Catalytic Additions of Acylsilanes to Imines: An Acyl Anion Strategy for the Direct Synthesis of α-Amino Ketones

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Supporting Information

General Information. All reactions were carried out under a nitrogen atmosphere in flame-dried glassware with magnetic stirring. THF, Et_2O, CH_2Cl_2, DMF and toluene were purified by passage through a bed of activated alumina.[1] $CHCl_3$ was purified by passage through a pad of alumina prior to use. Reagents were purified prior to use unless otherwise stated following the guidelines of Perrin and Armarego.[2] Purification of reaction products was carried out by flash chromatography using EM Reagent silica gel 60 (230-400 mesh). Analytical thin layer chromatography was performed on EM Reagent 0.25 mm silica gel 60-F plates. Visualization was accomplished with UV light and anisaldehyde, ceric ammonium nitrate stain, potassium permangenate, or phosphomolybic acid followed by heating. Melting points were obtained on a Thomas Hoover capillary melting point apparatus and are uncorrected. Infrared spectra were recorded on a Bio-Rad Win FT-IR Pro spectrometer. ^{1}H-NMR spectra were recorded on a Varian Inova 500 (500 MHz) or Mercury 400 (400 MHz) spectrometer and are reported in ppm using solvent as an internal standard ($CDCl_3$ at 7.26 ppm). Data are reported as (ap = apparent, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, b = broad; coupling constant(s) in Hz; integration. Proton-decoupled ^{13}C-NMR spectra were recorded on a Varian Inova 500 (125 MHz) or Mercury 400 (100 MHz) spectrometer and are reported in ppm using solvent as an internal standard ($CDCl_3$ at 77.0 ppm). Laser desorption mass spectra were obtained with PE BioSystems time-of-flight MALDI mass spectrometer with 2,5-dihydroxybenzoic acid as matrix.

Benzoyltrimethylsilane, *p*-chlorobenzoyltrimethylsilane, and *p*-toluoyltrimethylsilane were prepared according to the procedure of Yamamoto and coworkers[3]. Acylsilanes derived from saturated acid chlorides were prepared using a modified procedure developed by Fleming and Ghosh.[4] Phosphoryl imines were prepared according to the procedure of Lovely and Jennings.[5]

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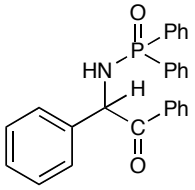
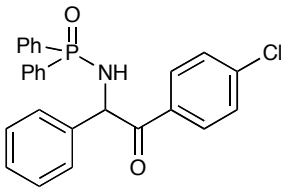
1. Pangborn, A. B.; Giardello, M. A.; Grubbs, R. H.; Rosen, R. K.; Timmers, F. J. *Organometal*. **1996**, *15*, 1518-1520.
2. Perrin, D. D. and Armarego, W. L. *Purification of Laboratory Chemicals;* 3rd Ed., Pergamon Press, Oxford. 1988.
3. Yamamoto, K.; Hayashi, A.; Suzuki S.; Tsuji, J. *Organometal*. **1987**, *6*, 974-979.
4. (a) Fleming, I.; Ghosh U. *J. Chem. Soc, Perkin Trans. 1* **1994**, 257-262. (b) Clark, C. T.; Milgram B. C.; Scheidt, K. A. *Org. Lett*. Submitted.

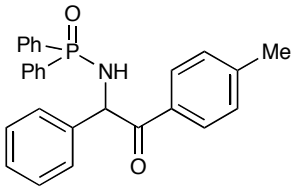
General Procedure for Thiazolium-Catalyzed Acylsilane Additions:
A screw-capped tube was charged with the thiazolium salt (20 mg, 0.08 mmol) in a nitrogen-filled dry box. The tube was removed from the box and placed under a positive pressure of nitrogen. Benzoyltrimethylsilane (84 mg, 0.47 mmol) in $CHCl_3$ (0.25 mL) was added by syringe followed by the addition of DBU (12 μL, 0.08 mmol). The reaction mixture was heated to 60 °C after which the phosphoryl imine (0.26 mmol) in $CHCl_3$ (0.25 mL) was added by syringe followed by the addition of isopropanol (80 μL, 1.05 mmol). The reaction was allowed to stir at 60 °C for 24 hours. Upon completion by HPLC the reaction was cooled to room temperature, diluted with methylene chloride (20 mL) and washed with water (20 mL). The aqueous layer was washed with methylene chloride (3x30 mL) and the combined organic extracts were dried over sodium sulfate, filtered, and concentrated *in vacuo*. The resulting residue was purified by flash column chromatography on silica gel.



2-(Diphenylphosphinamide)-1,2-diphenylethanone: Purified with 1% methanol/ethyl acetate, yielding 100 mg (93%) of **13** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 135.5-136 °C; IR (film) 3184, 3057, 1682, 1200 cm^{-1} ; ^1H NMR (500 MHz, $CDCl_3$) δ 7.86-7.81 (m, 4H); 7.69-7.65 (m, 2H); 7.47-7.39 (m, 5H); 7.33-7.30 (M, 4H); 7.15 (bs, 5H); 5.96 (dd, *J* = 8.9, 8.9 Hz, 1H); 4.96 (dd, *J* = 7.9, 7.9 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.7, 138.9, 134.4, 133.8, 133.5, 132.7, 132.7, 132.5, 132.2, 131.9, 131.8, 131.7, 129.4, 129.2, 128.9, 128.8, 128.8, 128.4, 128.3, 128.2, 128.2, 59.4; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{22}NO_2P$ $[M+H]^+$, 412.4. Found 412.2.



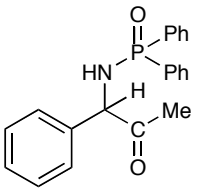
1-(4-Chlorophenyl)-2-(diphenylphosphinamide)-2-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 105 mg (90%) of **14** as a white foam. R_f = 0.74 (100% ethyl acetate); Mp: 150-151 °C; IR (film) 3170, 3057, 1685, 1200 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.84-7.82 (m, 4H); 7.80-7.65 (m, 3H); 7.48-7.40 (m, 4H); 7.39-7.29 (m, 4H); 7.16-7.14 (m, 4H); 5.91 (dd, *J* = 8.6, 8.6 Hz, 1H); 4.91 (dd, *J* = 8.1, 8.1 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 195.6, 140.3, 138.7, 138.5, 132.8, 132.7, 132.7, 132.5, 132.3, 131.9, 131.8, 131.6, 130.7, 129.3, 129.2, 128.9, 128.8, 128.5, 128.4, 128.3, 128.2, 59.4; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{21}ClNO_2P$ $[M+H]^+$, 446.1. Found 447.4.



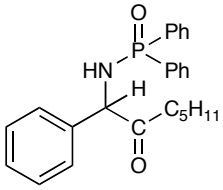
2-(Diphenylphosphinamide)-2-phenyl-1-*p*-tolylethanone: Purified with 1% methanol/ethyl acetate, yielding 90 mg (81%) of **15** as a white foam. R_f = 0.74 (100% ethyl acetate); Mp: 138-138.5 °C; IR (film) 3177, 3057, 1680, 1202 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.85-7.81 (m, 2H); 7.77-7.75 (m, 2H); 7.69-7.65 (m, 2H), 7.48-7.38 (m, 4H); 7.28-7.25 (m, 3H); 7.15-7.11 (m, 6H); 5.94 (dd, *J* = 10.1, 8.2 Hz, 1H); 4.99 (dd, *J* = 8.2, 8.2 Hz, 1H); 2.31 (s, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.2, 144.9, 139.3, 132..7, 132.7, 132.2, 131.9, 131.8, 129.5, 129.1, 128.9,

5. Jennings, W.B.; Lovely, C. J. *Tetrahedron* **1991**, *47*, 5561-5568.

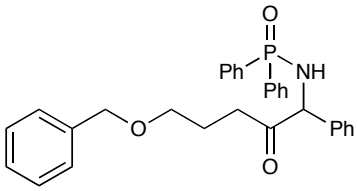
128.8, 128.4, 128.3, 128.2, 128.1, 59.2, 21.9; LRMS (MALDI-TOF): Mass calculated for $C_{27}H_{24}NO_2P$ $[M+H]^+$, 426.2. Found 427.8.



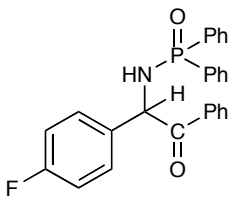
1-(Diphenylphosphinamide)-1-phenylpropan-2-one: Purified with 1% methanol/ethyl acetate, yielding 80 mg (87%) of **16** as a white foam. R_f = 0.46 (100% ethyl acetate); Mp: 99-100 °C; IR (film) 3168, 3057, 1717, 1196 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.84-7.80 (m, 2H); 7.61-7.57 (m, 2H); 7.49-7.41 (m, 3H); 7.34-7.32 (m, 1H); 7.21-7.17 (m, 5H); 7.07-7.06 (m, 2H); 5.05 (dd, J = 11.1, 6.7 Hz, 1H); 4.84 (dd, J = 6.2, 6.2 Hz, 1H); 2.02 (s, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 204.0, 138.3, 132.7, 132.7, 132.4, 132.3, 131.8, 131.8, 129.1, 128.9, 128.8, 128.4, 128.3, 128.2, 128.1, 64.0, 27.1; LRMS (MALDI-TOF): Mass calculated for $C_{21}H_{20}NO_2P$ $[M+H+Na]^+$, 372.1. Found 372.4.



1-(Diphenylphosphinamide)-1-phenylheptane-2-one: Purified with 1% methanol/ethyl acetate, yielding 73 mg (71%) of **17** as a white foam. R_f = 0.75 (100% ethyl acetate); Mp: 100-101 °C; IR (film) 3178, 3057, 2953, 1717, 1194 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.84-7.78 (m, 2H); 7.61-7.56 (m, 2H); 7.49-7.31 (m, 5H); 7.21-7.18 (m, 5H); 7.17-7.04 (m, 2H); 5.02 (dd, J = 11.0, 6.7 Hz, 1H); 4.84 (dd, J = 6.6, 6.6 Hz, 1H); 2.30-2.25 (m, 2H); 1,46-1.40 (m, 2H); 1.15-1.03 (m, 4H); 0.77 (t, J = 6.7 Hz, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 206.6, 138.4, 132.7, 132.6, 132.5, 132.2, 131.8, 131.7, 129.0, 128.8, 128.7, 128.3, 128.3, 128.2, 128.1, 63.4, 39.7, 31.3, 23.7, 22.5, 14.1; LRMS (MALDI-TOF): Mass calculated for $C_{25}H_{29}NO_2P$ $[M+H]^+$, 406.2. Found 406.7.

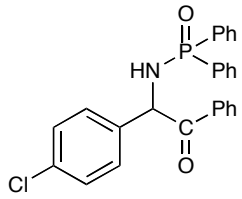


5-(Benzyloxy)-1-(diphenylphosphinamide)-1-phenylpentan-2-one: Purified with 1% methanol/ethyl acetate, yielding 40 mg (63%) of **18** as an orange oil. R_f = 0.70 (100% ethyl acetate); IR (film) 3175, 3059, 2928, 1718, 1198 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.83-7.79 (m, 2H); 7.62-7.58 (m, 2H); 7.50-7.21 (m, 14H); 7.06 (m, 2H); 5.03 (dd, J = 10.4, 7.0 Hz, 1H); 4.84 (m, 1H); 4.33 (q, J = 12.2 Hz, 2H); 3.30 (m, 2H); 2.43 (m, 2H); 1.78 (m, 2H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 210.7, 138.4, 132.7, 132.6, 132.3, 131.9, 131.8, 129.1, 128.9, 128.8, 128.6, 128.4, 128.3, 128.3, 128.2, 127.8, 127.8, 69.0, 63.5, 36.4, 24.1; LRMS (MALDI-TOF): Mass calculated for $C_{30}H_{30}NO_3P$ $[M+H+Na]^+$, 507.2. Found 507.2.

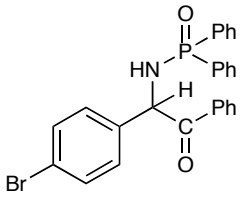


2-(Diphenylphosphinamide)-2-(4-fluorophenyl)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 101 mg (89%) of **21** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 169-170 °C; IR (film) 3156, 3057, 1686, 1200 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.83-7.80 (m, 4H); 7.66-7.64 (m, 3H); 7.46-7.28 (m, 8H); 7.10 (m, 2H); 6.83-6.80 (m, 2H); 5.97 (dd, J = 8.5, 8.5 Hz, 1H); 4.96 (dd, J = 7.3, 7.3 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.5, 163.5, 161.5, 134.9, 134.2, 134.0, 132.7, 132.6, 132.3, 131.9, 131.9, 131.8, 131.7, 130.0, 130.0, 129.3, 128.9, 128.8, 128.5, 128.4, 116.2, 116.0,

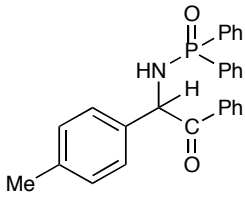
58.58; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{21}FNO_2P$ $[M+H+Na]^+$, 453.1. Found 453.5.



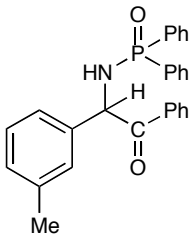
2-(4-Chlorophenyl)-2-(diphenylphosphinamide)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 100 mg (85%) of **22** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 152-152.5 °C; IR (film) 3171, 3057, 1685, 1197 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.82-7.81 (m, 4H); 7.67-7.63 (m, 2H); 7.48-7.28 (m, 9H); 7.11-7.05 (M, 4H); 5.94 (dd, *J* = 8.5, 8.5 Hz, 1H); 4.96 (dd, *J* = 7.9, 7.9 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.3, 137.6, 134.2, 134.1, 134.1, 132.7, 132.6, 132.3, 131.9, 131.9, 131.8, 129.6, 129.3, 128.9, 128.8, 128.5, 128.4, 58.7; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{21}ClNO_2P$ $[M+H+Na]^+$, 469.1. Found 469.3.



2-(4-Bromophenyl)-2-(diphenylphosphinamide)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 105 mg (82%) of **23** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 143-144 °C; IR (film) 3165, 3056, 1685, 1197 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.84-7.81 (m, 4H); 7.68-7.64 (m, 3H); 7.50-7.42 (m, 5H); 7.36-7.26 (m, 5H); 7.02-7.01 (m, 2H); 5.94 (dd, *J* = 8.8, 8.8 Hz, 1H); 4.97 (dd, *J* = 8.0, 8.0 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.2, 138.1, 134.1, 132.7, 132.6, 132.4, 132.3, 132.0, 131.9, 131.8, 129.9, 129.3, 128.9, 128.9, 128.5, 128.4, 122.4, 58.8; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{21}BrNO_2P$ $[M]^+$, 513.1. Found 513.9.

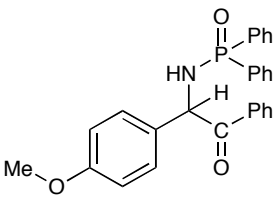


2-(Diphenylphosphinamide)-1-phenyl-2-*p*-tolylethanone: Purified with 1% methanol/ethyl acetate, yielding 104 mg (94%) of **24** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 151-152 °C; IR (film) 3179, 3056, 2976, 2918, 1684, 1437, 1199 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.86-7.82 (m, 4H); 7.72-7.68 (m, 2H); 7.48-7.41 (m, 5H); 7.33-7.27 (m, 4H) 7.04-7.03 (m, 2H); 6.98-6.96 (m, 2H); 5.92 (dd, *J* = 9.2, 9.2 Hz, 1H); 4.91 (dd, *J* = 8.2, 8.2 Hz, 1H); 2.23 (s, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.8, 138.0, 136.0, 134.5, 133.8, 133.5, 132.8, 132.7, 132.5, 132.2, 132.0, 131.9, 131.8, 129.9, 129.3, 128.9, 128.8, 128.4, 128.3, 128.1, 59.2, 21.3; MALDI: Mass (m/e) calculated for $C_{27}H_{24}NO_2P$ $[M+H+Na]^+$, 449.2: Found 449.4.

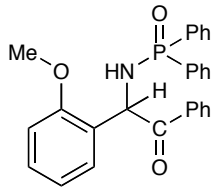


2-(Diphenylphosphinamide)-1-phenyl-2-*m*-tolylethanone: Purified with 1% methanol/ethyl acetate, yielding 92 mg (83%) of **25** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 111.5-113 °C; IR (film) 3179, 3056, 2976, 1684, 1199 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.87-7.81 (m, 4H), 7.71-7.67 (m, 2H); 7.48-7.41 (m, 5H); 7.39-7.28 (m, 4H); 7.07-7.04 (m, 1H); 6.95-6.91 (m, 3H); 5.92 (dd, *J* = 9.1, 9.1 Hz, 1H); 4.92 (dd, *J* = 8.0, 8.0 Hz, 1H); 2.17 (s, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.7, 138.9, 138.8, 134.4, 133.8, 133.6,

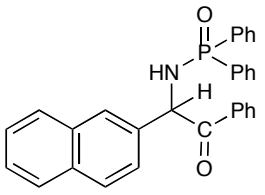
132.8, 132.7, 132.6, 132.2, 131.9, 131.8, 129.4, 129.1, 129.0, 128.9, 128.8, 128.3, 128.2, 125.2, 59.4, 21.5; LRMS (MALDI-TOF): Mass calculated for $C_{27}H_{24}NO_2P$ $[M+H]^+$, 426.2. Found 427.9.



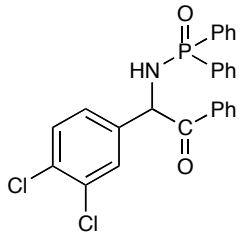
2-(Diphenylphosphinamide)-2-(4-methoxyphenyl)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 100 mg (86%) of **26** as a white foam. R_f = 0.58 (100% ethyl acetate); Mp: 157-158 °C; IR (film) 3179, 3055, 2957, 1684, 1198 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.85-7.81 (m, 4H); 7.71-7.67 (m, 2H); 7.47-7.41 (m, 5H); 7.33-7.29 (m, 4H); 7.06-7.05 (m, 2H); 6.69-6.67 (m, 2H); 5.92 (dd, *J* = 8.9, 8.9 Hz, 1H); 4.91 (dd, *J* = 7.8, 7.8 Hz, 1H); 3.69 (s, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.7, 159.5, 134.5, 133.7, 132.8, 132.7, 132.2, 131.9, 131.9, 131.1, 129.5, 129.3, 128.9, 128.8, 128.4, 128.3, 114.6, 58.8, 55.4; LRMS (MALDI-TOF): Mass calculated for $C_{27}H_{24}NO_3P$ $[M+H+Na]^+$, 465.2. Found 465.8.



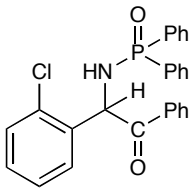
2-(Diphenylphosphinamide)-2-(2-methoxyphenyl)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 81 mg (70%) of **27** as a white foam. R_f = 0.50 (100% ethyl acetate); Mp: 80-80.5 °C; IR (film) 3175, 3057, 1686, 1204 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.91-7.82 (m, 4H); 7.68-7.64 (m, 2H); 7.47-7.39 (m, 5H); 7.37-7.22 (m, 4H); 7.14-7.10 (m, 2H); 6.82-6.79 (m, 1H); 6.60-6.58 (m, 1H); 6.36 (dd, *J* = 10.2, 8.1 Hz, 1H); 5.02 (dd, *J* = 7.6, 7.6 Hz, 1H); 3.47 (s, 3H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.9, 156.0, 134.5, 133.9, 133.6, 133.0, 132.9, 132.0, 131.8, 131.7, 131.5, 129.7, 129.1, 128.9, 128.8, 128.7, 128.6, 128.1, 128.0, 128.0, 121.3, 111.2, 55.4, 53.0; LRMS (MALDI-TOF): Mass calculated for $C_{27}H_{24}NO_3P$ $[M+Na]^+$, 464.2. Found 464.9.



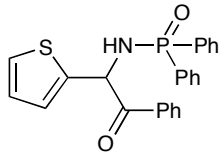
2-(Diphenylphosphinamide)-2-(napthalen-2-yl)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 97 mg (80%) of **28** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 134-135 °C; IR (film) 3173, 3056, 1685, 1200 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.92-7.84 (m, 4H), 7.73-7.62 (m, 5H); 7.54-7.41(m, 7H); 7.32-7.25 (m, 4H); 7.15-7.13 (m, 2H); 6.15 (dd, *J* = 9.2, 9.2 Hz, 1H); 5.06 (dd, *J* = 8.0, 8.0 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.6, 136.3, 134.4, 133.9, 133.5, 133.0, 132.7, 132.6, 132.5, 132.5, 131.9, 131.9, 131.8, 131.6, 129.4, 129.3, 128.9, 128.8, 128.3, 128.2, 127.9, 127.8, 126.6, 126.5, 125.4, 59.6; LRMS (MALDI-TOF): Mass calculated for $C_{30}H_{24}NO_2P$ $[M+H+Na]^+$, 485.2. Found 485.1.



2-(3,4-Dichlorophenyl)-2-(diphenylphosphinamide)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 85 mg (67%) of **29** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 111-112 °C; IR (film) 3157, 3057, 1686, 1189 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.84-7.81 (m, 4H); 7.68-7.64 (m, 2H); 7.50-7.30 (m, 9H); 7.20-7.17 (m, 2H); 7.00-6.98 (m, 1H); 5.95 (dd, *J* = 8.5, 8.5 Hz, 1H); 5.02 (dd, *J* = 8.06, 8.06 Hz, 1H);^{13}C NMR (500 MHz, $CDCl_3$) δ 195.7, 195.7, 139.1, 134.3, 133.9, 133.1, 132.6, 132.5, 132.5, 132.1, 131.9, 131.8, 131.4, 131.1, 130.2, 29.3, 129.1, 129.0, 128.9. 128.5, 128.4, 127.6, 58.3; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{20}Cl_2NO_2P$ $[M+H+Na]^+$, 503.1. Found 503.1.



2-(2-Chlorophenyl)-2-(diphenylphosphinamide)-1-phenylethanone: Purified with 1% methanol/ethyl acetate, yielding 90 mg (77%) of **30** as a white foam. R_f = 0.69 (100% ethyl acetate); Mp: 158-158.5 °C; IR (film) 3149, 3058, 1685, 1197 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.90-7.83 (m, 4H); 7.70-7.67 (m, 2H); 7.47-7.38 (m, 7H); 7.37-7.31 (m, 3H); 7.25-7.06 (m, 3H); 6.35 (dd, *J* = 10.2, 7.5 Hz, 1H); 5.09 (dd, *J* = 7.2, 7.2 Hz, 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.3, 136.9, 134.2, 134.0, 133.6, 132.9, 132.8, 132.5, 132.2, 131.8, 131.7, 131.5, 130.3, 129.8, 129.6, 129.1, 128.9, 128.8, 128.3, 128.2, 127.7, 56.4; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{21}ClNO_2P$ $[M+H+Na]^+$, 469.1. Found 469.6.

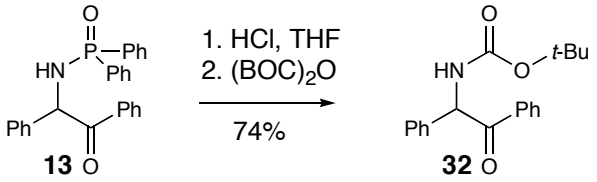


2-(Diphenylphosphinamide)-1-phenyl-2-(thiophen-2-yl)ethanone: Purified with 1% methanol/ethyl acetate, yielding 87 mg (80%) of **31** as a white foam. R_f = 0.61 (100% ethyl acetate); IR (film) 3187, 2058, 1685, 1199 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.92-7.80 (m, 6H); 7.51-7.36 (m, 9H); 7.16-7.15 (m, 1H); 6.77 (s, 2H); 6.24 (dd, *J* = 9.3, 9.3 Hz, 1H); 4.89 (dd, *J* = 8.4, 8.4 Hz, 1H);^{13}C NMR (500 MHz, $CDCl_3$) δ 195.6, 141.9, 134.1, 133.2, 132.7, 132.6, 132.4, 132.1, 132.0, 131.9, 131.6, 129.4, 128.9, 128.8, 128.6, 128.5, 127.3, 127..2, 126.5, 54.1; LRMS (MALDI-TOF): Mass calculated for $C_{24}H_{20}NO_2PS$ $[M+H+Na]^+$, 441.1. Found 440.7.

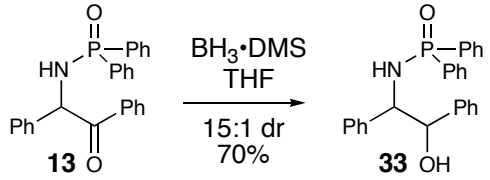
Determination of Silyl Acceptor: An authentic sample of 3-trimethylsilyloxy-octane was prepared by combining 3-octanol (1 mL, 6.29 mmol), trimethylsilyl chloride (2.4 mL, 18.9 mmol), and triethylamine (2.6 mL, 18.9 mmol) in CH_2Cl_2 (16 mL) and stirring at room temperature for 24 hours. Upon completion, the reaction mixture was diluted with pentane, washed with water (30 mL) and saturated aqueous $CuSO_4$ (3 x 30 mL). The organic layer was dried over Na_2SO_4, filtered, and concentrated *in vacuo*. A retention time (4.720 min) was collected on an Agilent Technologies 6890N gas chromatograph (equipped with Agilent 19091J-413 HP-5 5% phenylmethylsiloxane capillary column- 30.0 m x 320 mm x 0.25 mm nominal) using the following conditions: 70 °C for 1 min then a ramp of 25 °C/min to 285 °C with 3 minute hold.

In the experiment, a screw-capped tube was charged with 3,4,5-trimethylthiazolium iodide (**10**, 10 mg, 0.04 mmol) in a nitrogen filled glove box. The tube was removed from box and put

under a positive pressure of nitrogen. Benzoyltrimethylsilane (41 mg, 0.23 mmol) in $CHCl_3$ (0.25 mL) was added by syringe to the tube followed by the addition of DBU (12 μL, 0.04 mmol). The reaction mixture was heated to 60 °C after which imine **12** (0.13 mmol) in $CHCl_3$ (0.25 mL) was added by syringe followed by the addition of 3-octanol (83 μL, 0.52 mmol). The reaction was allowed to stir at 60 °C for 4 hours. At this time an aliquot was filtered through glass wool and analyzed by GC (see above for details). The following retention times were observed: 3.89 min (3-octanol), 4.71 min (3-trimethylsilyloxy-octane), 5.96 min (benzoyltrimethylsilane), 15.00 min (imine). The α-amino ketone product (**13**) was not observed due to its molecular weight and highly polar nature.



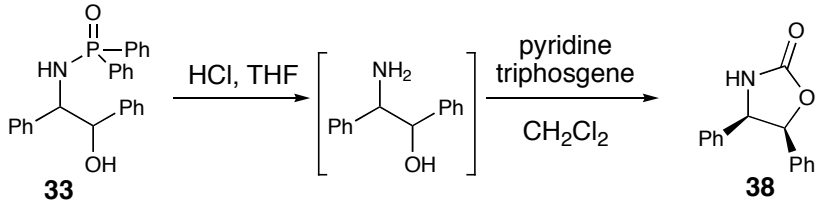
BOC Protection: A flame-dried 10 mL round bottom flask was charged with α-amino ketone **13** (50 mg, 0.122 mmol) and THF (0.6 mL). The resulting solution was cooled to 0 °C and concentrated HCl (0.6 mL) was added. The reaction was allowed to warm to room temperature and stirred for 3 hours. After this time, the reaction was complete as judged by TLC (8:1 methylene chloride:methanol). The reaction was diluted with 5 mL H_2O and 5 mL THF and then neutralized with solid $NaHCO_3$. The reaction mixture was then cooled to 0 °C, $(BOC)_2O$ (40 mg, 0.18 mmol) was added, and allowed to attain room temperature then stirred overnight. Analysis by TLC (100% ethyl acetate) indicated that the reaction was complete. The solution was diluted with ethyl acetate and washed with water. The aqueous layer was extracted with ethyl acetate, and the combined organic layers were dried over anhydrous Na_2SO_4, filtered and then concentrated *in vacuo*. The unpurified residue (60 mg) was then purified by flash column chromatography (SiO_2, 10% ethyl acetate/hexanes) to afford 28 mg (74%) of **32** as a white solid. R_f = 0.44 (20% ethyl acetate/hexanes); Mp = 104-106 °C; IR (film) 3424, 3379, 3061, 22977, 1709, 1684 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.97-7.96 (m, 2H); 7.52-7.50 (m, 1H); 7.41-7.31 (m, 4H); 7.29-7.23 (m, 3H); 6.28 (dd, *J* = 7.5 Hz, 1H), 6.03 (dd, *J* = 6.2 Hz, 1H); 1.44 (s, 9H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 196.4, 155.2, 137.8, 134.8, 133.8, 129.4, 129.3, 128.9, 128.5, 128.3, 80.2, 60.0, 28.6; LRMS (MALDI-TOF): Mass calculated for $C_{19}H_{21}NO_3$ $[M+H+Na]^+$, 335.2. Found 335.3.



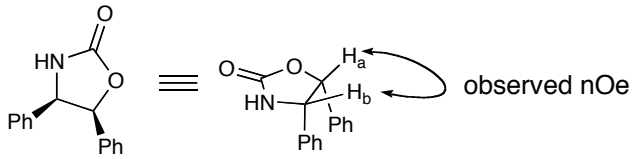
Reduction of α-Amino Ketone 13: To a solution of α-amino ketone **13** (100mg, 0.24 mmol) in THF (2.4 mL) was added DMS-borane (24 μL, 0.25 mmol). After 24 hours at room temperature, the reaction was *carefully* quenched with saturated aqueous NH_4Cl. The reaction was diluted with ethyl acetate and then washed with water. The aqueous layer was extracted two times with ethyl acetate. The organic layers were combined, dried over anhydrous Na_2SO_4, filtered and

then concentrated *in vacuo*. The resulting white solid was purified by flash column chromatography (SiO_2, 1-4% methanol/ethyl acetate), yielding 35 mg (70%) of **33** as a white solid. R_f = 0.69 (100% ethyl acetate); Mp: 229-229.5 °C; IR (KBr) 3337, 1162 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.89-7.82 (m, 3H); 7.54-7.40 (m, 5H); 7.32-7.27 (m, 6H); 7.17-7.16 (m, 3H); 7.05-7.03 (m, 2H); 6.92-6.90 (m, 2H); 5.1 (d, *J* = 2.0 Hz, 1H); 4.74 (dd, *J* = 11.7, 9.9 Hz, 1H); 3.21 (dd, *J* = 11.9, 4.5 Hz, 1H); ^{13}C NMR (500 MHz, CD_3OD) δ 132.2, 132.1, 132.0, 131.9, 128.5, 128.4, 128.3, 128.2, 128.1, 127.8, 127.6, 127.3, 127.1, 126.9, 77.8, 61.8; LRMS (MALDI-TOF): Mass calculated for $C_{26}H_{24}NO_2P$ $[M+Na]^+$, 436.2. Found 436.5.

Determination of Relative Stereochemistry:



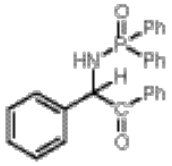
A flame-dried 10 mL round bottom flask was charged with **33** (73 mg) and THF (0.8 mL), then cooled to 0 °C at which time concentrated HCl (0.8 mL) was added. Reaction was allowed to warm to room temperature and stirred overnight. Upon completion of the reaction (as judged by TLC) solid K_2CO_3 was added to adjust the pH to 10. The reaction was then extracted 3 times with CH_2Cl_2. The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated *in vacuo* to ~2 mL. This solution was then cooled to –78 °C and pyridine (20 μL, 0.25 mmol) was added by syringe, followed by triphosgene (35 mg, 0.12 mmol). The cold reaction mixture was stirred for 4 hours, after which time it was quenched with saturated aqueous $NaHCO_3$. The biphasic mixture was diluted with ethyl acetate, the layers were separated, and the organic layer was washed with 1M HCl, followed by saturated aqueous $NaHCO_3$. The organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated *in vacuo*. The resulting residue (28 mg) was purified by flash column chromatography (30-50% ethyl acetate/hexanes) yielding 10 mg (24%) of **38** as a white solid. R_f = 0.40 (50% ethyl acetate/hexanes); IR (KBr) 3277, 3171, 3034, 1712 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.12(s, 6H), 6.97 (s, 4H); 5.96 (d, *J* = 8.1 Hz, 1H); 5.75 (s, 1H); 5.20 (d, *J* = 8.1 Hz; 1H); ^{13}C NMR (500 MHz, $CDCl_3$) δ 147.0, 136.2, 134.6, 128.5, 128.3, 128.2, 127.2, 126.4, 82.6, 61.7; LRMS (MALDI-TOF): Mass calculated for $C_{15}H_{13}NO_2$ $[M+Na]^+$, 262.3. Found 262.5. The relative stereochemistry of the two phenyl substituents of the 2-oxazolidinone product was determined to be cis by 1D NOE experiments as well as by comparison to spectra reported for the cis and trans products.

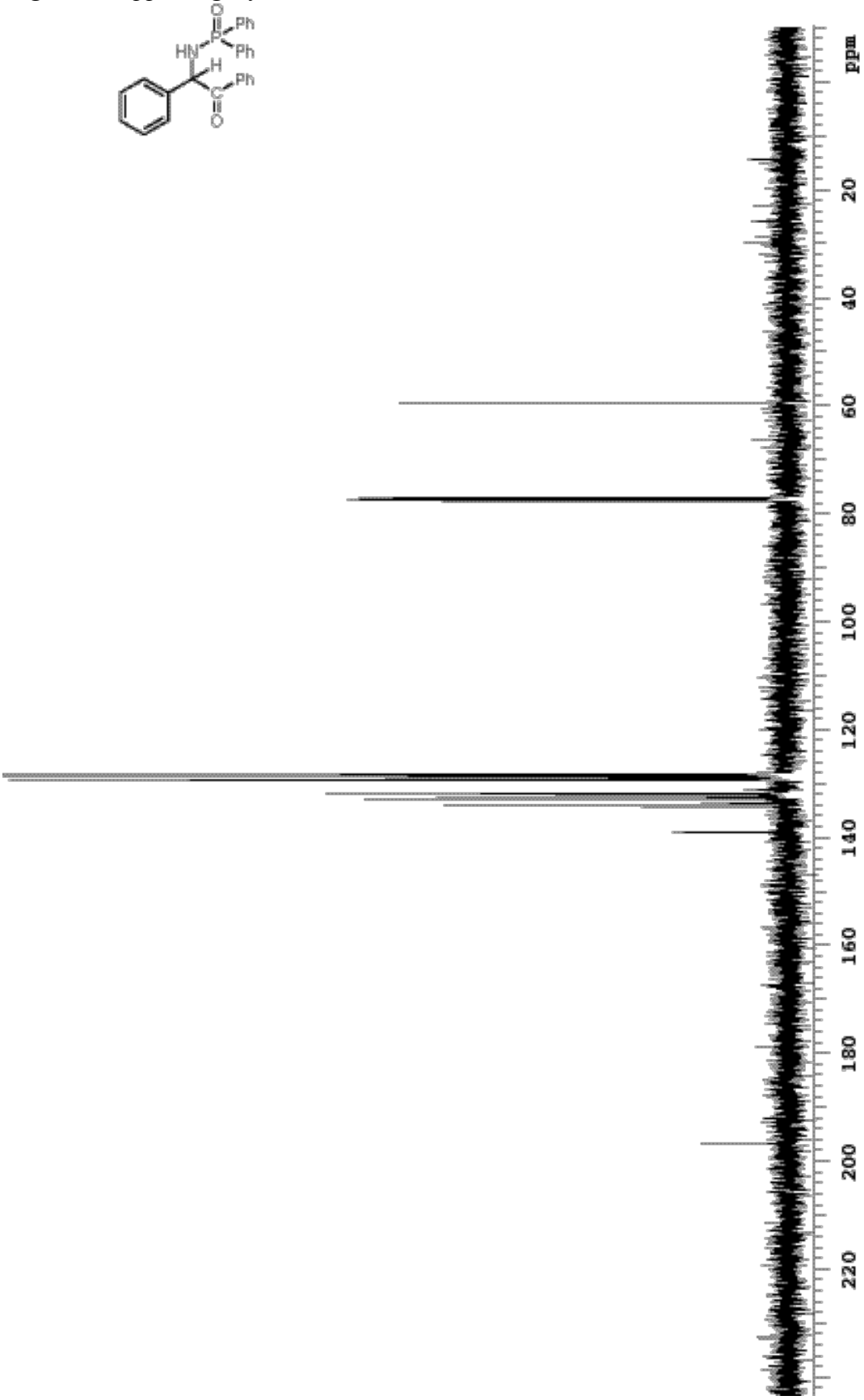


	38	Cis[6]	Trans[7]
H_a	5.96ppm	5.95ppm	5.24ppm
H_b	5.20ppm	5.15ppm	4.76ppm

6. Pirkle, W.; Simmons, K. *J. Org. Chem.* **1983**, *48*, 2520-2527.
7. Foglia, T.; Swern, D. *J. Org. Chem.* **1968**, *34*, 1680-1684.

Selected NMR Spectra

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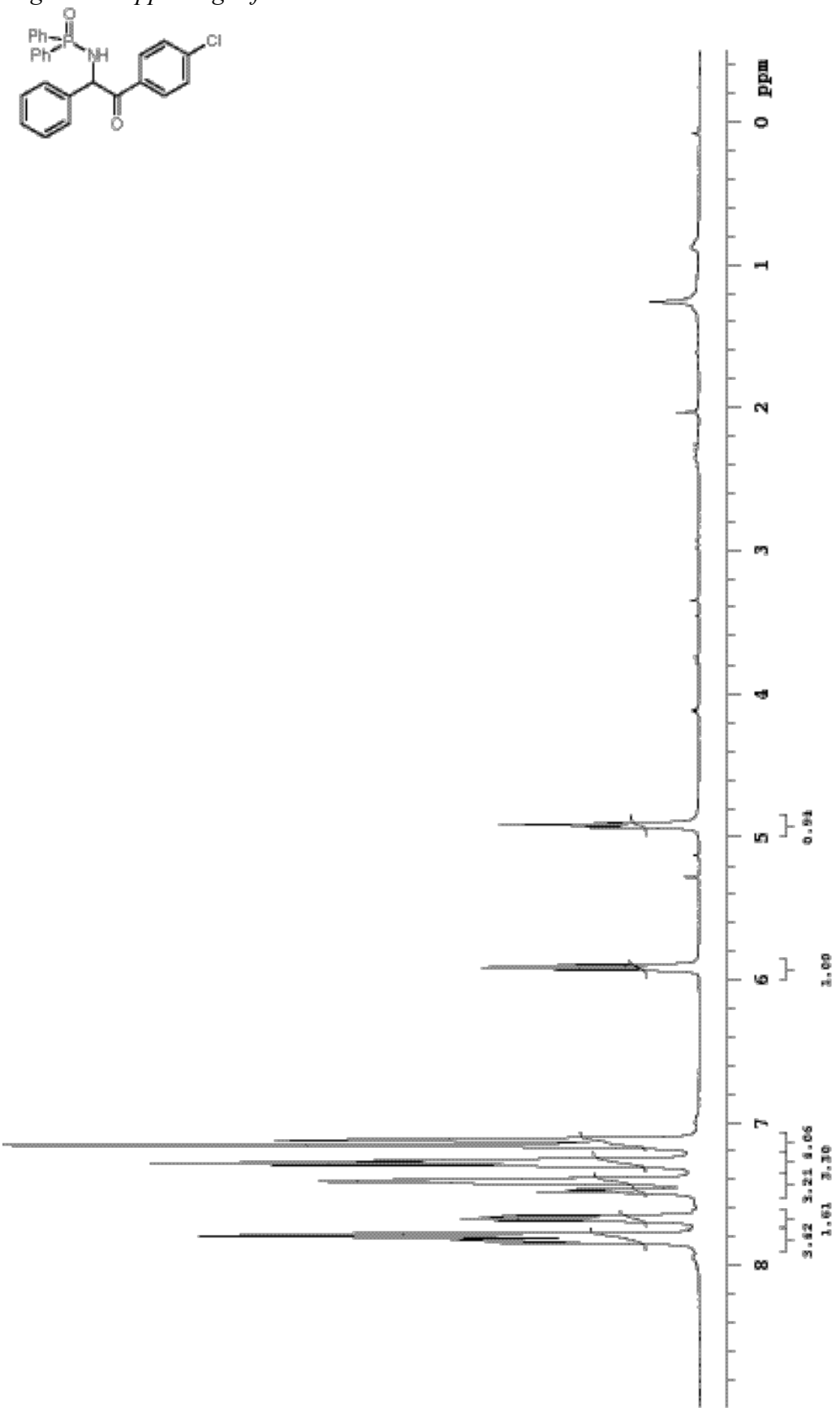
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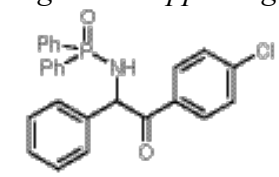
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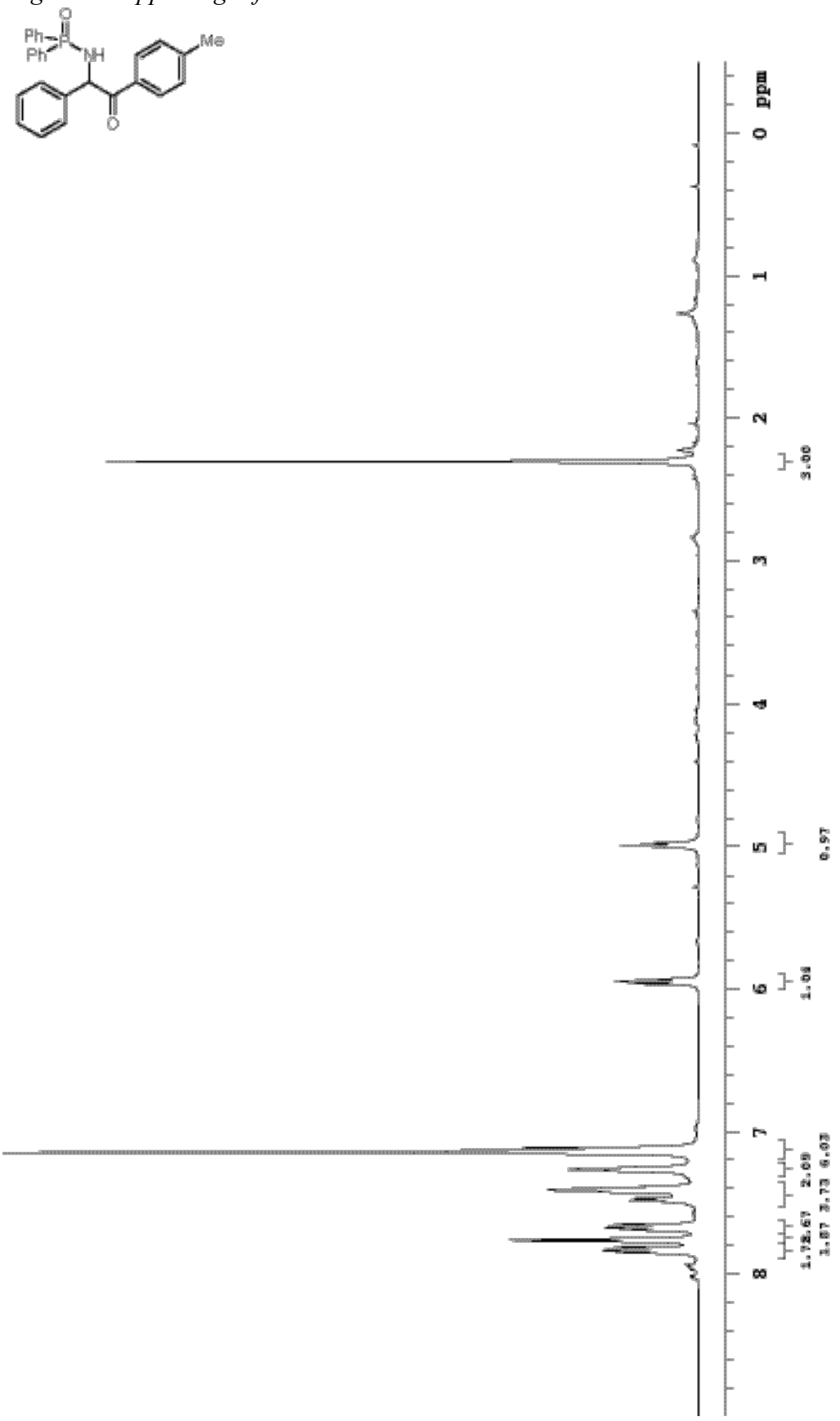
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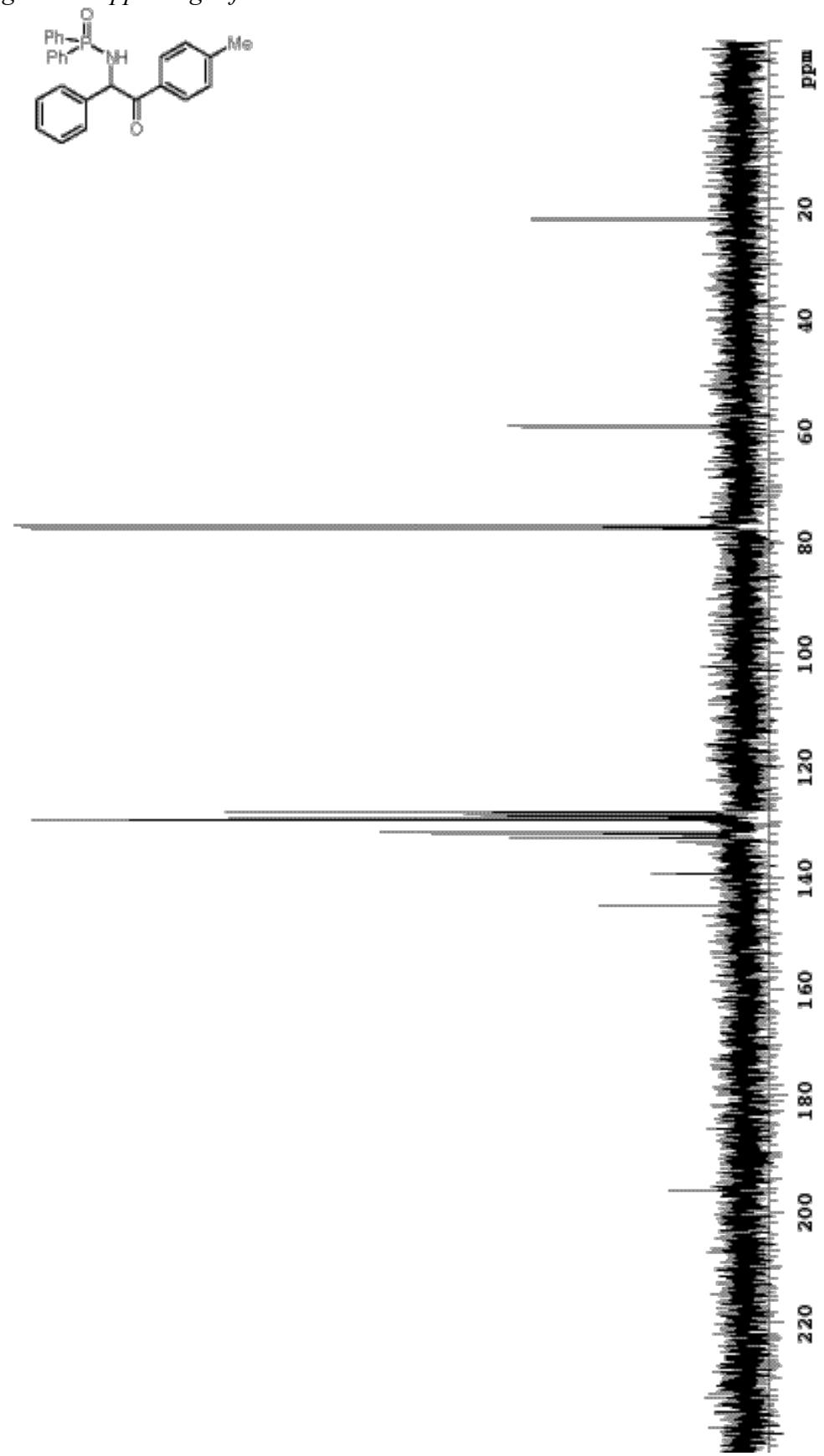
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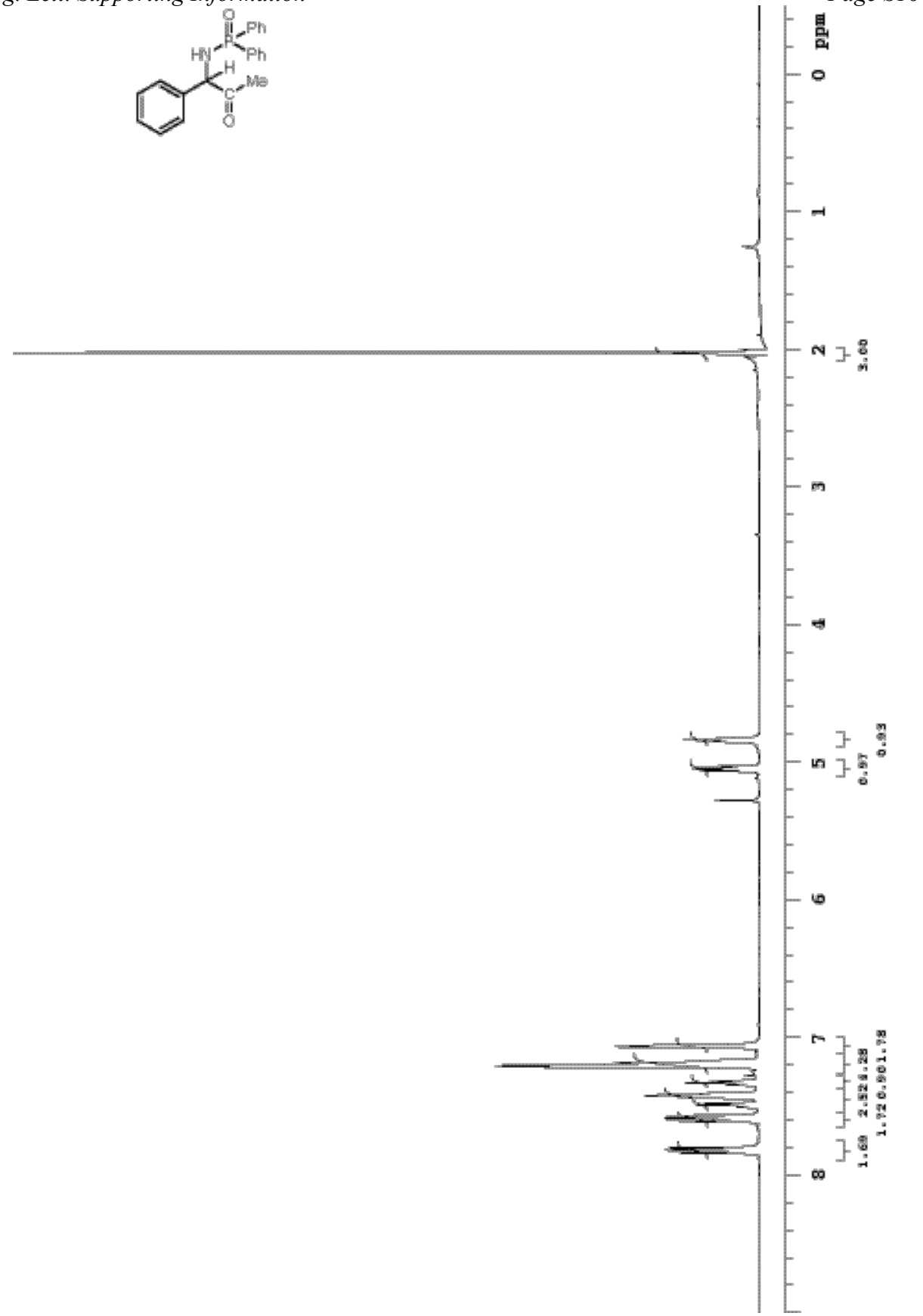
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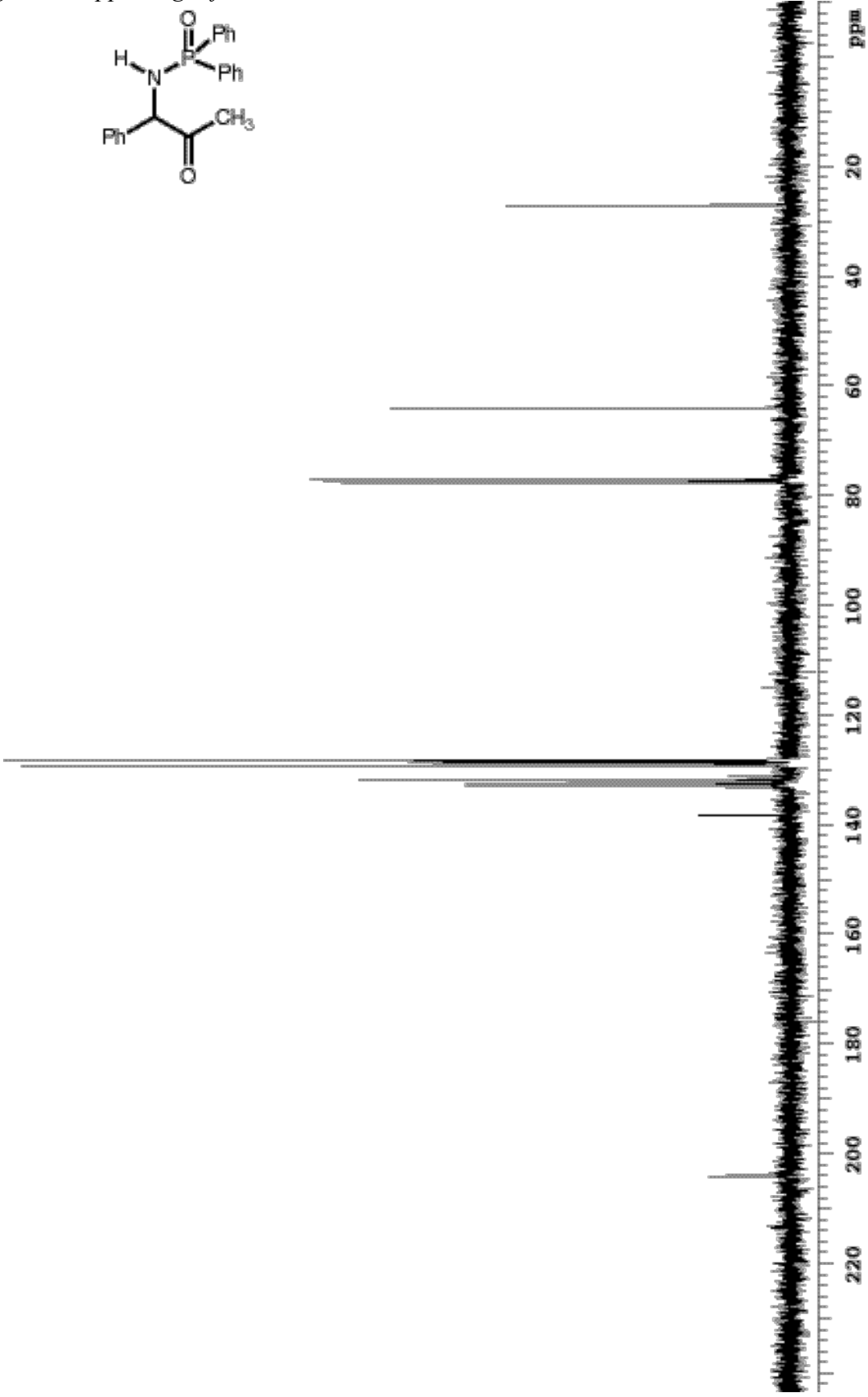
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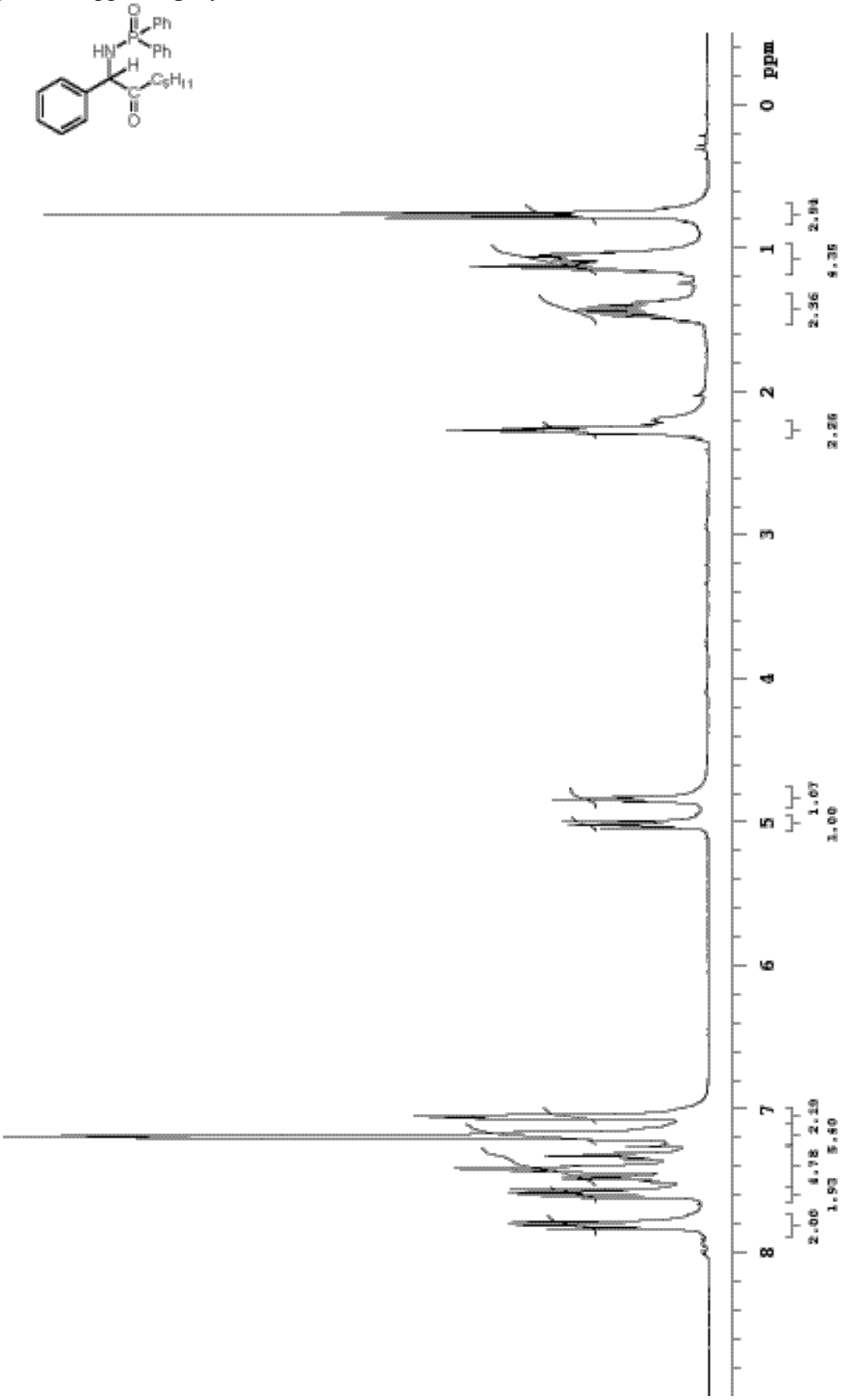
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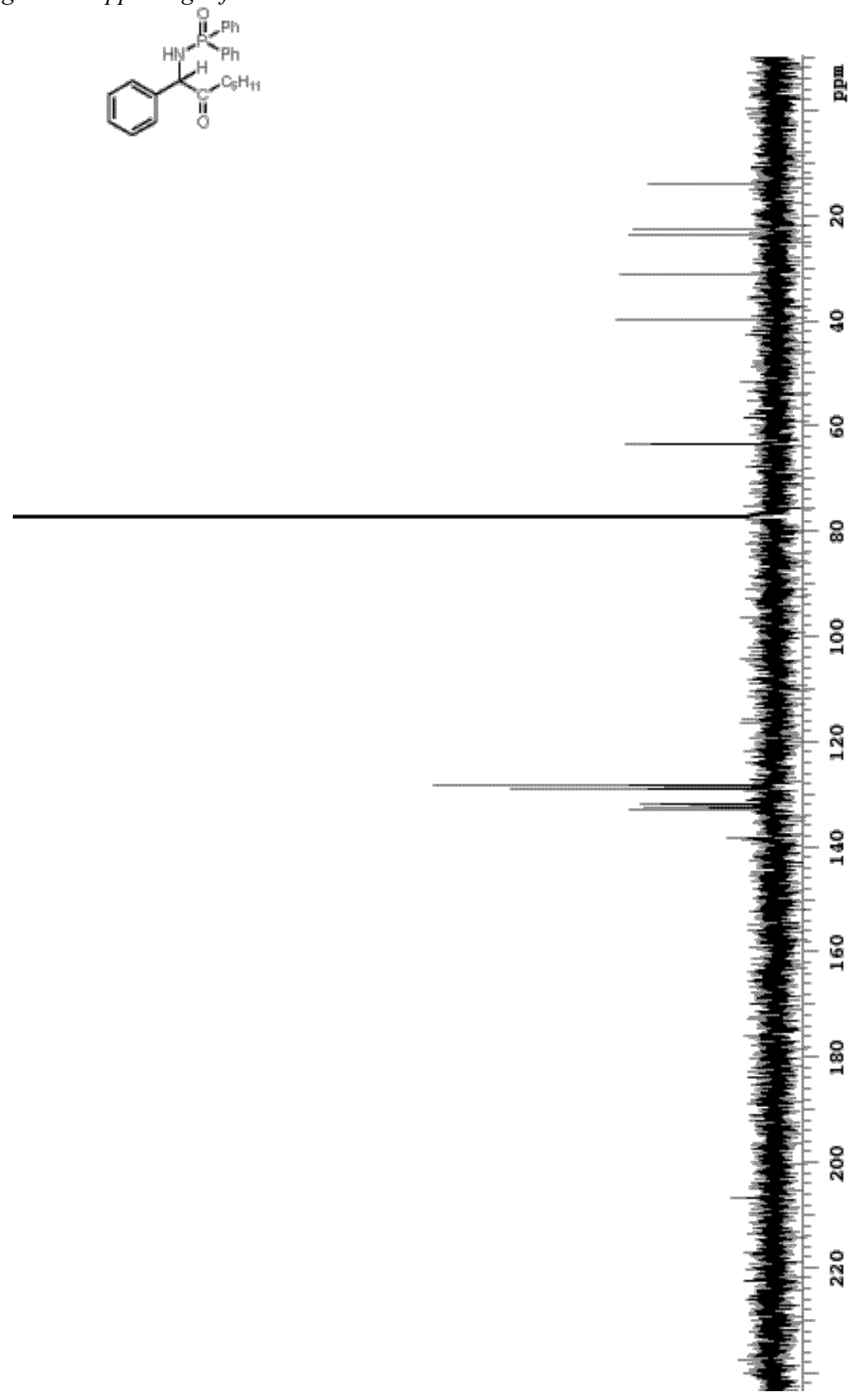
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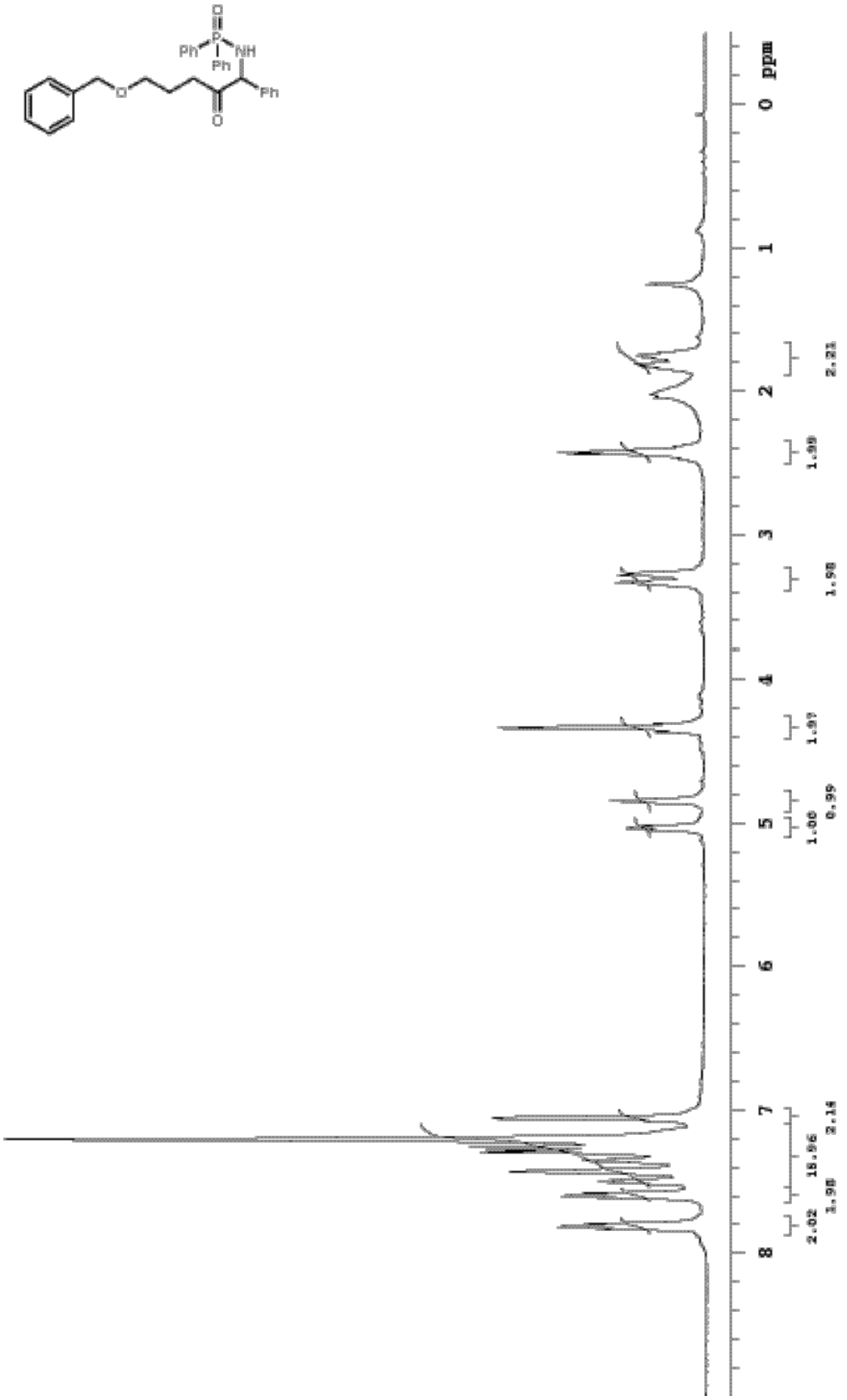
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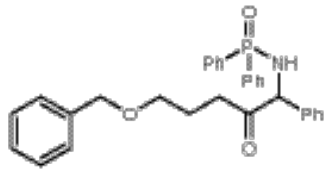
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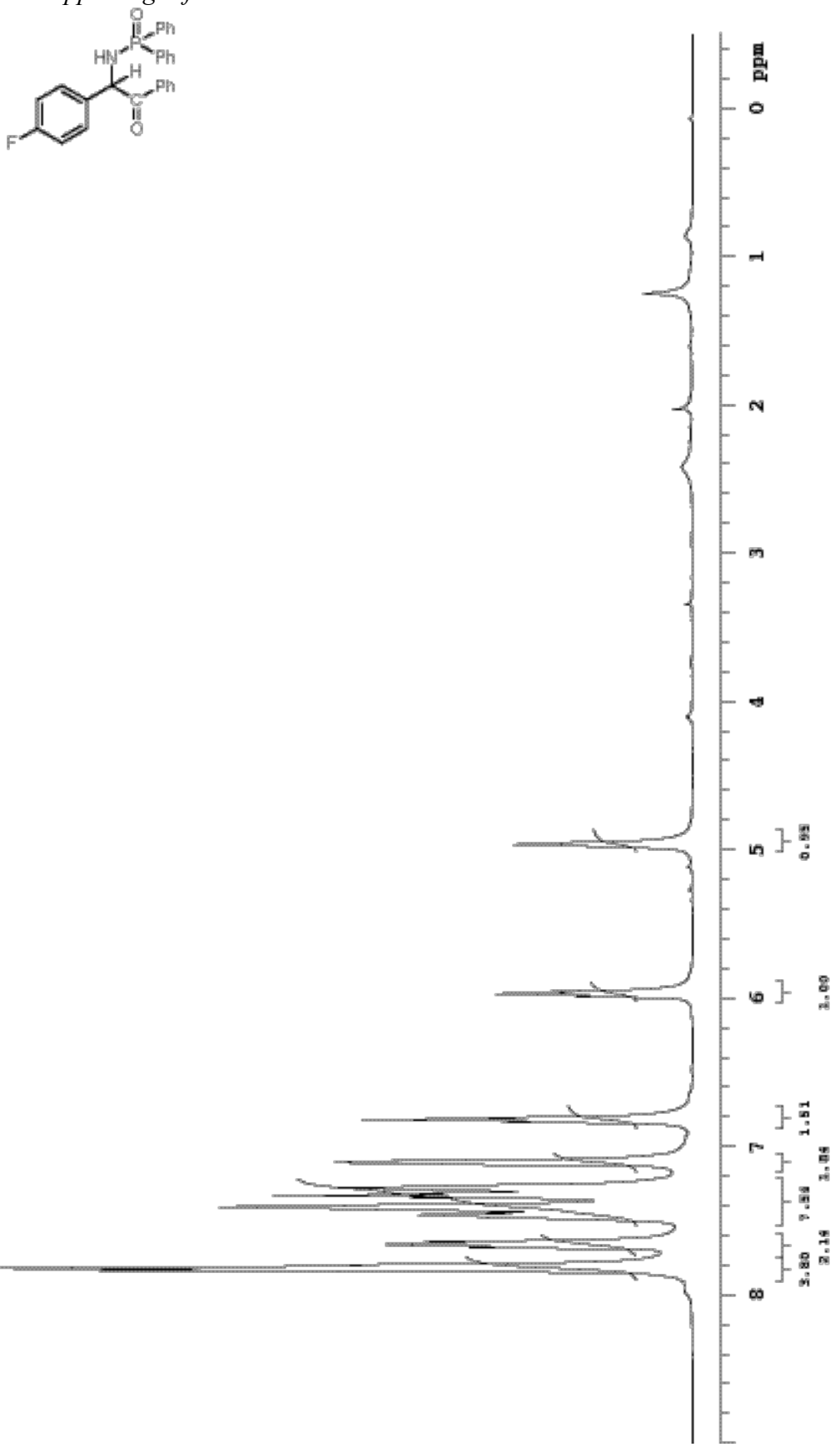
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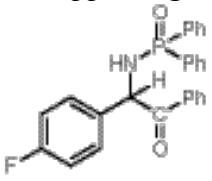
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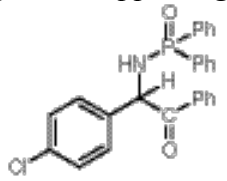
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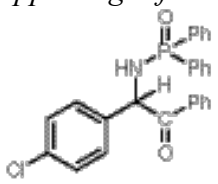
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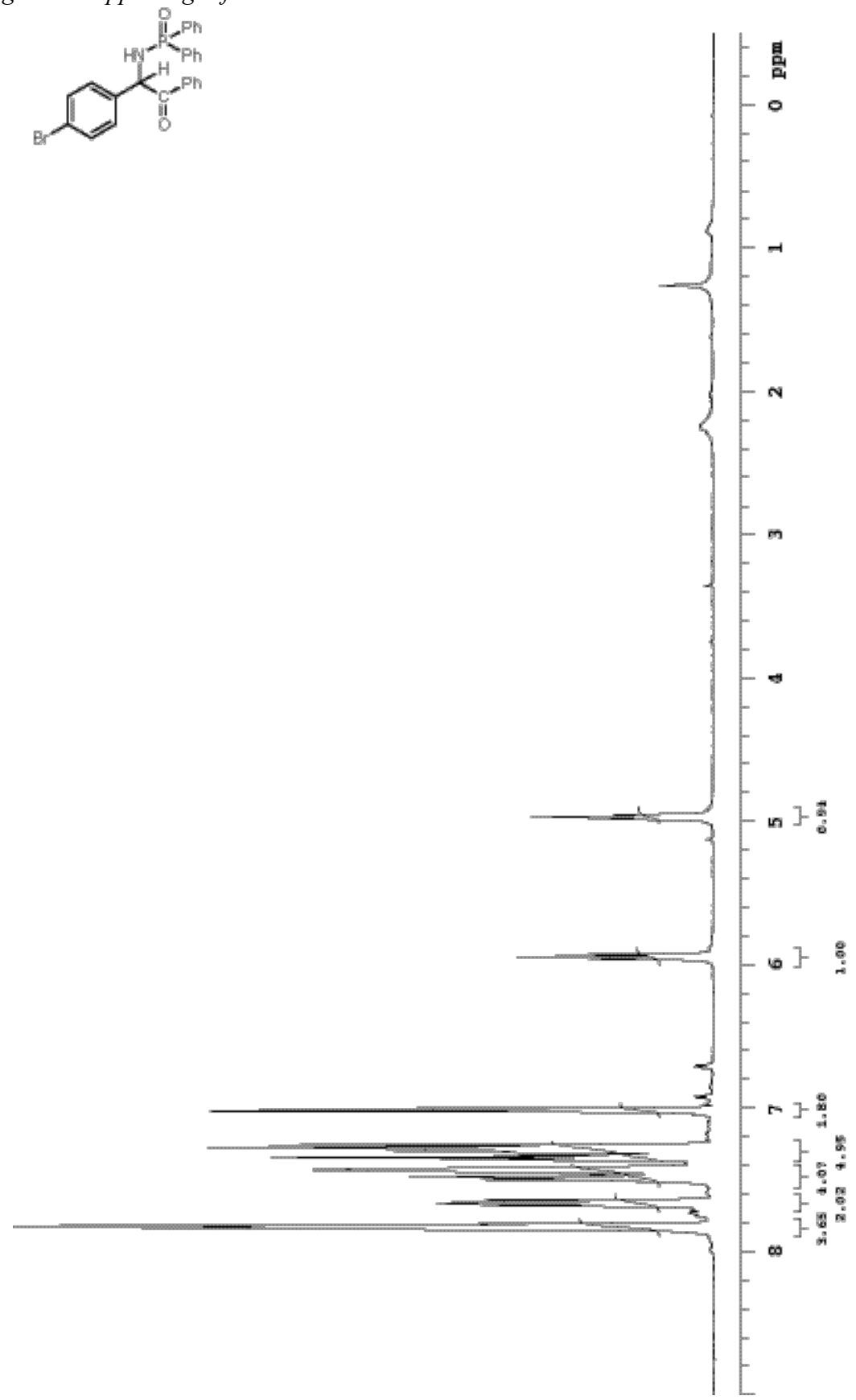
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Ph
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Br
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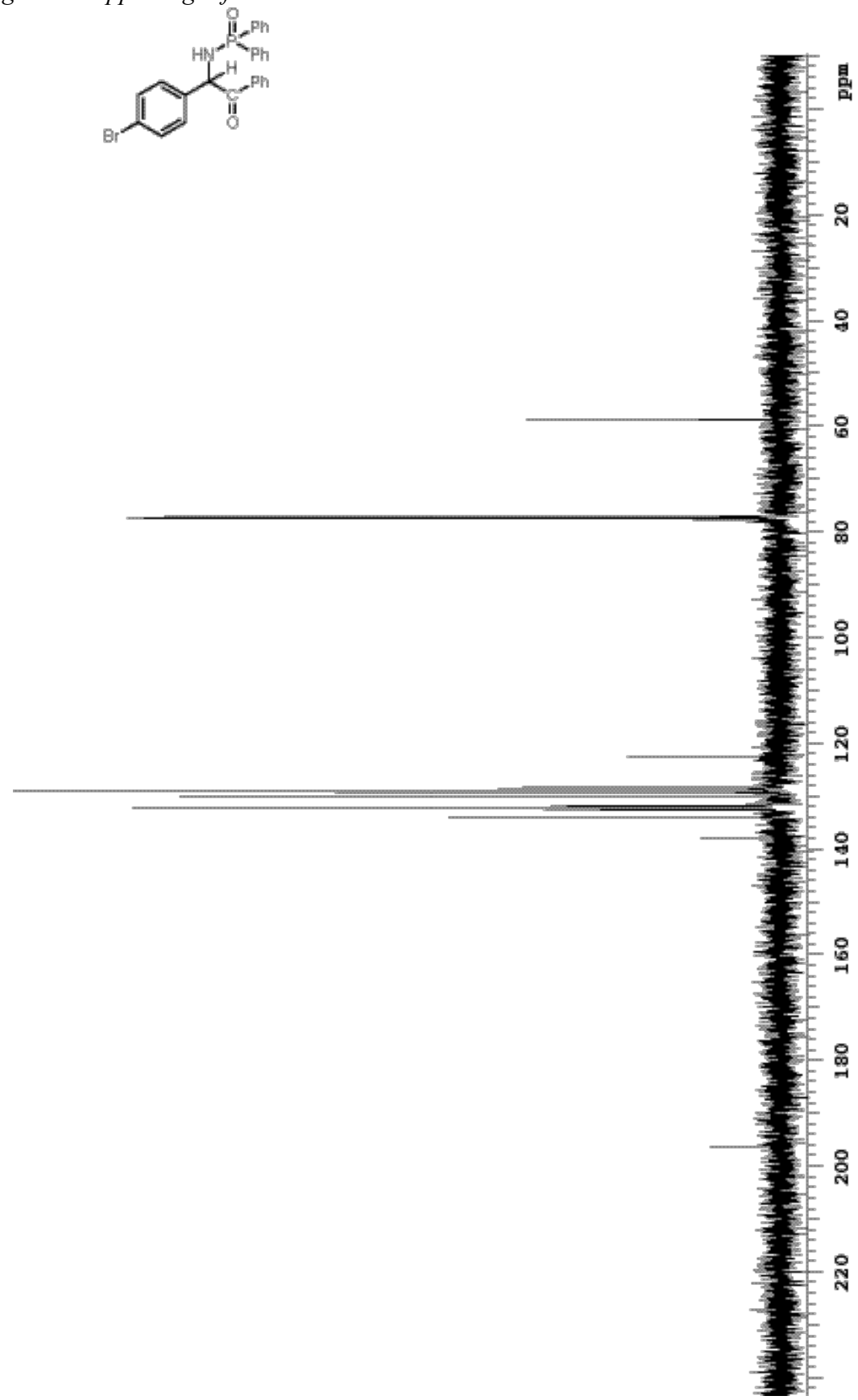
2.02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C
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Br
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200
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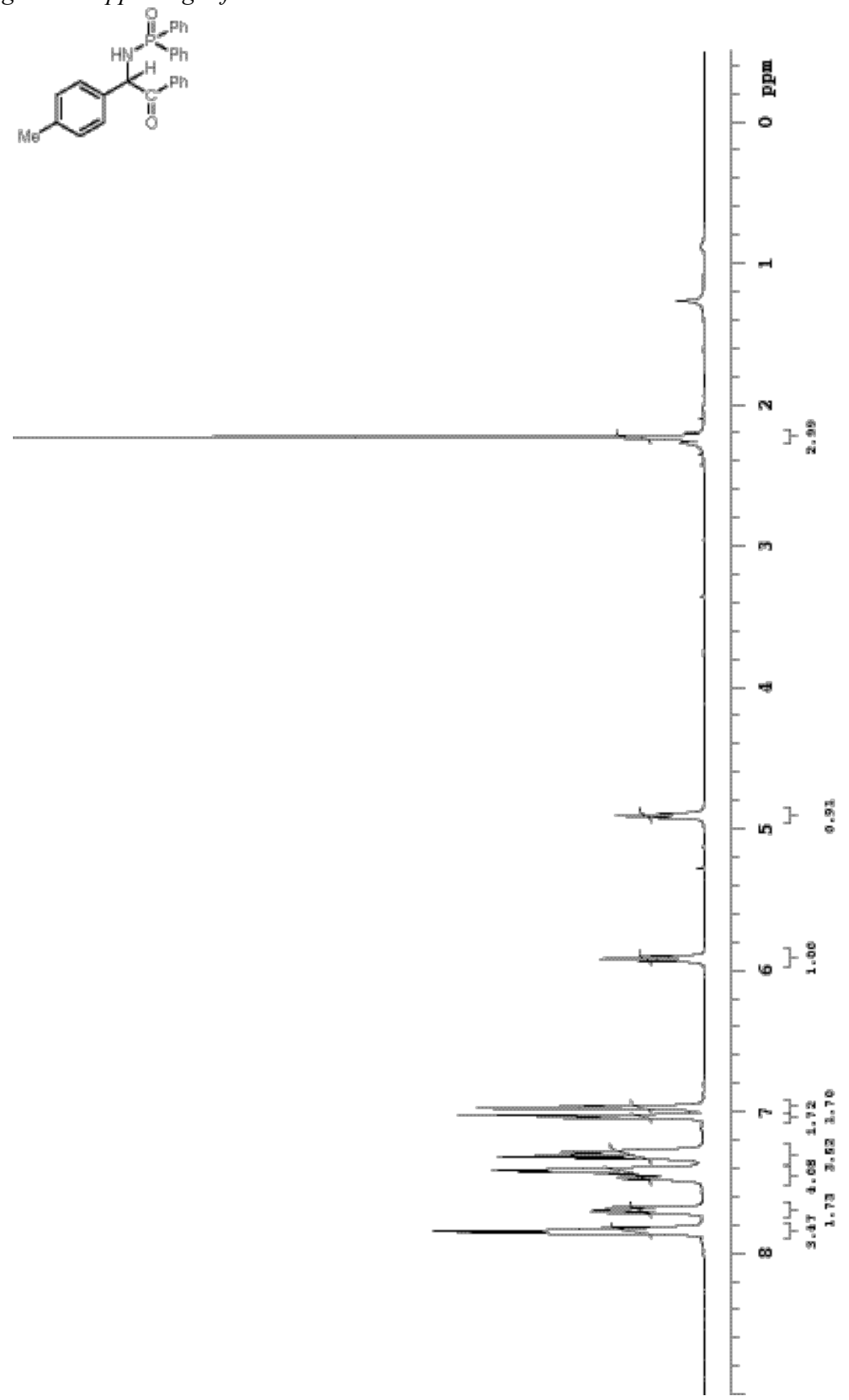
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H
Ph
C
O
Me
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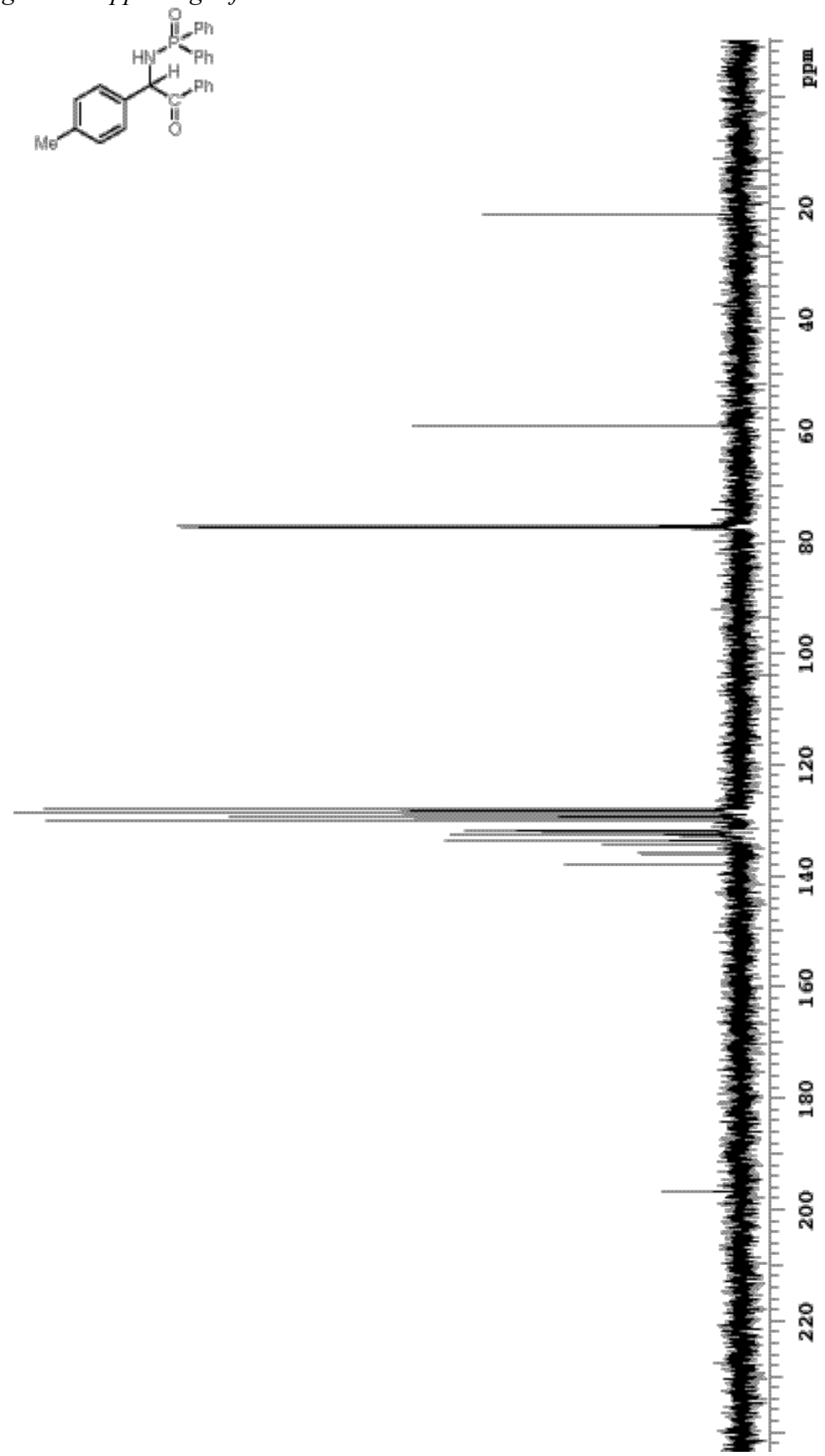
1.70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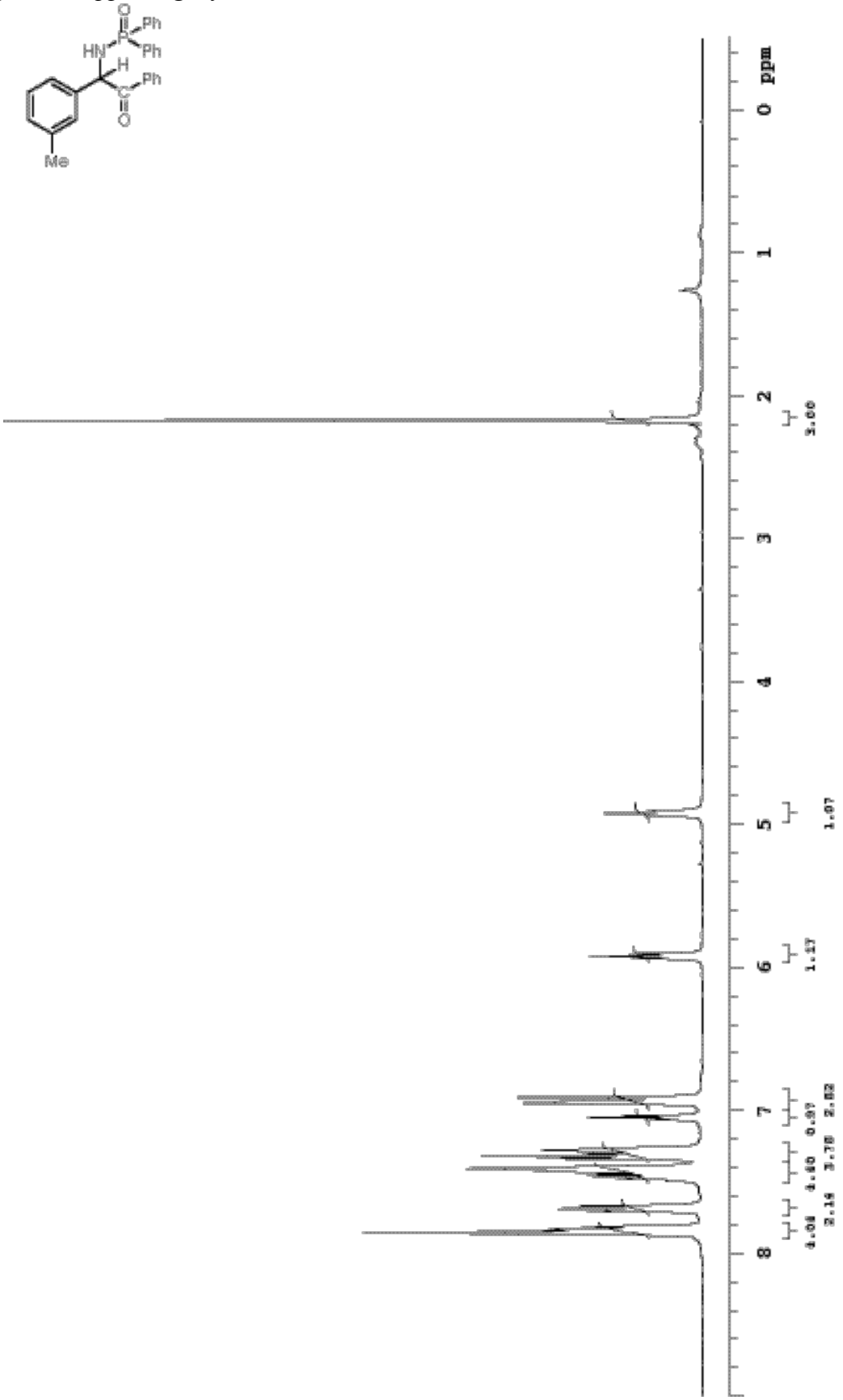
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Ph
HN
H
Ph
C
O
Me
ppm
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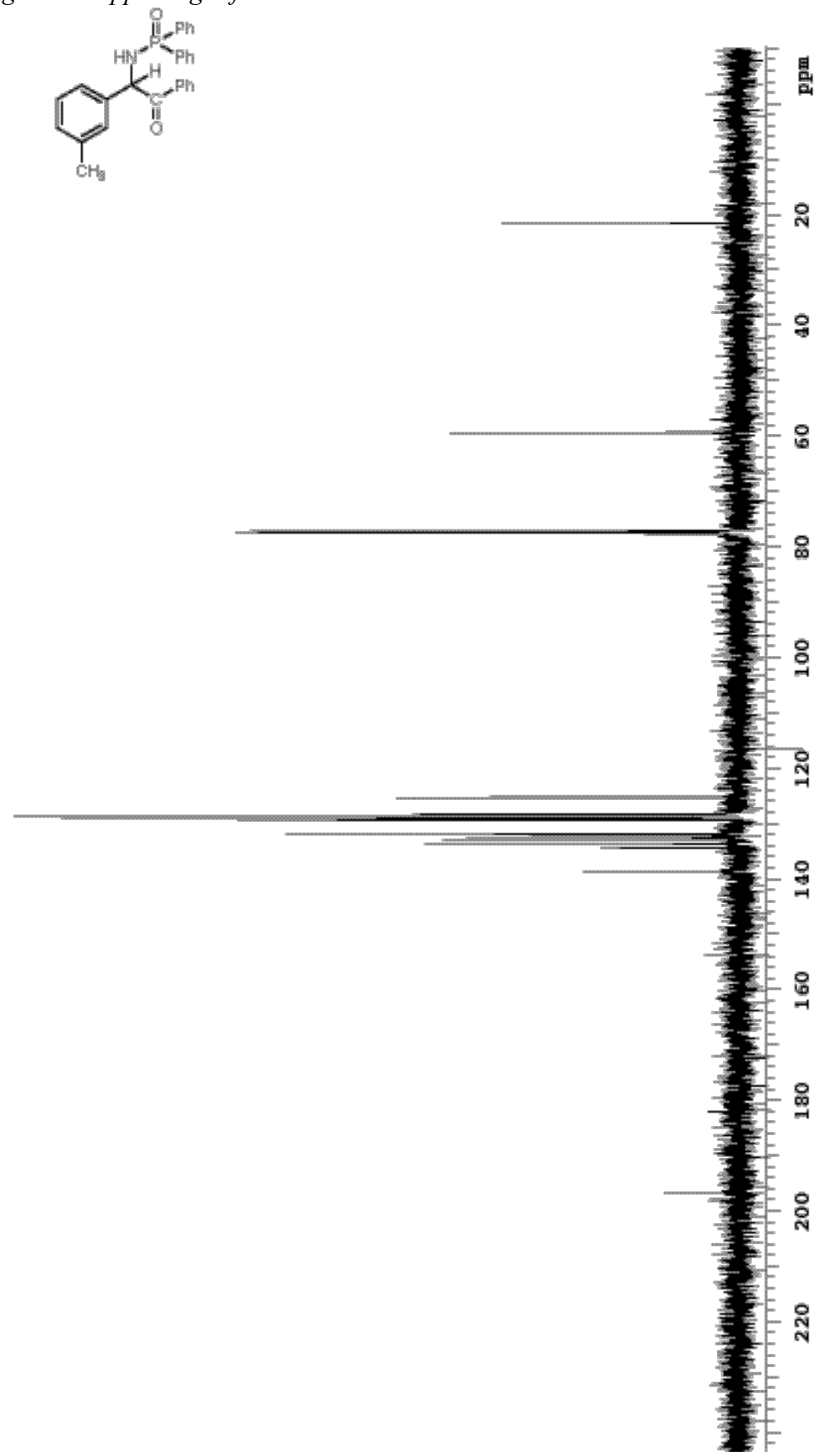
2.14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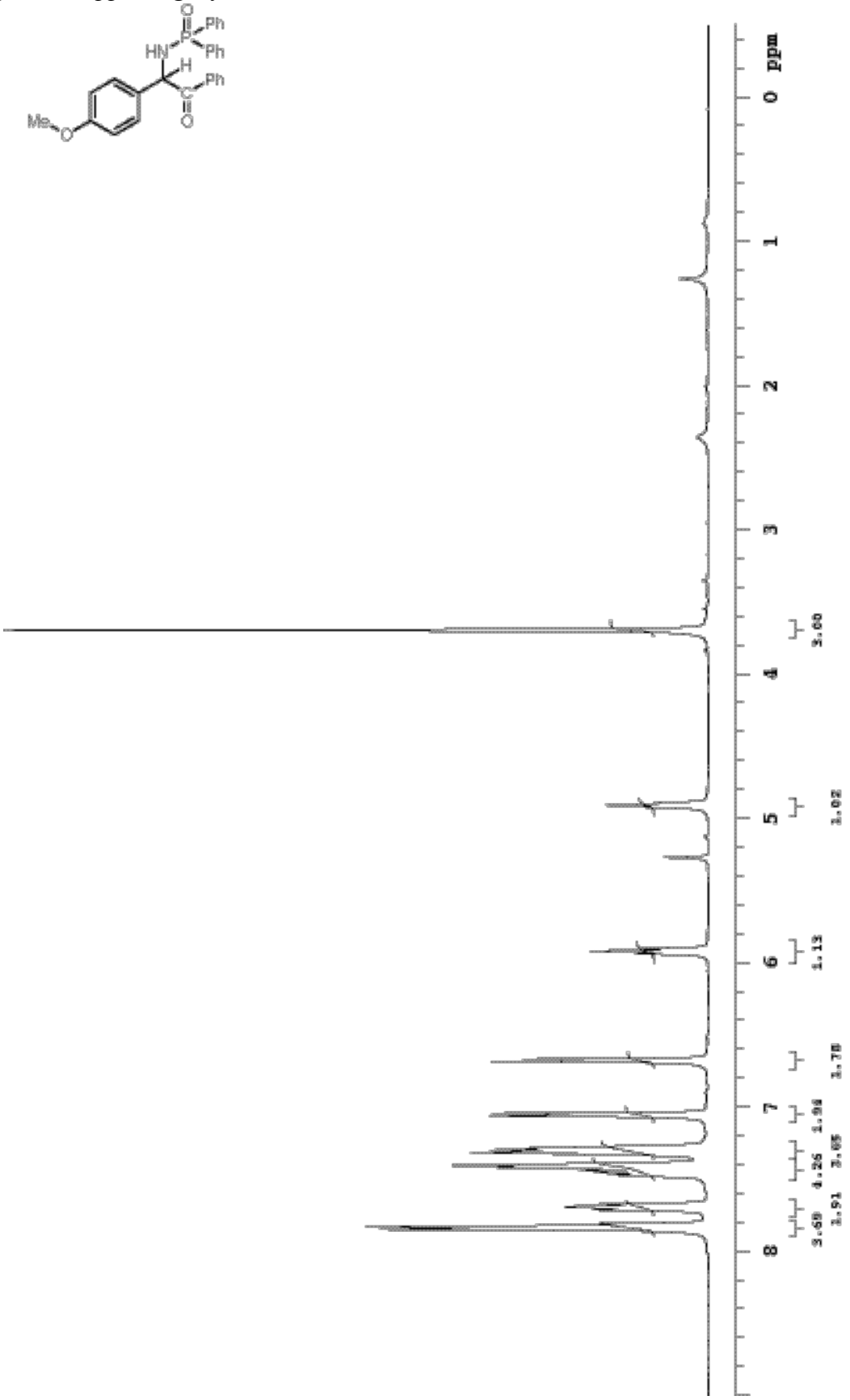
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H
Ph
C
O
Me
O
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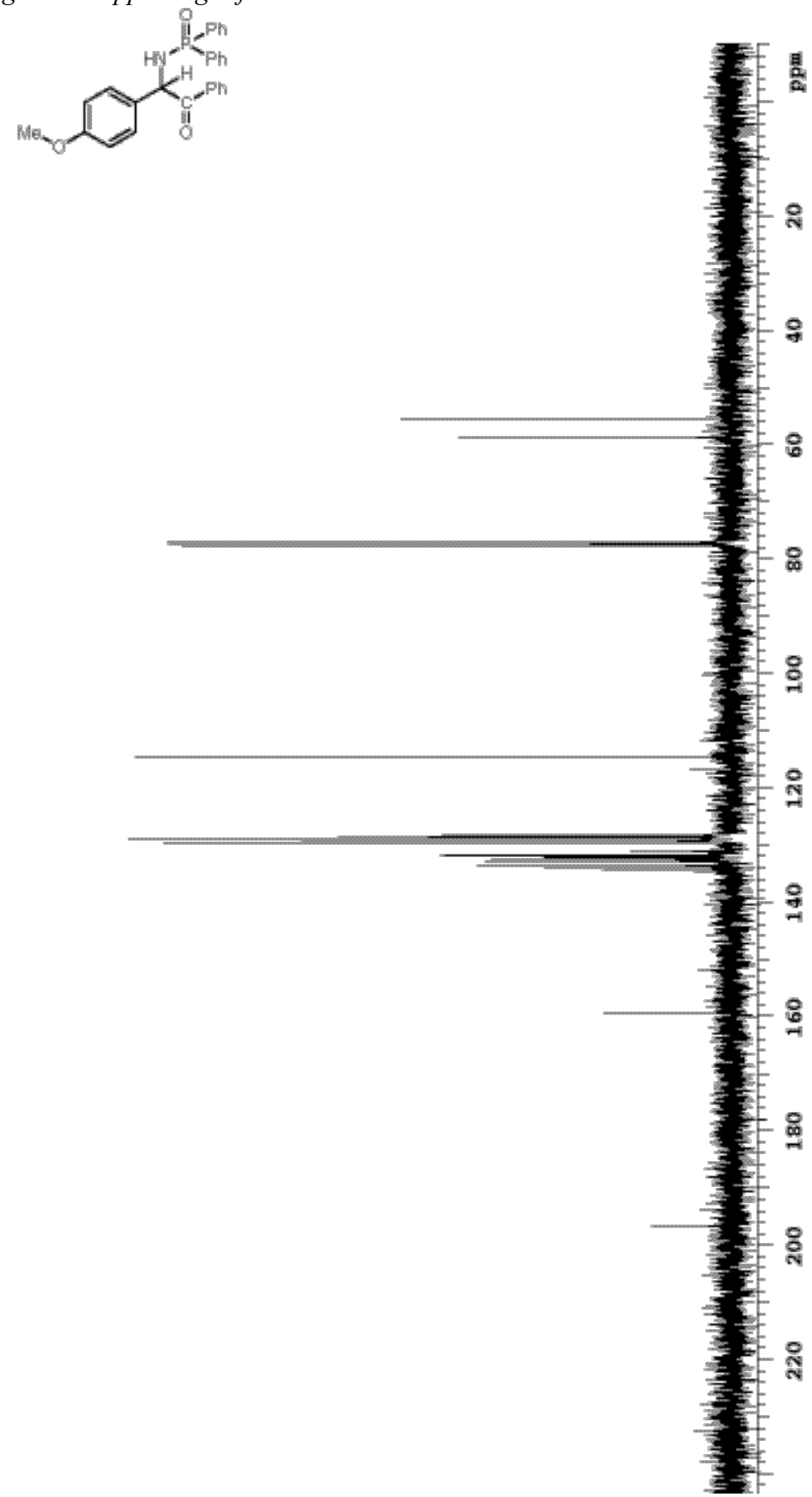
1.91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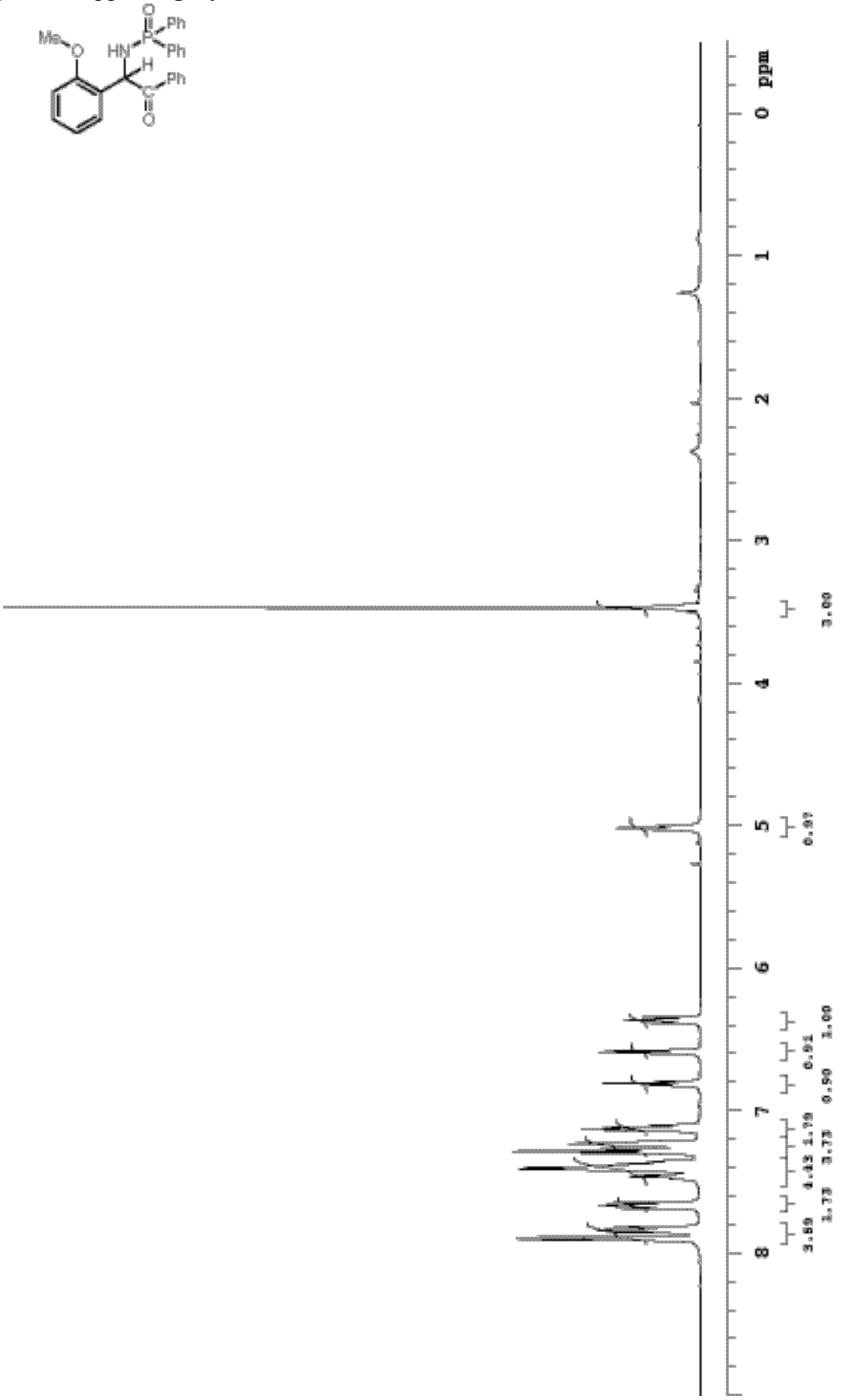
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Ph
C
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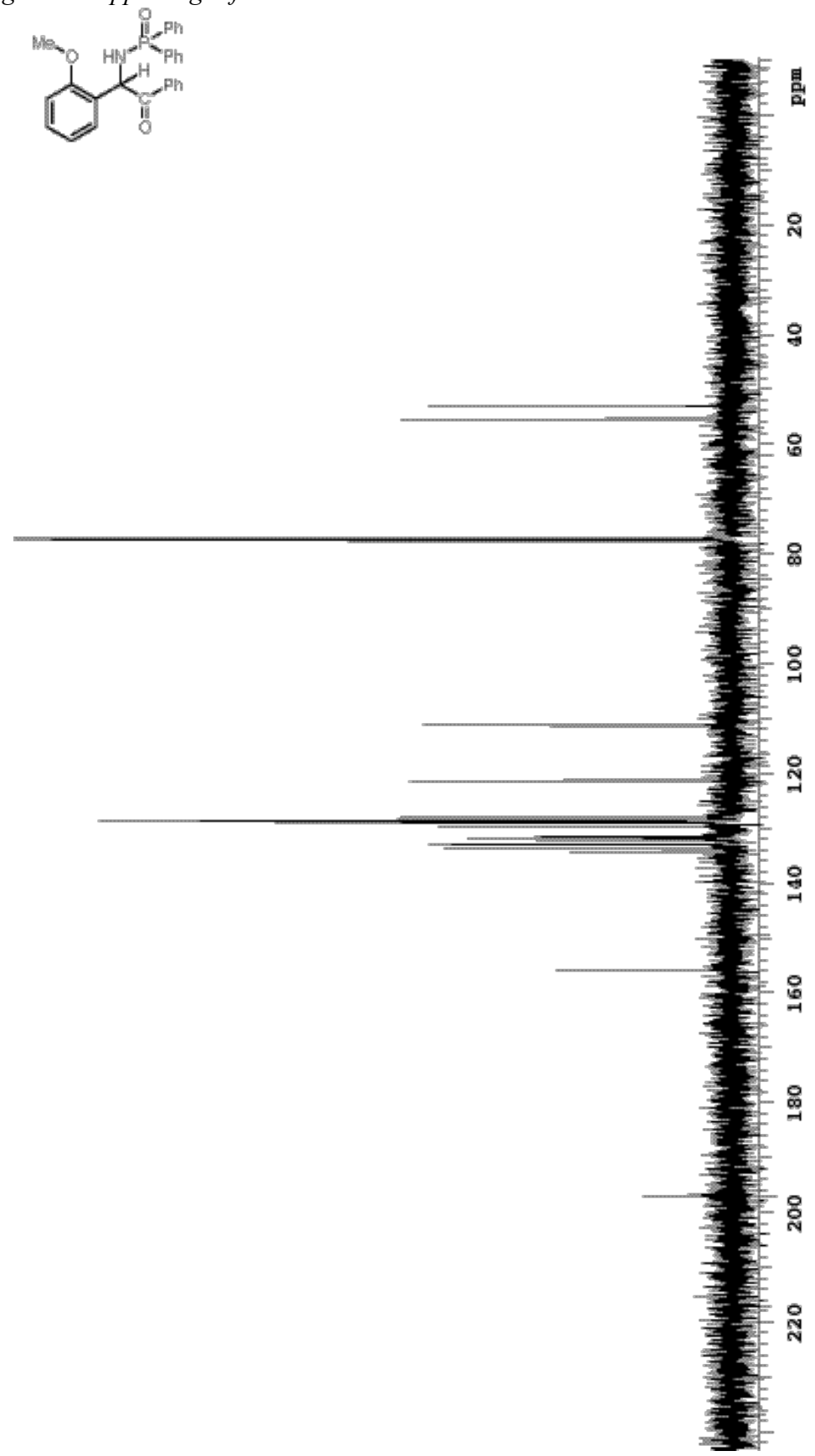
1.00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100
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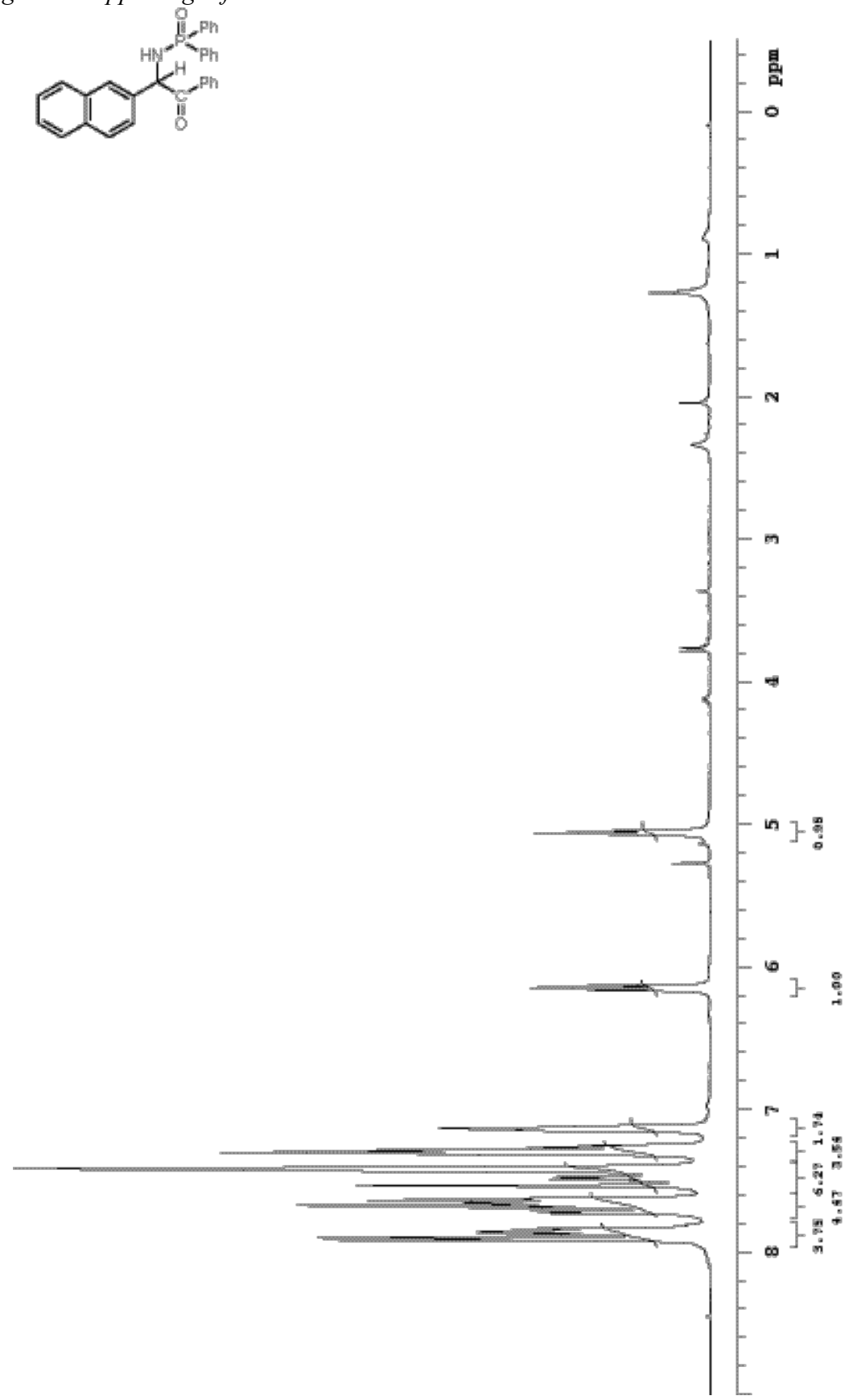
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Ph
HN
H
Ph
C
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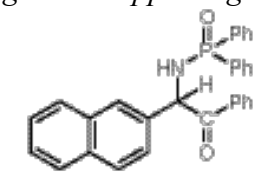
6.27
3.56
4.67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H
Ph
C
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ppm
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60
80
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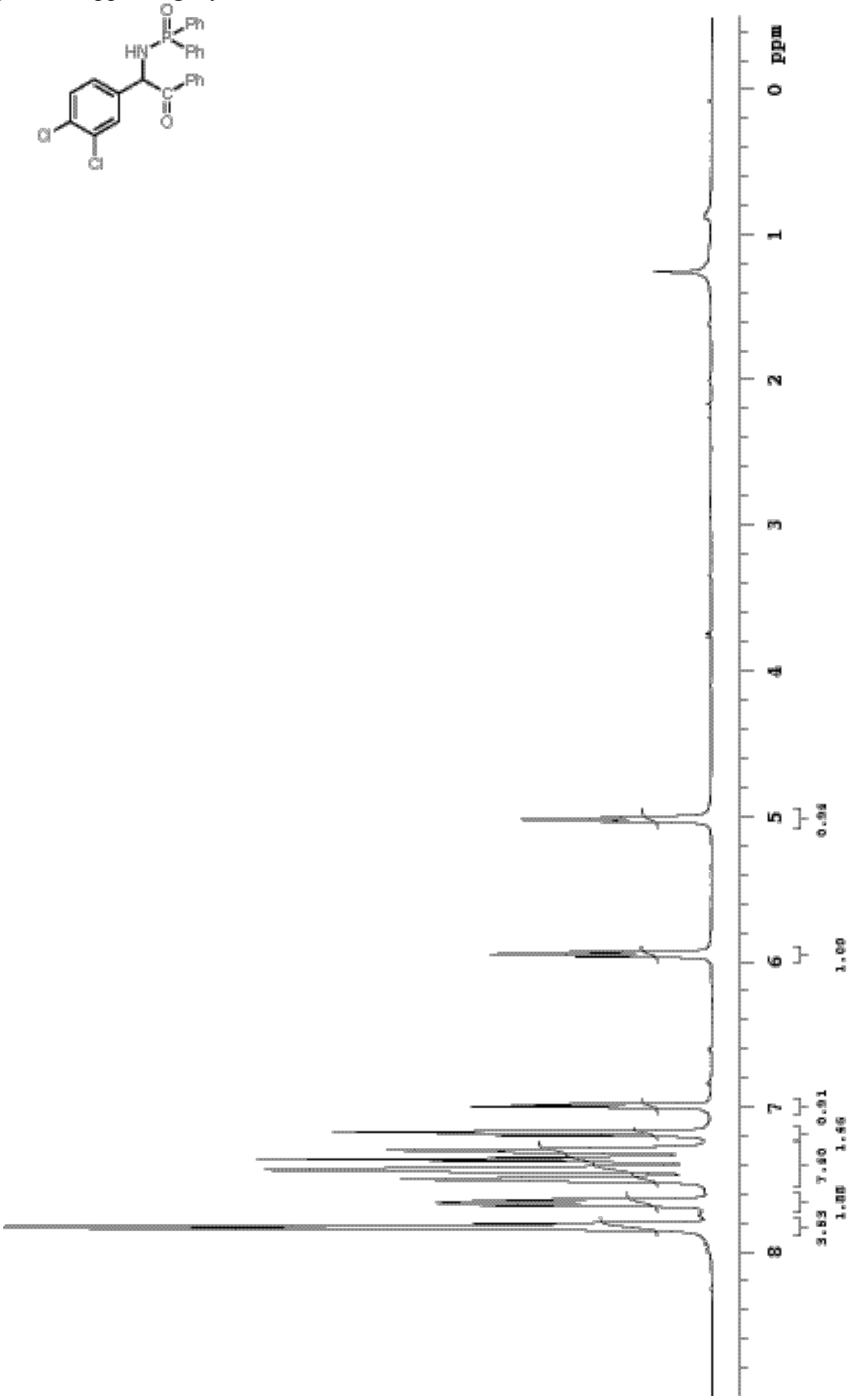
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Ph
Ph
HN
Ph
C
O
Cl
Cl
ppm
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6
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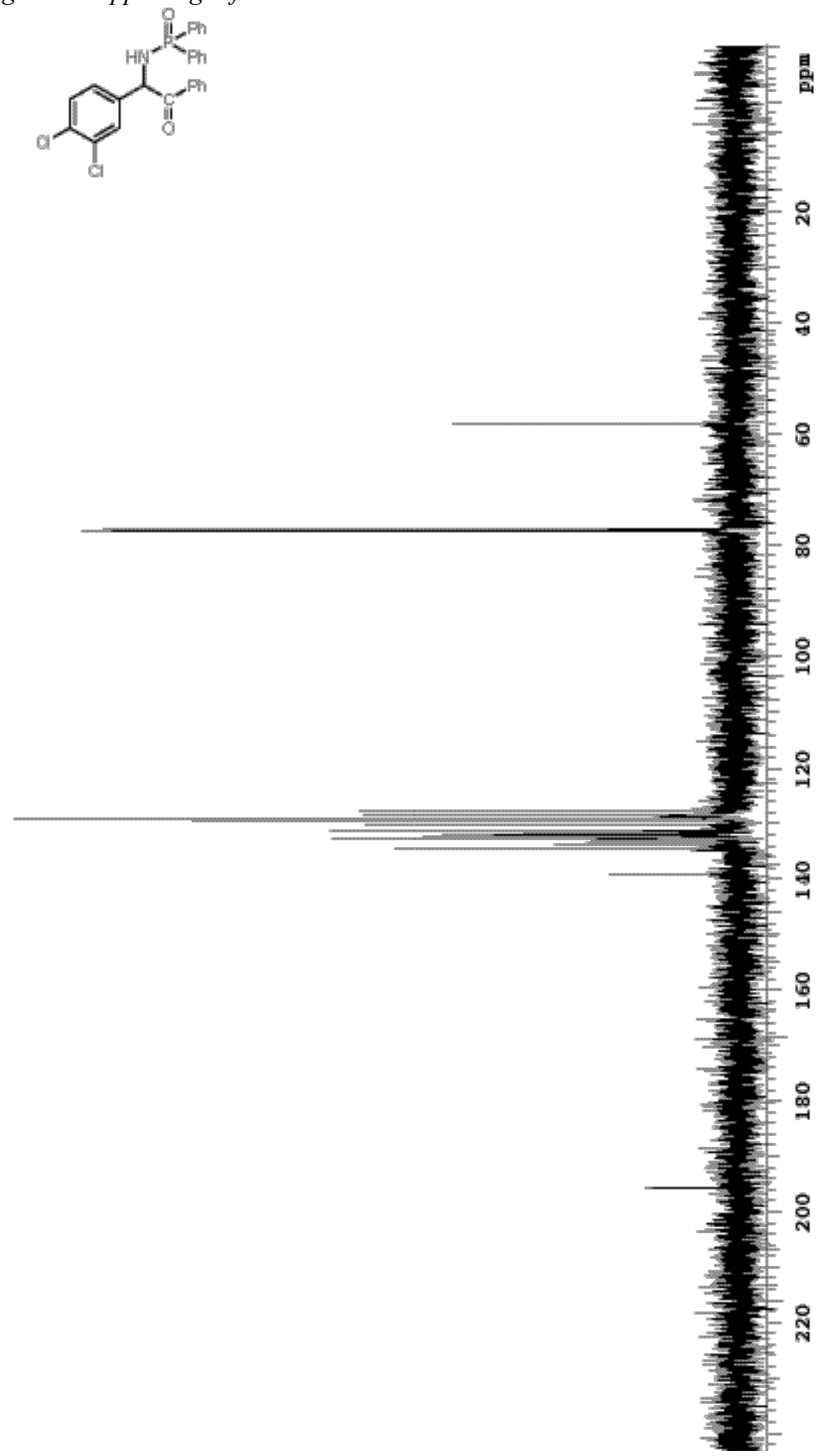
1.88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Ph
HN
Ph
C
O
Cl
Cl
ppm
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60
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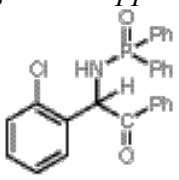
100
120
140
160
180
200
220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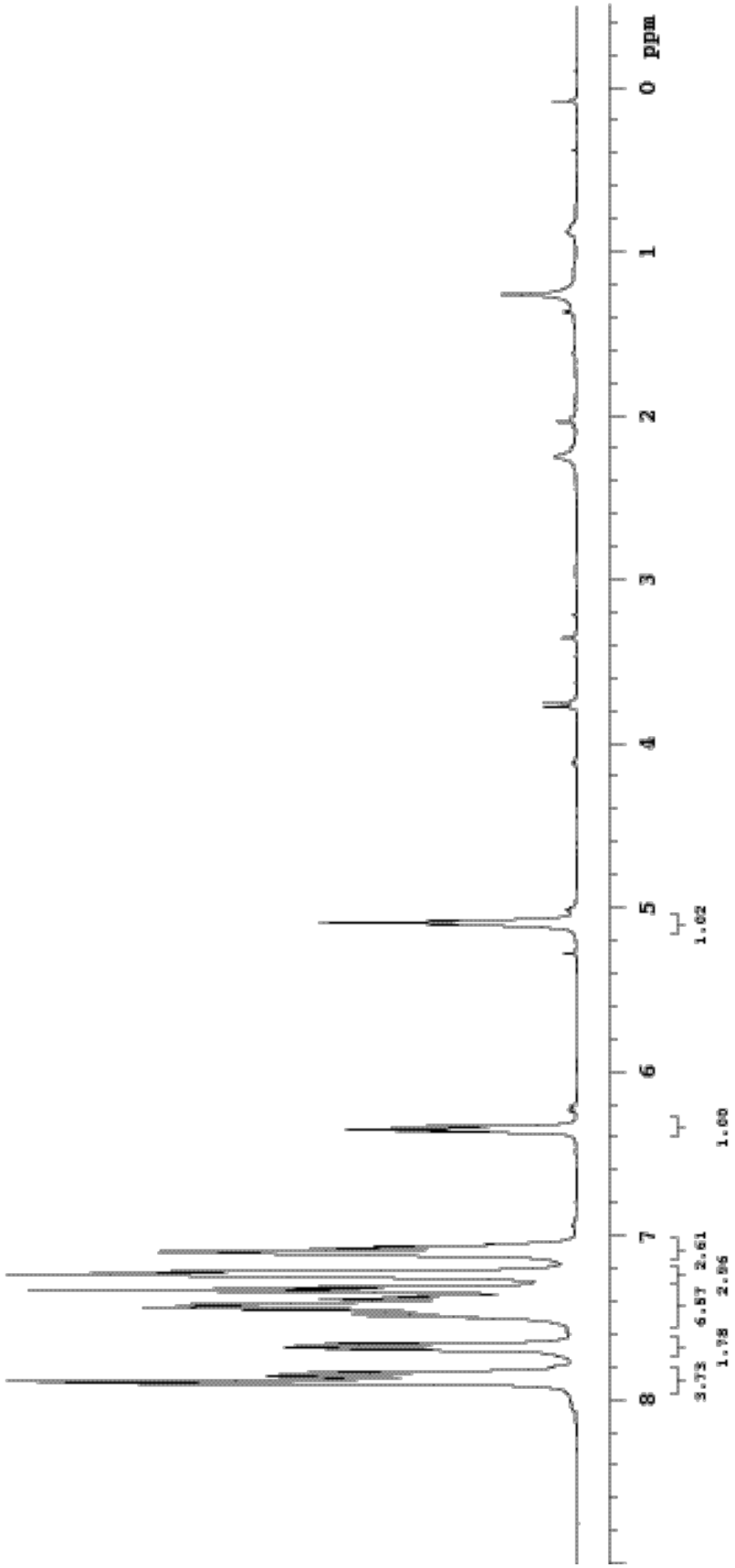
Cl
HN
P
Ph
H
Ph
C
O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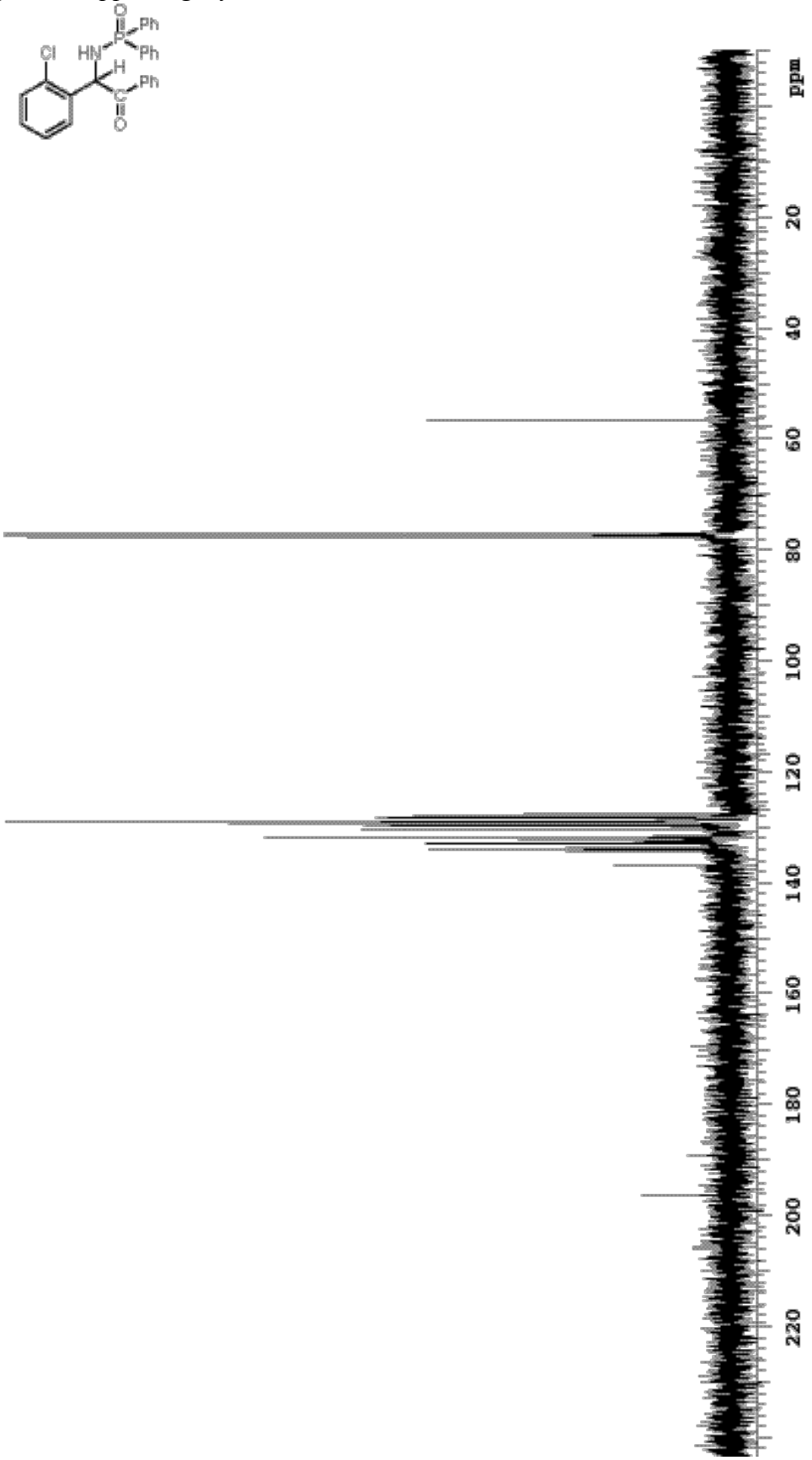
2.86


Cl
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P
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Ph
Ph
C
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ppm
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160
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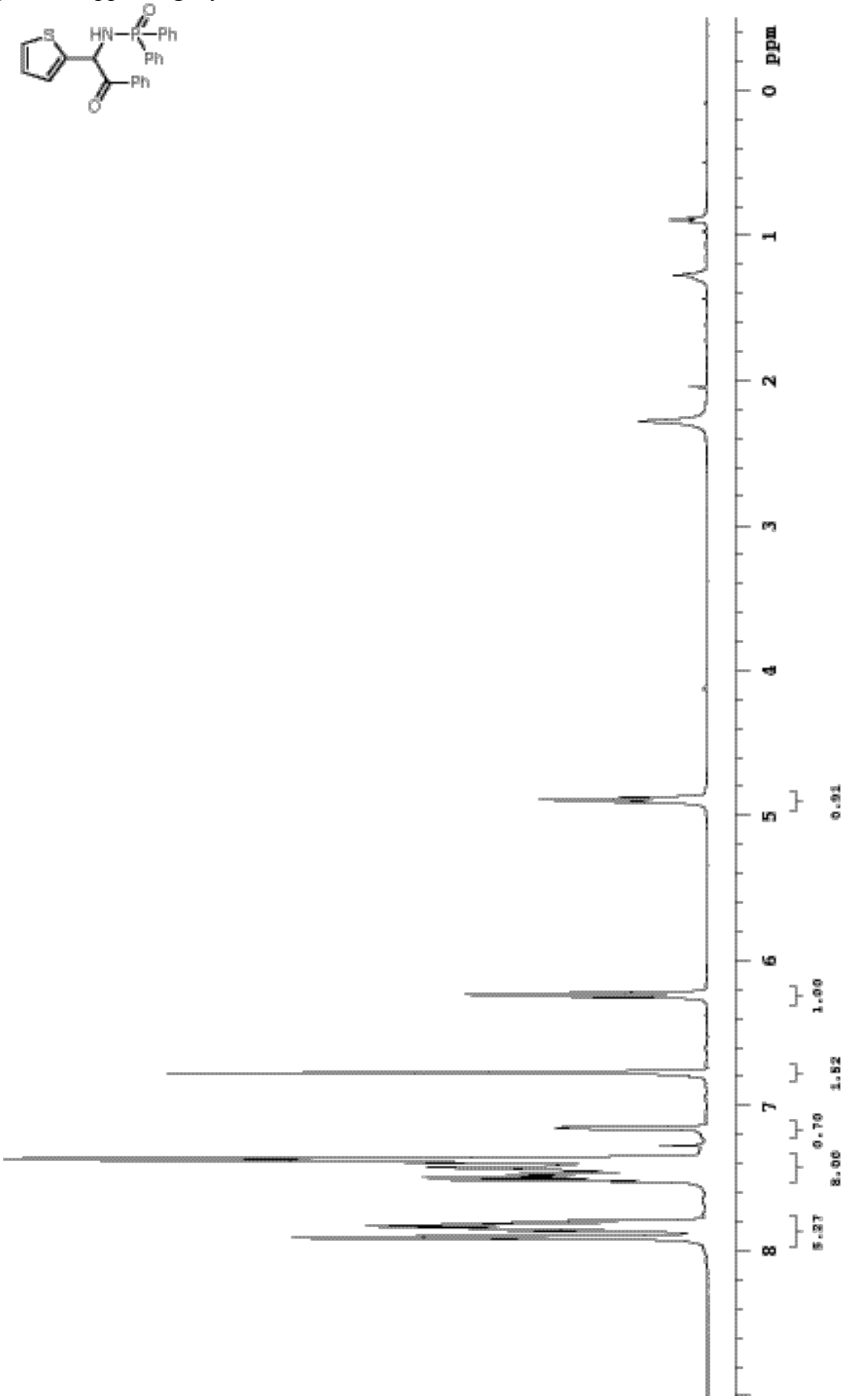
200
220


S
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P
O
Ph
Ph
Ph
O
ppm
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6
7
8
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1.00
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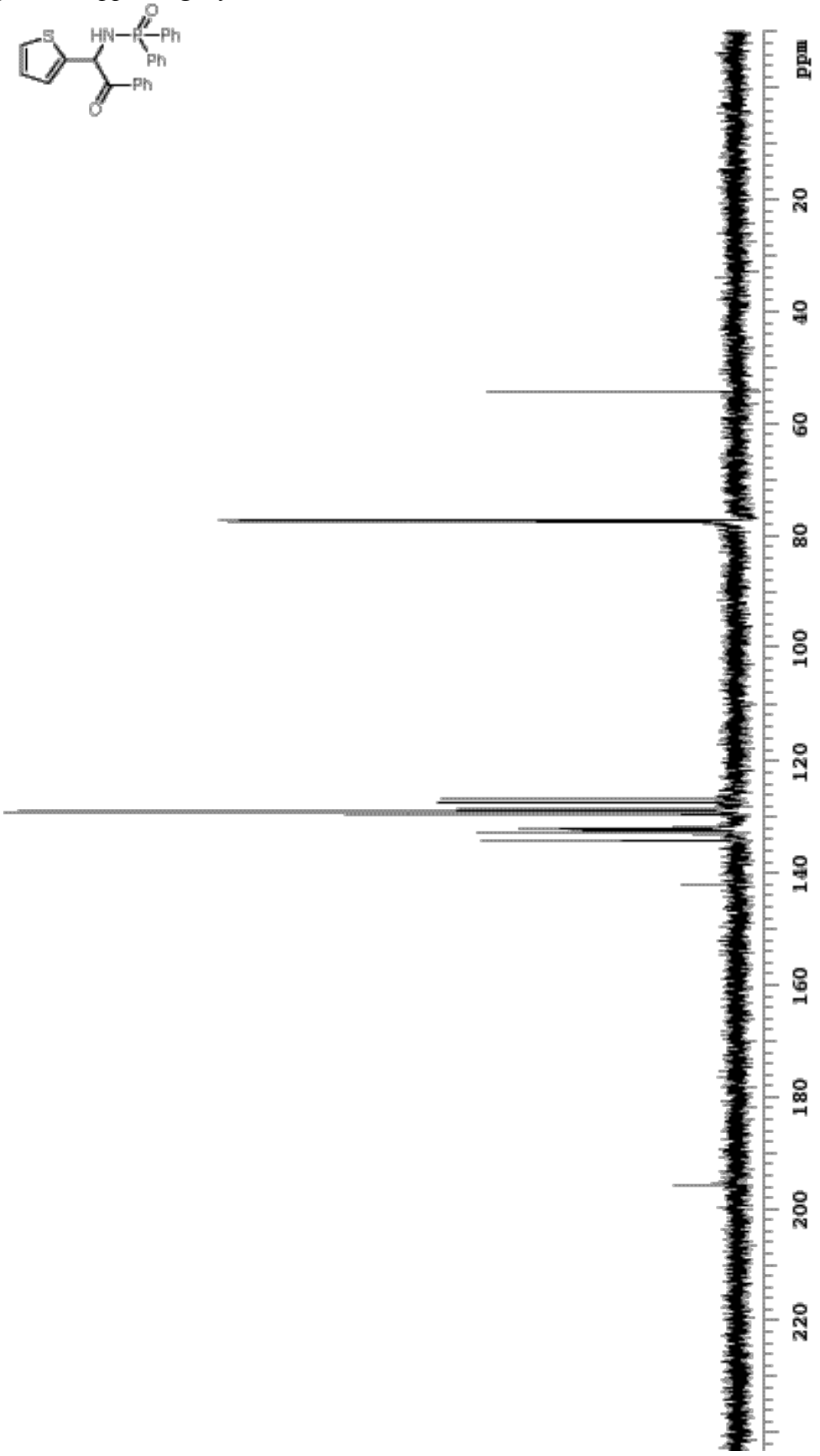
8.00
5.27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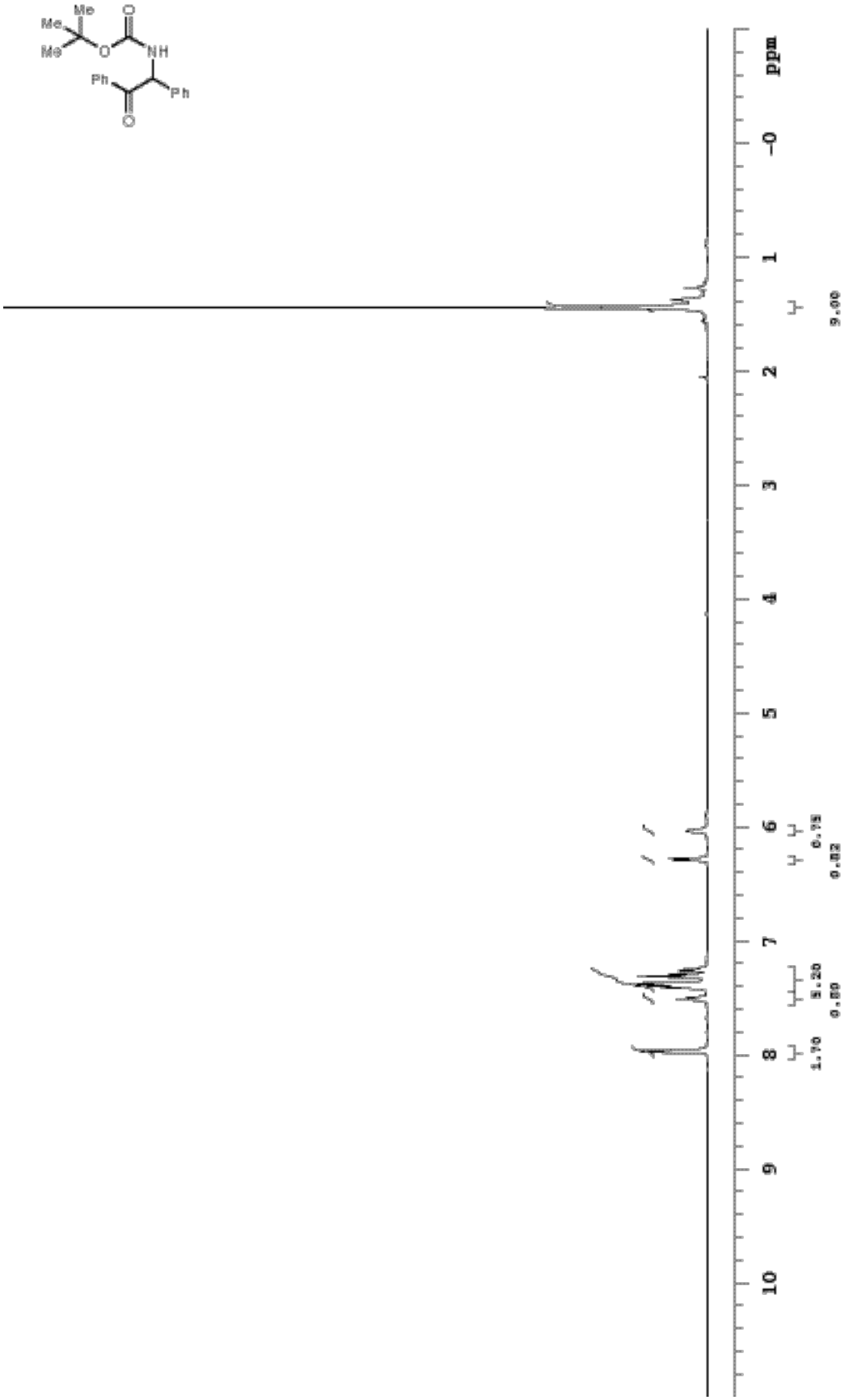
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Ph
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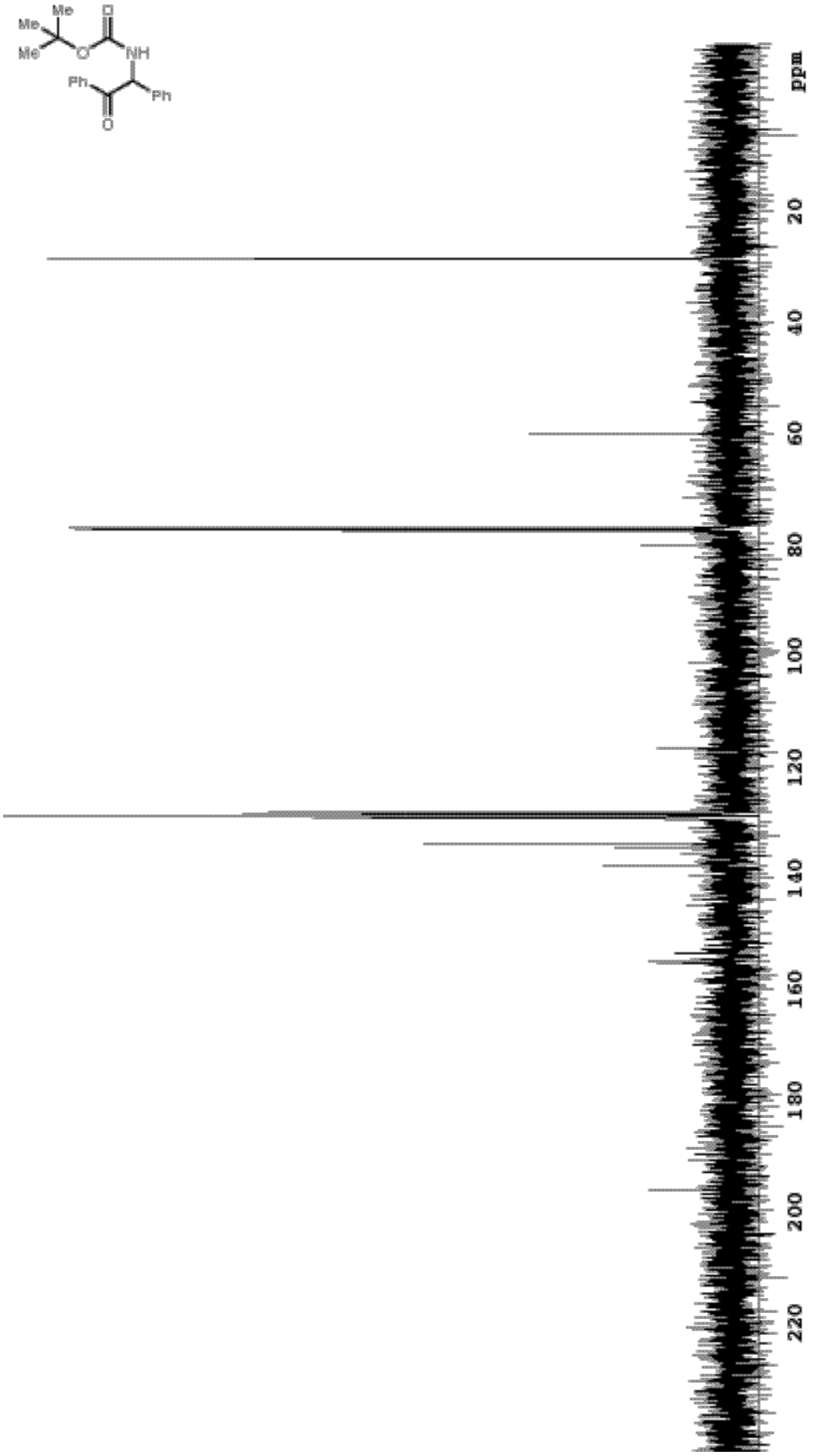
1.70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Me
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NH
Ph
Ph
O
ppm
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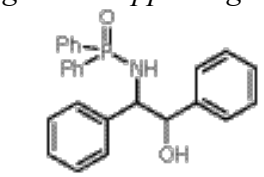
O
Ph
Ph
P
NH
OH

0 ppm
1
2
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4
5
6
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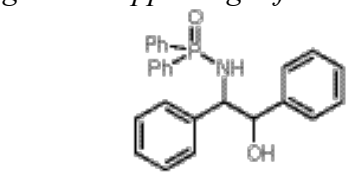
8
0.86
0.93
1.00
3.28
5.13
1.88
4.86
2.57
3.79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Ph
P
NH
OH

ppm
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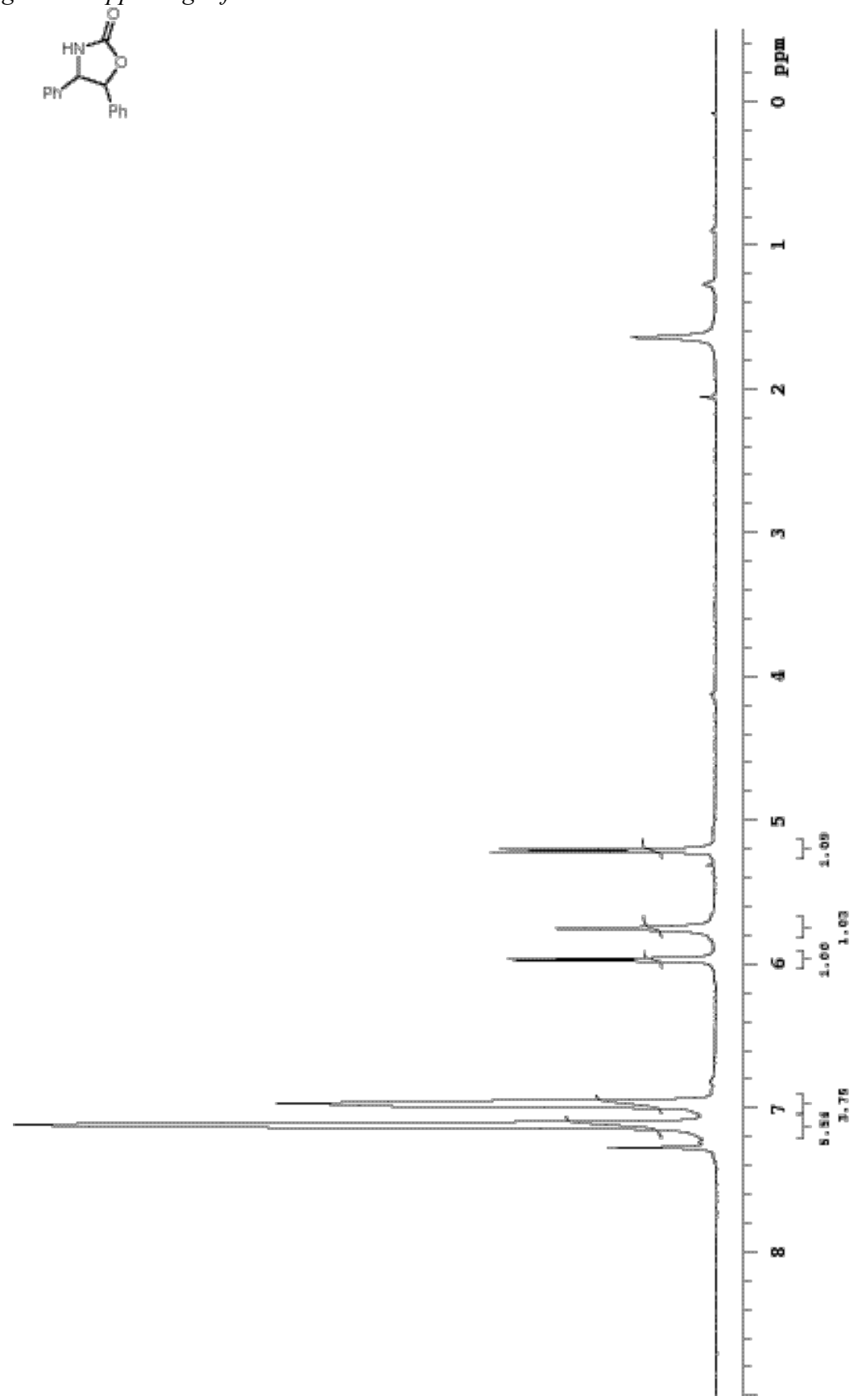
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Ph
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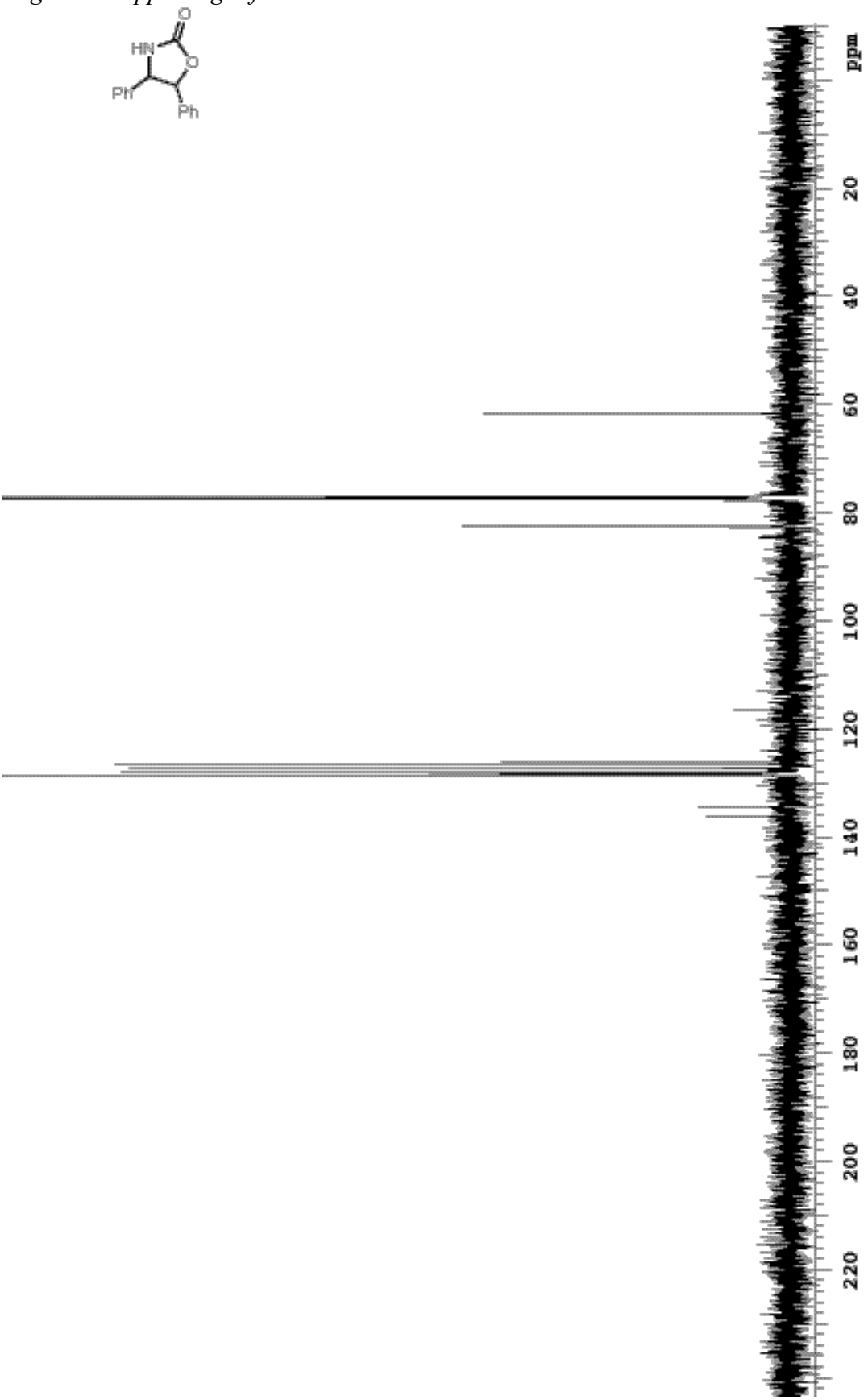
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