SUPPORTING INFORMATION

Synthesis of 2-Alkylidene Cyclopentanones via Palladium-Catalyzed Cross-Coupling of 1-(1-Alkynyl)cyclobutanols and Aryl or Vinylic Halides

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Synthesis of the 1-(1-Alkynyl)cyclobutanols

Representative Synthesis of a 1-(1-Alkynyl)cyclobutanol: 1-(Phenylethynyl)cyclobutanol (1). A three neck flask with thermometer inlet was charged with diisopropylamine (1.212 g, 12 mmol) in THF (5 ml). The flask was cooled to –78 °C and *n*-BuLi (5.7 ml, 12 mmol) was added dropwise under an argon atmosphere. The reaction mixture was allowed to warm to room temperature for 20 min and then cooled to –78 °C and phenylacetylene (1.224 g, 12 mmol) in THF (2 ml) was added. The flask was allowed to warm to 0 °C for 20 min and then stirred for 1 h. The flask was again cooled to –78 °C and cyclobutanone (0.700 g, 10 mmol) in THF (4 ml) was added. The flask was allowed to warm to room temperature for 30 min and further stirred for 2 h, quenched with water and extracted with ether (3 x 25 ml) and the combined extracts were washed with saturated aqueous NH_4Cl, water, and brine, and then dried (Na_2SO_4) and filtered. The solvent was removed under reduced pressure and the resulting oil was purified by flash column chromatography using 60:40 hexanes/diethyl ether to afford 1.566 g (91%) of the desired compound as a white solid: mp 42 °C; ^{1}H NMR ($CDCl_3$) δ 1.82-1.93 (m, 2H), 2.10 (br s, 1H), 2.23-2.40 (m, 2H), 2.50-2.58 (m, 2H), 7.26-7.34 (m, 3H), 7.42-7.46 (m, 2H); ^{13}C NMR

($CDCl_3$) δ 12.3, 38.6, 68.2, 83.4, 92.6, 122.7, 128.2, 131.7 (one carbon missing as a result of overlap).

1-(1-Propynyl)cyclobutanol (7). A three neck flask with thermometer inlet was charged with anhydrous cerium(III) chloride (2.46 g, 10 mmol) in THF (20 ml). The flask was cooled to –78 °C and 1-propynylmagnesium bromide (20 ml, 10 mmol) was added dropwise under an argon atmosphere. After the mixture had been stirred for 1 h at –78 °C, cyclobutanone (0.56 g, 8 mmol) in THF (6 ml) was added. The resulting reaction mixture was allowed to warm to room temperature for 30 min and further stirred for 2 h, quenched with water and extracted with ether (3 x 25 ml) and the combined extracts were washed with saturated aqueous NH_4Cl, water, and brine, and then dried (Na_2SO_4) and filtered. The solvent was removed under reduced pressure and the resulting oil was purified by flash column chromatography using 70:30 hexanes/diethyl ether to afford 0.6457 g (73%) of the desired compound as a colorless oil: ^1H NMR ($CDCl_3$) δ 1.71-1.82 (m, 2H), 1.86 (s, 3H), 2.15-2.26 (m, 3H), 2.32-2.41 (m, 2H); ^{13}C NMR ($CDCl_3$) δ 3.6, 12.7, 38.6, 68.0, 79.4, 83.0.

3-Phenyl-1-(phenylethynyl)cyclobutanol (11). This cyclobutanol was prepared by the same method used to prepare cyclobutanol **1**, but 3-phenylcyclobutanone (1.46 g, 10 mmol) was employed. Removal of the solvent afforded 2.1 g (85%) of the cyclobutanol **11** as a white solid: mp 78 °C; ^1H NMR ($CDCl_3$) δ 2.51-2.59 (m, 2H), 2.88 (br s, 1H), 3.00-3.07 (m, 2H), 3.39-3.51 (m, 1H), 7.26-7.39 (m, 8H), 7.53-7.56 (m, 2H); ^{13}C NMR ($CDCl_3$) δ 30.5, 46.3, 64.4, 83.6, 92.5, 122.6, 126.2, 126.7, 128.3, 128.4, 128.4, 131.7, 144.0.

6-(Phenylethynyl)bicyclo[3.2.0]hept-2-en-6-ol (13). This cyclobutanol was prepared by the same method used to prepare cyclobutanol **1**, but bicyclo[3.2.0]hept-2-en-6-one (1.0 g, 10 mmol) was employed. Removal of the solvent afforded 1.89 g (90%) of the cyclobutanol **13** as a light yellow solid: mp 51 °C; ^1H NMR ($CDCl_3$) δ 2.06-2.12 (dddd, J = 1.2, 0.9, 1.2, 0.9 Hz, 1H), 2.31-2.53 (m, 2H), 2.81-2.99 (m, 2H), 3.20 (s, 1H), 3.42 (t, J = 7.5 Hz, 1H), 5.83-5.89

(m, 2H), 7.29-7.33 (m, 3H), 7.42-7.48 (m, 2H); ^{13}C NMR ($CDCl_3$) δ 32.5, 39.3, 45.2, 48.8, 67.6, 83.6, 93.4, 122.7, 128.2, 131.5, 132.5, 134.4.

1-Methyl-7-(phenylethynyl)bicyclo[4.2.0]octan-7-ol (15). This cyclobutanol was prepared by the same method used to prepare cyclobutanol **1**, but 1-methylbicyclo[4.2.0]octan-7-one (1.38 g, 10 mmol) was employed. Removal of the solvent afforded 2.15 g (90%) of the cyclobutanol **15** as a colorless liquid: ^{1}H NMR ($CDCl_3$) δ 1.24-1.67 (m, 9H), 1.74-1.86 (m, 2H), 2.03 (br s, 1H), 2.18-2.31 (m, 2H), 2.38 (t, J = 6.0 Hz, 1H), 7.28-7.31 (m, 3H), 7.40-7.43 (m, 2H); ^{13}C NMR ($CDCl_3$) δ 20.8, 21.2, 22.3, 28.8, 31.4, 35.7, 48.9, 50.4, 67.7, 83.3, 94.2, 123.2, 128.2, 128.3, 131.6.

General Procedure for the Palladium-Catalyzed Cross-Coupling of 1-(1-Alkynyl)cyclobutanols and Organic Halides: DMF (5 mL), $Pd(OAc)_2$ (11 mg, 0.05 mmol), PPh_3 (26 mg, 0.1 mmol), the organic iodide (1.0 mmol), *i*-Pr_2NEt (130 mg, 1.0 mmol), *n*-Bu_4NCl (277 mg, 1.0 mmol) and the 1-(1-alkynyl)cyclobutanol (0.5 mmol) were placed in a 4 dram vial. The vial was flushed with argon and heated in an oil bath at 80 °C for the indicated period of time. The reaction was monitored by TLC to establish completion. The reaction mixture was cooled, diluted with 30 ml of ether, washed with 40 ml of saturated NaCl, dried (Na_2SO_4), and filtered. The solvent was evaporated under reduced pressure and the product was isolated by chromatography on a silica gel column.

Compounds Prepared

2-(Diphenylmethylene)cyclopentanone (2). The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 87 mg (70%) of the indicated compound as a yellow solid: mp 105 °C ; ^{1}H NMR ($CDCl_3$) δ 1.93 (q, J = 7.5 Hz, 2H), 2.38 (t, J = 7.8 Hz, 2H), 2.82 (t, J = 7.0 Hz, 2H), 7.10-7.14 (m, 2H), 7.17-7.20 (m, 2H), 7.30-7.35 (m, 6H); ^{13}C NMR ($CDCl_3$) δ 20.5, 32.9, 39.8, 127.8, 127.9, 128.3, 129.4, 129.6, 134.3, 140.1, 141.8, 148.2, 206.5 (one carbon

missing as a result of overlap); IR ($CHCl_3$, cm^{-1}) 1706; MS *m/z* (rel intensity) 248 (50, M^+), 247 (100), 191 (30). Anal. Calcd for $C_{18}H_{16}O$: C, 87.06; H, 6.49. Found: C, 86.90; H, 6.80.

***E*-2-[(2-Methoxyphenyl)phenylmethylene]cyclopentanone (3).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 103 mg (74%) of the indicated compound as a yellow solid: mp 110 °C ; ^1H NMR ($CDCl_3$) δ 1.85-1.95 (m, 2H), 2.40 (t, *J* = 7.8 Hz, 2H), 2.54 (t, *J* = 7.2 Hz, 2H), 3.74 (s, 3H), 6.91-6.96 (m, 2H), 7.04-7.07 (m, 1H), 7.21-7.33 (m, 6H); ^{13}C NMR ($CDCl_3$) δ 19.6, 31.8, 40.3, 55.4, 111.3, 120.4, 127.3, 127.5, 128.9, 129.2, 129.8, 131.2, 135.0, 139.6, 145.2, 156.0, 205.9; IR ($CHCl_3$, cm^{-1}) 1712; MS *m/z* (rel intensity) 278 (50, M^+), 247 (100). Anal. Calcd for $C_{19}H_{18}O_2$: C, 81.99; H, 6.52. Found: C, 81.47; H, 6.75.

***E*-2-[(2-Nitrophenyl)phenylmethylene]cyclopentanone (4).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 103 mg (70%) of the indicated compound as a yellow viscous oil: ^1H NMR ($CDCl_3$) δ 1.88-1.97 (m, 2H), 2.49 (tt, *J* = 6.9, 6.7 Hz, 4H), 7.24-7.29 (m, 5H), 7.39 (dt, *J* = 1.5, 1.2 Hz, 1H), 7.49 (dqd, *J* = 1.5, 0.9, 1.5 Hz, 1H), 7.66 (ddd, *J* = 1.2, 1.2, 1.5 Hz, 1H), 8.00 (tt, *J* = 0.7, 0.6 Hz, 1H); ^{13}C NMR ($CDCl_3$) δ 19.5, 31.8, 40.1, 124.8, 127.5, 128.4, 128.8, 129.5, 130.7, 133.4, 134.6, 136.5, 136.9, 144.4, 147.5, 205.0; IR ($CHCl_3$, cm^{-1}) 1716; HRMS calcd for $C_{18}H_{14}NO_3$: 292.09737. Found: 292.09678.

***E*-2-[(2*E*)-1-Phenylhept-2-enylidene]cyclopentanone (5).** The reaction mixture was chromatographed using 70:30 hexanes/ether to afford 50 mg (40%) of the indicated compound as a yellow oil: ^1H NMR ($CDCl_3$) δ 0.88 (t, *J* = 6.9 Hz, 3H), 1.27-1.37 (m, 4H), 1.95-2.03 (m, 2H), 2.17 (q, *J* = 6.6 Hz, 2H), 2.29 (t, *J* = 7.8 Hz, 2H), 2.88 (t, *J* = 7.2 Hz, 2H), 5.55-5.65 (m, 1H), 6.47 (d, *J* = 15.3 Hz, 1H), 7.02-7.05 (m, 2H), 7.31-7.39 (m, 3H); ^{13}C NMR ($CDCl_3$) δ 13.8, 19.4, 22.2, 29.2, 30.9, 33.3, 40.2, 126.9, 127.6, 128.6, 130.8, 131.1, 138.0, 144.9, 206.0; IR ($CHCl_3$, cm^{-1}) 1708; HRMS calcd for $C_{18}H_{22}O$: 254.16707. Found: 254.16701.

***Z*-[Phenyl(4-phenylcyclohex-1-enyl)methylene]cyclopentanone (6a).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 60 mg (36%) of the indicated compound as a yellow viscous oil: ^{1}H NMR ($CDCl_3$) δ 1.83-2.13 (m, 5H), 2.25-2.48 (m, 5H), 2.71 (t, J = 6.9 Hz, 2H), 2.90-3.00 (m, 1H), 5.61-5.62 (m, 1H), 7.19-7.41 (m, 10H); ^{13}C NMR ($CDCl_3$) δ 20.7, 29.1, 30.0, 32.2, 33.8, 39.5, 39.7, 125.7, 125.9, 126.9, 128.0, 128.3, 128.7, 133.3, 138.1, 140.4, 145.0, 147.2, 150.7, 207.2. This compound was too unstable for further characterization.

***E*-[Phenyl(4-phenylcyclohex-1-enyl)methylene]cyclopentanone (6b).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 57.4 mg (35%) of the indicated compound as a yellow viscous oil: ^{1}H NMR ($CDCl_3$) δ 1.75-1.85 (m, 1H), 1.93-2.11 (m, 5H), 2.33-2.43 (m, 3H), 2.50-2.56 (m, 1H), 2.79-2.90 (m, 3H), 5.95 (s, 1H), 7.19-7.41 (m, 10H); ^{13}C NMR ($CDCl_3$) δ 20.4, 27.9, 29.8, 32.3, 33.5, 39.5, 39.9, 126.1, 126.7, 127.5, 127.7, 128.3, 128.4, 128.6, 131.9, 138.7, 139.0, 146.4, 150.6, 206.5. This compound was too unstable for further characterization.

***E*-2-(1-Phenylethylidene)cyclopentanone (8).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 56 mg (60%) of the indicated compound as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 1.74-1.83 (m, 2H), 2.37 (t, J = 7.5 Hz, 2H), 2.52-2.60 (m, 5H), 7.22-7.39 (m, 5H); ^{13}C NMR ($CDCl_3$) δ 19.8, 20.3, 31.7, 40.5, 127.2, 127.8, 128.1, 132.6, 143.5, 147.4, 208.8; IR ($CHCl_3$, cm^{-1}) 1703; HRMS calcd for $C_{13}H_{14}O$: 186.10447. Found: 186.10391.

***E*-2-[(2-Methoxyphenyl)ethylidene]cyclopentanone (9).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 63 mg (63%) of the indicated compound as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 1.73-1.83 (m, 2H), 2.34-2.45 (m, 7H), 3.79 (s, 3H), 6.89-7.04 (m, 3H), 7.24-7.29 (m, 1H); ^{13}C NMR ($CDCl_3$) δ 19.8, 19.9, 30.8, 40.7, 55.4, 111.0, 120.5, 128.1, 128.8, 132.4, 133.3, 145.8, 155.4, 208.7; IR ($CHCl_3$, cm^{-1}) 1701; HRMS calcd for $C_{14}H_{16}O_2$: 216.11503. Found: 216.11451.

***E*-2-[(2*E*)-1-Methylhept-2-enylidene]cyclopentanone (10).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 34 mg (35%) of the indicated compound as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 0.91 (t, J = 4.5 Hz, 3H), 1.29-1.45 (m, 4H), 1.85-1.92 (m, 2H), 2.18-2.36 (m, 7H), 2.72 (t, J = 6.3 Hz, 2H), 6.21-6.25 (m, 2H); ^{13}C NMR ($CDCl_3$) δ 13.1, 13.9, 19.4, 22.3, 29.3, 31.3, 33.4, 40.8, 131.0, 131.1, 139.9, 142.7, 208.9; IR ($CHCl_3$, cm^{-1}) 1692, 1585; HRMS calcd for $C_{13}H_{20}O$: 192.15142. Found: 192.15127.

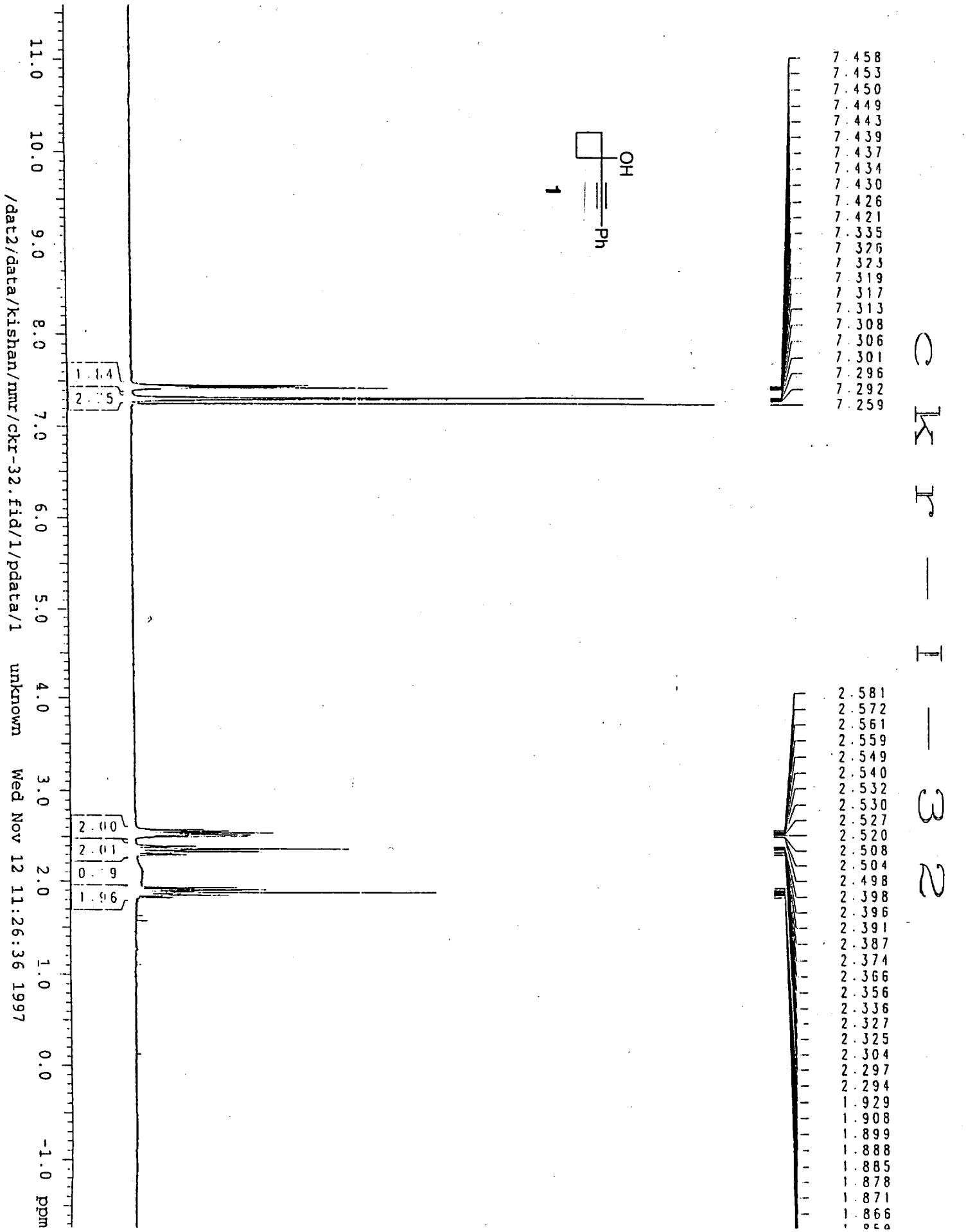
***E*-Ethyl 4-[(2-oxo-4-phenylcyclopentylidene)phenylmethyl]benzoate (12).** The reaction mixture was chromatographed using 80:20 hexanes/ether to afford 126 mg (64%) of the indicated compound as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 1.40 (t, J = 7.0 Hz, 3H), 2.65 (q, J = 10.8 Hz, 1H), 2.83-3.02 (m, 2H), 3.19 (q, J = 6.9 Hz, 1H), 3.40-3.52 (m, 1H), 4.41 (q, J = 7.0 Hz, 2H), 7.17-7.39 (m, 12H), 8.05 (d, J = 8.4 Hz, 2H); ^{13}C NMR ($CDCl_3$) δ 14.2, 39.2, 40.9, 46.8, 61.0, 126.6, 126.7, 127.9, 128.2, 128.6, 129.2, 129.3, 129.4, 130.2, 134.8, 139.1, 142.8, 145.9, 147.6, 165.9, 204.3 (two carbons missing as a result of overlap); IR ($CHCl_3$, cm^{-1}) 1710; HRMS calcd for $C_{27}H_{24}O_3$: 396.1726. Found: 396.1720.

***E*-2-[(2-Methoxyphenyl)phenylmethylene]bicyclo[3.3.0]oct-6-en-3-one (14).** The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 82 mg (52%) of the indicated compound as a yellow oil: ^{1}H NMR ($CDCl_3$) δ 2.23-2.31 (m, 3H), 2.69 (q, J = 9.9 Hz, 1H), 3.25-3.33 (m, 1H), 3.56 (q, J = 8.7 Hz, 1H), 3.72 (s, 3H), 5.62-5.69 (m, 2H), 6.89-6.98 (m, 2H), 7.22-7.31 (m, 7H); ^{13}C NMR ($CDCl_3$) δ 42.4, 44.1, 45.0, 55.4, 111.4, 120.5, 127.3, 127.5, 128.7, 129.1, 130.7, 133.9, 140.0, 206.4 (six carbons missing as a result of overlap); IR ($CHCl_3$, cm^{-1}) 1706; HRMS calcd for $C_{22}H_{20}O_2$: 316.14633. Found: 316.14571.

7-Diphenylmethylene-1-methylbicyclo[4.3.0]nonan-8-one (16). The reaction mixture was chromatographed using 60:40 hexanes/ether to afford 94 mg (60%) of the indicated compound as a yellow solid: mp 157-158 °C; ^{1}H NMR ($CDCl_3$) δ 1.07-1.47 (m, 7H), 1.59-1.72 (m, 4H), 1.93 (dd, J = 1.5, 1.2 Hz, 1H), 2.50 (q, J = 5.4 Hz, 1H), 2.68 (d, J = 18.0 Hz, 1H), 7.16-7.36 (m, 10H); ^{13}C NMR ($CDCl_3$) δ 21.7, 24.5, 29.2, 30.2, 34.8, 35.3, 47.2, 49.1, 127.6, 127.7, 128.1,

128.4, 128.9, 140.3, 140.7, 141.9, 148.3, 206.4 (one carbon missing as a result of overlap); IR ($CHCl_3$, cm^{-1}) 1710; HRMS calcd for $C_{23}H_{23}O$ (M-1): 315.17489. Found: 315.17551.

The ^1H and ^{13}C NMR spectra for all starting cyclobutanols and all cyclopentanones in Table 1 follow (39 pages).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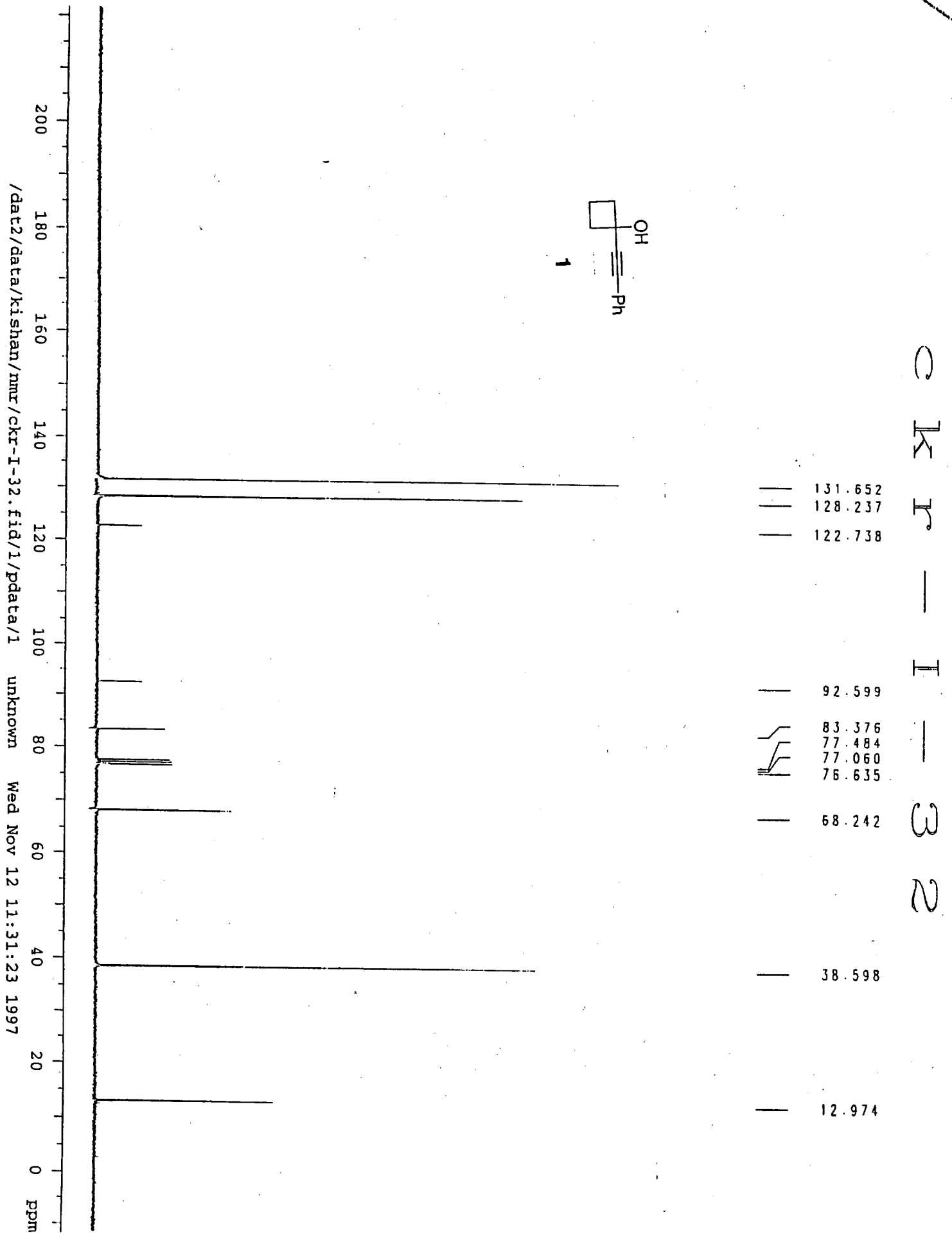

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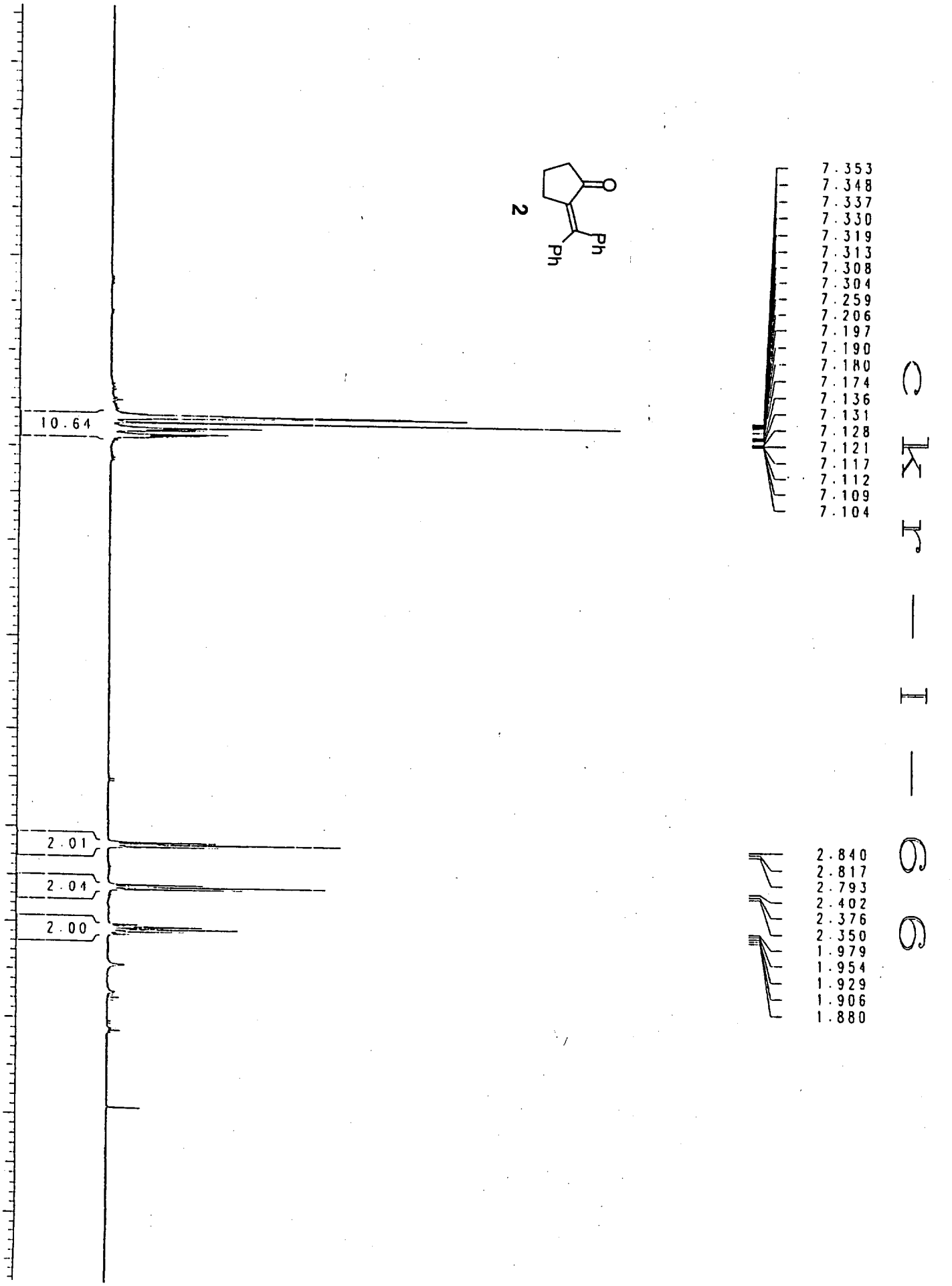
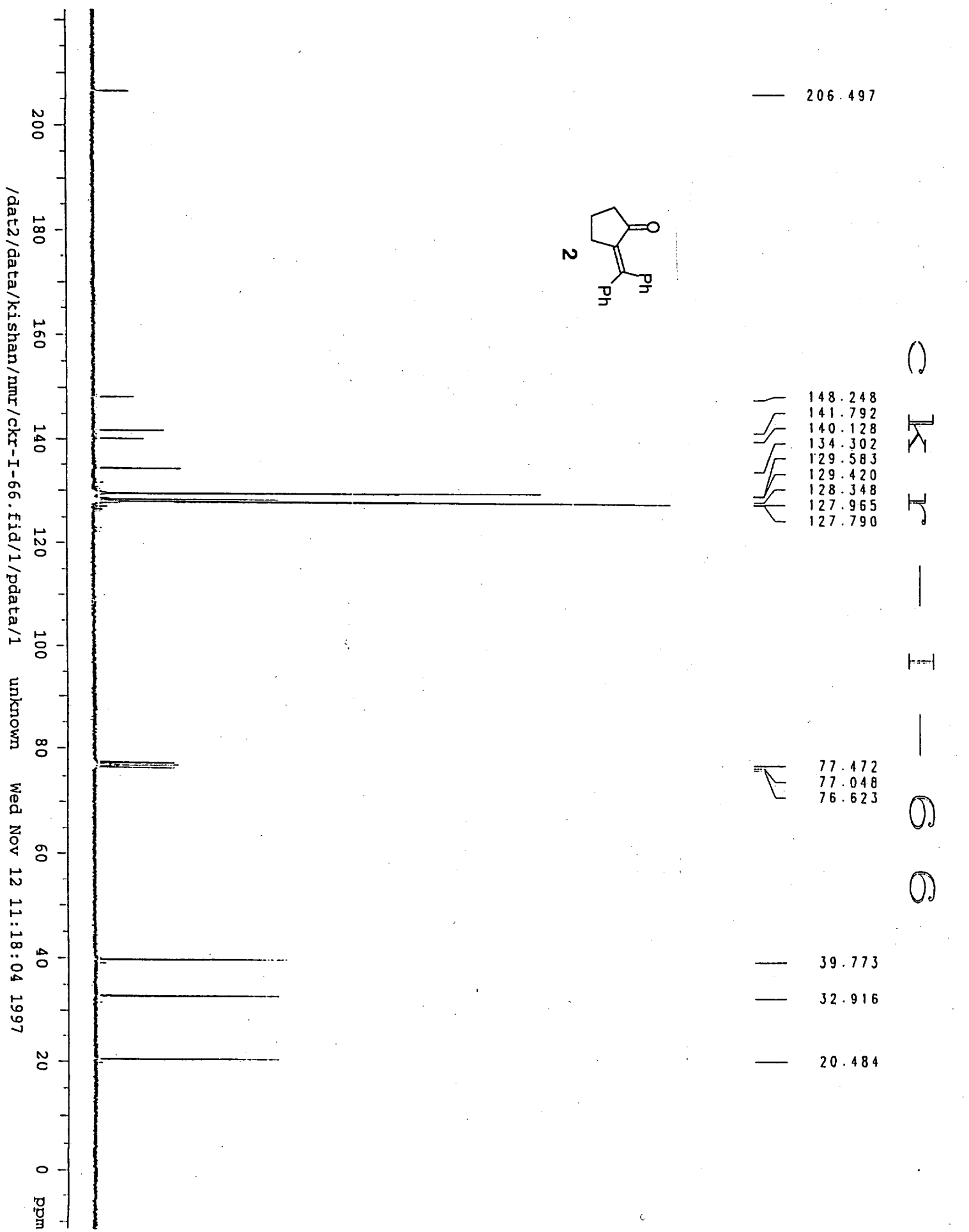
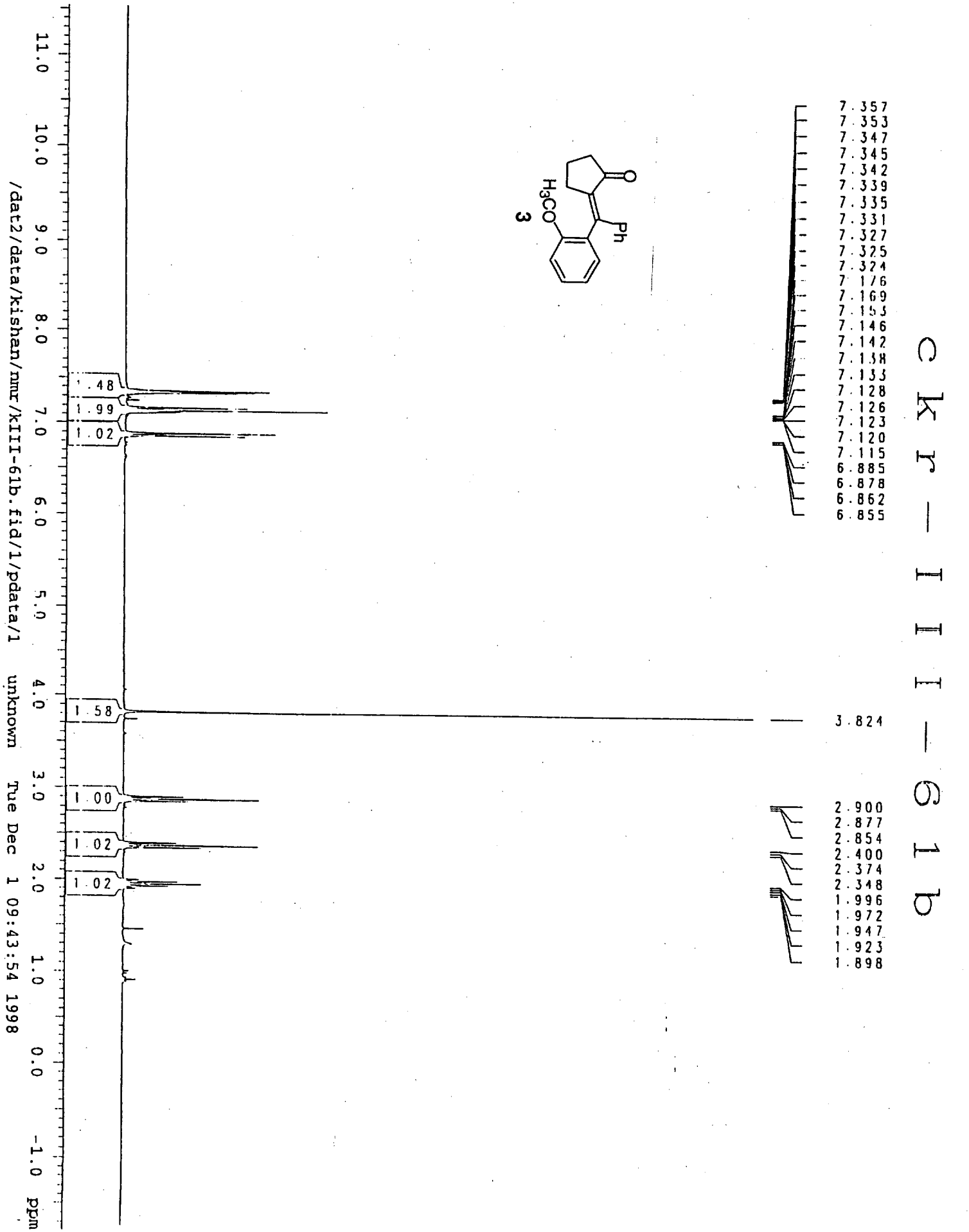
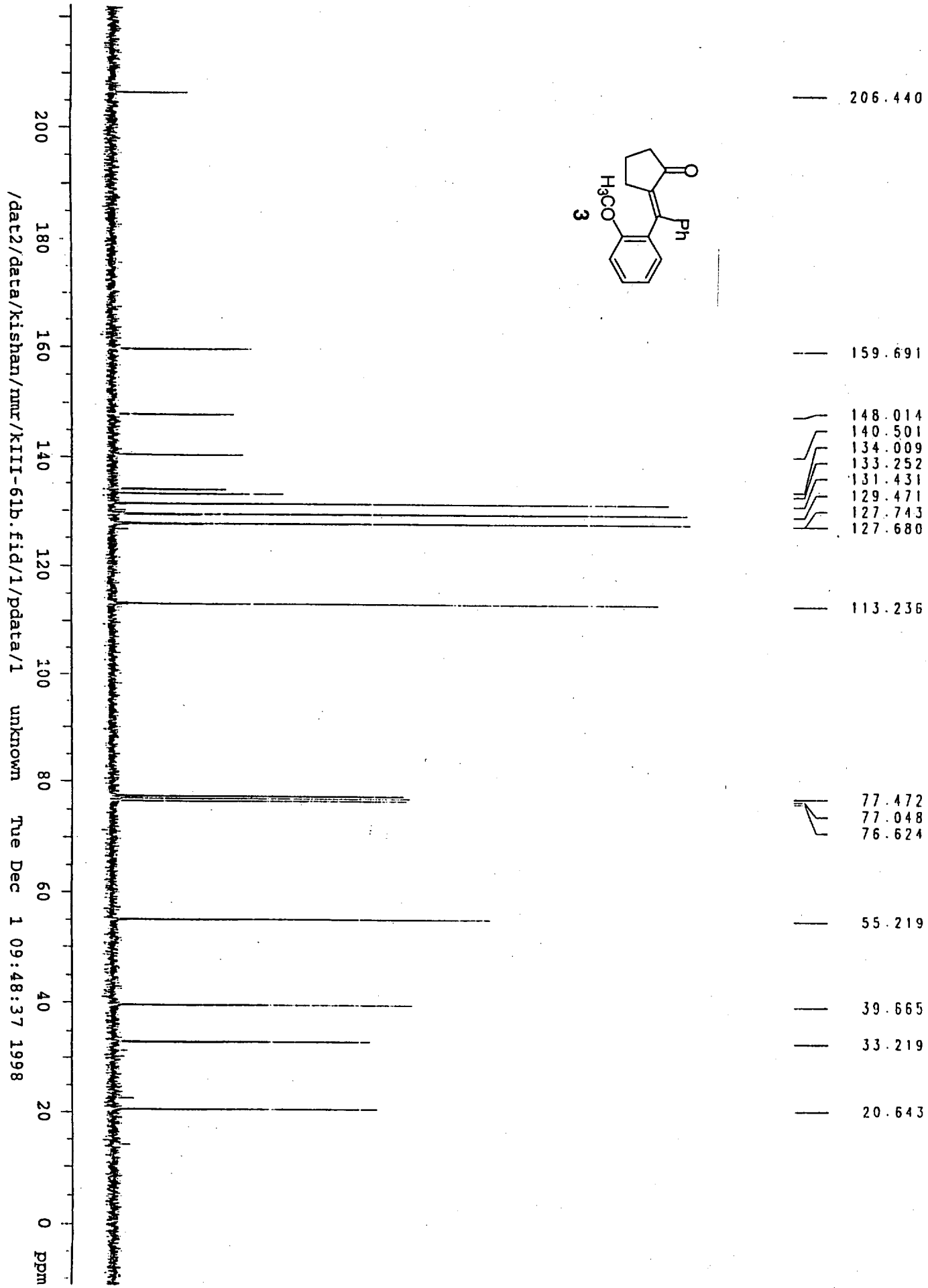
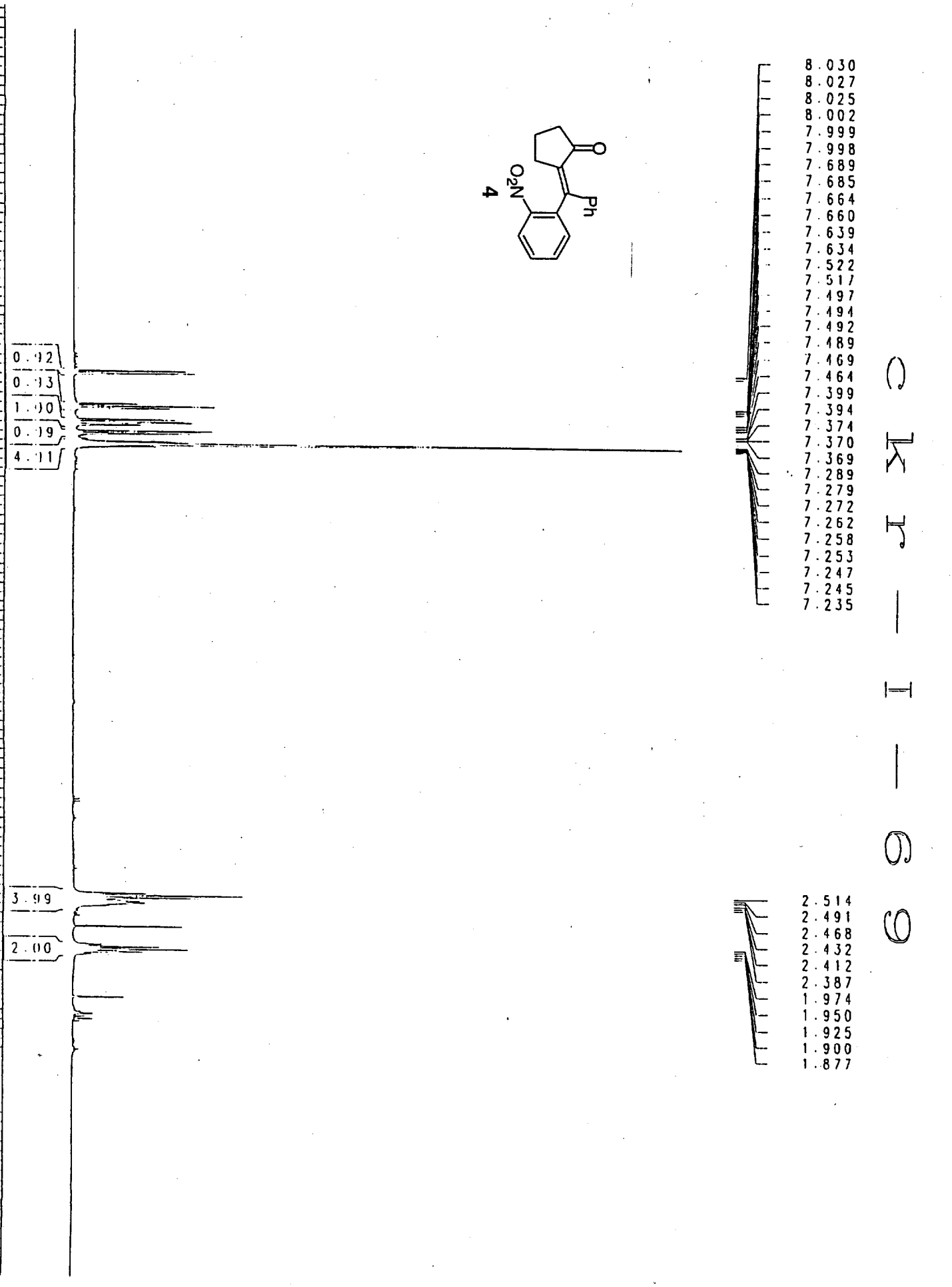


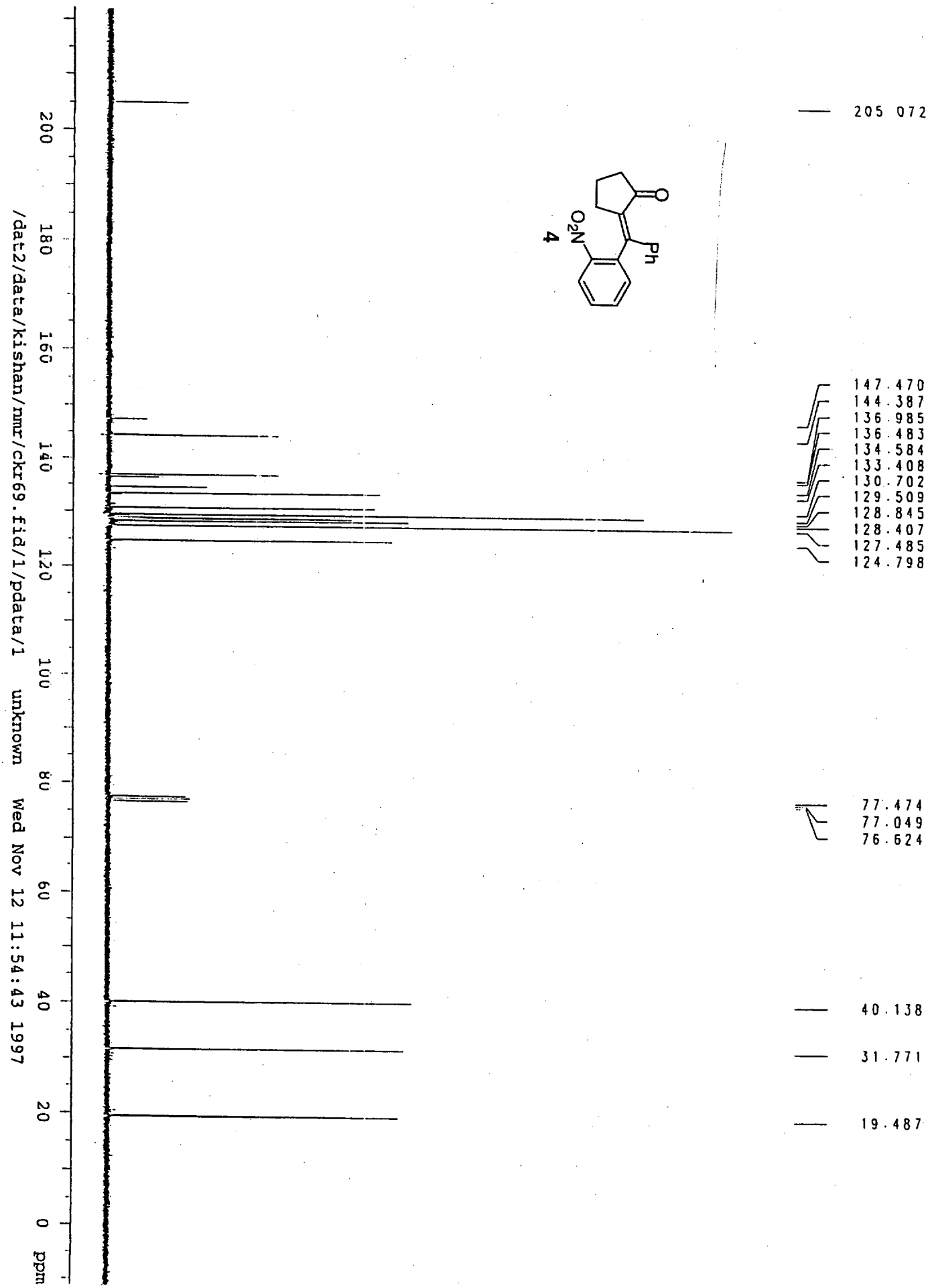






CKF — III — 61b





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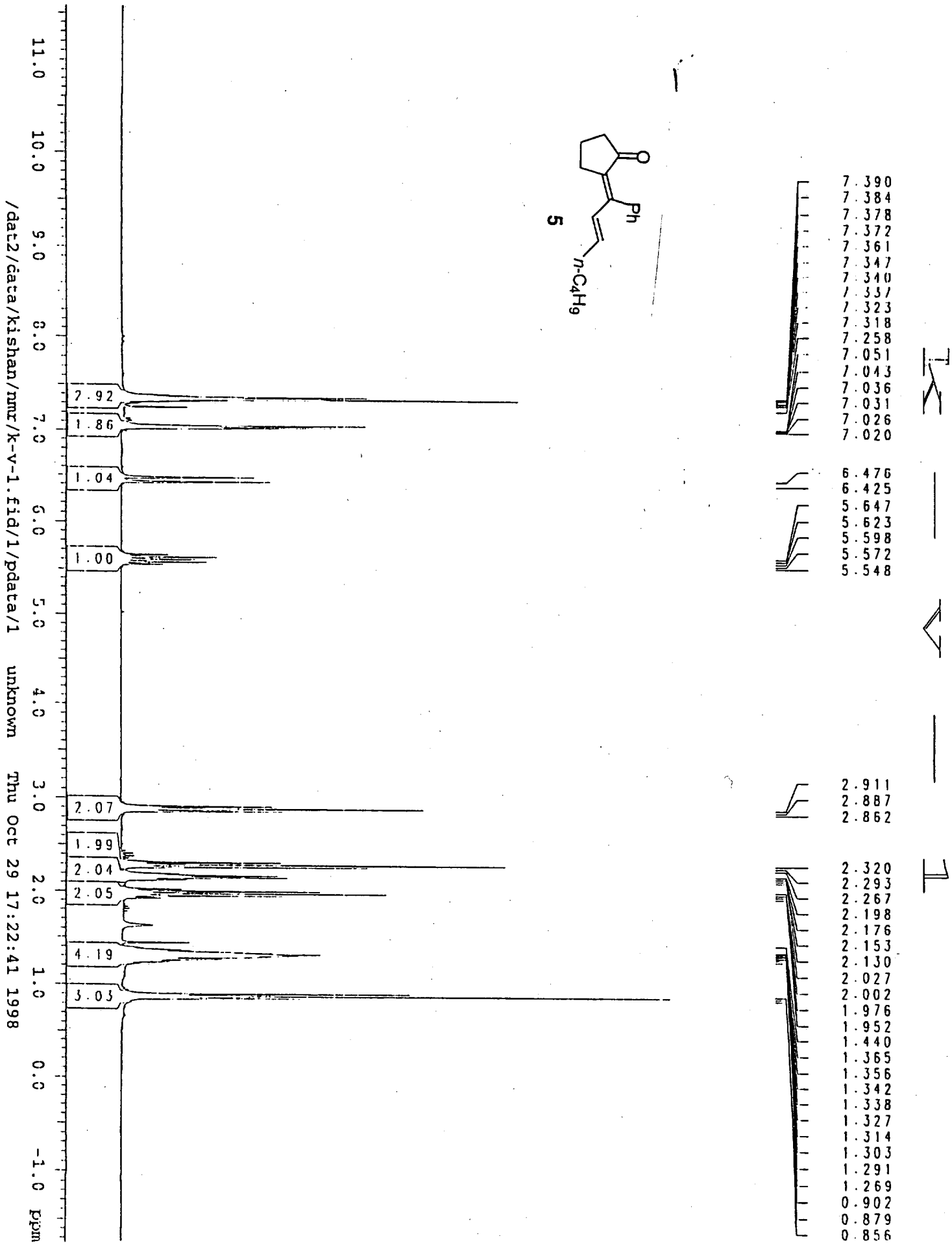

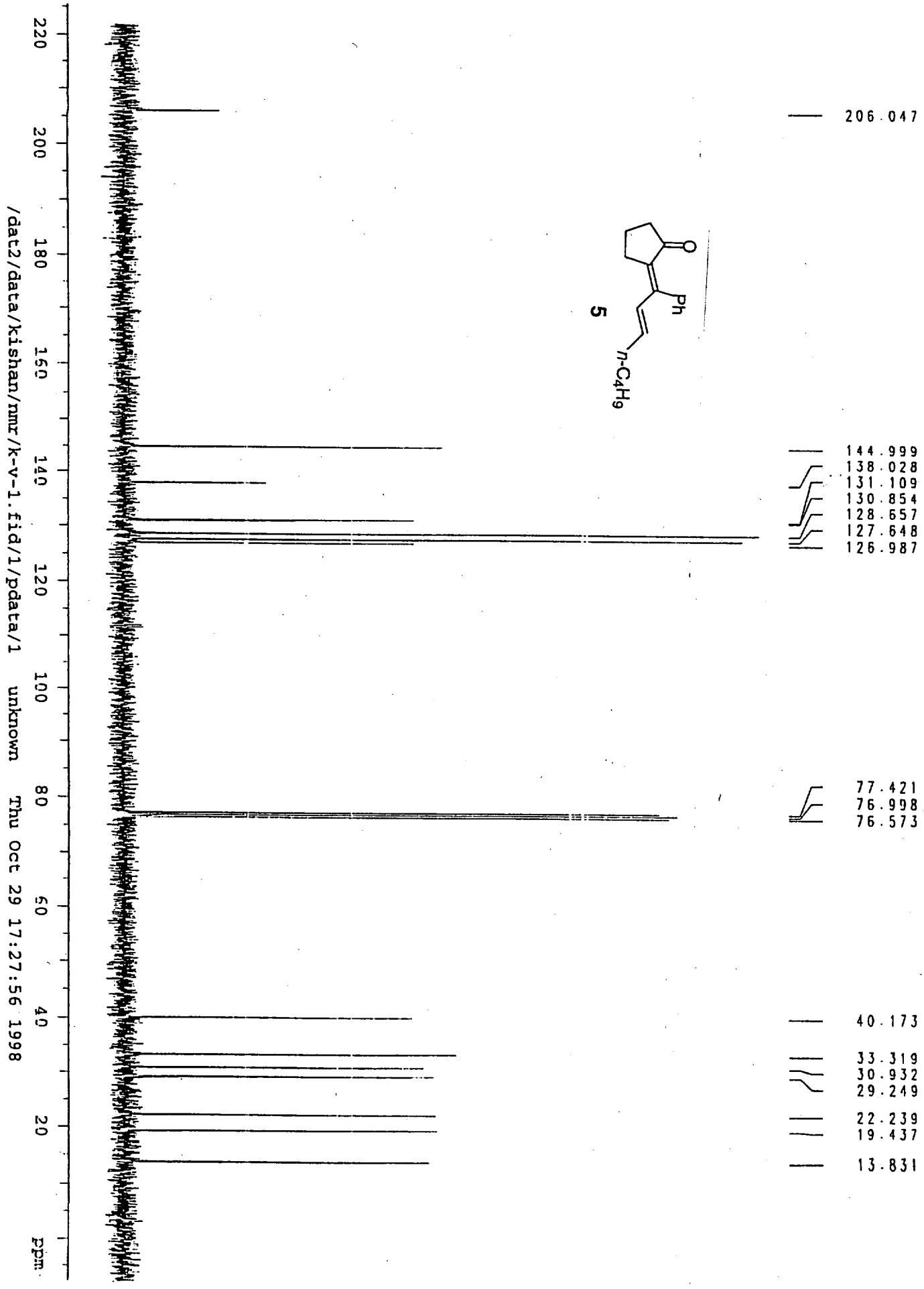

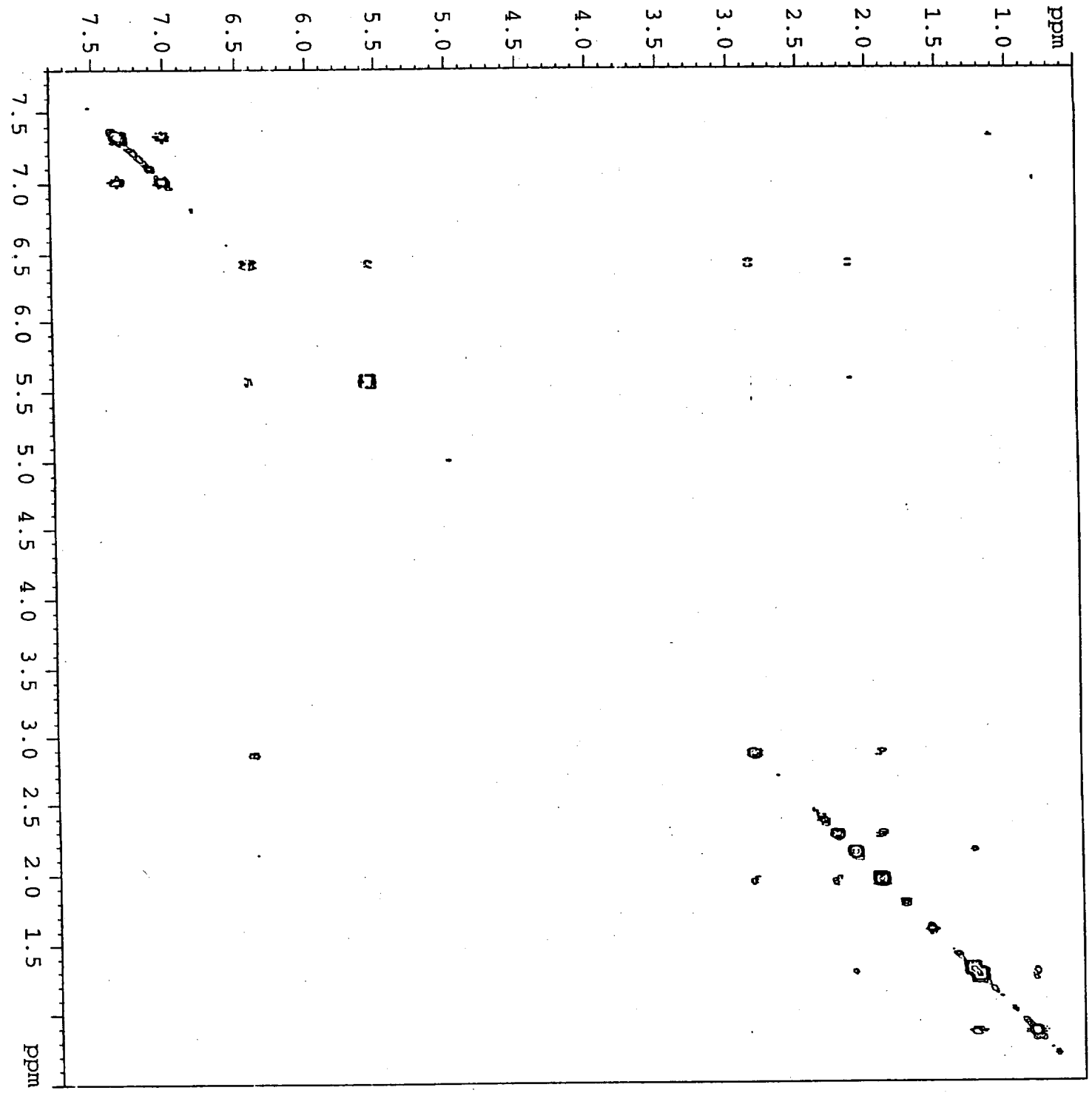

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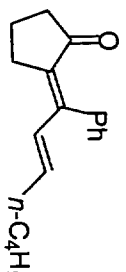

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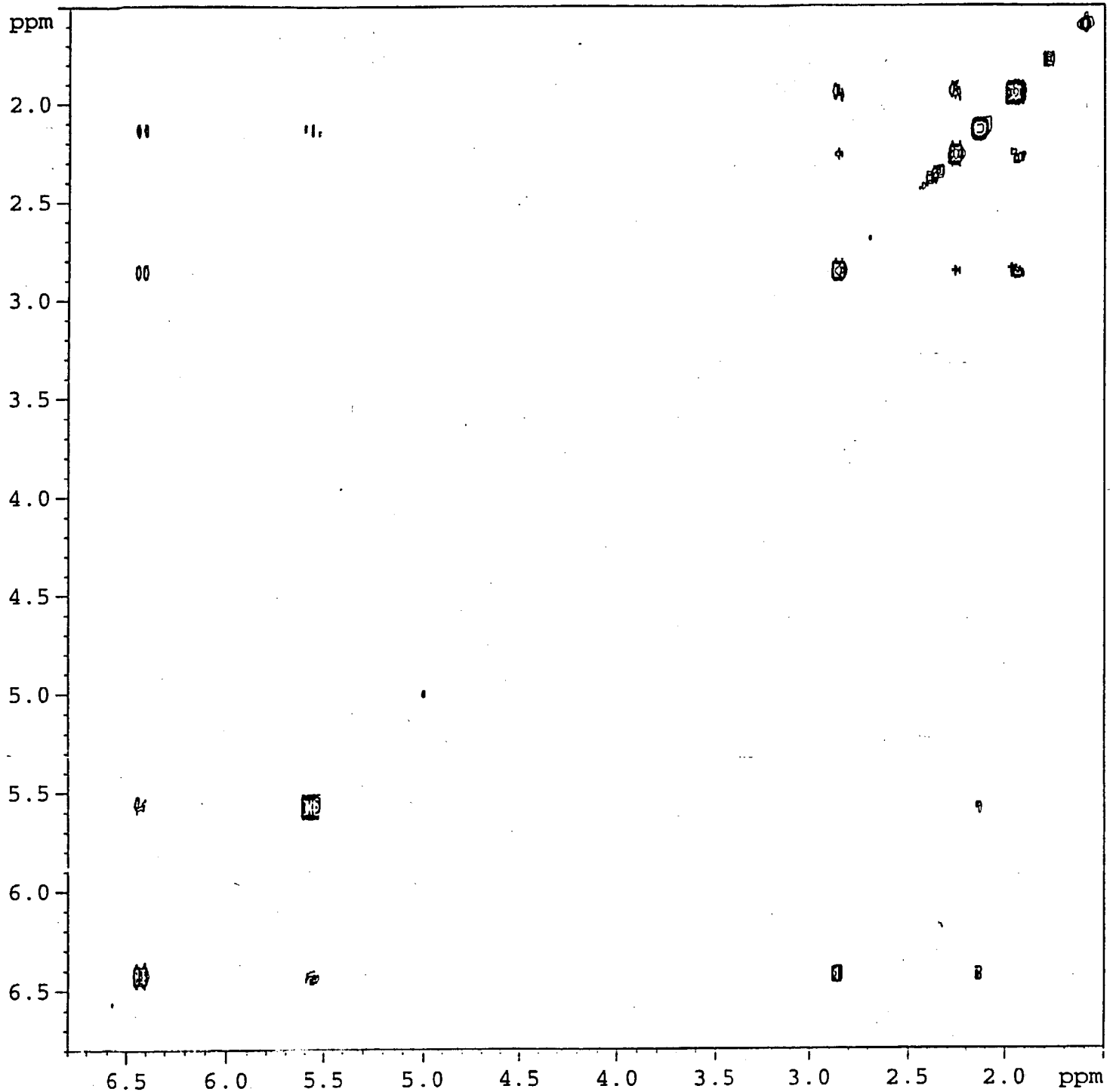


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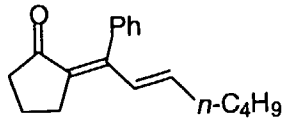
FIDRES           1.614687 Hz
AQ               0.3097076 sec
RG                   40.3
DW                151.200 usec
DE                  4.50 usec
TE                 300.0 K

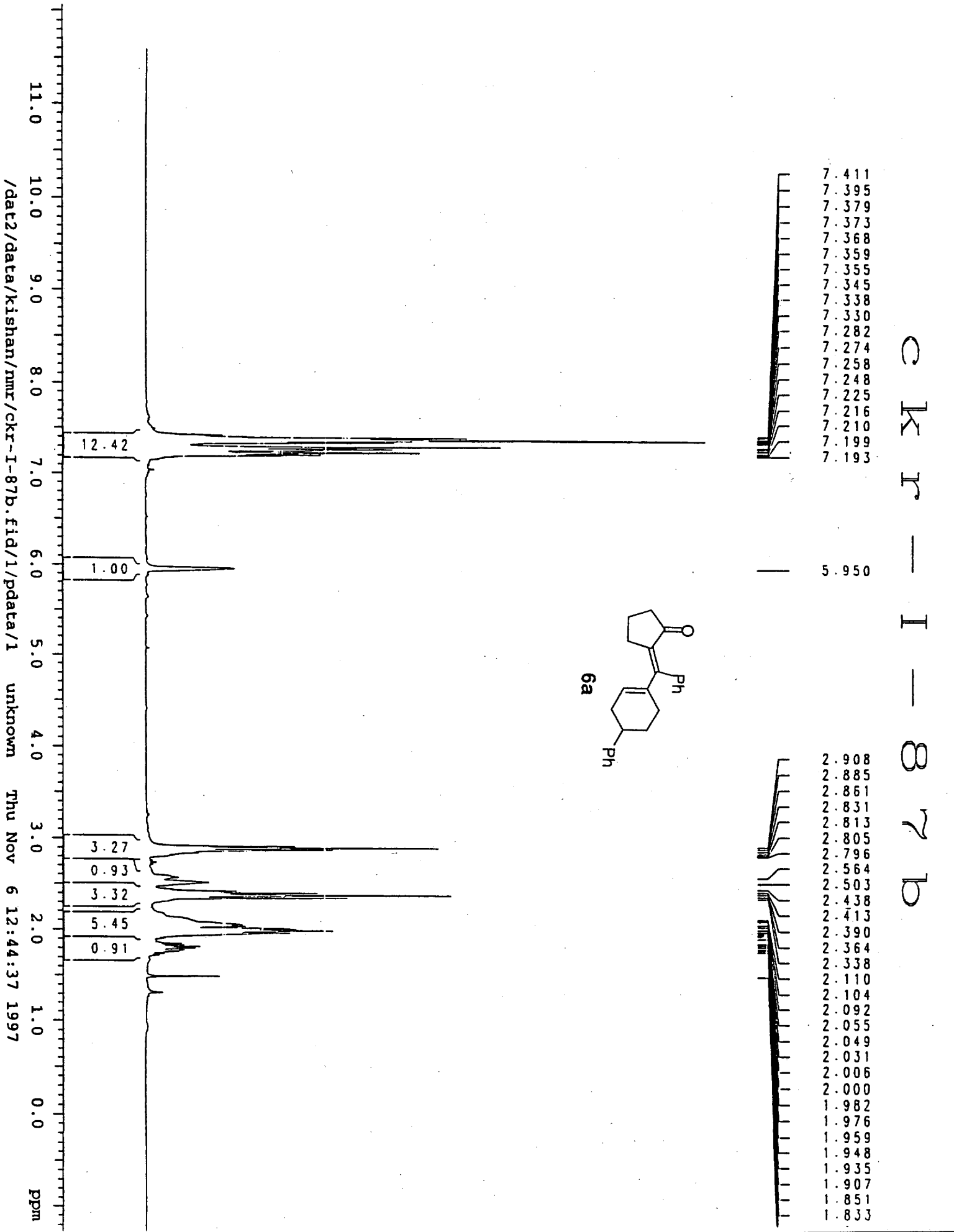
F1 - Acquisition parameters
ND0                     1
TD                    512
SFO1             400.1316 MHz
FIDRES           6.458747 Hz
SW                8.264 ppm

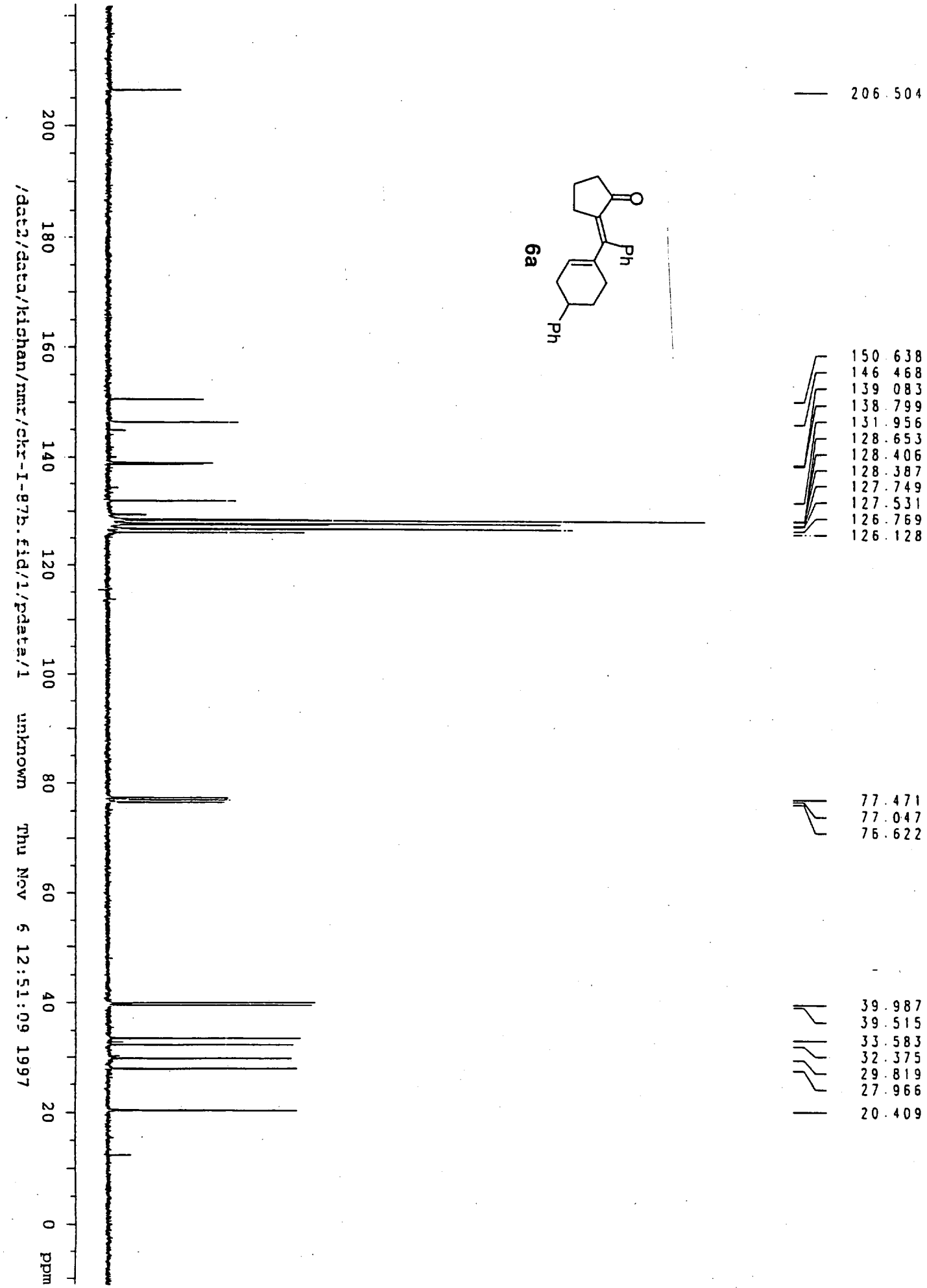
F2 - Processing parameters
SI                   1024
SF           400.1300180 MHz
WDW                 QSINE
SSB                     2
LB                0.00 Hz
GB                      0
PC                1.00

F1 - Processing parameters
SI                   1024
MC2           States-TPPI
SF           400.1300180 MHz
WDW                 QSINE
SSB                     2
LB                0.00 Hz
GB                      0
```



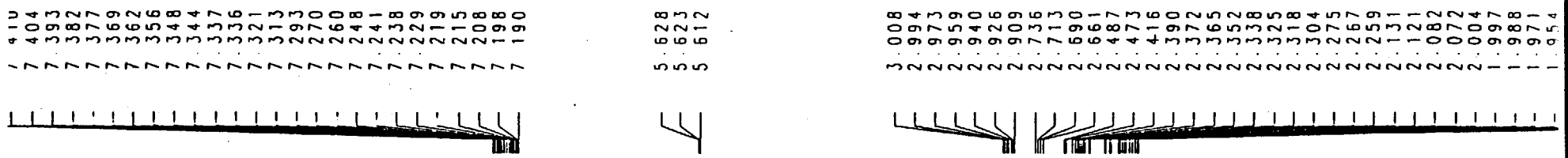
5

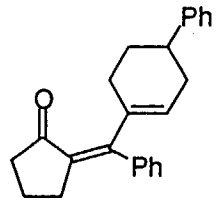




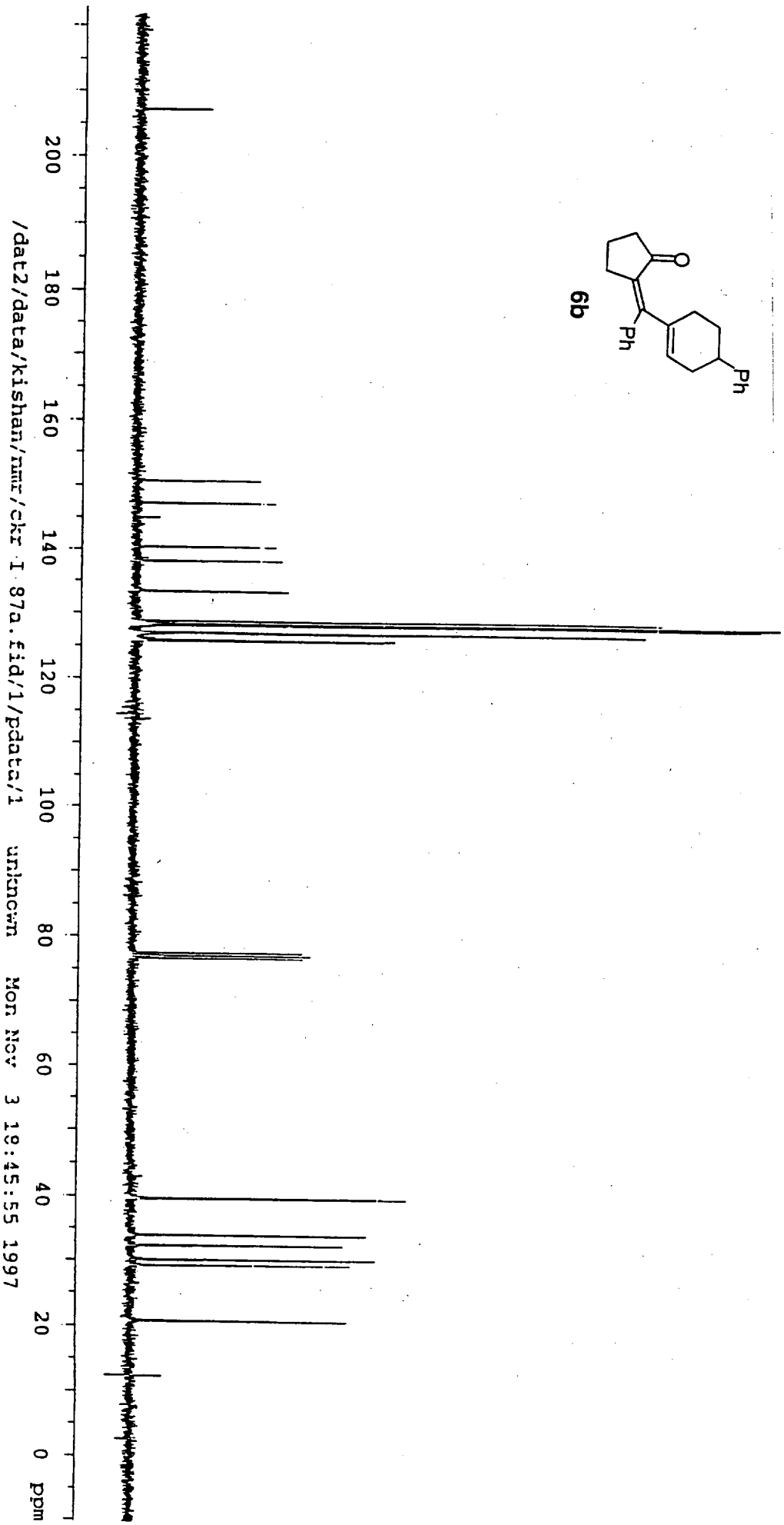
ckr — I — 87b

c k r — I — 8 7 a



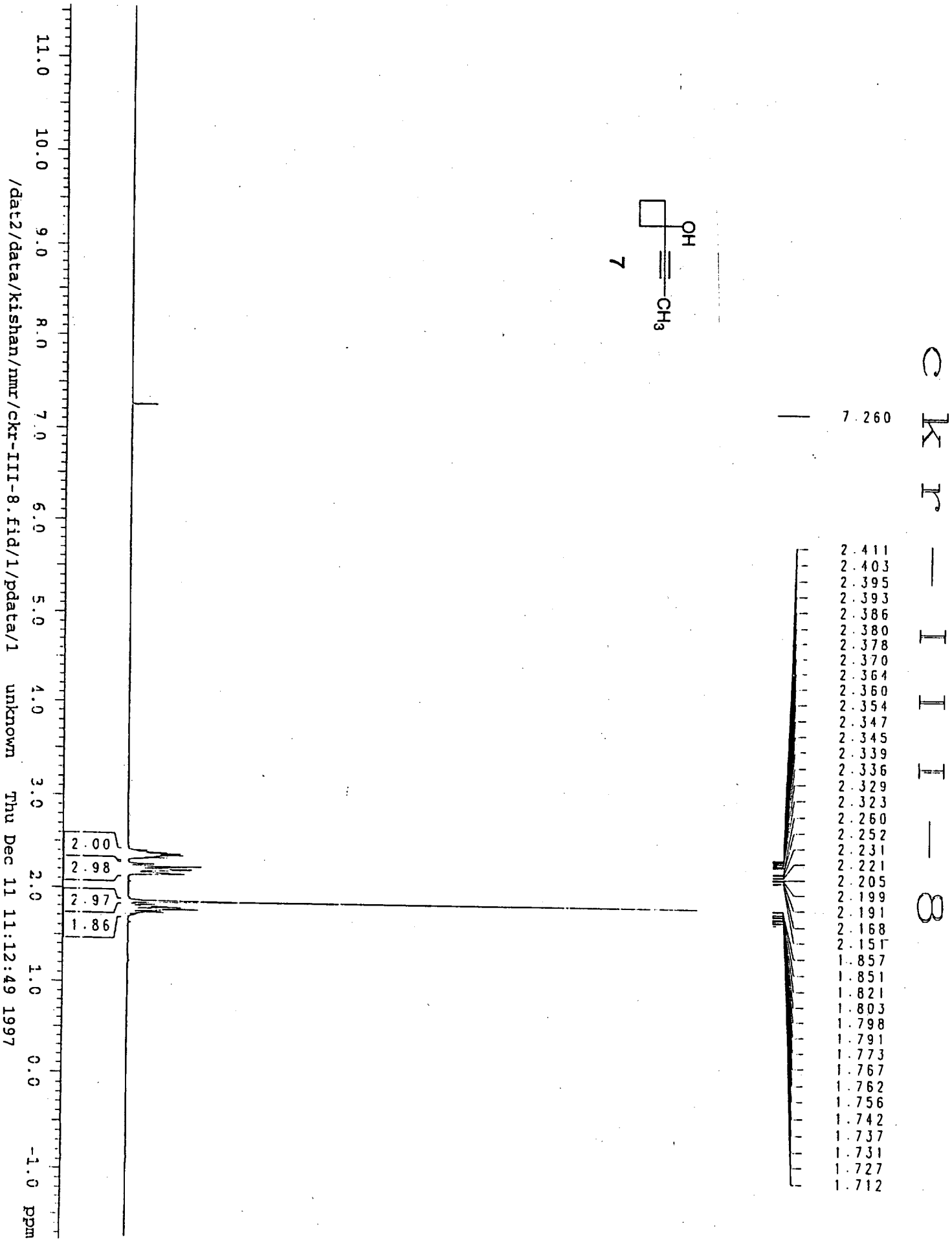


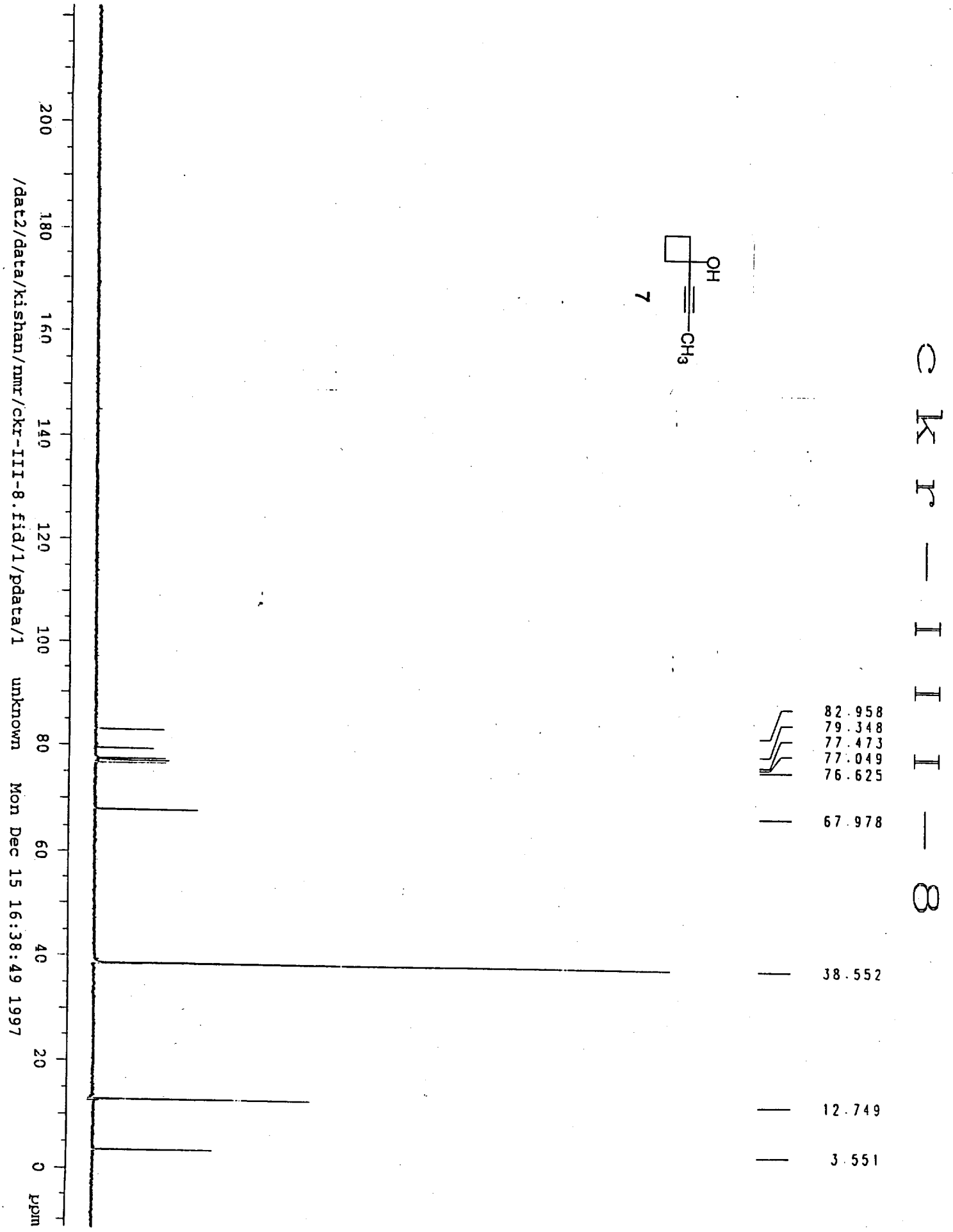
6b

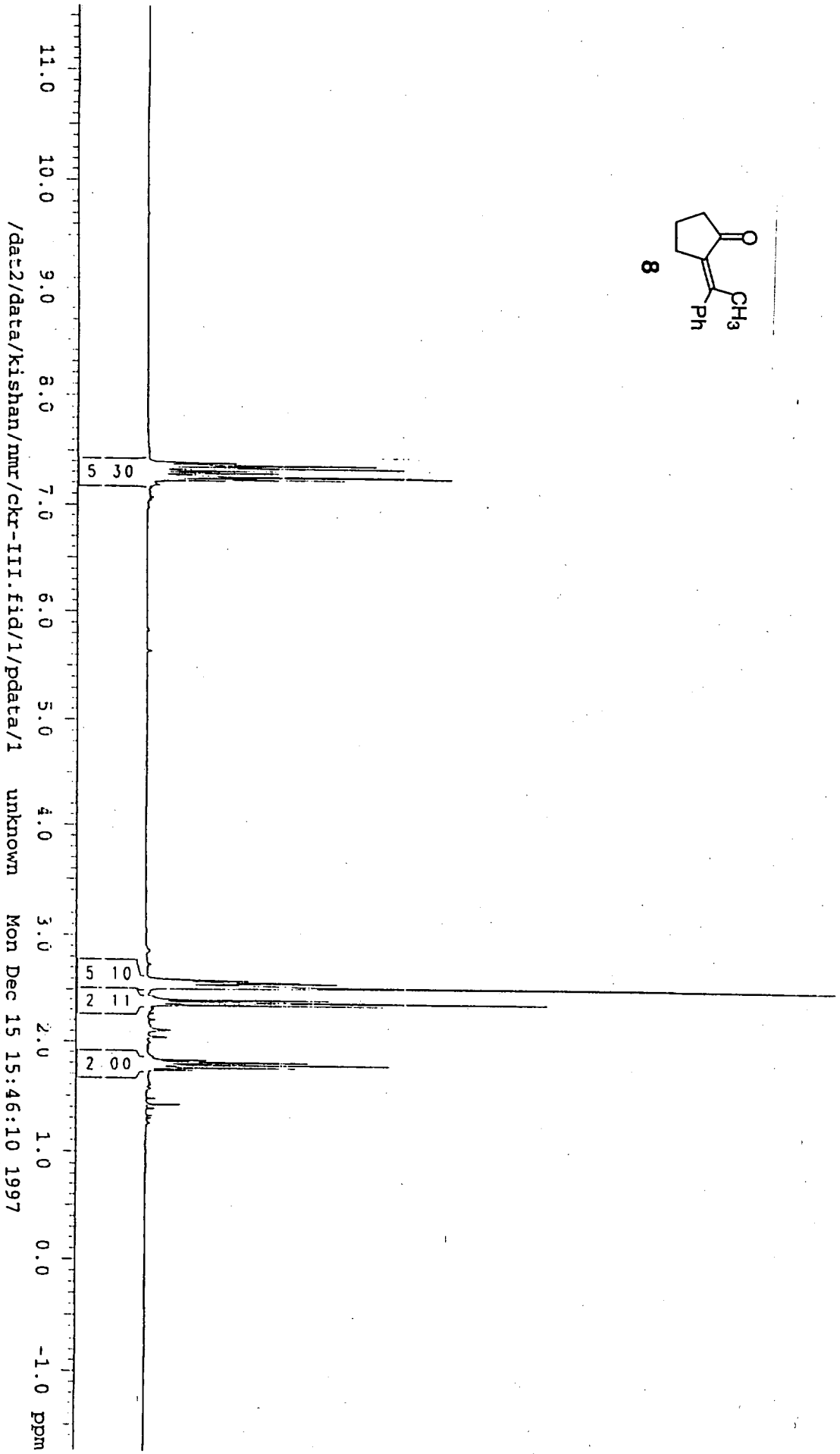


6b

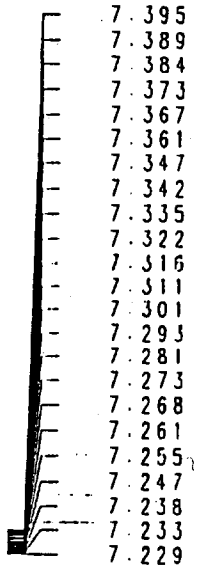
ckr_I_87a

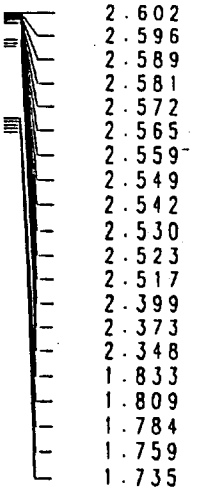




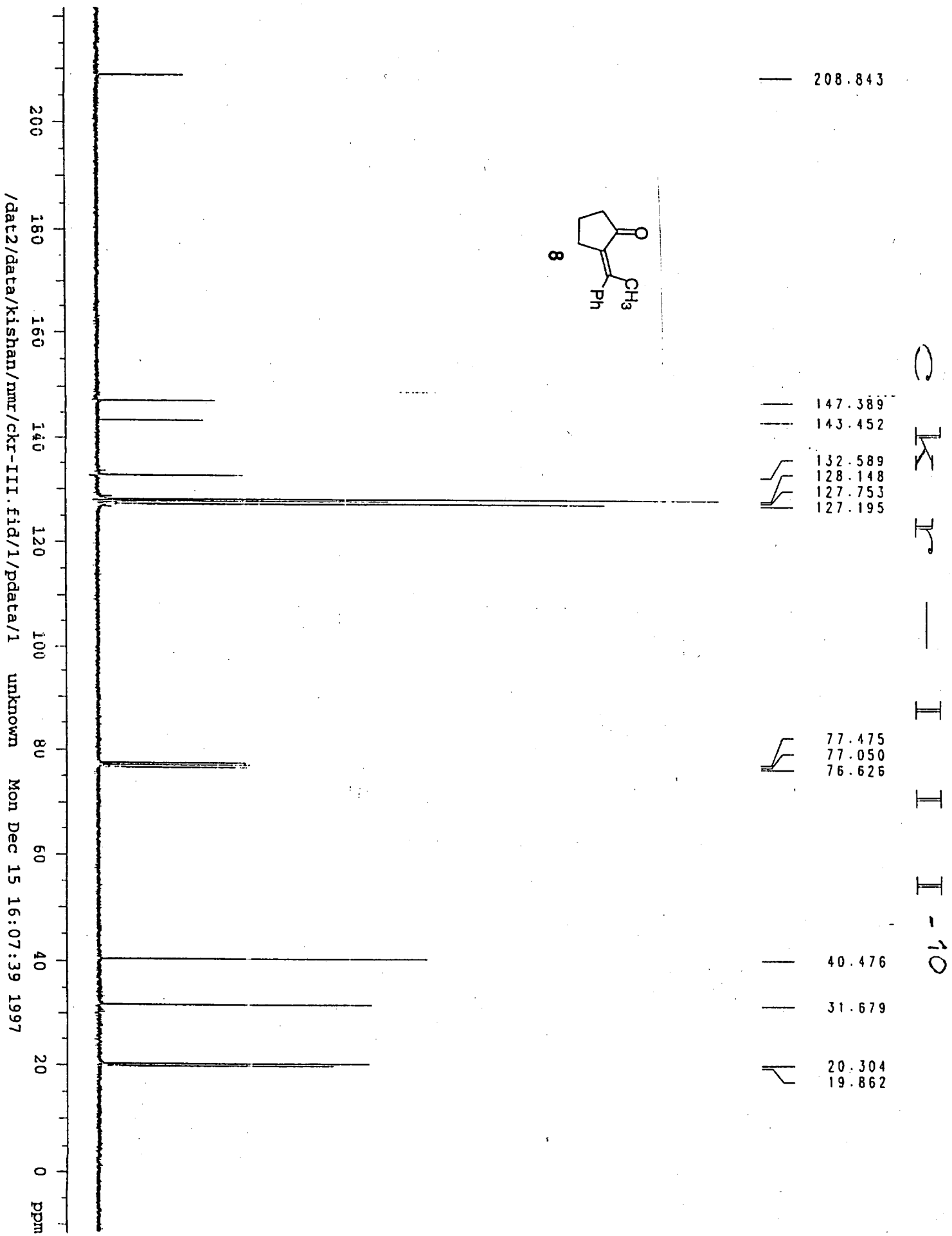


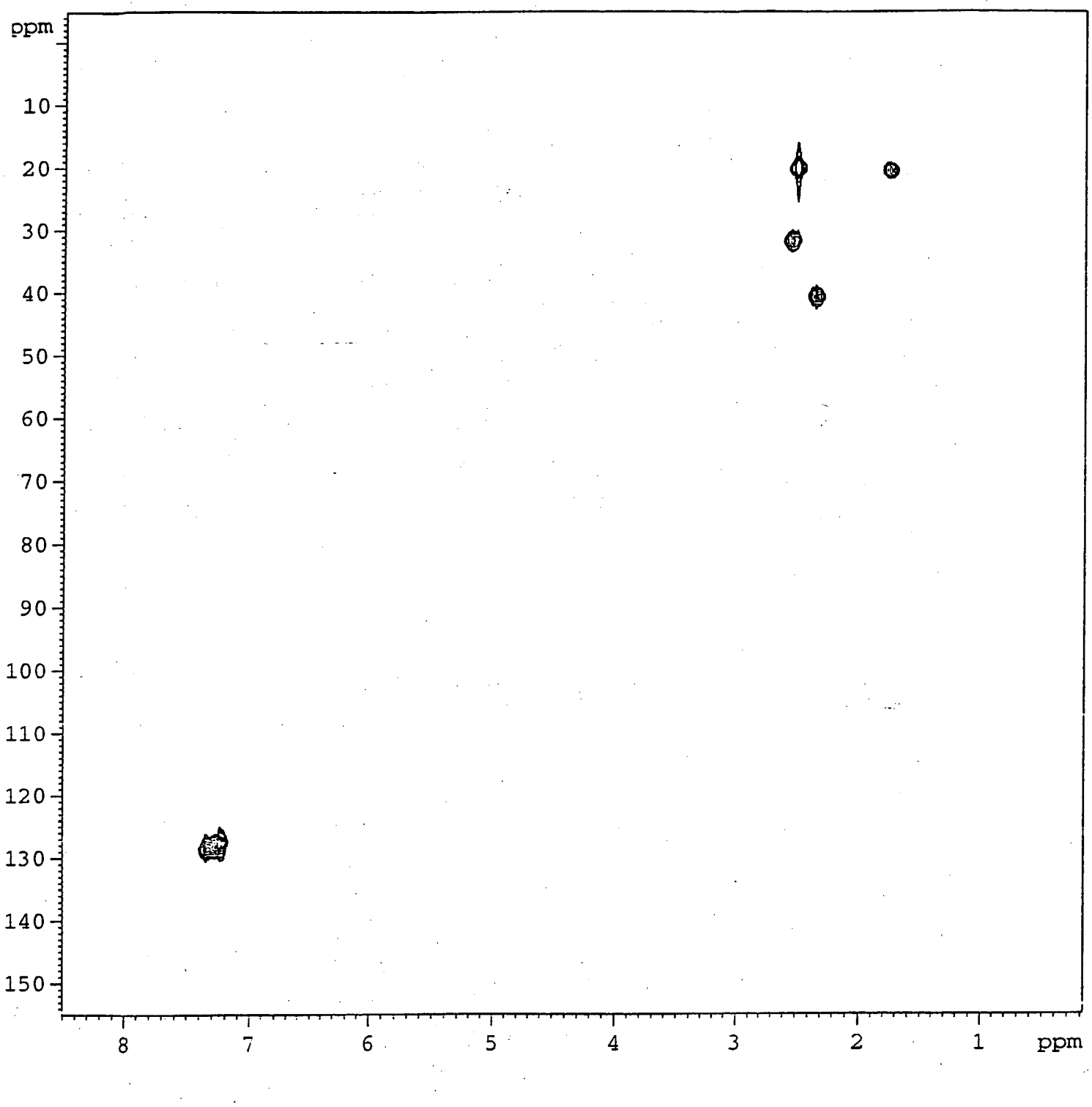
8

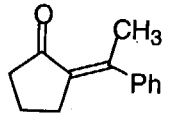




CKR-III-10


208.843
147.389
143.452
132.589
128.148
127.753
127.195
77.475
77.050
76.626
40.476
31.679
20.304
19.862
8
Ph
CH3
O
200
180
160
140
120
100
80
60
40
20
0
ppm
/dat2/data/kishan/nmr/ckr-III.fid/1/pdata/1 unknown Mon Dec 15 16:07:39 1997





8

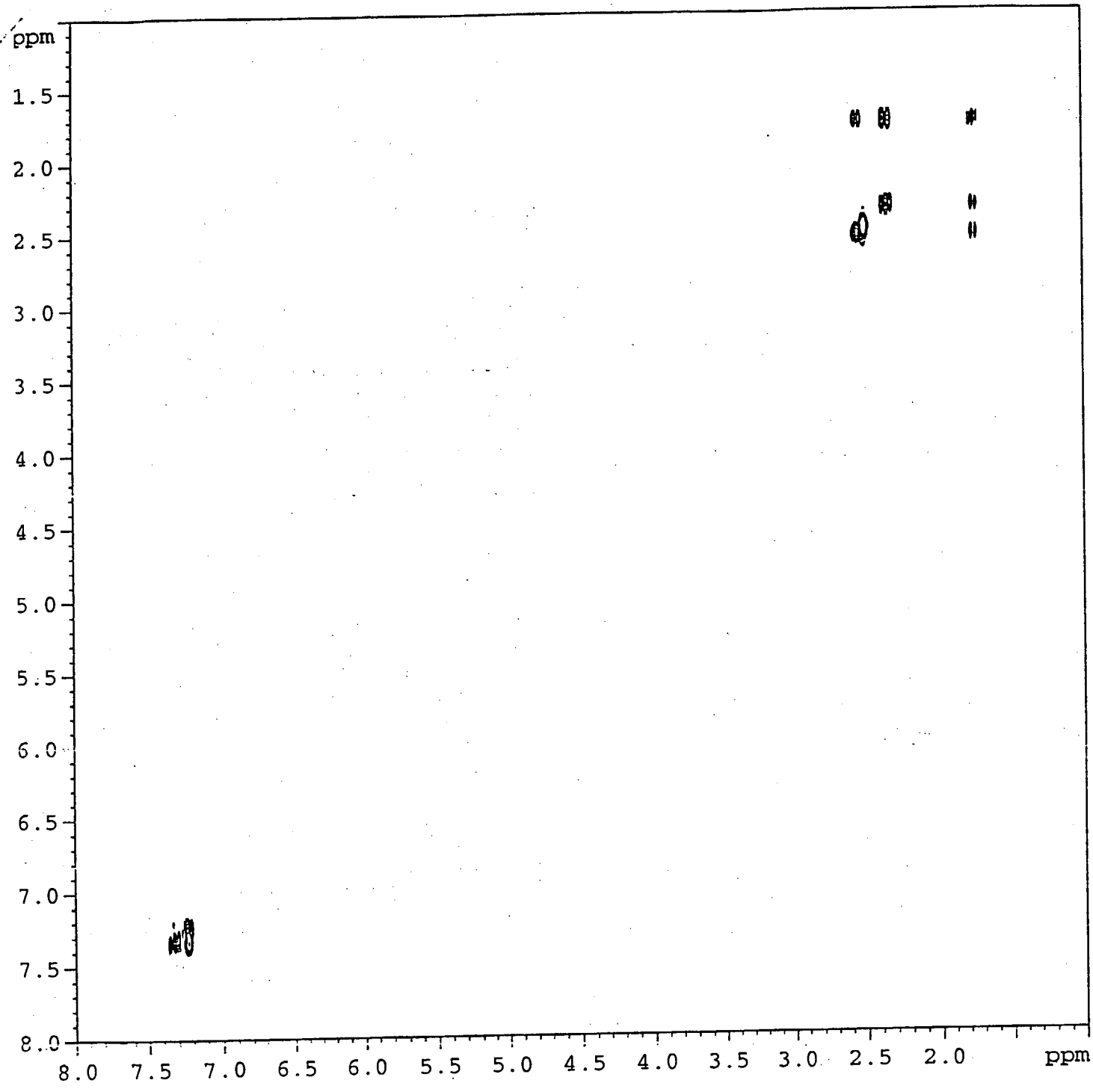
```
Current Data Parameters
NAME                  ld.8000
EXPNO                       5
PROCNO                      1

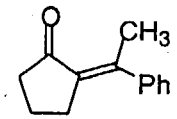
F2 - Acquisition Parameters
Date_                  980206
Time                    15.33
INSTRUM                 spect
PROBHD       5 mm TXI 31P
PULPROG              inv4gs
TD                      1024
SOLVENT                 CDCl3
NS                          1
DS                          8
SWH                3333.333 Hz
FIDRES             3.255208 Hz
AQ                 0.1536500 sec
RG                    9195.2
DW                  150.000 usec
DE                    4.50 usec
TE                    300.0 K

F1 - Acquisition parameters
ND0                         2
TD                        128
SFO1               100.6203 MHz
FIDRES           125.754524 Hz
SW                 159.974 ppm

F2 - Processing parameters
SI                        1024
SF              400.1300180 MHz
WDW                     QSINE
SSB                         2
LB                   0.00 Hz
GB                          0
PC                   1.00

F1 - Processing parameters
SI                        1024
MC2                         QF
SF              100.6127290 MHz
WDW                     QSINE
SSB                         2
LB                   0.00 Hz
GB                          0
```





8

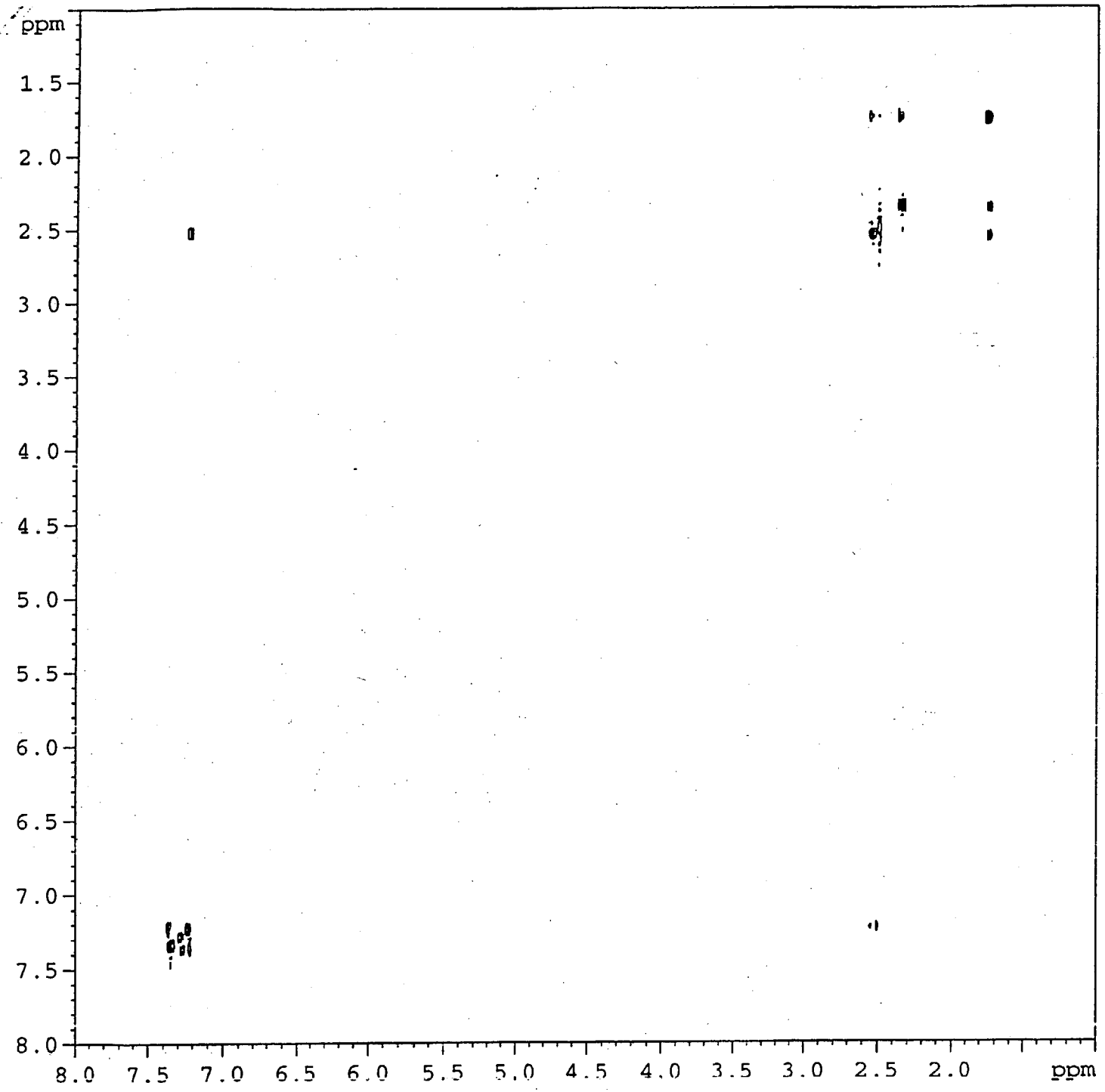
Current Data Parameters	
NAME	1d.8000
EXPNO	2
PROCNO	1

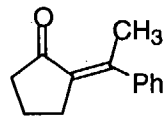
F2 - Acquisition Parameters	
Date_	980206
Time	15.04
INSTRUM	spect
PROBHD	5 mm TXI 31P
PULPROG	cosygs
TD	1024
SOLVENT	CDCl3
NS	1
DS	16
SWH	3333.333 Hz
FIDRES	3.255208 Hz
AQ	0.1536500 sec
RG	64
DW	150.000 usec
DE	4.50 usec
TE	300.0 K

F1 - Acquisition parameters	
ND0	1
TD	128
SFO1	400.1318 MHz
FIDRES	26.041666 Hz
SW	8.331 ppm

F2 - Processing parameters	
SI	1024
SF	400.1300180 MHz
WDW	SINE
SSB	0
LB	0.00 Hz
GB	0
PC	1.00

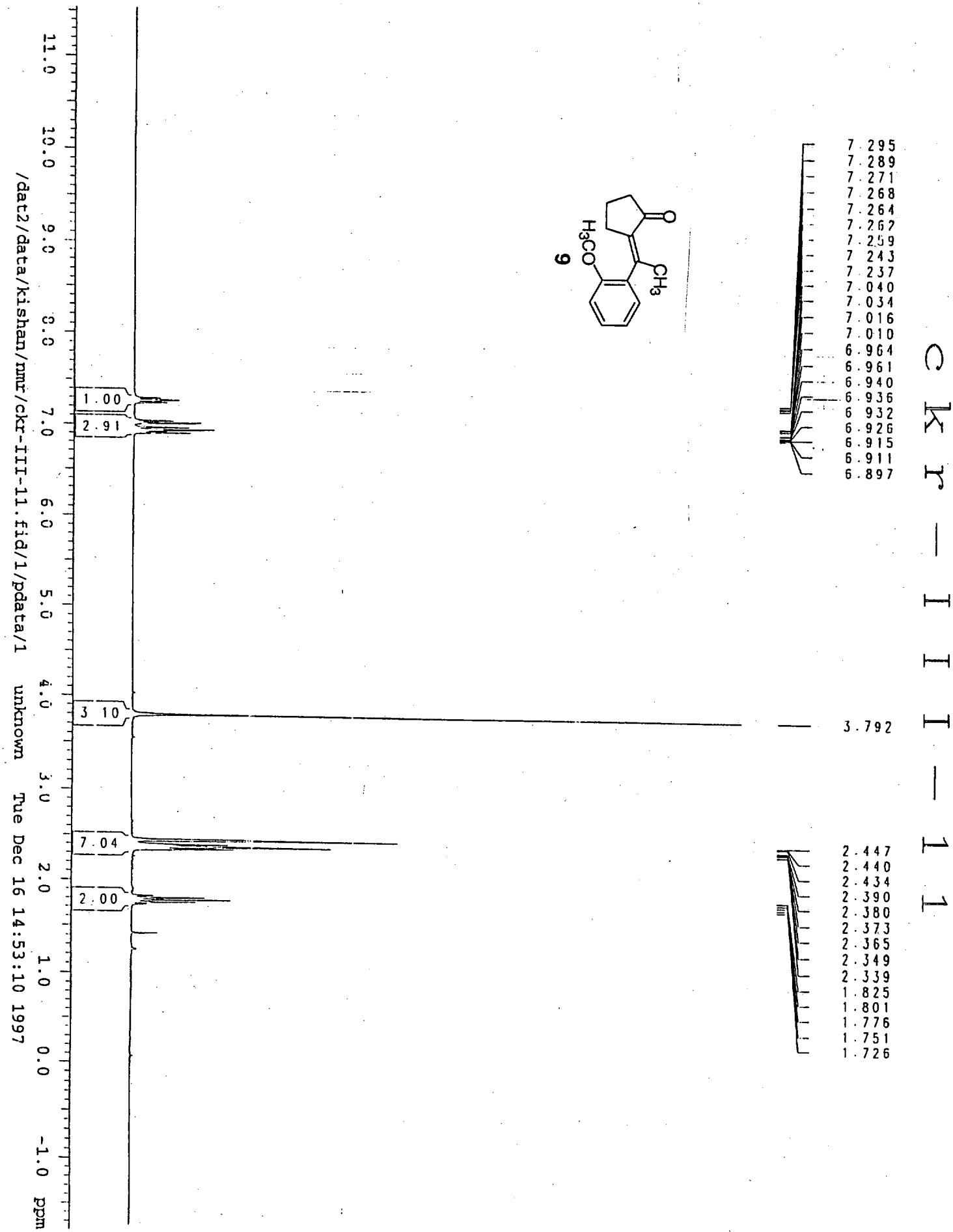
F1 - Processing parameters	
SI	512
MC2	QF
SF	400.1300180 MHz
WDW	SINE
SSB	0
LB	0.00 Hz
GB	0

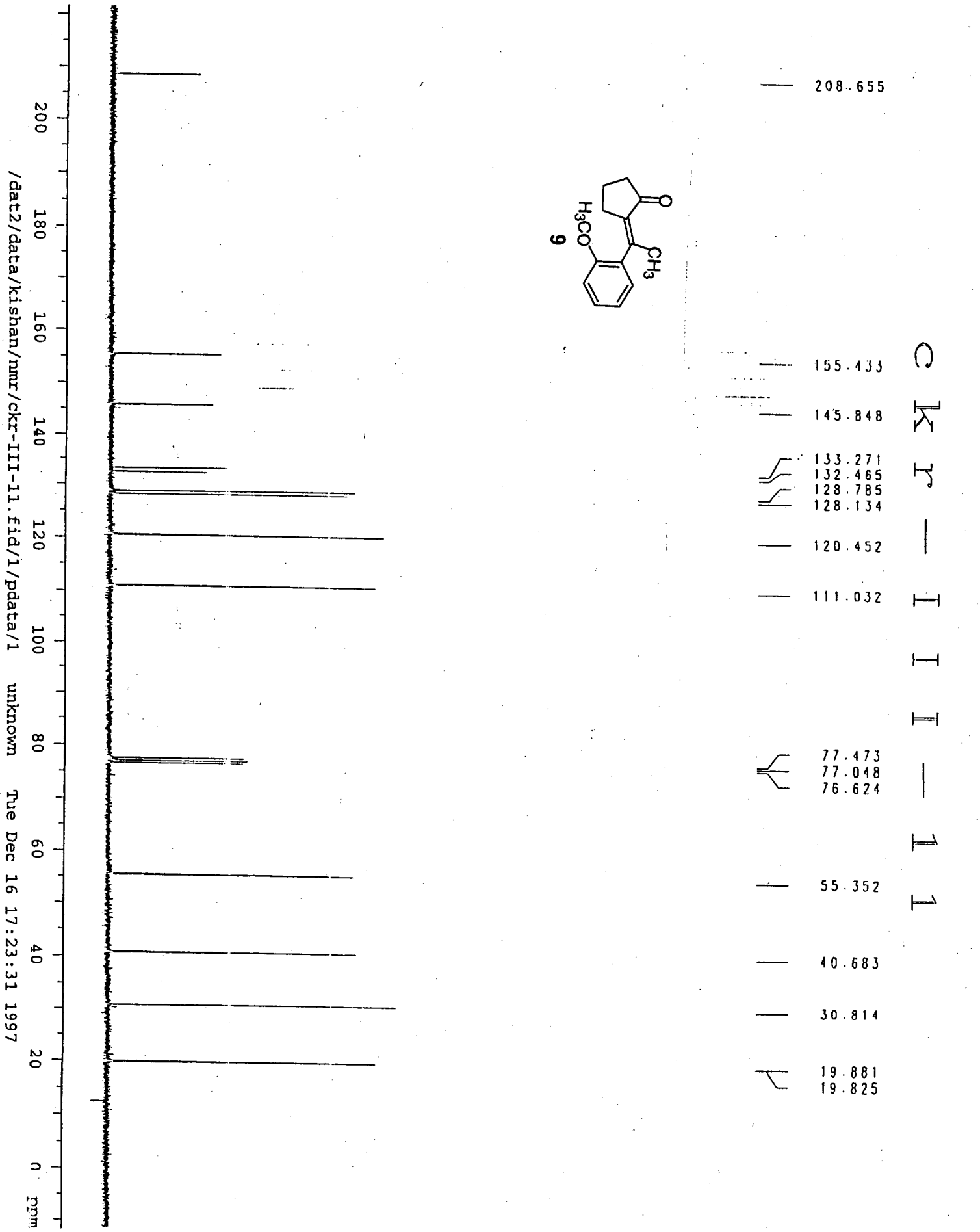


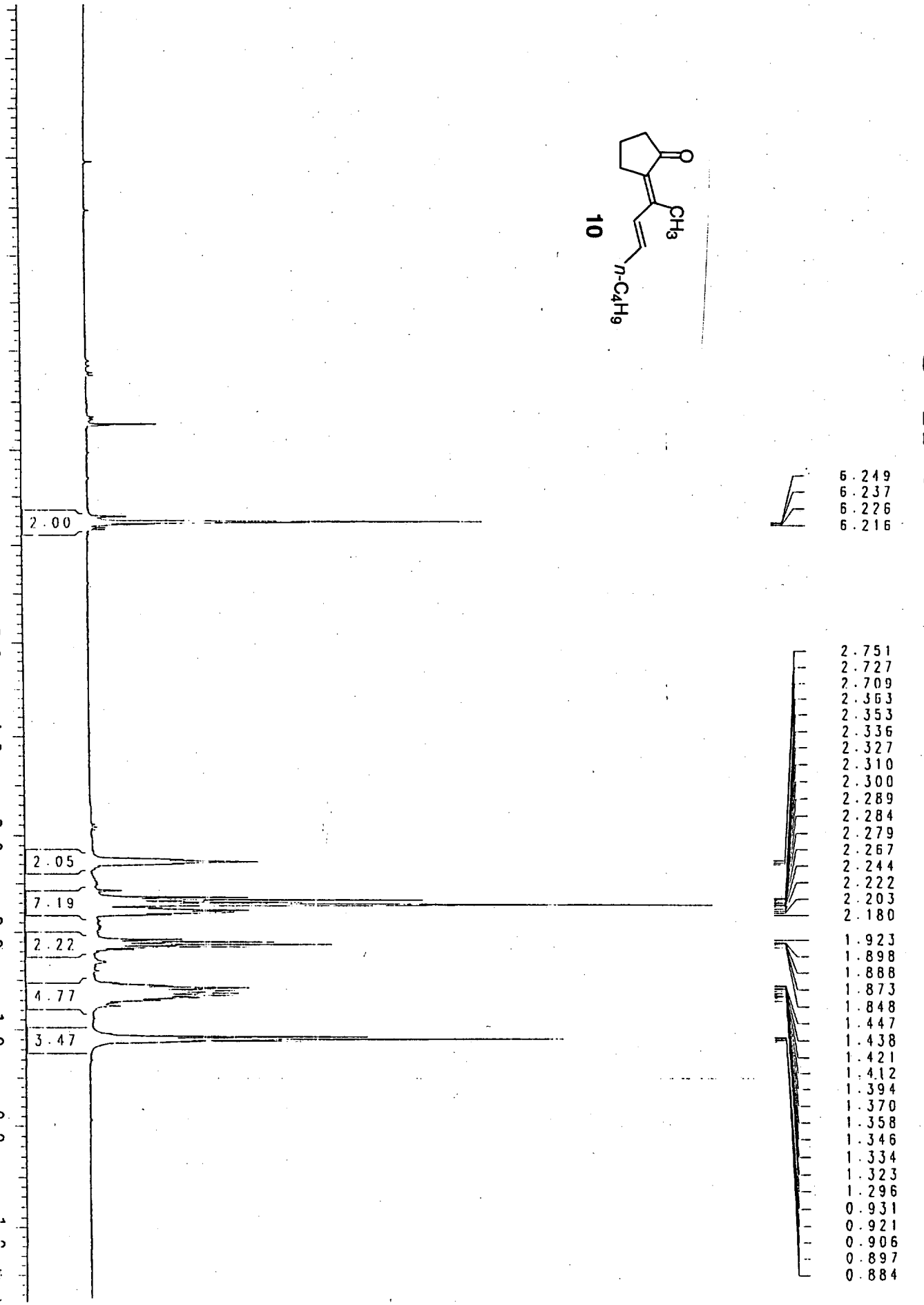


8

Current Data Parameters	
NAME	1d.8000
EXPNO	10
PROCNO	1
F2 - Acquisition Parameters	
Date_	980206
Time	15.41
INSTRUM	spect
PROBHD	5 mm TXI 31P
PULPROG	noesyst
TD	2048
SOLVENT	CDCl3
NS	8
DS	4
SWH	3333.333 Hz
FIDRES	1.627604 Hz
AQ	0.3072500 sec
RG	20.2
DW	150.000 usec
DE	4.50 usec
TE	300.0 K
F1 - Acquisition parameters	
ND0	1
TD	340
SFO1	400.1318 MHz
FIDRES	9.803922 Hz
SW	8.331 ppm
F2 - Processing parameters	
SI	1024
SF	400.1300180 MHz
WDW	QSINE
SSB	2
LB	0.00 Hz
GB	0
PC	1.00
F1 - Processing parameters	
SI	1024
MC2	States-TPPI
SF	400.1300180 MHz
WDW	QSINE
SSB	2
LB	0.00 Hz
GB	0

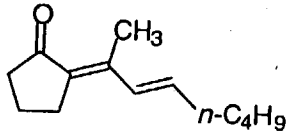




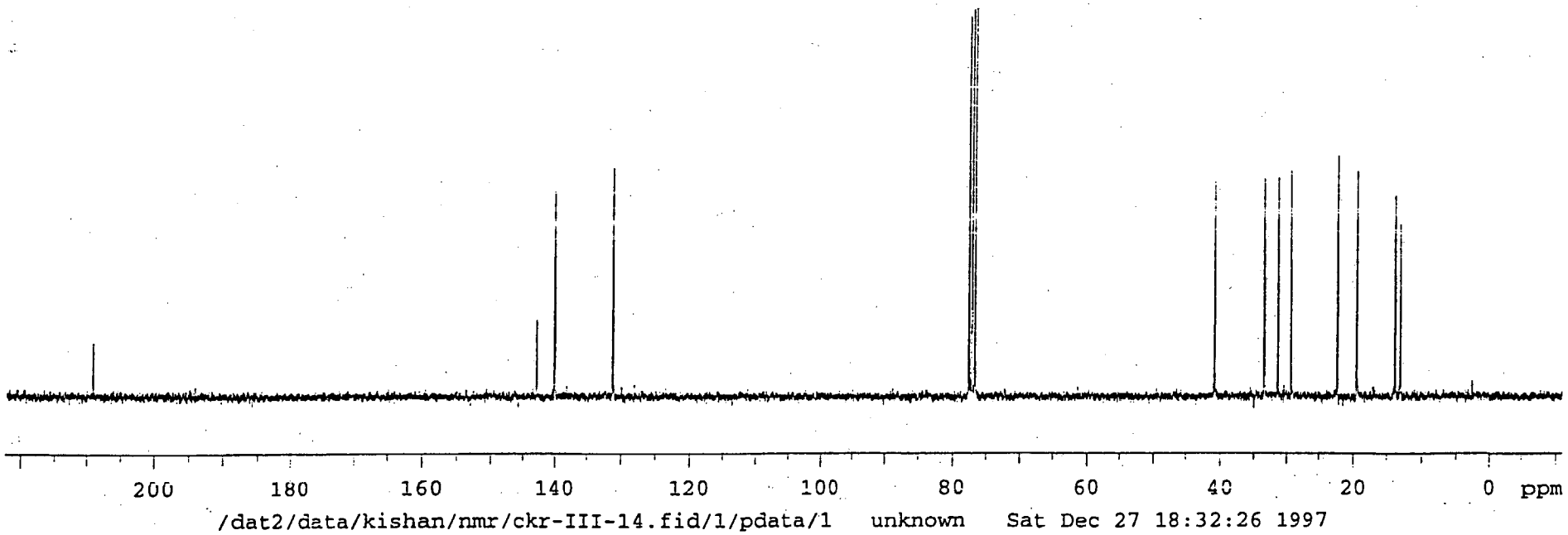

ckr-III-14
6.249
6.237
6.226
6.216
2.751
2.727
2.709
2.363
2.353
2.336
2.327
2.310
2.300
2.289
2.284
2.279
2.267
2.244
2.222
2.203
2.180
1.923
1.898
1.888
1.873
1.848
1.447
1.438
1.421
1.412
1.394
1.370
1.358
1.346
1.334
1.323
1.296
0.931
0.921
0.906
0.897
0.884
CH3
n-C4H9
10
2.00
2.05
7.19
2.22
4.77
3.47
/dat2/data/kishan/nmr/ckr-III-14.fid/1/pdata/1 unknown Wed Dec 24 09:45:45 1997
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
ppm

c k r — I I I — 1 4

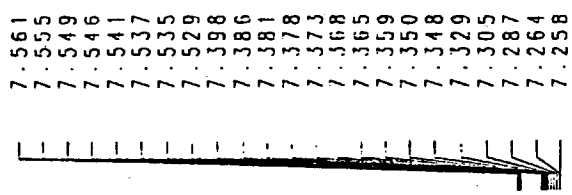
208.978
142.708
139.987
131.040
131.001
77.470
77.047
76.623
40.832
33.386
31.300
29.279
22.311
19.446
13.919
13.166

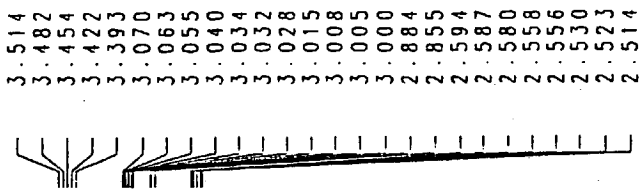


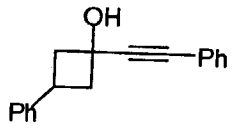
10



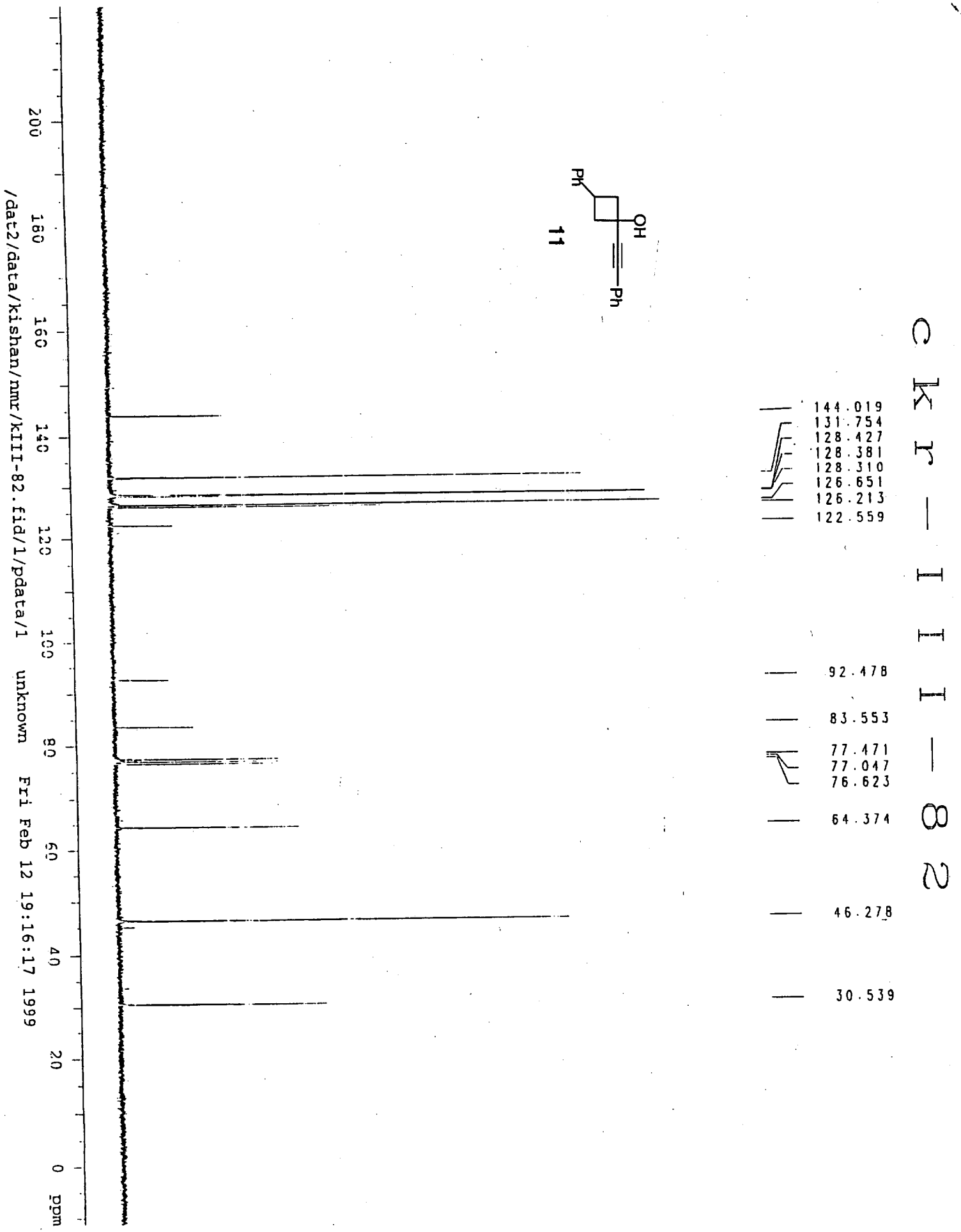
c k r — I I I — 8 2

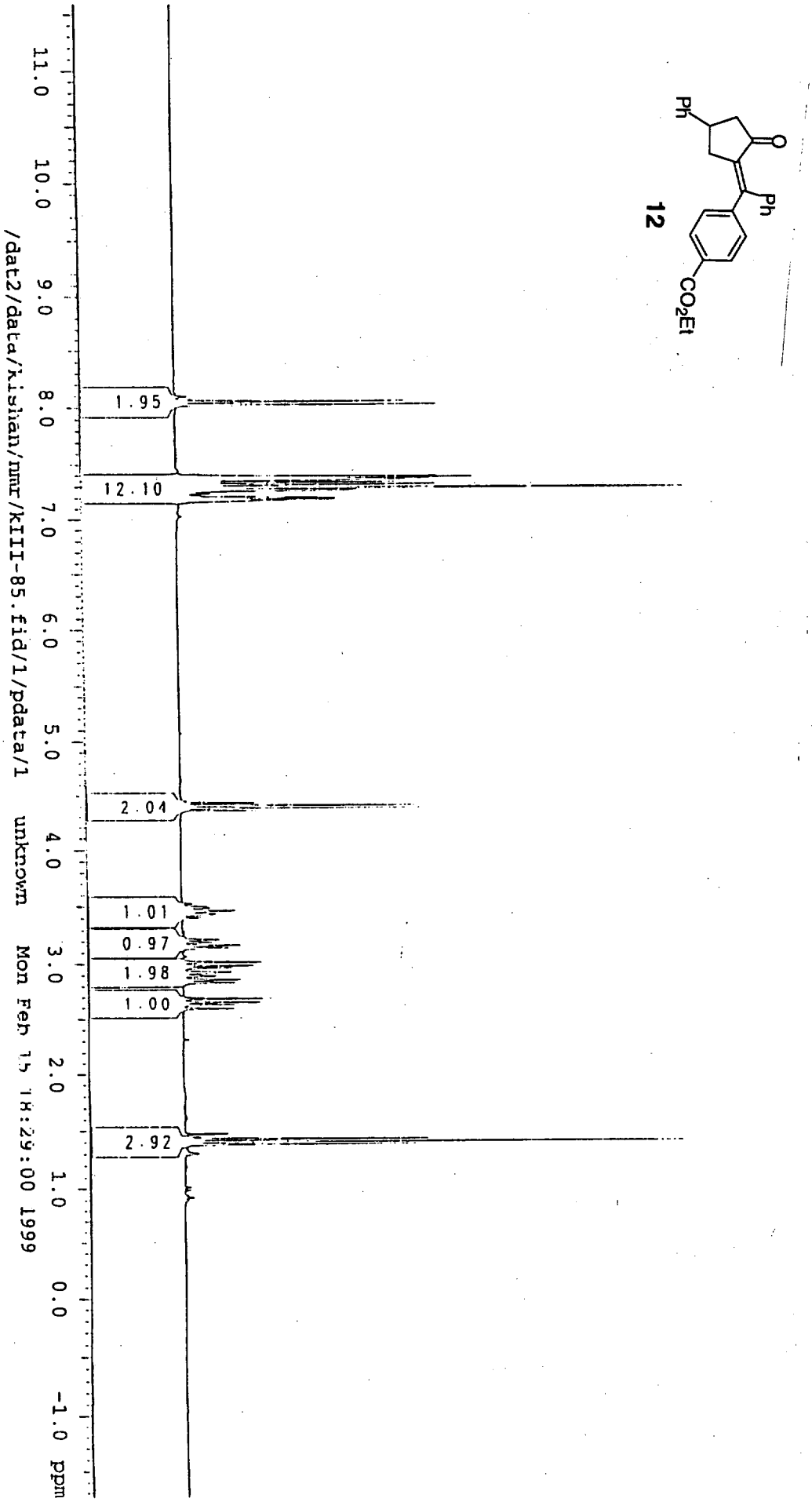


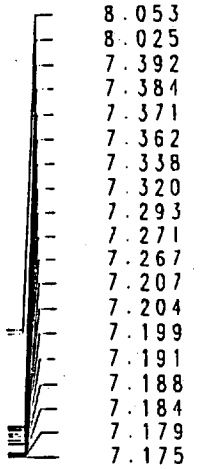


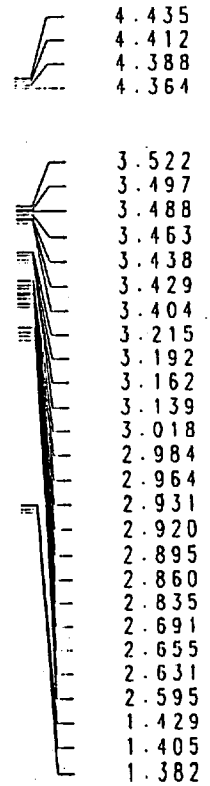


11

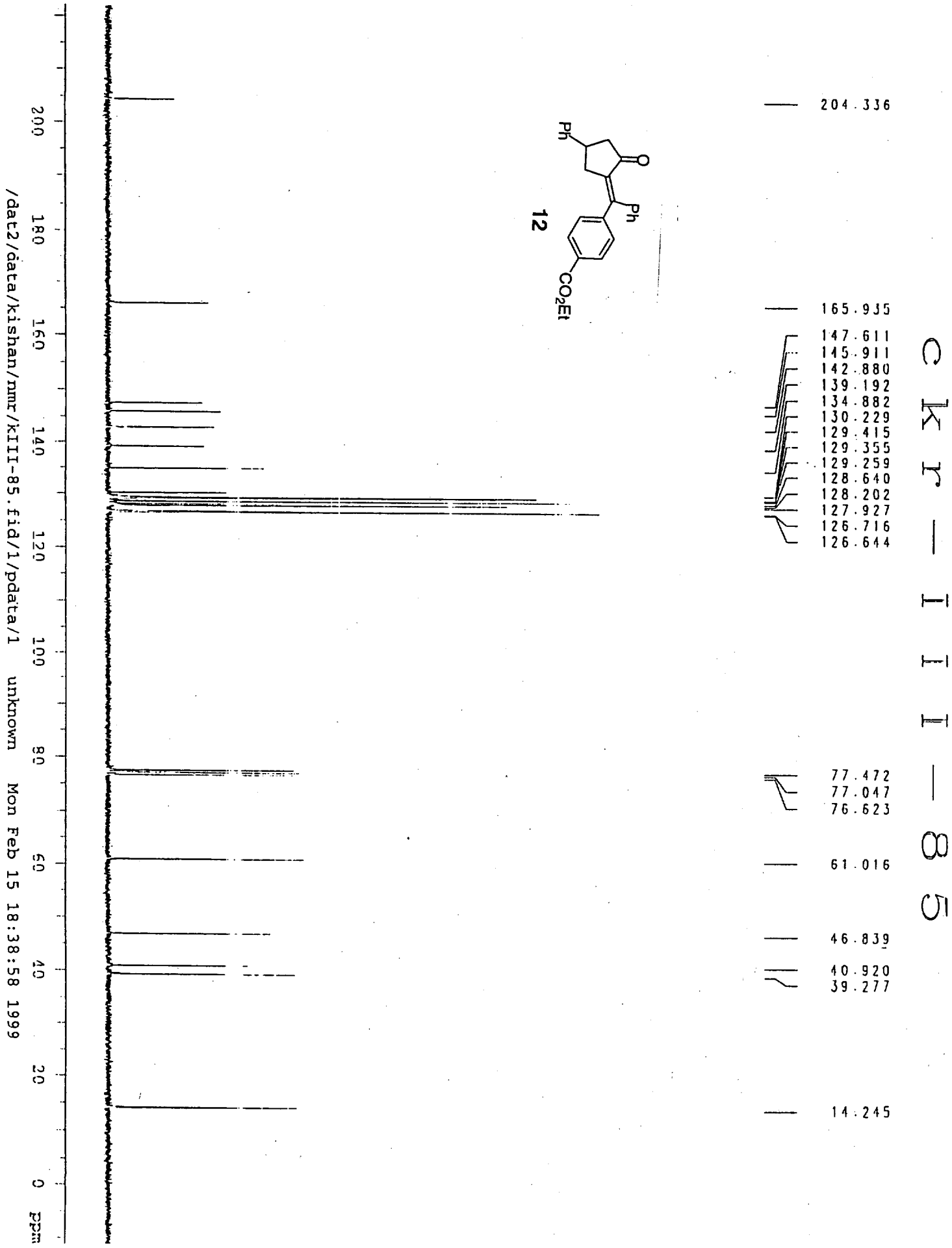

kIII-82
144.019
131.754
128.427
128.381
128.310
126.651
126.213
122.559
92.478
83.553
77.471
77.047
76.623
64.374
46.278
30.539
Ph
OH
Ph
11
/dat2/data/kishan/nmr/kIII-82.fid/1/pdata/1 unknown Fri Feb 12 19:16:17 1999
200
180
160
140
120
100
80
60
40
20
0
ppm

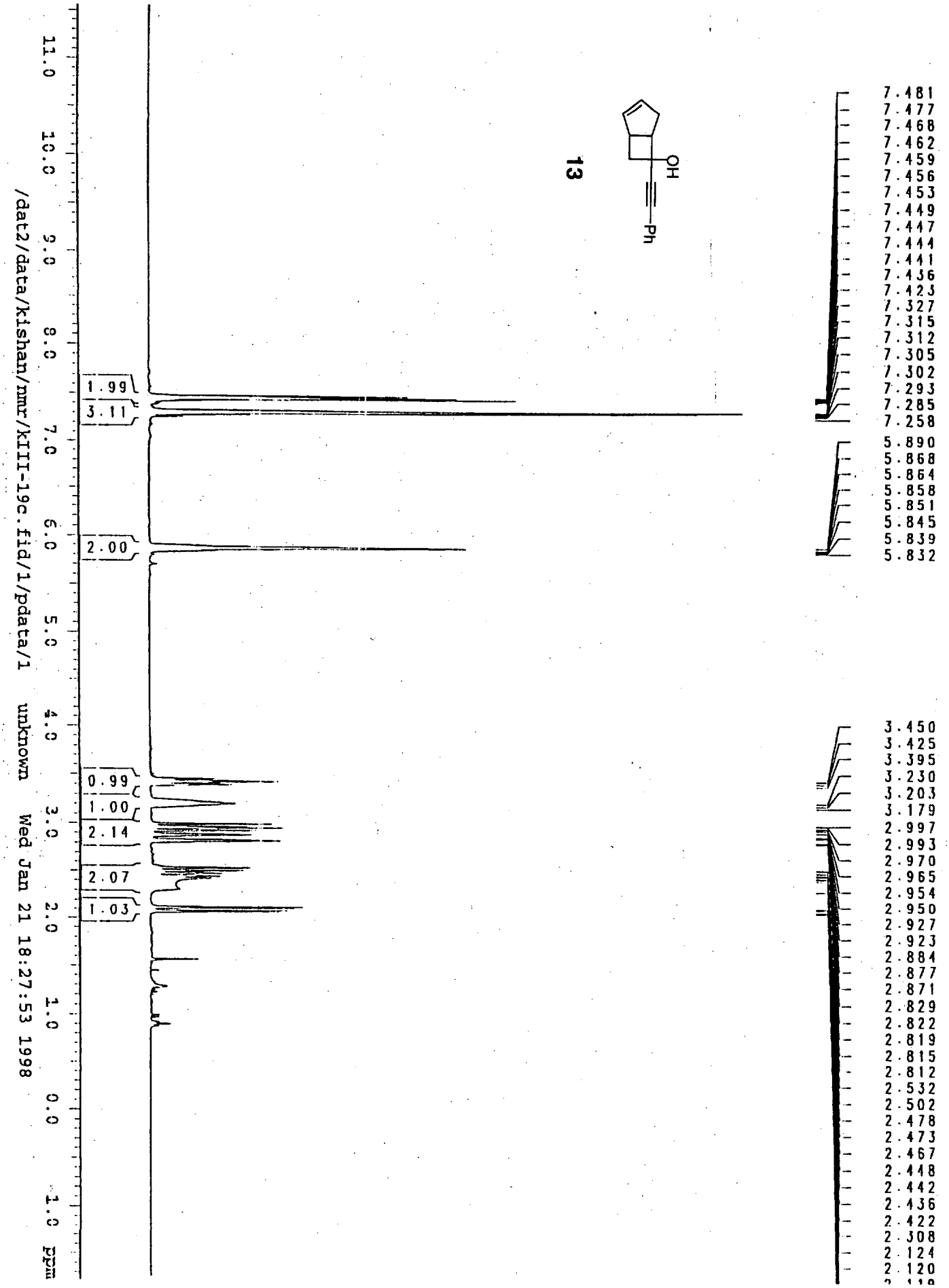


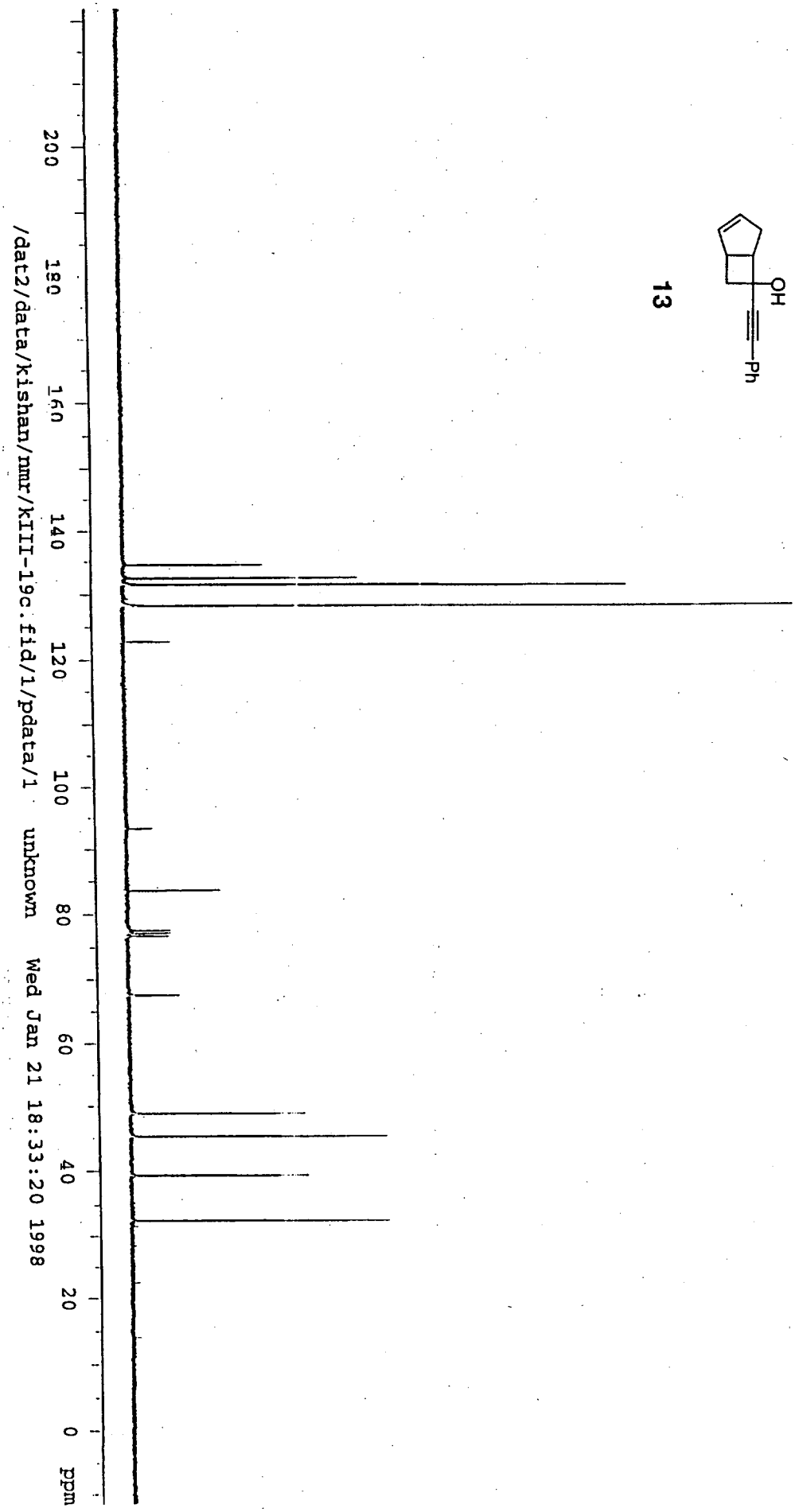




CKR—III—85







ckr — III — 19c