Raney Nickel Desulfurization of DL-III.—A solution of 0.80 g. of DL-1,4-thiazane-3-carboxylic acid in 250 ml. of 80% ethanol containing 20 ml. of Raney nickel suspension[11] was refluxed for 6 hr. It was then filtered through a layer of filter aid and the filter cake was washed with 600 ml. of 1:10 aqueous ammonia. After removal of ammonia *in vacuo* and precipitation of nickel with hydrogen sulfide, the final solution was concentrated *in vacuo* to an oil which was dissolved in 85% ethanol. Evaporation of the solution yielded 100 mg. of N-ethyl-D,L-alanine as small plates. Paper chromatography with butanol–acetic acid–water and collidine–lutidine gave the same R_f as for the authentic synthetic compound. The infrared spectrum (potassium bromide disk) was identical with that of a synthetic specimen.

Cyclohexylamine Salt of N-2,4-Dinitrophenyl-L-1,4-thiazane-3-carboxylic Acid.—The dinitrophenyl derivative was prepared as previously described[12] from 0.5 g. of the amino acid. After abortive attempts to crystallize, the compound was converted to the cyclohexylamine salt[12] which was crystallized from acetone as long yellow needles (0.98 g.), m.p. 185° dec., $[\alpha]^{25}D$ −135.8 (*c* 2, acetic acid).

Anal. Calcd. for $C_{17}H_{24}N_4O_6S$: C, 49.50; H, 5.86; S, 7.77. Found: C, 49.2; H, 5.83; S, 7.89.

(+)-L-1,4-Thiazane-3-carboxylic Acid 1-Oxide (Chondrine, IV).—To a suspension of 2.344 g. (0.0159 mole) of L-1,4-thiazane-3-carboxylic acid (III) in 35 ml. of acetic acid, 1.2 ml. of 30% hydrogen peroxide was added in 0.2-ml. portions over a period of 3 hr. with continuous stirring at 25°. The solution was allowed to stand overnight at room temperature and was then concentrated *in vacuo* to an oil. Crystallization from a mixture of 40 ml. of water and 140 ml. of acetone yielded 1.78 g. of product, $[\alpha]^{25}D$ +9.57. A second crop was obtained, 0.656 g., $[\alpha]^{15}D$ +2.35. Infrared (potassium bromide disk) showed typical sulfoxide absorption at 9.7–9.8 μ and no sulfone absorption for each fraction. Paper chromatography with two solvent systems showed only one ninhydrin-active spot. Five recrystallizations of the more dextrorotatory fraction from a combination of 20 parts of water and 40–50 parts of ethanol at 0° yielded 160 mg. (least soluble fraction) of (+)-L-1,4-thiazane-3-carboxylic acid 1-oxide, m.p. 252° dec. (sealed capillary), $[\alpha]^{26}D$ +19.0 (*c* 1, water).[13]

Anal. Calcd. for $C_5H_9NO_3S$: C, 36.81; H, 5.52; N, 8.59; S, 19.63. Found: C, 36.5; H, 5.64; N, 8.45; S, 19.6.

Paper chromatography with collidine–lutidine (1:3, saturated with water) at 25° gave the relative R_f with respect to alanine of 1.36. With butanol–acetic acid–water (52:13:35), the relative R_f was 0.80.

Acknowledgment.—We are indebted to L. M. White and Geraldine Secor for elemental analyses.

(11) R. Mozingo, *Org. Syn.*, **21**, 15 (1941).

(12) J. F. Carson and F. F. Wong, *J. Org. Chem.*, **26**, 4997 (1961).

(13) Kuriyama, *et al.* (ref. 3), report $[\alpha]^{16}D$ +20.91 (water) for the naturally occurring sulfoxide "chondrine."

The Multicentered Reactivity of Pseudoxazolones

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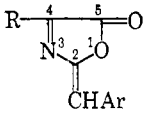
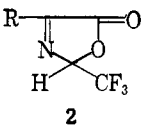
Received December 2, 1963

2-Arylidene pseudoxazolones possess several reactive sites for nucleophilic attack. The hydrolysis, aminolysis, and catalytic hydrogenation of these compounds are discussed and their behavior toward lithium aluminum hydride, phenylmagnesium bromide, and benzene under Friedel–Crafts conditions is reported. The attempted preparation of the linearly conjugated 2-benzylidene-4-benzyl-5(2H)-oxazolone gives instead the cross-conjugated 2-benzyl-4-benzylidene-5(4H)-oxazolone.

In recent years, there has been considerable impetus in the study of pseudoxazolones,[2] the 5(2H) isomers of the familiar 5(4H)-oxazolones or azlactones. Two classes of pseudoxazolones have been investigated,[3] the 2-arylidene type (**1**), the subject of this paper, and the 2-trifluoromethyl compounds (**2**), which Weygand and co-workers[4] have examined for the synthesis of α-keto acids and peptides.

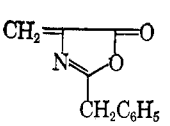


1



2

The only member of the 2-arylidene series to receive much attention has been 2-benzylidene-4-methyl-5-(2H)-oxazolone (**1a**, R = CH_3; Ar = C_6H_5). It is conveniently prepared by ring closure of either 2-phenylacetamido-3-bromopropionic acid[5] or N-(α-halophenylacetyl)alanine.[6,7] Recently, we have shown[8] that this pseudoxazolone, when exposed to light, slowly forms a dimer having a cyclobutane structure. Although the ultraviolet spectrum of **1a** supports the 5(2H) formulation rather than the isomeric 5(4H) form (**3**), the chemical evidence has been indecisive.[7] The formation of the photodimer now provides support for the 5(2H) structure.



3

Since the pseudoxazolones possess several potential sites for chemical attack, we have explored the chemistry of these compounds in order to shed further light on their reactivity.

Discussion and Results

While the 2-arylidene linkage is the reactive center for photodimerization and for attack by weak nucleo-

(1) Abstracted from the Ph.D. Thesis of E. J. Piasek, June, 1962.

(2) The *Chemical Abstracts* nomenclature for this system is 3-oxazolin-5-one.

(3) For a detailed discussion of pseudoxazolones, see R. Filler, "Advances in Heterocyclic Chemistry," Vol. IV, A. R. Katritzky, Ed., Academic Press, New York, N. Y., 1964, in press.

(4) F. Weygand and U. Glockler, *Chem. Ber.*, **89**, 653 (1956); F. Weygand and W. Steglich, *Angew. Chem.*, **73**, 433 (1961); F. Weygand, W. Steglich, and H. Tanner, *Ann.*, **658**, 128 (1962); F. Weygand, A. Prox, L. Schmidhammer, and W. Konig, *Angew. Chem., Intern. Ed. Engl.*, **2**, 183 (1963).

(5) I. L. Knunyants and V. V. Shokina, *Bull. Acad. Sci. USSR, Div. Chem. Sci.*, 409 (1955).

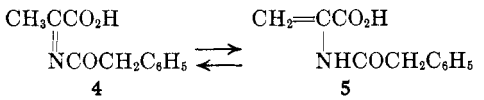
(6) M. Bergmann and F. Stern, *Ann.*, **448**, 20 (1926).

(7) J. A. King and F. H. McMillan, *J. Am. Chem. Soc.*, **72**, 833 (1950).

(8) R. Filler and E. J. Piasek, *J. Org. Chem.*, **28**, 221 (1963).

philes,[9] the principal sites of attack by most nucleophiles are the 4- and 5-positions. Reaction at the lactone carbonyl leads to open-chain acids and their derivatives. Addition to the >C=N linkage, as well as ring opening may occur, and occasionally, fragmentation at the carbon-nitrogen bond is also observed.

Hydrolysis.—Compound **1a** is hydrolyzed rapidly in acidic, basic, or neutral media to form pyruvic acid and phenylacetamide (or phenylacetic acid). Even atmospheric moisture is sufficient to cause some hydrolysis after several weeks (as well as dimerization[8]). The precursor of these products undoubtedly is the imido acid (**4**), which probably exhibits triad prototropy with 2-phenylacetamidoacrylic acid (**5**). In dilute sodium hydroxide solution, a small amount of **5** accompanies the products of >C=N cleavage.[10]

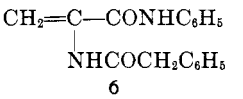


4 **5**

With the 4-unsubstituted pseudoxazolone[11] (**1b**, Ar = C_6H_5; R = H), prepared from N-(α-bromophenylacetyl)glycine, such prototropic shifts cannot occur. The instability of this compound is characterized by formation of a dark, resinous material with dilute sodium hydroxide and decomposition to a charred mass on brief exposure to air. With hydrochloric acid, an acidic substance[12] is obtained.

Aminolysis.—It has been reported[11] that **1a** reacts with benzylamine to form a product by addition of two molecules of amine, but no experimental data were presented. In our hands, this reaction gave phenylacetamide (79%) and a small amount of material, believed to be pyruvic benzylamide, isolated as its 2,4-dinitrophenylhydrazone. These products apparently arise by hydrolytic cleavage of the imidoamide, perhaps from traces of water.

The reports[11,13a] that **1a** fails to react with aniline in boiling xylene seemed to us most surprising, although it was found[11] that reaction proceeds in methanol (containing N-ethylpiperidine) to give methyl 2-anilino-2-phenylacetamidopropionate.[13b] We have observed that **1a** does, indeed, react with aniline in refluxing benzene to give, in 45% yield, a product which absorbs bromine without evolution of HBr and whose analytical data and infrared spectrum are compatible with the anilide structure (**6**).[14]



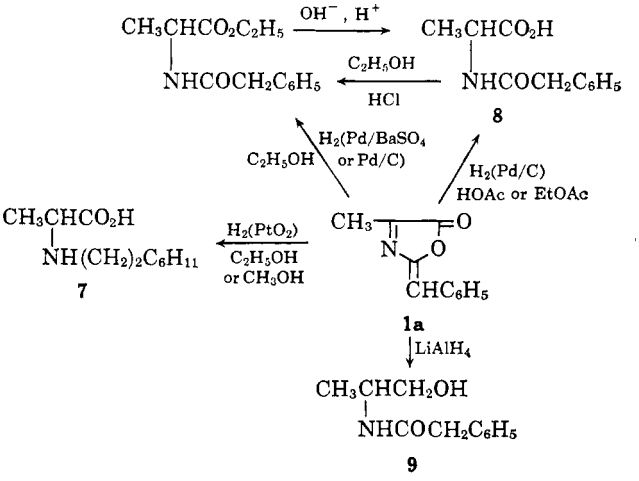
6

Hydrogenation.—The results of our studies on the reduction of **1a** are summarized in Scheme I. The pseudoxazolone is hydrogenated under catalytic conditions, but the 2-benzyl-4-methyl-5(4H)-oxazolone formed initially[15] is solvolyzed readily to open-chain reduction products. Of particular interest is compound **7**, obtained with platinum oxide catalyst.

In methanol and ethanol, the system (including the aromatic ring) is completely reduced to the α-amino acid, which shows the expected amphoteric properties (acid–base solubility and infrared spectra).

SCHEME I

REDUCTION OF 2-BENZYLIDENE-4-METHYL-5(2H)-OXAZOLONE



Attempts to prepare the azlactone by cyclization of **8** resulted in an oil of complex composition, but a prominent band at 1800 cm.$^{-1}$ is indicative of the presence of oxazolone.

The reaction of **1a** with lithium aluminum hydride is attended by reduction at both the >C=N and lactone >C=O groups with formation of the amido alcohol (**9**).

Reaction with Grignard Reagent.—Phenylmagnesium bromide and phenyl lithium attack the carbonyl group of **1a**. The structure of the product has not been clearly established, although its infrared spectrum suggests the presence of –OH, –NH, and aryl ketone groups. Further studies on this reaction are in progress.

Reaction with Benzene (Aluminum Chloride).—The reaction of **1a** with benzene under Friedel–Crafts conditions was complex and failed to yield any identifiable product. From **1b**, however, the acylamino ketone (**10**) was isolated. Two molecules of benzene are incorpo-

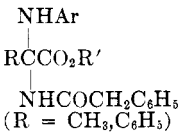
(9) O. V. Kil'disheva, M. G. Lin'kova, and I. L. Knunyants, *Izv. Akad. Nauk SSSR, Otd. Khim. Nauk*, 719 (1957).

(10) King and McMillan (ref. 7) were also able to isolate compound **5** after hydrolysis with 5% sodium carbonate solution or with dilute ammonia. We obtained only cleavage products with sodium carbonate.

(11) "The Chemistry of Penicillin," H. T. Clarke, J. R. Johnson, and R. Robinson, Ed., Princeton University Press, Princeton, N. J., 1949, pp. 739–741.

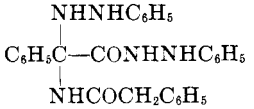
(12) We have not established the structure of this substance. On alkaline hydrolysis, phenylacetamide was obtained.

(13) (a) M. Brenner and K. Rüfenacht, *Helv. Chim. Acta*, **37**, 203 (1954). (b) NOTE ADDED IN PROOF.—It has been reported very recently [A. Mustafa, M. K. Hilmy, A. E. Sammour, and M. M. N. Eldeen, *Tetrahedron*, **20**, 1063 (1964)] that **1a** and its 4-phenyl analog react with aryl amines in alcohols to give compounds of the following type.



(R = CH_3, C_6H_5)

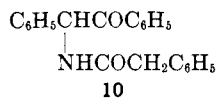
The phenyl analog and excess phenylhydrazine gave a product for which structure A has been proposed.



(14) Brenner and Rüfenacht[13] reported the isolation of **6**, m.p. 139–142°, in 9% yield and **1a** as the major product in the reaction of **5** with ethyl chloroformate and aniline. Our product had m.p. 112–115°.

(15) Reduction in the presence of Raney nickel and ethyl acetate solvent gave the 5(4H)-oxazolone.[11] In methanol, methyl 2-phenylacetamidopropionate was isolated. This oxazolone could be formed by hydrogenation of either the >C=C< or >C=N— bonds, followed by a 1,3-proton shift.

rated and it is reasonable to postulate the 1,4-addition of benzene to the >C=N—C=C— chain, followed by acylation of the 2-benzyl-4-phenyl-5(4H)-oxazolone formed initially. Azlactones *acrylate* benzene readily under these conditions.[3,16,17]



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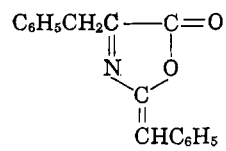
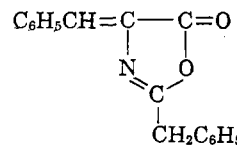
5(2H)-5(4H) Equilibrium.—While the possibility of a rapid equilibrium between the 5(2H)- and 5(4H)-oxazolones cannot be excluded, Knunyants[9] has concluded that the preferred structure is the one which permits the most extended conjugation. The evidence cited earlier in the present paper in favor of the 5(2H) structure for **1a** tends to support Knunyants' postulate. In this connection, it seemed desirable to investigate the isomeric pair, **11** and **12.**



11



12

The pseudoxazolone contains a linear conjugated chain of three double bonds and a terminal aromatic ring. The azlactone also possesses these features, but in a cross-conjugated arrangement. The structures may be differentiated by positions of maxima in the ultraviolet region. Compound **11** should absorb near 355 mμ and **12,** near 330 mμ.[18]

Compound **12** was obtained from benzaldehyde and phenaceturic acid.[19] In an attempt to prepare **11** by cyclization of N-(α-chlorophenylacetyl)phenylalanine in acetic anhydride–pyridine, only **12,** λ_{max}^{EtOH} 331 mμ, was obtained. Compound **12** is readily solvolyzed in ethanol to the open-chain ester, λ_{max}^{EtOH} 282 mμ, a behavior typical of the 5(4H)-oxazolones.[18]

We conclude, therefore, that the cross-conjugated oxazolone **12** is the thermodynamically stable isomer.

Experimental[20]

2-Benzylidene-4-methyl-5(2H)-oxazolone (1a).—This compound was prepared according to a procedure described previously.[8]

Hydrolysis of Pseudoxazolone (1a). 1. With Sodium Hydroxide.—One gram (5.3 mmoles) of **1a** in 20 ml. of 1.5% sodium hydroxide was allowed to stand for 40 min. with occasional shaking to yield, after filtration, 0.06 g. (8.3%) of phenylacetamide, m.p. 156°. Acidification of the filtrate and concentration by air blowing gave 0.04 g. (3.6%) of α-phenylacetamidoacrylic acid, m.p. 168° (lit.[7] m.p. 166°); ν^{CHCl_3} 3310, 1710, 1675, and 1630 cm.$^{-1}$. The filtrate reacted with 2,4-dinitrophenylhydrazine to give pyruvic acid 2,4-dinitrophenylhydrazone, m.p. 215°.

With 10% NaOH, a 41% yield of phenylacetamide, m.p. 157–158°, was obtained. When the reaction was allowed to proceed for 36 hr. and the solution acidified with 20% HCl, phenylacetic acid, m.p. 76–77°, was isolated in 41.2% yield and pyruvic acid was recovered from the filtrate as its 2,4-dinitrophenylhydrazone.

2. With Sodium Carbonate.—Reaction of **1a** with 5% Na_2CO_3 solution at room temperature for 10 hr. gave phenylacetamide in 57% yield.

3. With Water.—The pseudoxazolone was heated on a steam bath with water for 10 hr. After cooling, a 41% yield of phenylacetamide was obtained.

4. With Hydrochloric Acid.—Reaction of the pseudoxazolone with 10% HCl at room temperature for 24 hr. furnished phenylacetic acid in 40% yield.

5. In Air.—Pseudoxazolone was exposed to the atmosphere for 1 month. A white solid, m.p. 140–185°, formed. One gram of this solid in 20 ml. of benzene was chromatographed on an alumina column. Pseudoxazolone and its dimer[8] were eluted with a large excess of benzene. From the methanol eluate, 60 mg. of phenylacetamide was obtained.

Hydrogenation of 1a.—A solution of **1a** in 95% ethanol was hydrogenated for 48 hr. at 40 p.s i. in the presence of 10% palladium-on-charcoal catalyst to give an oil (ν 3300, 1745, and 1685 cm.$^{-1}$) believed to be ethyl α-phenylacetamidopropionate. The oil was allowed to stand overnight at room temperature with 10% sodium hydroxide solution. The solution was acidified with 10% HCl and the resulting solid crystallized from ethyl acetate–methanol to give α-phenylacetamidopropionic acid, m.p. 150°. Similar results were obtained with palladium ($BaSO_4$) catalyst in ethanol.

When reduction was carried out in glacial acetic acid, α-phenylacetamidopropionic acid (m.p. 153–154°; ν^{KBr} 3200, 1715, and 1650 cm.$^{-1}$) was isolated in 35% yield.

Anal. Calcd. for $C_{11}H_{13}NO_3$: C, 63.75; H, 6.32. Found: C, 63.75; H, 6.50.

This acid was converted to the ethyl ester (*vida supra*) on treatment with ethanol and dry hydrogen chloride.

The reduction of **1a** in ethanol or methanol in the presence of platinum oxide catalyst furnished the amino acid **7.** This amorphous solid was purified by dissolving it in a large volume of ethanol at room temperature and reducing the volume by evaporation under vacuum, yield 24%, m.p. 268–270°, ν^{KBr} 2950 and 1585 cm.$^{-1}$, soluble in acid and base.

Anal. Calcd. for $C_{11}H_{21}NO_2$: C, 66.29; H, 10.62; N, 7.03. Found: C, 66.43; H, 10.54; N, 7.25.

Reduction of 1a with Lithium Aluminum Hydride.—A slurry of 1.64 g. (0.0432 mole) of lithium aluminum hydride in 125 ml. of anhydrous ether was agitated and heated under reflux for 45 min. Pseudoxazolone (4 g., 0.021 mole) in 250 ml. of anhydrous ether was added cautiously during a 15 min. period. The reaction mixture was refluxed for 2.5 hr., then decomposed with 50 ml. of wet ether, followed by 5 ml. of water. The white suspension was filtered under suction and the filter cake washed with 30 ml. of ether. The ether solution, dried over anhydrous magnesium sulfate, was evaporated by air blowing to an amorphous residue, $\nu^{CH_2Cl_2}$ 3300 and 1600 cm.$^{-1}$, which was dried at 80° (1 mm.) for 1.5 hr. The residue was treated with 8 ml. of phenyl isocyanate and heated on a hot plate at 80° for 5–10 min. The solution was placed in a freezer overnight and a white solid separated. It was filtered under suction, washed with ethyl acetate, and air-dried. A solid, m.p. 160–180°, was obtained, which when crystallized twice from ethyl acetate gave 2.0 g. (30%) of the urethan of **9,** m.p. 142–144°; ν^{KBr} 3250, 1700, and 1640 cm.$^{-1}$.

Anal. Calcd. for $C_{18}H_{20}N_2O_3$: C, 69.21; H, 6.45. Found: C, 69.18; H, 6.56.

Reaction of 1a with Benzylamine.—A solution of 1 g. (5.25 mmoles) of pseudoxazolone in 13 ml. of dry benzene, containing 1 ml. of benzylamine, was refluxed for 1 hr. A white solid (0.30 g.), m.p. 158–160°, separated as the mixture cooled. The volume of filtrate was brought up to 13 ml. with benzene and refluxed for 2 hr. to yield an additional 0.26 g. of solid. Thus, 0.56 g. (79%) of product was obtained. It crystallized from ethyl acetate as transparent platelets, m.p. 160–161°; ν^{KBr} 3200, 3070, and 1640 cm.$^{-1}$.

Anal. Calcd. for C_8H_9NO: C, 71.09; H, 6.71. Found: C, 71.42; H, 6.74.

No depression in melting point was observed upon admixture of the product with an authentic sample of phenylacetamide.

The filtrate was dissolved in a large volume of ether and extracted with 17 ml. of 5% hydrochloric acid, followed by water. A droplet of oil separated at the ether–acid interface, but the addition of several milliliters of methanol dissolved the oil. The

(16) E. Cioránescu, L. Birladeanu, and R. Sternberg, *Izv. Akad. Nauk SSSR, Otd. Khim. Nauk,* 144 (1961).

(17) R. Filler and Y. S. Rao, *J. Org. Chem.,* **27,** 2403 (1962), and references therein.

(18) R. Filler and H. Novar, *ibid.,* **25,** 663 (1960), and references therein.

(19) E. Erlenmeyer, *Chem. Ber.,* **31,** 2239 (1898).

(20) Melting points are corrected and boiling points uncorrected. Analyses were conducted by Micro-Tech Laboratories, Skokie, Ill. Infrared spectra were measured on a Perkin-Elmer 21 spectrophotometer using sodium chloride optics and ultraviolet spectra were determined on a Beckman DK-2 spectrophotometer.

ether solution was dried over anhydrous magnesium sulfate and concentrated by evaporation to an amorphous residue, which was dissolved in ethanol and treated with 2,4-dinitrophenylhydrazine. A small amount of orange solid (*ca.* 20 mg.), m.p. 210–240°, precipitated.

Two crystallizations from benzene gave several milligrams of solid, m.p. 245–247°, believed to be pyruvic benzylamide 2,4-dinitrophenylhydrazone.

Reaction of 1a with Aniline.—To 1 ml. of aniline (freshly distilled) in 5 ml. of dry benzene was added 0.5 g. (2.67 mmoles) of pseudoxazolone and the solution refluxed for 0.5 hr. Evaporation of the solution under vacuum gave an oil, which solidified to a yellow-green amorphous solid. Suspension of the solid in petroleum ether (b.p. 40–60°) and suction filtration gave a cream-colored solid, m.p. 80–110°. The product was crystallized from ethanol to yield white crystals, m.p. 114–118°. A second crystallization gave 0.34 g. (45%) of anilide **6**, m.p. 112–115°; ν^{KBr} 3355, 1687, 1635, and 1600 cm.$^{-1}$.

Anal. Calcd. for $C_{17}H_{16}N_2O_2$: C, 72.83; H, 5.75. Found: C, 73.19; H, 6.46.

The product was insoluble in alkali and decolorized a solution of bromine in carbon tetrachloride.

Grignard Reaction of 1a.—The Grignard reagent was prepared from 1.08 g. (0.045 mole) of magnesium and 4.72 ml. (0.045 mole) of bromobenzene in 100 ml. of anhydrous ether. To this reagent was added a suspension of 2.8 g. (0.015 mole) of pseudoxazolone in 100 ml. of anhydrous ether over a 15-min. period. When approximately one-half of the suspension had been added, a tan-colored solid separated from the reaction mixture. The mixture was refluxed and stirred for 30 hr., but the solid did not dissolve. This mixture was hydrolyzed with 18% hydrochloric acid; the ether layer separated, was washed with several portions of water, and dried over anhydrous magnesium sulfate. Evaporation of the ether gave an amorphous product, which dissolved in chloroform and precipitated with petroleum ether to yield 2.2 g. of solid, m.p. 90–95°. The product was soluble in most organic solvents and could only be purified by repeated chloroform–petroleum ether precipitations until a constant melting product, m.p. 104–106°, was obtained; λ_{max}^{EtOH} end absorption; $\nu^{CH_2Cl_2}$ 3450, 3310, and 1695 cm.$^{-1}$.

Anal. Calcd. for $C_{17}H_{17}NO_3$: C, 72.06; H, 6.05; N, 4.94. Found: C, 73.06; H, 6.03; N, 4.79.

Attempts to prepare a 3,5-dinitrobenzoate, oxime, and urethan derivative were unsuccessful. 2,4-Dinitrophenylhydrazine gave a crude, dark brown solid, m.p. 158–170°, which could not be purified.

The same product was obtained when tetrahydrofuran replaced ether, or when inverse addition was employed. With phenyllithium, the yield of this product was lower.

N-(α-Chlorophenylacetyl)phenylalanine.—To a solution of 2.5 g. (0.062 mole) of sodium hydroxide in 150 ml. of water was added 5 g. (0.03 mole) of *dl*-phenylalanine. The suspension was stirred magnetically and when the amino acid had dissolved cooled to 8°, α-chlorophenylacetyl chloride (5.7 g., 0.03 mole) was added dropwise, the clear solution extracted with 20 ml. of ether, and the aqueous layer acidified with 300 ml. of chloroform. The chloroform solution was washed with two 100-ml. portions of water, dried over anhydrous magnesium sulfate, and evaporated on a steam bath until the volume was reduced by one-fourth. After refrigeration for several hours, a white solid was obtained, which was washed with chloroform and air-dried. N-Substituted phenylalanine (4.13 g., 42%), m.p. 123–150°, was obtained. Two crystallizations of the solid from chloroform gave a product, m.p. 142–162°.

Anal. Calcd. for $C_{17}H_{16}ClNO_3$: C, 64.25; H, 5.08. Found: C, 64.45; H, 5.50.

2-Benzyl-4-benzylidene-5(4H)-oxazolone (**12**).—One gram of the substituted alanine was dissolved in a solution of 2.5 ml. of pyridine and 12 ml. of acetic anhyride. After 25 min. the deep red solution was poured over ice. A dense oily layer with occluded solid formed on the bottom of the flask. The aqueous layer was decanted and the residue treated with enough ethanol (50%) to dissolve the oil and to yield 0.62 g. (44%) of yellow solid, m.p. 108–111°. Crystallization from carbon tetrachloride gave white needles, m.p. 109–112° (lit.[19] m.p. 105°); λ_{max}^{EtOH} 331 mμ (after several days, 282 mμ, ε 19,300); ν^{KBr} 1784, 1800 sh, and 1655 cm.$^{-1}$.

Anal. Calcd. for $C_{17}H_{13}NO_2$: C, 77.55; H, 4.98. Found: C, 77.74; H, 5.11.

Sublimation of the oxazolone at 90° (1 mm.) for 24 hr. gave a long-needled, transparent solid, m.p. 110–112°, ν^{KBr} 1784 and 1800 sh cm.$^{-1}$.

Phenaceturic Acid.—The N-substituted glycine was prepared by dropwise addition of 4.14 g. of phenacetyl chloride to an alkaline solution (2.14 g. of sodium hydroxide in 40 ml. of water) of glycine (2 g.), maintained at 10°. The reaction mixture, after extraction with ether, was acidified with 10 ml. of 18% hydrochloric acid. A white solid (2.68 g., 52%), m.p. 148–150° (lit.[21] m.p. 143° for phenaceturic acid), was collected on a Büchner funnel and had ν^{KBr} 3378, 1725, and 1608 cm.$^{-1}$.

2-Benzyl-4-benzylidene-5(4H)-oxazolone from Phenaceturic Acid.—Two grams of the acid were added to 1.1 ml. of benzaldehyde in 2.2 ml. of acetic anhydride, containing 0.8 g. of sodium acetate. The mixture was heated on a steam bath for 1 hr. Ice was added and an amorphous solid settled to the bottom of the flask. The aqueous solution was decanted and several milliliters of ethanol was added to the residue. The mixture was filtered under suction; the filter cake was washed with several milliliters of ethanol. Colorless crystals were obtained, m.p. 108–111°, which did not depress the melting point of the product prepared by the Bergmann synthesis.

2-Benzylidene-5(2H)-oxazolone (**1b**).—This pseudoxazolone was prepared by cyclization of N-(α-chlorophenylacetyl)glycine according to a procedure described previously.[11]

Hydrolysis of 1b.—To 250 mg. of pseudoxazolone was added 19 ml. of 0.1 *N* sodium hydroxide. After 10 min., the solution had turned deep red. Acidification gave an emulsion which was extracted with 1-butanol. Evaporation of the solvent yielded a dark viscous residue.

Reaction of 1b under Friedel–Crafts Conditions.—One gram of **1b** in 25 ml. of dry benzene was added dropwise to a stirred slurry of 2.32 g. of anhydrous aluminum chloride in 50 ml. of dry benzene. After the solution had been stirred for 30 min., 12 ml. of 18% hydrochloric acid was added. The mixture was filtered under suction to yield 0.30 g. of product, m.p. 137–160°. Two crystallizations from ethanol gave the acylamino ketone **10**, m.p. 142–143.5°; ν^{KBr} 3300, 1690, and 1650 cm.$^{-1}$.

Anal. Calcd. for $C_{22}H_{19}NO_2$: C, 80.22; H, 5.81. Found: C, 79.84; H, 6.06.

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