

Experimental section

All reactions were carried out under inert atmosphere (Ar). THF and ether were dried and freshly distilled from sodium/benzophenone. DMF was dried by distillation over calcium hydride. Flash chromatography was carried out with Merck silica gel (silica gel, 230-400 Mesh). ^1H NMR and ^{13}C NMR spectra were recorded on a Bruker AC 200 (200MHz) or a Bruker AMX 400 (400MHz) nuclear magnetic resonance spectrometer using CDCl_3 as the solvent. Chemical shifts are given in ppm (referring to Me_4Si). The mass spectra were obtained on a Hewlett Packard (engine 5989A) in direct introduction mode (70eV). IR spectra were recorded on a Nicolet 250FT-IR spectrophotometer. Melting points are uncorrected. (Z)-3-iodoprop-2-enoic acid and (Z)-3-iodobut-3-enoic acid were prepared by previously reported procedure (ref 12c). 4-methoxybut-2-ynoic acid was prepared by carbonatation of 3-methoxybut-1-ynmagnesium bromide. Tributylstannylacetylene, propynoic acid, tetrolic acid, 3-trimethylsilylprop-2-ynoic acid and 3-phenylpropynoic acid are commercially available.

(Z)-3-iodo-4-methoxybut-2-enoic acid

In a 100 mL flask, at -40°C , to 11.4 g (0.1 mol) of 4-methoxybut-2-ynoic acid were added 17 mL (0.13 mol) of hydroiodic acid (57% from Lancaster corp.). After stirring for 6h at 0°C , a saturated solution of sodium bicarbonate were added until pH 7 is reached then the reaction mixture was washed with 50 mL of 2M HCl and extracted with diethylether (3x50 mL). The organic phases were dried over magnesium sulfate and concentrated affording 19.4 g (80% yield) of a 96/4 mixture of stereoisomers *Z* and *E* of 3-iodo-4-methoxybut-2-enoic acid. The pure *Z*-acid is obtained by cristallisation (petroleum ether/ether = 85/15). IR: 1700, 1626, 1308, 1266, 1112. ^1H NMR (200 MHz) (CDCl_3) δ (ppm): 3.46 (3H, s), 4.23 (2H, d, $^4J_{\text{1H}} = 1.8\text{Hz}$), 6.85 (1H, t, $^4J_{\text{2H}} = 1.8\text{Hz}$), 10.5 (1H, bs). ^{13}C NMR (50.2 MHz) (CDCl_3) δ (ppm): 58.5, 81.7, 119.0, 122.9, 169.2. MS (70eV) : $m/z = 242$ (M, 100), 127 (17), 115 (99), 87 (34), 85 (18), 84 (17), 83 (40), 69 (32), 57 (19), 55 (24), 45 (45), 39 (30).

(Z)-3-iodo-3-phenylpropenoic acid

In a 100 mL flask, at 20°C , to 14.6 g (0.1 mol) of 3-phenylpropynoic acid were added 17 mL (0.13 mol) of hydroiodic acid (57% from Lancaster corp.). After stirring for 16h at 75°C , a saturated solution of sodium bicarbonate were added until pH 7 is reached then the reaction mixture was washed with 50 mL of 2M HCl and extracted with diethylether (3x50 mL). The organic phases were dried over magnesium sulfate and concentrated affording 19.2 g (70% yield) of (Z)-3-iodo-3-phenylpropenoic acid. Mp = 140°C . IR (KBr) : 3456, 3063, 2808, 1690, 1599, 1240, 1210, 750, 703. ^1H NMR (200 MHz) (CDCl_3) δ (ppm): 6.84 (1H, s), 7.4-7.85 (5H, m), 10.05 (1H, s). ^{13}C NMR δ (ppm) : 115.9, 128.3, 129.3, 129.5, 130.8, 144.1, 165.7. MS (70eV) : $m/z = 147$ (73), 103 (25), 102 (48), 77 (54), 76 (24), 75 (15), 74 (14), 69 (86), 63 (12), 52 (10).

(Z)-3-iodo-3-trimethylsilylpropenoic acid

In a 100 mL flask, at -40°C , to 14.2 g (0.1 mol) of 3-trimethylsilylpro-2-ynoic acid were added 17 mL (0.13 mol) of hydroiodic acid (57% from Lancaster corp.). After stirring for 3h at 100°C , a saturated solution of sodium bicarbonate were added until pH 7 is reached then the reaction mixture was washed with 50 mL of 2M HCl and extracted with diethylether (3x50 mL). The organic phases were dried over magnesium sulfate and concentrated affording 16.7 g (62% yield) of a 92/8 mixture of stereoisomers *Z* and *E* of 3-iodo-3-trimethylsilylpropenoic acid. The pure *Z*-acid is obtained by cristallisation (petroleum ether/ether = 85/15). IR : 3077, 2783, 2573, 1698, 1587, 1207, 867. ^1H NMR (200 MHz) (CDCl_3) δ (ppm): 0.30 (9H, s), 7.04 (1H, s), 10.50 (1H, bs). ^{13}C NMR (50.2 MHz) (CDCl_3) δ (ppm): -1.67, 129.9, 133.8, 169.1.

MS (70eV) : m/z = 270 (M, 29), 255 (28), 185 (23), 127 (16), 83 (50), 75 (100), 73 (63), 67 (14), 55 (20), 53 (49), 45 (46), 44 (12), 43 (77).

General procedure for the preparation of 4-substituted (*E*)-5-tributylstannylmethylidene-5*H*-furan-2-one:

To a DMF (35 mL) solution containing 4.87 g (10 mmol) of tributylstannyl (*Z*)-3-iodoprop-2-enoate and 0.115 g (0.1 mmol) of tetrakis(triphenylphosphine)palladium(0) is added dropwise 5.67 g (18 mmol) of tributyl(ethynyl)stannane dissolved in 5 mL of DMF. The mixture is stirred at 25° C for 16h, then extracted with diethylether (4x25 mL). The organic layer was washed with a saturated solution of ammonium chloride (3x25 mL), dried over magnesium sulphate and concentrated in vacuo. The (*E*)-5-tributylstannylmethylidene-5*H*-furan-2-one **1a** (2.5 g) is purified by column chromatography on silica gel (eluent: hexane/Et₂O/Et₃N: 90/8/2).

(*E*)-5-tributylstannylmethylidene-5*H*-furan-2-one **1a**

IR : 2957, 2923, 2855, 1776, 1746, 1612, 1558. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 0.9 (9H, t, ³J_{2H} = 7.2Hz), 1.02-1.68 (18H, m), 6.14 (1H, dd, ⁵J_{1H} = 1.8Hz, ⁴J_{1H} = 0.5Hz, ²J_{Sn-H} = 23-26Hz), 6.31 (1H, dd, ³J_{1H} = 5.5Hz, ⁵J_{1H} = 1.8Hz), 7.24 (1H, dd, ³J_{1H} = 5.5Hz, ⁴J_{1H} = 0.5Hz). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): 11.4 (3C, ¹J_{Sn-C} = 341-357Hz), 14.1 (3C), 27.7 (3C, ³J_{Sn-C} = 58Hz), 29.4 (3C, ²J_{Sn-C} = 22Hz), 116.3 (¹J_{Sn-C} = 268-280Hz), 123, 144 (³J_{Sn-C} = 17Hz), 158 (²J_{Sn-C} = 34Hz), 170.3. ¹¹⁹Sn NMR (CDCl₃) δ(ppm): - 42.7. MS : m/z = 329 (M-57, 44), 273 (17), 217 (16), 96 (13), 81 (18), 57 (30), 56 (20), 55 (15), 54 (11), 44 (11), 43 (14), 42 (21), 41 (100), 40 (13), 39 (37).

(*E*)-5-tributylstannylmethylidene-4-methyl-5*H*-furan-2-one **1b**

IR : 2950, 2920, 2860, 2840, 1770, 1750, 1605. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 0.91 (9H, t, ³J_{2H} = 7Hz), 1.03-1.62 (18H, m), 2.18 (3H, d, ⁴J_{1H} = 1.7Hz), 5.98 (1H, d, ⁵J_{1H} = 0.7Hz, ²J_{Sn-H} = 10-12Hz), 6.03-6.07 (1H, qd, ⁴J_{3H} = 1.7Hz, ⁵J_{1H} = 0.7Hz). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): 11.5 (3C, ¹J_{Sn-C} = 343-359Hz), 13.2, 13.5 (3C), 27 (3C, ³J_{Sn-C} = 60-62Hz), 28.8 (3C, ²J_{Sn-C} = 24Hz), 112.1 (¹J_{Sn-C} = 272-284Hz), 120.1, 154.2, 159.1 (²J_{Sn-C} = 29Hz), 169.3. ¹¹⁹Sn NMR (CDCl₃) δ(ppm): - 45.5. MS : m/z = 343 (M-57, 100), 231 (27), 95 (40), 93 (20), 65 (12), 57 (20), 56 (11), 43 (12), 41 (79), 40 (10), 39 (39). (*E*)-stereochemistry was determined by NOESY NMR experiment.

(*E*)-5-tributylstannylmethylidene-4-methoxymethyl-5*H*-furan-2-one **1c**

IR: 2956, 2924, 2854, 1774, 1761, 1605, 1464. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 0.93 (9H, t, ³J_{2H} = 7Hz), 1.04-1.62 (18H, m), 3.47 (3H, s), 4.35 (2H, dd, ⁴J_{1H} = 1.5Hz, ⁵J_{1H} = 0.7Hz), 6.02 (1H, td, ⁵J_{1H} = 0.8Hz, ⁵J_{2H} = 0.7Hz, ²J_{Sn-H} = 11Hz), 6.3 (1H, td, ⁴J_{2H} = 1.5Hz, ⁵J_{1H} = 0.8 Hz). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): 11.3 (3C, ¹J_{Sn-C} = 344-360Hz), 13.4 (3C), 27.1 (3C, ³J_{Sn-C} = 61Hz), 28.8 (3C, ²J_{Sn-C} = 21Hz), 58.8, 67.0, 113.0 (¹J_{Sn-C} = 267-280Hz), 119.2, 154.8 (³J_{Sn-C} = 8Hz), 155.9 (²J_{Sn-C} = 28Hz), 168.5. ¹¹⁹Sn NMR (CDCl₃) δ(ppm): - 42.1. MS : m/z = 373 (M-57, 15), 120 (5), 110 (27), 67 (16), 57 (42), 56 (17), 55 (18), 53 (13), 45 (16), 43 (15), 42 (24), 41 (100), 40 (10), 39 (47).

(*E*)-5-tributylstannylmethylidene-4-phenyl-5*H*-furan-2-one **1d**

IR: 3080, 2956, 2924, 2854, 1777, 1748, 1602. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 0.87 (9H, t, ³J_{2H} = 6.8Hz), 1.15-1.5 (18H, m), 6.2 (1H, d, ⁵J_{1H} = 1.8Hz, ²J_{Sn-H} = 9Hz), 6.25 (1H, d, ⁵J_{1H} = 1.8Hz), 7.36-7.6 (5H, m). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): 11.8 (3C, ¹J_{Sn-C} = 345-361Hz), 14.2 (3C), 27.6 (3C, ³J_{Sn-C} = 62Hz), 29.4 (3C, ²J_{Sn-C} = 21Hz), 117.2 (¹J_{Sn-C} = 266-279Hz), 120.5, 129.1 (2C), 129.7 (2C), 130.8, 132.3, 157.9 (²J_{Sn-C} = 19Hz), 158.0, 168.7. ¹¹⁹Sn

NMR (CDCl₃) δ(ppm): - 41.2. MS: m/z = 405 (M-57, 100), 349 (9), 291 (17), 233 (25), 177 (22), 175 (17), 173 (17), 157 (37), 155 (17), 145 (23), 143(17), 141 (15), 137 (27), 135 (21), 133 (13), 129 (10), 127 (20), 121 (16), 57 (10), 41 (50), 39 (13).

(E)-5-tributylstannylmethylidene-4-trimethylsilyl-5*H*-furan-2-one **1e**

IR : 2958, 2923, 2854, 1775, 1750, 1600, 1463, 1192. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 0.34 (9H, s), 0.92 (9H, t, ³J_{2H} = 7.2Hz), 1.06-1.62 (18H, m), 5.83 (1H, d, ⁵J_{1H} = 0.8Hz, ²J_{Sn-H} = 30Hz), 6.31 (1H, d, ⁵J_{1H} = 0.8Hz). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): -0.6 (3C), 11.3 (3C, ¹J_{Sn-C} = 341-357Hz), 14.2 (3C), 27.7 (3C, ³J_{Sn-C} = 57Hz), 29.6 (3C8, ²J_{Sn-C} = 22Hz), 118.3 (¹J_{Sn-C} = 268-280Hz), 129.3, 159.4, 164.9 (³J_{Sn-C} = 17Hz), 171.3. ¹¹⁹Sn NMR (CDCl₃) δ(ppm): - 43.2. MS : m/z = 401 (M-57, 100), 289 (16), 153 (35), 145 (19), 143 (14), 141 (10), 137 (12), 135 (14), 83 (10), 73 (67), 57 (13), 45 (14), 41 (43), 39 (10).

(E) and *(Z)*-5-iodomethylidene-5*H*-furan-2-one **2**

1.78 g (7 mmol) of iodine in 50 mL of diethylether are added dropwise at 0°C to an ethereal solution (30 mL) of 2.31 g (6 mmol) of **1a**. The mixture is stirred at 0° C for 1h. Then the organic layer was washed with a 5% solution of sodium thiosulfate (3x15 mL), dried over magnesium sulphate and concentrated in vacuo. The pure *(E)*-5-iodomethylidene-5*H*-furan-2-one **2** (1.99 g, 90% yield) is obtained and, after 6 hours, quantitatively isomerises into *(Z)*-5-iodomethylidene-5*H*-furan-2-one **2**. *(E)*-**2**: ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 6.41 (1H, s), 6.60 (1H₃, d, ³J_{1H} = 5.6Hz), 7.72 (1H₄, d, ³J_{1H} = 5.6Hz). *(Z)*-**2**: IR : 3056, 1775, 1753, 1627, 1551, 1290, 1151, 931. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 6.26 (1H, s), 6.34 (1H₃, d, ³J_{1H} = 5.4Hz), 7.37 (1H₄, d, ³J_{1H} = 5.4Hz). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): 63.7, 121.7, 141.2, 156.8, 168.5. MS : m/z = 222 (M, 65), 168 (13), 95 (23), 54 (21), 50 (19), 41 (11), 39 (100), 38 (24), 37 (13). Anal. Calcd for C₅H₃O₂I C, 27.03; H, 1.36; I, 57.18 found C, 27.16; H, 1.35; I, 57.19

General procedure for cross-coupling reactions:

To a DMF (50 mL) solution of the aryl iodide (8.4 mmol), 10.1 mmol (3.9 g) of *(E)*-5-tributylstannylmethylidene-5*H*-furan-2-one **1a** diluted in DMF (10 mL) are added dropwise. At the end of the addition, dichlorobis(acetonitrile)palladium (II) (129 mg, 0.5 mmol) is added. The mixture is stirred for 3h at 25°C then hydrolysed with a saturated solution of ammonium chloride. The aqueous layer is extracted with diethylether (3x20 mL). After the usual treatment, the crude products are purified by column chromatography on silica gel (petroleum ether/Et₂O/Et₃N, 88/10/2, as eluent).

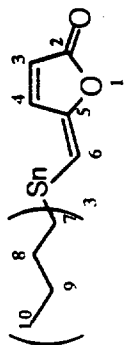
(Z)-5-benzylidene-5*H*-furan-2-one **3** (see ref 3b)

Mp = 82-84 °C. IR : 3117, 3102, 3035, 3028, 3012, 1791, 1762, 1745, 1550, 1438. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 6.08 (1H, s); 6.18 (1H, d, ³J_{1H} = 5.3Hz); 7.30-7.48 (3H, m); 7.47 (1H, d, ³J_{1H} = 5.3Hz); 7.74-7.78 (2H, m). ¹³C NMR (50.2 MHz) (CDCl₃) δ(ppm): 114.8, 118.7, 129.4, 129.9, 131.3, 133.4, 145.8, 149, 170.8. MS : m/z = 172 (M, 100), 144 (33), 118 (14), 116 (52), 115 (68), 90 (42), 89 (46), 86 (14), 72 (10), 64 (11), 63 (33), 62 (13), 58 (24), 57 (19), 51 (17), 50 (12), 45 (14), 39 (25), 38 (10)

(E)-5-thienylmethylidene-5*H*-furan-2-one **4**

Mp = 104-106 °C. IR : 3115, 3104, 3097, 1792, 1762, 1545, 1435. ¹H NMR (200 MHz) (CDCl₃) δ(ppm): 6.31 (1H, d, ³J_{1H} = 5.5Hz), 6.83 (1H, bs), 7.04 (1H, dd, ³J_{1H} = 4.8Hz, ³J_{1H} = 2.9Hz), 7.14 (1H, d, ³J_{1H} = 2.9Hz), 7.38 (1H, d, ³J_{1H}

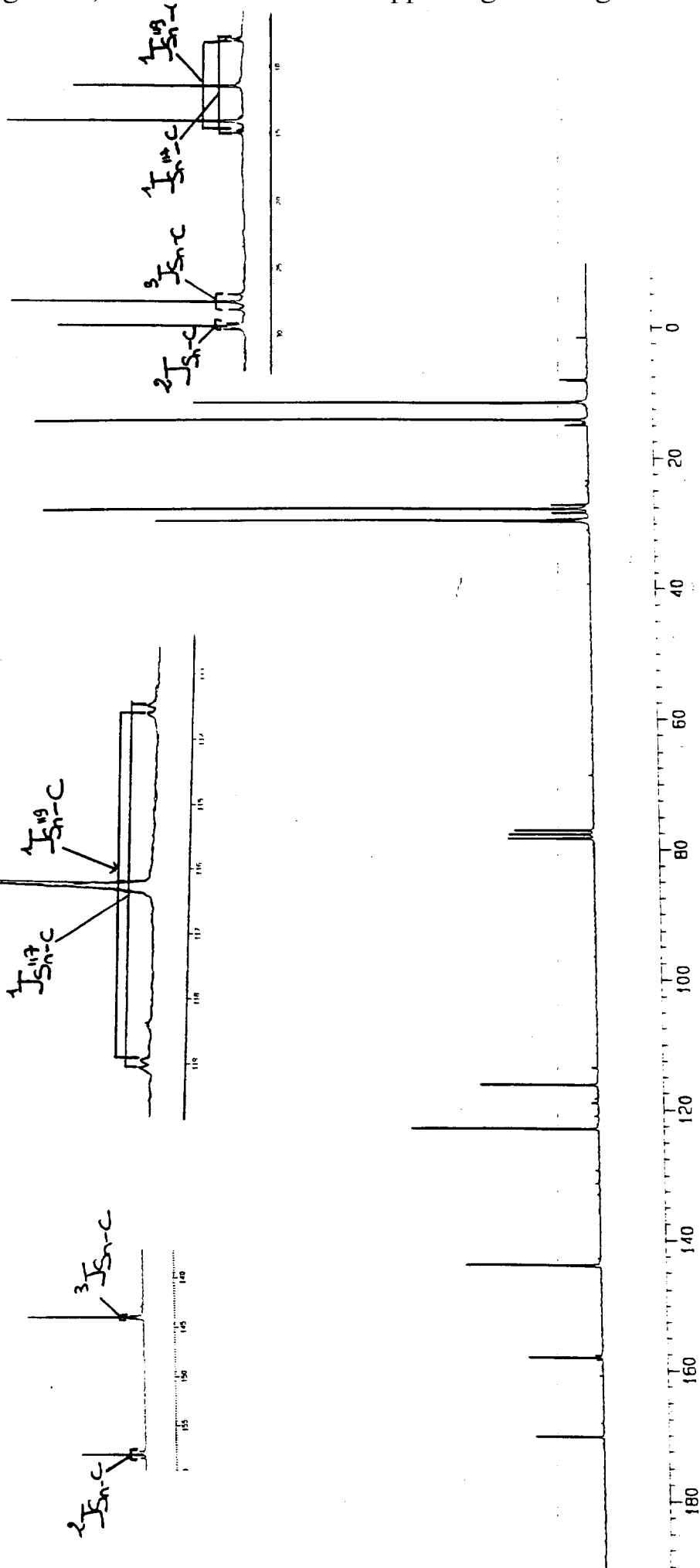
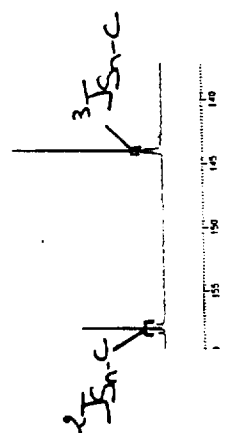
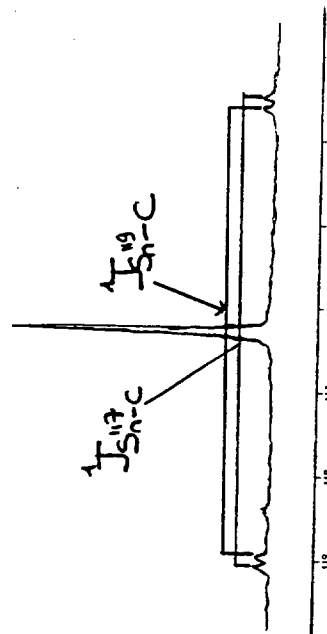
= 4.8Hz), 8.01 (1H, d, $^3J_{1H} = 5.5\text{Hz}$). ^{13}C NMR (50.2 MHz) (CDCl_3) δ (ppm): 109.9, 121.7, 128.6, 129.0, 131.9, 135.0, 140.4, 149.4, 169.7. MS: $m/z = 178$ (M, 100), 150 (19), 122 (55), 121 (32), 96 (57), 95 (12), 89 (10), 78 (16), 70 (28), 69 (16), 63 (13), 62 (31), 54 (18), 51 (12), 48 (20), 45 (28), 39 (17). Anal. Calcd for $\text{C}_9\text{H}_6\text{O}_2\text{S}$ C, 60.67; H, 3.39; found C, 60.87; H, 3.38

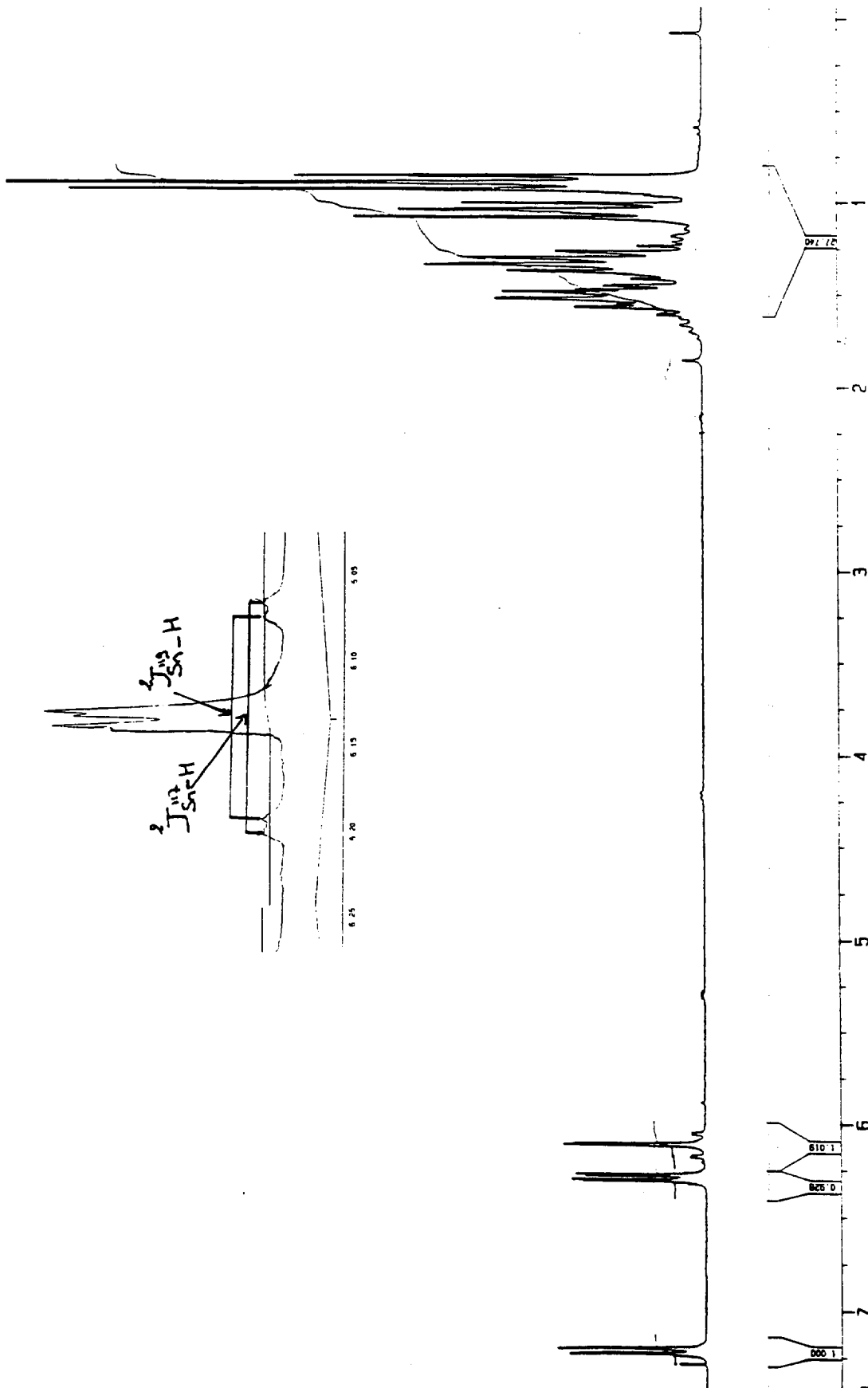
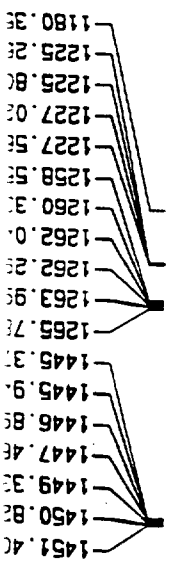
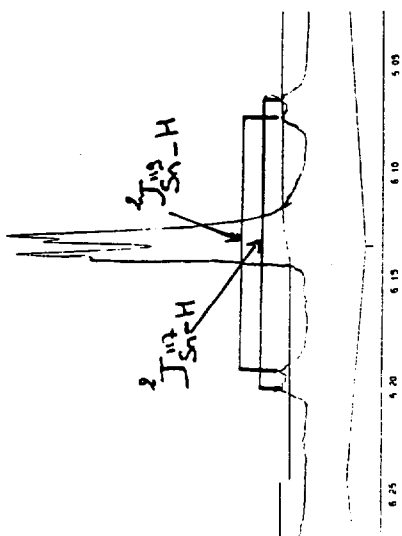
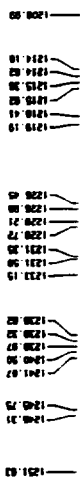
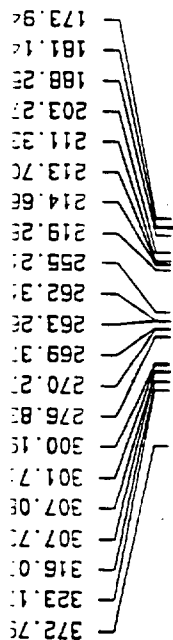
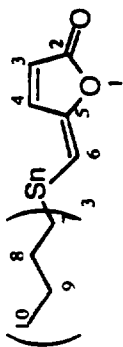


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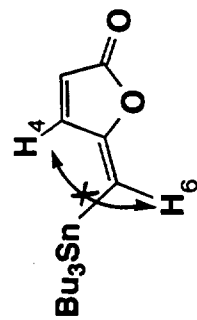
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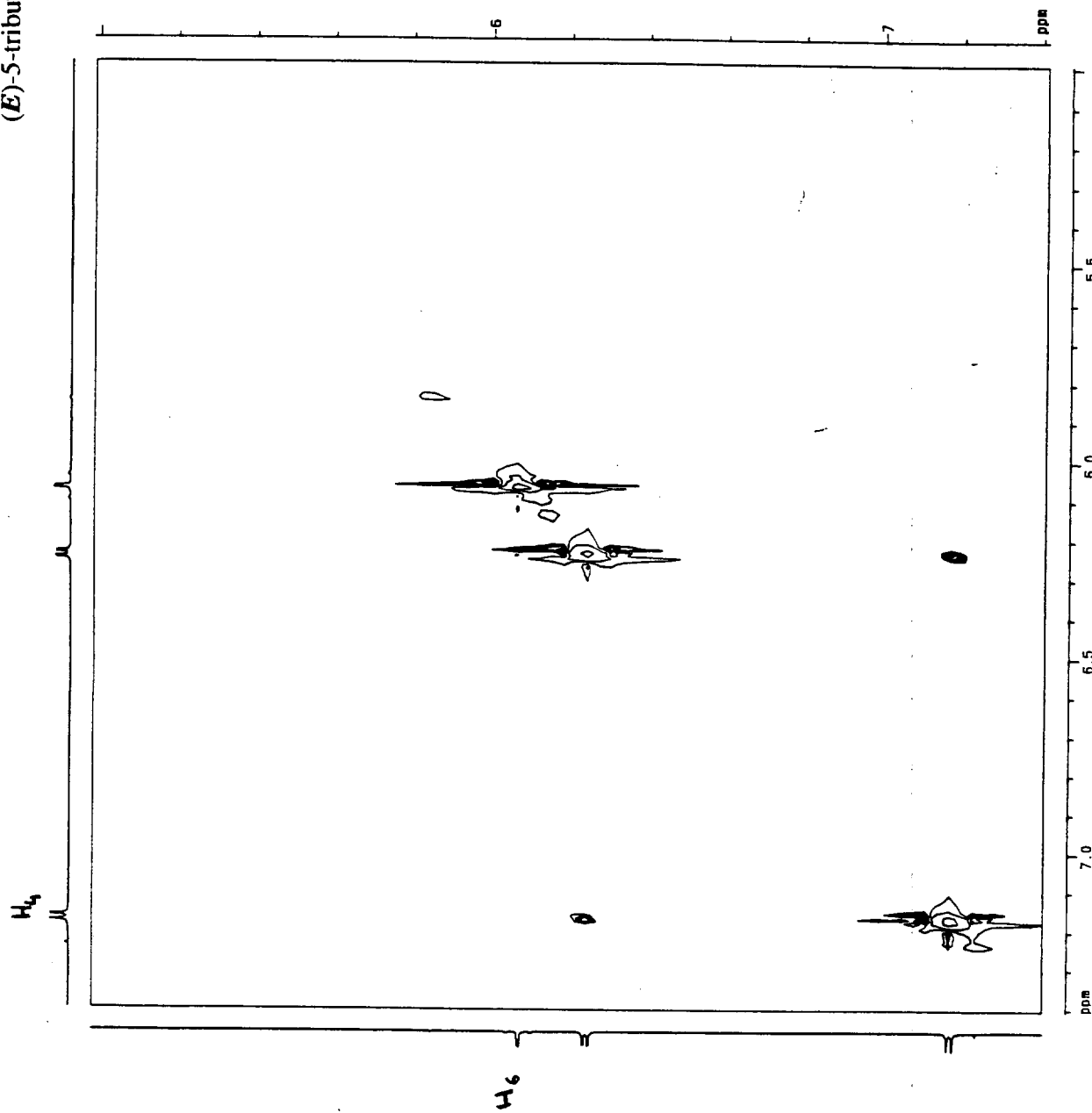




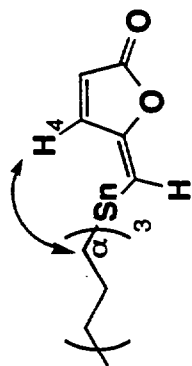
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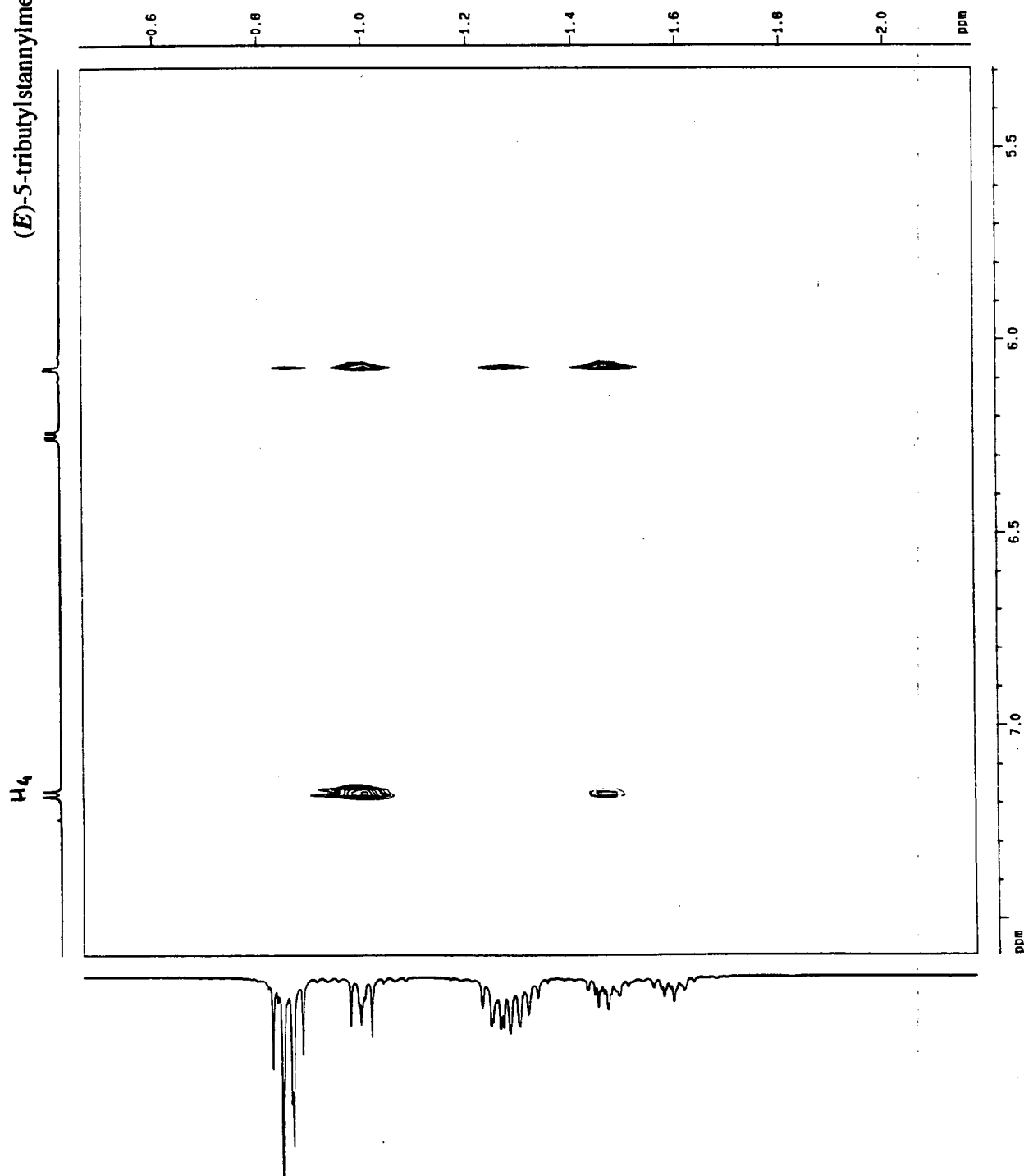
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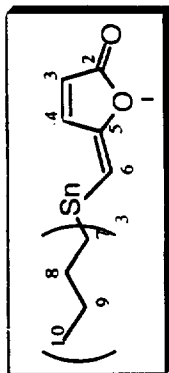
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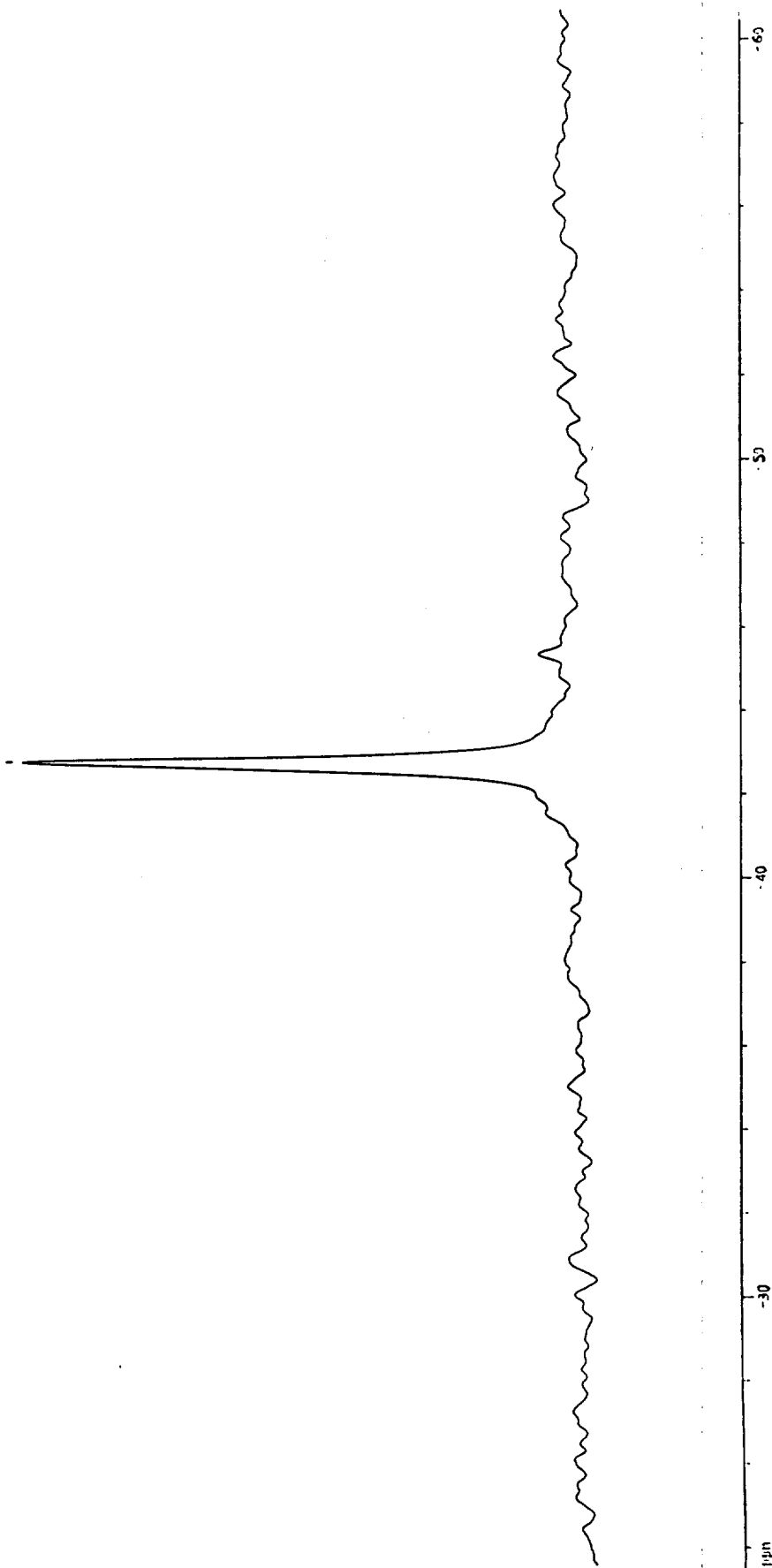


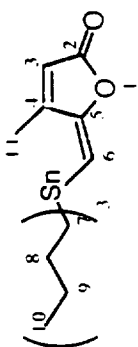
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42.6953

ppm



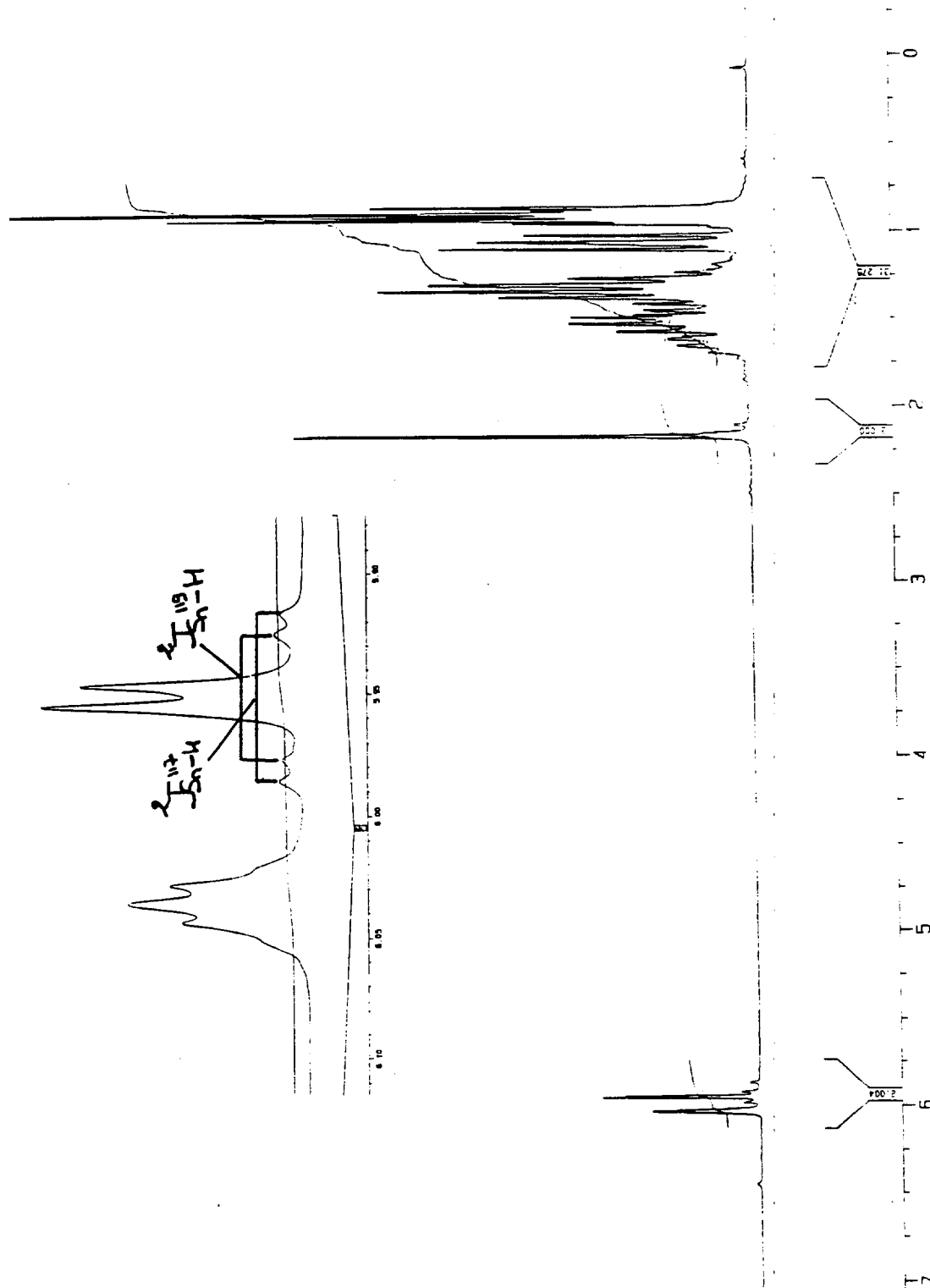


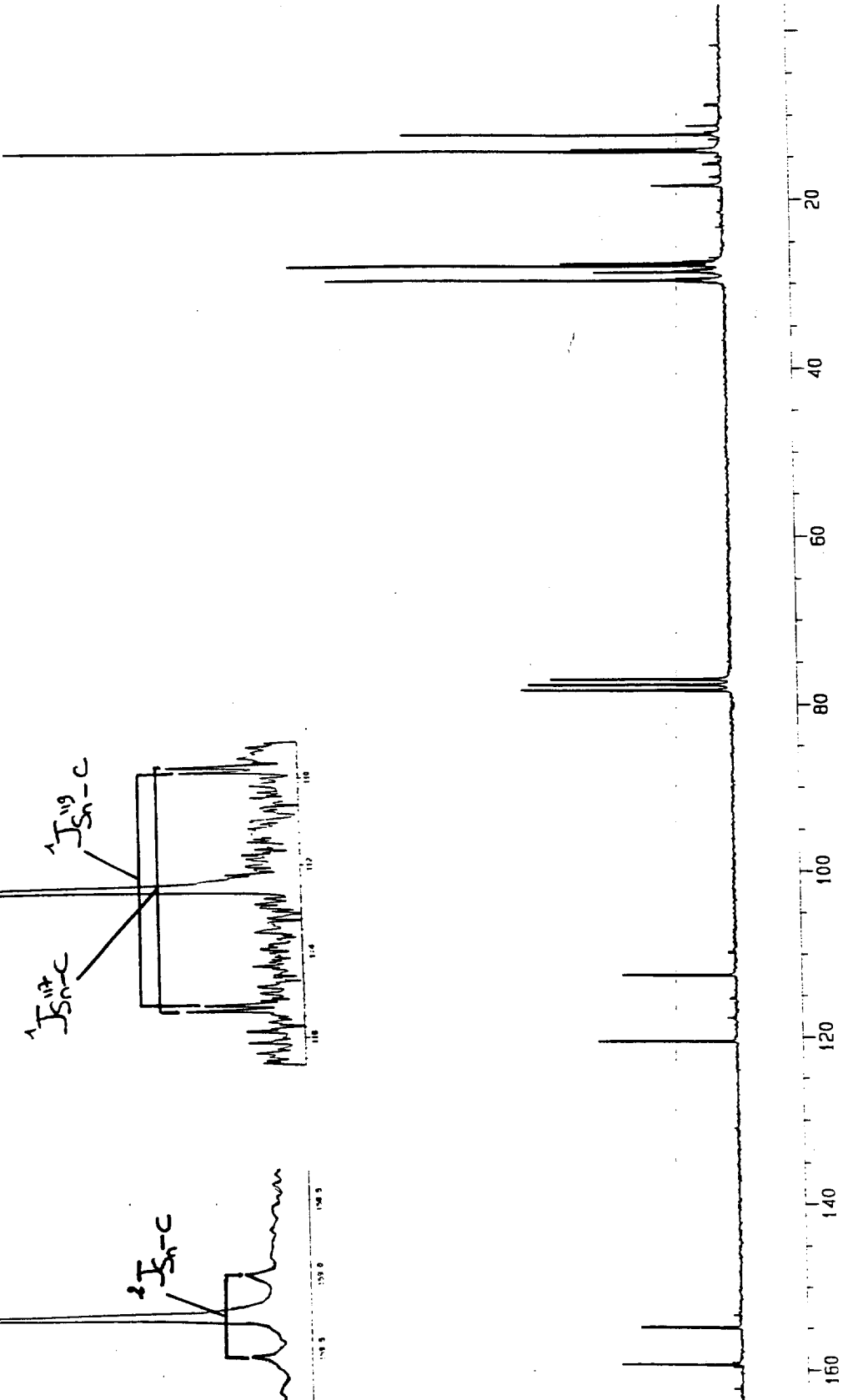
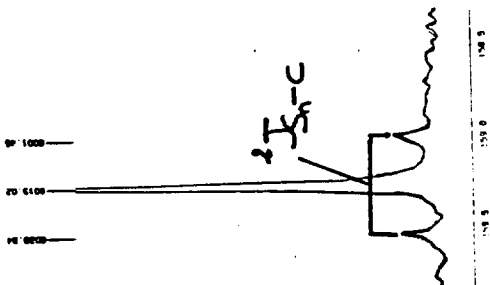
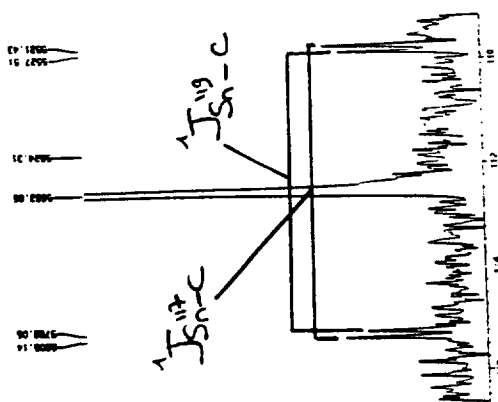
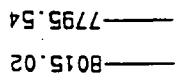
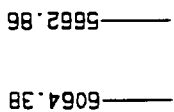
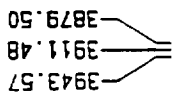
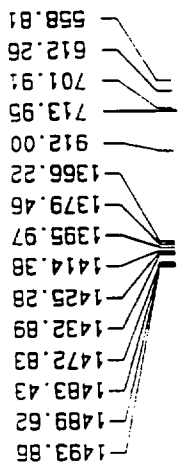
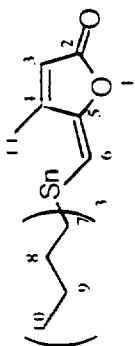
- 14.93
- 172.70
- 176.18
- 179.87
- 183.42
- 186.98
- 190.55
- 204.50
- 212.24
- 220.41
- 253.58
- 260.54
- 268.25
- 275.35
- 282.55
- 295.72
- 298.75
- 300.36
- 306.27
- 314.72
- 330.24
- 431.67
- 434.19
- 435.55

- 1184.14
- 1185.85
- 1190.16
- 1191.91
- 1196.22
- 1197.95
- 1206.56
- 1208.08
- 1209.66

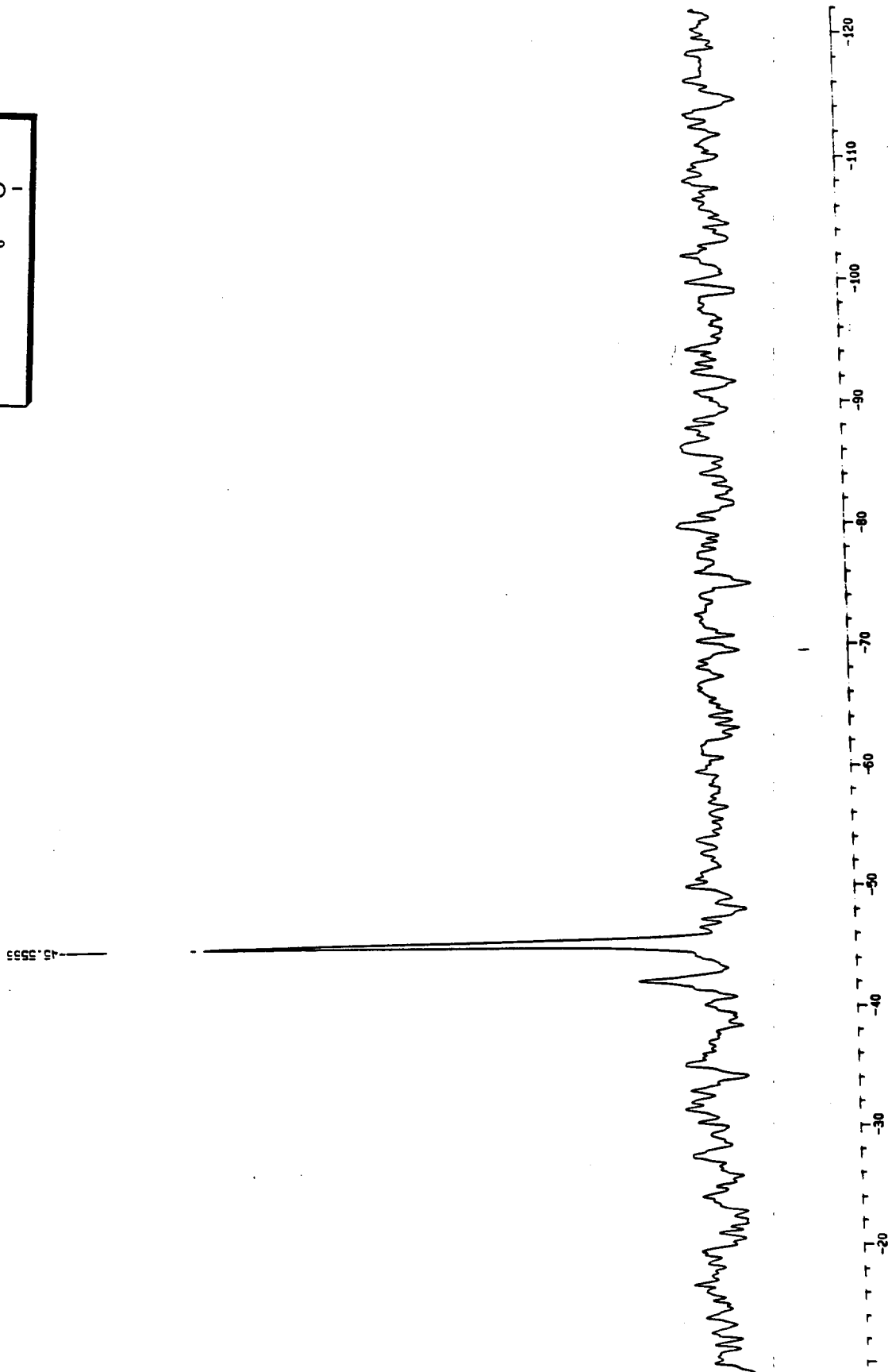
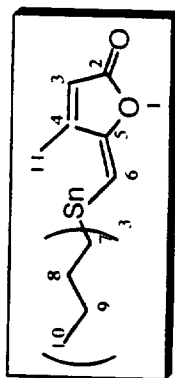
1461.73

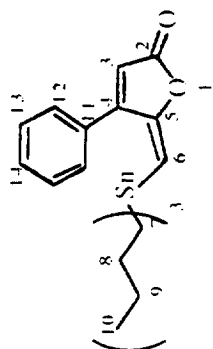
- 1184.14
- 1185.85
- 1190.16
- 1191.91
- 1196.22
- 1197.95
- 1206.56
- 1208.08
- 1209.66





RMN ^{119}Sn (CDCl_3)

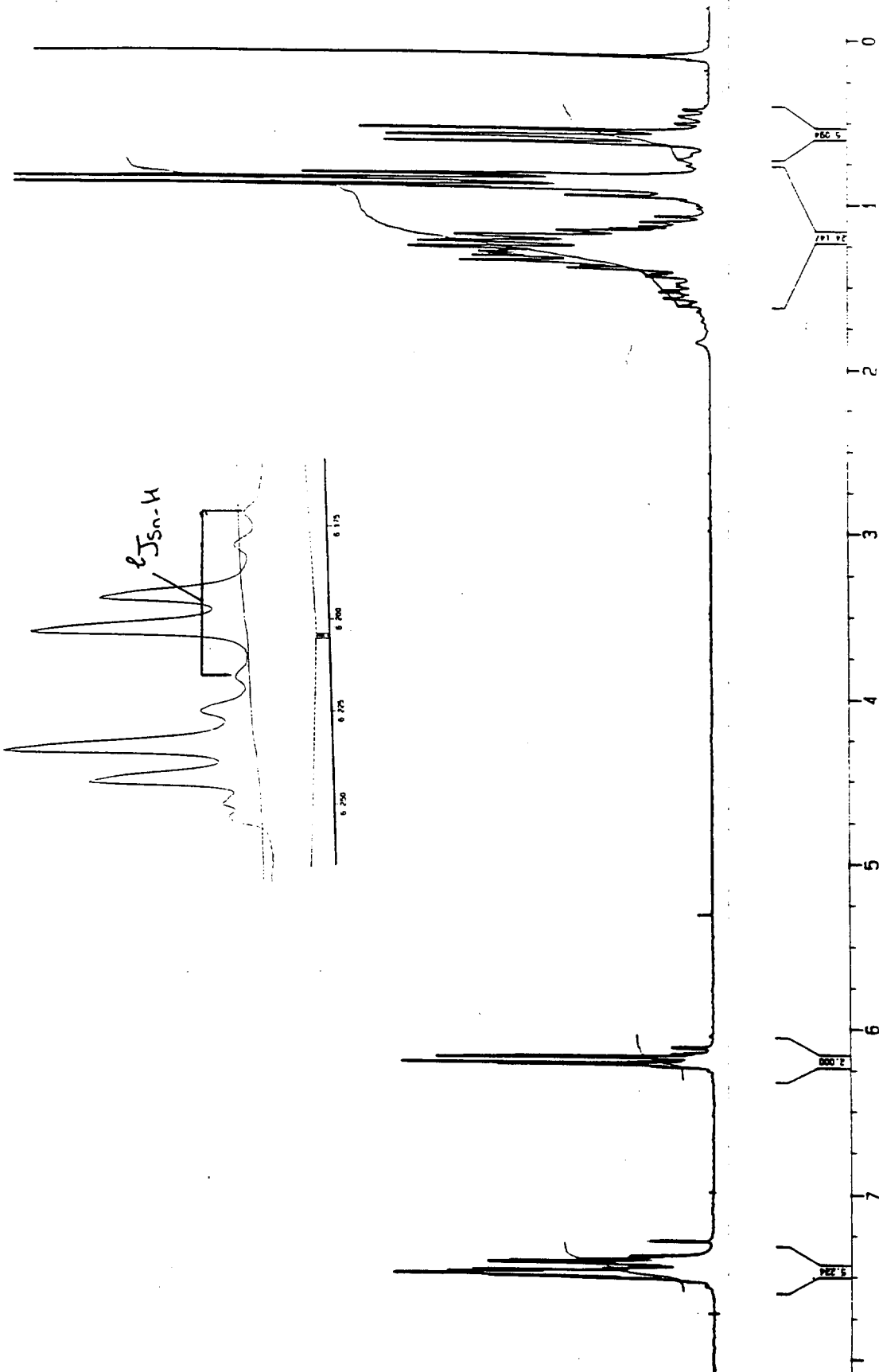


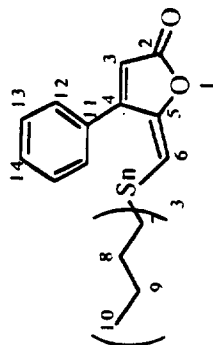


- 21.41
- 112.01
- 120.21
- 127.91
- 158.15
- 175.37
- 182.17
- 184.57
- 242.58
- 244.25
- 249.42
- 250.78
- 257.25
- 262.99
- 264.92
- 265.75
- 267.86
- 273.62
- 309.20
- 368.02
- 369.22

- 1291.44
- 1290.76
- 1289.46
- 1247.67
- 1246.75
- 1243.94
- 1241.29
- 1239.52
- 1228.18
- 1226.03

- 1507.18
- 1504.88
- 1503.46
- 1502.07
- 1500.21
- 1499.60
- 1497.31
- 1496.11
- 1489.92
- 1487.90
- 1484.75
- 1483.87
- 1462.24
- 1251.44
- 1250.76
- 1249.48
- 1247.67
- 1245.75
- 1241.29
- 1239.52
- 1228.18
- 1066.35

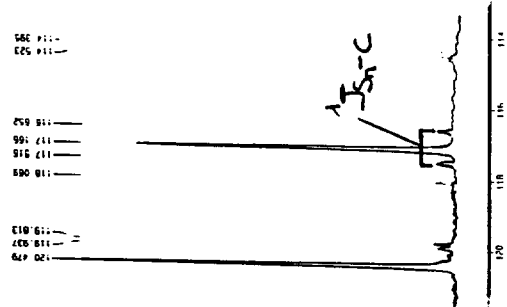
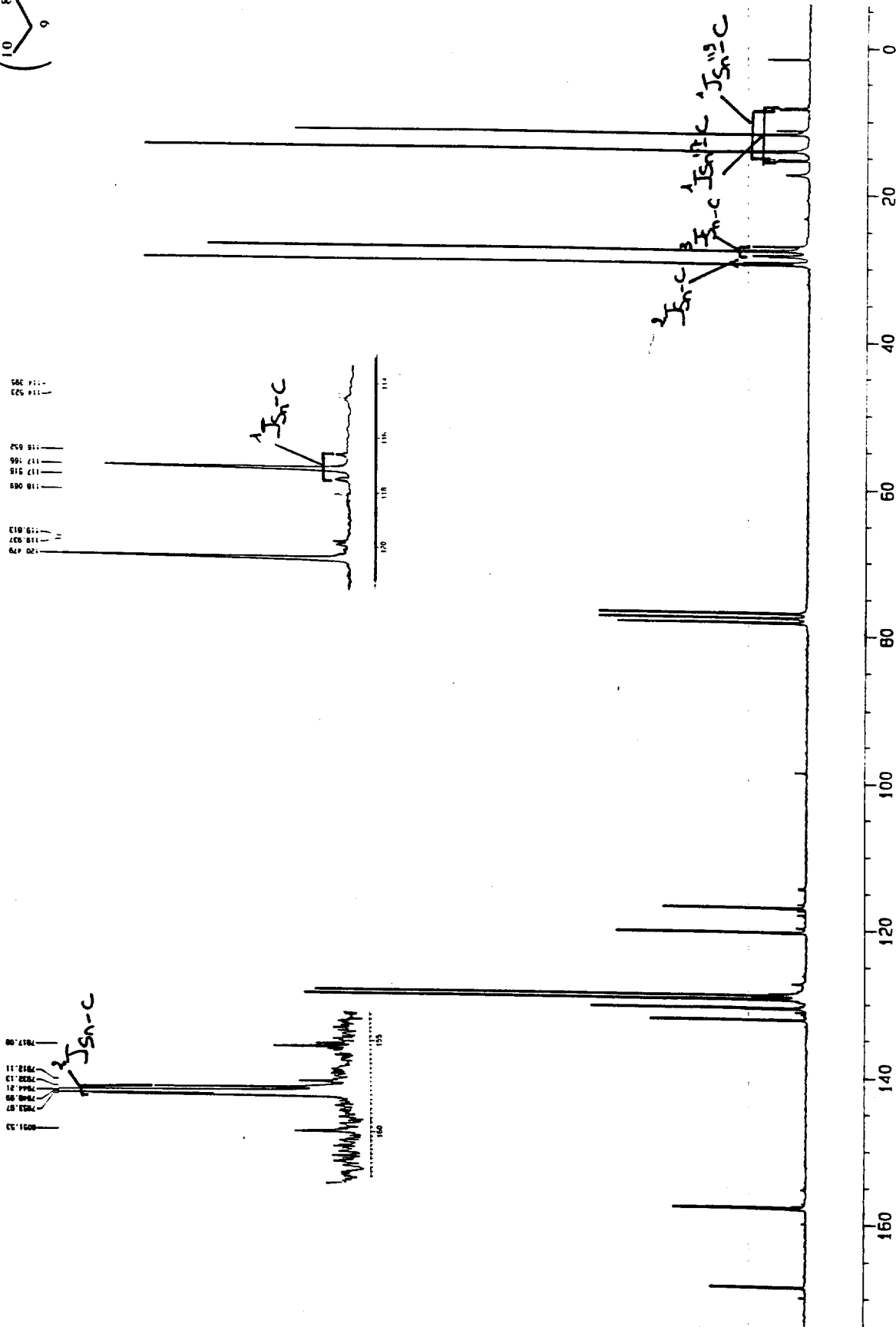




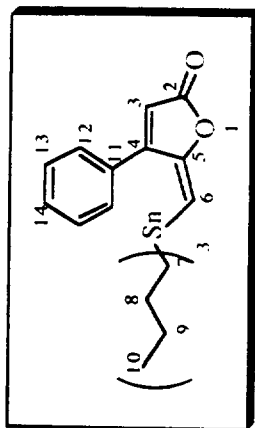
- 1490.62
- 1480.48
- 1469.89
- 1427.90
- 1421.43
- 1408.36
- 1390.23
- 1359.69
- 867.38
- 775.14
- 767.40
- 712.26
- 594.41
- 577.20
- 568.10
- 422.30
- 414.32
- 78.95

- 3941.63
- 3909.57
- 3877.45

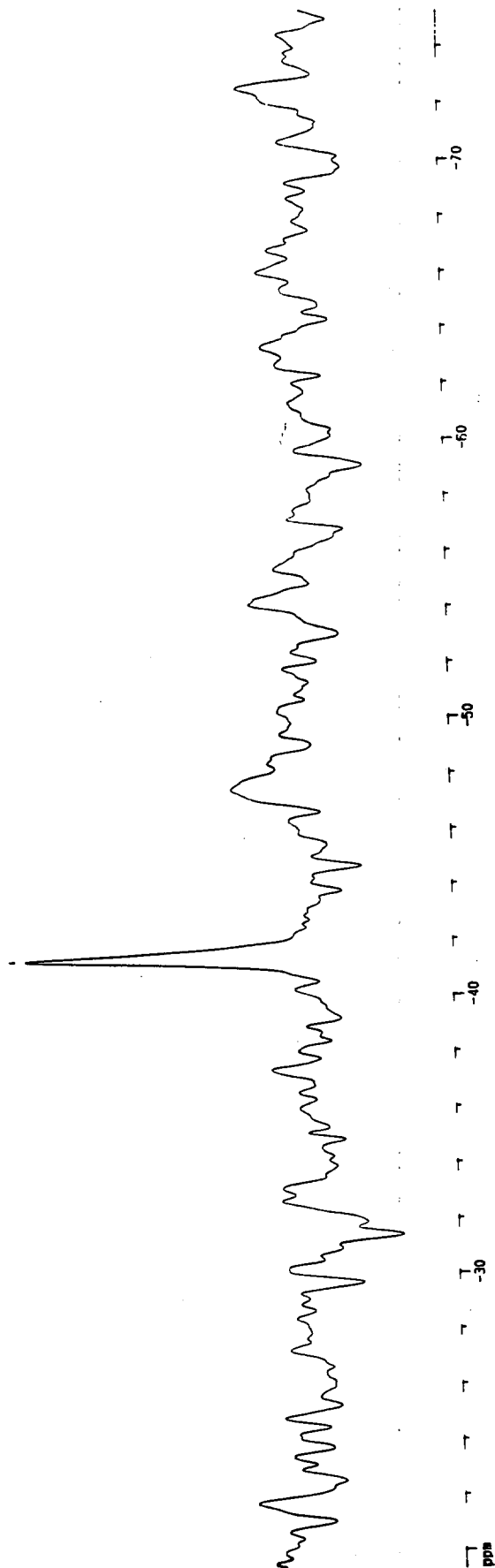
- 8334.72
- 8488.92
- 7953.97
- 7948.99
- 7944.21
- 7932.13
- 7817.08
- 6657.73
- 6618.01
- 6604.29
- 6580.99
- 6563.39
- 6524.39
- 6513.64
- 6498.30
- 6484.40
- 6412.64
- 6062.81
- 6035.57
- 6029.31
- 5941.55
- 5913.74
- 5896.10
- 5870.26
- 5763.12
- 5756.68
- 4958.71

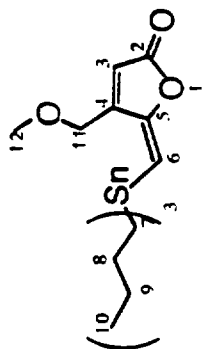


RMN ^{119}Sn (CDCl_3)



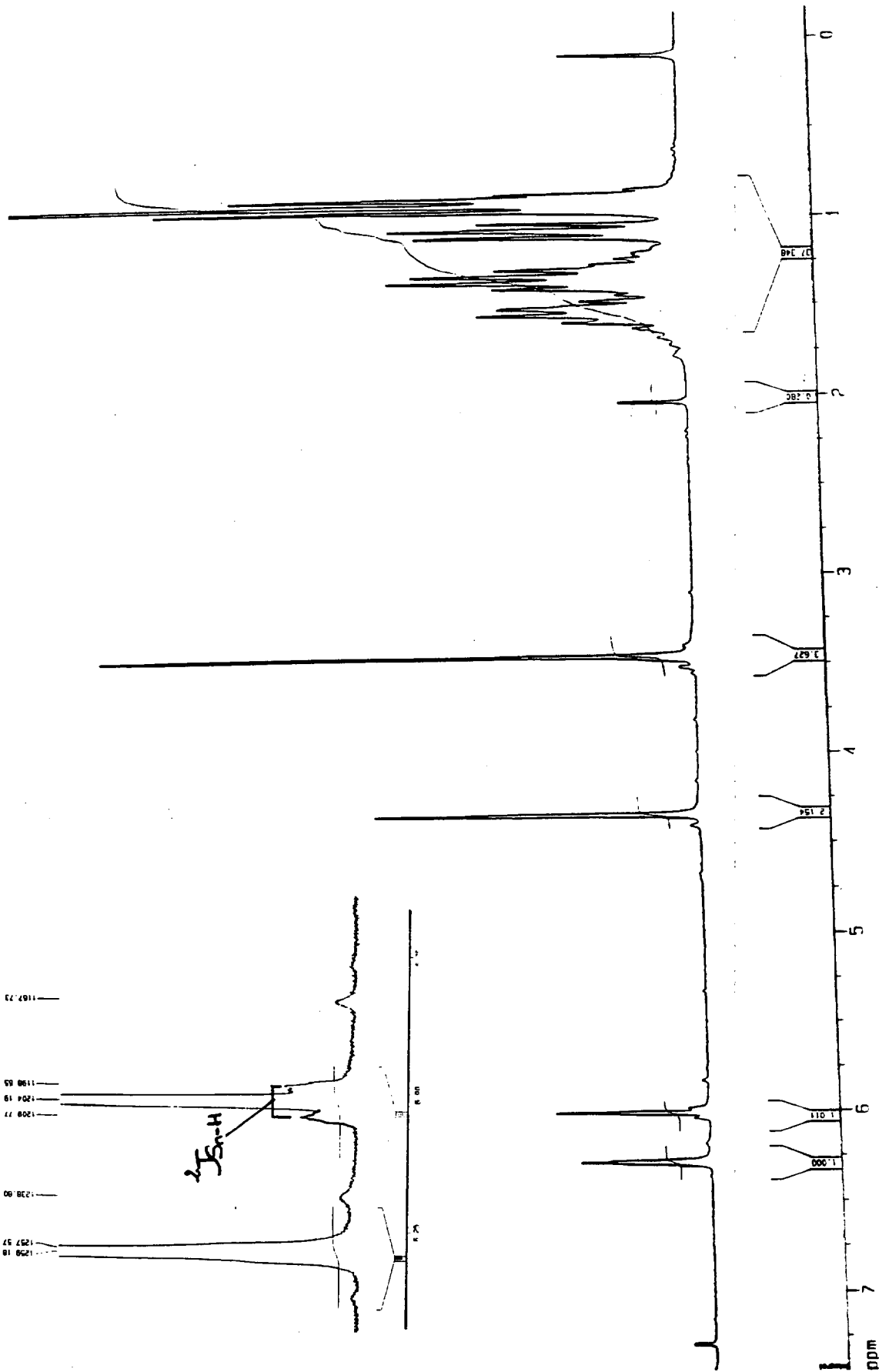
41.2422

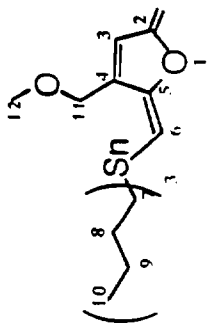




Chemical shift data (Hz) for the spectrum:

19.58
20.27
174.88
176.42
179.65
186.49
193.51
207.96
215.34
223.82
260.04
267.10
274.54
278.83
281.56
303.61
304.21
306.16
311.04
319.07
407.01
407.80
408.60
680.43
680.71
681.54
682.32
685.41
685.92
692.73
693.42
694.11
704.41
704.81
705.61
863.30
870.71
882.61
882.81
1197.11
1197.31
1198.61
1199.81
1200.41
1204.11
1205.71
1208.51
1209.71
1254.11
1257.51
1259.11
1260.81
1461.11
1461.51
1461.71
1462.81

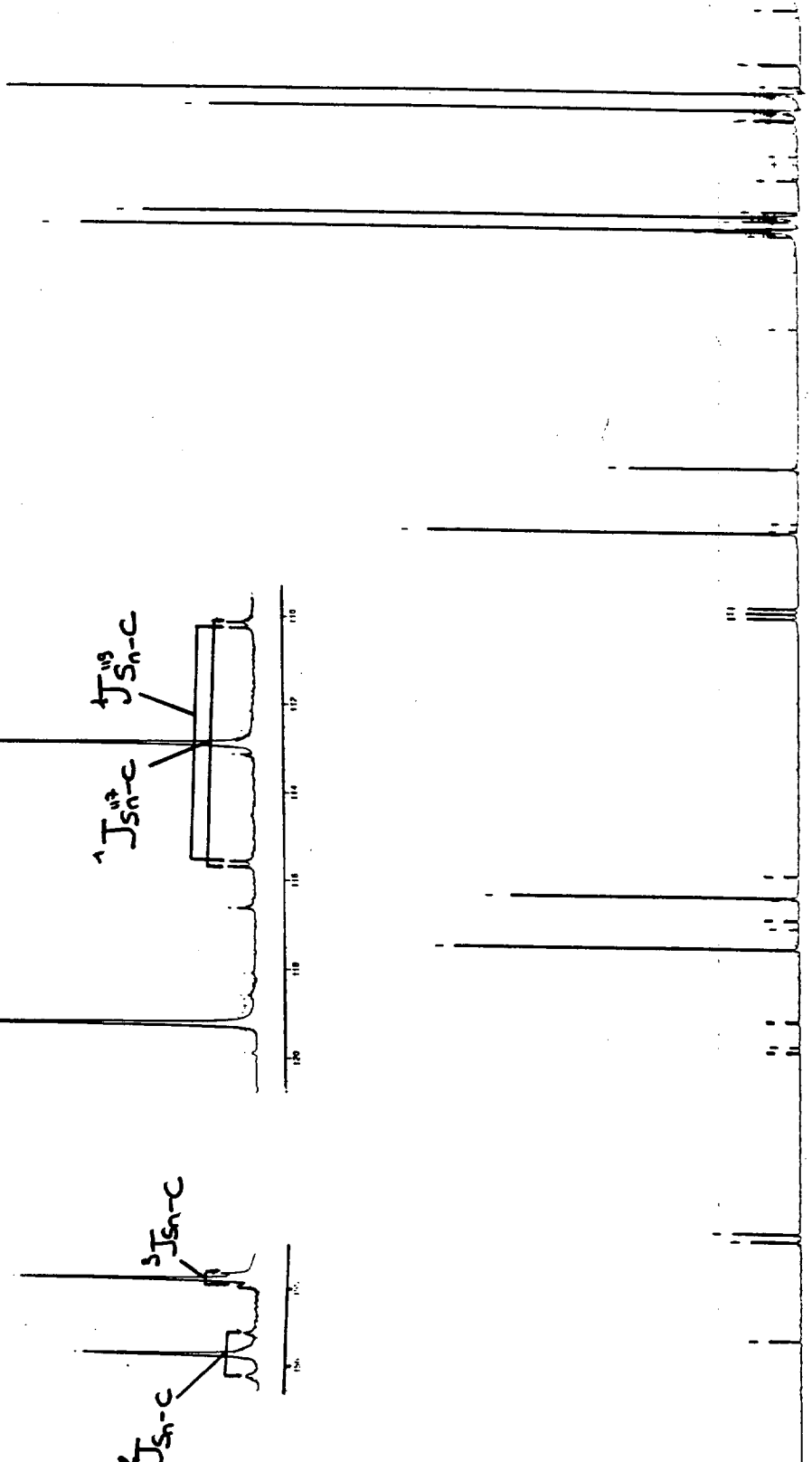
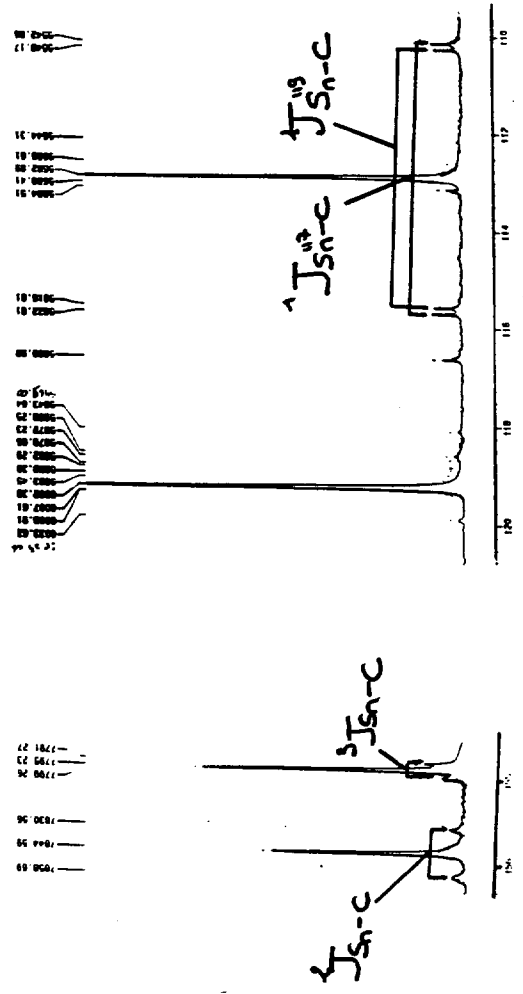


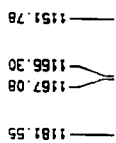
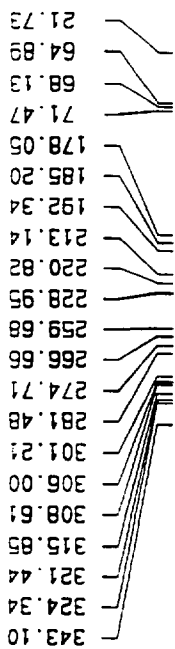
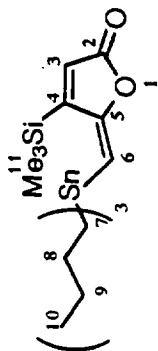


- 389.75
- 397.75
- 569.92
- 678.22
- 742.09
- 750.08
- 1330.96
- 1332.12
- 1361.47
- 1392.04
- 1437.20
- 1447.70
- 1451.57
- 1452.84
- 1458.19
- 1487.06
- 2072.95
- 2958.92
- 2965.47
- 3305.93
- 3352.07
- 3369.73
- 3376.21
- 3840.41
- 3872.40
- 3904.41

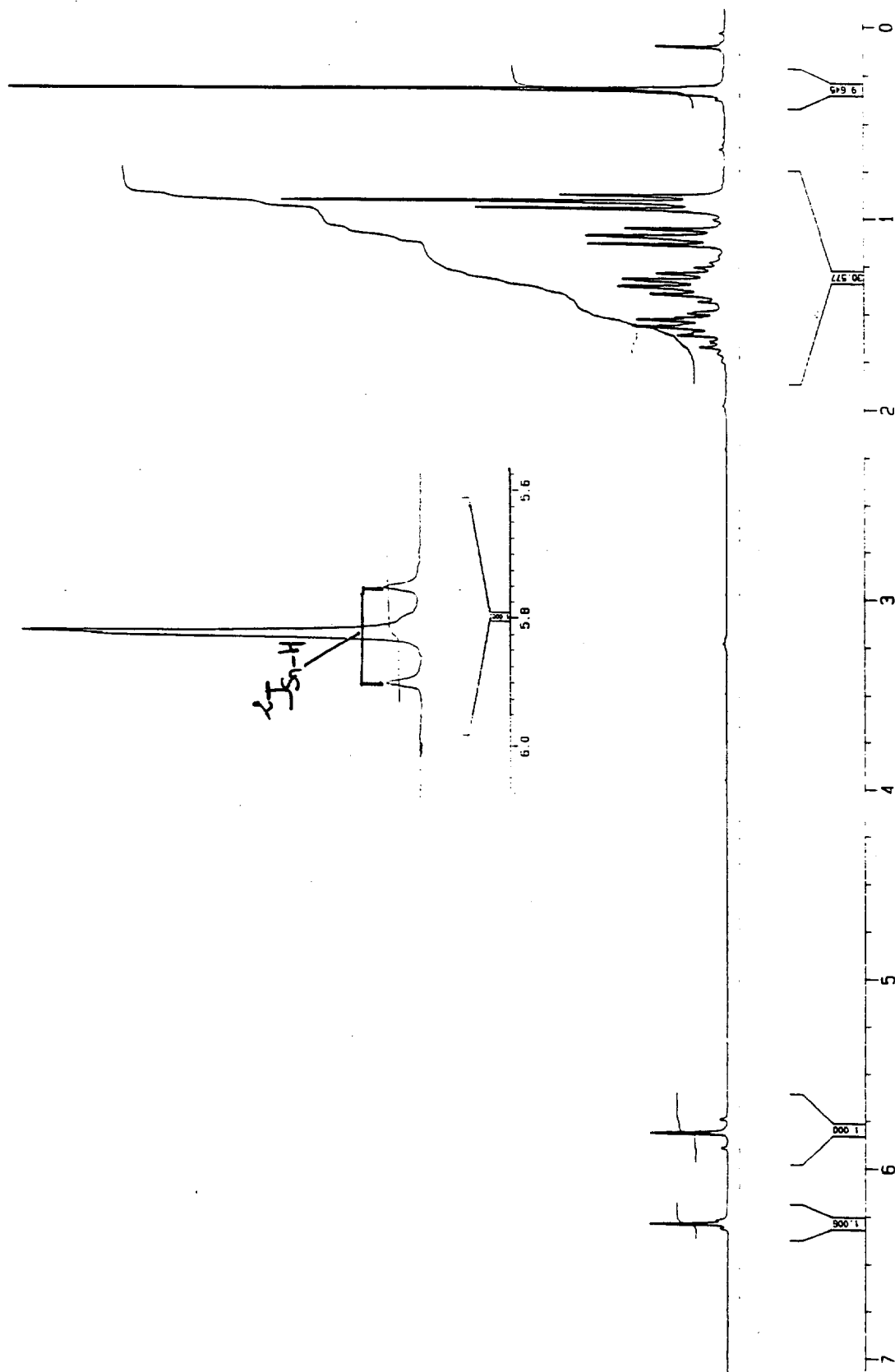
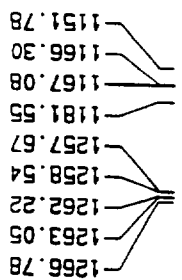
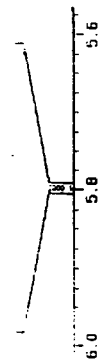
- 5542.96
- 5549.17
- 5682.89
- 5694.51
- 5816.61
- 5822.81
- 5869.98
- 6002.39
- 6452.78
- 6465.31
- 6610.48
- 6613.44
- 6642.47
- 6653.21

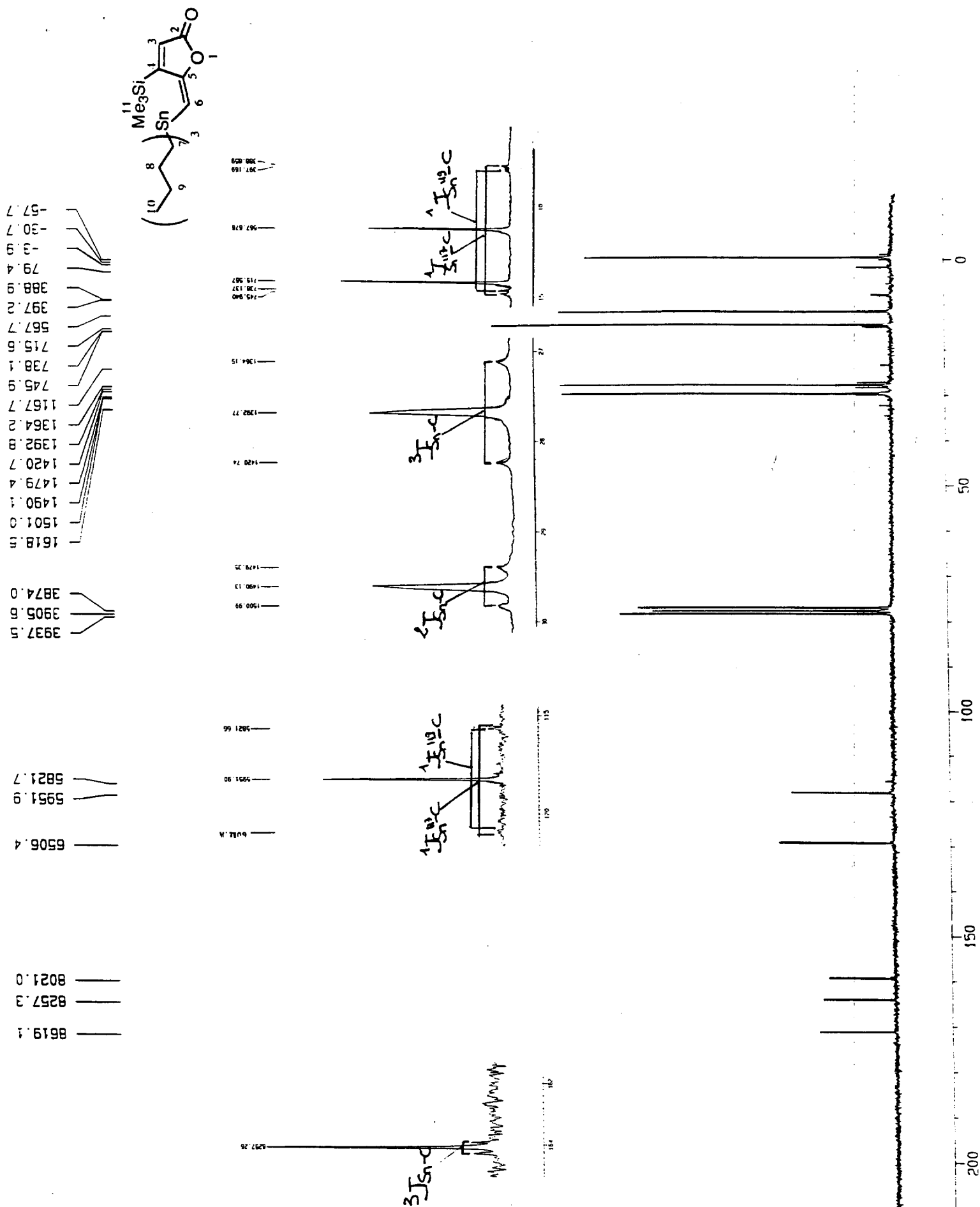
- 7791.27
- 7795.23
- 7844.59
- 8473.93



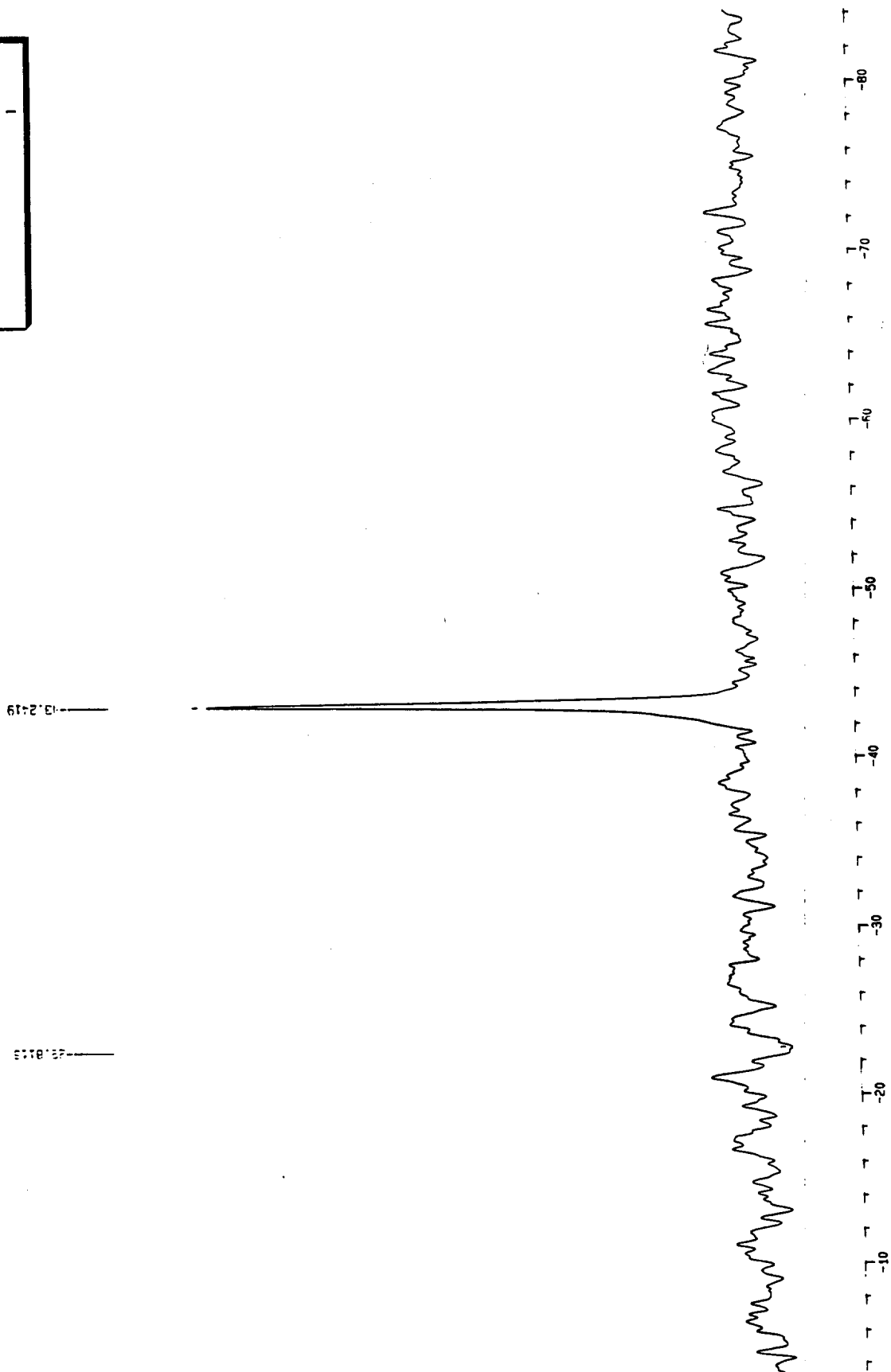
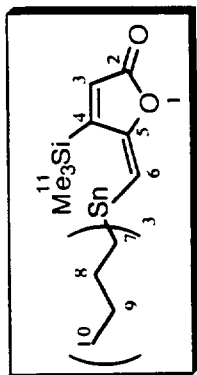


H-Si

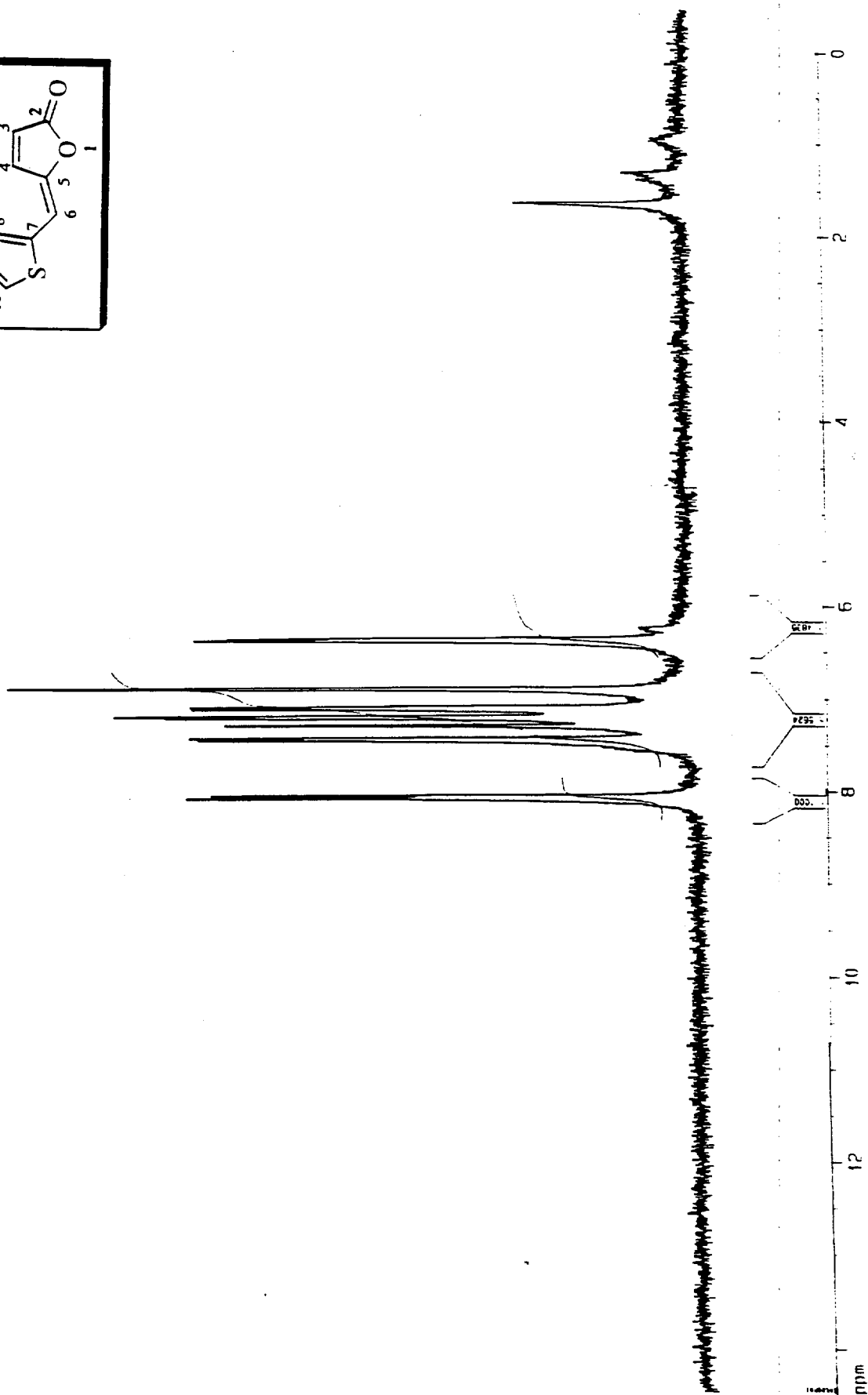
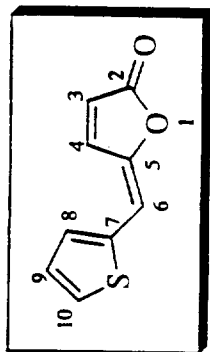




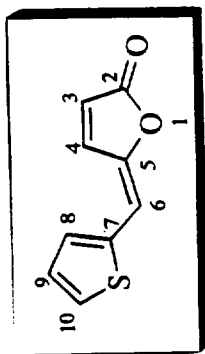
RMN ^{119}Sn (CDCl_3)



- 1619.82
- 1614.25
- 1493.84
- 1489.08
- 1461.74
- 1451.68
- 1445.53
- 1445.10
- 1442.64
- 1437.83
- 1433.83
- 1433.26
- 1427.53
- 1423.88
- 1422.53
- 1419.11
- 1380.99
- 1279.66
- 1278.18
- 1274.23
- 1272.86
- 940.36
- 938.10
- 937.73
- 336.42
- 335.68
- 334.41
- 333.33
- 332.89
- 331.69
- 328.29
- 327.64
- 327.01
- 326.50
- 321.67
- 320.89
- 259.17
- 258.52
- 258.17



Hz



78.240
77.604
76.968

109.936

121.721

128.647

128.982

131.903

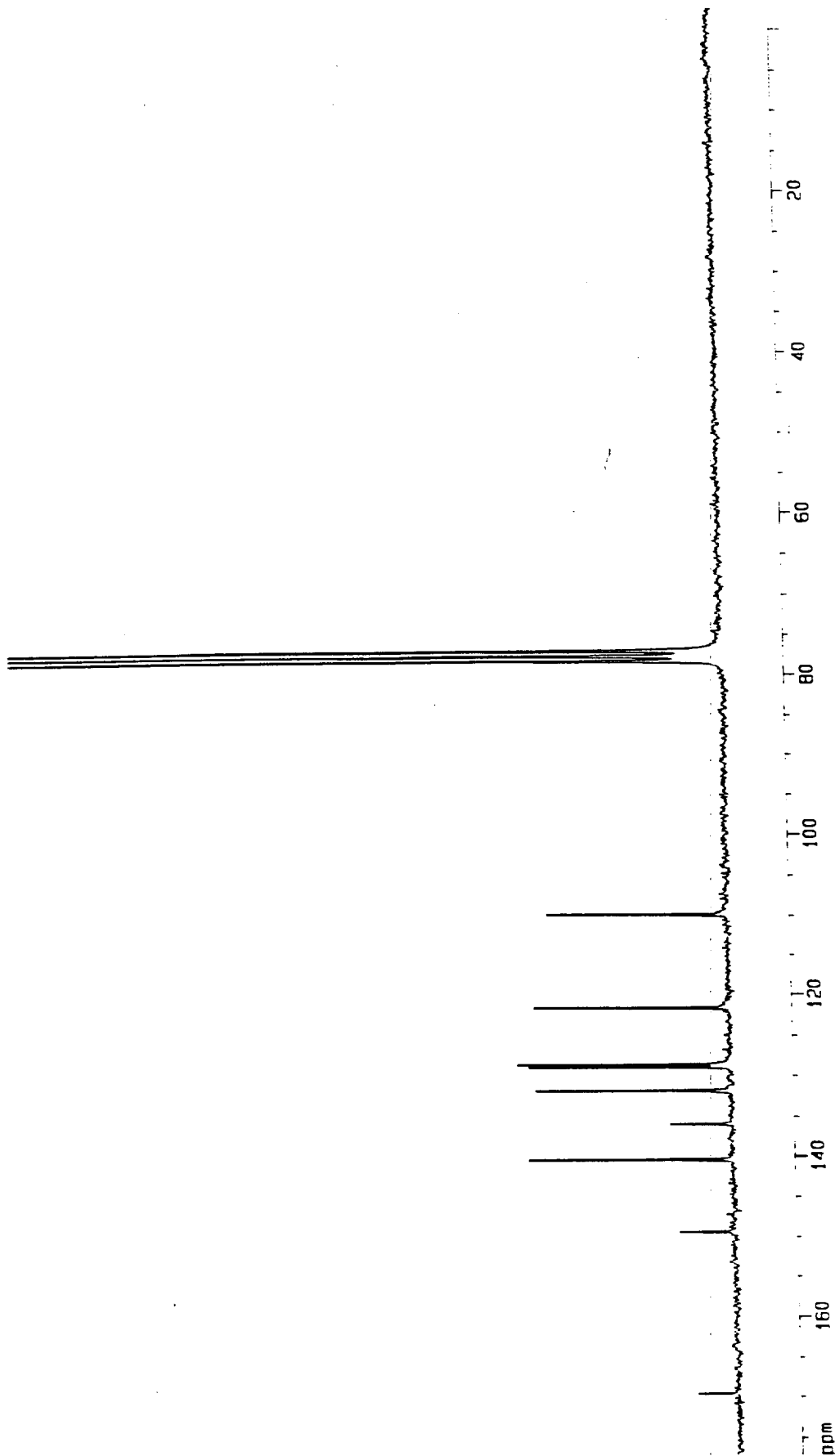
136.051

140.437

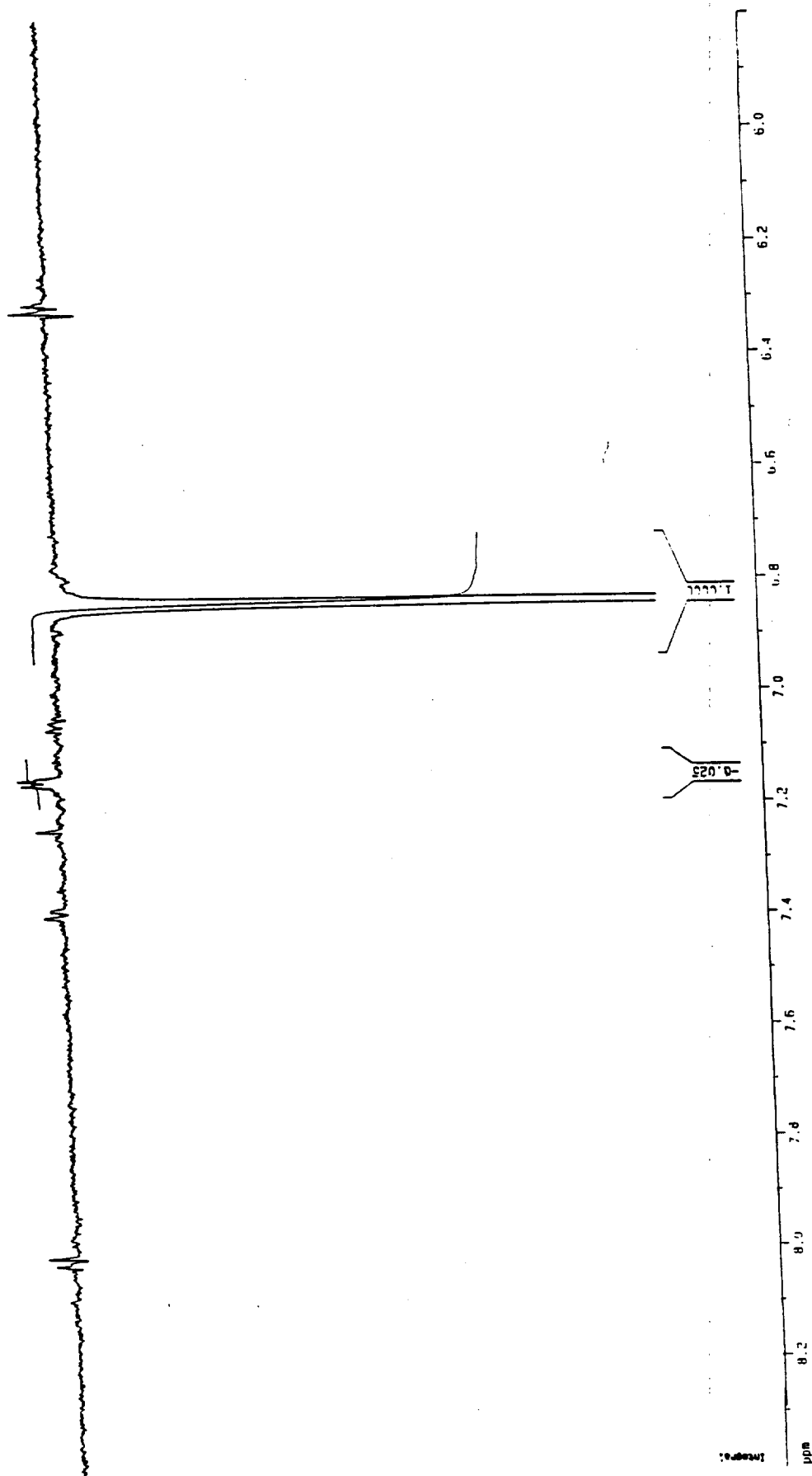
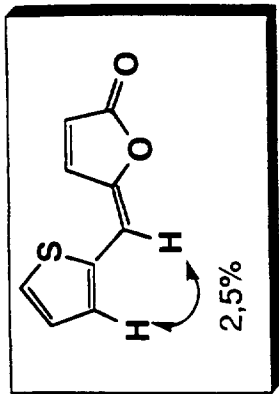
149.398

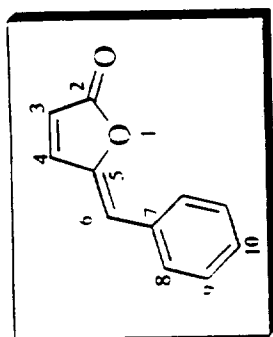
159.690

ppm

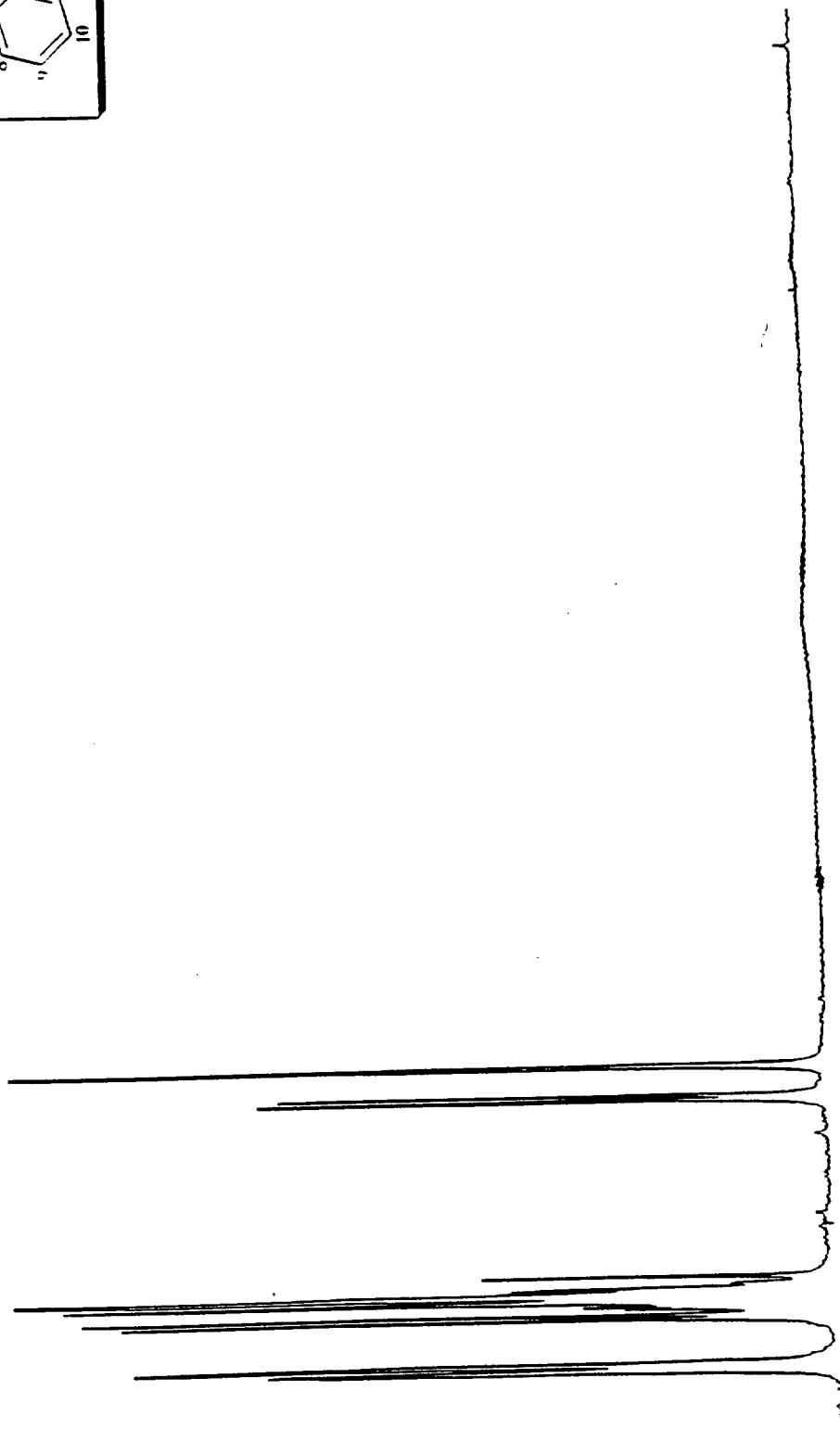


NOE DIFF (CDCl₃)

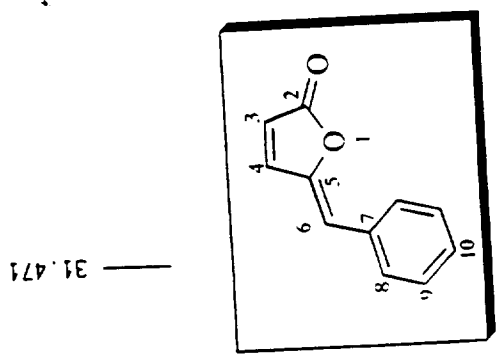




1558.12
1556.42
1550.06
1548.83
1497.26
1491.91
1475.90
1468.06
1466.14
1461.85
1446.97
1441.22
1374.26
1373.71
1240.05
1234.73
1201.90
1194.37
Hz



10
9
8
7
6
5
4
3
2
1
0
ppm



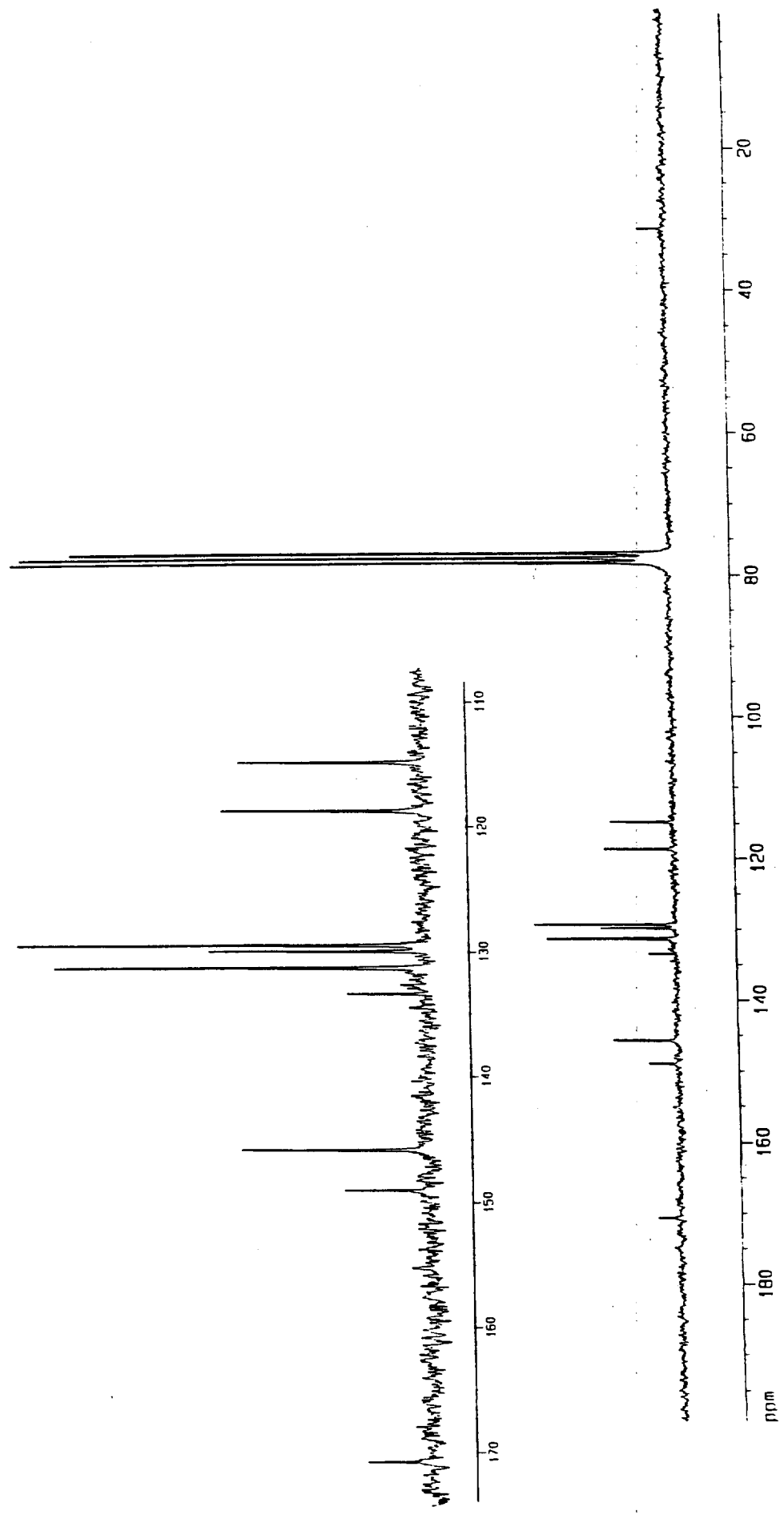
31.471

76.974
77.608
78.244

170.784
149.041
145.844
133.438
131.344
129.925
129.443
118.742
114.843
133.438
131.344
129.925
129.443
118.742
114.843

ppm

170.784



NOE DIFF (CDCl₃)

