}H_{15}NO_3$: C, 68.55; H, 6.16; N, 5.71. Found: C, 68.54; H, 6.09; N, 5.53.

4-(o-Hydroxybenzylidene)-2-phenyl-2-oxazoline-5-one. A mixture of 60 g. of hippuric acid, 41.5 g. of salicylaldehyde, 120 ml. of acetic anhydride, and 27.2 g. of freshly fused sodium acetate was heated to reflux for 45 min., cooled, and poured with vigorous stirring into 2 l. of ice cold water. The precipitate which formed was collected, washed with cold water, and dried *in vacuo* over potassium hydroxide to yield 29 g. of product. Crystallization from acetone-water followed by acetone gave light pink needles, m.p. 181–182°.[15]

Anal. Calcd. for $C_{16}H_{11}NO_3$: C, 72.44; H, 4.18; N, 5.28. Found: C, 72.94; H, 4.52; N, 5.48.

4-(4-Acetoxy-2-hydroxybenzylidene)-2-phenyl-2-oxazoline-5-one. A mixture of 14 g. of hippuric acid, 11 g. of 2,4-dihydroxybenzaldehyde, 30 ml. of acetic anhydride and 6.4 g.

(11) Same as in J. M. Ravel, B. Felsing, E. M. Lansford, Jr., R. H. Trubey, and W. Shive, *J. Biol. Chem.*, **214**, 498 (1955) except that the Tween 80 was omitted.

(12) All melting points are uncorrected. The paper chromatographs were made by the ascending technique and the papers were examined in a darkroom using an ultraviolet lamp of the appropriate wave length. The ultraviolet absorption spectra were determined on a Beckman model DK-2 recording spectrophotometer at a concentration of 10 γ/ml. in water with the *p*H adjusted to 1 or 11 using hydrochloric acid or sodium hydroxide, respectively. The authors are indebted to W. H. Orme-Johnson, J. Morehead, and A. G. Lane for the chemical analyses and to Drs. J. M. Ravel and E. M. Lansford, Jr., for a preliminary study of the microbiological properties of some of these compounds.

(13) $Pb(OAc)_2 \cdot 3H_2O$ proved to be as satisfactory as anhydrous lead acetate.

(14) D. E. Metzler and E. E. Snell, *J. Am. Chem. Soc.*, **74**, 979 (1952).

(15) E. Erlenmeyer, Jr., and W. Stadlin, *Ann.*, **337**, 283 (1904) reported a m.p. 137–138°.

of sodium acetate was reacted and worked up as described above to yield 7 g. of product. Crystallization from ethyl alcohol–water gave yellow needles, m.p. 192–193°.

Anal. Calcd. for $C_{18}H_{13}NO_5$: C, 66.86; H, 4.05; N, 4.33. Found: C, 67.00; H, 3.91; N, 4.50.

2-Methyl-4-(2-methyl-2-butenylidene)-2-oxazoline-5-one. To a mixture of 29 g. of *N*-acetylglycine, 20 g. of freshly fused sodium acetate, and 100 ml. of acetic anhydride was added 40 g. of tiglic aldehyde. After standing for 4 hr. at room temperature, the reaction mixture was heated to 100° for about 8 hr., and then allowed to cool. The solid mass which separated upon cooling was washed thoroughly with a large volume of ice water and the residual semisolid material was taken up in ethyl alcohol. After cooling overnight in a dry ice–isopropyl alcohol mixture, a solid precipitated which was filtered and quickly taken up in fresh ethyl alcohol, treated with Norit, and reduced in volume to induce crystallization. Upon cooling, there was recovered 4 g. of light yellow crystals, 86–88°. An analytical sample was obtained by recrystallization from ethyl alcohol, m.p. 87–89°.

Anal. Calcd. for $C_9H_{11}NO_2$: C, 65.44; H, 6.71; N, 8.48. Found: C, 65.03; H, 6.61; N, 8.44.

2-Cyclopentyl-3-hydroxyquinoxaline. A solution of 108 mg. of *o*-phenylenediamine in 40 ml. of 2*N* hydrochloric acid was added to a solution of 142 mg. of cyclopentaneglyoxylic acid dissolved in 5 ml. of ethyl alcohol. The reaction mixture was stirred at room temperature for about 15 min., warmed on a steam cone for a few minutes, and finally cooled in an ice bath to yield a precipitate. The product was filtered, washed with small portions of cold water, and recrystallized once from ethyl alcohol–water, and twice from ethyl alcohol. There was recovered 110 mg. of colorless needles, m.p. 237–238° dec. The ultraviolet absorption is recorded elsewhere.

Anal. Calcd. for $C_{13}H_{14}N_2O$: C, 72.87; H, 6.59; N, 13.08. Found: C, 72.82; H, 6.61; N, 13.07.

2-Cyclohexyl-3-hydroxyquinoxaline. Using the same procedure as described above for the cyclopentane- derivative, 108 mg. of *o*-phenylenediamine was allowed to react with 156 mg. of cyclohexaneglyoxylic acid. The reaction product was recrystallized several times from ethyl alcohol to yield 140 mg. of colorless crystals, m.p. 257–258° dec.

Anal. Calcd. for $C_{14}H_{16}N_2O$: C, 73.65; H, 7.06; N, 12.27. Found: C, 73.92; H, 7.07; N, 12.50.

Ultraviolet Absorption Spectra of 2-R-3-Hydroxyquinoxalines

R	λ_{max}, mμ (*p*H 1)	(λ_{max}, mμ *p*H 11)	λ_{min}, mμ (*p*H 1)	(λ_{min}, mμ *p*H 11)
Cyclopentyl-	334, 286	346	300	280–300
	249–255	238	267	226
	228		244	
Cyclohexyl-	330, 282	346	306	280–298
	250, 227	238	264	228
			242	

4-Amino-7-cyclohexyl-6-hydroxypteridine. A 125-mg. sample of 4,5,6-triaminopyrimidine was dissolved in 40 ml. of 2*N* sulfuric acid with gently warming, and, after cooling to room temperature, 156 mg. of cyclohexaneglyoxylic acid dissolved in 5 ml. of ethyl alcohol was added. The reaction mixture was stirred at room temperature for about 2 hr., heated an additional hour over a steam cone, and then cooled and taken to *p*H 5 with 10% potassium hydroxide solution. Upon cooling in an ice bath a precipitate formed which was filtered, washed with several small volumes of cold water, and dried to yield 100 mg. of crude product. The material was crystallized by taking it up in hot ethyl alcohol and slowly reducing the volume of the solvent using an air jet. The resulting crystals start decomposing at about 260°, and melted with decomposition at 298°.

Anal. Calcd. for $C_{12}H_{15}N_5O$: C, 58.76; H, 6.16; N, 28.56. Found: C, 58.70; H, 5.88; N, 27.82.[16]

R_f value in pyridine:2,6-lutidine:water (3:3:4) was 0.85. The spot was observed using a 365 mμ ultraviolet light source, and was strongly fluorescent. The other solvent systems tried carried the compound to the solvent front, and were discarded. This derivative was chromatographically different from its isomer prepared below, as evidenced by overlay techniques in the solvent system indicated above. The ultraviolet absorption spectrum is presented elsewhere.

4-Amino-6-cyclohexyl-7-hydroxypteridine. A sample of 156 mg. of cyclohexaneglyoxylic acid in 5 ml. of ethyl alcohol was added to a solution of 125 mg. of 4,5,6-triaminopyrimidine dissolved in 40 ml. of acetate buffer at *p*H 5. The reaction mixture was stirred at room temperature for about 2 hr., and then heated an additional 2 hr. on a steam cone; after which, the volume was reduced to about one half the original, and a precipitate formed. The product was filtered, washed with a small volume of cold water, and recrystallized from ethyl alcohol–water to yield 7.0 mg. of material, m.p. 330–332° dec.

Anal. Calcd. for $C_{12}H_{15}N_5O$: C, 58.76; H, 6.16; N, 28.56. Found: C, 58.05; H, 6.38; N, 28.36.

R_f value in pyridine:2,6-lutidine:water (3:3:4) was 0.93. Using a 365 mμ ultraviolet lamp, the spot was observed as a weak bluish fluorescent spot. After being irradiated with a 254 mμ light source for several minutes, the intensity of fluorescence at 365 mμ increased until it was comparable to the isomeric 6-hydroxy derivative described above. The ultraviolet absorption spectrum of this compound is presented elsewhere.

4-Amino-7-cyclopentyl-6-hydroxypteridine. To a solution of 4,5,6-triaminopyrimidine dissolved in 40 ml. of 2*N* sulfuric acid was added 142 g. of cyclopentaneglyoxylic acid dissolved in 5 ml. of ethyl alcohol. The reaction mixture was stirred at room temperature for about 2 hr., and then heated for 1 hr. over a steam cone. After cooling, it was taken to *p*H 5 with 10% potassium hydroxide, cooled in an ice bath, and the resulting light yellow precipitate which formed was collected, washed with cold water, and dried *in vacuo*. There was recovered 176 mg. of product, which was recrystallized from ethyl alcohol–water until a constant ultraviolet spectrum was obtained, m.p. 260°.

Anal. Calcd. for $C_{11}H_{13}N_5O$: N, 30.29. Found: N, 30.62.

Ultraviolet Absorption Spectra of Some Substituted-4-Aminopteridines

Substituent Groups	λ_{max}, mμ *p*H 1	λ_{max}, mμ *p*H 11	λ_{min}, mμ *p*H 1	λ_{min}, mμ *p*H 11
7-Cyclohexyl-6-hydroxy-	355, 339	362	348	304
	243	253	292, 225	235
6-Cyclohexyl-7-hydroxy-	324	328		
	293	231	259	273
7-Cyclopentyl-6-hydroxy-	352, 338	360	349	303
		252	295	236

Austin, Tex.

(16) Nitrogen analyses of hydroxy- and amino-pteridines frequently give low values due to a difficulty in burning, A. Albert, *Quart. Rev. Chem. Soc.*, VI, No. 3, 1952, p. 198.