hydride) were added to the cooled flask, and the solution was cooled on ice. Bromine (2.76 g, 17.2 mmol) was added dropwise with stirring. The ether was removed from the slightly yellow solid by vacuum distillation. The remaining solid was washed with ether which was removed by vacuum distillation while the flask was warmed periodically in a mineral oil bath held below 50 °C. The flask was transferred to an ice–salt bath. Compound **2**[3,4] (0.62 g, 1.65 mmol) in benzene[17] (94 mL, freshly distilled from lithium aluminum hydride) and pyridine (0.14 mL, 1.7 mmol, freshly refluxed in and distilled from BaO) were added to a fresh dropping funnel. The steroid solution was added over 10 min, the flask was allowed to warm to room temperature, and the mixture was stirred for 2 h. The mixture was washed with distilled H_2O (100 mL), and the aqueous layer was washed with benzene (50 mL). The combined benzene layers were warmed in a water bath and the solvent was removed under a stream of nitrogen. The crude material was chromatographed on Alumina F20 (102 g) in benzene–hexanes (increasing polarity from 1:1, v/v). The product (0.34 g, 0.77 mmol, 46.7%, mp 157–159.5 °C), which was eluted with benzene–hexanes 4:1, was rechromatographed on Alumina F20 and recrystallized from distilled MeOH to yield cubes: mp 157.5–158.5 °C; IR (KBr) 580 (CBr) cm^{-1}. Anal. Calcd for $C_{24}H_{37}O_2Br$ (437.452): C, 65.9; H, 8.5; Br, 18.3. Found: C, 65.98, H, 8.65; Br 18.32.

Cholesta-5,24-dien-3β-ol (Desmosterol, 4). A 15-mL three-neck distilling flask equipped with a magnetic stirring bar, dropping funnel, reflux condensor, nitrogen inlet, and drying tube was flame dried under nitrogen. Luer-lok syringes and needles were used for the transfer of all liquids. Lithium wire (2.4 cm, approximately 100 mg, 0.014 g-atom cut into six pieces) was added to the cooled flask, and the lithium was washed with ether (10 and 5 mL, freshly distilled from lithium aluminum hydride) from the dropping funnel. The washings were discarded, and fresh ether (1.2 mL) was added to the lithium. Freshly distilled bromobenzene (0.68 g, 4.3 mmol) was added to ether (2.4 mL) in the dropping funnel, and 10 drops of the mixture was added to the lithium. The remaining mixture was added in two equal portions after 5 and 12 min of stirring. The dark brown cloudy liquid (4 mL) was transferred to a 25-mL three-neck flask equipped with a nitrogen inlet, drying tube, and magnetic stirring bar and containing dimethylallyltriphenyltin (2.2 g, 5.25 mmol) in ether (10.4 mL). A cream-colored precipitate formed quickly, and stirring was discontinued after 5 min. The precipitate was allowed to settle, and the clear brown dimethylallyllithium solution (9 mL) was transferred to a three-neck distilling flask containing **3** (226 mg, 0.51 mmol). The flask was equipped with a reflux condensor, nitrogen inlet, drying tube, magnetic stirring bar, heating mantle, and a dropping funnel which supplies ether to maintain the reaction volume. The mixture was refluxed gently for 6.5 h. Saturated NH_4Cl (pH adjusted to 9 with NH_4OH) was added. The mixture was partitioned between distilled H_2O (20 mL) and ether (30 mL), and the aqueous layer was washed with ether (2 × 30 mL). The combined ether layers were warmed in a water bath, and the solvent was removed under a stream of nitrogen. The oily residue was saponified for 0.5 h with 5% alcoholic KOH (15 mL) and distilled H_2O (20 mL) and hexanes (40 mL) were added. The dried organic layer was chromatographed on a $AgNO_3$/silicic acid/Super-Cel column[18] (88.6 g) in benzene. Desmosterol (79.35 mg, 115–116.5 °C, 0.2 mmol, 39.2%) was rechromatographed on Alumina F20 (49 g) in benzene followed by benzene–EtOAc (1:1, v/v) and recrystallized from distilled MeOH (mp 119–119.5 °C) [lit. mp 120–122,[16] 120.5–121,[15] 117–118 °C[14]]: IR (KBr) 1373, 1056, 1022, 959, 950, 835, 800 cm^{-1}. Anal. Calcd for $C_{27}H_{44}O$: M^+ *m/e* 384.3389. Found: M^+ *m/e* 384.3421.

23,23-Dimethyl-26,27-dinorcholesta-5,24-dien-3β-ol (5). The isomer which is produced in the coupling reaction (26.65 mg, 191–195 °C) was also rechromatographed on Alumina F20 and recrystallized from distilled MeOH (mp 192–194 °C with sublimation): IR (KBr) 1469, 1461, 1457, 1444, 1434, 1378, 1372, 1360, 1290, 1061, 1053, 1023, 1006, 963, 956, 907, 839, 800, 782, 685, 668 cm^{-1}; ^1H NMR ($CDCl_3$) δ 5.8 (q, 1, J_{cis} = 7.0 Hz, J_{trans} = 17.2 Hz, $C_{24}CH$=), 5.35 (m, 1, C_6), 4.87 (d, 1, J = 11.7 Hz, C_{25}=$CH_{2_{cis}}$), 4.87 (d, 1, J = 16.25 Hz, C_{25}=CH_2 (trans)); ^{13}C NMR ($CDCl_3$) δ_C 149.8 (C_{24}), 121.86 (C_6), 109.7 (C_{25}). Anal. Calcd for $C_{27}H_{44}O$: M^+ *m/e* 384.3389. Found: M^+ *m/e* 384.3406.

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Registry No.—**1**, 50585-10-9; **2**, 55509-37-0; **3**, 58507-57-6; **4**, 313-04-2; **5**, 65733-48-4; triphenyltin chloride, 639-58-7; 1-chloro-3-methyl-2-butene, 503-60-6; dimethylallyltriphenyltin, 65733-49-5.

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General Procedure for the Synthesis of Mono-N-acylated 1,6-Diaminohexanes

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Studies in our laboratory required the ready availability of *N*-acrylyl-1,6-diaminohexane and *N*-(2-methylacrylyl)-1,6-diaminohexane in high purity. When attempts were made to prepare *N*-acrylyl-1,6-diaminohexane using the published procedure,[1] a product was isolated which agreed with the reported characteristics of the compound; however, analysis revealed the product to be bis(*N,N'*-acrylyl)-1,6-diaminohexane. In addition, the synthesis of monoacrylated product by reaction of acryloyl chloride and excess 1,6-diaminohexane gave poor yields due both to the preferential formation of the bis(N,N'-acrylated) product and to the similar physical properties of the bases, *N*-acrylyl-1,6-diaminohexane and 1,6-diaminohexane.

The key to the successful synthesis of mono-N-acylated 1,6-diaminohexanes is the protection of one of the amino groups of 1,6-diaminohexane by some readily removable group, particularly when this protecting group also favorably alters the solubility properties of the product so that its separation from the unsubstituted and disubstituted by-products is readily accomplished. Hence the easily removable, hydrophobic *tert*-butyloxycarbonyl[2] (Boc) group was used, which renders *N-tert*-butyloxycarbonyl-1,6-diaminohexane separable from the unreacted diamine and bis(*N,N'-tert*-butyloxycarbonyl)-1,6-diaminohexane.

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The introduction of the Boc group is accomplished with *S-tert*-butyloxycarbonyl-4,6-dimethyl-2-mercaptopyrimidine.[3] Isolation and purification of the desired *N-tert*-butyloxycarbonyl-1,6-diaminohexane as the hydrochloride is readily accomplished in approximately 60% yield. *N-tert*-Butyloxycarbonyl-1,6-diaminohexane is then reacted with the appropriate acid chloride, i.e., acryloyl and 2-methylacryloyl chloride, in the presence of tertiary base to yield *N-tert*-butyloxycarbonyl-*N'*-acrylyl-1,6-diaminohexane or *N-tert*-butyloxycarbonyl-*N'*-(2-methylacrylyl)-1,6-diaminohexane in excellent yield. Finally, the Boc group is removed with 3 M HCl in ethyl acetate to give in nearly quantitative yield the hydrochloride salts of monoacrylated 1,6-diaminohexanes.

Experimental Section

All melting points were determined in open capillary tubes and are reported uncorrected. Thin-layer chromatography was performed on precoated plates of silica gel G-60 F-254 (E. Merck). Compounds were applied in loads of up to 100 μg, and chromatograms were developed for 10–15 cm in the following solvent systems: A, $CHCl_3$–CH_3OH–CH_3CO_2H (9:1:1, v/v/v); B, butanone–CH_3CO_2H–H_2O (15:1:1); C, $CHCl_3$–CH_3OH (9:1); D, acetone–CH_3CO_2H–H_2O (9:1:1). Visualization was performed by UV, Cd/ninhydrin spray,[4] followed by treatment with Cl_2 gas and starch/NaI spray. Products gave single spots under these conditions.

***N-tert*-Butyloxycarbonyl-1,6-diaminohexane·HCl (1).** 1,6-Diaminohexane (23.2 g, 0.2 mol) was dissolved in dioxane (90 mL). To the stirred solution *S-tert*-butyloxycarbonyl-4,6-dimethyl-2-mercaptopyrimidine[3] (24.6 g, 0.1 mol) in dioxane (100 mL) was added slowly over a period of 3 h, and the reaction was allowed to proceed overnight. The precipitate (4,6-dimethyl-2-mercaptopyrimidine) was removed by filtration, and the filtrate was evaporated to 100 mL. The subsequent addition of water (150 mL) precipitated bis(*N,N'-tert*-butyloxycarbonyl)-1,6-diaminohexane (5.95 g, 0.02 mol) which was then removed by filtration. The dioxane was removed from the filtrate under reduced pressure and, following the addition of ~40 g of NaCl, the aqueous solution was extracted with EtOAc (50 mL, four times). The organic phase was pooled and evaporated under reduced pressure. The resulting oil was dissolved in water (100 mL) and acidified with 1 M HCl (70 mL) to a pH of 3. The aqueous phase was washed with EtOAc until the solution was colorless at which time the aqueous solution was saturated with NaCl. *N-tert*-Butyloxycarbonyl-1,6-diaminohexane·HCl crystallized and was isolated by filtration (18.3 g). The product was dissolved in C_2H_5OH (150 mL), decolorized with Norit, and filtered. The ethanol solution was evaporated to ~75 mL and added to 400 mL of acetone. The material, which crystallized shortly thereafter, was then filtered and dried: yield 14.6 g (58%); mp 162.5–163 °C; TLC R_f(A) 0.22, R_f(B) 0.20. Anal. Calcd for $C_{11}H_{25}N_2O_2Cl\cdot\frac{1}{4}H_2O$ (257.3): C, 51.4; H, 10.0; N, 10.9. Found: C, 51.5; H, 10.1; N, 10.5.

***N-tert*-Butyloxycarbonyl-*N'*-(2-methylacrylyl)-1,6-diaminohexane (2).** Compound 1 (7.58 g, 29.5 mmol) was suspended in $CHCl_3$ (200 mL) and cooled in an ice bath and triethylamine (8.74 mL, 63 mmol) was added. To the stirring suspension, 2-methylacryloyl chloride (3.0 mL, 30 mmol) dissolved in $CHCl_3$ (50 mL) was added dropwise. Following the addition, the solution was washed with water (100 mL, thrice), dried with Na_2SO_4, and evaporated in vacuo. The product crystallized upon the addition of hexane: yield 7.37 g (86%); mp 59–60 °C. A sample was recrystallized from benzene–hexane (1:10): mp 61–62 °C; TLC R_f(C) 0.58. Anal. Calcd for $C_{15}H_{28}N_2O_3$ (284.4): C, 63.4; H, 9.92; N, 9.85. Found: C, 63.4; H, 9.82; N, 9.69.

***N-tert*-Butyloxycarbonyl-*N'*-acrylyl-1,6-diaminohexane (3).** A sample of compound 1 (17.8 g, 70.4 mmol) was dissolved in CH_3OH and converted to the free base by elution through a Rexyn 201 (OH^-) column (2 × 50 cm, previously washed with CH_3OH). The CH_3OH was removed in vacuo and the resulting oil, after dissolution in $CHCl_3$ (250 mL) and addition of triethylamine (9.82 mL, 70.4 mmol), was added dropwise to a solution of acryloyl chloride (7.0 mL, 80 mmol) in $CHCl_3$ (250 mL) that was being stirred and kept at −5 to −10 °C. When the reaction solution reached room temperature, it was washed with water (250 mL, four times) and evaporated under reduced pressure and the material was crystallized from benzene: yield 15.9 g (83%), mp 107–109 °C. A sample was recrystallized from benzene: mp 108.5–109.5 °C; TLC R_f(C) 0.51. Anal. Calcd for $C_{14}H_{26}N_2O_3$ (270.4): C, 62.2; H, 9.69; N, 10.4. Found: C, 62.5; H, 9.63; N, 10.3.

***N*-(2-Methylacrylyl)-1,6-diaminohexane·HCl (4).** Compound 2 (2.56 g, 9.0 mmol) was dissolved in 3 M HCl–EtOAc (5 mL). After 30 min the solution was removed in vacuo and the oil was triturated with ether, filtered, and dried: yield 1.92 g (96%); mp 110–112 °C. Since the material was hygroscopic, a sample was converted to the free base by passage through a Rexyn 201 (OH^-) column and crystallized as the tosylate from C_2H_5OH–ether: mp 132–132.5 °C; TLC R_f(D) 0.28. Anal. Calcd for $C_{17}H_{28}N_2O_4S$ (356.5): C, 57.3; H, 7.92; N, 7.86. Found: C, 57.2; H, 7.76; N, 7.65.

***N*-Acrylyl-1,6-diaminohexane·HCl (5).** Compound 3 (2.38 g, 7.54 mmol) was treated with 3 M HCl–EtOAc as described above and the product was isolated in a 98% yield. The material polymerized on heating and melted at ~160 °C. For the purpose of analysis, the tosylate was prepared and crystallized as described for 4: mp 145 °C (sharp); TLC R_f(D) 0.24. Anal. Calcd for $C_{16}H_{26}N_2O_4S$ (342.5): C, 56.1; H, 7.65; N, 8.18. Found: C, 56.1; H, 7.46; N, 7.96.

Note Added in Proof: The overall yield of *N-tert*-butyloxycarbonyl-1,6-diaminohexane·HCl (1) can be further increased by storing the by-product, bis(*N,N'-tert*-butyloxycarbonyl)-1,6-diaminohexane, in anhydrous Et_2O saturated with HCl gas at 25 °C. During the next 12 h, *N-tert*-butyloxycarbonyl-1,6-diaminohexane·HCl crystallizes free of 1,6-diaminohexane·2HCl.

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Registry No.—1 HCl, 65915-94-8; **2**, 65915-95-9; **3**, 65915-96-0; **4**, 65915-97-1; **4** HCl, 65915-98-2; **4** tosylate, 65915-99-3; **5**, 7530-30-5; **5** tosylate, 65916-00-9; **5** HCl, 65916-01-0; 1,6-diaminohexane, 124-09-4; *S*-Boc-4,6-dimethyl-2-mercaptopyrimidine, 41840-28-2; 2-methylacryloyl chloride, 920-46-7; acryloyl chloride, 814-68-6.

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A New Synthesis of α-(2-Pyridyl) Ketones by Acylation of 2-Picolyllithium and 2,6-Lutidyllithium with *N,N*-Dimethylcarboxamides

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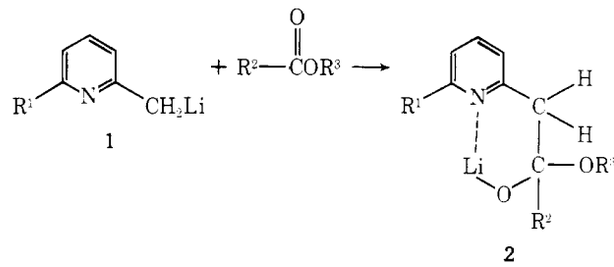
In connection with a study[2] of the synthesis and characterization of nickel(II), copper(II), and cobalt(II) complexes of various α-(2-hetaryl) ketones we required a series of α-(2-pyridyl) ketones of type **4**. The most widely used method for the synthesis of such compounds involves reaction of 2-lithiomethylpyridines (**1**) with an appropriate ester.[3–5] The mechanism of this process, as proposed by Levine and Raynolds,[5] involves initial reaction of **1** with the acylating ester to form **2**, which then reacts with more **1** either by proton abstraction to form the enolate of the desired ketone or by



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