zinc powder (0.3 g) in acetic anhydride (15 ml) was stirred vigorously for 3 hr at 20°. The insoluble product[13] (**4**, 0.17 g) was separated from the zinc, filtered, and washed with acetic acid and then water. The filtrate was concentrated to 5 ml. Colorless needles of **11** (0.01 g, <4%) separated.[13]

2. **With Zinc Bromide and Acetic Anhydride.**—A suspension of **4**[8] (0.1 g) and zinc bromide (0.5 g) in acetic anhydride (8 ml) was stirred vigorously for 20 min at 20°. The insoluble colorless needles of **11**[13] (0.15 g, 95%) were filtered and washed with acetic acid and water successively.

Acidic Debromination of the Brominated Derivatives.—A suspension of **6**,[7] **7**, or **8** (0.2 g) and activated zinc powder (0.5 g) in acetic acid[14] (15 ml) was stirred vigorously for 20 min. The suspended **4** was separated from the zinc. The insoluble **4**[13] (0.09, 0.11, and 0.1 g, respectively) was filtered and washed with diluted hydrochloric acid and water successively.

Registry No.—**2a**, 14734-20-4; **2b**, 14734-19-1; **7**, 27150-37-4; **8**, 27150-38-5; **9**, 27189-17-9; **12**, 19817-51-7.

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(14) If ethanol was used as solvent, **6** and **8** yielded **4**. In the case of **7**, however, an unidentified, noncrystalline product was obtained.

Sulfur-Containing Polypeptides. XIV. Removal of the *tert*-Butyloxycarbonyl Group with Boron Trifluoride Etherate[1,2]

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In recent years the *tert*-butyloxycarbonyl (*t*-BOC) nitrogen protective group[3,4] has become widely used in peptide synthesis. The utility of the *t*-BOC group has been primarily due to the ease of introduction by the controlled pH technique,[5] the properties of *t*-BOC peptide derivatives, and the relatively mild conditions required for removal of the group. Although hydrogen chloride in various solvents[3,4] and neat trifluoroacetic acid[6] have been classically employed for cleavage of the *t*-BOC group, the availability of a reagent that would permit clean, rapid removal without the necessity of a strongly acidic solvent would be advantageous in many circumstances.[7]

These criteria can be met in many situations by use of boron trifluoride diethyl etherate in either glacial acetic acid or acetic acid–chloroform mixtures. While attempts to conduct the cleavage in chloroform alone have proved unsatisfactory, the addition of as little as 10% acetic acid gave good results. An important requirement is the exclusion of moisture from reagent and solvent.

In general, the *t*-BOC peptide is treated with a threefold excess of freshly distilled boron trifluoride diethyl etherate (0.4 ml/mmol). The reaction mixture is maintained at room temperature for 15–30 min and neutralized with either aqueous sodium acetate, 5% ammonium hydroxide, or potassium bicarbonate. The reaction is conveniently followed by tlc and generally goes to completion in 5 min although at 0° the reaction requires about 1 hr.

The *N*-carbobenzoxy group is not affected by these conditions; methyl, ethyl, benzyl, and trimethylbenzyl esters are likewise not affected, permitting possible use of this reagent with solid-phase resins. The stability of the *S*-trityl and *S*-benzhydryl thioethers of cysteine as well as the sulfur–sulfur bond of unsymmetrical cystine derivatives to these conditions has also been of considerable utility. Several protective groups are cleaved at rates comparable to cleavage of the *t*-BOC group; thus selective removal of the *t*-BOC group with boron trifluoride in the presence of benzhydryl or *tert*-butyl esters, *tert*-butyl ethers, of the *N*-triphenylmethyl group is uncertain and depends on the nature of the particular substrate.

Although this reagent has been superior for *t*-BOC removal with water-insoluble peptide derivatives, use with small water-soluble peptides must be approached with care due to the possible formation of boric acid salts. In such cases trifluoroacetic acid usually is the reagent of choice.

Experimental Section[8]

***N*-*tert*-Butyloxycarbonyl-*S*-diphenylmethyl-L-cysteine Dicyclohexylammonium Salt (I).**—A suspension of *S*-diphenylmethyl-L-cysteine[9] (57.4 g, 0.20 mol) in 400 ml of dioxane–water (1:1) was adjusted to pH 10.2 with 4.0 *N* NaOH. *tert*-Butyloxycarbonylazide (42.9 ml, 0.3 mol) was added and the reaction was stirred 9 hr at 25°, maintaining the pH at 10.2. The resulting clear yellow solution was extracted with ether and then acidified to pH 3 with 1 *N* H_2SO_4. The oily product was extracted into 500 ml of ether, washed with water and brine, dried over $MgSO_4$, and precipitated by addition of 40 g of dicyclohexylamine. The product was collected and dried over P_2O_5 to yield 101.3 g (90%): mp 158–159°; $[\alpha]^{22}D$ +6.38° (*c* 0.925, $CHCl_3$); homogeneous system D.

Anal. Calcd for $C_{38}H_{48}N_2O_4S$: C, 69.68; H, 8.51; N, 4.93; S, 5.64. Found: C, 69.64; H, 8.62; N, 4.82; S, 5.31.

***N*-*tert*-Butyloxycarbonyl-*S*-diphenylmethyl-L-cysteine *N*-Hydroxysuccinimide Ester (II).**—The salt, I (187 g, 0.33 mol), was neutralized with 2 *N* sulfuric acid. The resulting oil was dissolved in 300 ml of dimethoxyethane (DME) along with *N*-hydroxysuccinimide (37.5 g, 0.33 mol). The solution was cooled to −10° and treated with dicyclohexylcarbodiimide (DCC) (68.1

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(8) Melting points are uncorrected. Elemental analyses were performed by Micro Tech Laboratories, Skokie, Ill. Optical rotations were performed on a Perkin-Elmer Model 141 polarimeter. Thin layer chromatograms were on 3-in. plates of silica gel GF. Solvent systems used were: chloroform–methanol (9:1), system A; chloroform–methanol–17% ammonia (3:3:1), system B; chloroform–methanol–34% ammonia (5.5:3.5:1), system C; chloroform–acetic acid (9:1), system D. Controlled pH reactions were carried out using a Radiometer titrimeter and magnetic valve. Solvents were dried over $CaSO_4$. Boron trifluoride etherate was Eastman Technical grade distilled from CaH_2.

(9) R. G. Hiskey and J. B. Adams, Jr., *J. Org. Chem.*, **30**, 1340 (1965).

g, 0.33 mol). The reaction was stirred 3 hr at −10° and 48 hr at 27°. The reaction mixture was diluted with 200 ml of ethyl acetate and filtered to remove dicyclohexylurea (DCU). The residue was washed with 100 ml of ethyl acetate and the combined filtrates were evaporated to a foam which was dissolved in ether; this solution was washed with saturated $NaHCO_3$, water, and brine, dried over $MgSO_4$, and evaporated to a foam. The foam was dissolved in ethyl acetate and treated with hexane to give an oil which solidified on trituration under hexane; the crude solid (112.3 g) was used in the next step without further purification.

Benzyl *N*-*tert*-Butyloxycarbonyl-*S*-diphenylmethyl-L-cysteinylglycinate (III).—II (97.0 g, 0.20 mol) was added to a solution of benzyl glycinate *p*-toluenesulfonate[10] (81.0 g, 0.24 mol) and *N*-methylmorpholine (33 ml, 0.3 mol) in 500 ml of ethyl acetate. The solution was stirred at 26° for 15 hr and then washed with 1 *N* sulfuric acid (3 times), water, saturated $NaHCO_3$ (2 times), water, and brine, dried over $MgSO_4$, and evaporated to an oil which was chromatographed on silica gel, eluting with chloroform. The product was isolated from the column as oil (102 g), pure by tlc (system A), and was used without further characterization.

Benzyl *S*-Diphenylmethyl-L-cysteinylglycinate *p*-Toluenesulfonate Salt (IV).—The ester, III (102 g), was dissolved in 360 ml of chloroform–glacial acetic acid (5:1) at 25° and treated with 80 ml of boron trifluoride etherate. After 20 min, the reaction mixture was treated with 75 ml of NH_4OH (34%) in 300 ml of water. Solid $KHCO_3$ was added to bring the pH to 10. The layers were separated and the organic layer was dried over $MgSO_4$ and evaporated to an oil. This oil was dissolved in 1000 ml of ether and treated with an ethereal solution of *p*-toluenesulfonic acid. On cooling, IV precipitated as 83.1 g (68%) of needles: mp 181–183°; $[\alpha]^{26}D$ +25.6° (*c* 1, MeOH); homogeneous, system A.

Anal. Calcd for $C_{32}H_{34}N_2O_6S_2$: C, 63.34; H, 5.65; N, 4.62; S, 10.57. Found: C, 63.28; H, 5.69; N, 4.60; S, 10.29.

Benzyl *N*-*tert*-Butyloxycarbonylglycyl-*S*-diphenylmethyl-L-cysteinylglycinate (V).—IV (6.07 g, 10 mmol) and *N*-methylmorpholine (1.10 ml, 10 mmol) were dissolved in 25 ml of chloroform and treated with *N*-*tert*-butyloxycarbonylglycine *N*-hydroxysuccinimide ester.[11] The reaction was stirred at 26° for 4 hr. The solution was evaporated to a foam which was dissolved in 60 ml of ethyl acetate; this solution was washed with 1 *N* H_2SO_4 (3 times), water, saturated $NaHCO_3$ (3 times), water, and brine, dried over $MgSO_4$, and evaporated to a foam. Recrystallization from ethyl acetate–hexane gave V as long needles: 5.31 g (90%); mp 123–125°; $[\alpha]^{24}D$ −12.18° (*c* 1.02, $CHCl_3$); homogeneous, system A.

Anal. Calcd for $C_{32}H_{37}N_3O_6S$: C, 64.95; H, 6.30; N, 7.10; S, 5.42. Found: C, 64.67; H, 6.30; N, 7.03; S, 5.41.

Benzyl Glycyl-*S*-diphenylmethyl-L-cysteinylglycinate *p*-Toluenesulfonate Salt (VI).—A solution of V (11.83 g, 20 mmol) in 40 ml of chloroform–acetic acid (3:1) was treated with 8.0 ml of boron trifluoride etherate for 30 min at 26°. A solution of 11.8 ml of NH_4OH in 100 ml of water was added, along with 25 ml of chloroform. The pH was adjusted to 10 with solid $KHCO_3$. The chloroform layer was separated, washed with water and brine, dried over $MgSO_4$, and evaporated *in vacuo* to a foam which was dissolved in 300 ml of ether–ethyl acetate (2:1) and treated with *p*-toluenesulfonic acid in ether. The product precipitated on cooling: 8.20 g (61%); mp 79–80°; homogeneous, system A.

Anal. Calcd for $C_{34}H_{37}N_3O_7S_2 \cdot H_2O$: C, 59.89; H, 5.77; N, 6.16; S, 9.41. Found: C, 60.04; H, 5.52; N, 6.45; S, 9.43.

***N*-*tert*-Butyloxycarbonyl-*S*-diphenylmethyl-L-cysteinylglycine Dicyclohexylammonium Salt (VII).**—A solution of II (4.84 g, 10.0 mmol) in 25 ml of DME was treated with a solution of glycine (0.83 g, 11.0 mmol) and $KHCO_3$ (2.20 g, 22.0 mmol) in 25 ml of water. The solution was stirred 2 hr at 28°. The pH was adjusted to 3 with 2 *N* H_2SO_4 giving a gummy precipitate which was extracted into ether. The ether extract was washed with water (3 times) and brine, dried over $MgSO_4$, and treated with dicyclohexylamine (2.0 g). After cooling, the crystalline product was collected and dried over P_2O_5: 5.7 g (82%); mp 153–154°; $[\alpha]^{23}D$ −23.55° (*c* 1.04, DMF); homogeneous, system A, system D.

Anal. Calcd for $C_{35}H_{51}N_3O_6S$: C, 67.18; H, 8.21; N, 6.71; S, 5.11. Found: C, 66.98; H, 8.20; N, 6.83; S, 4.98.

***S*-Diphenylmethyl-L-cysteinylglycine (VIII).**—A solution of VII (3.13 g, 5 mmol) in glacial acetic acid (20 ml) was treated with boron trifluoride etherate (2.0 ml) for 30 min at 25°. The reaction mixture was then poured onto a solution of sodium acetate (10 g) in 50 ml of ice water. The flocculent precipitate was collected and washed with water (5 times) and ether (5 times) and then dried over P_2O_5 *in vacuo*: 1.68 g (97%); mp 182–185° dec; $[\alpha]^{23}D$ −2.63° (*c* 1.0, hexamethylphosphoramide); homogeneous, system B.

Anal. Calcd for $C_{18}H_{20}N_2O_3S$: C, 62.77; H, 5.85; N, 8.13; S, 9.31. Found: C, 62.53; H, 5.97; N, 8.21; S, 9.21.

***N*-*tert*-Butyloxycarbonylglycyl-*S*-diphenylmethyl-L-cysteinylglycine (IX).**—A slurry of VIII (865 mg, 2.5 mmol) in 10 ml of chloroform was treated with *N*-methylmorpholine (1.0 ml) and then with *N*-*tert*-butyloxycarbonylglycine *N*-hydroxysuccinimide ester (680 mg, 2.5 mmol). The mixture was stirred 7 hr, slowly going to a clear solution. The solvent was removed *in vacuo* and the residue was partitioned between 50 ml of ethyl acetate and 50 ml of 2 *N* H_2SO_4. The organic layer was washed with water (2 times) and brine and then dried over $MgSO_4$. The remaining solution was heated to boiling and diluted with an equal volume of hexane. On cooling, IX appeared as 1.04 g (83%) of needles: mp 174–176°; $[\alpha]^{30}D$ −13.1° [*c* 1.01, $CHCl_3$–DMF (2:1)]; homogeneous, system D.

Anal. Calcd for $C_{25}H_{31}N_3O_6S$: C, 59.86; H, 6.23; N, 8.38; S, 6.40. Found: C, 59.77; H, 6.14; N, 8.29; S, 6.40.

Glycyl-*S*-diphenylmethyl-L-cysteinylglycine (X).—A solution of IX (502 mg, 1.0 mmol) in 10 ml of acetic acid was treated with boron trifluoride etherate (0.4 ml) for 30 min at 26°. The reaction was then poured onto a solution of sodium acetate (5 g) in 50 ml of water. The fine white precipitate was collected, washed with water (5 times) and ether (5 times), and dried over P_2O_5: yield, 330 mg (83%); mp 206–207°; $[\alpha]^{24}D$ −13.04° (*c* 1.00, hexamethylphosphoramide); homogeneous, system C.

Anal. Calcd for $C_{20}H_{23}N_3O_4S \cdot {}^1/_2H_2O$: C, 58.52; H, 5.89; N, 10.21; S, 7.81. Found: C, 58.38; H, 5.75; N, 10.18; S, 7.72.

***N*-*tert*-Butyloxycarbonyl-*S*-triphenylmethyl-L-cysteine (XI).**—A suspension of *S*-triphenylmethyl-L-cysteine[9] (18.3 g, 50 mmol) in 200 ml of dioxane–water (1:1) was adjusted to pH 10.2 with 4 *N* NaOH. *tert*-Butyloxycarbonylazide (10.8 g, 75 mmol) was added and the pH was maintained at 10.2 for 5 hr. The clear, yellow solution was extracted with ether (2 times) and then treated with 2 *N* H_2SO_4 to pH 3. The oily precipitate was extracted into ether. The ether solution was washed with water (2 times) and brine, dried over $MgSO_4$, and evaporated to a foam, 19.32 g (83.2%). For characterization, a 463-mg sample was dissolved in ether and treated with 0.2 ml of dicyclohexylamine to yield 640 mg (99%) of the salt: mp 210–211° dec; $[\alpha]^{20}D$ +23.8° (*c* 1.0, methanol); homogeneous, system D.

Anal. Calcd for $C_{39}H_{52}N_2O_4S$: C, 72.63; H, 8.13; N, 4.34; S, 4.97. Found: C, 71.96; H, 8.10; N, 4.19; S, 4.97.

***N*-*tert*-Butoxycarbonyl-*S*-triphenylmethyl-L-cysteinylglycine Dicyclohexylammonium Salt (XII).**—A solution of XI (18.6 g, 40.0 mmol) and *N*-hydroxysuccinimide (5.06 g, 44 mol) in 40 ml of DME was cooled to −10° and treated with DCC (9.3 g, 44 mol). The reaction was stirred at −10° for 1 hr and at 25° for 12 hr. The DCU was removed by filtration and the remaining solution was evaporated *in vacuo* to a foam which was dissolved in 200 ml of ether; this solution was washed with saturated $NaHCO_3$ (2 times), water, and brine, dried over $MgSO_4$, and evaporated to a foam which was dried over P_2O_5 *in vacuo*.

The foam was dissolved in 80 ml of DME and treated with a solution of glycine (3.30 g, 44 mmol) and $KHCO_3$ (4.41 g, 44 mmol) in 80 ml of water. After 4 hr, the reaction mixture was acidified to pH 3 with 2 *N* H_2SO_4, and the precipitated product was extracted into ether, washed with water (2 times) and brine, dried over $MgSO_4$, and treated with dicyclohexylamine (8.0 ml). Cooling produced XII which was 25.4 g (90.7%) of microcrystalline solid: mp 130.5–133°; $[\alpha]^{21}D$ +14.56° (*c* 1.00, $CHCl_3$); homogeneous, system D.

Anal. Calcd for $C_{41}H_{55}N_3O_5S$: C, 70.15; H, 7.90; N, 5.99; S, 4.57. Found: C, 70.18; H, 7.88; N, 5.95; S, 4.48.

***S*-Triphenylmethyl-L-cysteinylglycine (XIII).**—A solution of XII (7.02 g, 10 mmol) in 50 ml of acetic acid was treated with boron trifluoride etherate (4.0 ml) for 30 min and then poured onto a solution of sodium acetate (18 g) in 100 ml of ice water. The gelatinous precipitate was collected, washed with water (6

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times) and ether (5 times), and dried over P_2O_5 *in vacuo* to yield 4.05 (96%) of solid: mp 114–116°; $[\alpha]^{25}D$ −6.03 (*c* 1.028, hexamethylphosphoramide); homogeneous, system B.

Anal. Calcd for $C_{24}H_{24}N_2O_3S \cdot {}^1/_2H_2O$: C, 67.10; H, 5.85; N, 6.51; S, 7.45. Found: C, 67.23; H, 5.86; N, 6.29; S, 7.87.

***N*-*tert*-Butyloxycarbonylglycyl-*S*-triphenylmethyl-L-cysteinylglycine (XIV).**—A suspension of XIII (3.15 g, 7.5 mmol) and *N*-*tert*-butyloxycarbonylglycine *N*-hydroxysuccinimide ester (2.24 g, 8.2 mmol) in 20 ml of chloroform was treated with 1.65 ml of *N*-methylmorpholine. The suspension was stirred 18 hr at 27°, with the solid slowly dissolving. The reaction mixture was evaporated to an oil which was taken up in 50 ml of ethyl acetate and equilibrated with 50 ml of 2 *N* H_2SO_4. The organic layer was washed with water (2 times) and brine, dried over $MgSO_4$, and evaporated to a foam which was recrystallized from chloroform–hexane. The product crystallized as small needles: 2.21 g (51%); mp 190–191°; $[\alpha]^{25}D$ +2.89° (*c* 1.00, $CHCl_3$), homogeneous, system D.

Anal. Calcd for $C_{31}H_{35}N_3O_6S$: C, 64.45; H, 6.11; N, 7.27; S, 5.55. Found: C, 64.71; H, 6.21; N, 7.24; S, 5.32.

Glycyl-*S*-triphenylmethyl-L-cysteinylglycine (XV).—A solution of XIV (1.154 g, 2.0 mmol) in 20 ml of acetic acid was treated with boron trifluoride etherate (0.80 ml) for 30 min at 26°. The reaction was then poured into a solution of sodium acetate (10 g) in ice water (100 ml). The product appeared as a gum which was collected by decantation and triturated under ice water to give a white powder which was washed with water (5 times) and ether (5 times) and dried over P_2O_5 *in vacuo* to yield 684 mg (71%) of solid: mp 154–155°; homogeneous, system B.

Anal. Calcd for $C_{26}H_{27}N_3O_4S \cdot H_2O$: C, 63.27; H, 5.93; N, 8.51; S, 6.50. Found: C, 63.05; H, 5.80; N, 8.16; S, 6.42.

***N*-*tert*-Butyloxycarbonyl-*S*-triphenylmethyl-L-cysteinyl-L-asparagine Trimethylbenzyl Ester (XVI).**—A suspension of the DCHA salt of XI (6.43 g, 10 mmol) and L-asparagine trimethylbenzyl ester hydrochloride[12] in 70 ml of DMAC was stirred 45 min at 20°, cooled to −10°, and treated with *N*-hydroxysuccinimide (1.15, 10 mmol) and DCC (2.06 g, 10 mmol). The reaction was stirred 2 hr at 0° and 16 hr at 27°. The DCU was removed by filtration and the filtrate was poured into brine and extracted with ethyl acetate (3 times). The extracts were combined and washed with water, 2 *N* H_2SO_4, water, saturated $NaHCO_3$, and brine, and then evaporated to a foam which was recrystallized from ether–petroleum ether. The product contained some XI which was precipitated from ether as the DCHA salt. The supernatant liquid was poured into hexane to give pure XVI: 4.4 g (61%); mp 161°; $[\alpha]^{31}D$ +19.5° (*c* 1.4, methanol); homogeneous, system A.

Anal. Calcd for $C_{41}H_{47}N_3O_6S$: C, 69.07; H, 6.59; N, 5.84; S, 4.40. Found: C, 69.37; H, 6.67; N, 5.92; S, 4.51.

***S*-Triphenylmethyl-L-cysteinyl-L-asparagine Trimethylbenzyl Ester (XVII).**—A solution of XVI (3.55 g, 5.0 mmol) in 15 ml of acetic acid was treated with boron trifluoride etherate (2.0 ml) for 60 min at 20°. The reaction was then poured into saturated $NaHCO_3$ and ethyl acetate. The aqueous layer was washed with ethyl acetate, and the combined extracts were washed with saturated $NaHCO_3$, water, and brine, dried over $MgSO_4$, and evaporated *in vacuo* to an oil. The oil was taken up in ether–methanol (5:1) and treated with anhydrous oxalic acid (425 mg) in ether. The precipitated oxalate salt was recrystallized from methanol–ether to yield 2.72 g (70%) of product: mp 119–121°; $[\alpha]^{27}D$ +48.9° (*c* 1.65, methanol); homogeneous, system C.

Anal. Calcd for $C_{36}H_{39}N_3O_4S \cdot C_2H_2O_4$: C, 64.68; H, 5.97; N, 6.06; S, 4.78. Found: C, 65.22; H, 5.91; N, 6.00; S, 4.58.

***N*-*tert*-Butyloxycarbonyl-*S*-triphenylmethyl-L-cysteinyl-*S*-diphenylmethyl-L-cysteinylglycyl-L-phenylalanylglycine *tert*-Butyl Ester (XVIII).**—A solution of *S*-diphenylmethyl-L-cysteinylglycyl-L-phenylalanylglycine *tert*-butyl ester[13] (1150 mg, 0.95 mmol) and XI (884 mg, 1.95 mmol) in 7 ml of DMF–methylene chloride (2.5:1) was cooled to −10° and treated with *N*-ethyl-*N*′-(3-diethylaminopropyl)carbodiimide (WSC) (372 mg, 1.95 mmol). The solution was stirred at −10° for 1 hr and at 20° for 24 hr. Methylene chloride (9 ml) was added to effect stirring. The resulting mixture was evaporated to a slurry which was washed into 40 ml of cold 1 *N* H_2SO_4 with 20 ml of methanol, and the suspension was filtered. The solid was washed with methanol–ether and dried over P_2O_5 to yield 1.69 g (82.5%) of product: mp 220–221°; $[\alpha]^{25}D$ −22.3° (*c* 1.0, dimethylformamide); homogeneous, system A.

Anal. Calcd for $C_{60}H_{67}N_5O_8S_2$: C, 68.61; H, 6.43; N, 6.67; S, 6.10. Found: C, 68.65; H, 6.49; N, 6.63; S, 6.03.

Studies on Cleavage of XVIII with Boron Trifluoride Etherate. A. Cleavage at 20°.—A solution of 10.5 mg of XVIII in 1 ml of chloroform–acetic acid (3:1) was treated with 0.1 ml of boron trifluoride etherate at 20°. Thin layer chromatography was used to follow the progress of the reaction. These conditions led to rapid cleavage of both *tert*-butyloxycarbonyl and *tert*-butyl ester. After 20 min only the completely deblocked peptide was identifiable on the chromatogram. At intermediate times, some amine ester was present but there appeared to be significant *tert*-butyl cleavage from the start.

B. Cleavage at 0°.—Conditions were identical with A, except the temperature was 0°. Cleavage was considerably slower, about 90 min being required for complete cleavage to the peptide. The transient free amine–ester had a considerably longer existence, but removal of both amine and ester protective groups occurred at comparable rates.

Investigation of the Action of Boron Trifluoride Etherate on *N*-Carbobenzoxyglycine (XIX).[14]—A solution of XIX (149 mg, 1.0 mmol) in acetic acid (1 ml) was treated with 0.4 ml of boron trifluoride etherate. The reaction was followed for 4 hr by thin layer chromatography. No evidence could be seen of consumption of starting material or of generation of any product; no ninhydrin positive material could be located. The reaction mixture was poured onto water and extracted with chloroform. The extract was washed with water, dried over $MgSO_4$, and evaporated. Recrystallization gave 98% recovery of starting material.

Registry No.—I, 26988-51-2; IV, 26988-52-3; V, 26988-54-5; VI, 26988-53-4; VII, 26988-55-6; VIII, 26988-56-7; IX, 26988-57-8; X, 26988-58-9; XI, 26988-59-0; XII, 26988-60-3; XIII, 26988-61-4; XIV, 26988-62-5; XV, 26988-63-6; XVI, 26985-35-3; XVII, 26985-36-4; XVIII, 27039-89-0.

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