lactone (m.p. 179–180°) in 80% yield by the method of Beschke.[8b] Upon treatment of the monolactone with alcoholic sodium hydroxide as described by Beschke[8b] for its ethyl ester, disodium β,β'-diphenylmuconate was obtained.

1,4-Dibenzoyl-2,3-diphenyl-1,3-butadiene (III). Phenyllithium was prepared from 1.7 g. (0.011 mole) of bromobenzene and 0.16 g. (0.023 mole) of lithium in 30 ml. of dry ether by the procedure of Evans and Allen.[14] To this solution was added 1 g. (0.003 mole) of disodium β,β'-diphenylmuconate (VI) and the resulting mixture was refluxed, with stirring, for 5 hours, after which time it was poured onto ice. The resulting mixture was extracted with ether, and the ether extract was dried and evaporated to 10 ml. The precipitated product weighed 0.2 g. (16% yield) and melted at 190–191°. It showed no melting point depression in admixture with the dibenzoyldiphenylbutadiene of Wislicenus and Lehmann.[3]

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(14) Evans and Allen in Blatt, *Org. Syntheses*, Coll. Vol. 2, 517 (1943).

Derivatives of 3,4,5-Trimethoxybenzamide[1]

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Received March 7, 1956

In the course of an investigation, involving the evaluation of qualitative and quantitative effects of certain radicals and functional groups upon the pharmacological action of mescaline, we have prepared several arylalkylamides of 3,4,5-trimethoxybenzoic acid. The pharmacological evaluation of these compounds is in progress.

EXPERIMENTAL

(All melting points are uncorrected. Microanalyses by Drs. G. Weiler and F. B. Strauss, Oxford, England. The compounds were obtained in their highest state of purity in 30 to 40% yields.)

dl-[N-(α-Methylbenzyl)-3,4,5-trimethoxybenzamide] (I). The 3,4,5-trimethoxybenzoyl chloride was prepared by using a modification of the Marsh and Stephen procedure.[2] To 12 g. (0.0565 mole) of 3,4,5-trimethoxybenzoic acid, dispersed in 200 ml. of anhydrous benzene, 67 g. (0.565 mole) of thionyl chloride was added. The resulting mixture was heated on the water-bath (50°) until a clear solution was obtained and the latter was refluxed for 30 minutes to 1 hour on the steam-bath. The excess thionyl chloride and the benzene were removed under reduced pressure (max. pot temp. 40°). The residual thionyl chloride was removed by azeotropic distillation under reduced pressure with two 100-ml. portions of anhydrous benzene. The residue was taken up in 400 ml. of anhydrous benzene and 35 g. (0.289 mole) of *dl*-(α-methylbenzylamine), in 100 ml. of anhydrous benzene, was added gradually. The contents of the reaction vessel were refluxed for 8 hours on the steam-bath. The reaction mixture was cooled to 20° and treated with cold 40% aqueous potassium hydroxide. The benzene layer was drawn off, dried over magnesium sulfate, filtered, and the benzene was removed under reduced pressure. The white crystalline residue was recrystallized thrice from benzene. The crystals melted at 177.5–178.0°.

Anal. Calc'd for $C_{18}H_{21}NO_4$: C, 68.54; H, 6.71; N, 4.44. Found: C, 68.74; H, 6.71; N, 4.40.

N-Phenethyl-3,4,5-trimethoxybenzamide (II). The acid chloride of 3,4,5-trimethoxybenzoic acid (12 g., 0.0565 mole) was prepared as above. To the acid chloride, dissolved in 400 ml. of anhydrous benzene, 35 g. (0.289 mole) of phenethylamine in 100 ml. of anhydrous benzene, was added gradually. The resulting mixture was heated for 3 hours on the water-bath (50°). The reaction mixture was cooled to 20° and the phenethylamine hydrochloride formed during the reaction was filtered off. The benzene solution was washed with cold 40% aqueous potassium hydroxide, dried over magnesium sulfate, filtered, and the benzene was removed under reduced pressure. The crystalline residue was three times recrystallized from benzene. The white crystals melted at 122.0–123.0°.

Anal. Calc'd for $C_{18}H_{21}NO_4$: C, 68.54; H, 6.71; N, 4.44. Found: C, 68.46; H, 6.71; N, 4.42.

N-(3,4-Dimethoxyphenethyl)-3,4,5-trimethoxybenzamide (III). The acid chloride of 3,4,5-trimethoxybenzoic acid (12 g., 0.0565 mole) was prepared as above. To the acid chloride, 12 g. (0.0665 mole) of 3,4-dimethoxyphenethylamine, dispersed in 200 ml. of 15% aqueous sodium hydroxide, was added. The reaction mixture was heated for 2 hours on the water-bath (50°), while applying vigorous stirring. The precipitate formed during the reaction was filtered off, washed with water, and the residual moisture was removed by azeotropic distillation under reduced pressure with two 300-ml. portions of anhydrous benzene. The product was three times recrystallized from benzene. The white crystals melted at 133.0–133.4°.

Anal. Calc'd for $C_{20}H_{25}NO_6$: C, 63.98; H, 6.71; N, 3.73. Found: C, 64.03; H, 6.74; N, 3.84.

N-(3,4,5-Trimethoxyphenethyl)-3,4,5-trimethoxybenzamide (IV). The acid chloride of 3,4,5-trimethoxybenzoic acid (4.5 g., 0.0212 mole) was prepared as above. To the acid chloride, 4.5 g. (0.0182 mole) of 3,4,5-trimethoxyphenethylamine hydrochloride, dispersed in 100 ml. of 15% aqueous sodium hydroxide, was added. The reaction mixture was heated for 4 hours on the water-bath (50°), while applying vigorous stirring. The precipitate formed during the reaction was filtered off and washed with water. The air-dried product was recrystallized thrice from a benzene-ethanol solvent system. The white crystals melted at 180.5–181.0°.

Anal. Calc'd for $C_{21}H_{27}NO_7$: C, 62.21; H, 6.71; N, 3.46. Found: C, 62.43; H, 6.76; N, 3.44.

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(1) This investigation is supported by grants from the Geschickter Foundation for Medical Research and the U. S. Public Health Service.

(2) J. T. Marsh and H. Stephen, *J. Chem. Soc.*, 127, 1635 (1925).

N-Benzylidenebenzylamine from Benzylamine and Butyl Nitrite

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When carefully dried benzylamine and butyl nitrite were mixed there was no apparent reaction, but in the presence of even a trace of water, a slow

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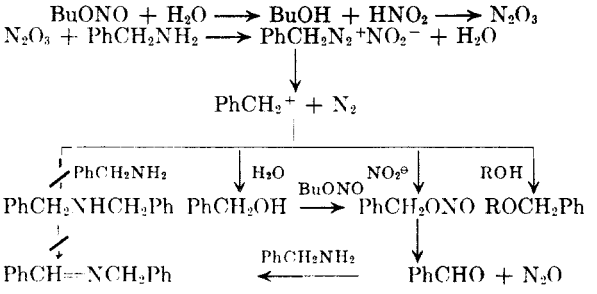
but steady evolution of gas began almost immediately. The principal liquid product of the reaction was N-benzylidenebenzylamine, which was identified by comparison of the solid bromo derivative with an authentic specimen, and by its ready hydrolysis to benzaldehyde. The recovered benzylamine contained a small amount of neutral material which was identified as benzyl *n*-butyl ether on the basis of its infrared absorption spectrum, since it does not readily form solid derivatives suitable for characterization. The evolved gas contained nitrous oxide which was also identified by infrared absorption. Any mechanism advanced for the reaction must explain the formation of all these products. The reactions considered are grouped in the flow sheet.



The observation that benzylamine and butyl nitrite do not react except in the presence of a trace of water agrees with the fact that aromatic amines such as aniline do not yield diazoaminobenzenes with methyl nitrite unless water is present.[2] The effective reagent, therefore, is not the ester but a hydrolysis product. In view of the recent work on diazotization, it is probably dinitrogen trioxide.[3] This can react with benzylamine in the same way as with an aromatic amine giving first the benzyldiazonium cation, which then decomposes to nitrogen and benzyl cation. In the presence of a large excess of water, displacement of a proton from the solvent leads to benzyl alcohol since no Whitmore shift or other rearrangement is possible. Benzyl alcohol is indeed the only organic product reported from the reaction of benzylamine and nitrous acid in aqueous medium.[4,5] Under the conditions used in this work, relatively little water is present. It seems reasonable to suppose that benzyl diazonium cation is still formed first, and that it again decomposes to benzyl cation and nitrogen, but other products than benzyl alcohol become possible. In particular, by displacement of a proton from an alcohol, benzyl cation can form a benzyl ether, and it appears most likely that the benzyl butyl ether observed has been formed in this way. Dibenzyl ether might also be formed in the same manner; however, it was not detected by infrared analysis.

Similarly, attack by the benzyl cation on benzylamine could form dibenzylamine, which might dehydrogenate to benzylidenebenzylamine. This dehydrogenation has been observed under quite different experimental conditions: in refluxing xylene in the presence of a hydrogenation catalyst, and with a stream of air continually passed.[6] Under the mild conditions used, butyl nitrite and dibenzylamine gave N-nitrosodibenzylamine, but no benzylidenebenzylamine was detected. Furthermore, since the residue from the distillation of the main reaction gave a negative Lieberman test, it is presumed that in this case no secondary amine was formed.[7]

Benzyl nitrite is another possible product, which could be formed either from benzyl cation and nitrite ion, or by exchange between benzyl alcohol and butyl nitrite. Such transalkylation is known to be rapid.[8] Benzyl nitrite has been reported as particularly unstable, even at room temperature.[8,9] This has been confirmed, and in addition it has been found that the products of this decomposition include both benzaldehyde and nitrous oxide. Although the detailed mechanism of this reaction is not yet known, it does enable a rational explanation to be given for the original observations. Benzyl nitrite is the essential intermediate, arising by either or both of the routes considered. Benzaldehyde from the autodecomposition of benzyl nitrite then forms the Schiff's base directly with excess benzylamine. An ionic mechanism is preferred for the diazotization, and subsequent reactions. An attempt to detect a radical mechanism by the addition of hydroquinone was frustrated by the intervention of two known reactions in sequence. The nitrite ester oxidized the hydroquinone through quinhydrone to quinone,[10] which then underwent nucleophilic substitution by benzylamine giving the known 2,5-bis-benzylamino-1,4-benzoquinone.[11] This effectively removed the hydroquinone from the system.

EXPERIMENTAL

All melting points and boiling points are uncorrected.

Benzylamine (0.1 mole; Eastman reagent grade) and *n*-butyl nitrite[12] (0.2 mole) were mixed without solvent and allowed to stand at room temperature (15–20°). Carefully dried reagents gave no gas evolution, but the addition of one drop of water led to an almost immediate steady evolution of gas. After three days unreacted ester and some water were removed under a vacuum without heating, and the residue was fractionated *in vacuo* through a semi-micro Vigreux column. Water and *n*-butyl alcohol were obtained

(2) Earl, private communication.
(3) Hughes, Ingold, and Ridd, *Nature*, **166**, 642 (1950).
(4) Ray and Datta, *J. Chem. Soc.*, **99**, 1476 (1911).
(5) Neogi, *J. Chem. Soc.*, **105**, 1273 (1914).
(6) Rosenmund and Jordan, *Ber.*, **58**, 52 (1925).
(7) Such a reaction may account for the formation of N-nitroso derivatives of secondary amines in the reaction of nitrous acid with some primary amines, as observed by D. W. Adamson and J. Kenner, *J. Chem. Soc.*, 838 (1934).
(8) Bayer and Villiger, *Ber.*, **34**, 755 (1901).
(9) Chretien and Longi, *Compt. rend.*, **220**, 746 (1945).
(10) Ajello and Sigillo, *Gazz. chim. ital.*, **69**, 57 (1939).
(11) Harger, *J. Am. Chem. Soc.*, **46**, 2540 (1924).
(12) Noyes, *Org. Syntheses*, **Coll. Vol. 2**, 108 (1943).

below 100° at 100 mm.; the alcohol was identified through the *3,5-dinitrobenzoate*, m.p. 63°. No low- boiling aldehyde was detected with Fehling's solution or Tollen's reagent. The remainder distilled in two main fractions, I, b.p. 100–110° at 20 mm., II, b.p. 190–210° at 20 mm. The residue from the distillation gave a negative Lieberman test for nitroso compounds.

N-Benzylidenebenzylamine. Fraction II consisted of 2.70 g. of a colorless oil which behaved as a base, giving a colorless crystalline hydrochloride with hydrogen chloride gas in dry ether solution, and also with 6 *N* aqueous hydrochloric acid. The hydrochloride decomposed on heating without having a reproducible melting point; its dilute aqueous solution when boiled gave a strong odor of benzaldehyde. Fraction II gave directly the 2,4-dinitrophenylhydrazone of benzaldehyde (m.p. and mixture m.p. 237°) using the normal preparative method for dinitrophenylhydrazone derivatives. Attempts to produce a toluenesulfonamide yielded only oils. A solution of Fraction II in ice-cold chloroform reacted rapidly with excess bromine to give an orange-red crystalline product, m.p. 148° after recrystallization from absolute ethanol.

Authentic benzylidenebenzylamine, prepared from equimolar amounts of benzaldehyde and benzylamine, was obtained as a colorless oil, b.p. 200–205° at 30 mm. (lit. b.p. 200–202° at 10–20 mm.),[13] n_D^{20} 1.6020. It showed the same qualitative behavior as Fraction II, and gave an orange-red crystalline bromide, m.p. 149° (lit., 149°)[14] under the same conditions as above. The mixture melting point of the two bromo derivatives was 148°.

Benzyl n-butyl ether. Fraction I (6.75 g.) was almost but not quite completely soluble in 1 *N* hydrochloric acid. It was identified as benzylamine through the benzamide (m.p. 103°) and *p*-toluenesulfonamide (m.p. 115°). In order to examine the acid insoluble portion of Fraction I, an experiment was carried out using 0.2 mole of benzylamine and 0.4 mole of butyl nitrite. The material, b.p. 100–110° at 20 mm., was separated by distillation as before. This was taken up in ether, and extracted twice with dilute hydrochloric acid. The ether layer was washed with dilute sodium carbonate till neutral and then with water, and dried over magnesium sulfate. The ether was removed on the water-bath and the residue was distilled: 2.3 g. of colorless oil was obtained, b.p. 120–125° at 40 mm. n_D^{20} 1.5240. Its infrared spectrum was examined over the range 3.3–14.2 μ using a 0.025-cm. cell without solvent.[15]

For comparison, the infrared spectrum of authentic benzyl *n*-butyl ether was determined. This was prepared by the method of Van Duzee and Adkins[16] in 77% yield, and had b.p. 116–119° at 28 mm. (lit. b.p. 111–112° at 23 mm.)[13] and n_D^{20} 1.4934 (lit. n_D^{10} 1.4926).[17] Both showed strong to medium bands at 2915, 1499, 1456, 1341, 1311, 1269, 1206, 1130, 1032, 974, 935, 904, 850, and 828 cm.$^{-1}$. These frequencies are in general agreement with the Raman data of Murray and Cleveland,[18] and also with the infrared data of Barnes, Gore, Liddell, and Williams.[19] In particular, the strong absorptions at 904 and 1130 cm.$^{-1}$ correspond to Raman bands at 902 and 1125 cm.$^{-1}$ assigned by Murray and Cleveland to ether-oxygen stretching vibrations. The strong absorption at 2915 cm.$^{-1}$ corresponds to the Raman band at 2911 cm.$^{-1}$ assigned by them to a vibration characteristic of the whole *n*-butyl group. Most of the other absorptions are expected in mono-substituted phenyl compounds and demonstrate only the presence of the benzyl group. This was the difficulty in attempting to detect benzyl alcohol, dibenzyl ether, and bibenzyl.

Nitrous oxide. The infrared spectrum of the gaseous products was examined[20] in a 10 cm. cell, and the presence of nitrous oxide was shown by a strong absorption at 2223 cm.$^{-1}$ and weak bands at 2562 and 3481 cm.$^{-1}$ The crude liquid reaction mixture was also examined, and showed the 2223 cm.$^{-1}$ band.[21] A strong doublet was also found in the gaseous product at 2882 and 2956 cm.$^{-1}$ which is due to vaporized butyl nitrite.[22] It was assumed that the other major gaseous product was nitrogen and no evidence was found to the contrary.

Auto-decomposition of benzyl nitrite. Benzyl nitrite was prepared by the method of Baeyer and Villiger[8] in 65% yield, b.p. 74° at 20 mm., n_D^{15} 1.5034 (lit., b.p. 71° at 18 mm., n_D^{24} 1.4989).[9] An attempt to distil the ester at atmospheric pressure led to extensive decomposition. When stored at 15°, the refractive index remained constant for two days after which it rose slowly at first and then more rapidly reaching 1.518 after 8 days. Benzaldehyde was first detectable by odor after three days, and a 2,4-dinitrophenylhydrazone, m.p. 235°, which did not depress the melting point of authentic benzaldehyde 2,4-dinitrophenylhydrazone was obtained. Benzyl nitrite was also stored under nitrogen and at intervals the infrared spectrum of the gas was examined in a 10 cm. cell.[23] Nitrous oxide was shown present by absorptions at 2223, 2461, 2562, 2798, 3365, and 3481 cm.$^{-1}$.[21]

Reaction of benzyl alcohol with butyl nitrite. Benzyl alcohol (1.1 g.; 0.01 mole) and butyl nitrite (2.1 g.; 0.02 mole) were mixed without solvent and allowed to stand for six days at room temperature. Low-boiling material was stripped up to 60° at 50 mm. The residue gave a strong positive reaction with Schiff's reagent, and a 2,4-dinitrophenylhydrazone, m.p. 235°, which did not depress the melting point of benzaldehyde 2,4-dinitrophenylhydrazone.

N-Nitrosodibenzylamine. Dibenzylamine and isoamyl nitrite have been reported to give N-nitrosodibenzylamine.[24] This was confirmed: 2.0 g. (0.01 mole) of dibenzylamine and 2.1 g. (0.02 mole) of butyl nitrite were allowed to stand at 15° for four days. There was no evolution of gas, and an almost colorless crystalline precipitate formed. Yield: 1.7 g. (75%). Recrystallization of the solid product from light petroleum (b.p. 60–90°) gave nitrosodibenzylamine, very pale yellow octahedra, m.p. 59–60° (lit. 61°).[25] The filtrate from the reaction was diluted with an equal volume of chloroform and was chilled in an ice-bath. The addition of bromine gave an instantaneous coloration; no bromo derivative of benzylidenebenzylamine was observed, but some hydrogen bromide was evolved.

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(13) Mason and Winder, *J. Chem. Soc.*, **65**, 191 (1894).

(14) Franzen, Wegrzyn, and Kritschewsky, *J. prakt. Chem.*, [2] **95**, 389 (1917).

(15) Through the courtesy of the Chief Superintendent, Defence Standards Laboratories, Commonwealth Department of Supply, Maribyrnong, Victoria. A Perkin Elmer 12 C infrared spectrometer was used, fitted with a Type 107 amplifier, and with sodium chloride optics. The actual tracings were obtained by Mr. J. F. Horwood.

(16) Van Duzee and Adkins, *J. Am. Chem. Soc.*, **57**, 147 (1935).

(17) Isagulants and Skoblinskaya, *J. Appl. Chem. U.S.S.R.*, **9**, 1112 (1936).

(18) Murray and Cleveland, *J. Chem. Phys.*, **9**, 129 (1941).

(19) Barnes, Gore, Liddell, and Williams, *Infrared Spectroscopy*, Reinhold Publishing Co., New York, 1944, p. 66, Chart No. 313.

(20) In the Model 12 C spectrometer, but with lithium fluoride optics.

(21) Herzberg, *Infrared and Raman Spectra of Polyatomic Molecules*, Van Nostrand, New York, 1945, p. 278.

(22) Tarte, *Bull. soc. chim. belges*, **60**, 227 (1951).

(23) By Mr. K. R. Every of this Department, using a Perkin Elmer Model 112 infrared spectrometer with sodium chloride optics.

(24) Smirnow, *Chem. Zent.*, **82**, I, 1682 (1911).

(25) Walker, *Ber.*, **19**, 3287 (1886).

2,5-Bisbenzylamino-1,4-benzoquinone. To 0.1 mole of butyl nitrite and 0.2 mole of benzylamine, 0.01 mole of hydroquinone was added; it was expected that the reaction would be inhibited if there were a free radical mechanism. However, a vigorous reaction began immediately; there was copious evolution of gas, and the appearance in the solution of an intense red color not previously observed. After a short time a red solid precipitated; it was found to be insoluble in all the usual solvents except glacial acetic acid, from which it was recrystallized as microscopic scarlet prisms, m.p. 259°, (lit. 246°)[11] not depressed by 2,5-bisbenzylamino-1,4-benzoquinone prepared from benzylamine and *p*-quinone in alcoholic solution.

Anal.[26] Calc'd for $C_{20}H_{18}N_2O_2$: C, 75.45; H, 5.70; N, 8.80. Found: C, 75.52; H, 5.67; N, 9.09.

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(26) Microanalysis by Dr. K. W. Zimmerman and staff, Organic Microanalytical Laboratory, Commonwealth Scientific and Industrial Research Organization, Melbourne, Victoria.

The Preparation of L-Arginine Dipeptides

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The synthesis of peptides containing L-arginine has been delayed by the lack of appropriate methods to cover its highly polar guanidino group under conditions that must be reversible in the presence of the newly formed peptide link. The preparation of a series of dipeptides containing L-arginine was recently described[1,2] in which α-carbobenzoxy-ω-nitro-L-arginine was used as an intermediate in the mixed anhydride method of condensation; Anderson[3] used the pyrophosphite method.

We wish to submit that *p*-nitrocarbobenzoxy chloride is a more satisfactory covering agent of ω-nitro-L-arginine in providing better yields and generally more crystalline intermediates. It has already been used by Gish and Carpenter to cover the α-amino group of L-arginine acid chloride, the guanidino group being either also covered by the *p*-nitrocarbobenzoxyl group[4] or considered sufficiently stable as a zwitterion to protect it against undesired condensations.[5] Both methods have been found to be impractical, cyclization products of substituted L-arginine being formed in the early stages of condensation reactions.

(1) Hofmann, Peckham, and Rheiner, *J. Am. Chem. Soc.*, **78**, 238 (1956).

(2) Van Orden and Smith, *J. Biol. Chem.*, **208**, 751 (1954).

(3) Anderson, *J. Am. Chem. Soc.*, **75**, 6081 (1953).

(4) Gish and Carpenter, *J. Am. Chem. Soc.*, **75**, 950 (1953).

(5) Gish and Carpenter, *J. Am. Chem. Soc.*, **75**, 5872 (1953).

α-*p*-Nitrocarbobenzoxy-ω-nitro-L-arginine was combined as a mixed anhydride with aniline and with the ethyl esters of the following amino-acids: glycine, L-phenylalanine, L-leucine, L-tyrosine, β-phenyl-L-serine and L-glutamic acid.

Saponification of the resulting ω-nitro-α-*p*-nitrocarbobenzoxy-L-arginyl peptide ethyl esters with NaOH gave the corresponding substituted dipeptides, the hydrogenation of which, with 10% palladium catalyst on carbon gave the dipeptides (or their acetates, in acetic solution).

In preparing ω-nitro-α-*p*-nitrocarbobenzoxy-L-arginyl-L-phenylalanine, we were able to couple the mixed anhydride directly with L-phenylalanine. The resulting product was identical with the compound obtained by the saponification of the corresponding ester.

EXPERIMENTAL

α-p-Nitrocarbobenzoxy-ω-nitro-L-arginine. ω-Nitro-L-arginine (2.19 g., 10 mmoles) was dissolved in 1 *N* NaOH (20 ml., 20 mmoles); the solution was stirred vigorously and cooled to −5° and *p*-nitrocarbobenzoxy chloride[6] (2.16 g., 10 mmoles) dissolved in tetrahydrofuran (15 ml.) was added during 25 minutes in five approximately equal portions The reaction mixture was stirred at room temperature for half an hour. The resulting alkaline solution was washed twice with ethyl acetate and was acidified with 1 *N* HCl (Congo Red). α-*p*-Nitrocarbobenzoxy-ω-nitro-L-arginine precipitated within a few hours. The crude product was re crystallized from methanol-water. Yield, 3.4 g. (85%); m.p. 145–146°, $[\alpha]_D^{23}$ −8.0° (*c*, 1.11 in acetone). For analysis, the product was dried for 12 hours *in vacuo* over P_2O_5 at 78°.

Anal. Calc'd for $C_{14}H_{18}N_6O_8$: C, 42.21; H, 4.55; N, 21.1. Found: C, 42.31; H, 4.75; N, 20.9.

α-p-Nitrocarbobenzoxy-ω-nitro-L-arginyl-β-phenyl-L-serine ethyl ether. α-*p*-Nitrocarbobenzoxy-ω-nitro-L-arginine (0.796 g., 2 mmoles) was dissolved in tetrahydrofuran (10 ml.) previously dried over sodium, tri-*n*-butylamine (0.47 ml., 2 mmoles) was added. The mixture was cooled with ice-salt mixture and ethyl chloroformate (0.19 ml., 2 mmoles) was added; the mixture was stirred for 15 minutes. After this time, a solution of β-phenyl-L-serine ethyl ester hydrochloride (0.491 g., 2 mmoles) and tri-*n*-butylamine (0.47 ml., 2 mmoles) in tetrahydrofuran (10 ml.) was added. The mixture was stirred for 1 hour at room temperature and the solvent was evaporated *in vacuo* at 50–60°. The residue, a thick oil, was dissolved in ethyl acetate (35 ml.) and this solution was washed with 5% aqueous bicarbonate, water, 1 *N* HCl and water, then dried over Drierite. The solvent was evaporated *in vacuo* and the residue was recrystallized from ethanol-water. Yield, 0.77 g., (65%), m.p. 116–117°. For analysis a sample was dried for 18 hours *in vacuo* over P_2O_5 at 78°.

Anal. Calc'd for $C_{25}H_{31}N_7O_{10}$: C, 50.92; H, 5.31; N, 16.63. Found: C, 50.88; H, 5.26; N, 16.65.

α-p-Nitrocarbobenzoxy-ω-nitro-L-arginyl-β-phenyl-L-serine. α-*p*-Nitrocarbobenzoxy-ω-nitro-L-arginyl-β-phenyl-L-serine ethyl ester (0.589 g., 1 mmole) was dissolved in methanol (4 ml.); 1 *N* NaOH (2 ml., 2 mmoles) was added and the mixture was allowed to stand at room temperature for 1 hour. The alkaline solution was washed with ethyl acetate, acidified to Congo Red with 1 *N* HCl; the product crystallized after a few hours; it was recrystallized from methanol-

(6) Prepared according to Gish and Carpenter, *J. Am. Chem. Soc.*, **74**, 3818 (1952).