From the bioassay results, Fraction III and Fraction X revealed weak inhibition against the fungi Pythium ultimum and Rhizoctonia solani with % T/C 20% and 11%, respectively as well as the weak antigrowth against the bacteria Xanthramonas campestrous (% T/C 36). These two fractions also exhibited the feeding inhibition activity against the insect, boll weevil with % inhibition 46% at dose level 30 mg.

CHAPTER IV

CONCLUSION

In this course of research, the leaves and the heartwoods of Rhizophora apiculata Bl., are selected for investigation their chemical constituents and biologically active substances according to the attractive preliminary bioassay results. Fifteen compounds are isolated from the leaves and thirteen substances are elucidated as a mixture of saturated long chain aliphatic hydrocarbons (C_{27}-C_{33}), β-amyrinpalmitate, a mixture of β-amyrinpalmitate and waxes, β-amyrenonylpalmitate, a mixture of saturated long chain aliphatic primary alcohols (C_{30}-C_{36}), β-amyrin, lupeol, taraxerol, a mixture of β-sitosterol, stigmasterol and campesterol, taraxeryl-cis-p-hydroxycinnamate, careaborin, wallichenol and β-sitosteryl-3-O-β-D-glucopyranoside. Nine additional compounds, besides a mixture of steroids and β-sitosterylglycoside, are separated from the heartwoods and seven of them are identified as a mixture of steroidal ester and waxes, a mixture of saturated long chain aliphatic primary alcohols (C_{28}-C_{32}), a mixture of eleven saturated long chain aliphatic carboxylic acids, 2,6-dimethoxy-p-benzoquinone, syringaldehyde, a mixture of saturated long chain hydroxy esters and a mixture of saturated long chain aliphatic primary amides. To our knowledge, there is no report of taraxeryl-cis-p-hydroxycinnamate in the chemical literatures. Hence, this compound is a novel naturally occuring ester of taraxerol. Moreover, it is also found that this

is the first report on the occurrence of other compounds except taraxerol, β-amyrin, β-sitosterol and triacontanol in this particular species. Chloride salts of sodium, potassium, magnesium, calcium, manganese, copper and iron, together with condensed and hydrolysable tannins, arabinose, several amino acids and various phenolic compounds are also found in this plant. All isolated substances from both parts of R. apiculata are summarized as shown in Table 4.1 and their structures of some compounds are given in Fig. 193.

Table 4.1 All isolated compounds from the leaves and the heartwoods of R. apiculata Bl.

Plant part	Solvent extract	Substances	Remarks
leaves	P.E.	β-amyrin, β-amyrone, taraxerol, β-sitosterol, triacontanol	former work
leaves	CH_2Cl_2	a mixture of long chain hydrocarbon (C_{27}-C_{33}), β-amyrinpalmitate, a mixture of β-amyrinpalmitate and waxes, β-amyrenonylpalmitate, a mixture of long chain alcohol (C_{30}-C_{36}), β-amyrin, lupeol, taraxerol, a mixture of β-sitosterol, stigmasterol and campesterol, taraxeryl-cis-p-hydroxycinnamate, careaborin, wallichenol, β-sitosteryl-3-0-β-D glucopyranoside	present work
	$CHCl_3$	β-sitosteryl-3-0-β-D-glucopyranoside	
	EtOAc	phenolic compounds	
	n-BuOH	flavone compounds	
	H_2O	chloride salts of Na, K, Mg, Mn, Ca, Fe and Cu arabinose several amino acids	
	insoluble parts (Fraction III)	condensed and hydrolysable tannins	
heartwoods	CH_2Cl_2	a mixture of steroidal ester and waxes, a mixture of long chain alcohol (C_{28}-C_{32}), a mixture of long chain carboxylic acids, a mixture of β-sitosterol, stigmasterol and campesterol, 2,6-dimethoxy-p-benzoquinone, syringaldehyde, a mixture of long chain hydroxy ester, a mixture of long chain amide, β-sitosteryl-3-0-β-D-glucopyranoside	
	$CHCl_3$	β-sitosteryl-3-0-β-D-glucopyranoside	
	EtOAc	phenolic compounds	
	H_2O	chloride salts of Na, K, Mg, Mn, Ca, Fe and Cu arabinose several amino acids	
	insoluble parts (Fraction X)	condensed and hydrolysable tannins	

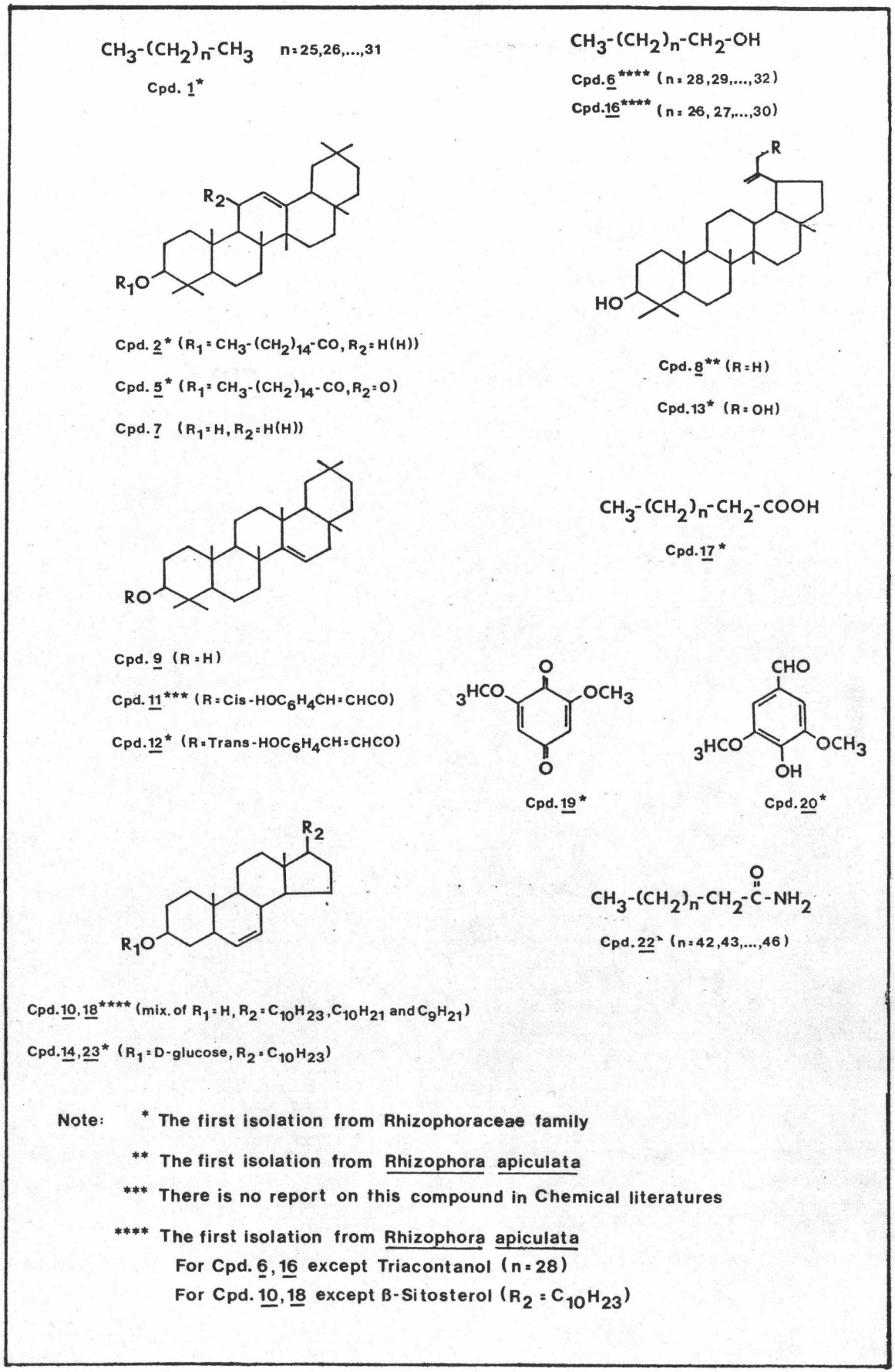


Figure 193 All isolated substances from the leaves and the heartwoods of Rhizophora apiculata Bl.

The mixture of saturated long chain aliphatic hydrocarbons is highly active as an antifungal and an insect antifeedant agent. The 2,6-dimethoxy-p-benzoquinone is moderately active not only fungi, bacteria, but also the insect, boll weevil. Wallichenol, taraxerol, β-amyrenonylpalmitate and syringaldehyde are highly active as antifungals. β-amyrinpalmitate, taraxerol, a mixture of β-sitosterol, stigmasterol and campesterol, a mixture of steroidal ester and waxes and a mixture of saturated long chain aliphatic carboxylic acids are highly active as boll weevil antifeedants. Moreover, the chemical literaure studies incidate that lupeol, 2,6-dimethoxy-p-benzoquinone, syringaldehyde and β-sitosteryl-3-O-β -D-glucopyranoside are the biologically active ingredients in pharmaceutical aspects. However, these active compounds need confirming their biological activity prior to use in the real conditions.

It is seen from this research work that the leaves of Rhizophora apiculata can be used as a good source of triterpenoids. Moreover, several active compounds are also obtained from this plant. Therefore, the study on chemical constituents and biological activities of mangrove plants is one of the most worth considering for natural product chemists.

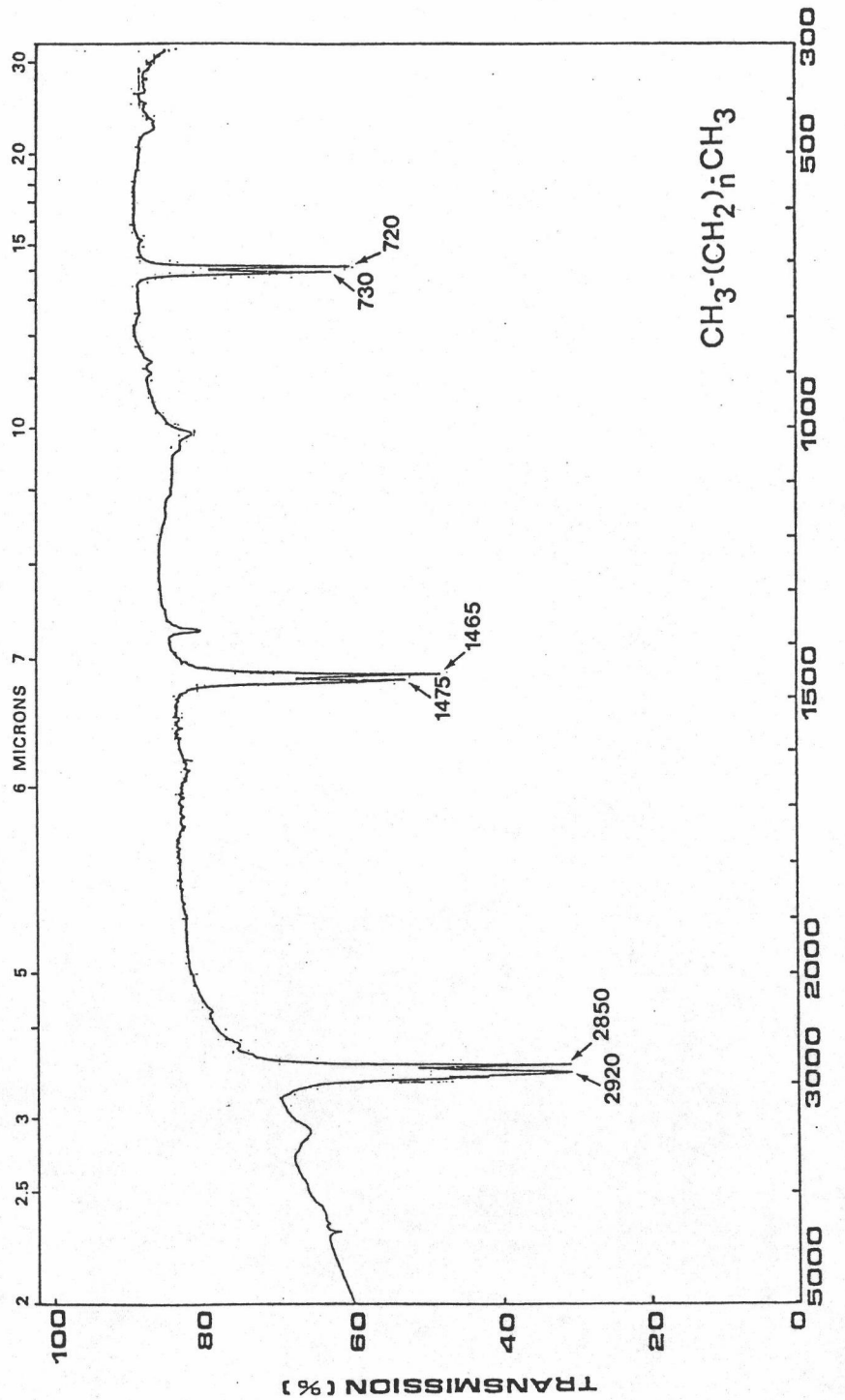


Figure 7 The IR spectrum of Compound 1

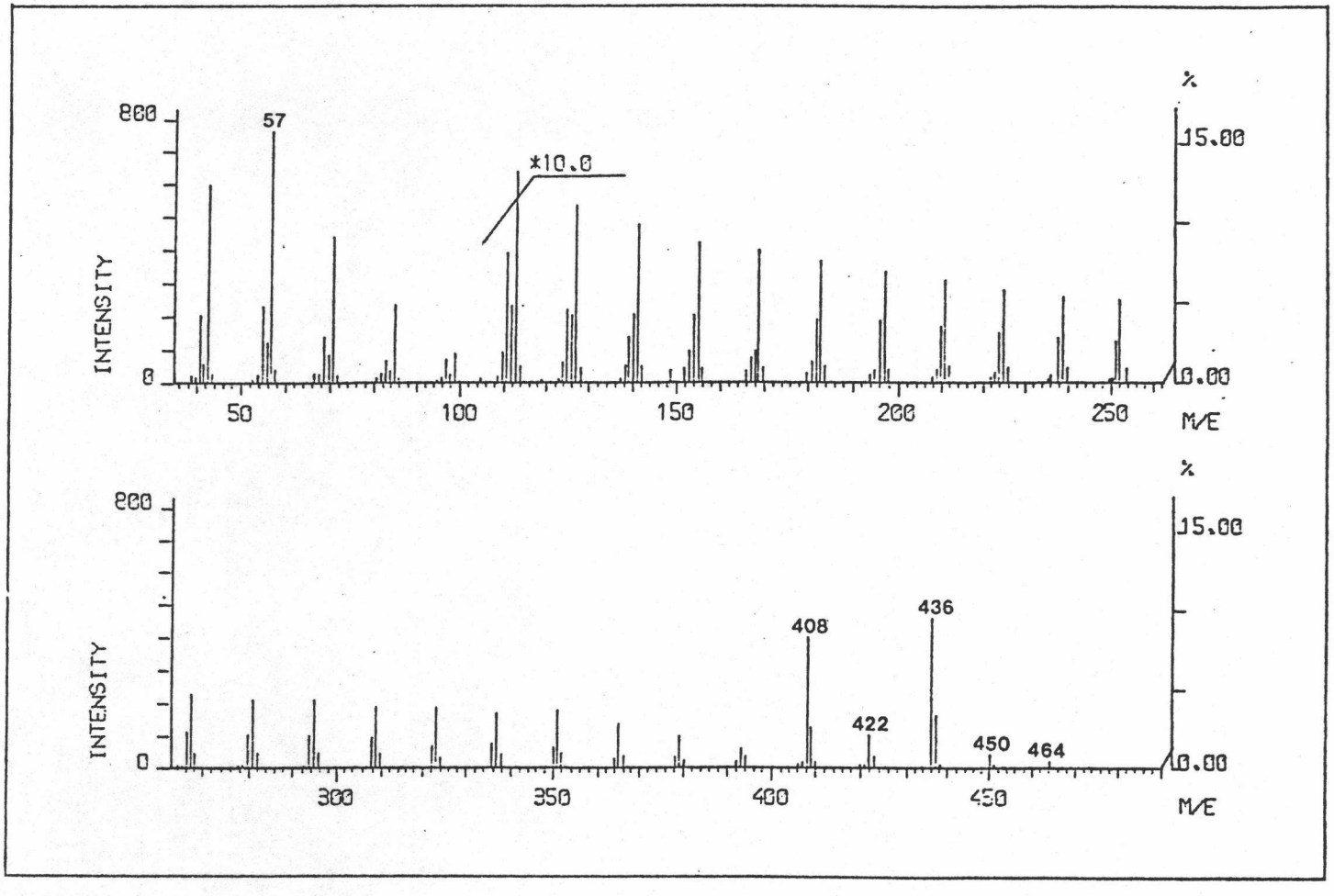


Figure 8 The mass spectrum of Compound 1

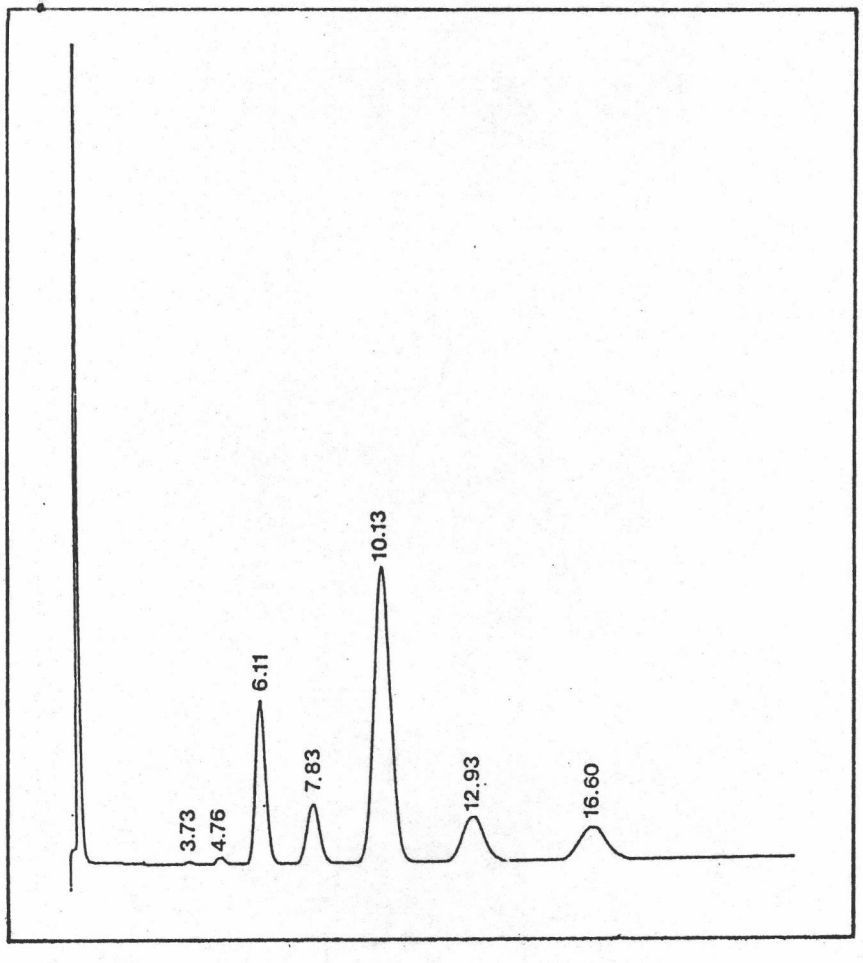


Figure 9 The GLC analysis result of Compound 1

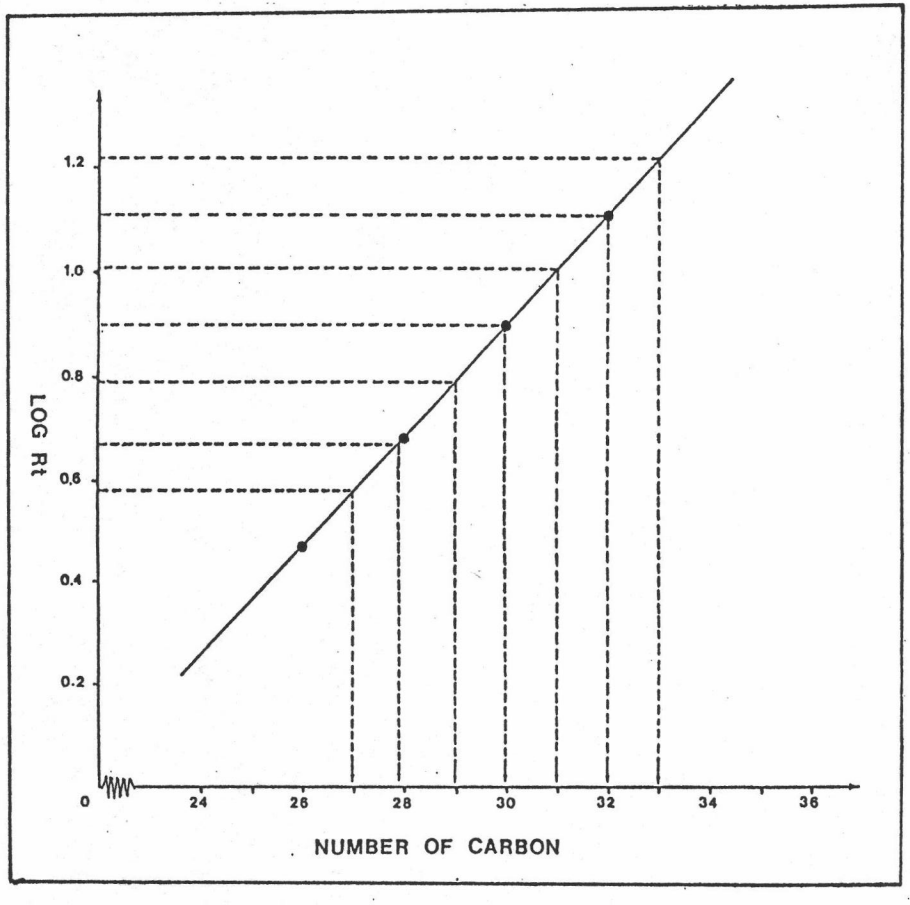


Figure 10 The correlation standard curve of Compound 1

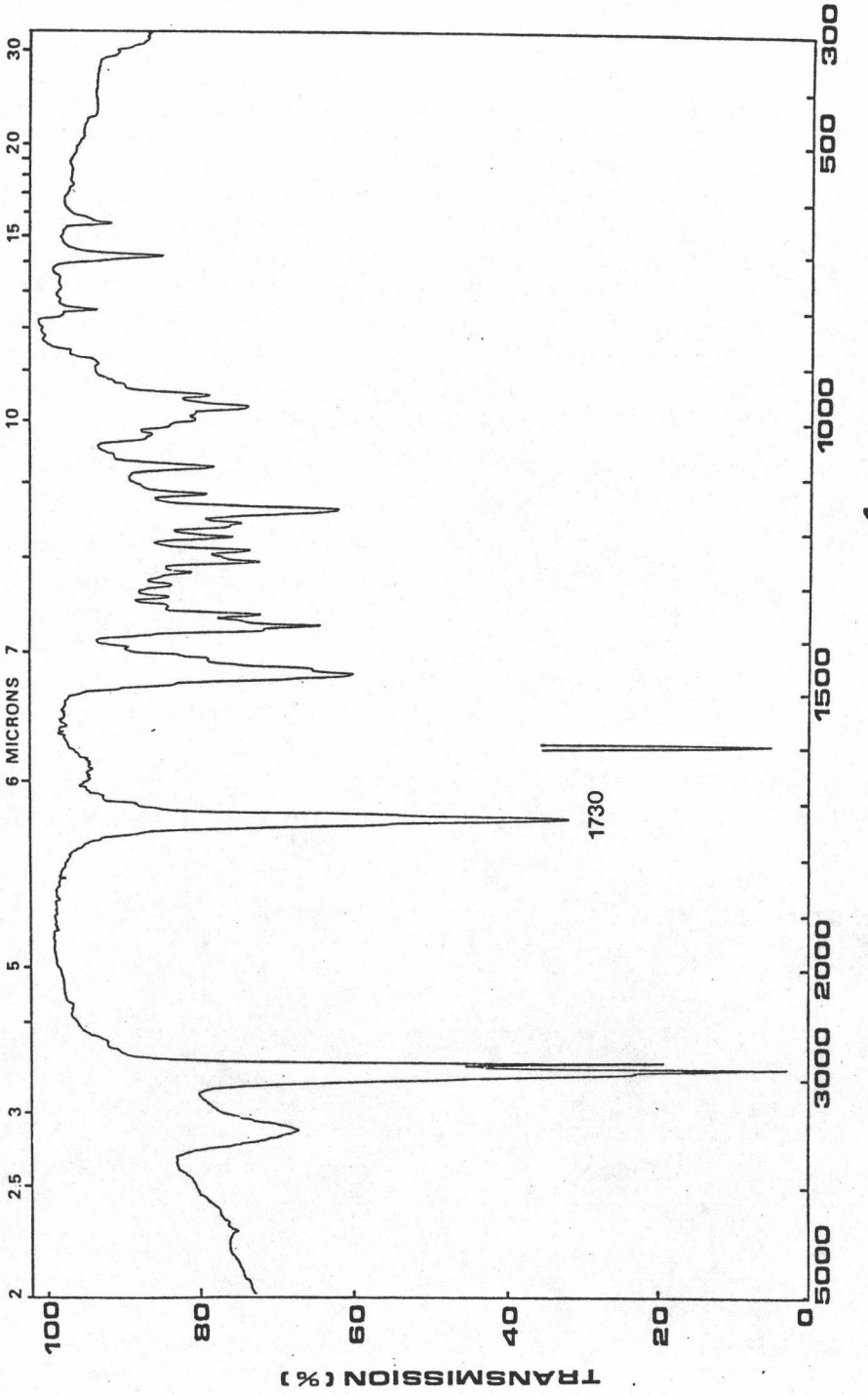


Figure 11 The IR spectrum of Compound 2

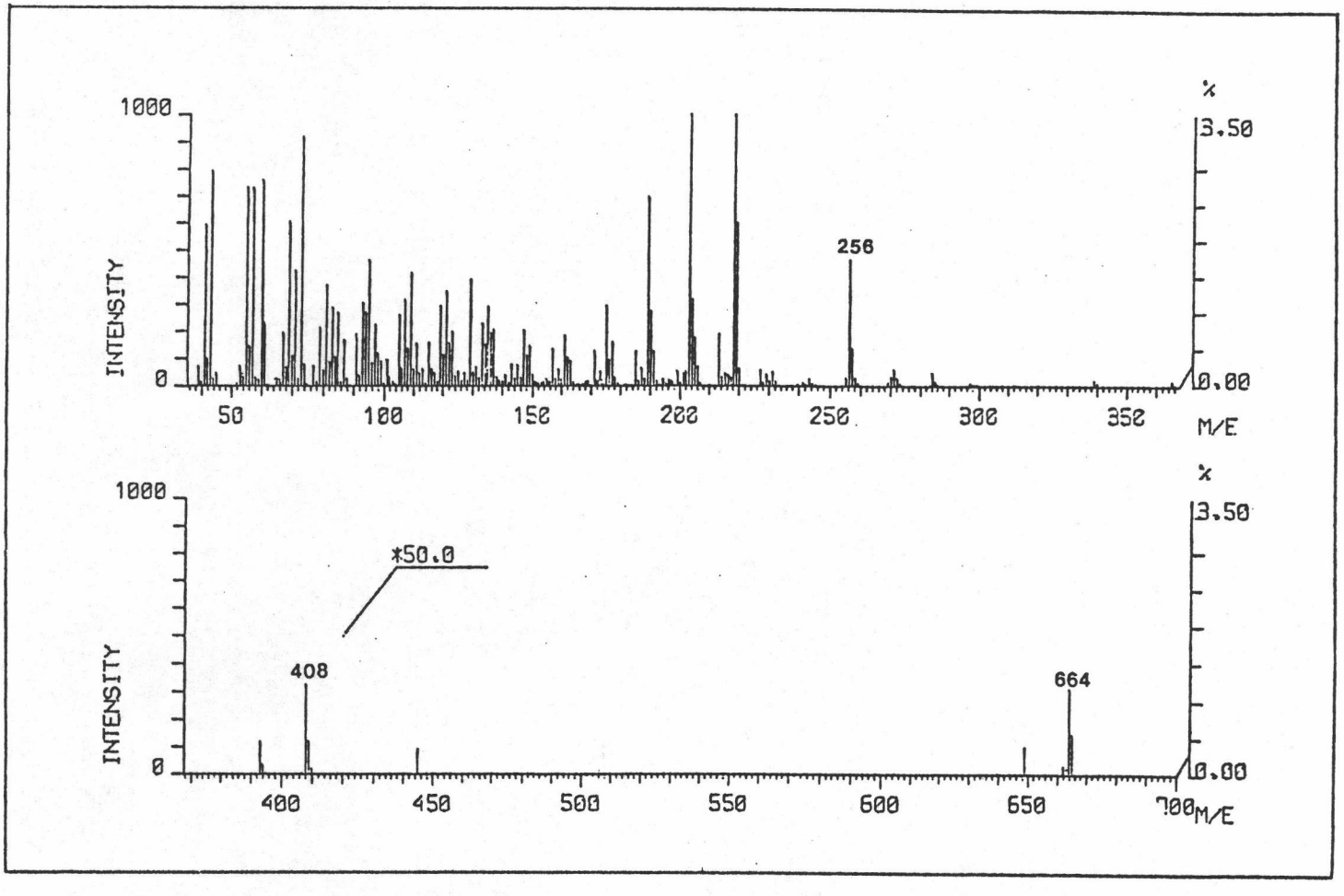


Figure 12 The mass pectrum of Compound 2

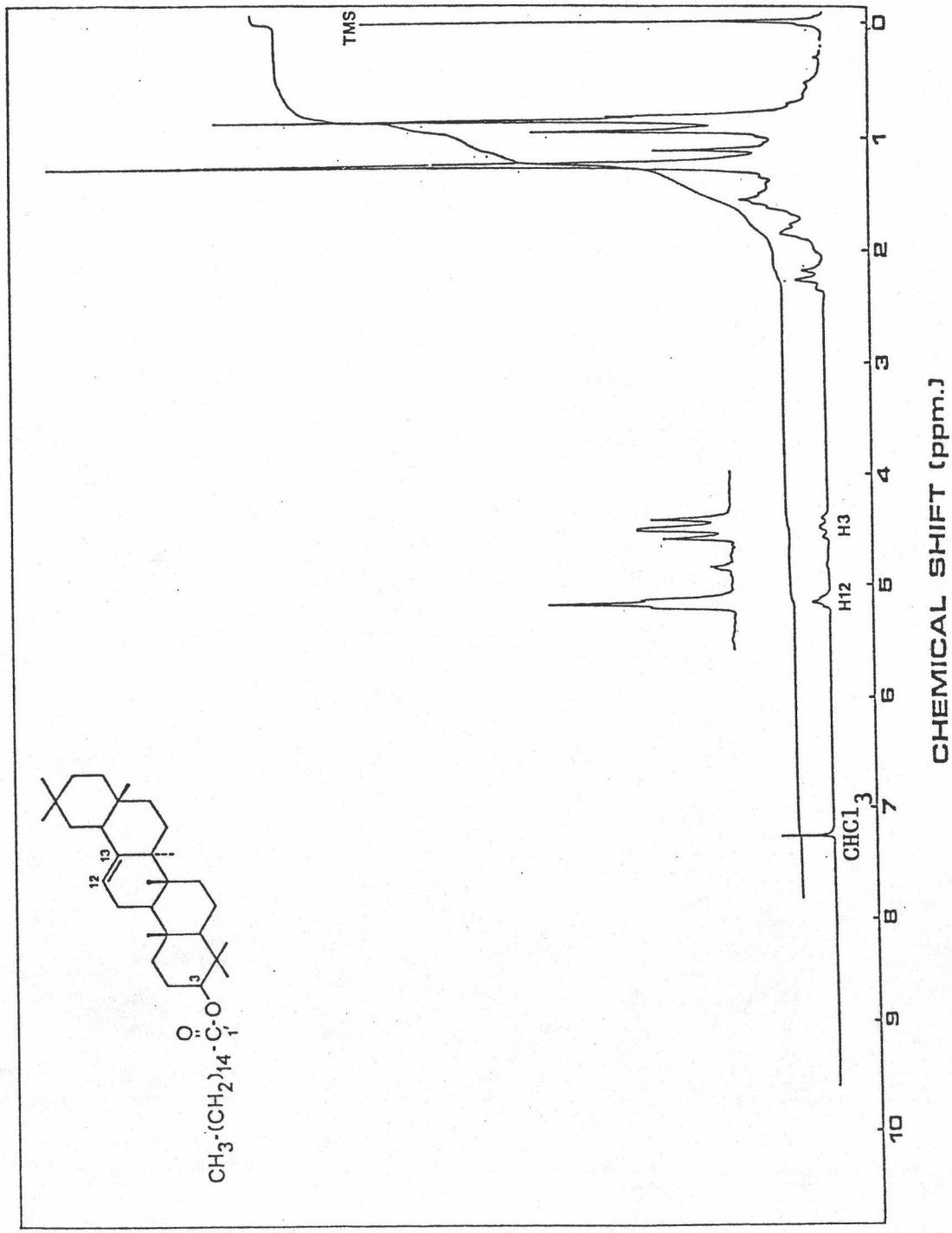


Figure 13 The ^{1}H NMR spectrum of Compound 2

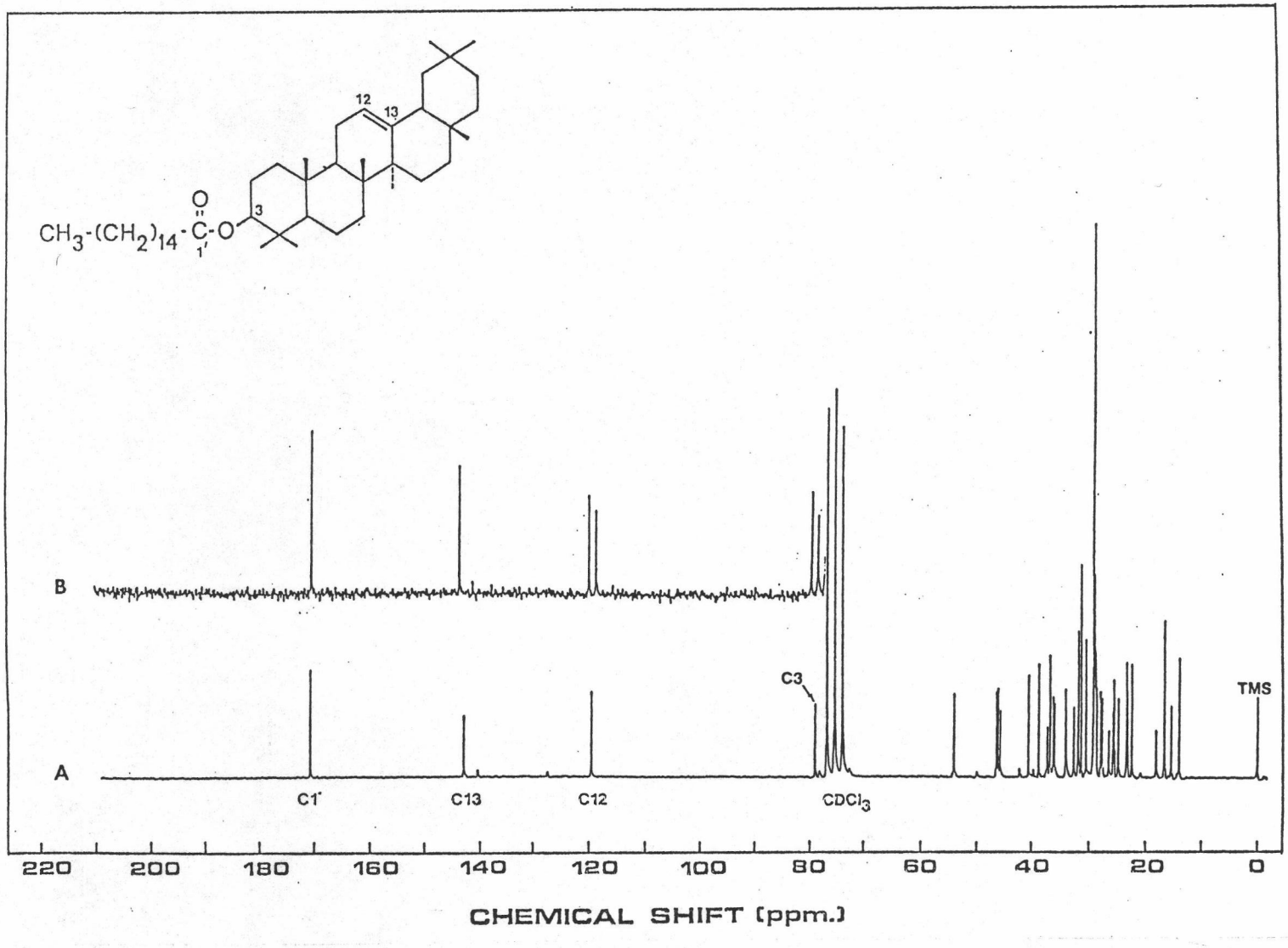


Figure 14 A) The ^{13}C NMR spectrum of Compound 2

B) The ^{13}C NMR off resonance spectrum of Compound 2

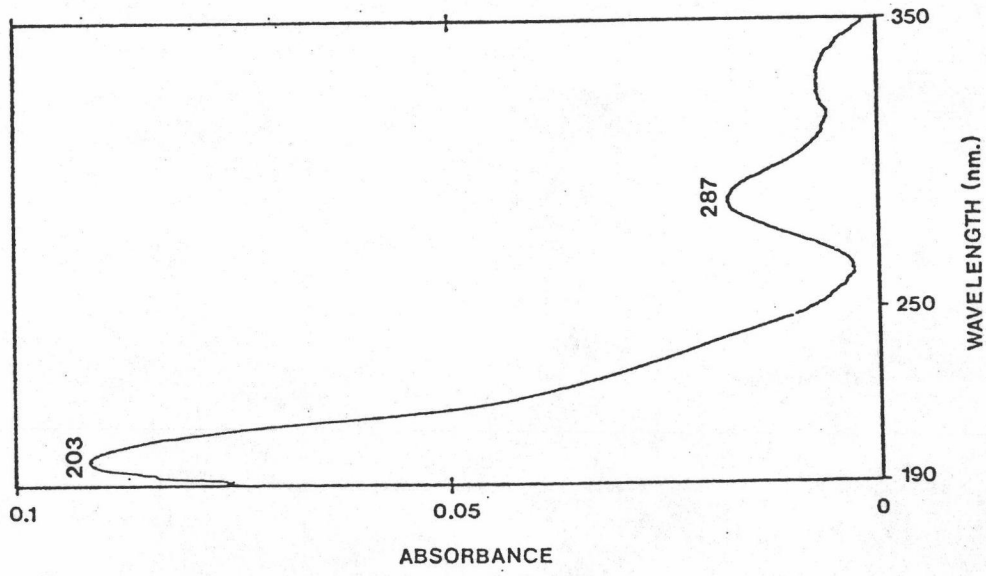


Figure 15 The UV spectrum of Compound 2

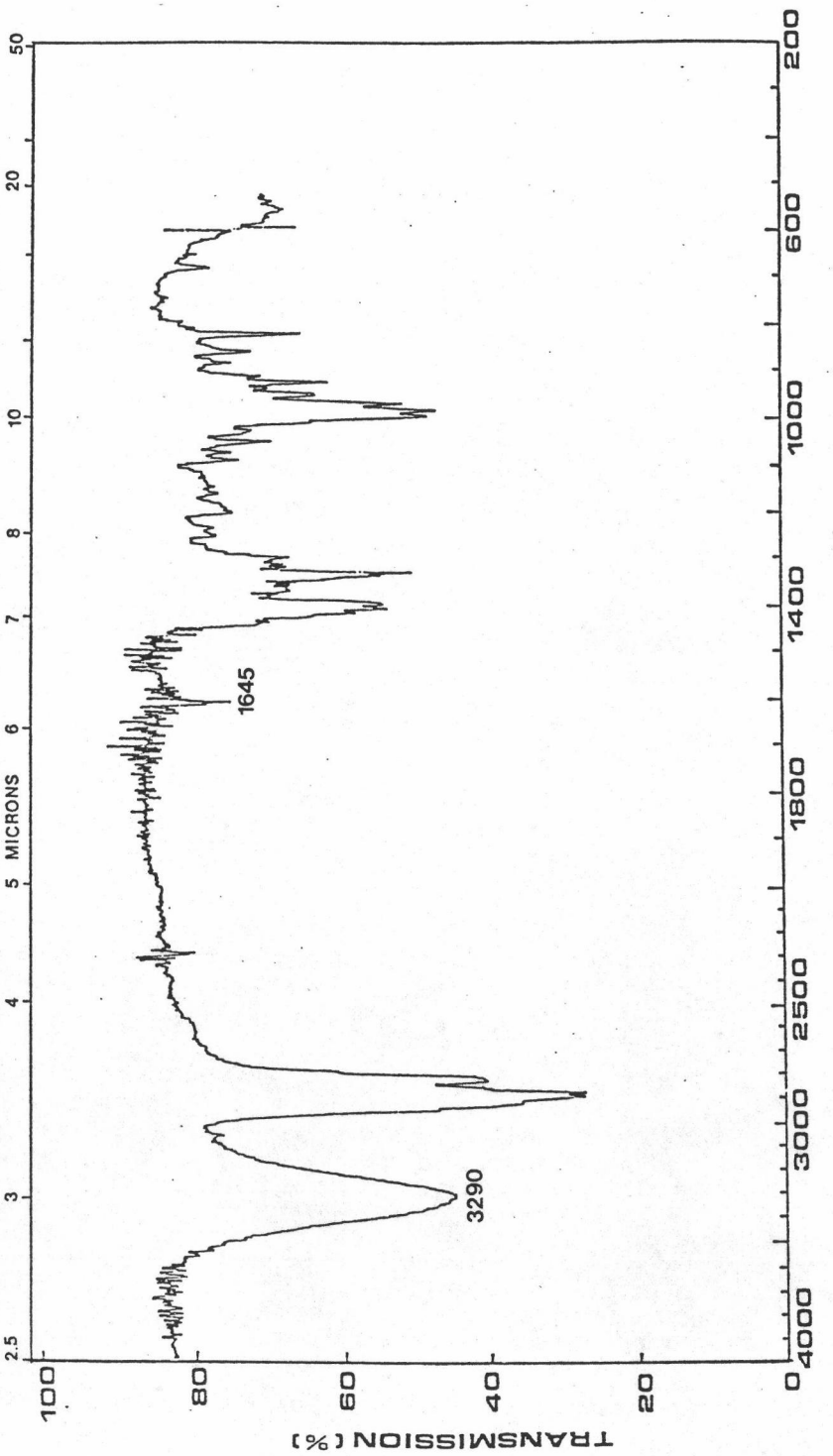


Figure 16 The IR spectrum of Compound 2A

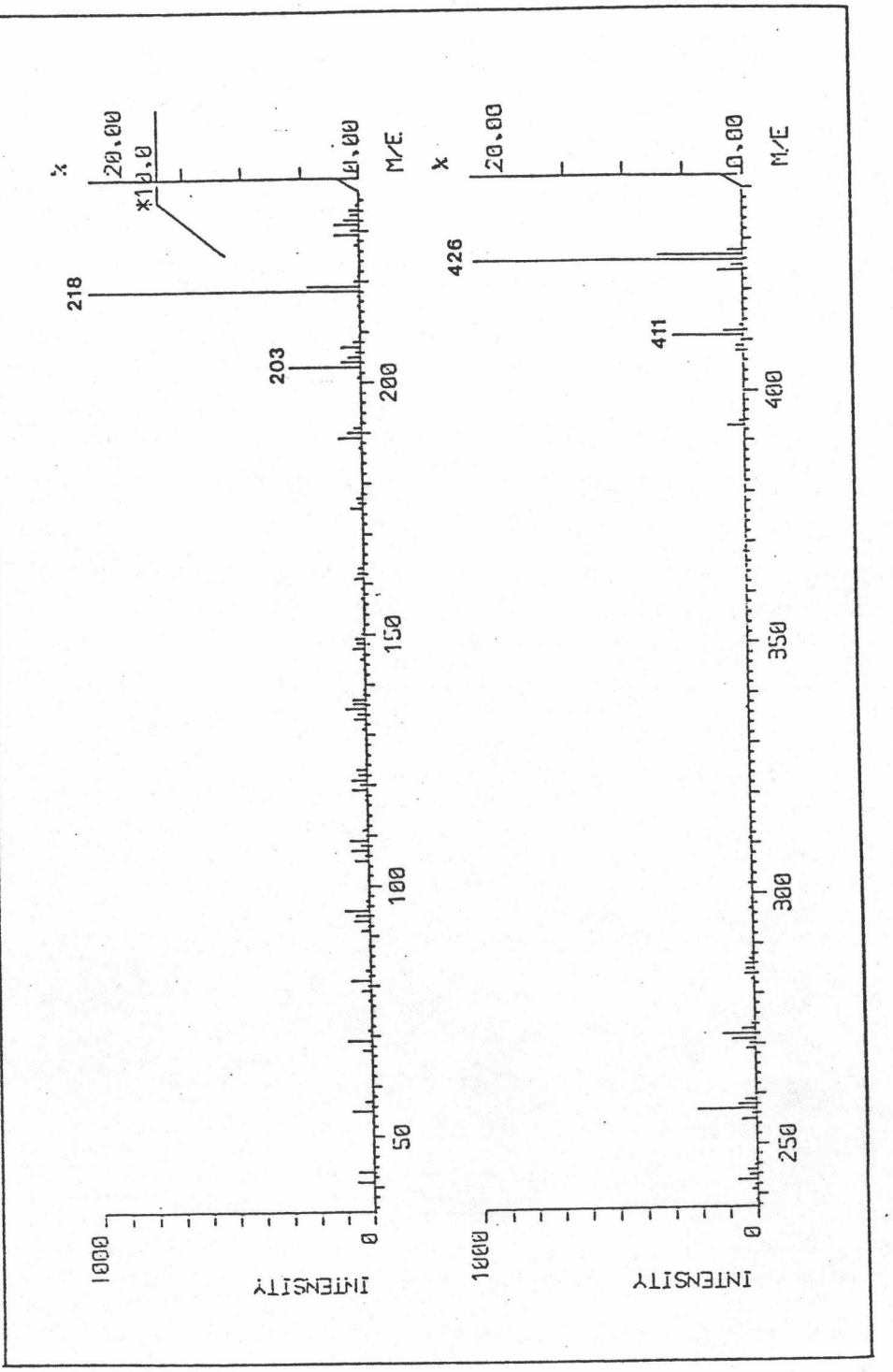


Figure 17 The mass spectrum of Compound 2A

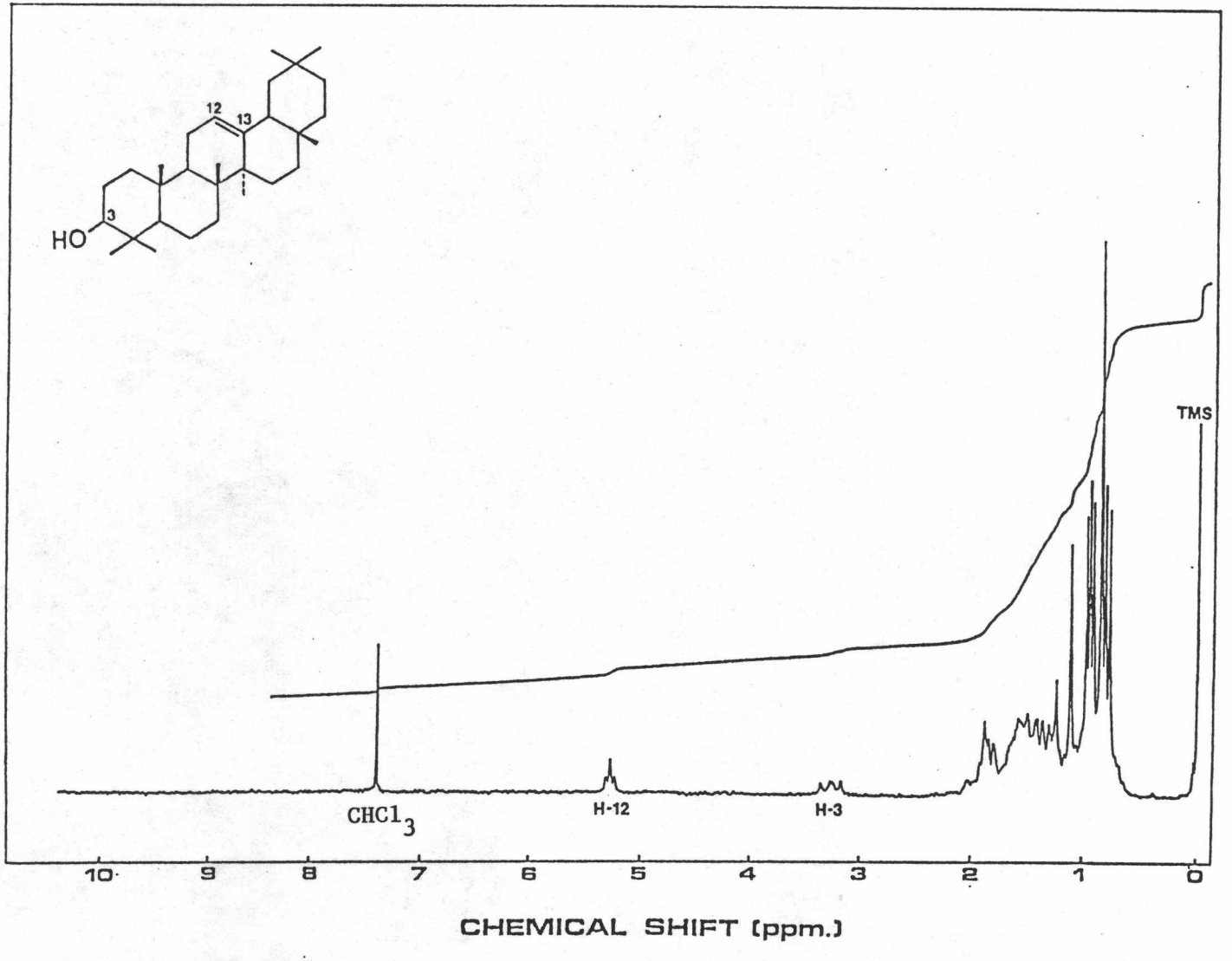


Figure 18 The ^{1}H NMR spectrum of Compound 2A

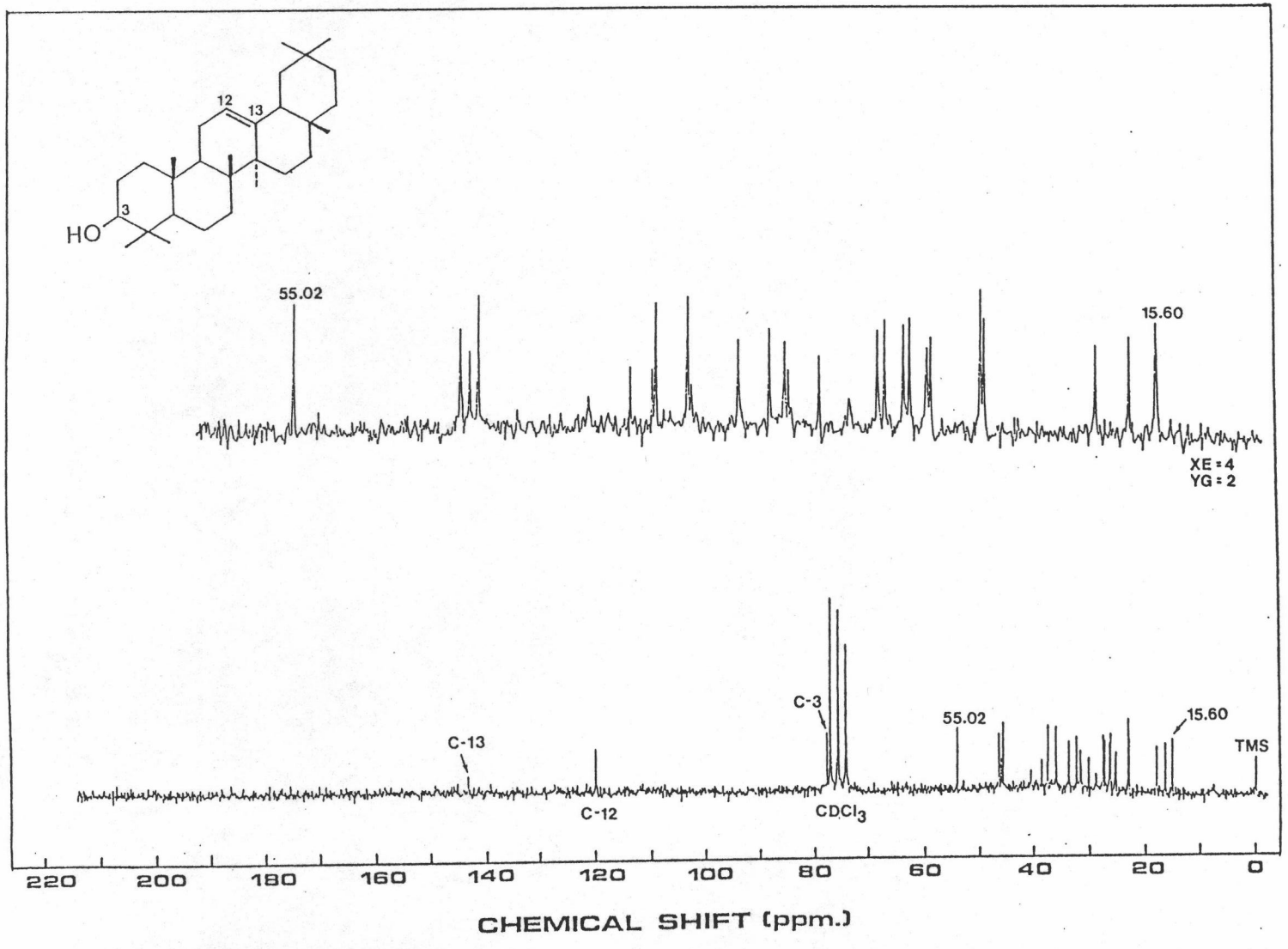


Figure 19 The ^{13}C NMR spectrum of Compound 2A

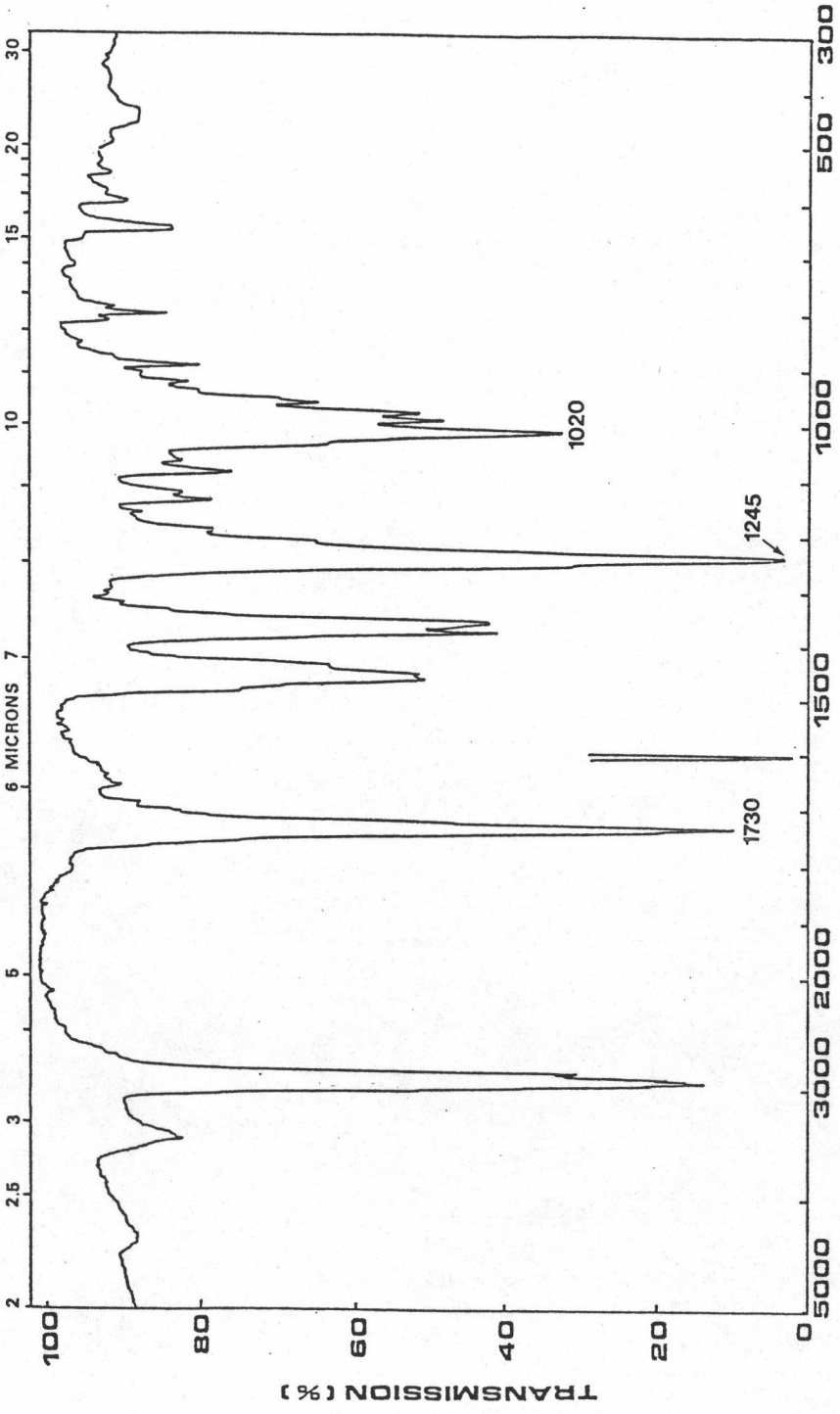


Figure 20 The IR spectrum of Compound 2A acetate

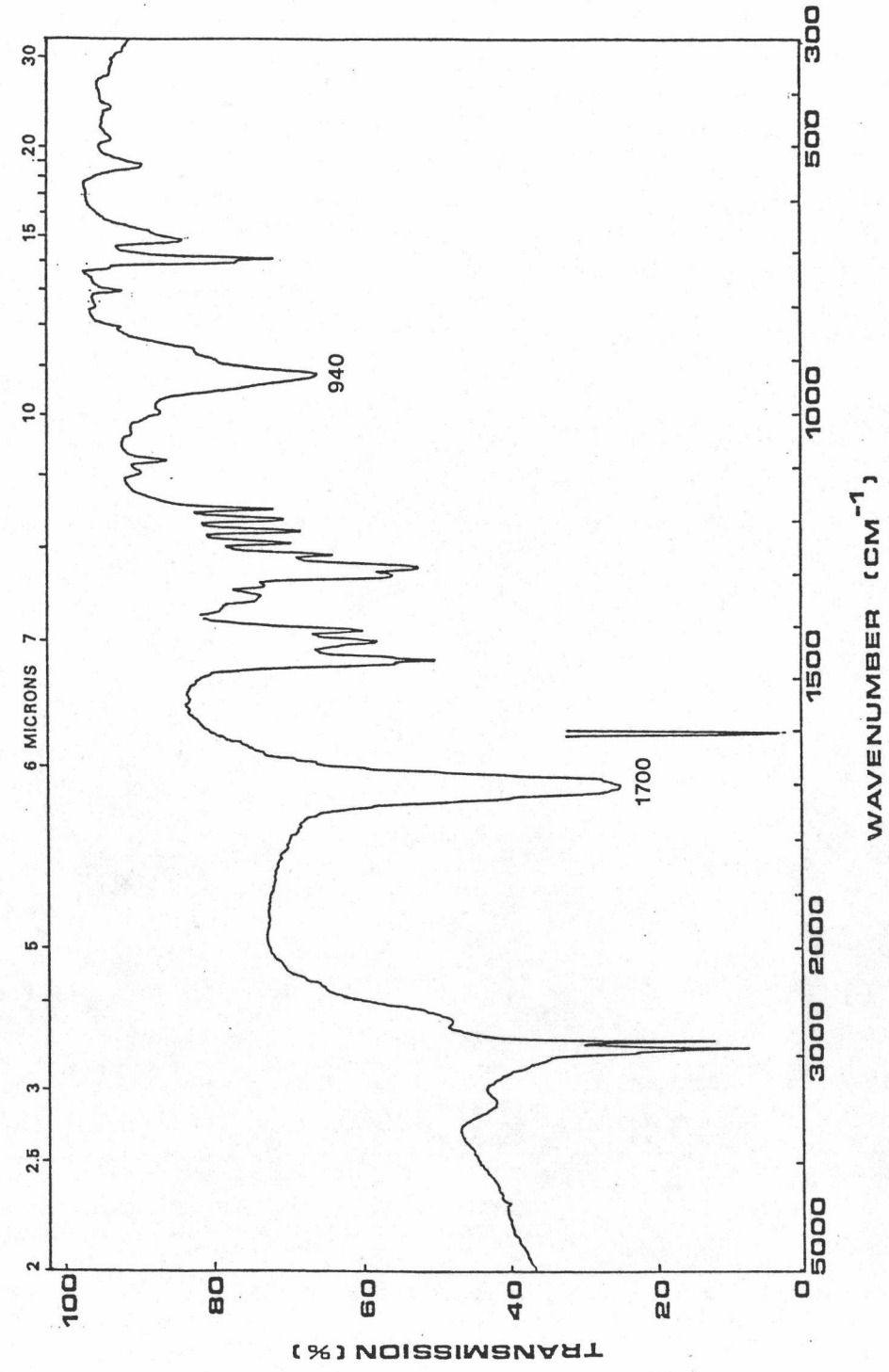


Figure 21 The IR spectrum of Compound 2B

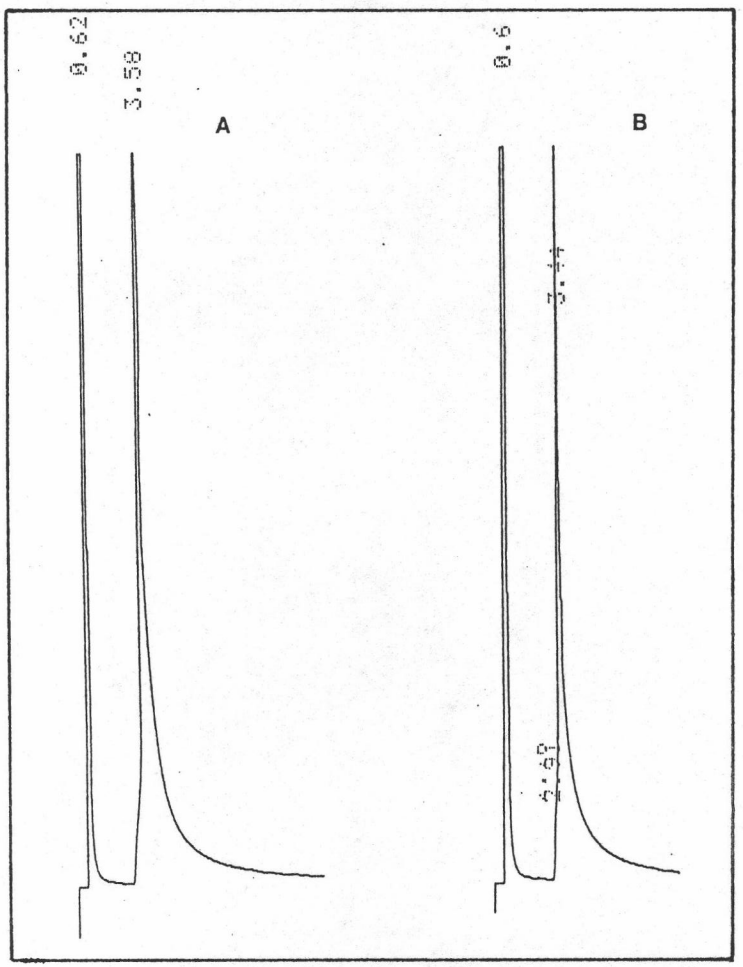


Figure 22 The GLC analysis results of

A) palmitic acid

B) Compound 2B

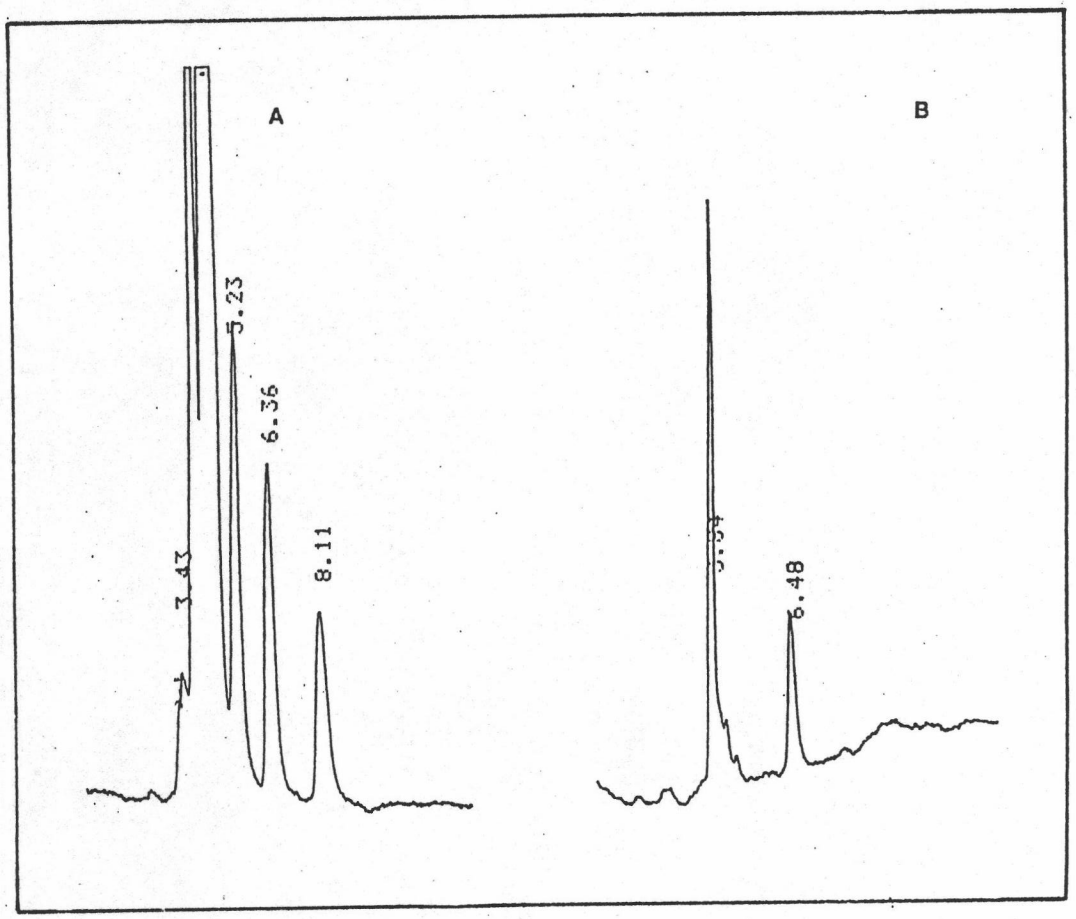


Figure 23 The HPLC analysis results of

A) standard acid : C_{12}, C_{14}, C_{16}, C_{18}

B) Compound 2B

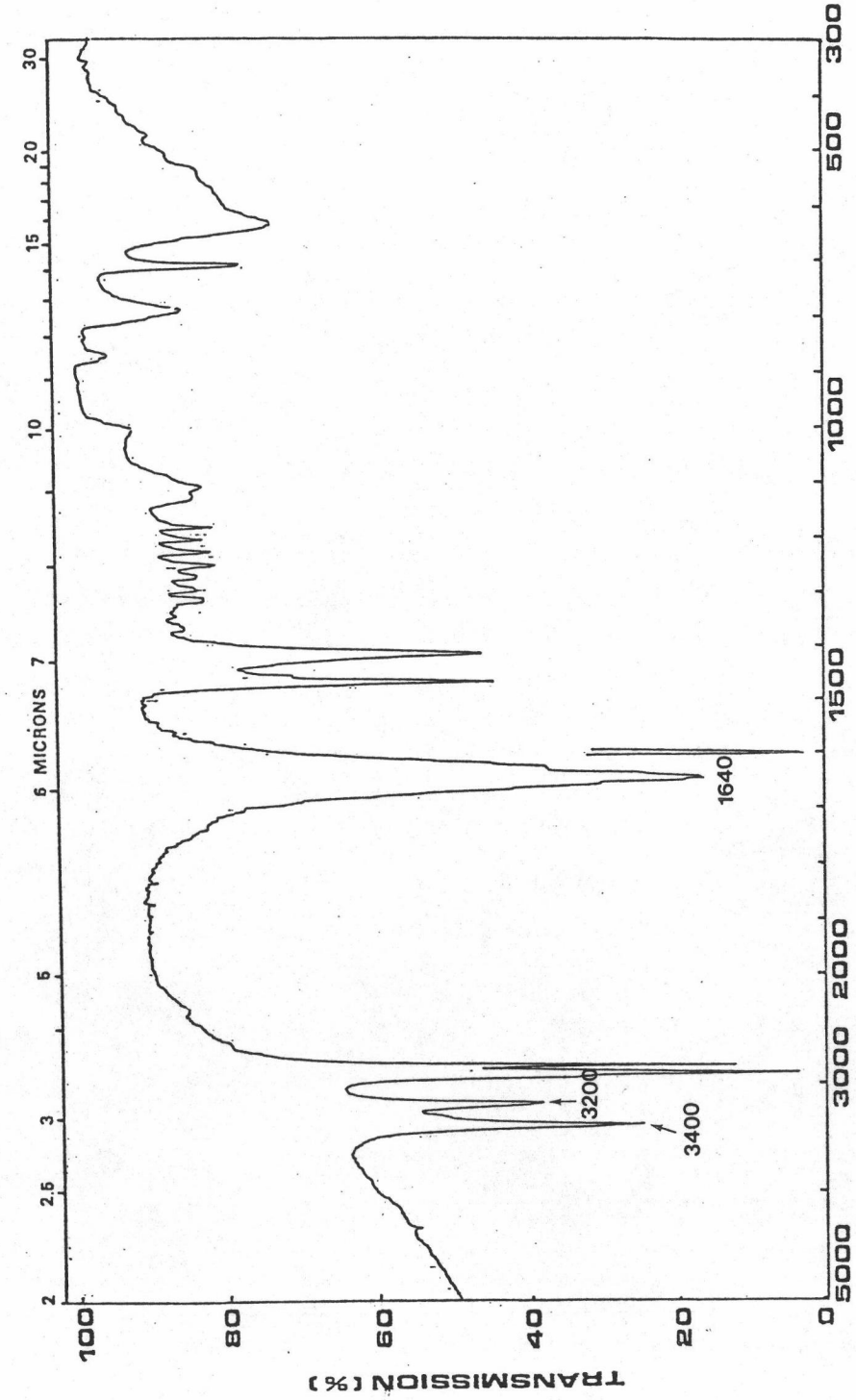


Figure 24 The IR spectrum of Compound 2B amide

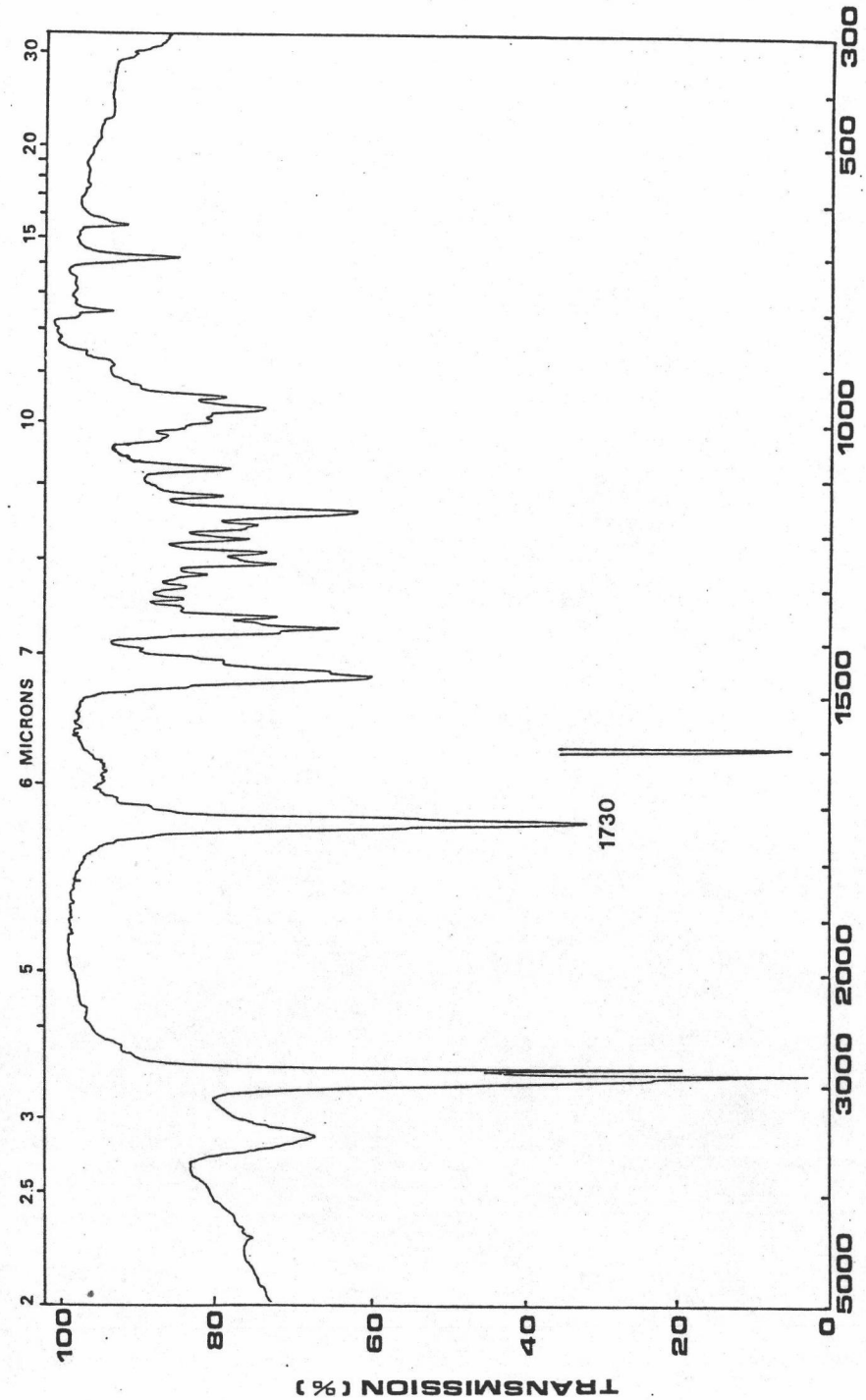


Figure 25 The IR spectrum of synthetic Compound 2

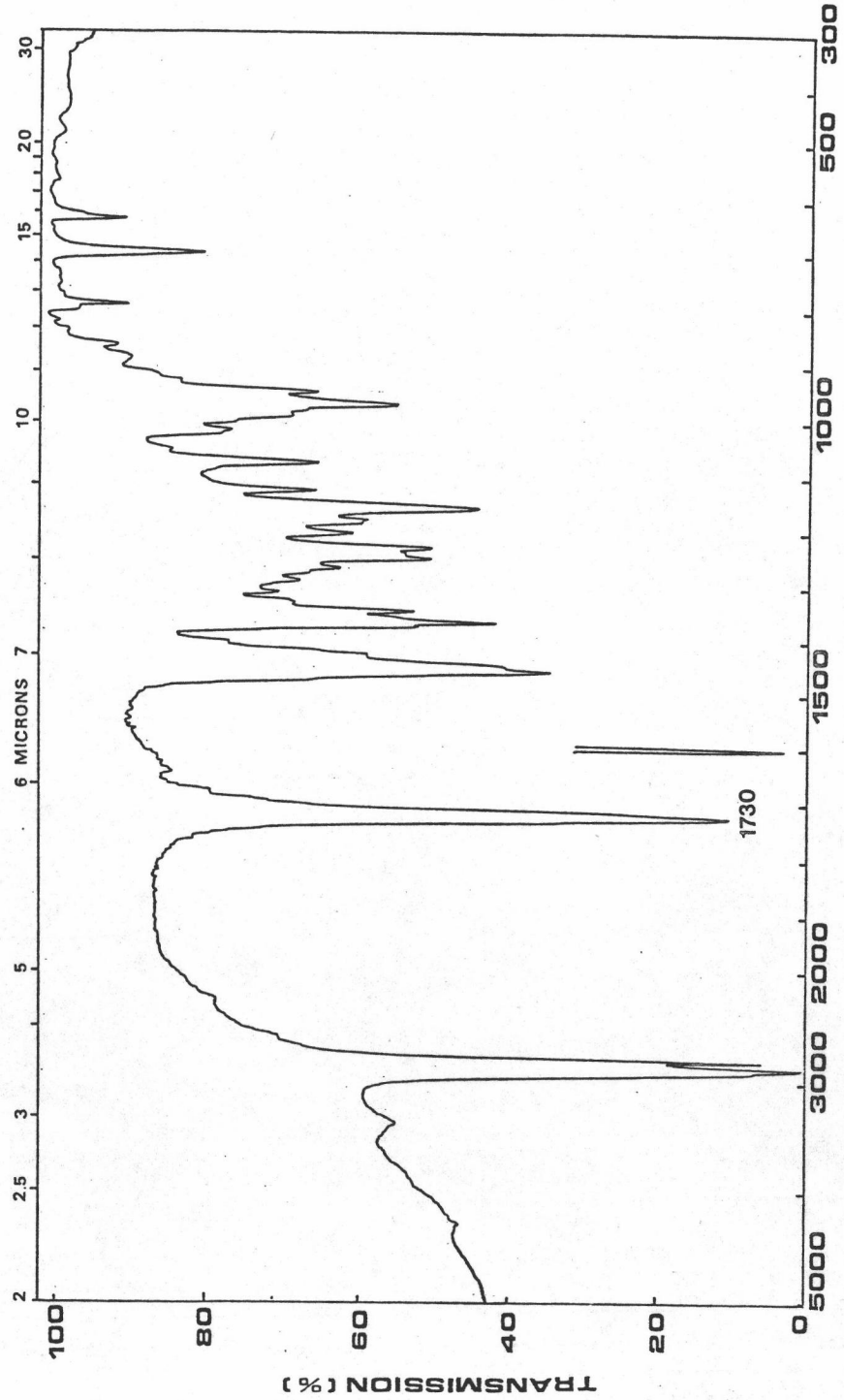


Figure 26 The IR spectrum of Compound 3

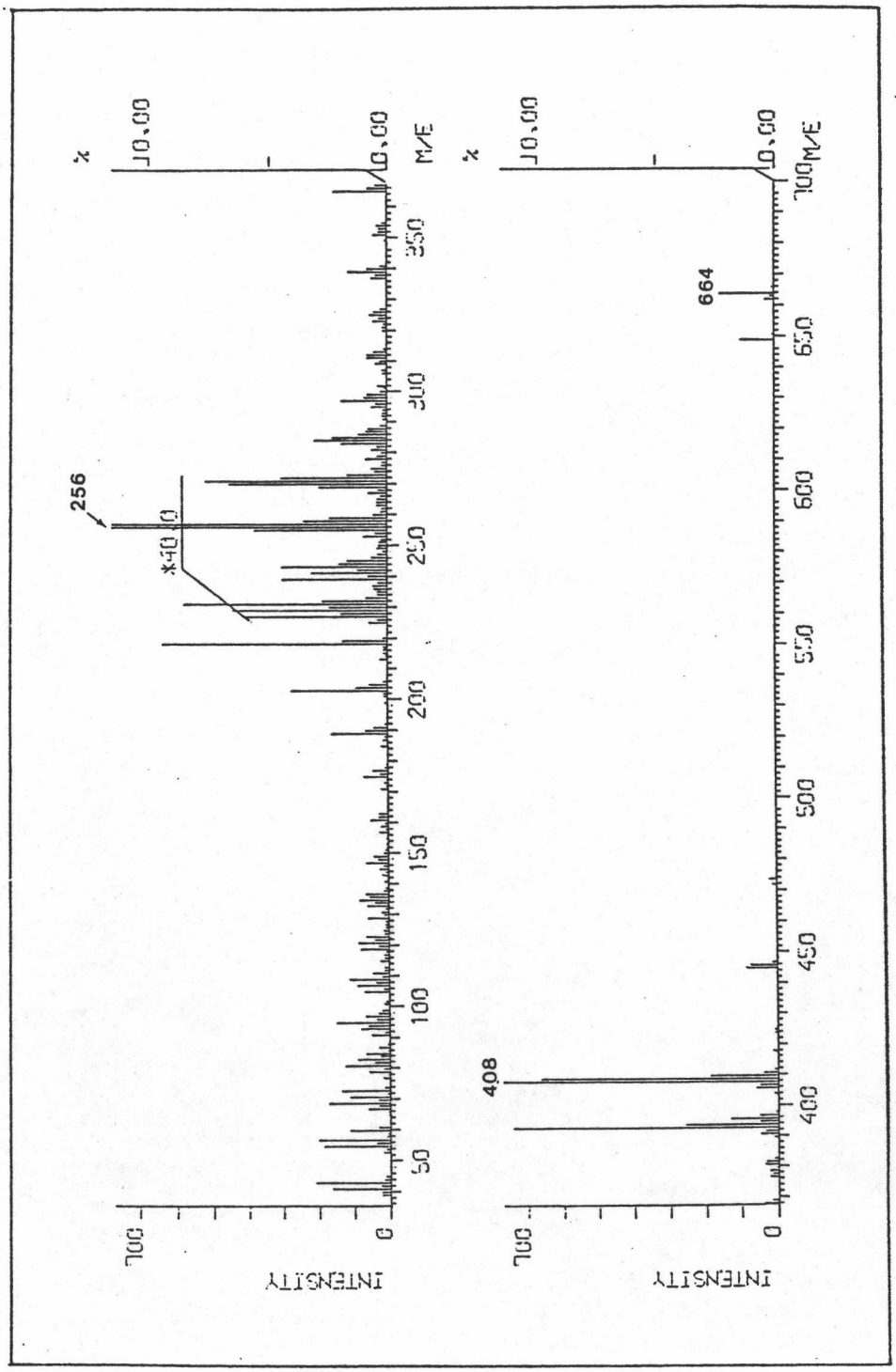


Figure 27 The mass spectrum pattern 1 of Compound 3

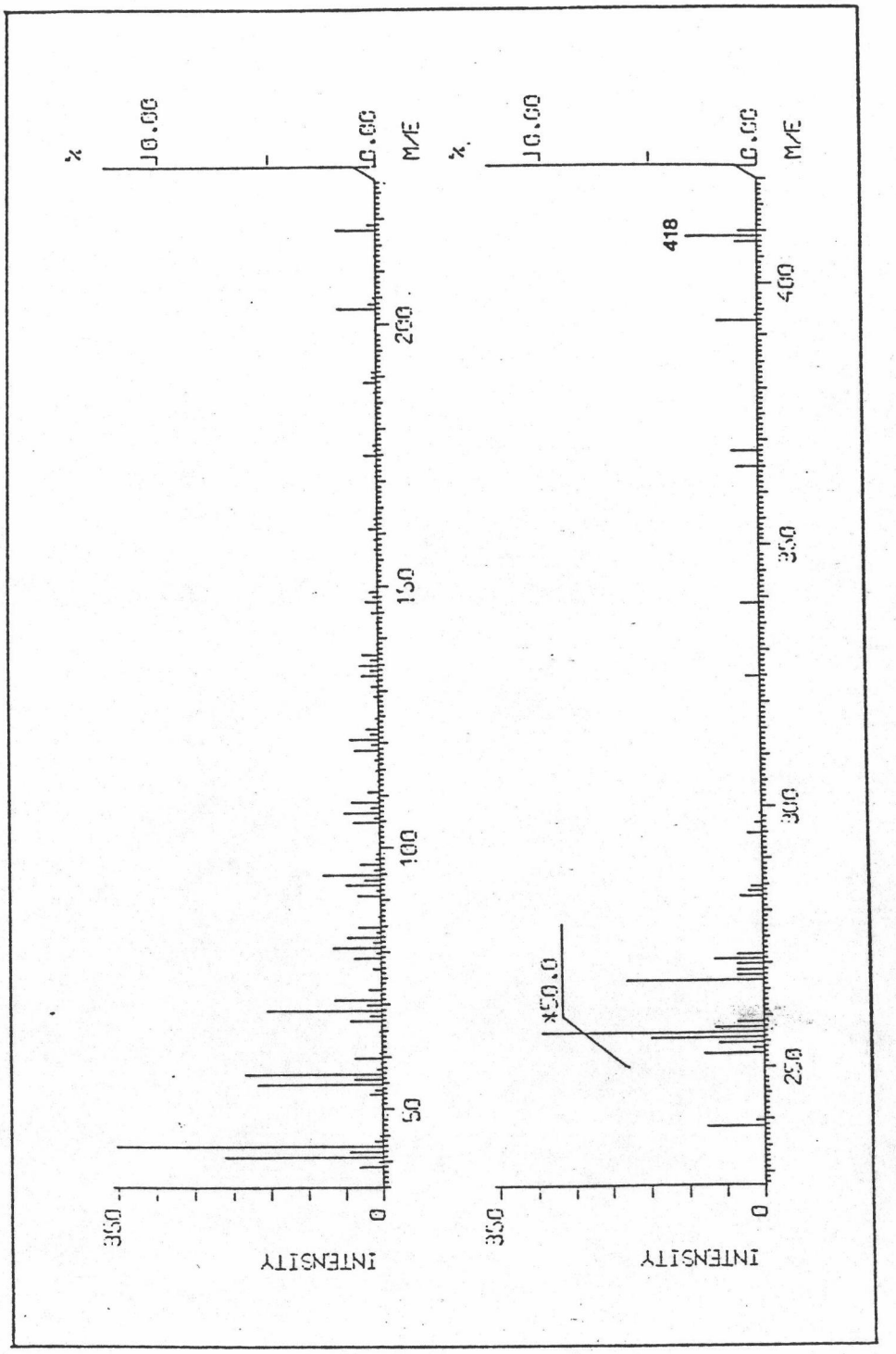


Figure 28 The mass spectrum pattern 2 of Compound 3

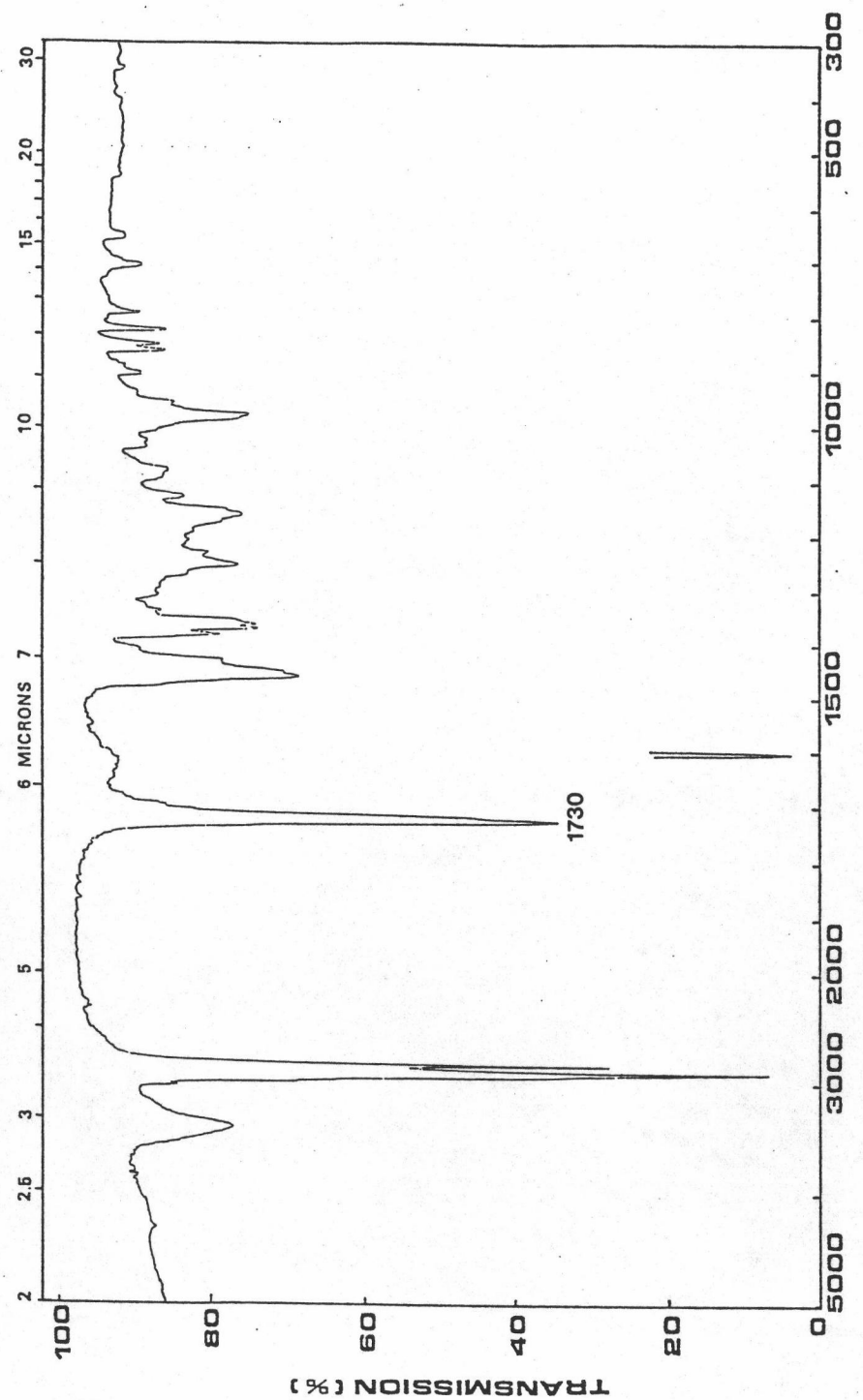


Figure 29 The IR spectrum of Compound 4

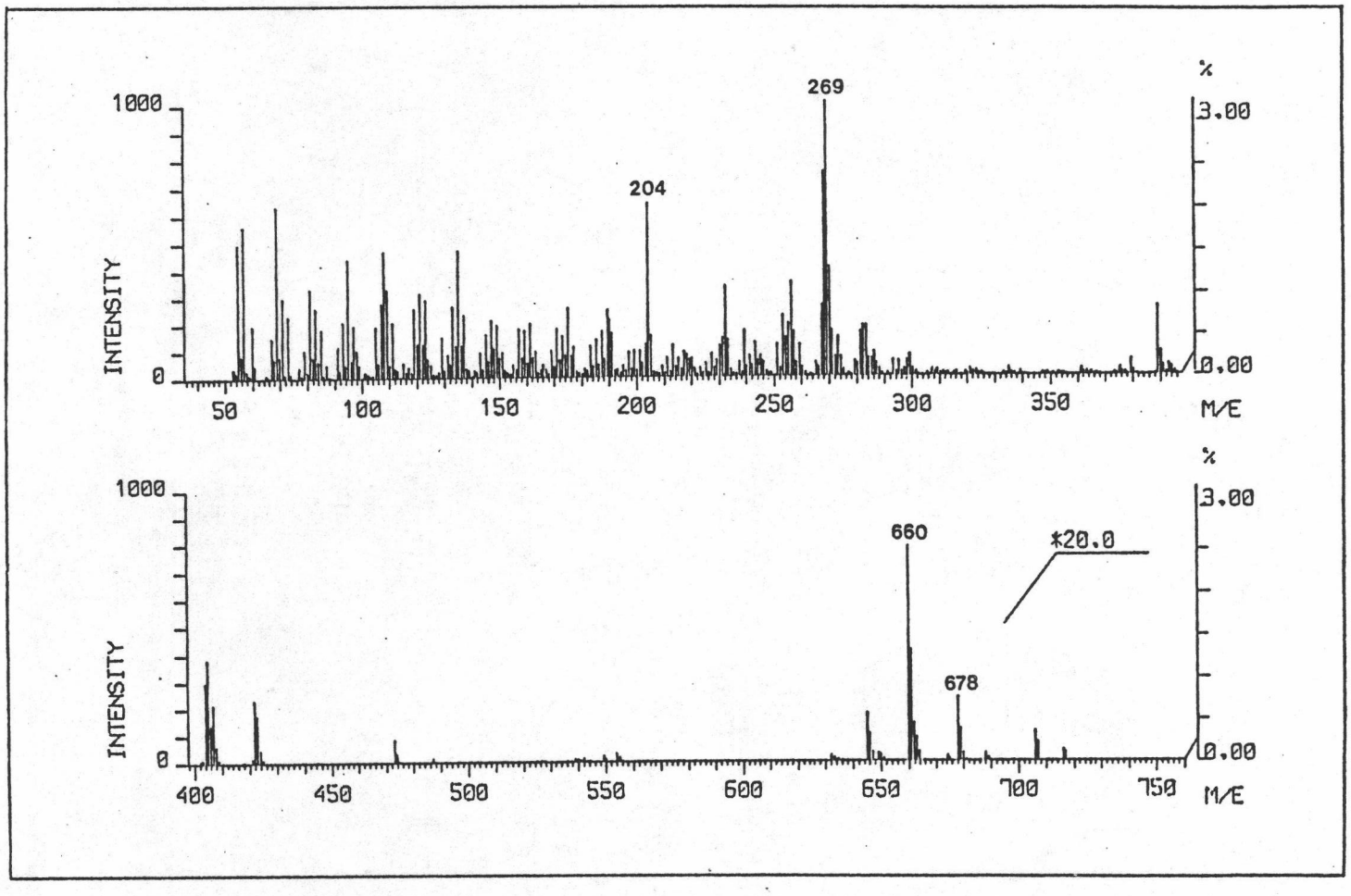


Figure 30 The mass spectrum of Compound 4

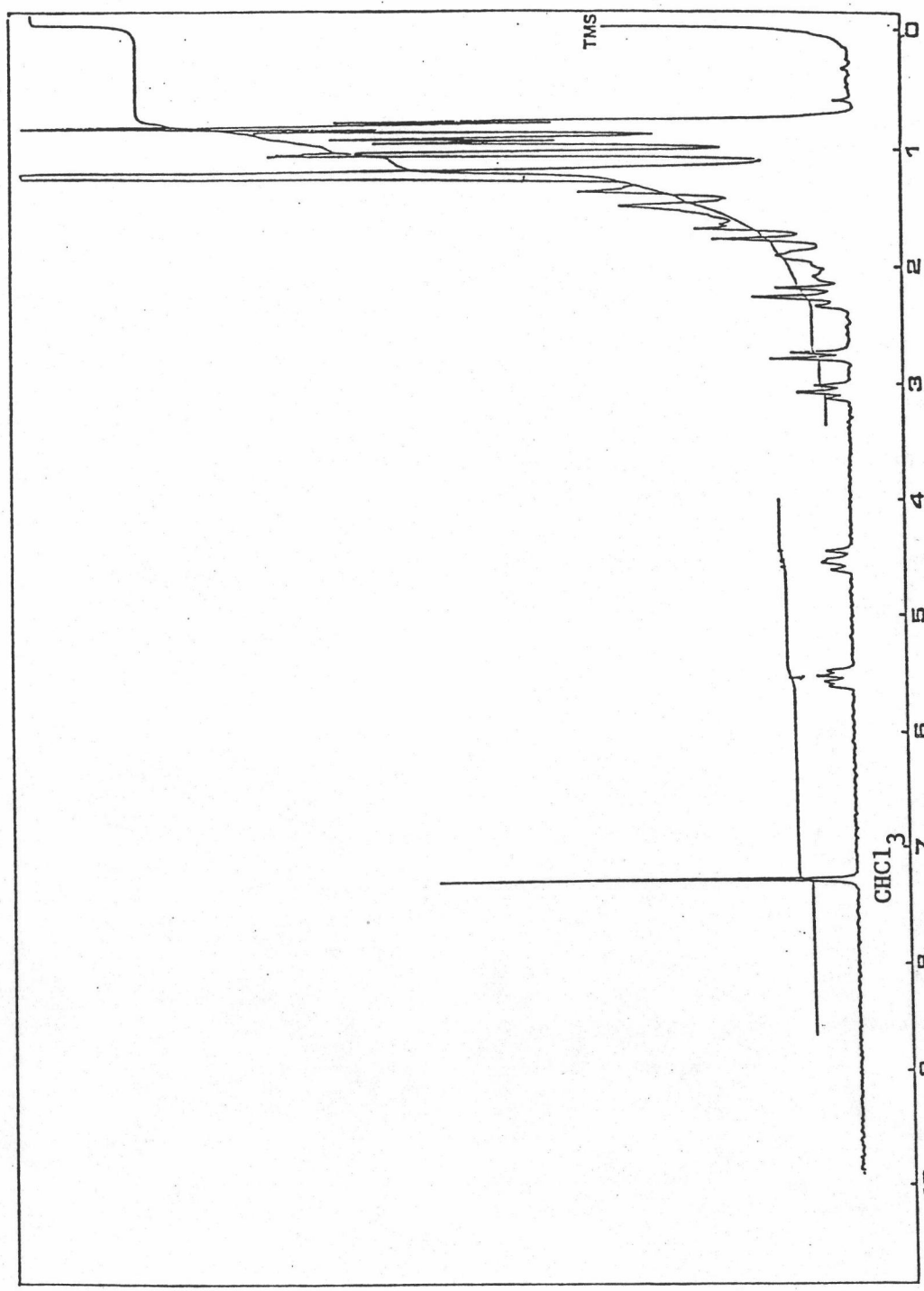


Figure 31 The ^1H NMR spectrum of Compound 4

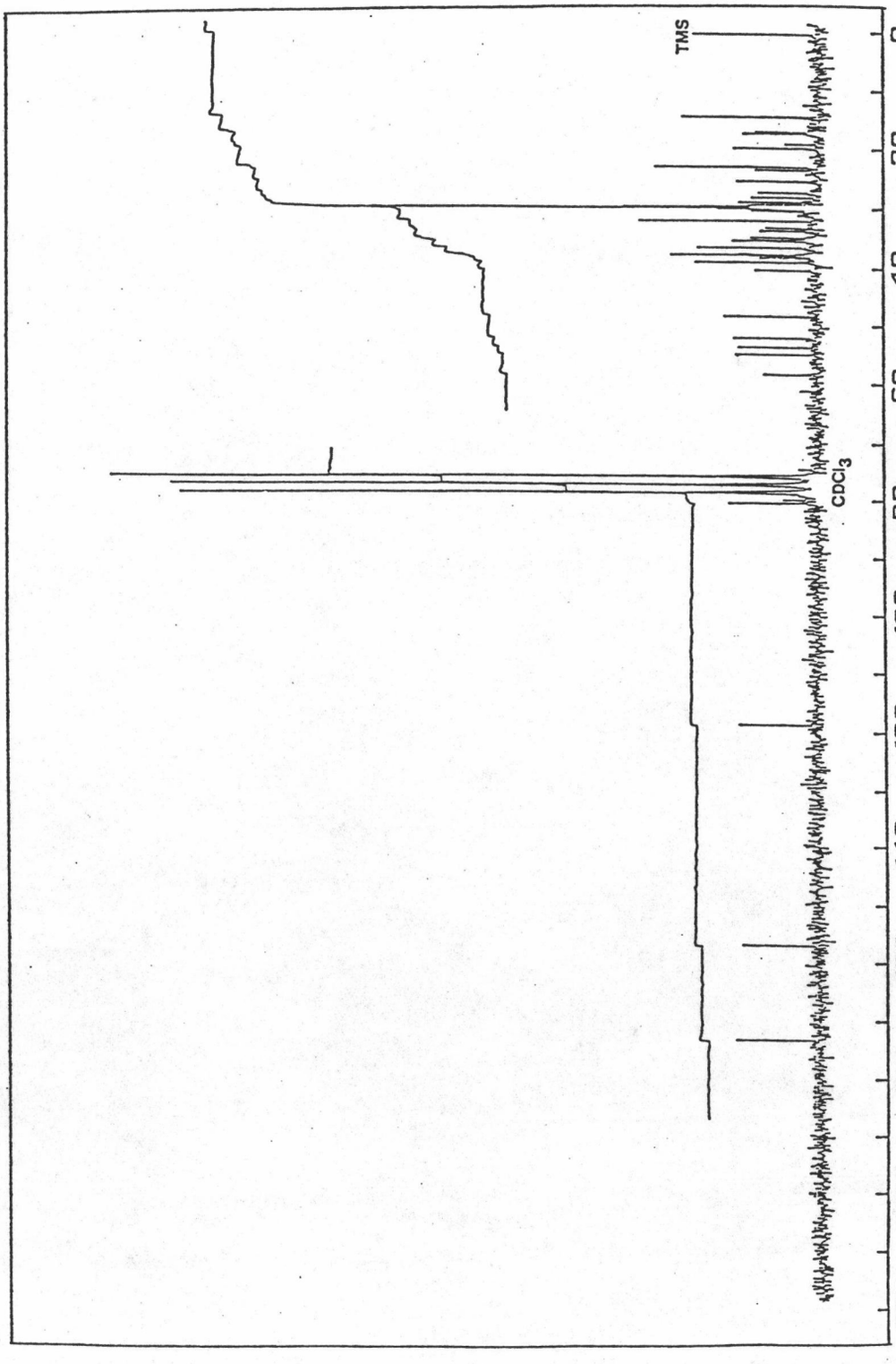


Figure 32 The ^{13}C NMR spectrum of Compound 4

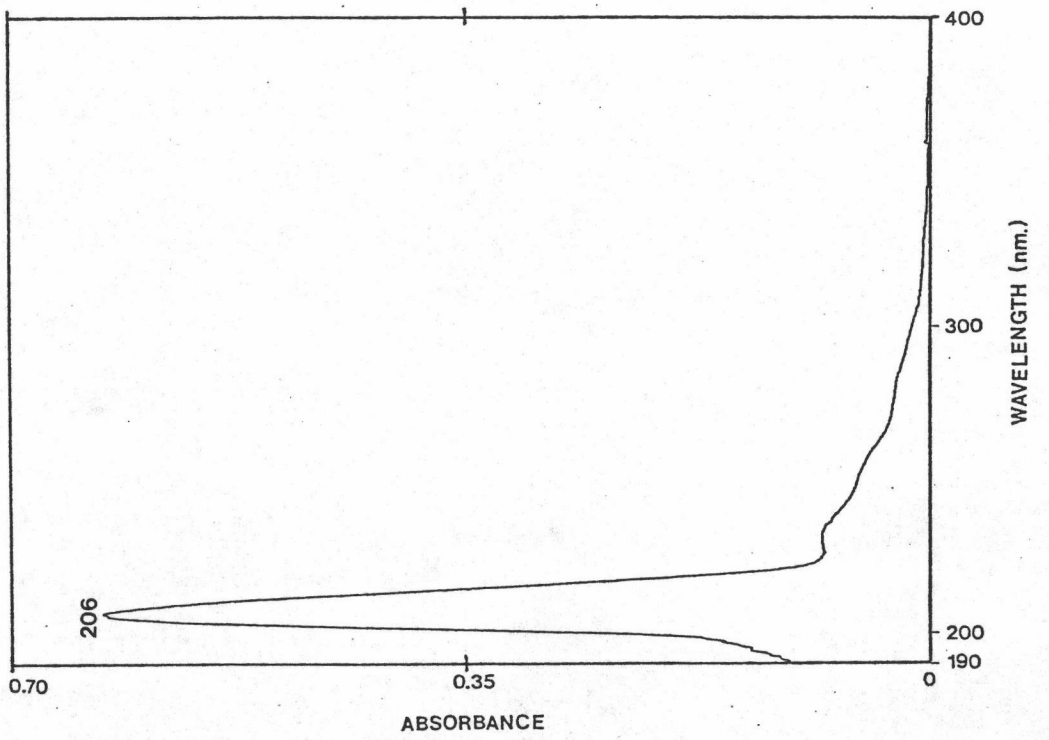


Figure 33 The UV spectrum of Compound 4

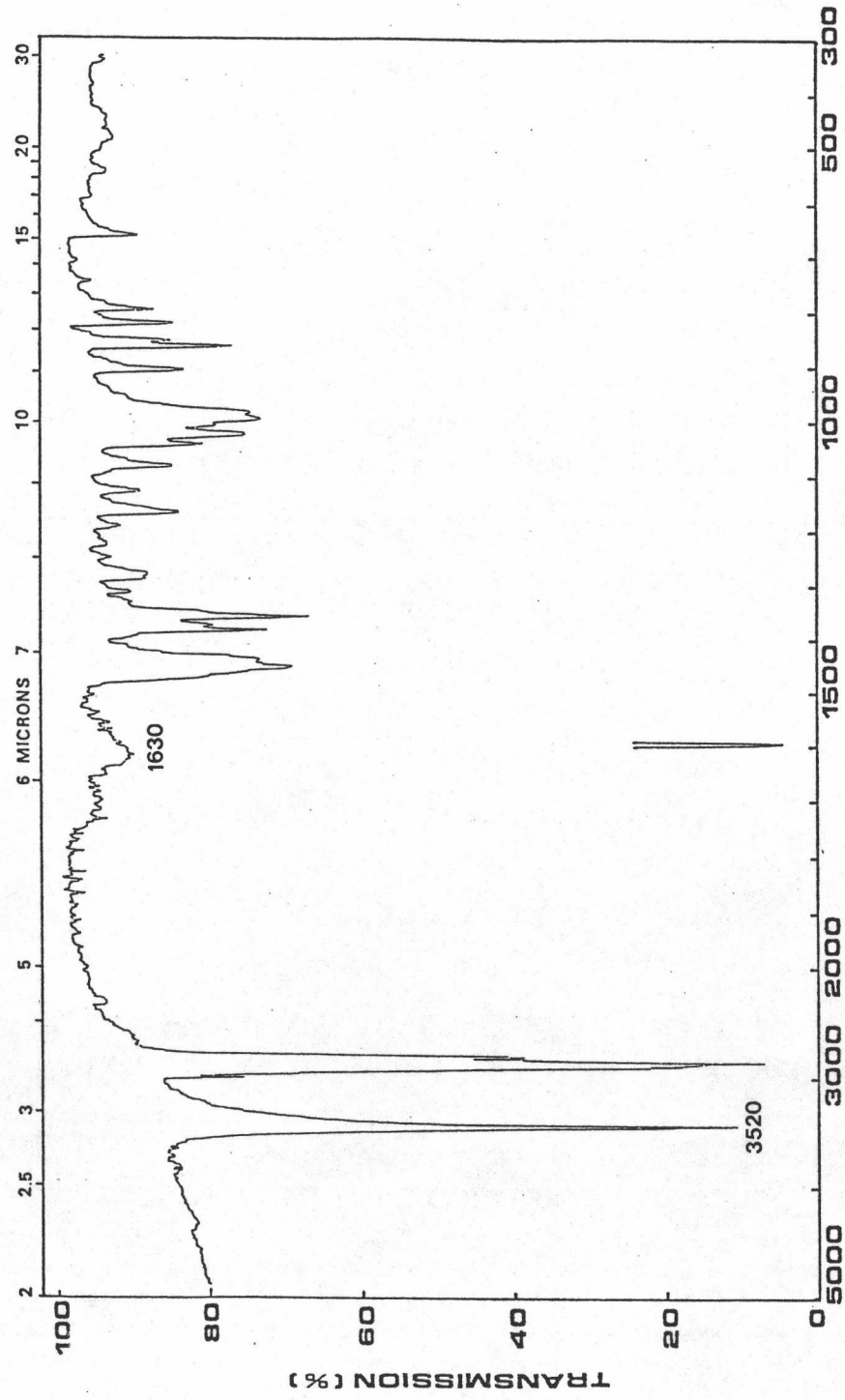


Figure 34 The IR spectrum of Compound 4A

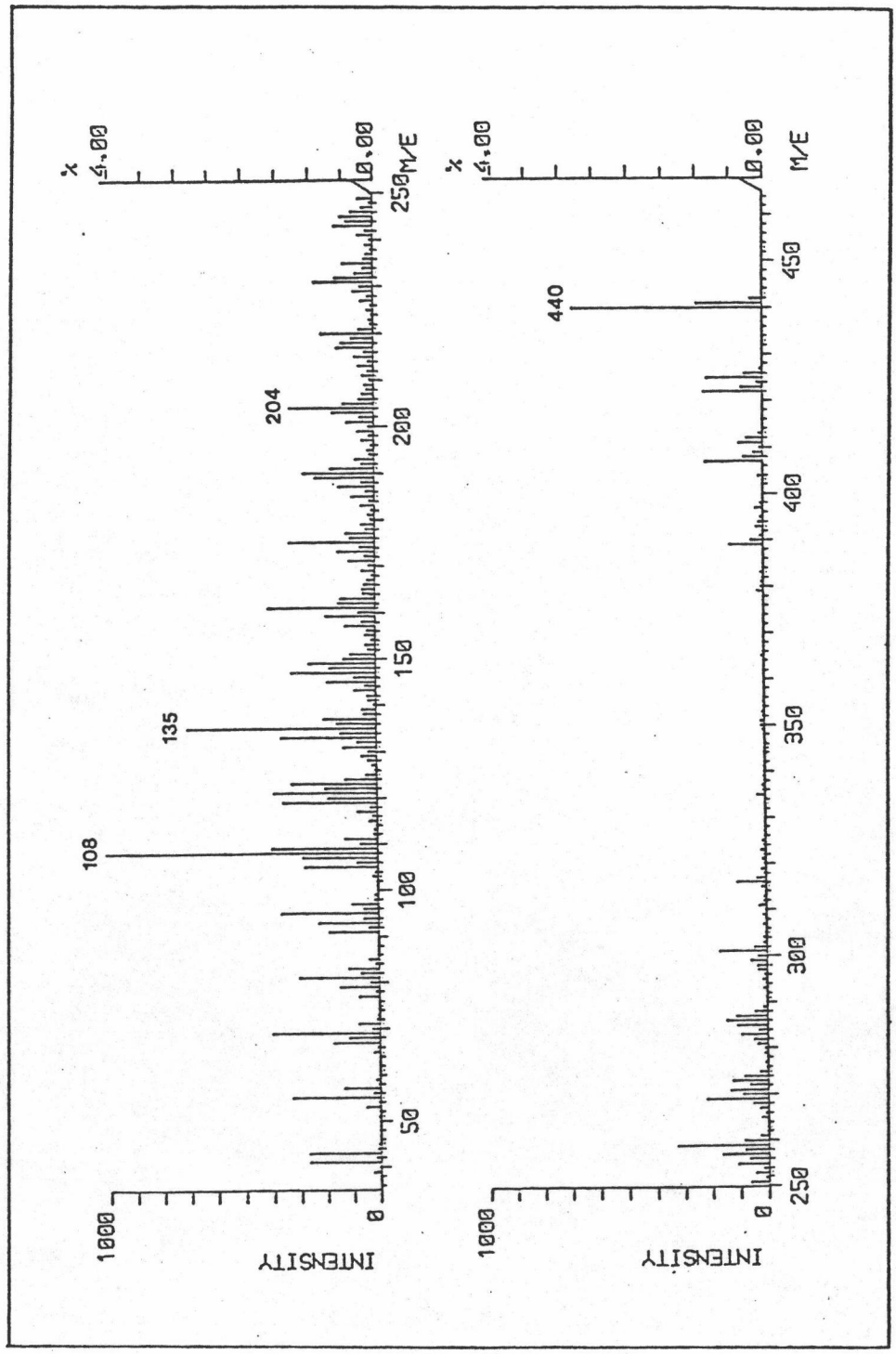


Figure 35 The mass spectrum of Compound 4A

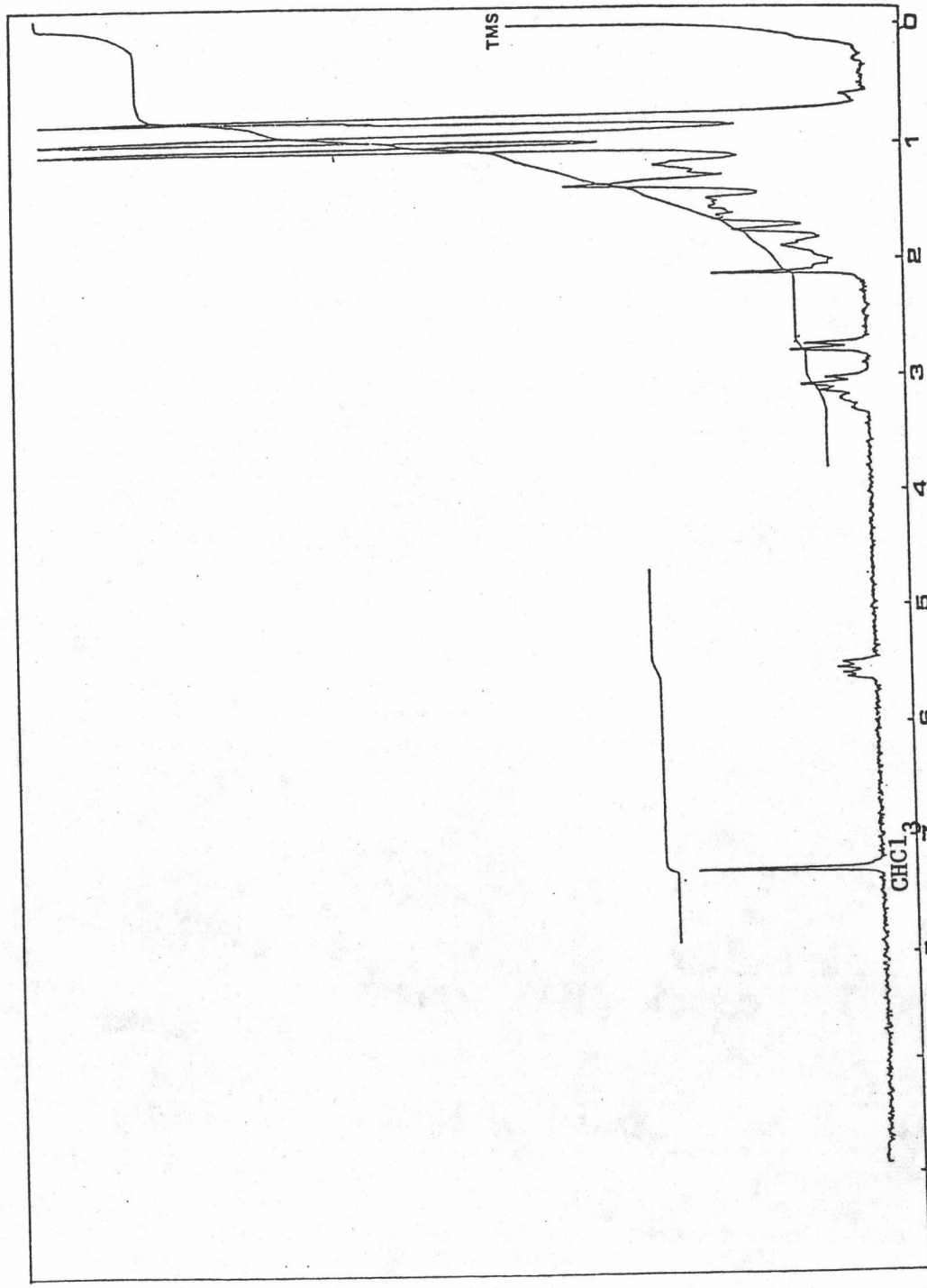


Figure 36 The ^{1}H NMR spectrum of Compound 4A

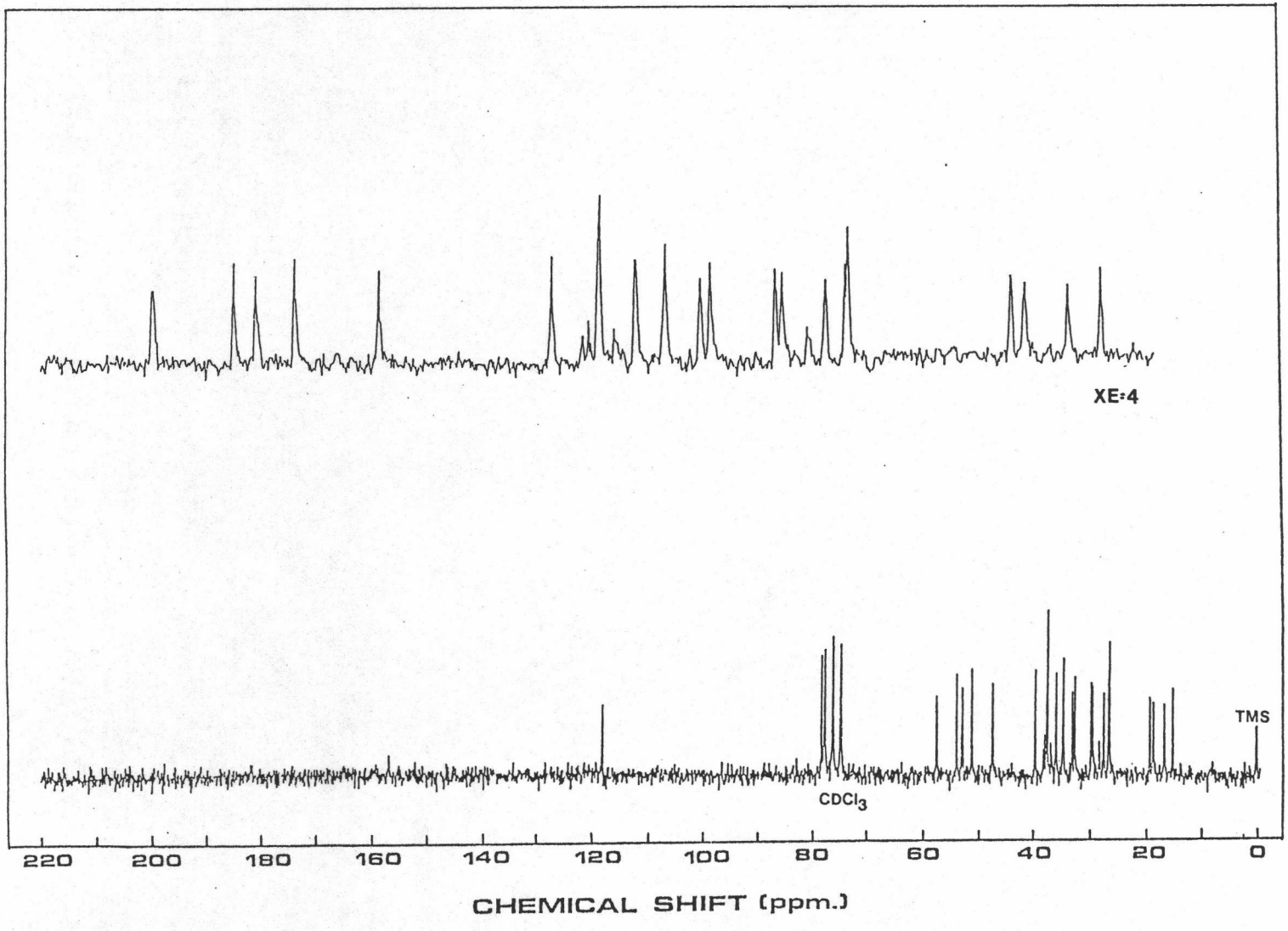


Figure 37 The ^{13}C NMR spectrum of Compound 4A

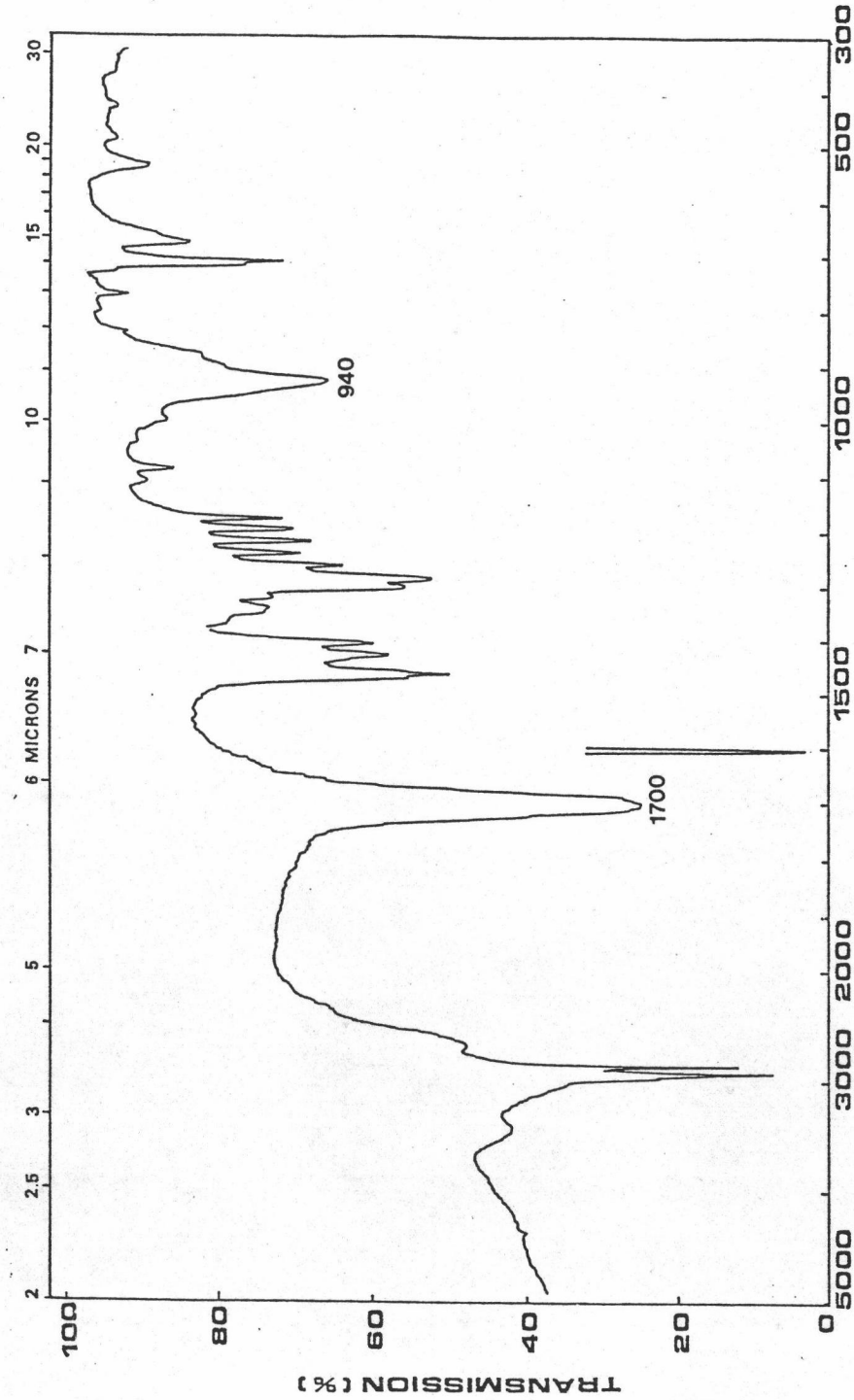


Figure 38 The IR spectrum of Compound 4B

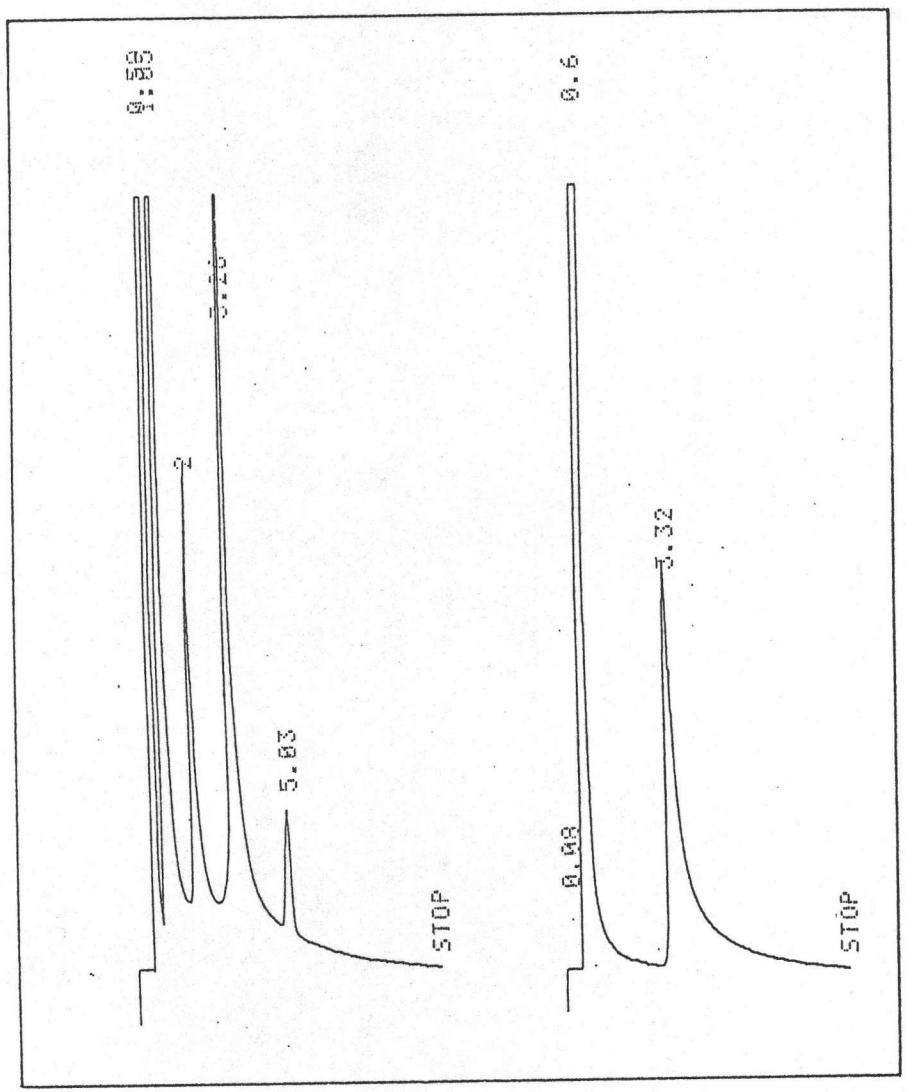


Figure 39 The GLC analysis results of

A) standard long chain carboxylic acid C 12, C 14, C 16 and C 20

B) Compound 4B

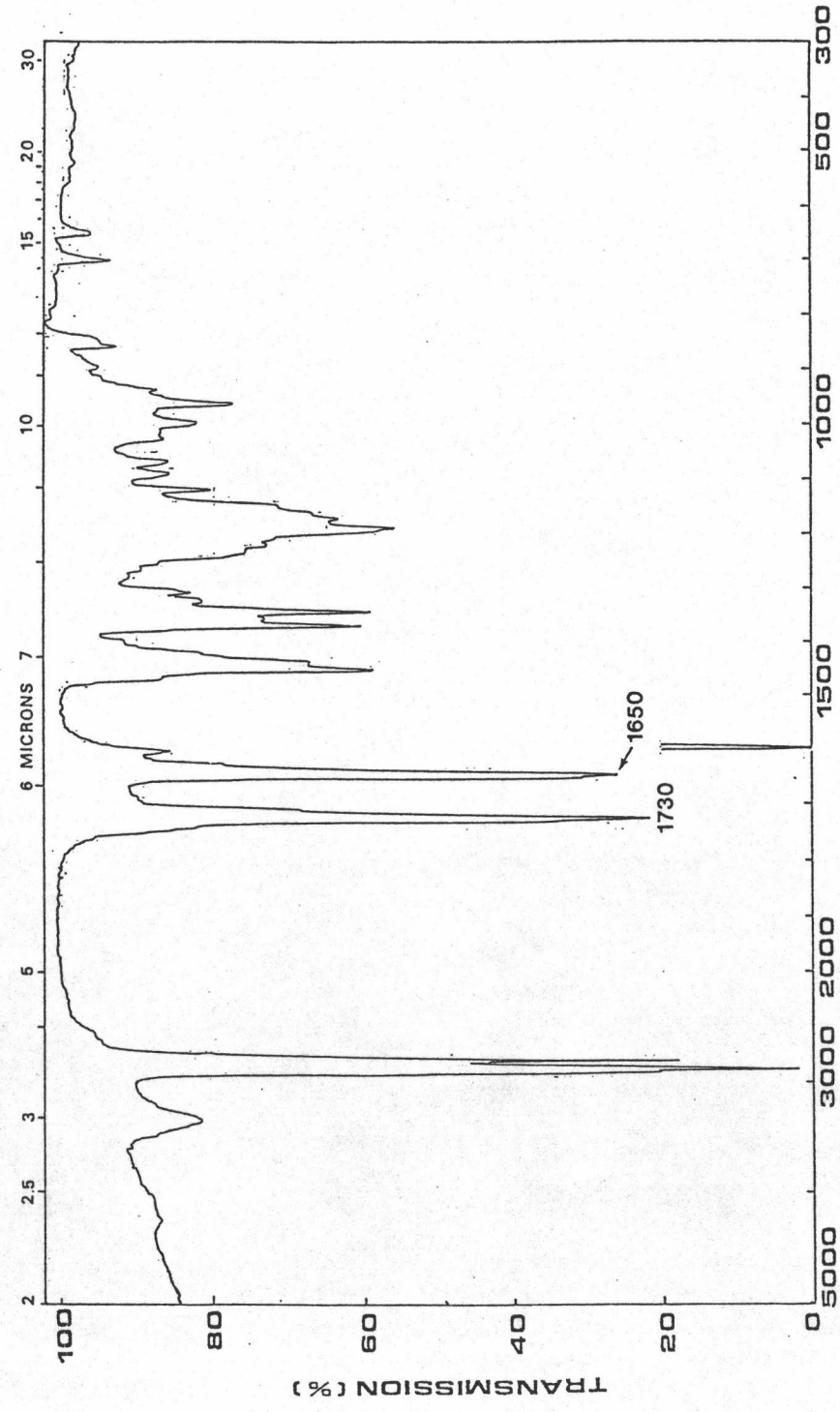


Figure 40 The IR spectrum of Compound 5

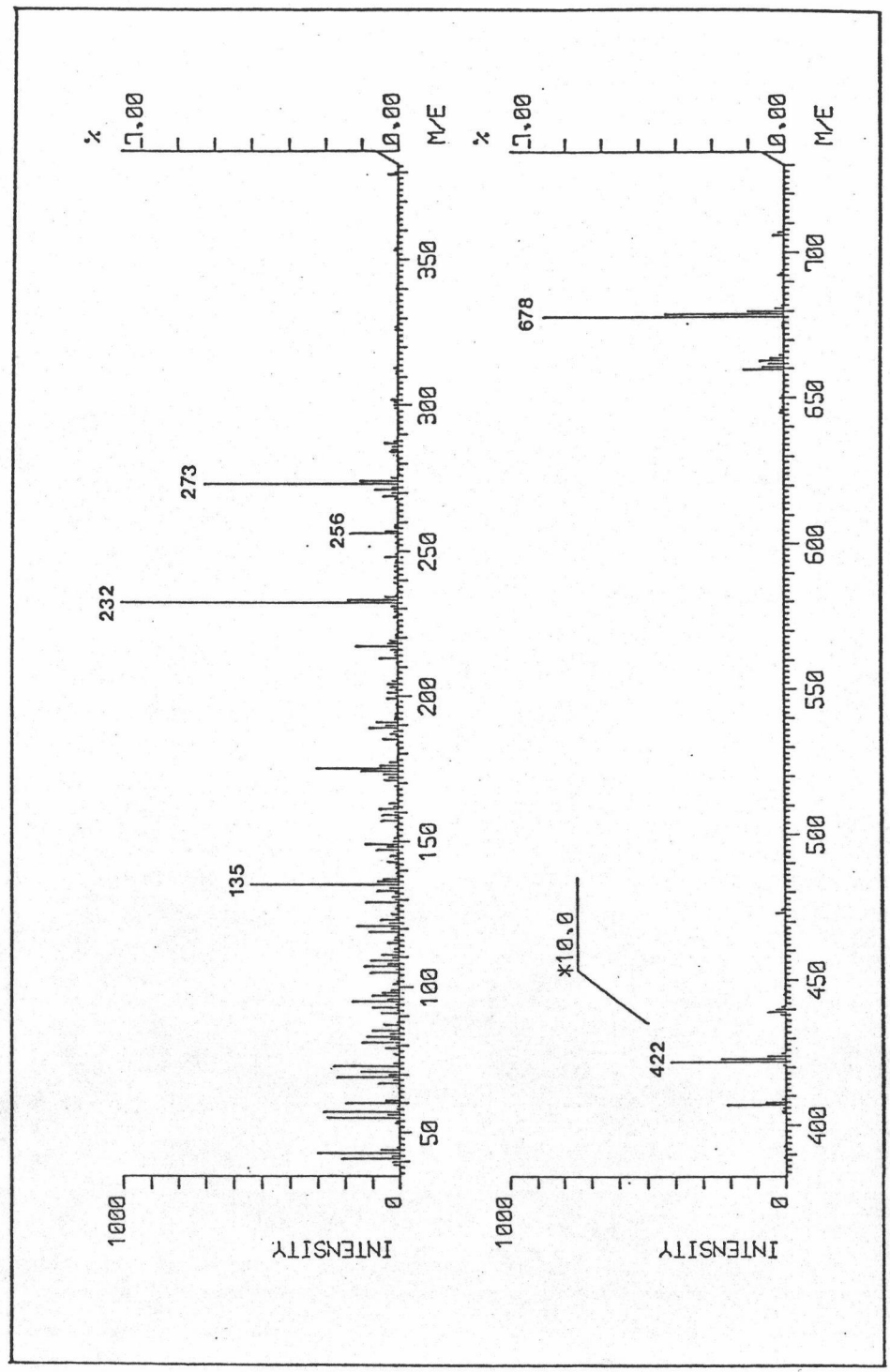


Figure 41 The mass spectrum of Compound 5

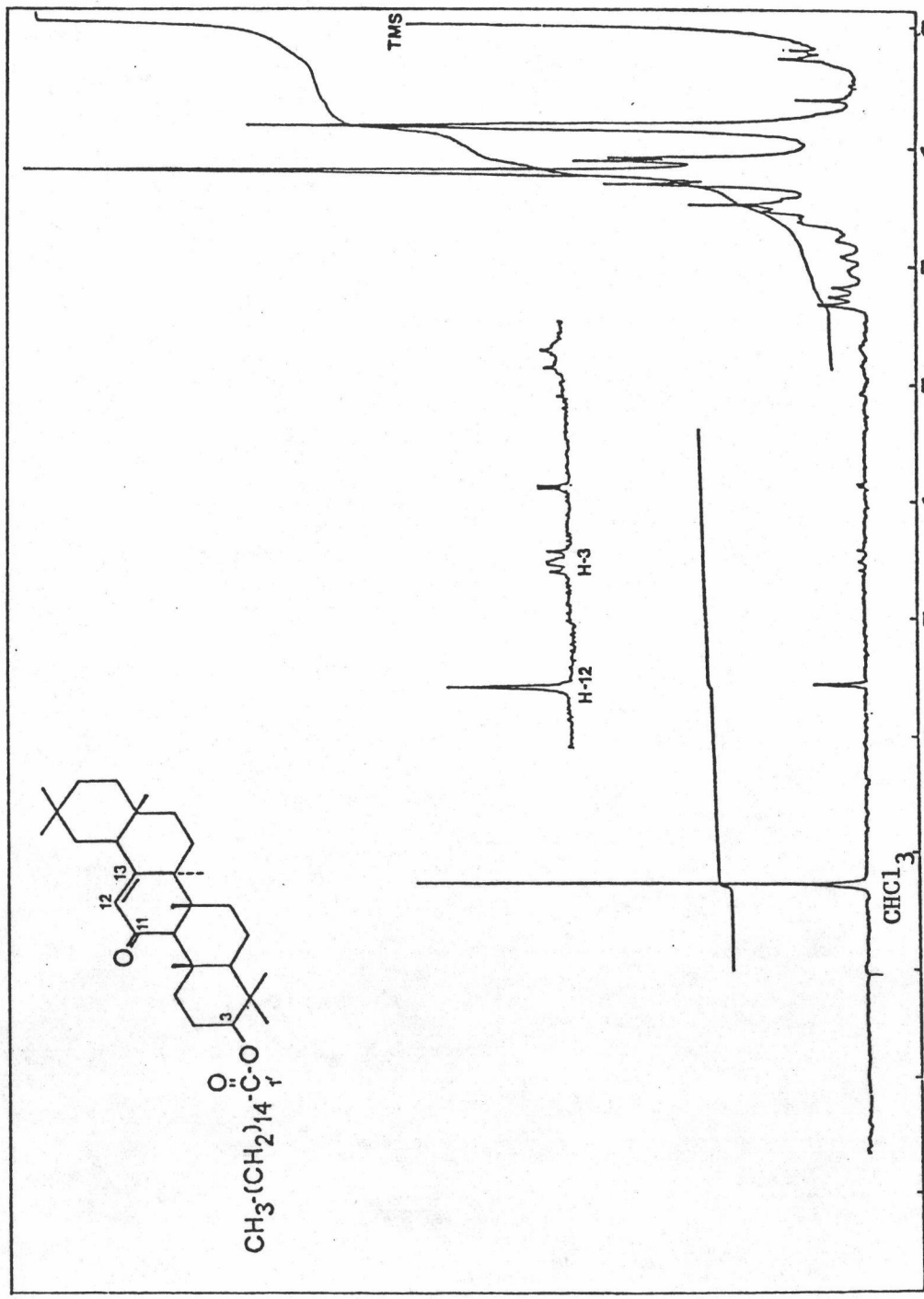


Figure 42 The ^{1}H NMR spectrum of Compound 5

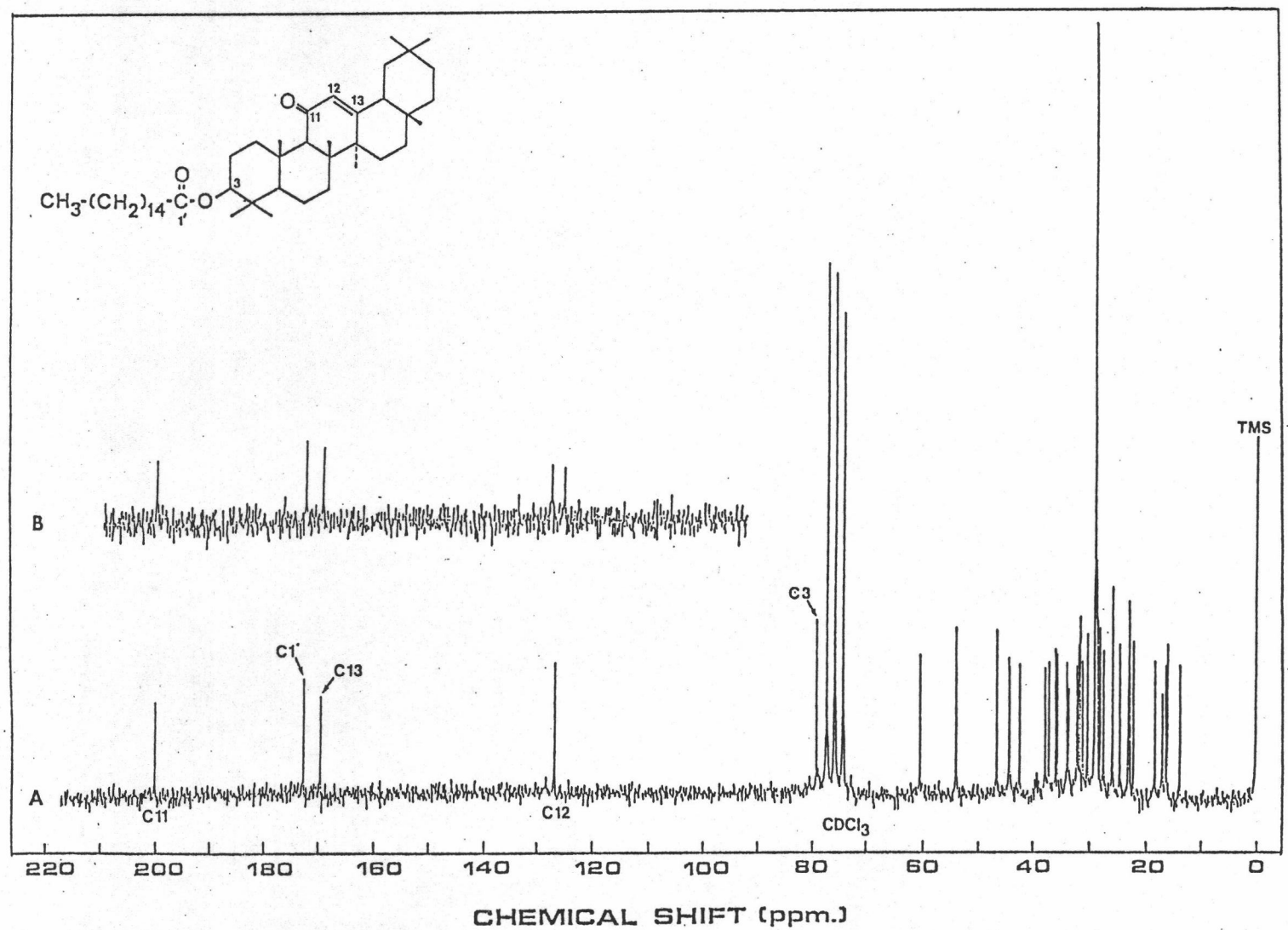


Figure 43 A) the ^{13}C NMR spectrum of Compound 5

B) The ^{13}C NMR spectrum off resonance spectrum of Compound 5

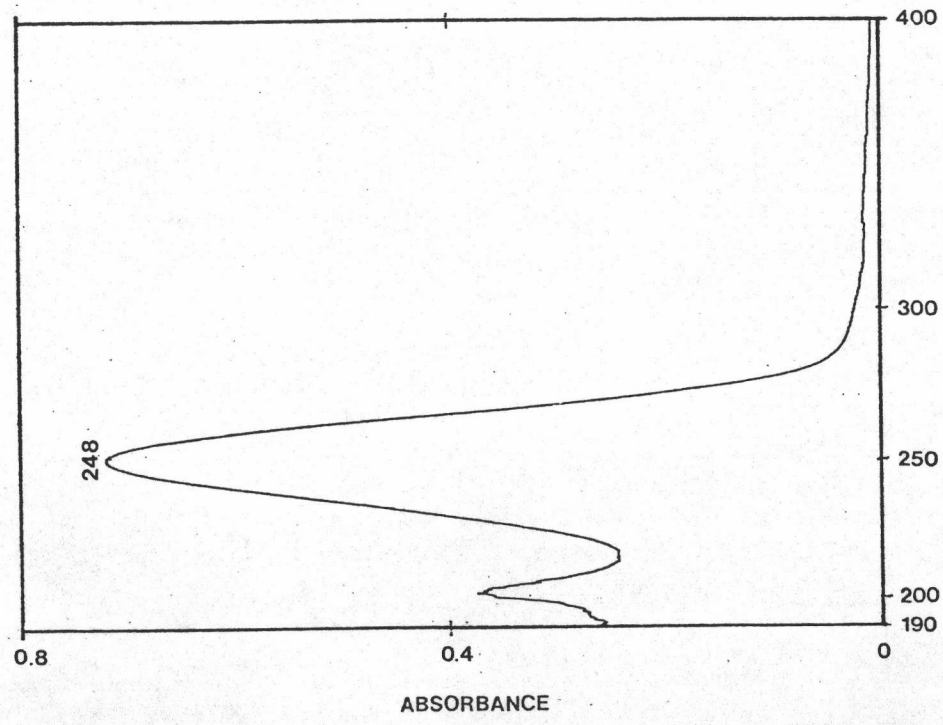


Figure 44 The UV spectrum of Compound 5

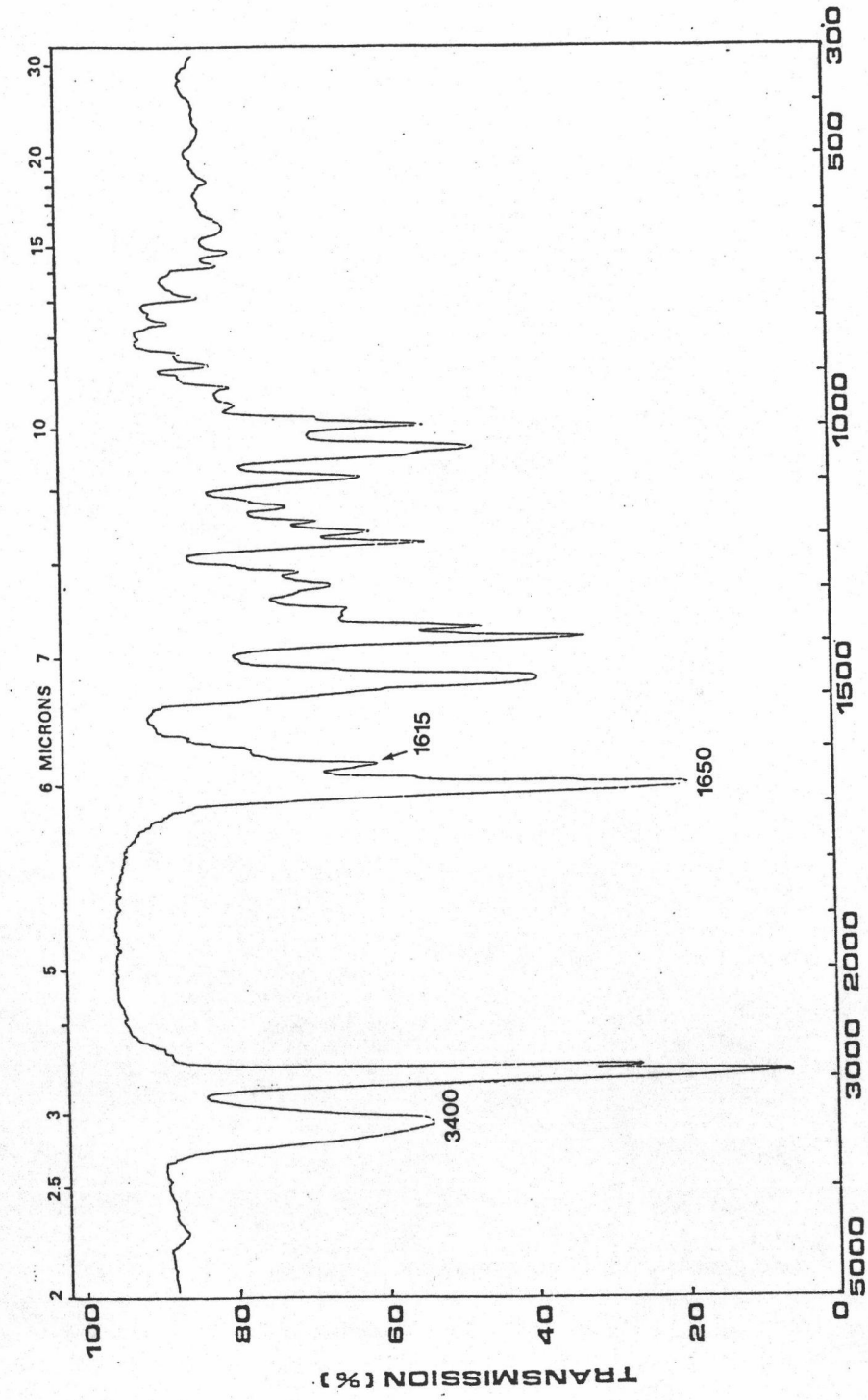


Figure 45 The IR spectrum of Compound 5A

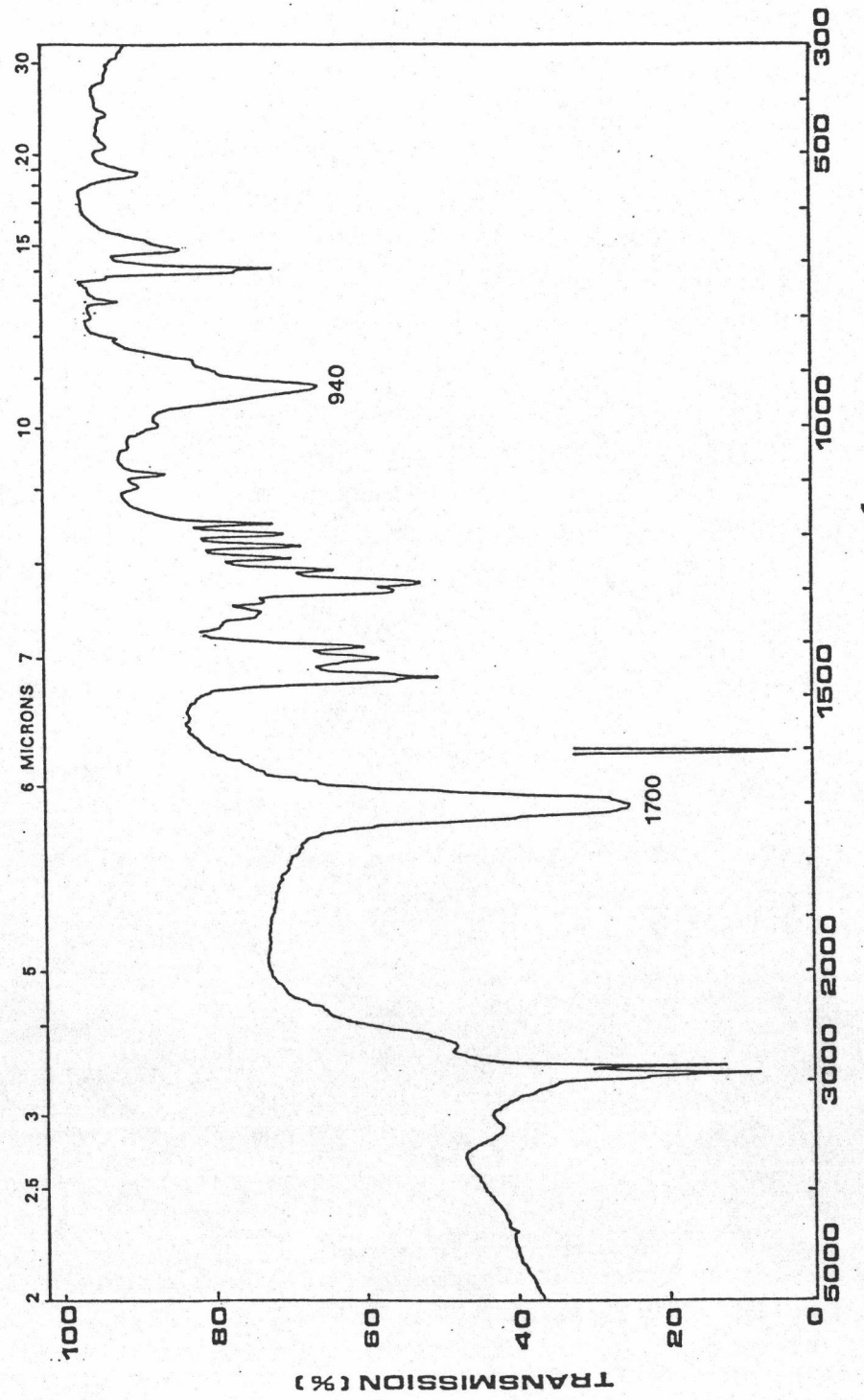


Figure 46 The IR spectrum of Compound 5B

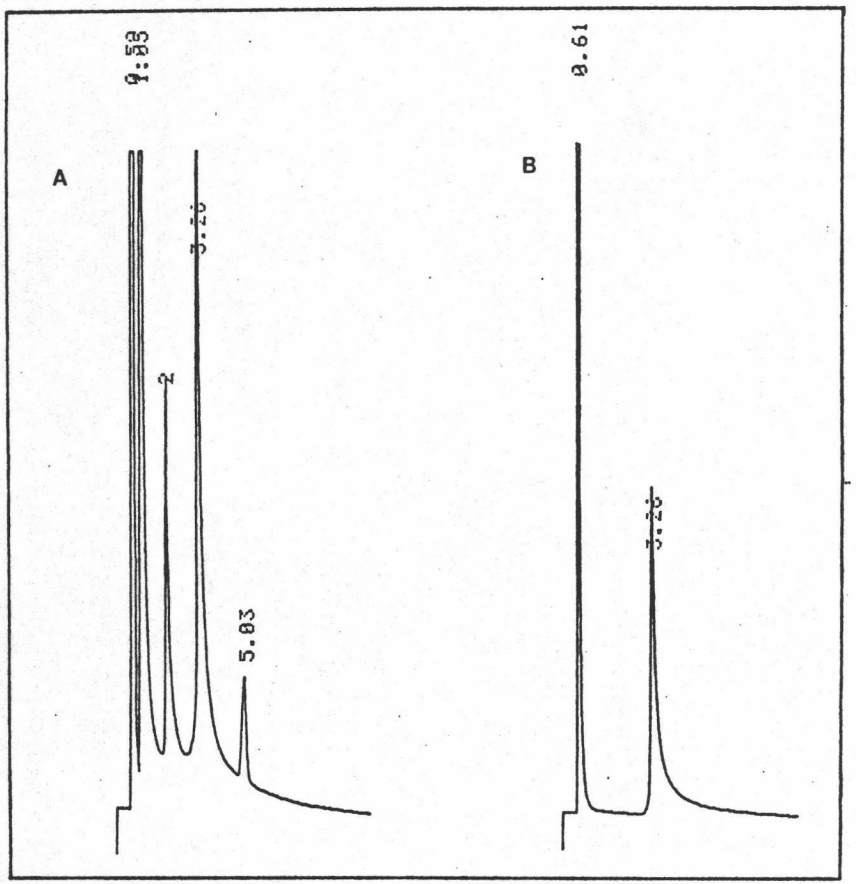


Figure 47 The GLC analysis results of

A) standard acid C_{12}, C_{14}, C_{16} and C_{18}

B) Compound 5B

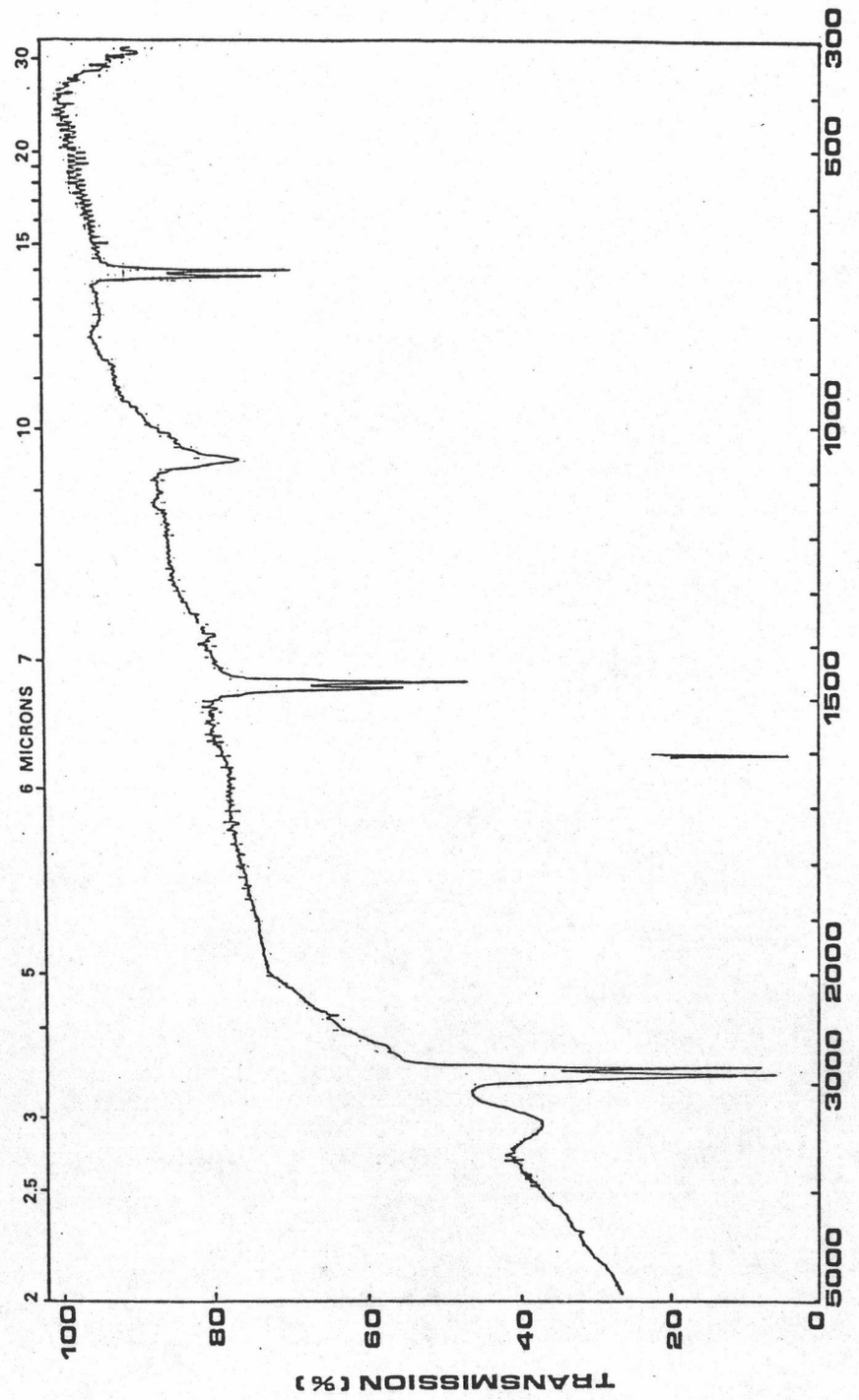


Figure 48 The IR spectrum of Compound 6

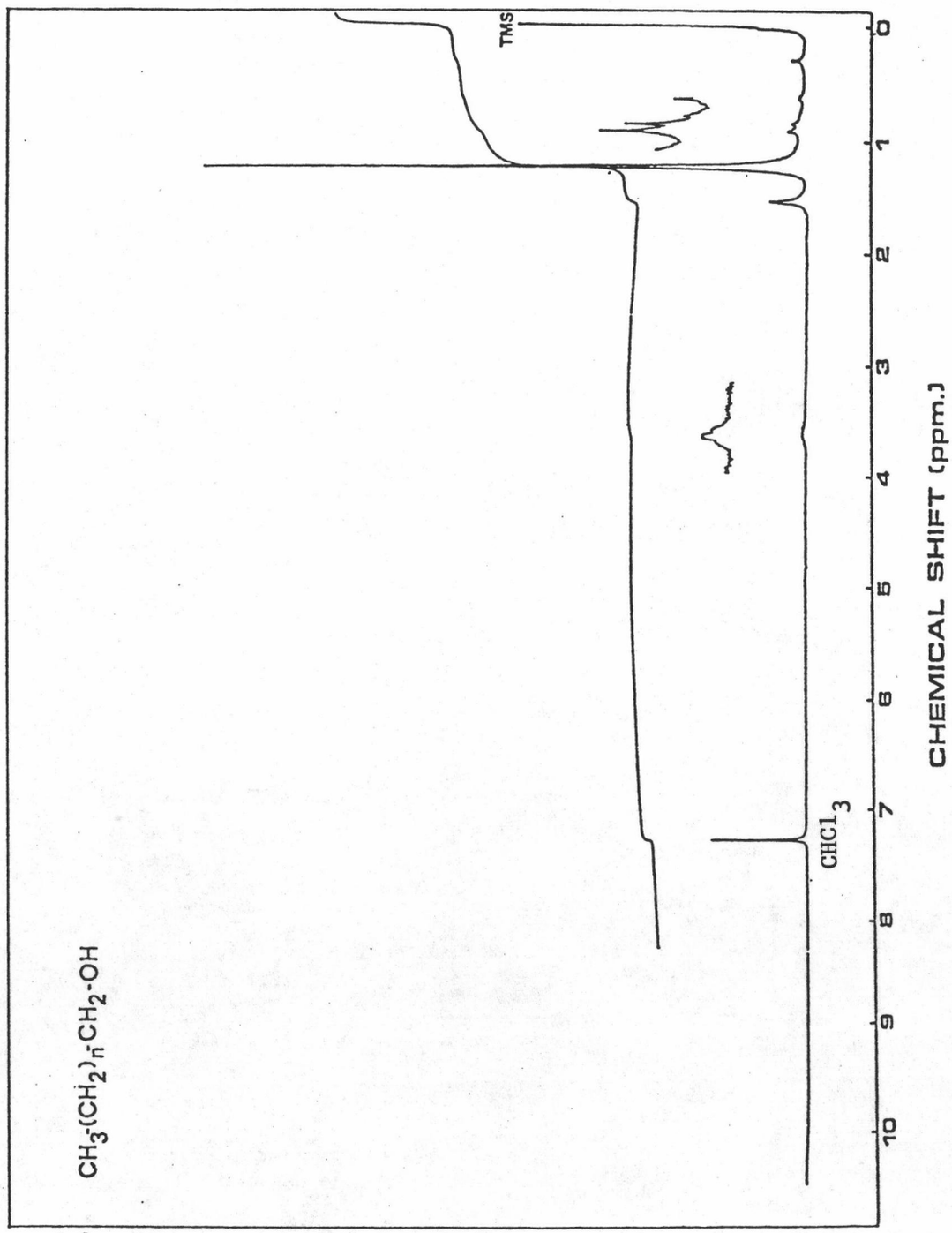


Figure 49 The ^1H NMR spectrum of Compound 6

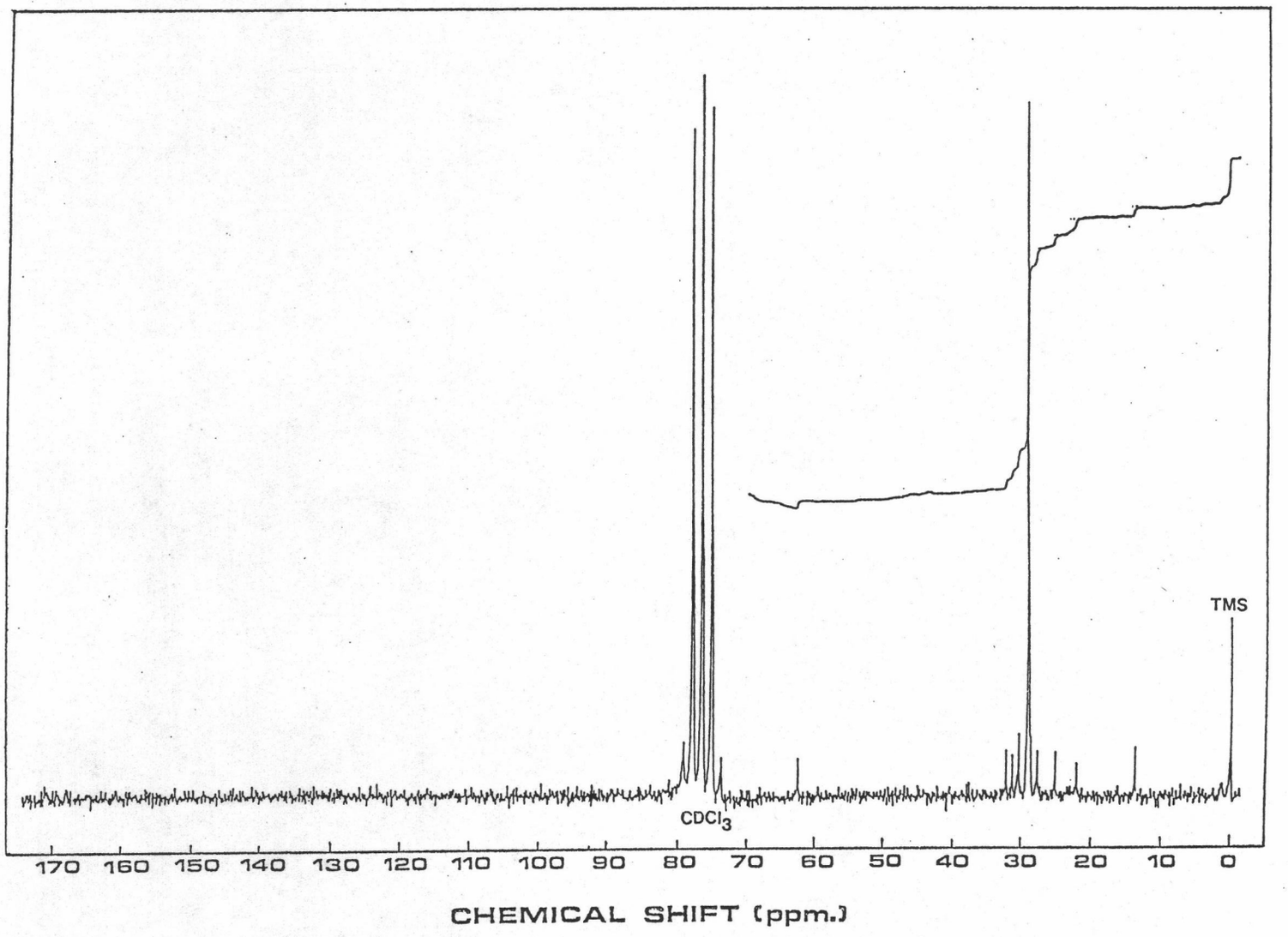


Figure 50 The ^{13}C NMR spectrum of Compound 6

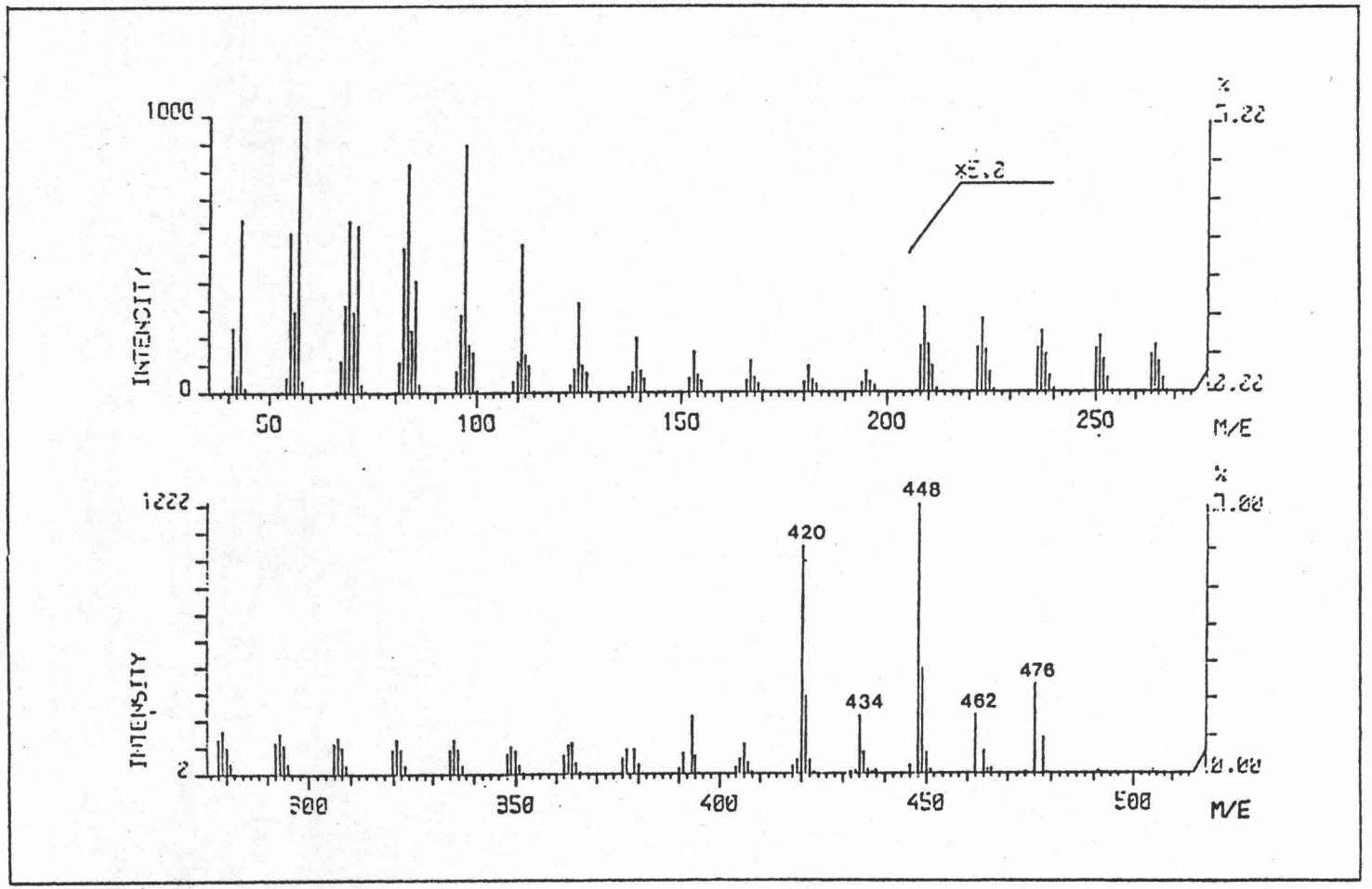


Figure 51 The mass spectrum of Compound 6

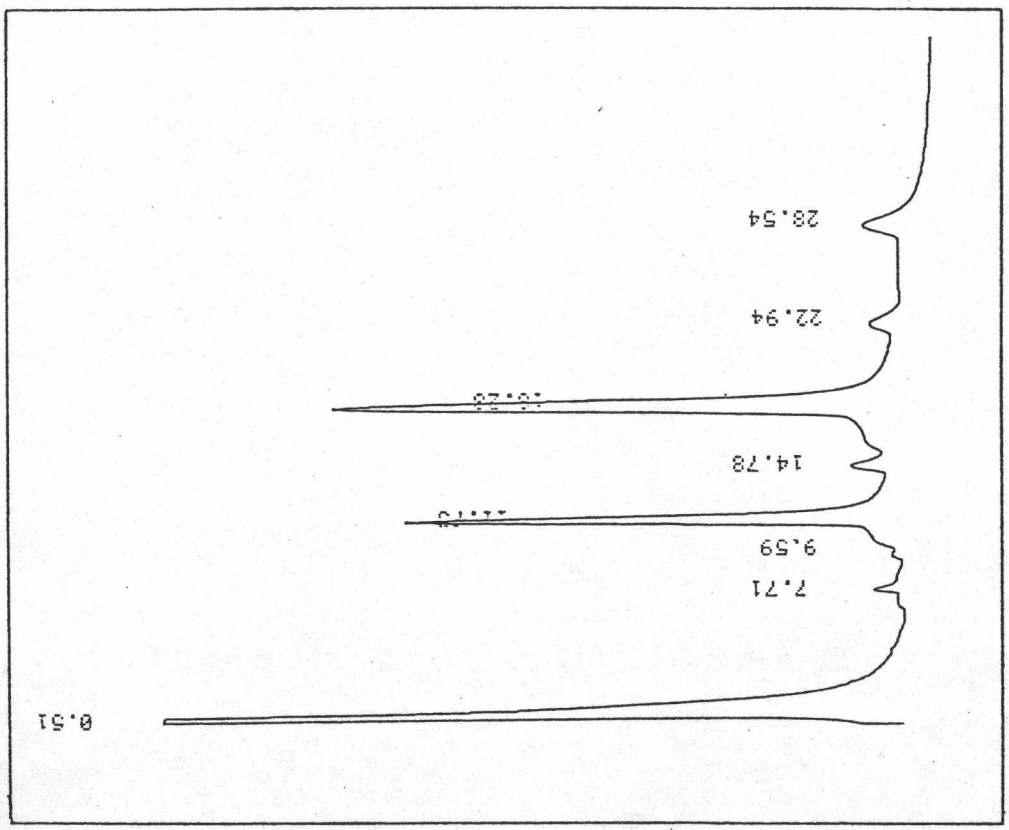


Figure 52 The GLC analysis of Compound 6

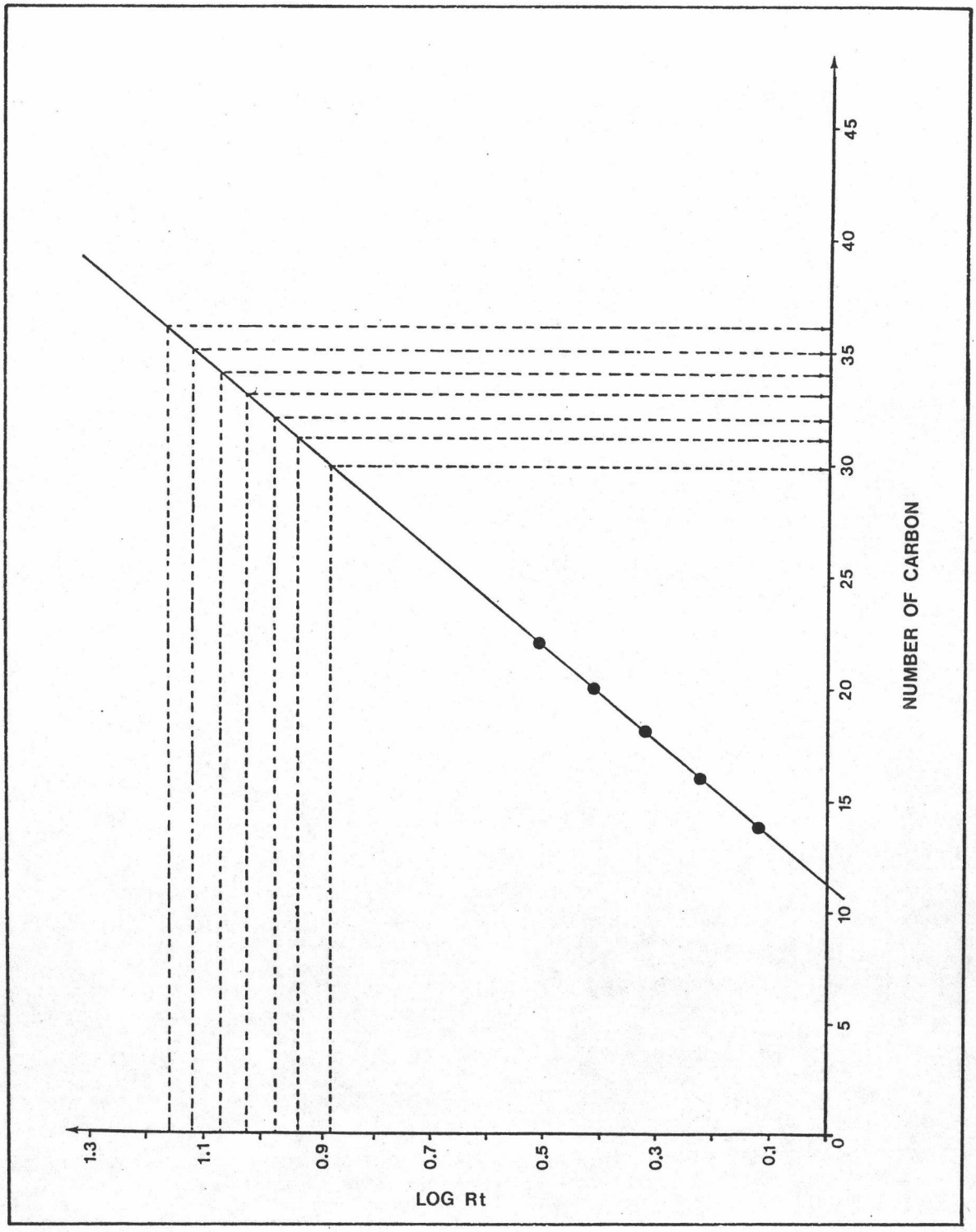


Figure 53 The standard correlation curve of Compound 6

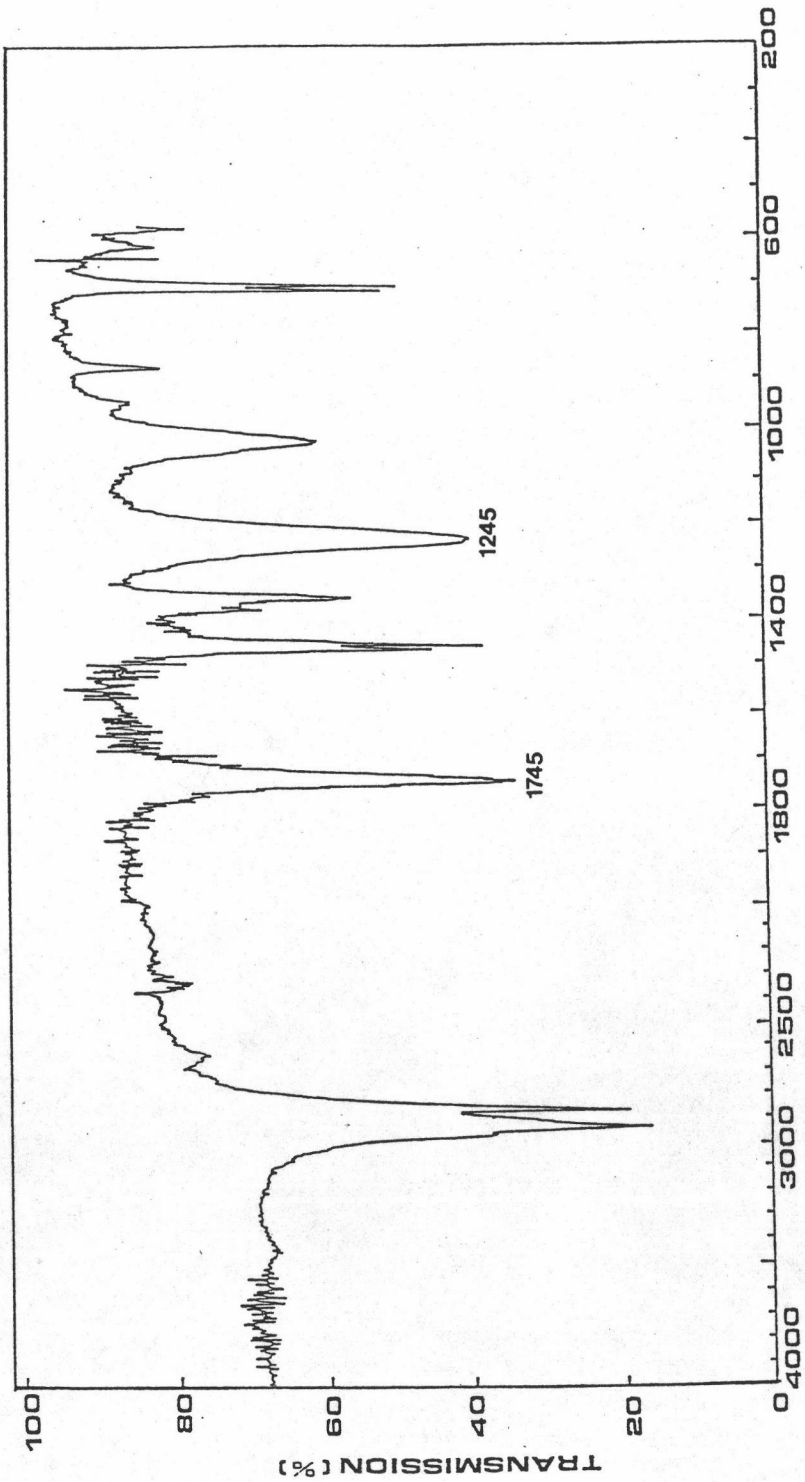


Figure 54 The IR spectrum of Compound 6 acetate

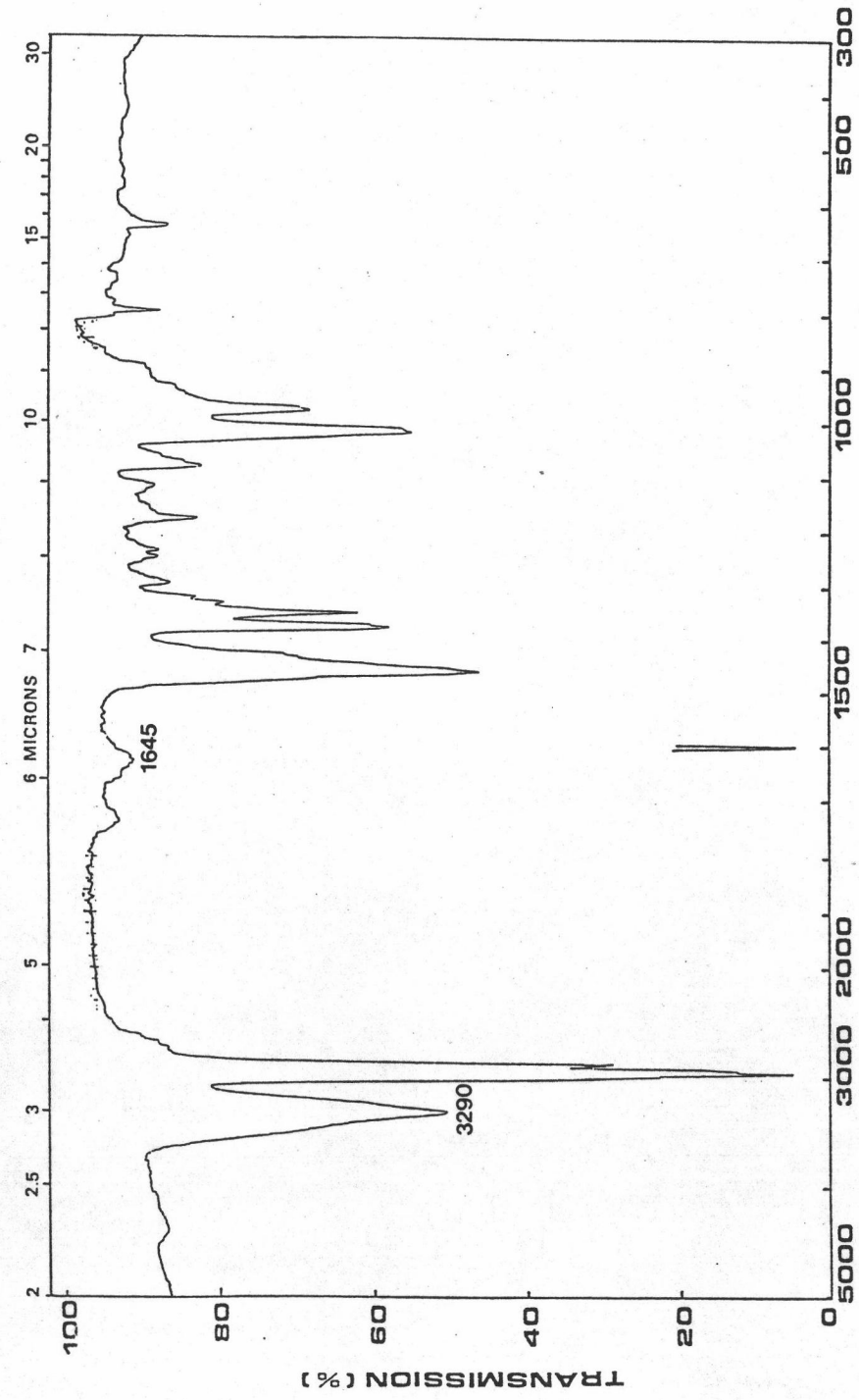


Figure 55 The IR spectrum of Compound 7

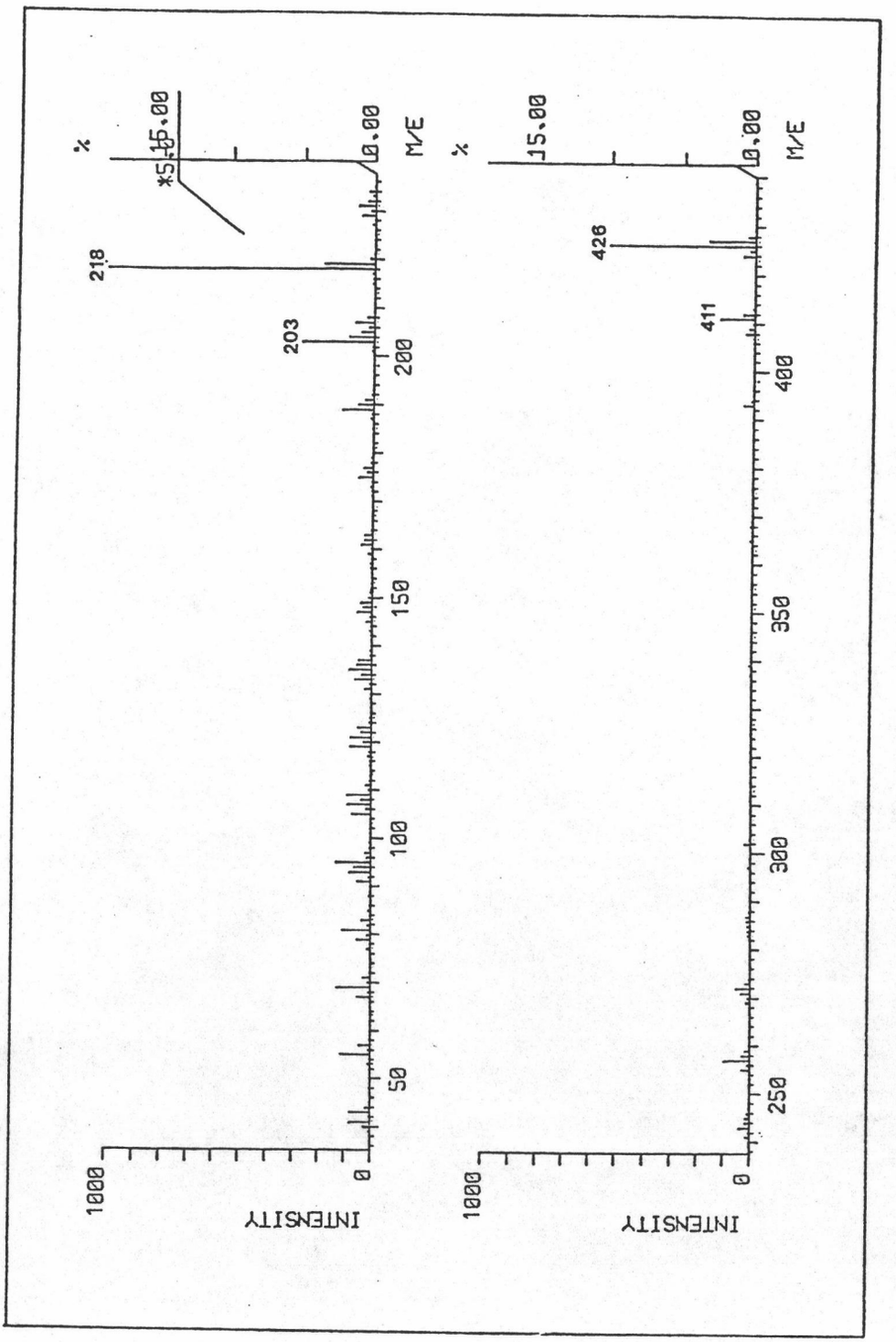


Figure 56 The mass spectrum of Compound 7

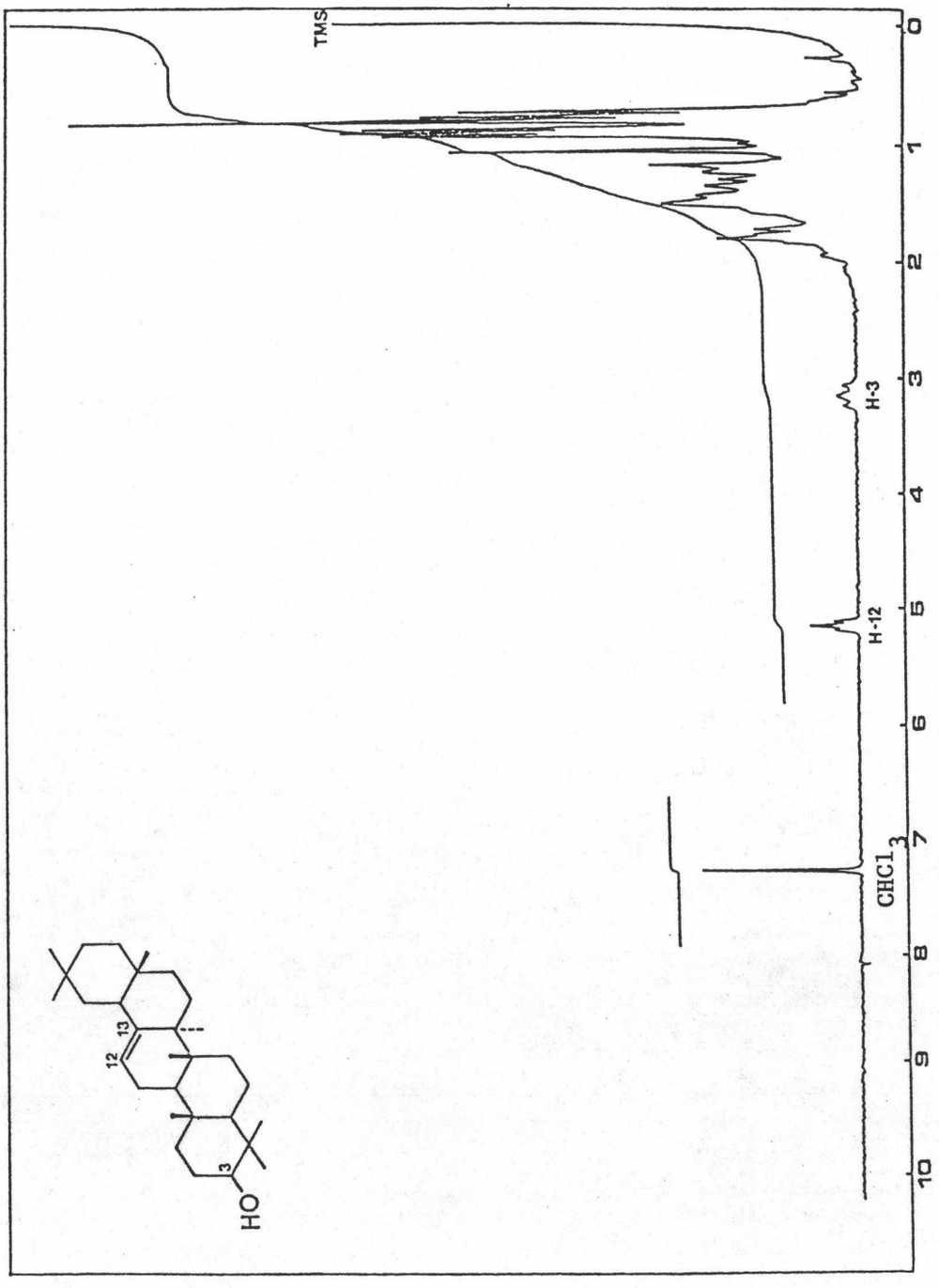


Figure.57 The ^{1}H NMR spectrum of Compound 7

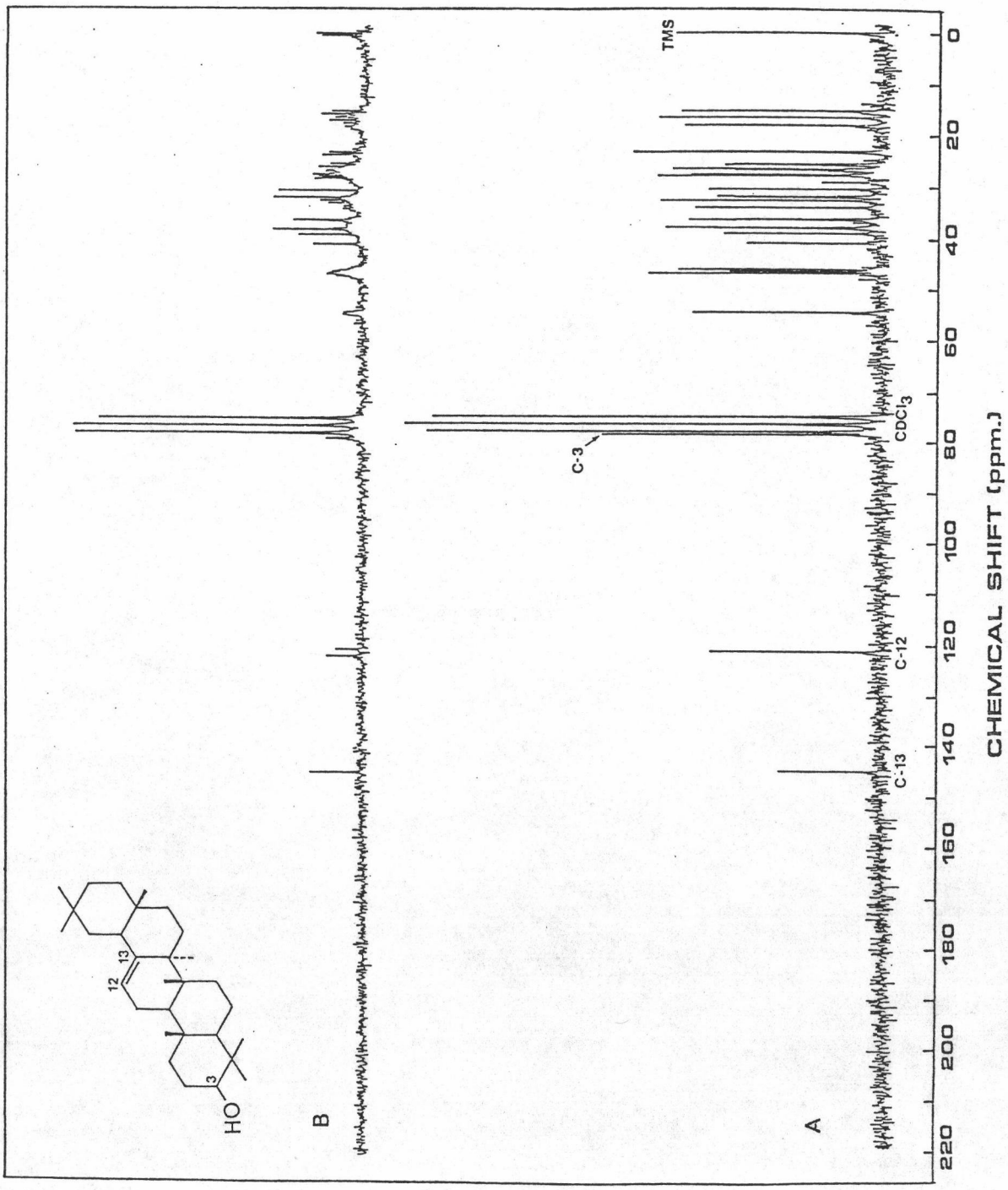


Figure 58 The ^{13}C NMR spectrum of Compound 7

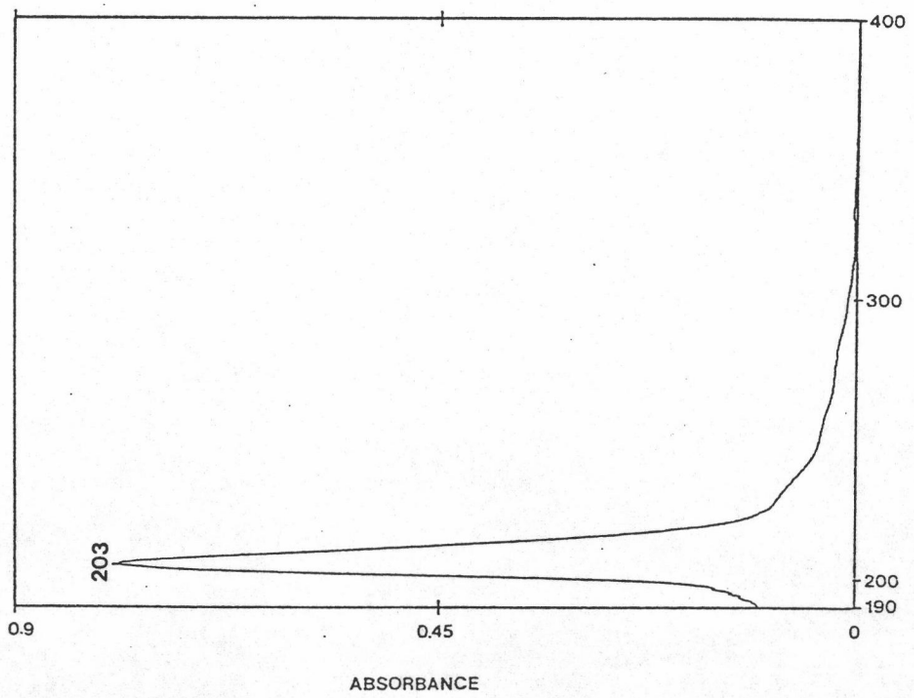


Figure 59 The UV spectrum of Compound 7

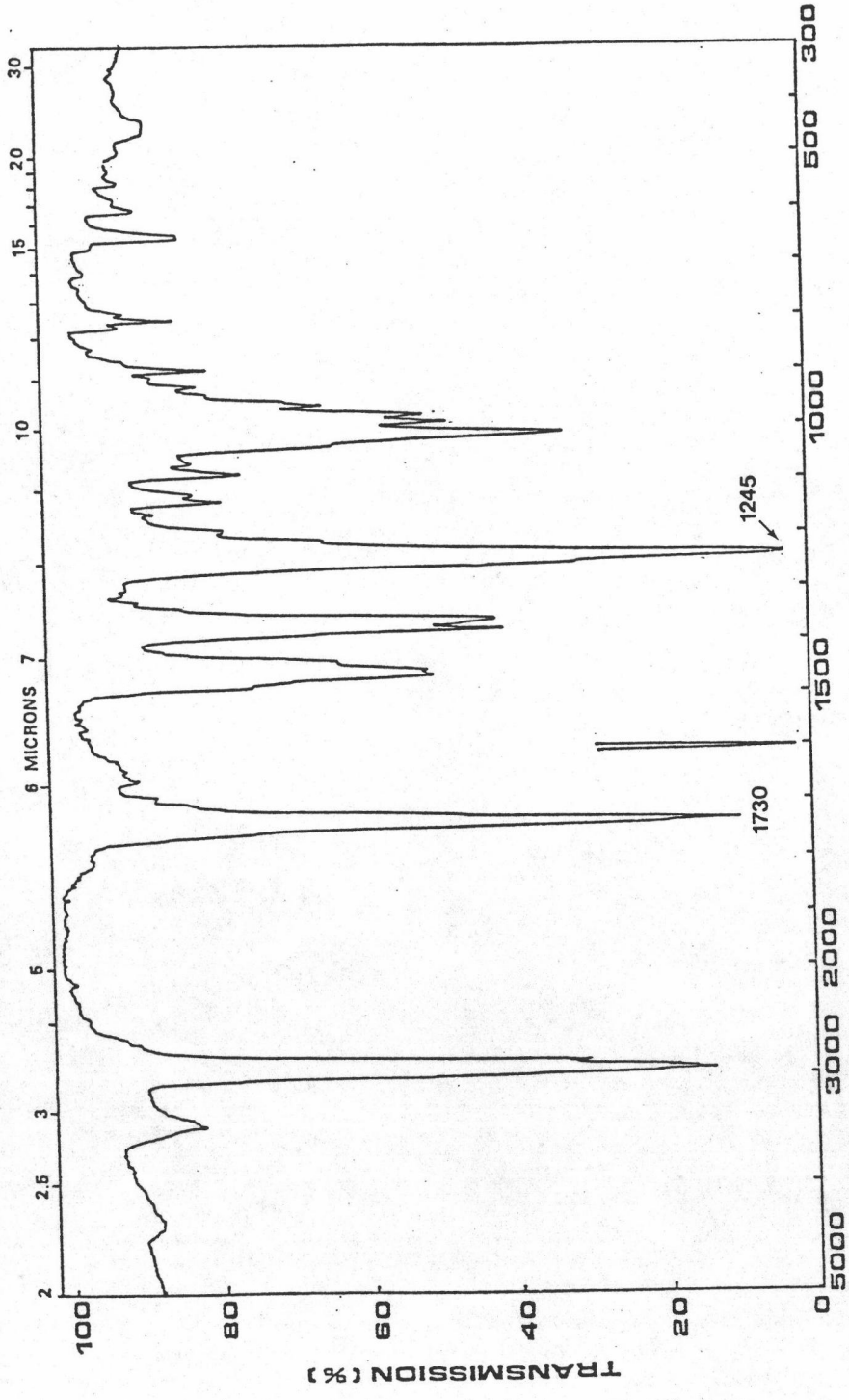


Figure 60 The IR spectrum of Compound 7 acetate

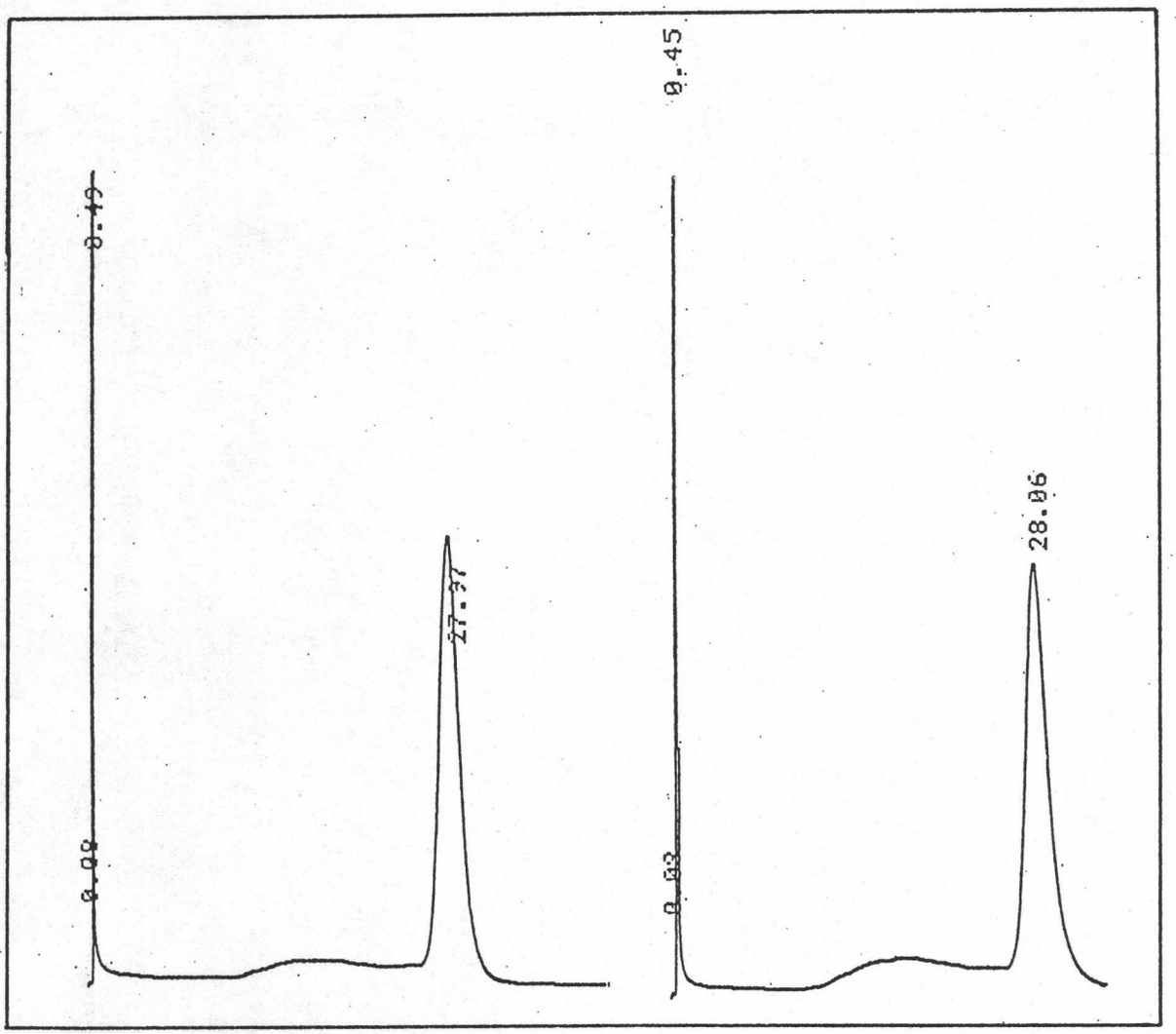


Figure 61 The GLC analysis results of

A) the authentic β-amyrinacetate

B) Compound 7 acetate

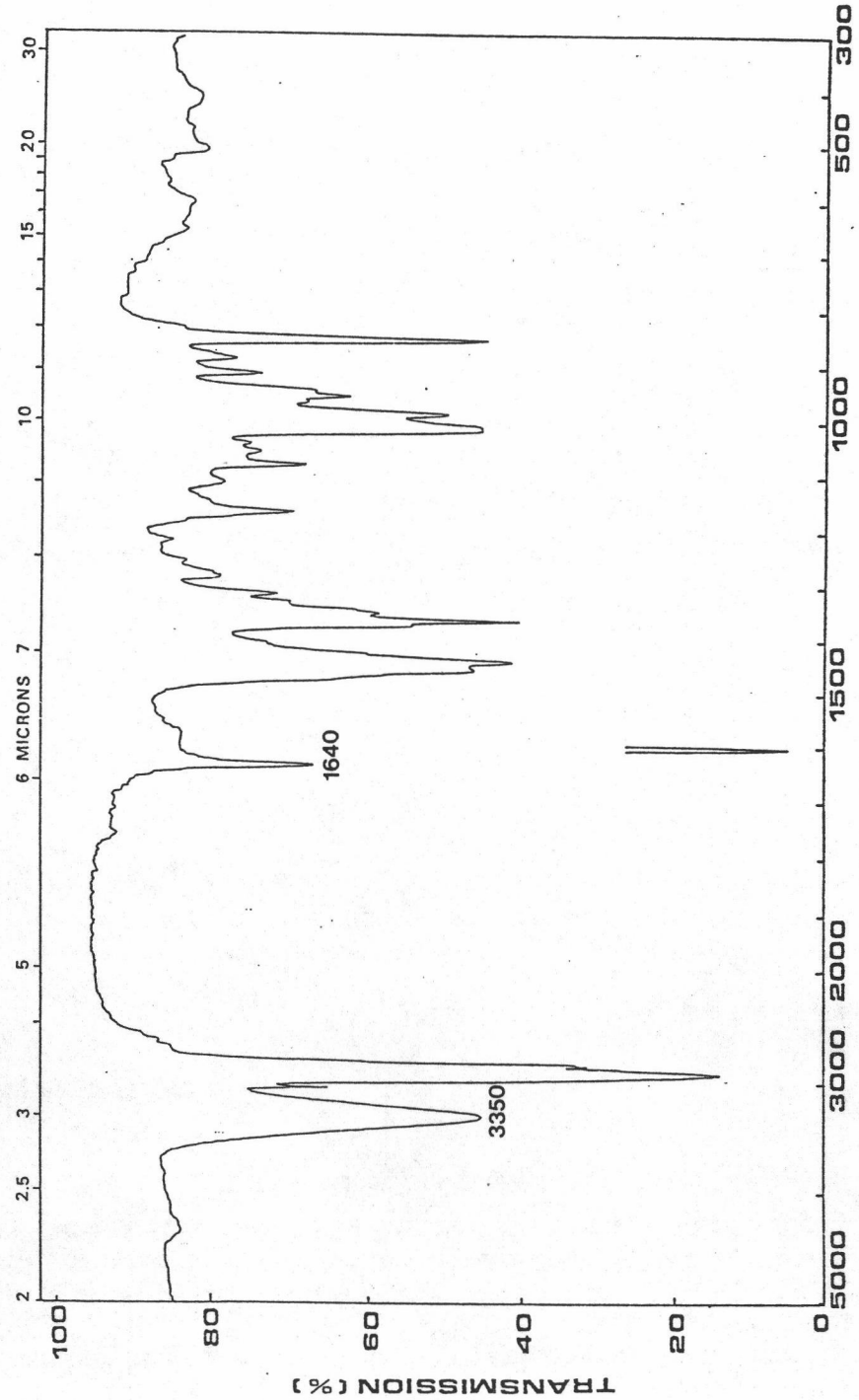


Figure 62 The IR spectrum of Compound 8

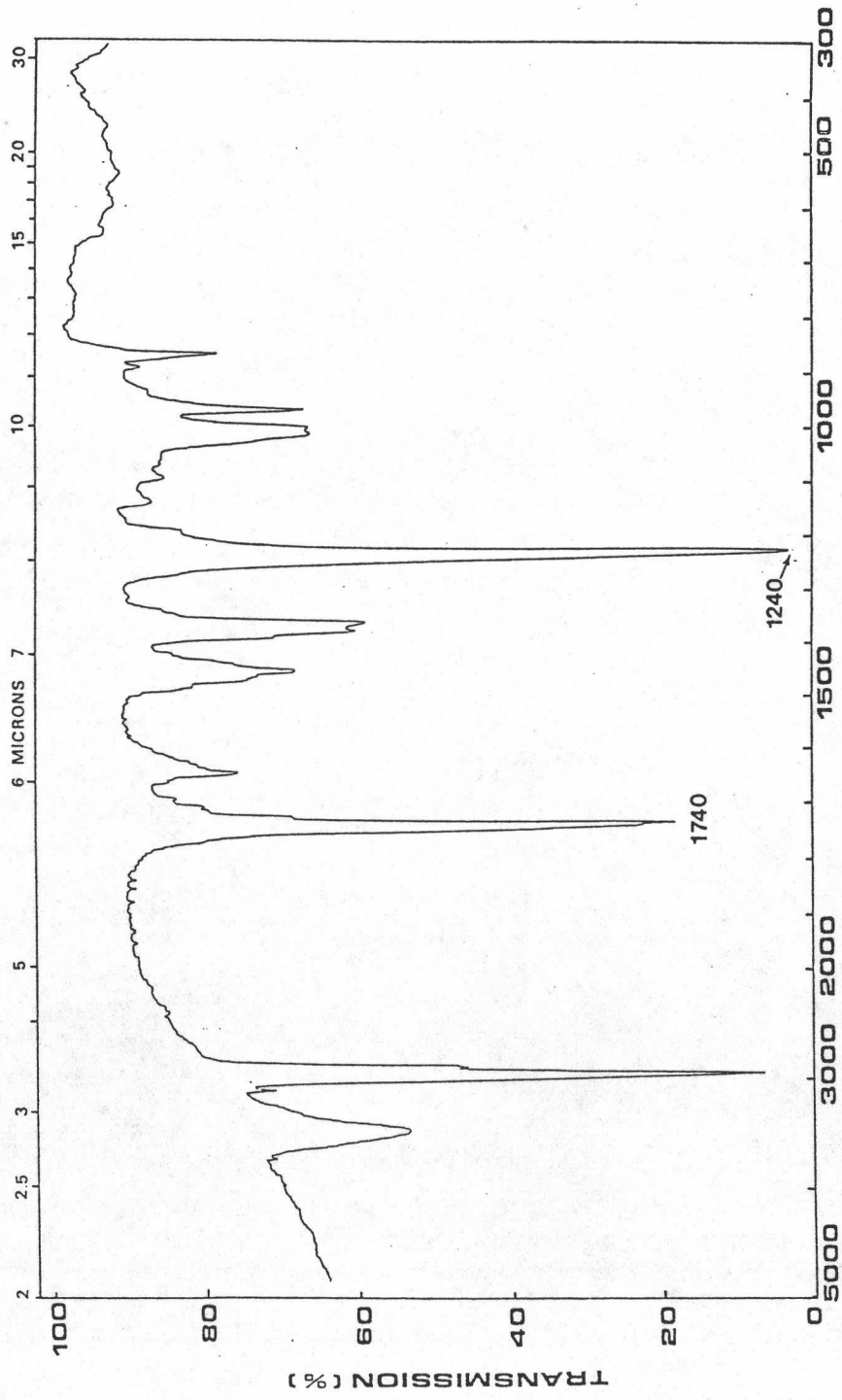


Figure 63 The IR spectrum of Compound 8 acetate

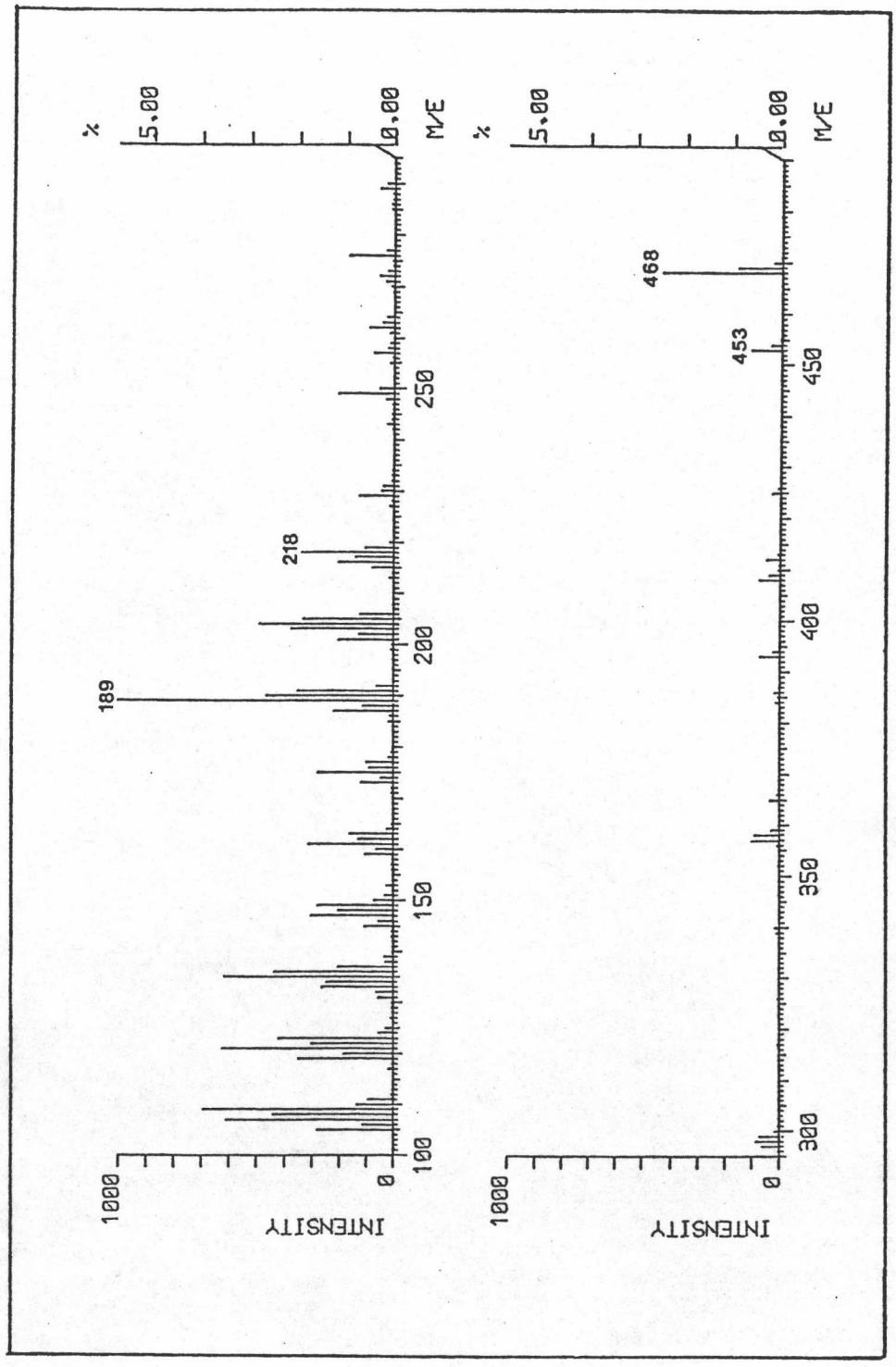


Figure 64 The mass spectrum of Compound 8 acetate

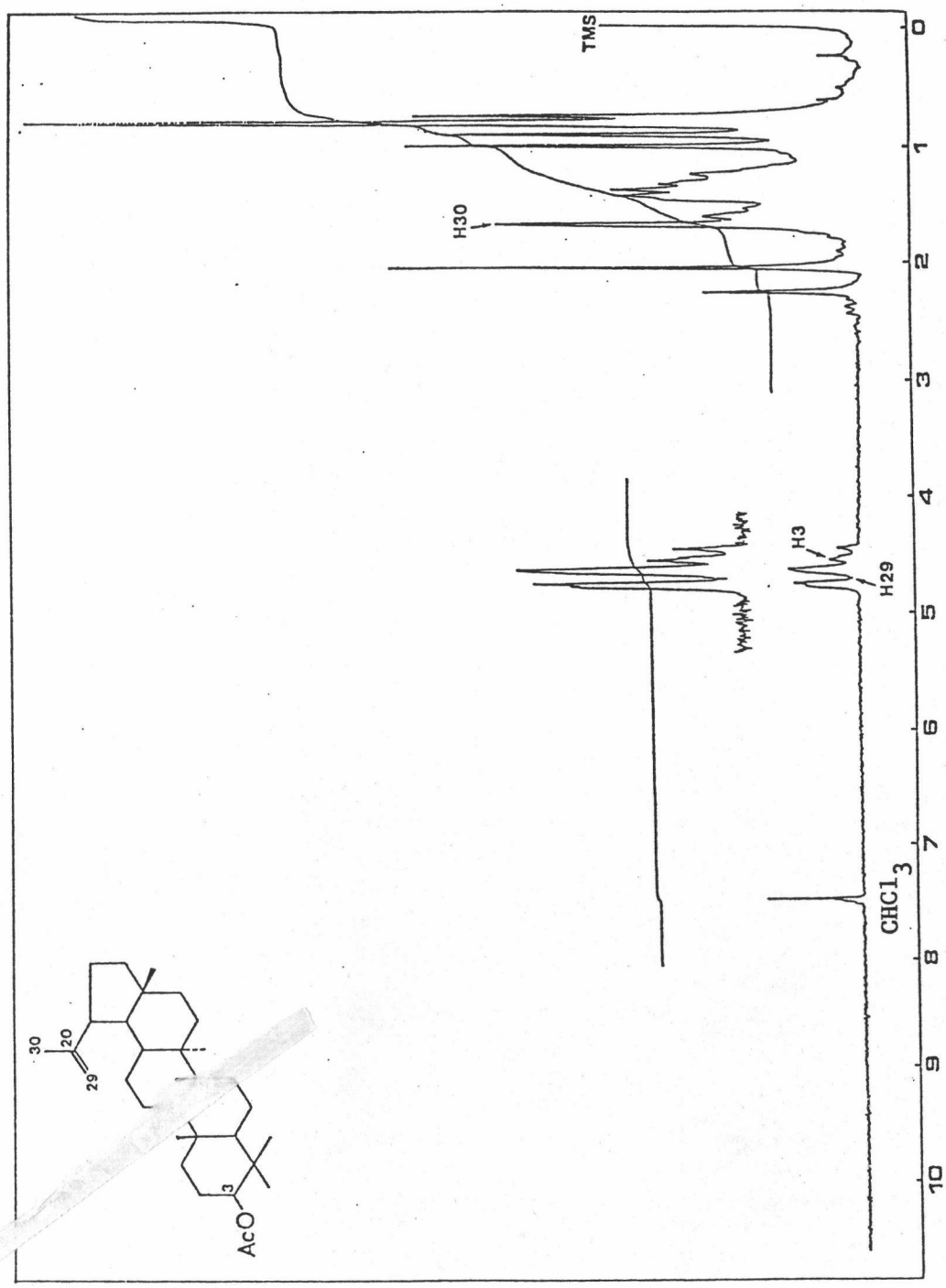


Figure 65 The ^{1}C NMR spectrum of Compound 8 acetate

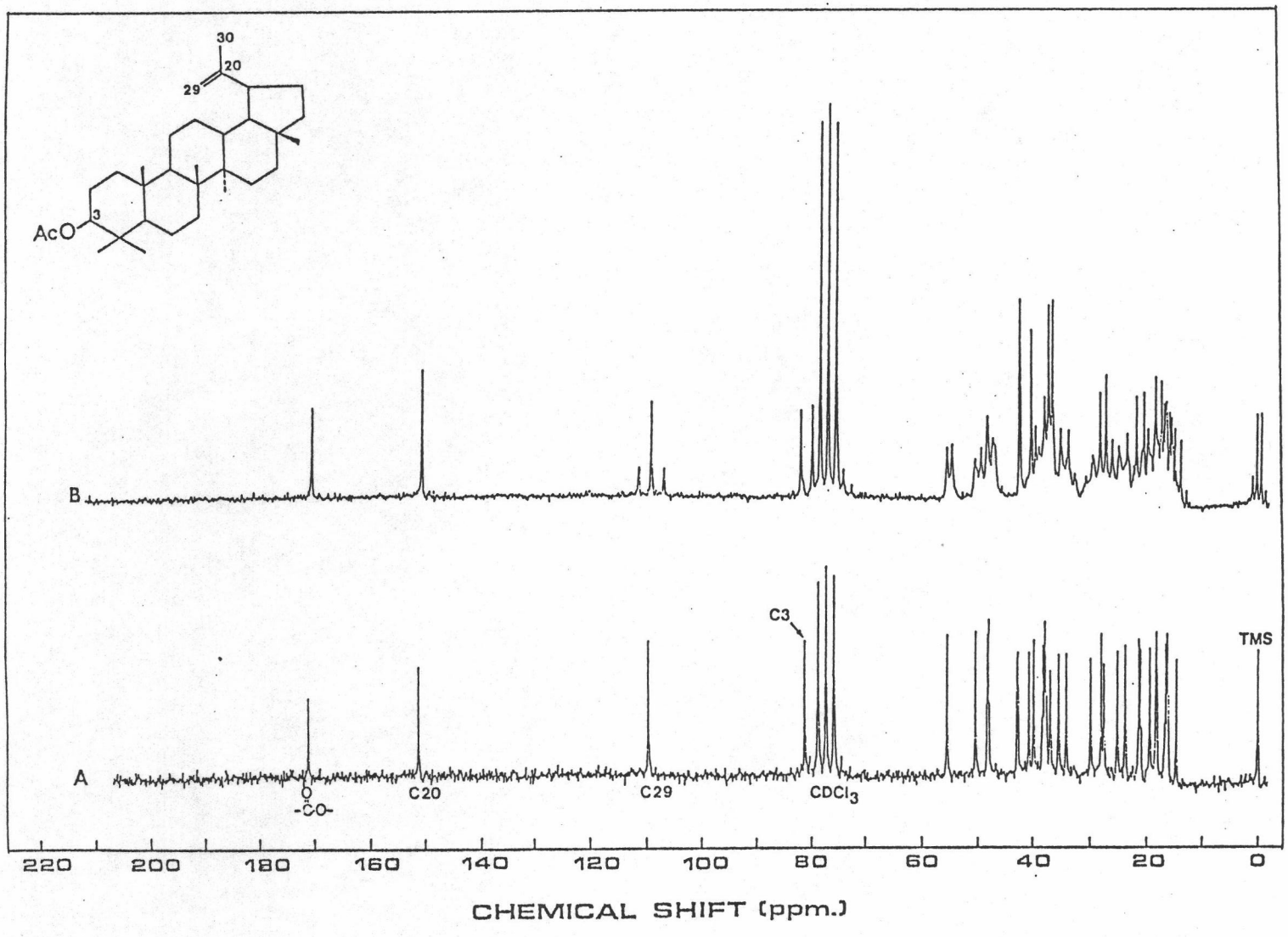


Figure 66 A) The ^{13}C NMR spectrum of Compound 8 acetate

B) The ^{13}C NMR off resonance spectrum of Compound 8 acetate

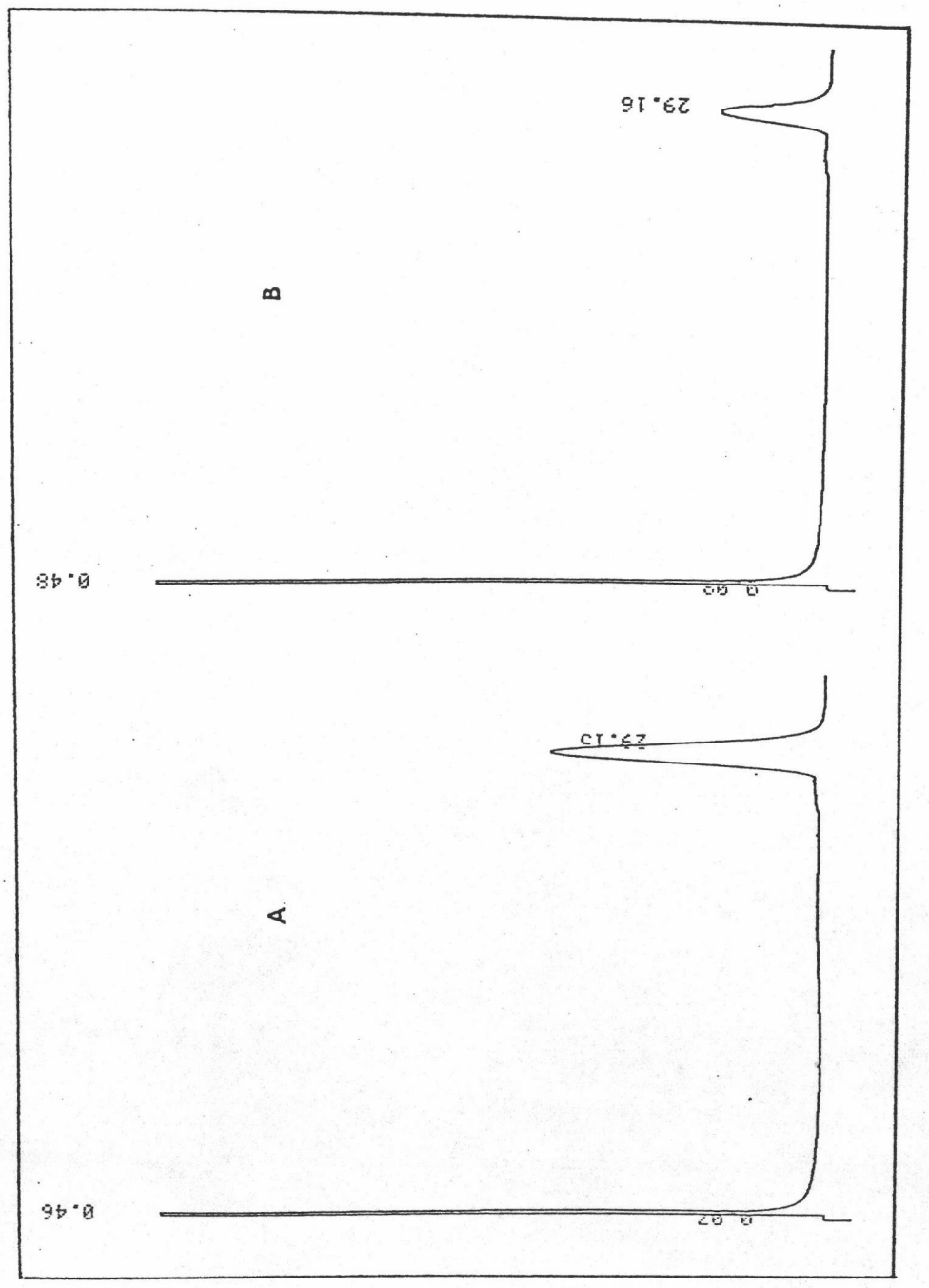


Figure 67 The GLC analysis results of

A) the authentic lupeolacetate

B) Compound 8 acetate

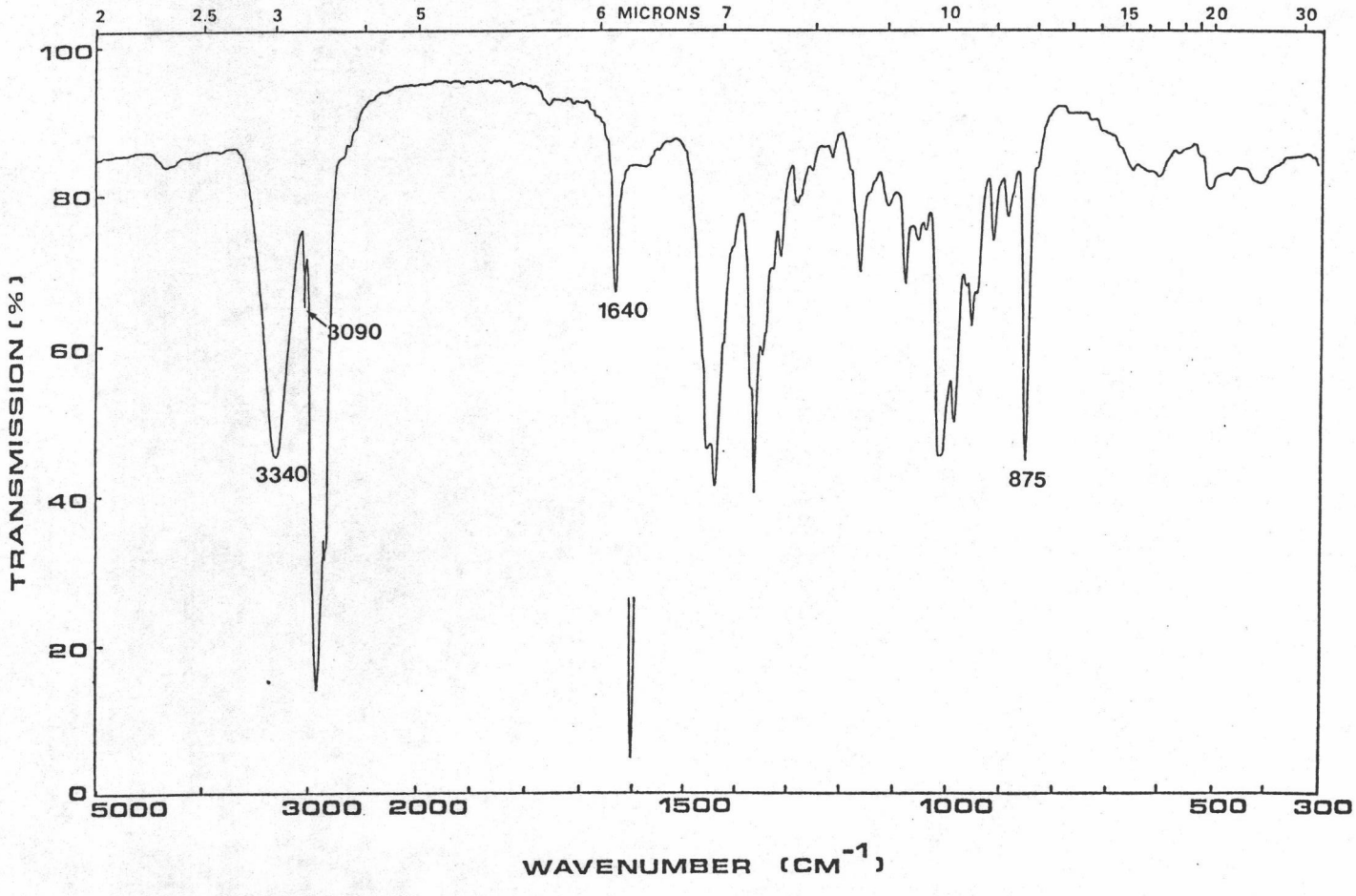


Figure 68 The IR spectrum of hydrolysis product of Compound 8 acetate (an alcoholic part)

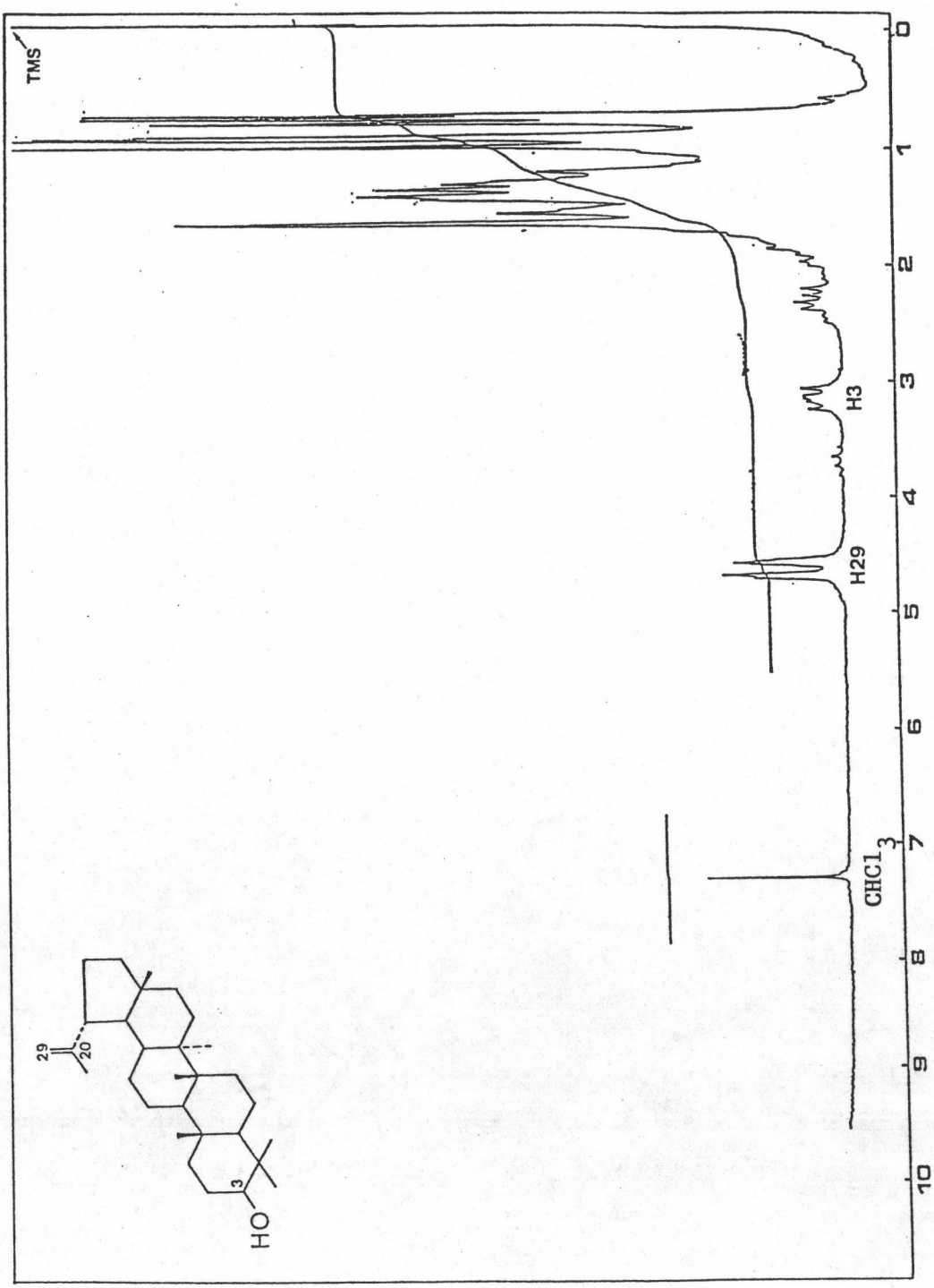


Figure 69 The ^{1}N NMR spectrum of hydrolysis product of Compound 8 acetate (an alcoholic part)

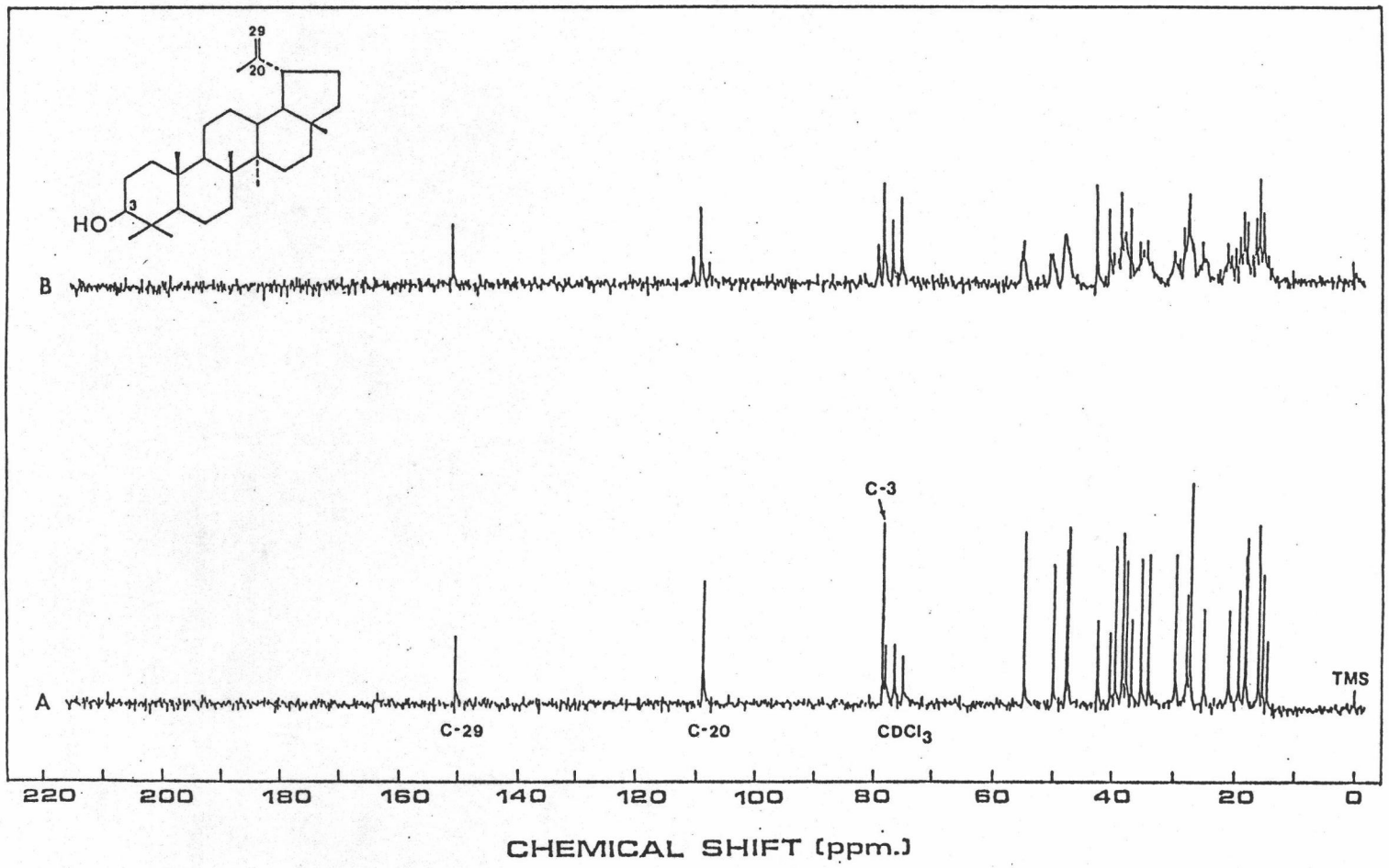


Figure 70 A) The ^{13}C NMR spectrum of hydrolysis product of Compound 8 acetate (an alcoholic part)

B) The ^{13}C NMR off resonance spectrum of hydrolysis product of Compound 8 acetate (an alcoholic part)

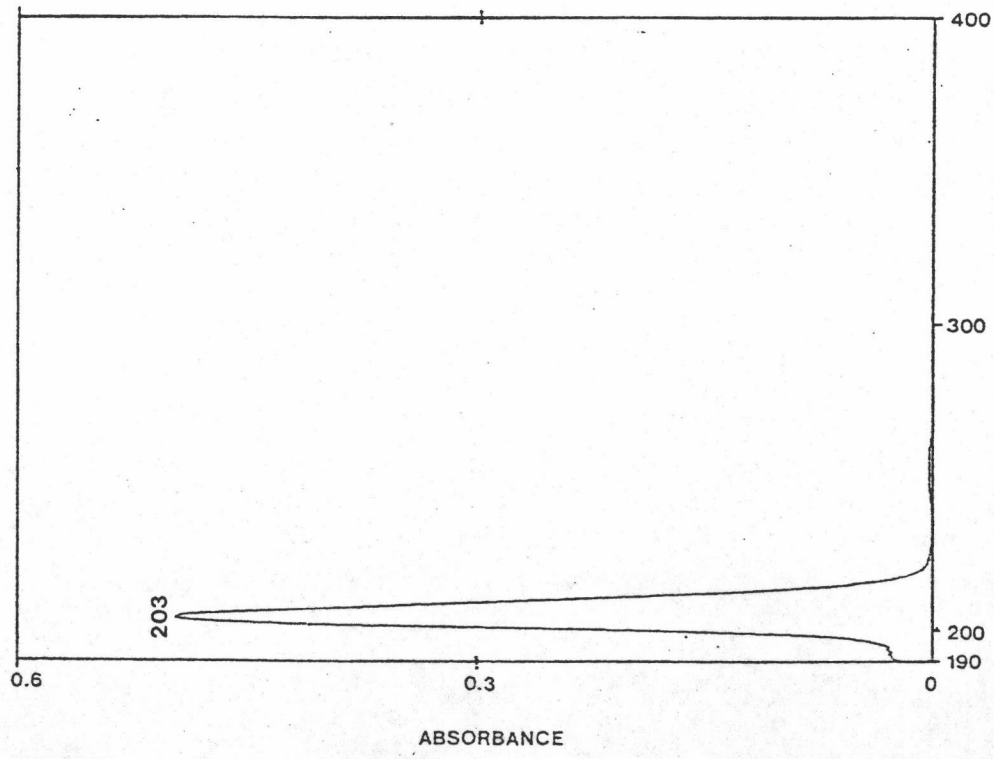


Figure 71 The UV spectrum of hydrolysis product of Compound 8 acetate (an alcoholic part)

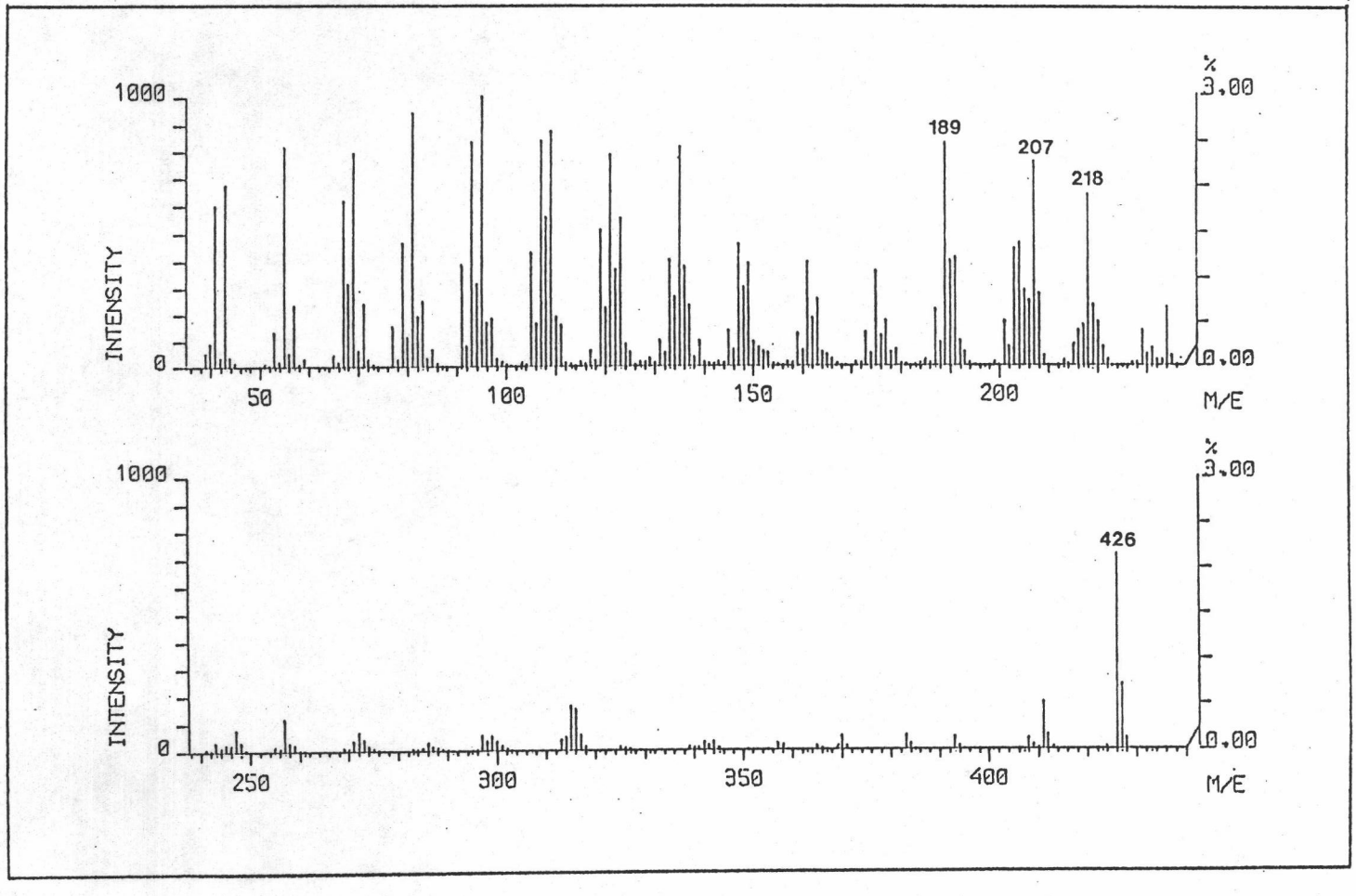


Figure 72 The mass spectrum of hydrolysis product of Compound 8 acetate (an alcoholic part)

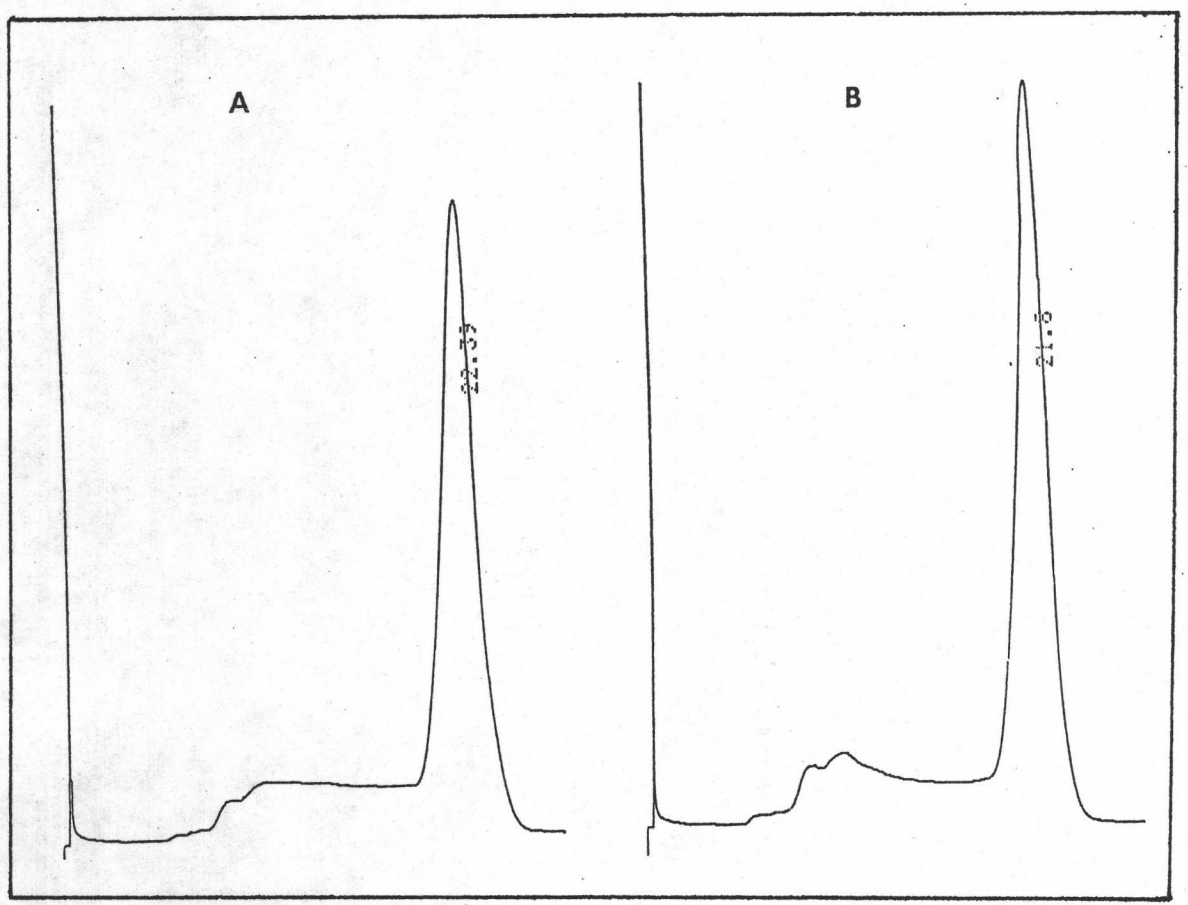


Figure 73 The GLC analysis results of

A) the authentic lupeol

B) the hydrolysis product of Compound 8 acetate

(an alcoholic part)

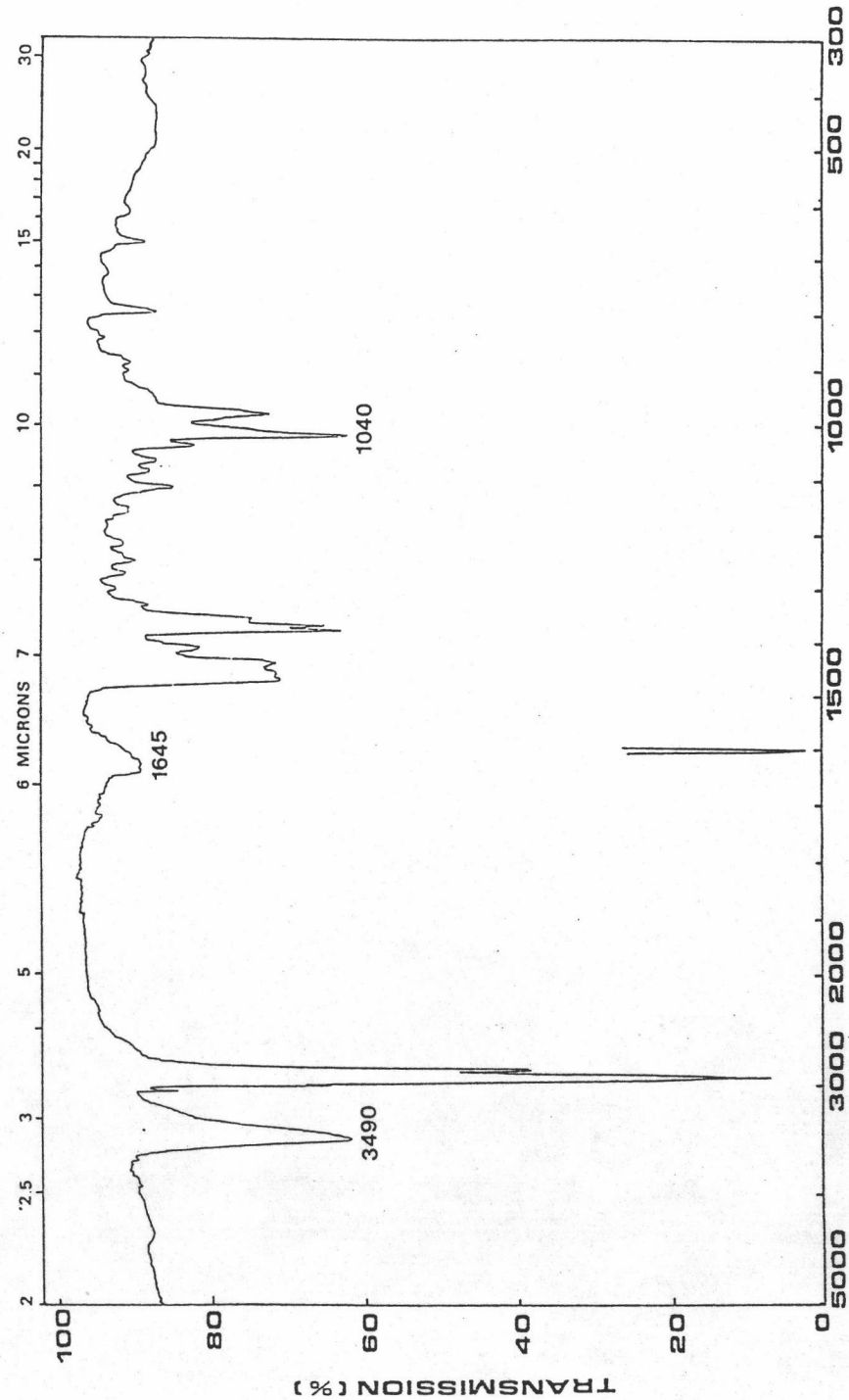


Figure 74 The IR spectrum of Compound 9

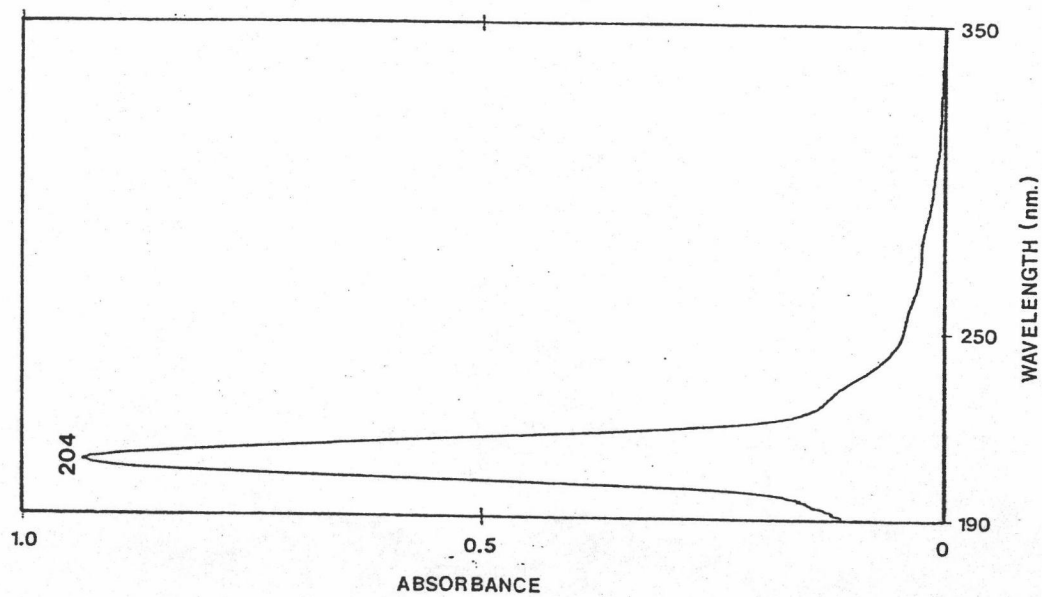


Figure 75 The UV spectrum of Compound 9

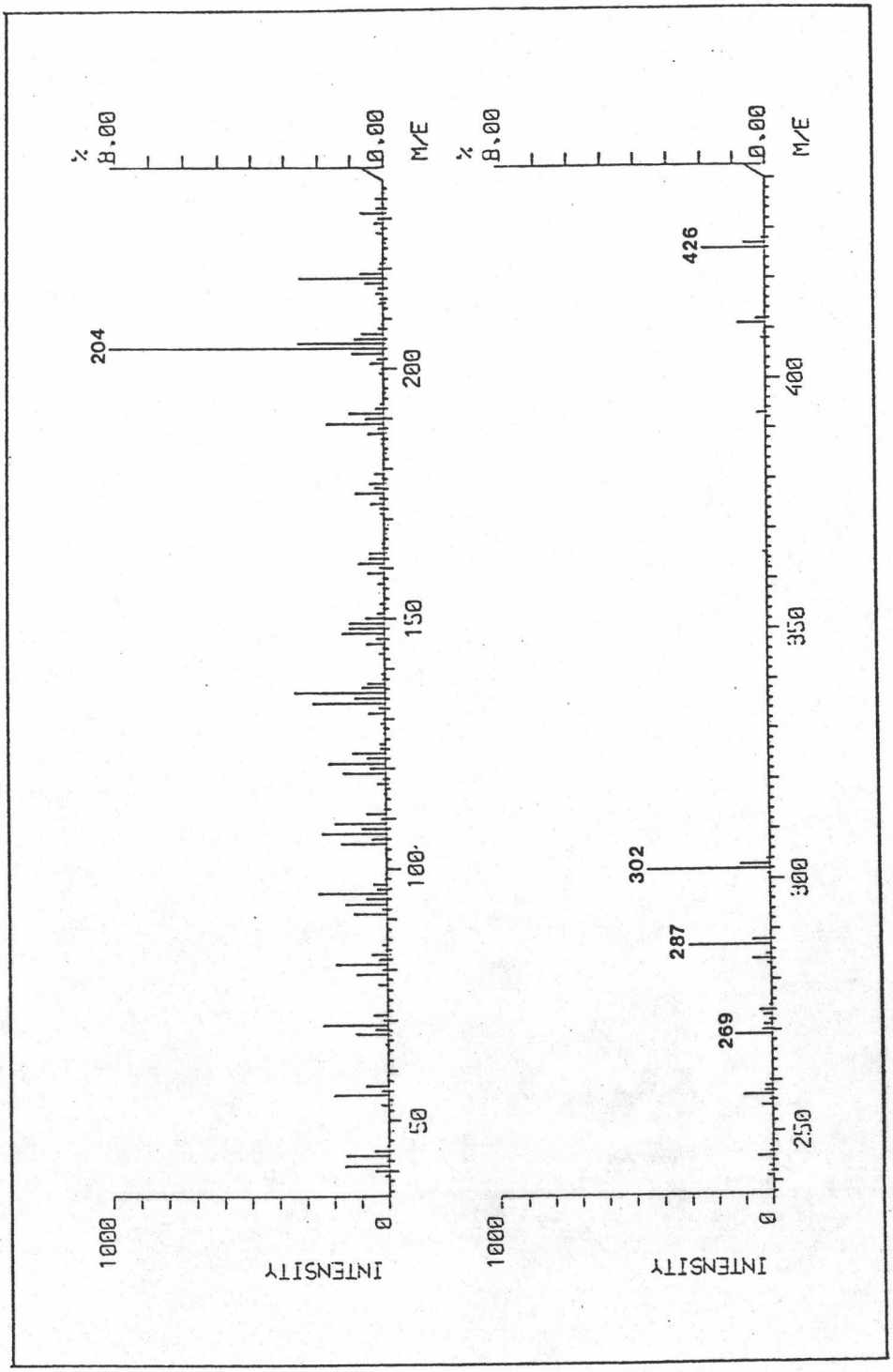


Figure 76 The mass spectrum of Compound 9

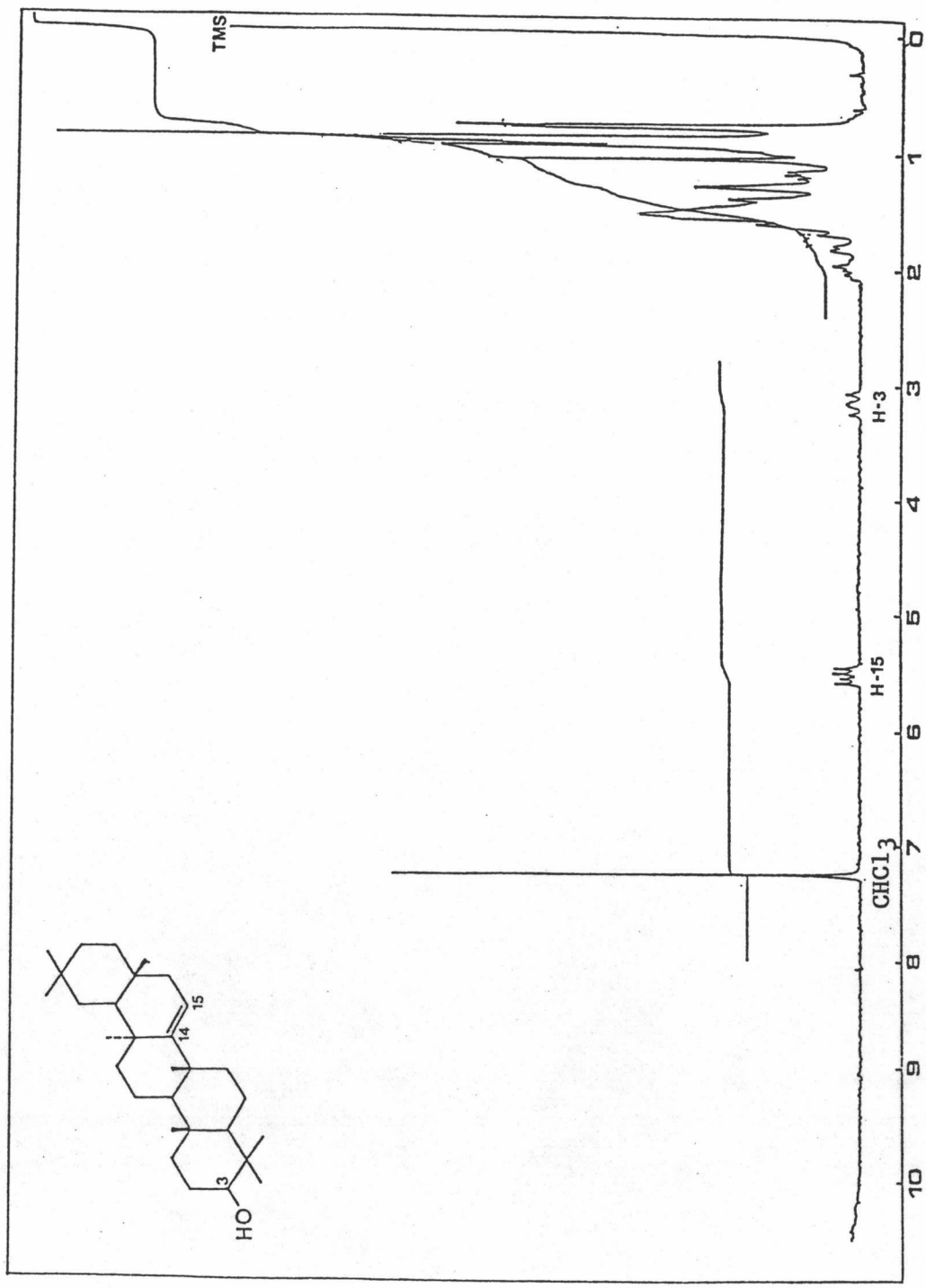


Figure 77 The ^1H NMR spectrum of Compound 9

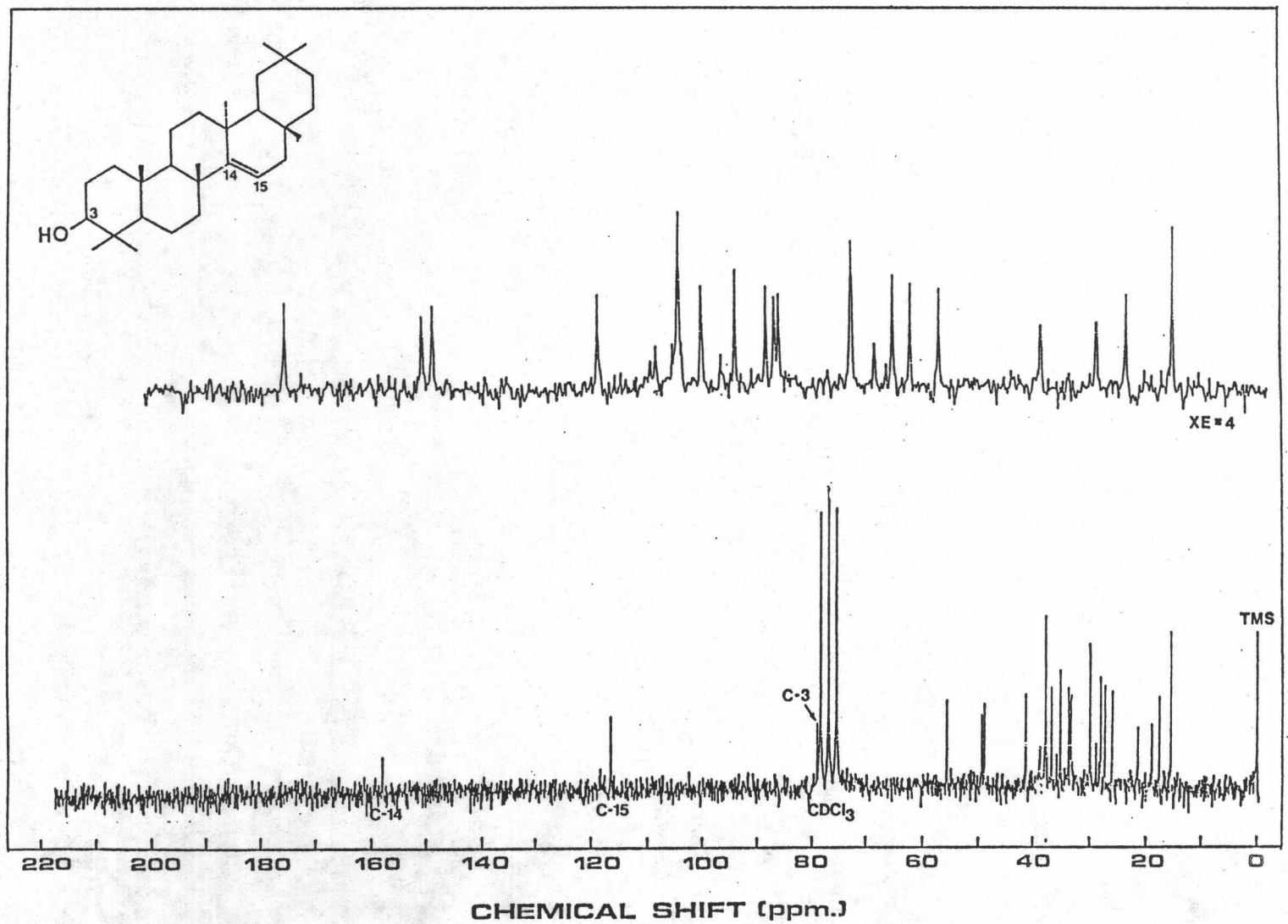


Figure 78 The ^{13}C NMR spectrum of Compound 9

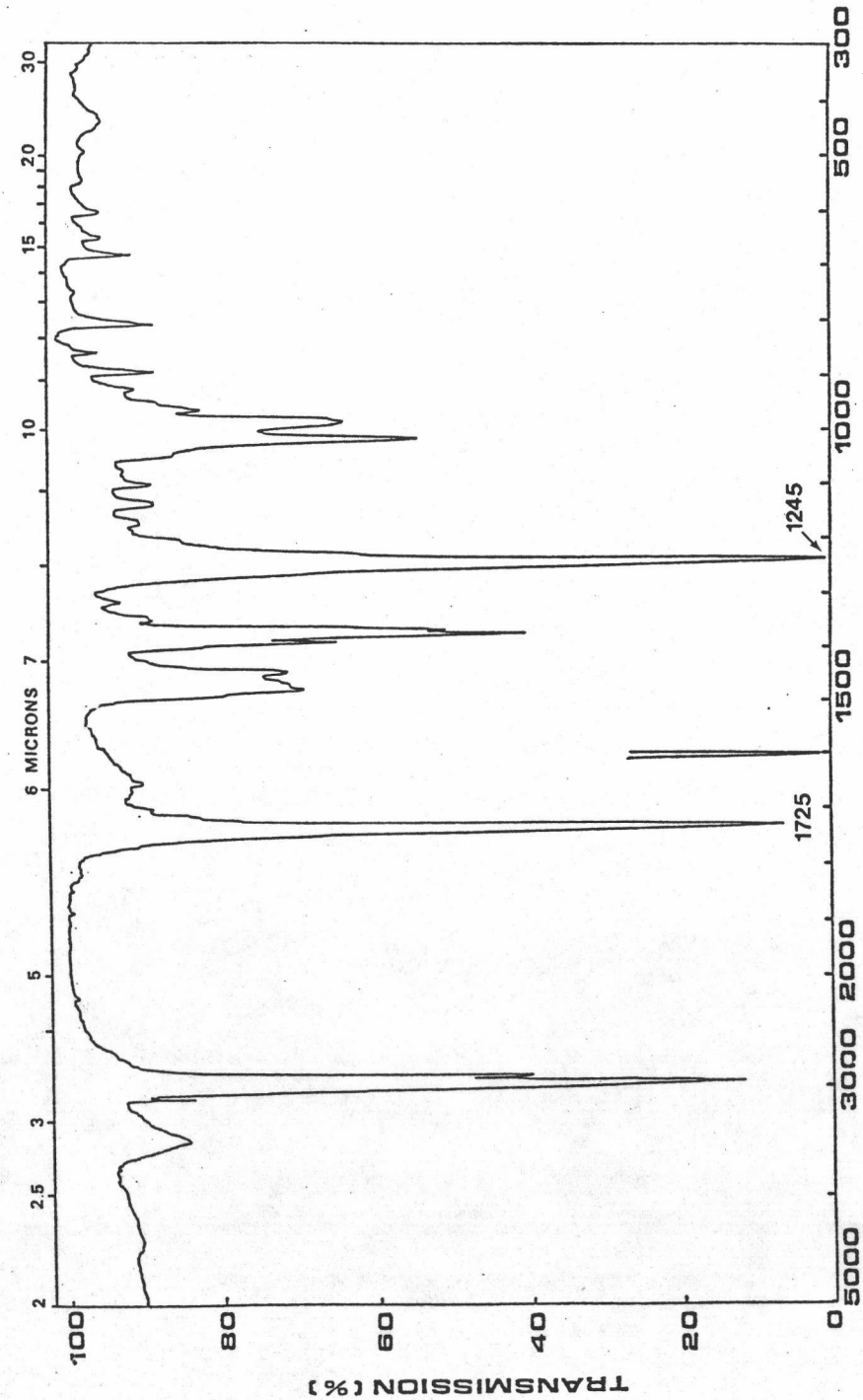


Figure 79 The IR spectrum of Compound 9 acetate

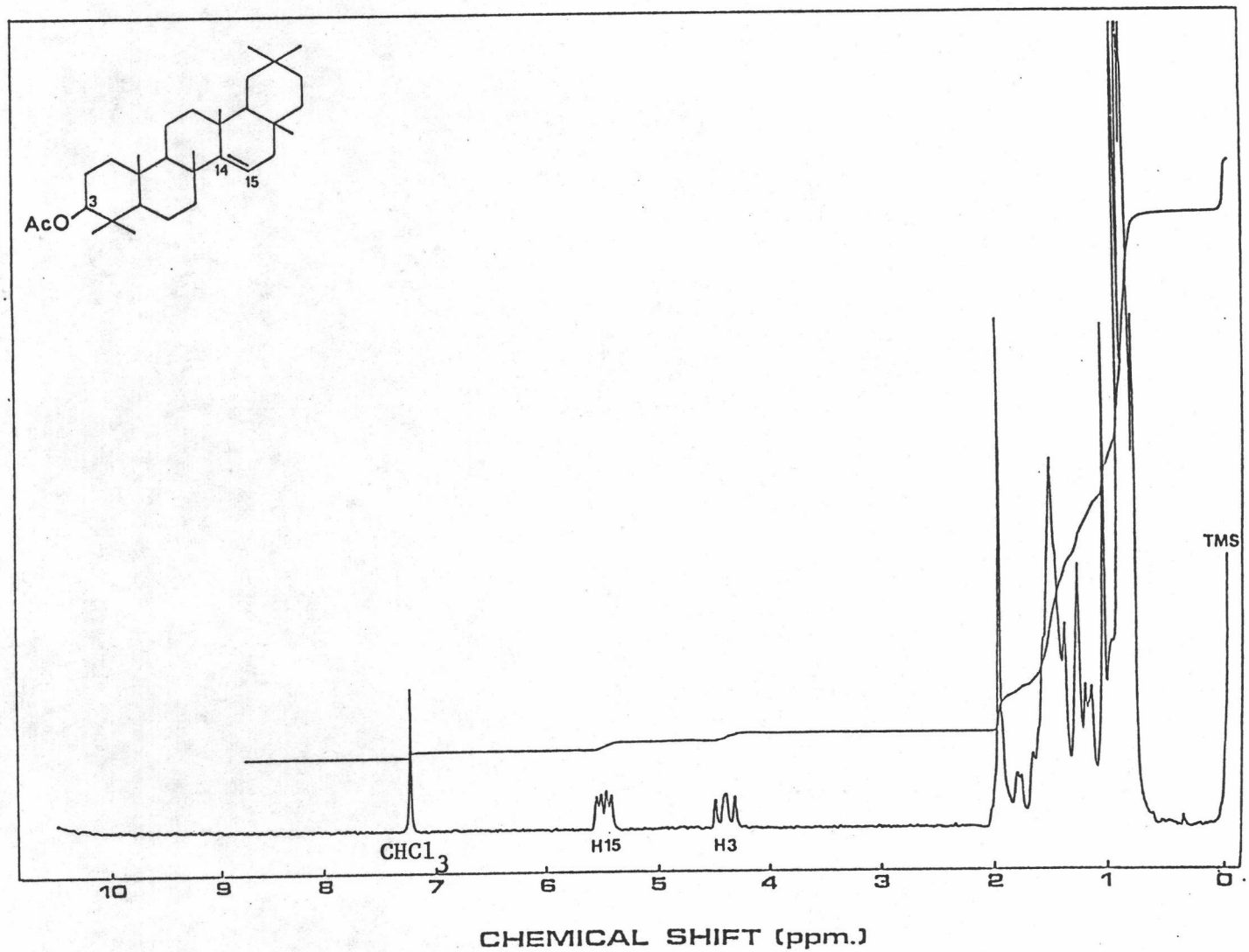


Figure 80 The ^{1}H NMR spectrum of Compound 9 acetate

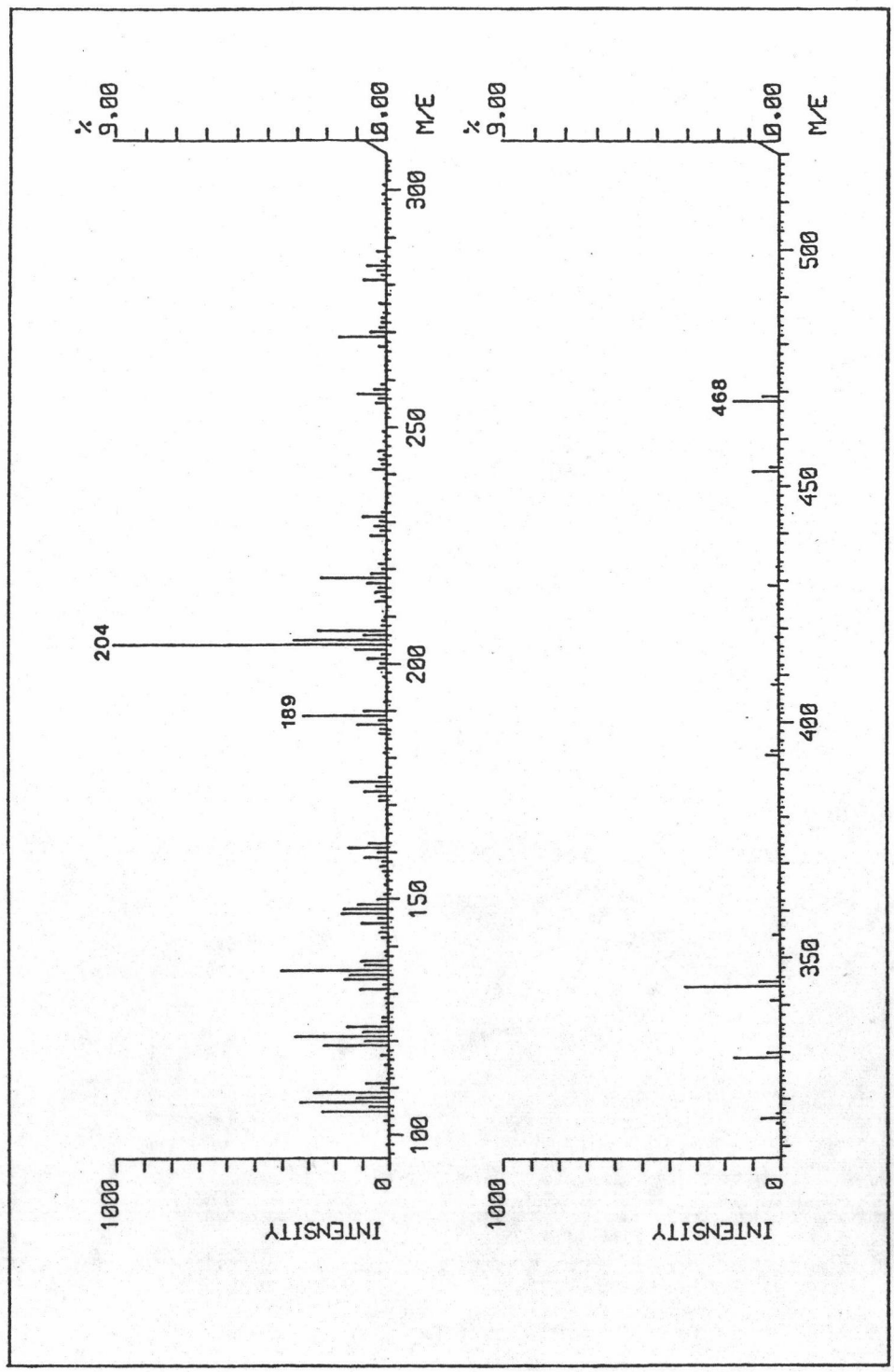


Figure 81 The mass spectrum of Compound 9 acetate

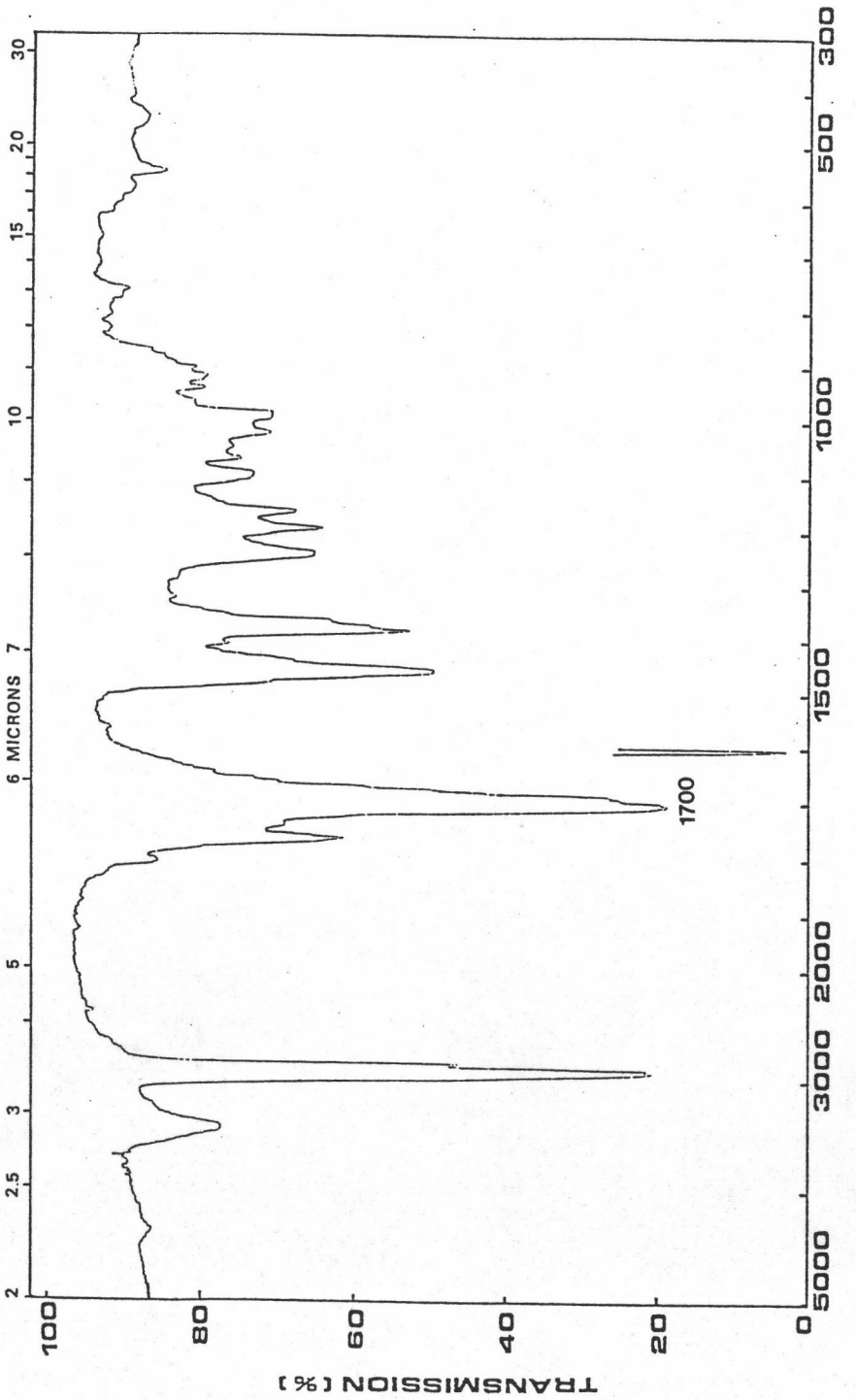


Figure 82 The IR spectrum of Compound 9A

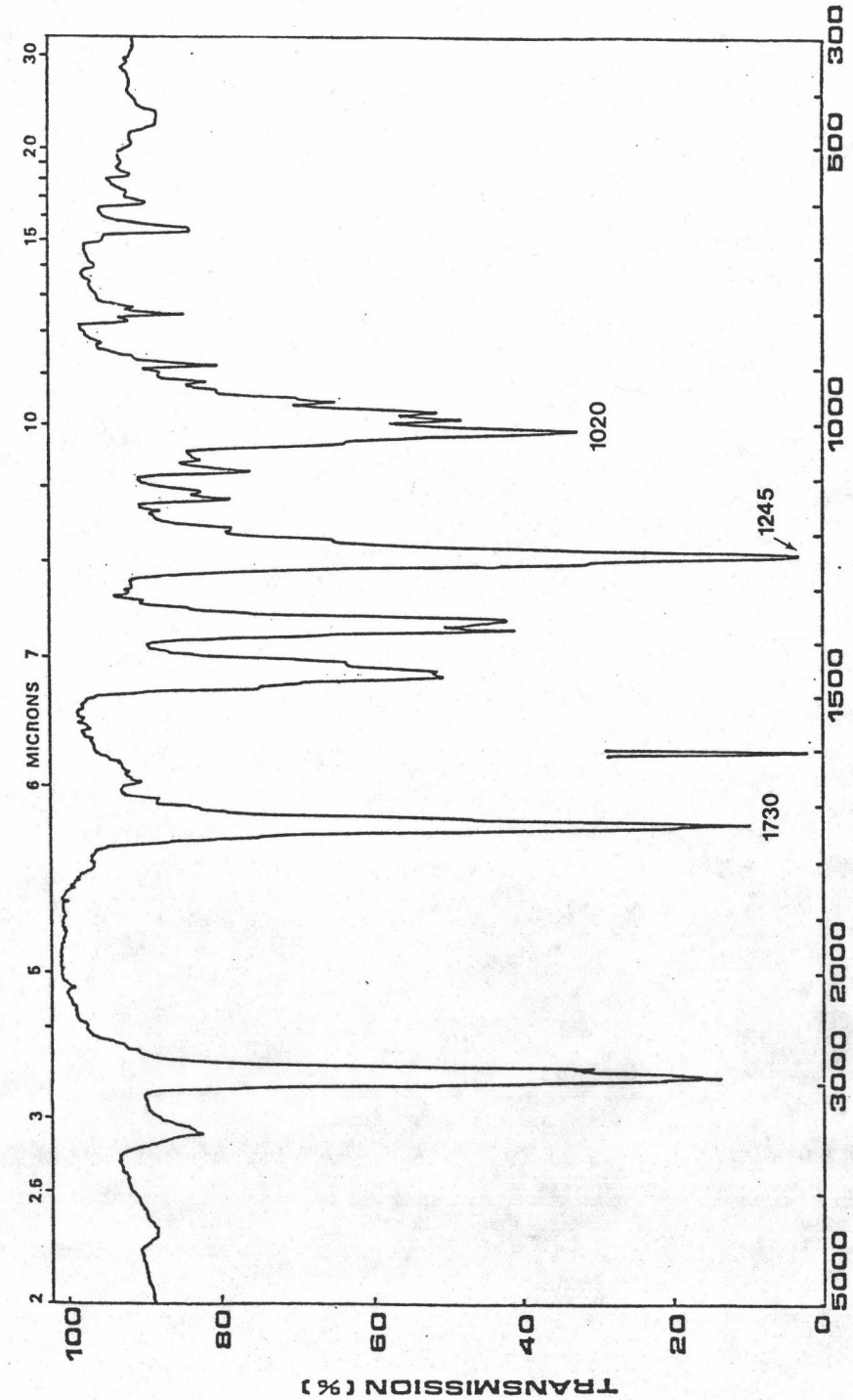


Figure 83 The IR spectrum of Compound 9B

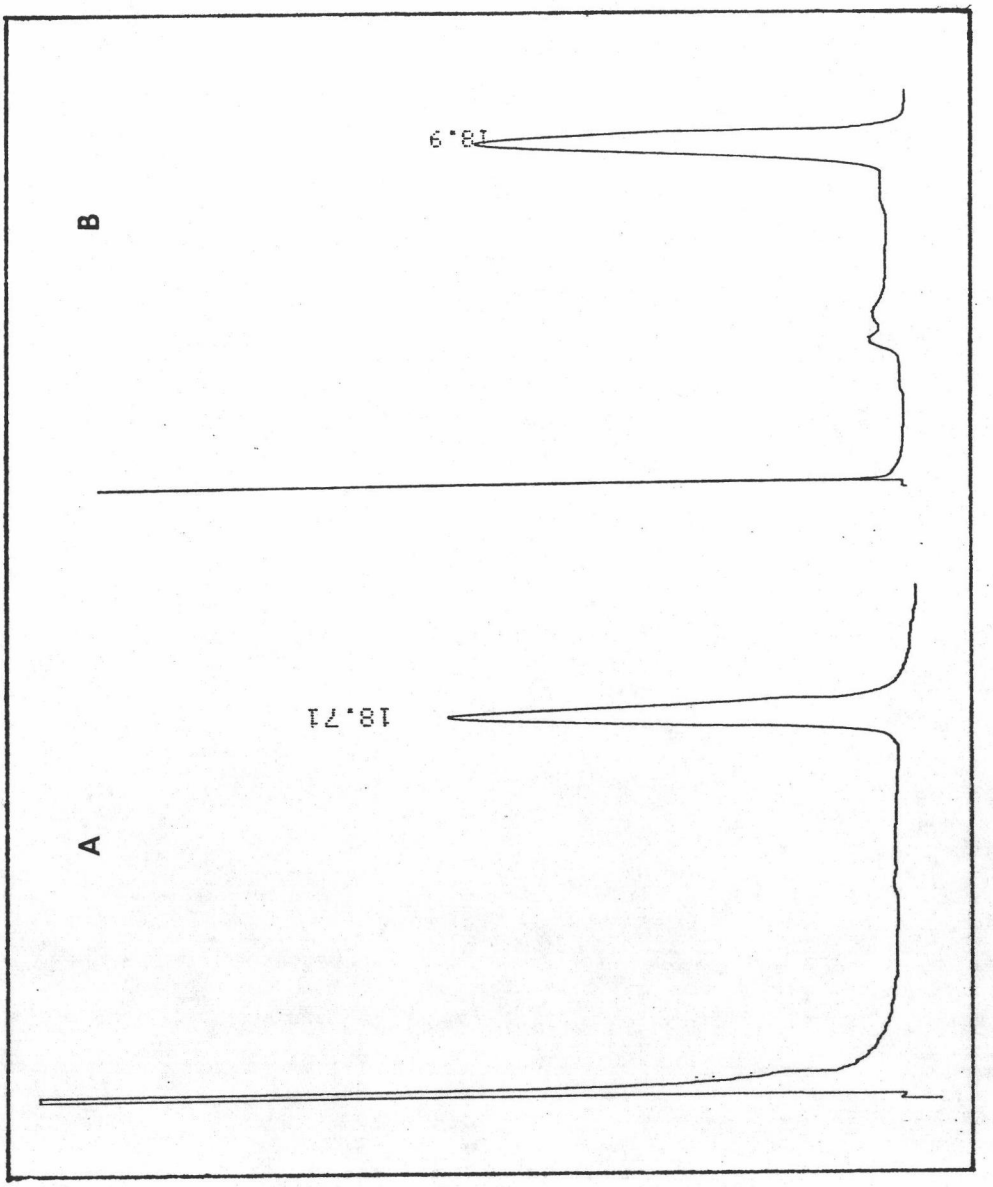


Figure 84 The GLC analysis of

A) the authentic β-amyrinacetate

B) Compound 9B

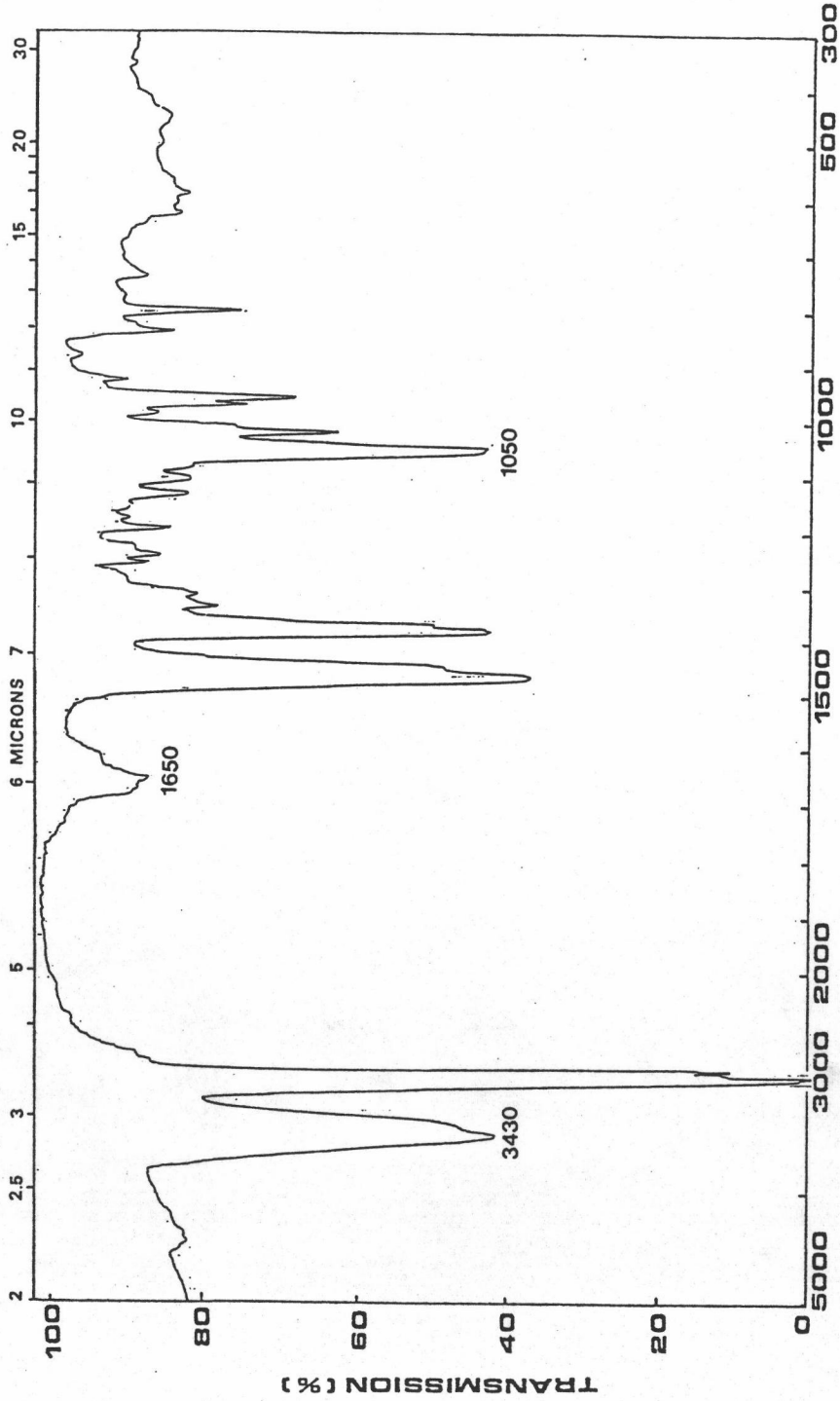


Figure 85 The IR spectrum of Compound 10

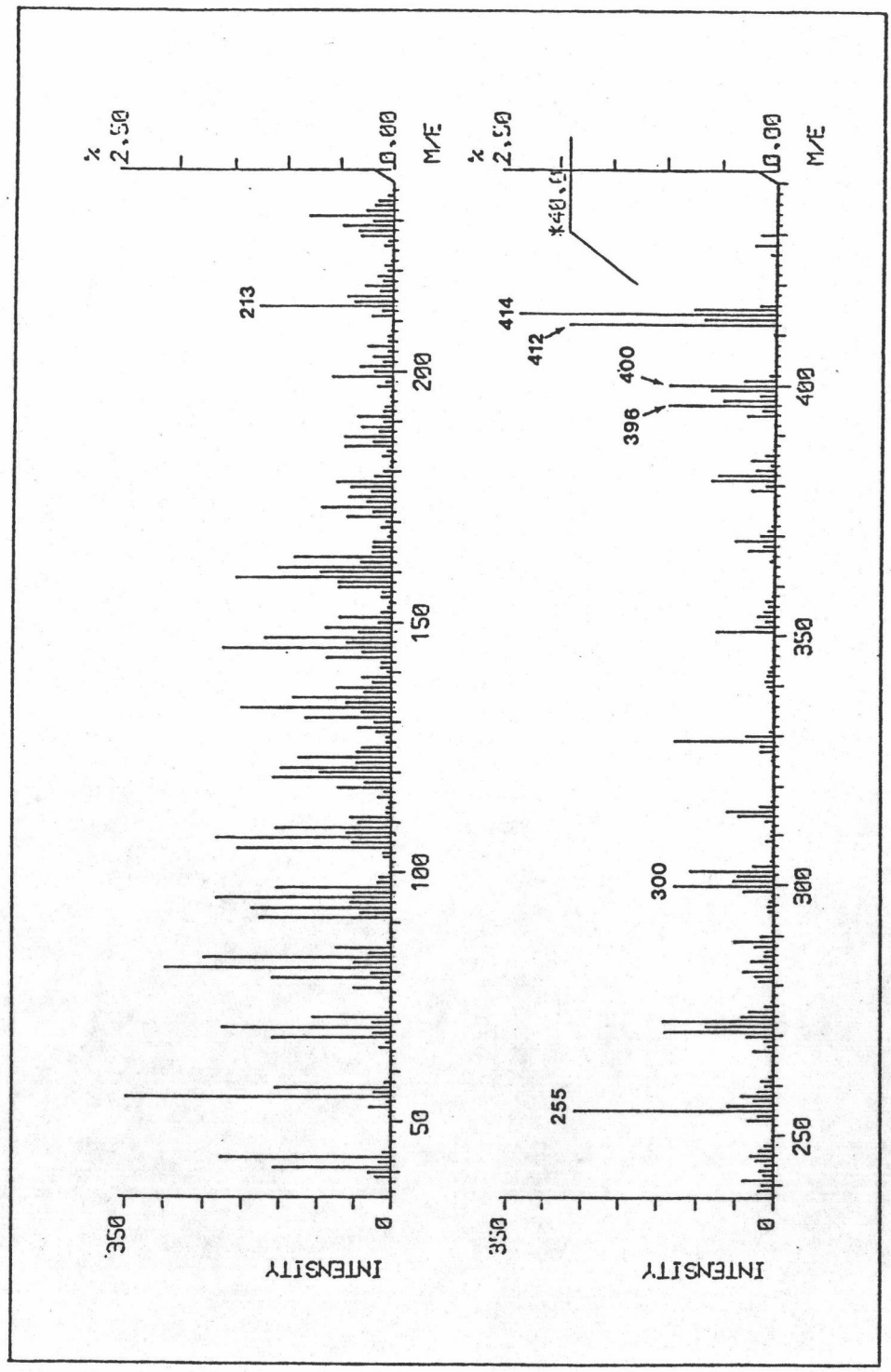


Figure 86 The mass spectrum of Compound 10

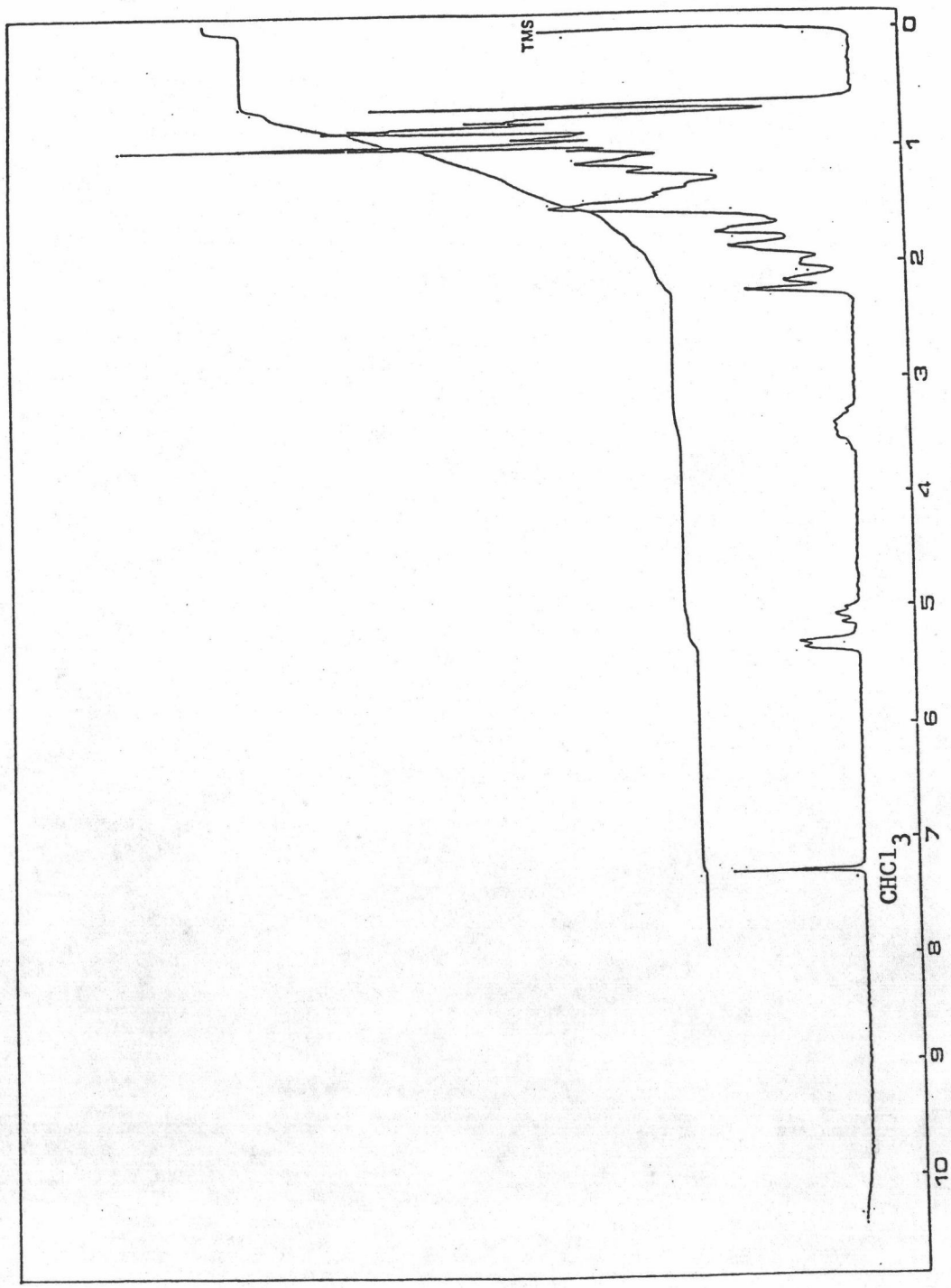


Figure 87 The ^1H NMR spectrum of Compound 10

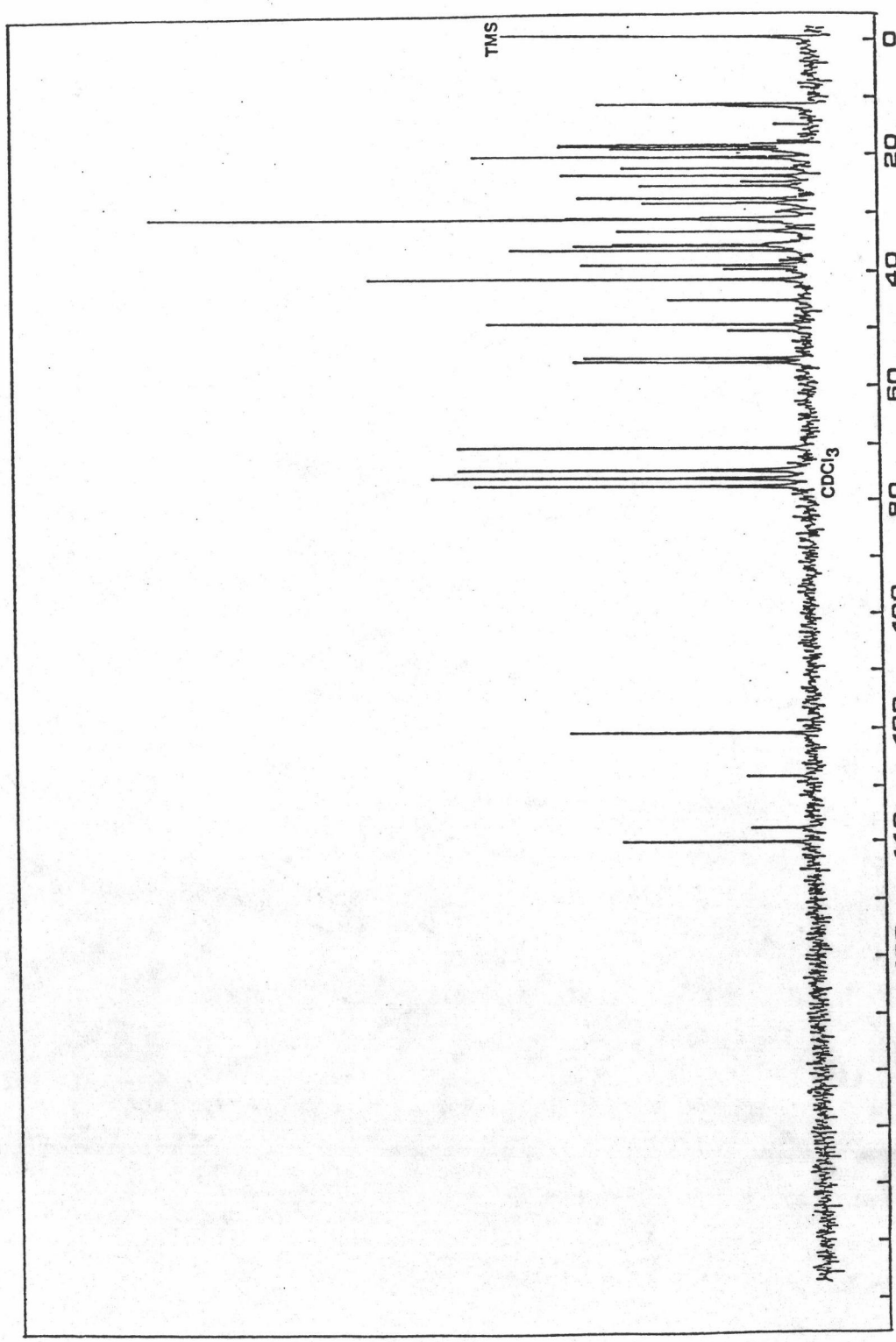


Figure 88 The ^{13}C NMR spectrum of Compound 10

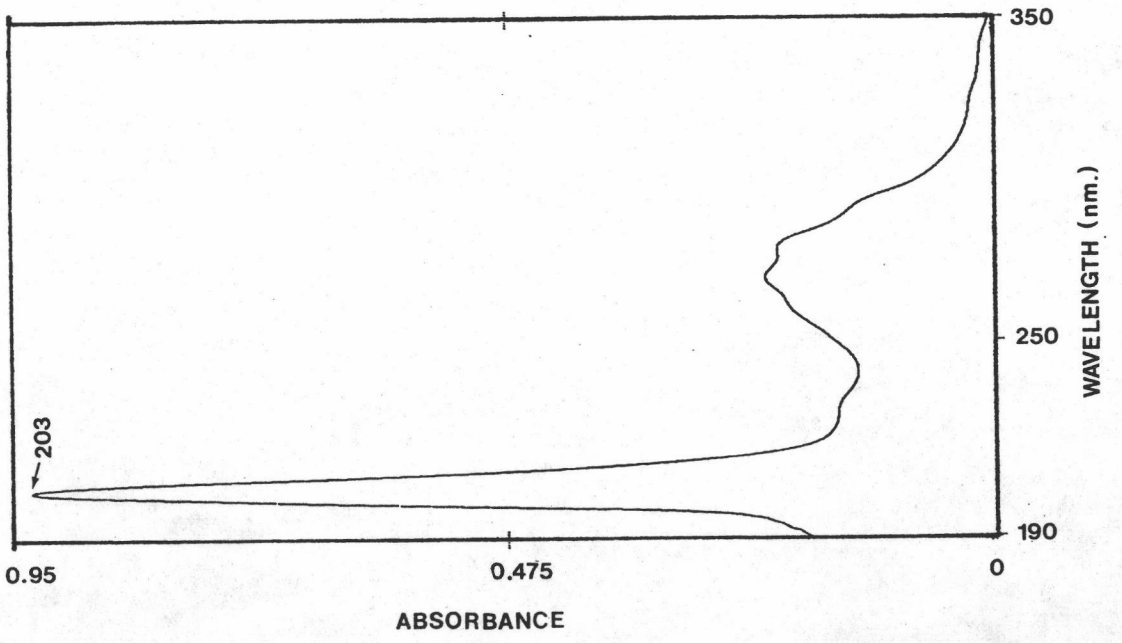


Figure 89 The UV spectrum of Compound 10

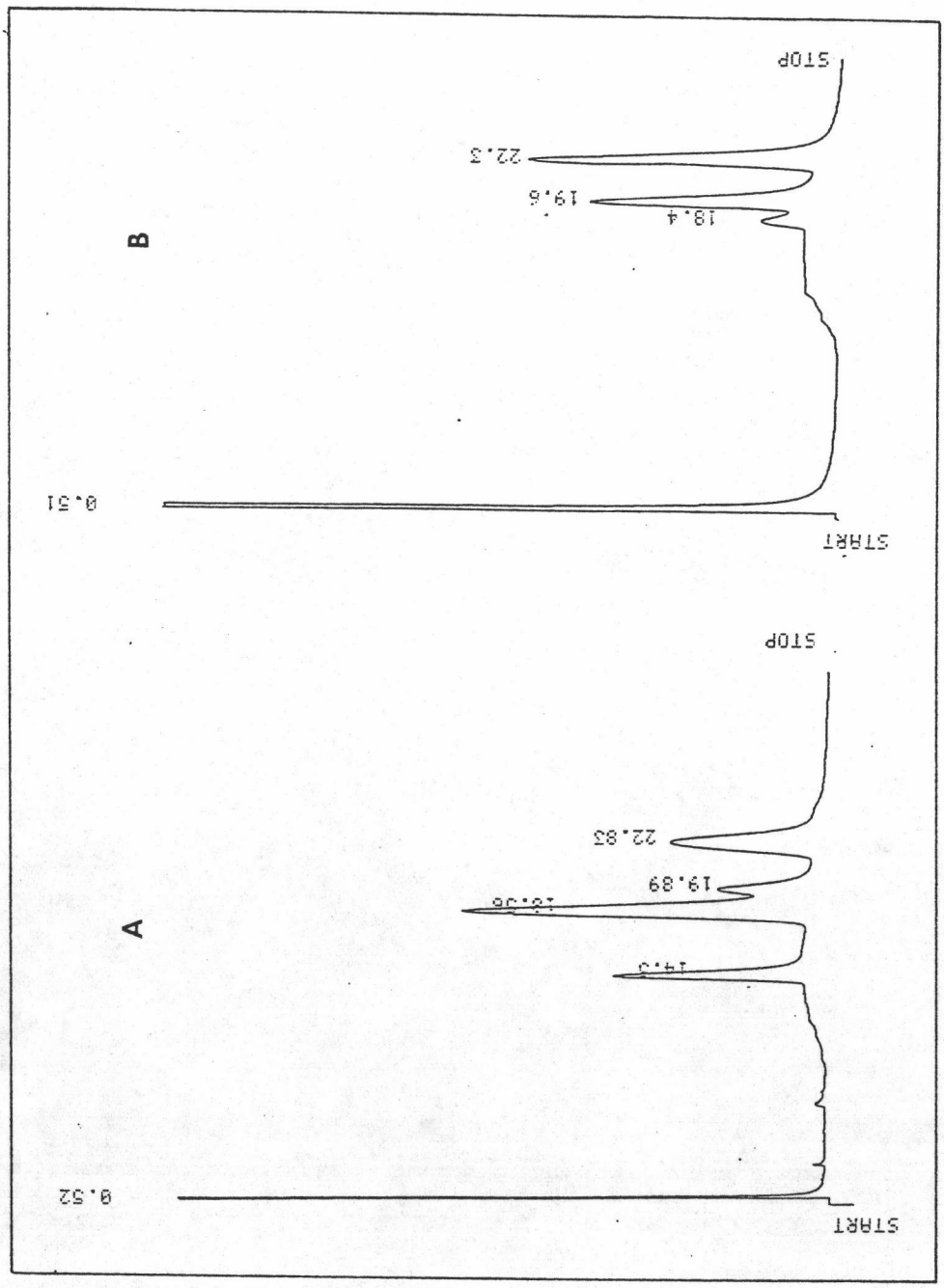


Figure 90 The GLC analysis results of

A) Standard chloresterol, compesterol stigmasterol and β-sitosterol

B) Compound 10

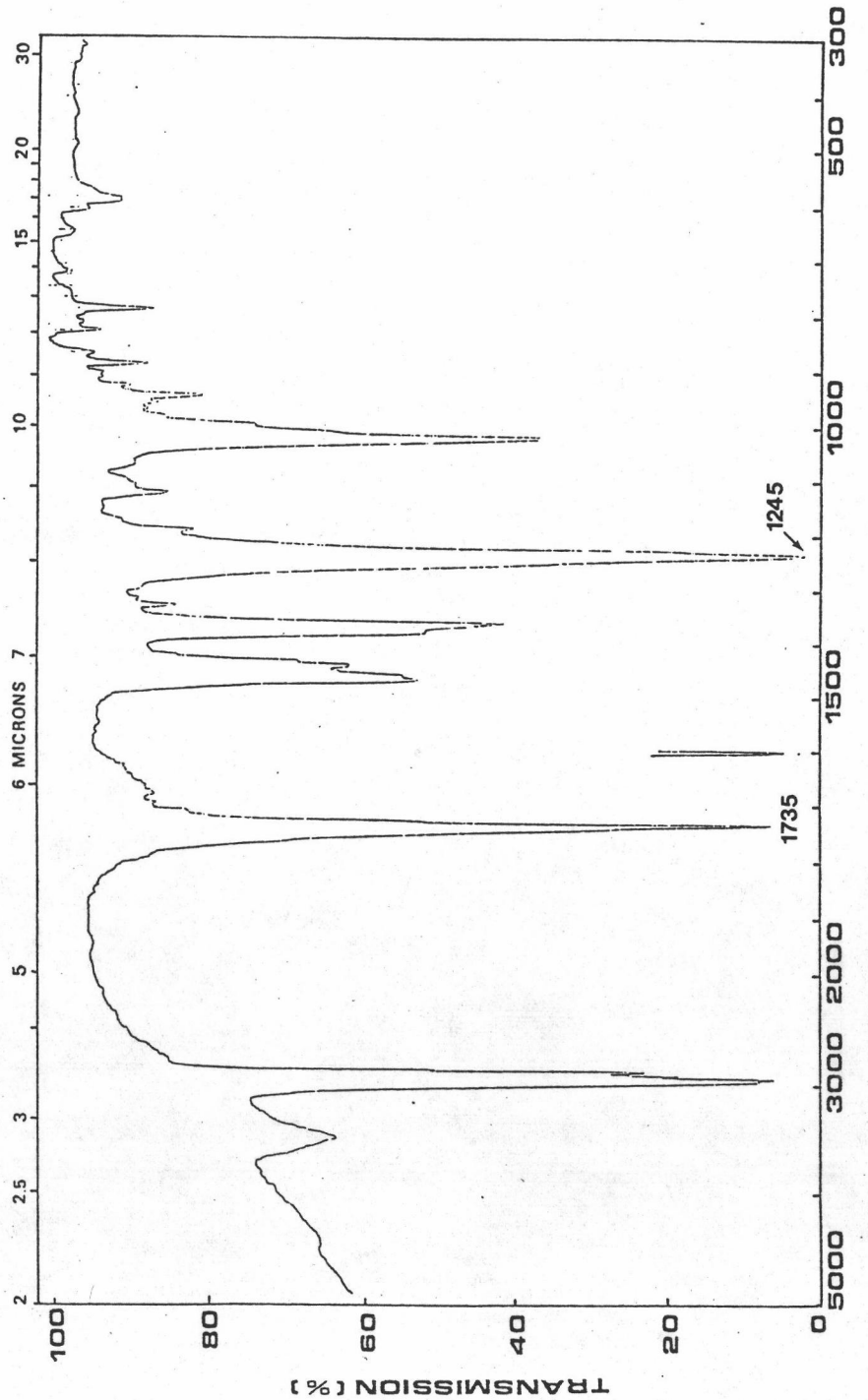


Figure 91 The IR spectrum of Compound 10 acetate

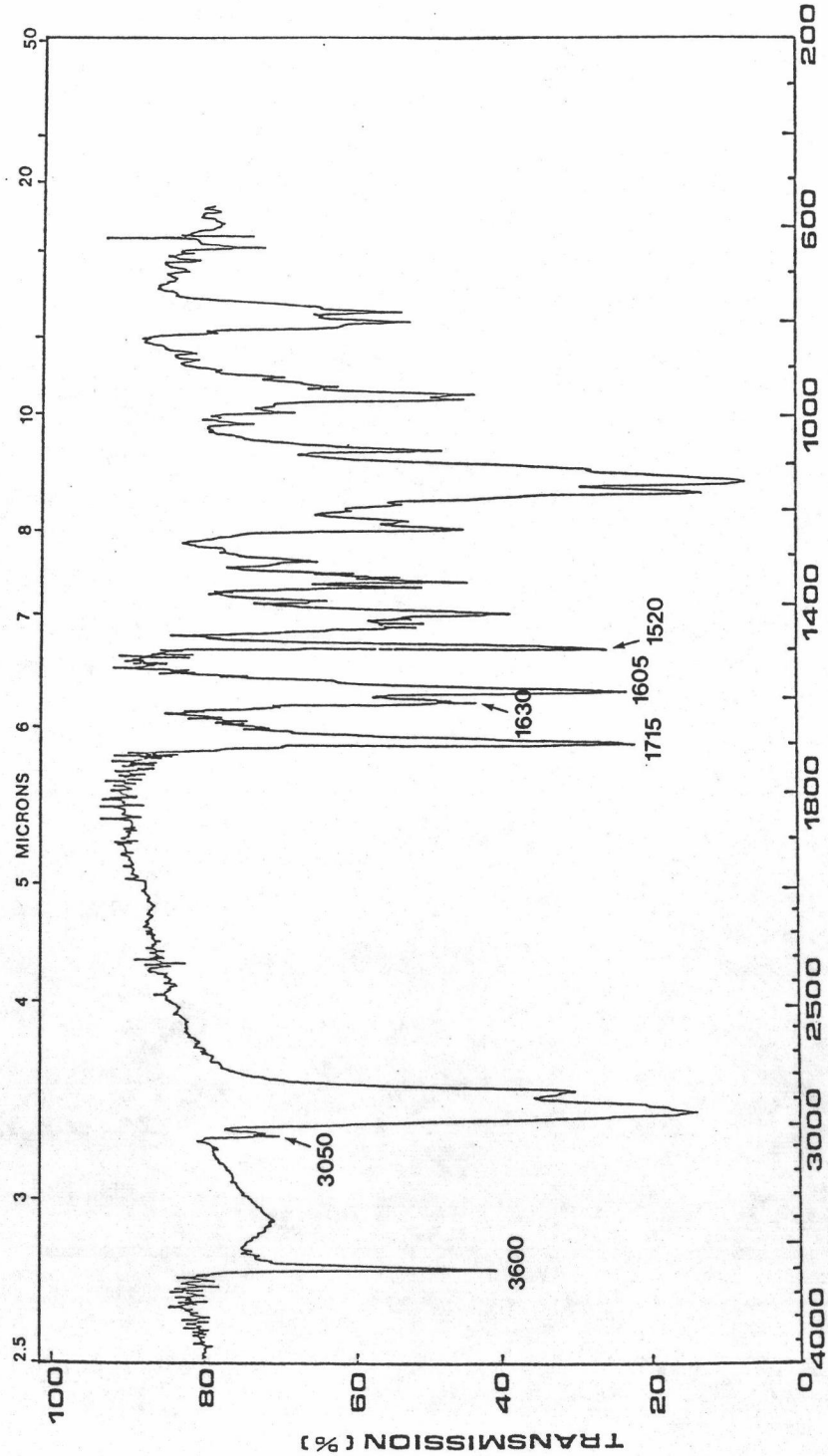


Figure 92 The IR spectrum of Compound 11

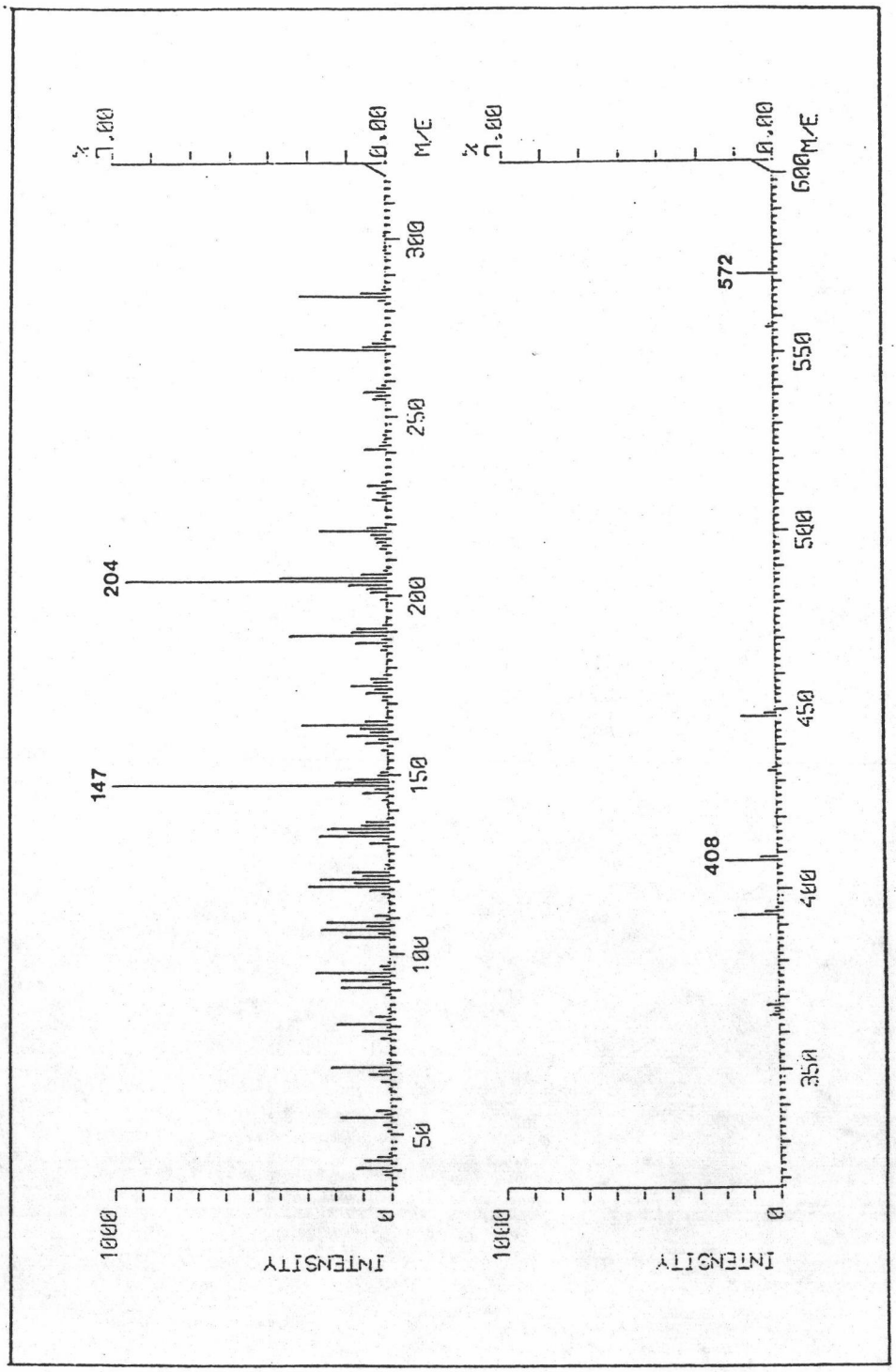
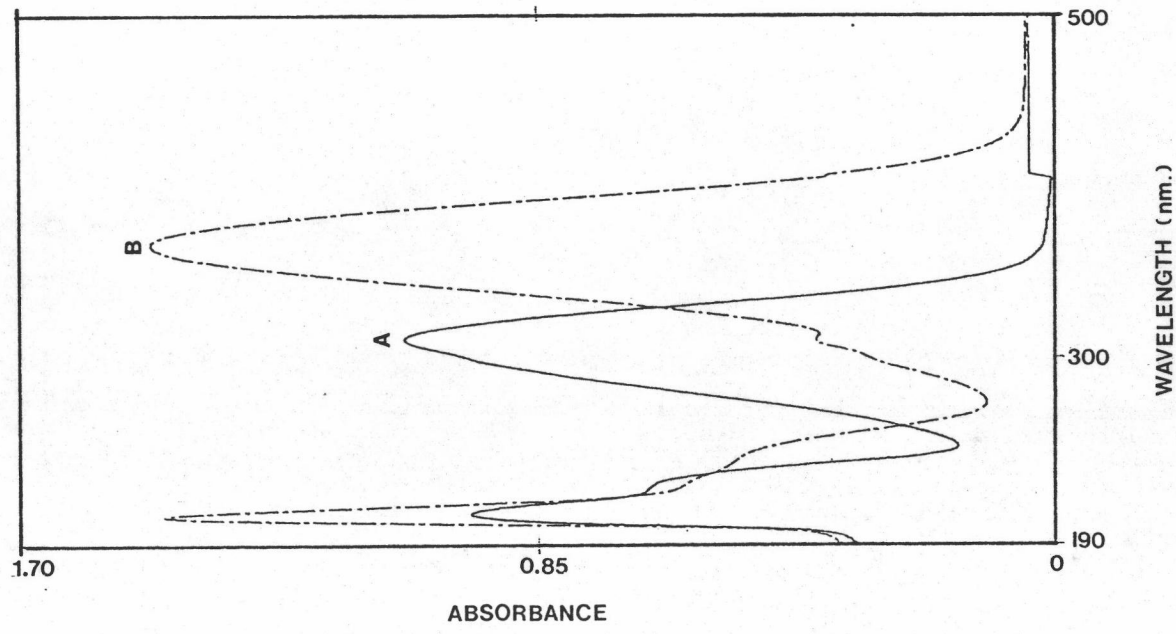


Figure 93 The mass spectrum of Compound 11

Figure 94 The UV spectrum of Compound 11

A) in ethanol

B) in ethanol + 3 drops 0.1 M. NaOH



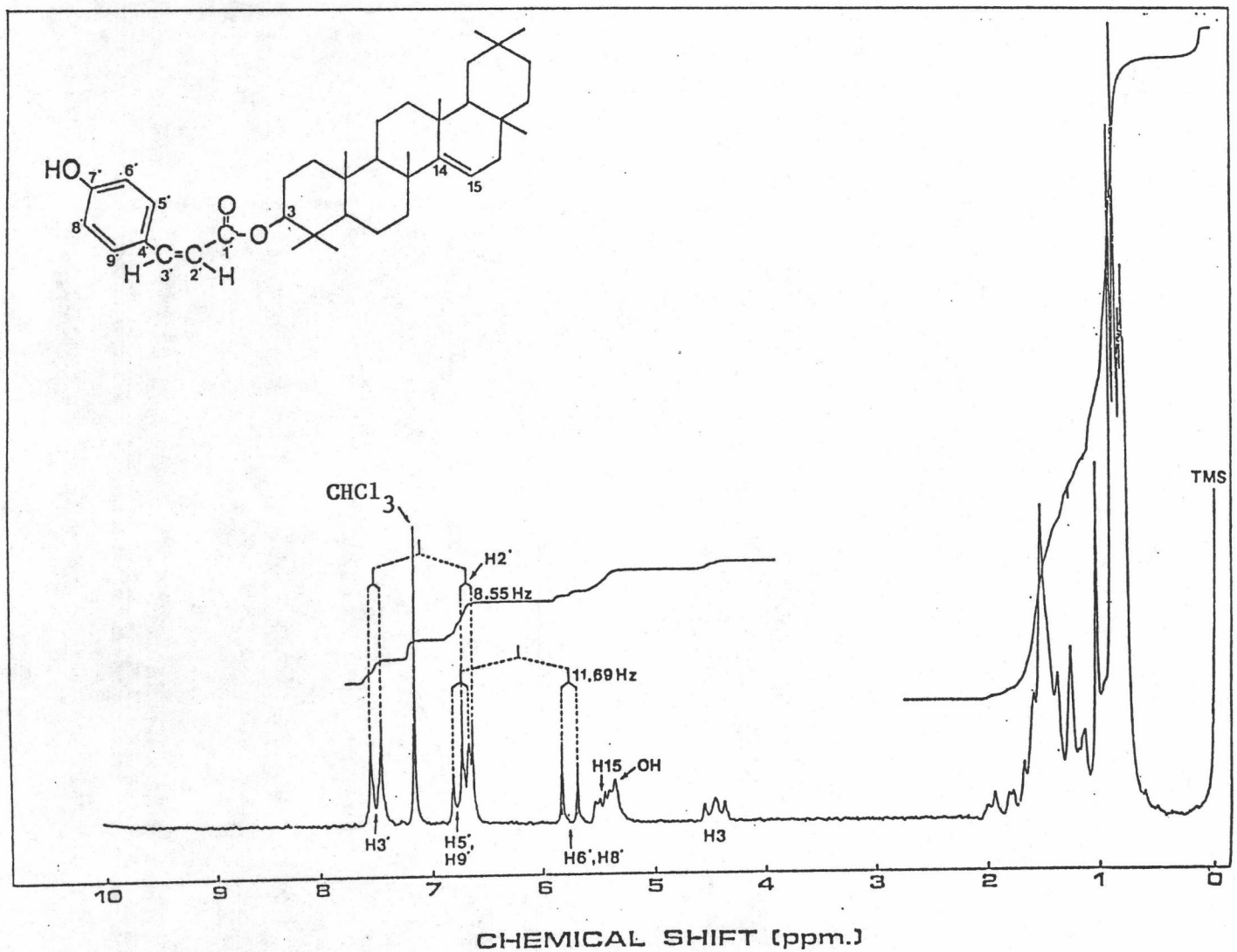


Figure 95 The ^{1}H NMR spectrum of Compound 11

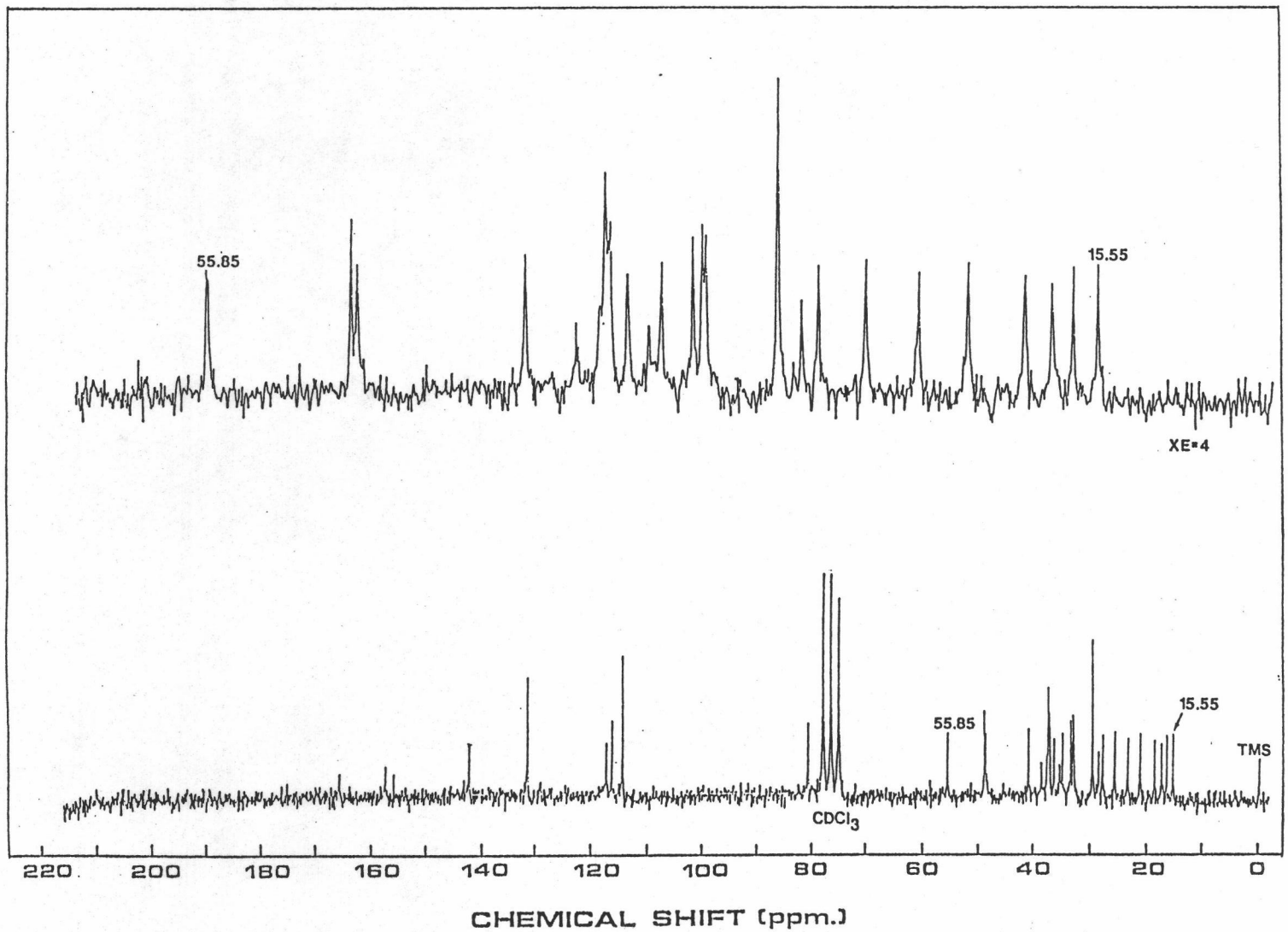


Figure 96 The ^{13}C NMR spectrum of Compound 11

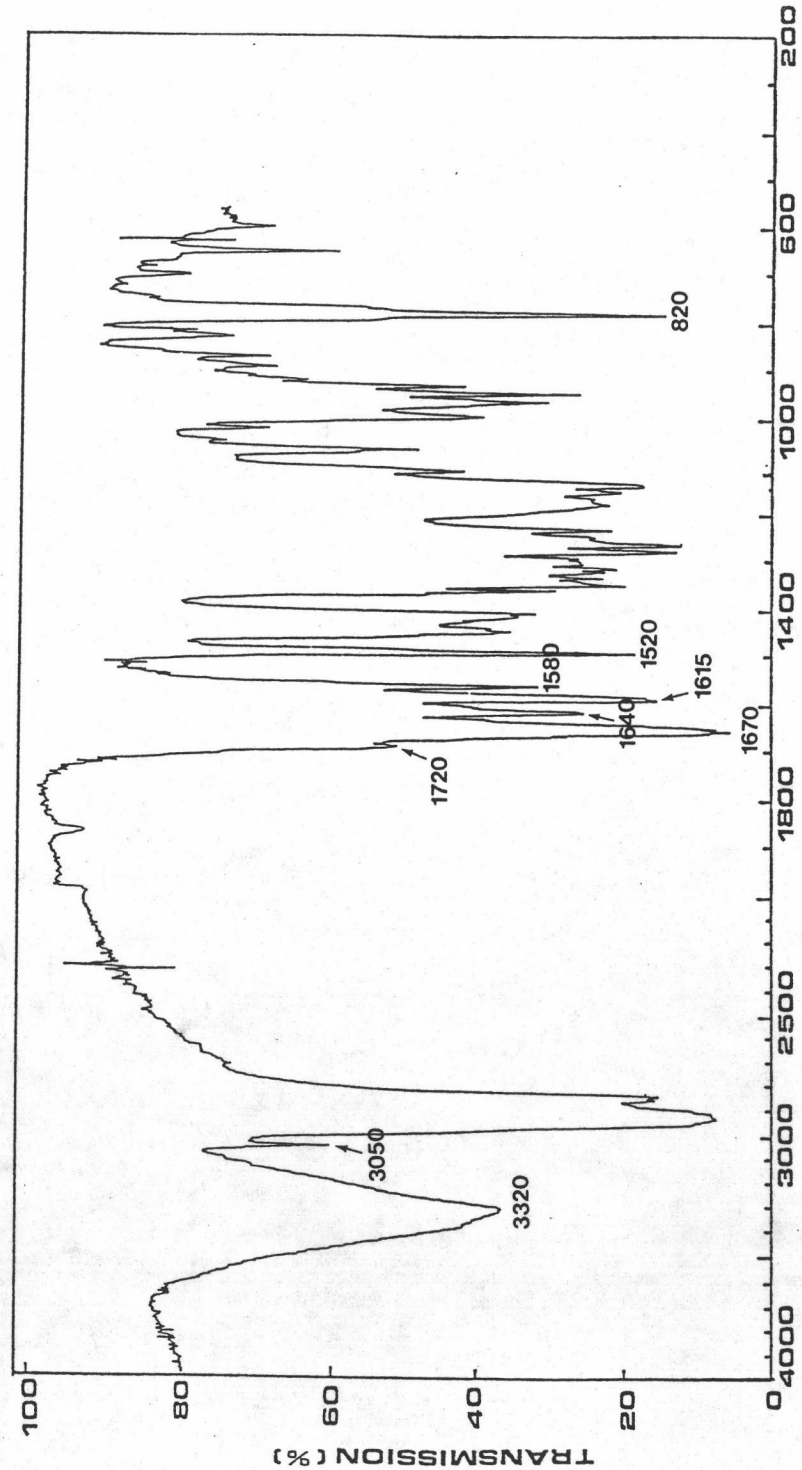


Figure 97 The IR spectrum of Compound 12

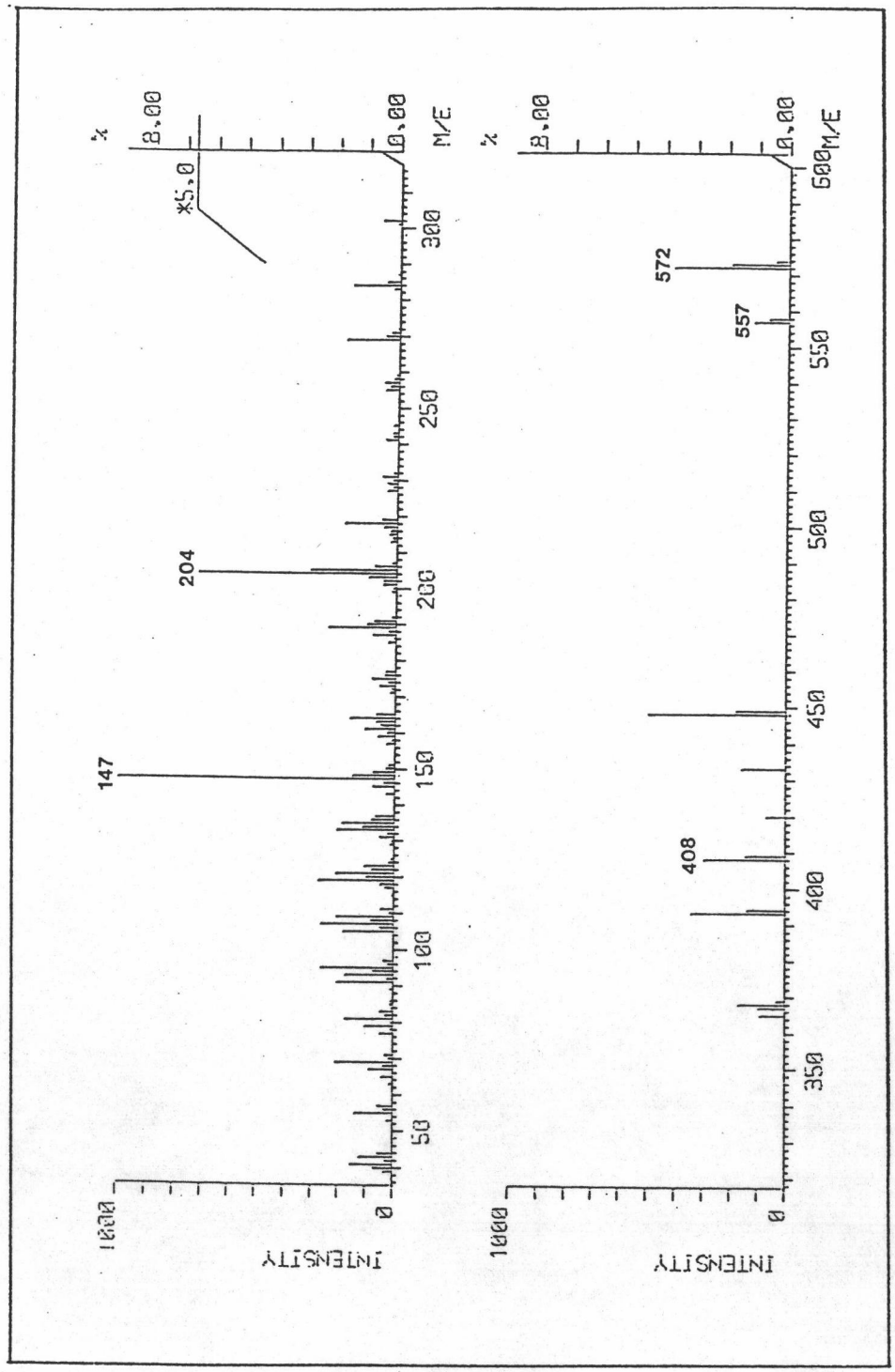


Figure 98 The mass spectrum of Compound 12

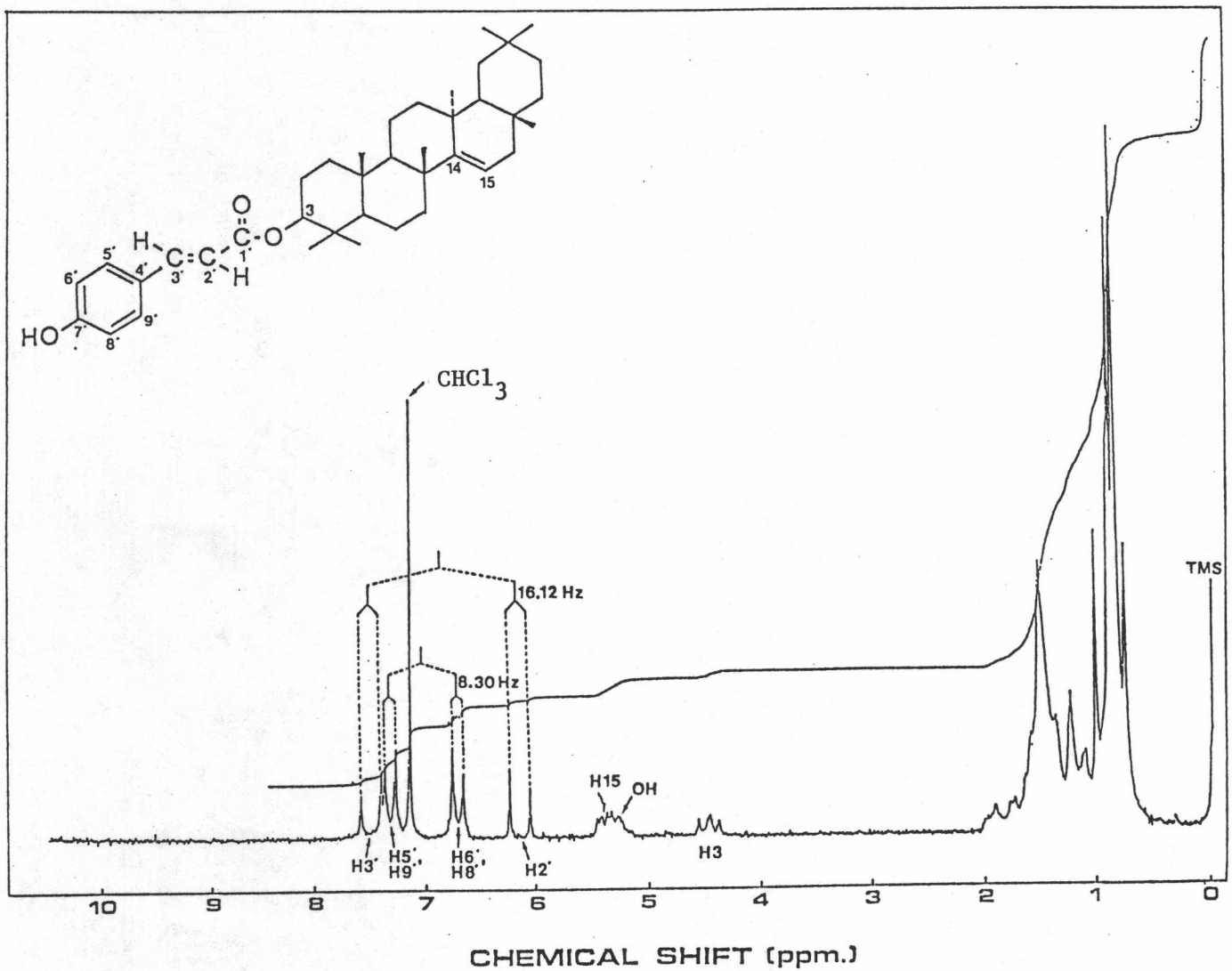


Figure 99 The ^{1}H NMR spectrum of Compound 12

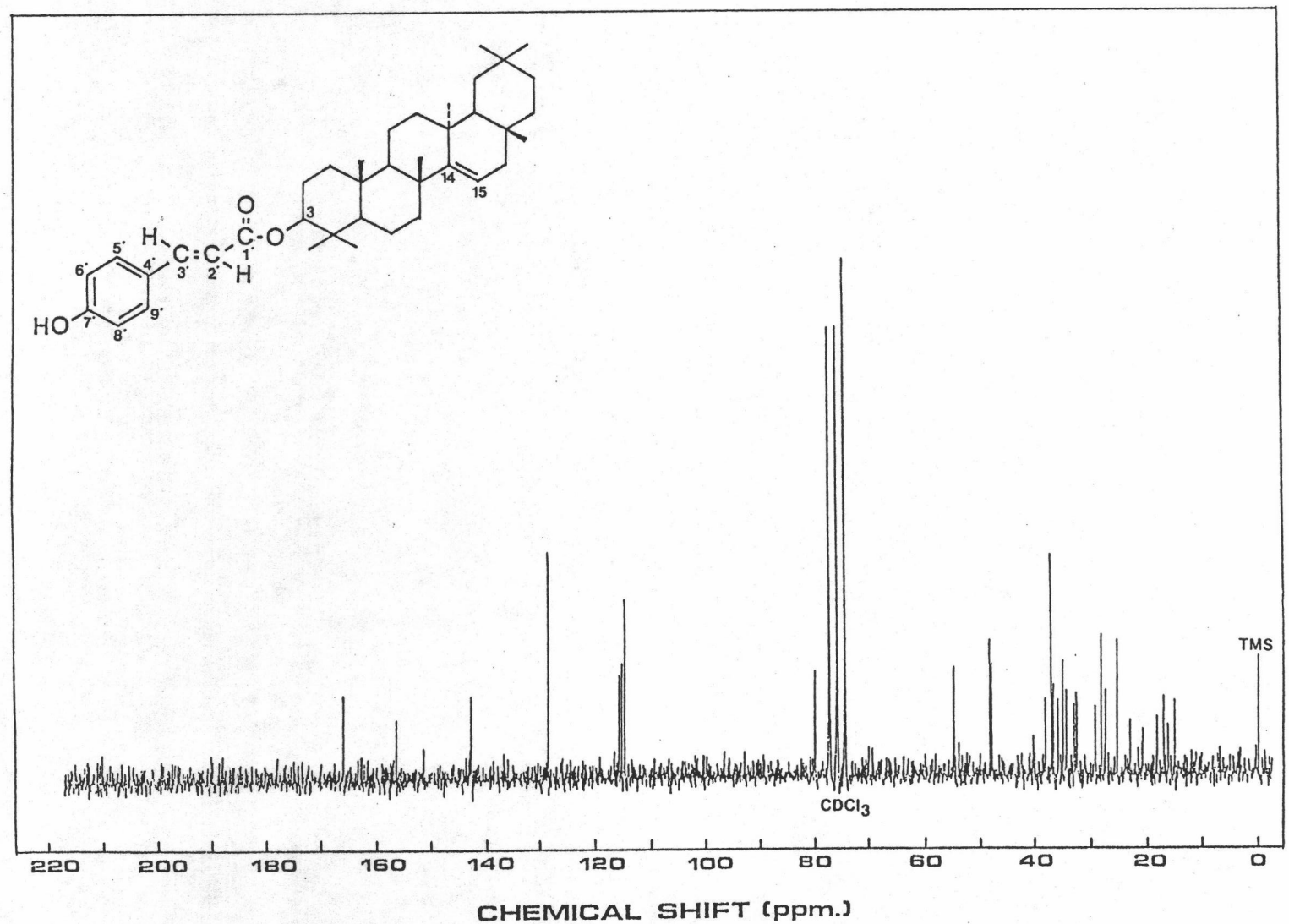
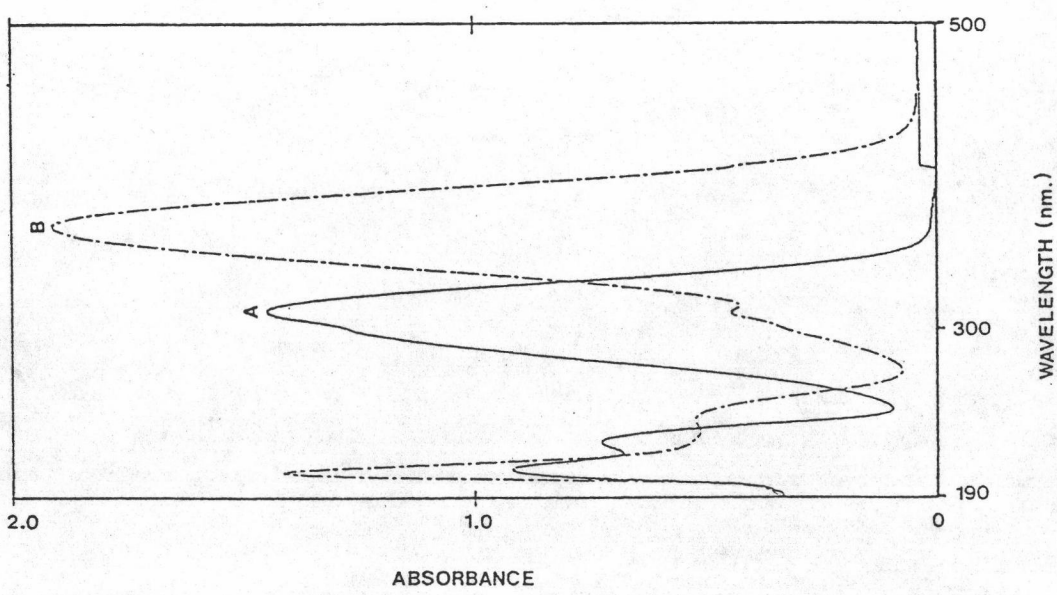


Figure 100 The ^{13}C NMR spectrum of Compound 12

Figure 101 The UV spectrum of Compound 12

A) in EtOH

B) in EtOH + 3 drops of 0.1 M. NaOH



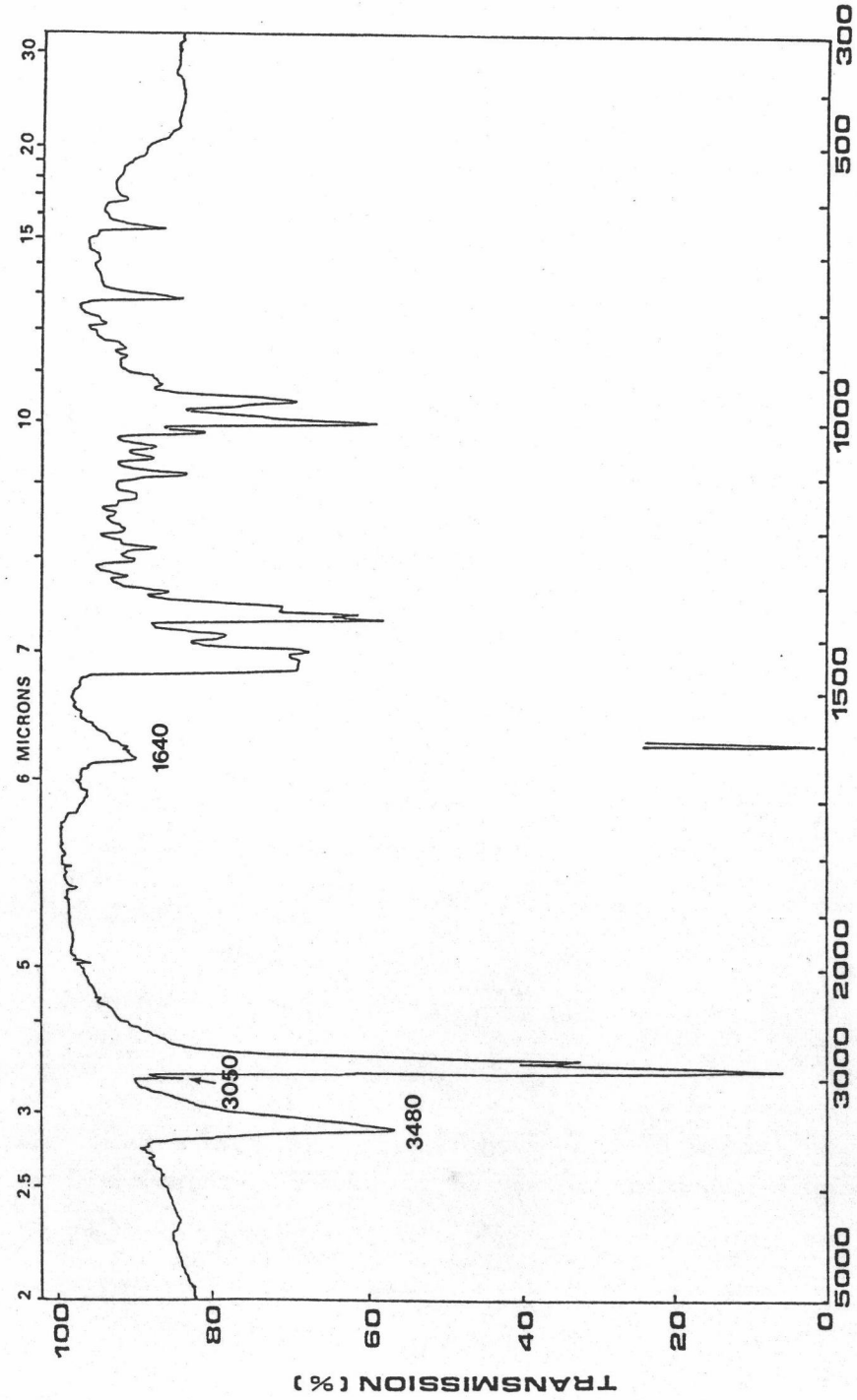


Figure 102 The IR spectrum of Compound 12A

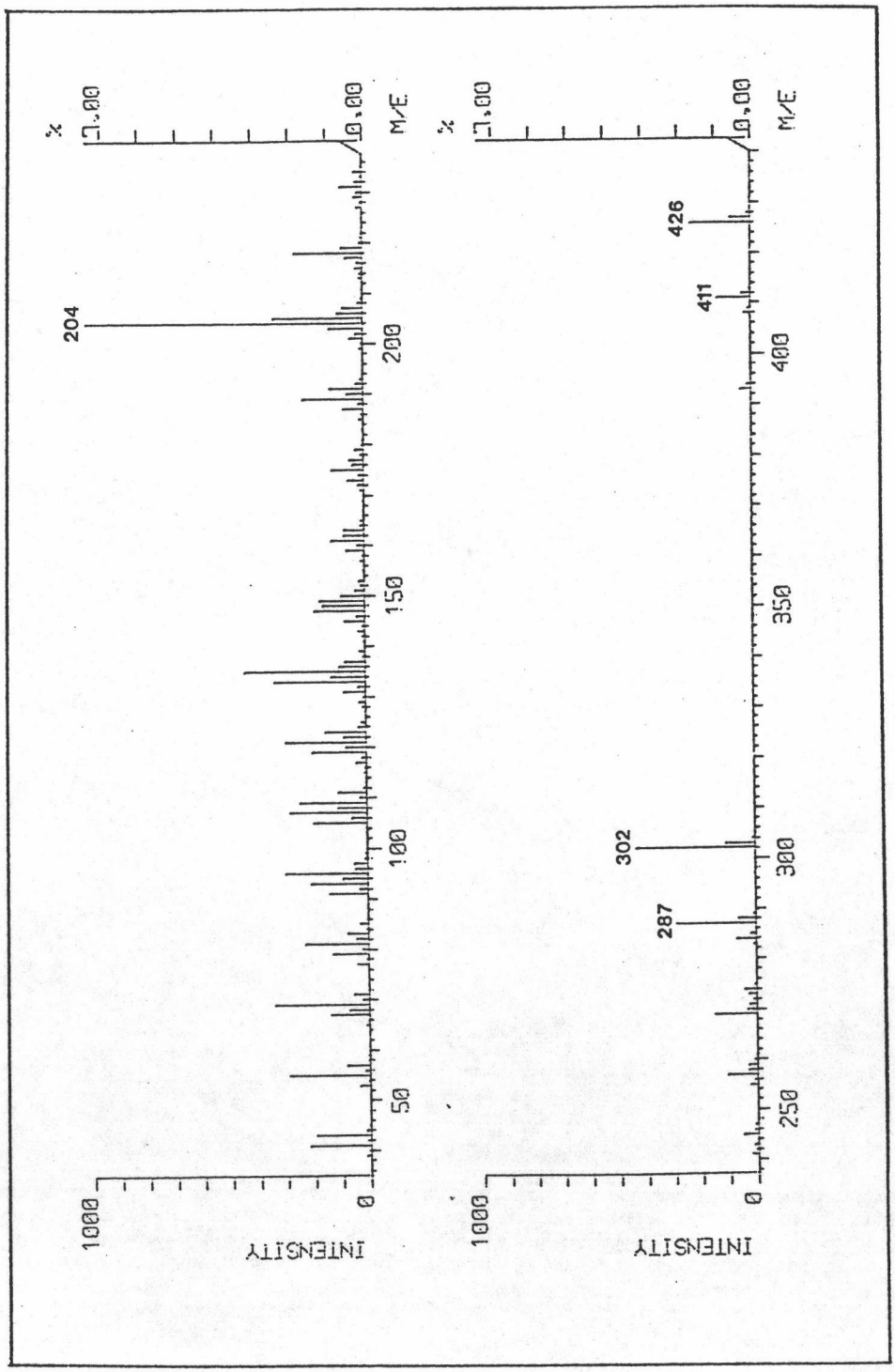


Figure 103 The mass psectrum of Compound 12A

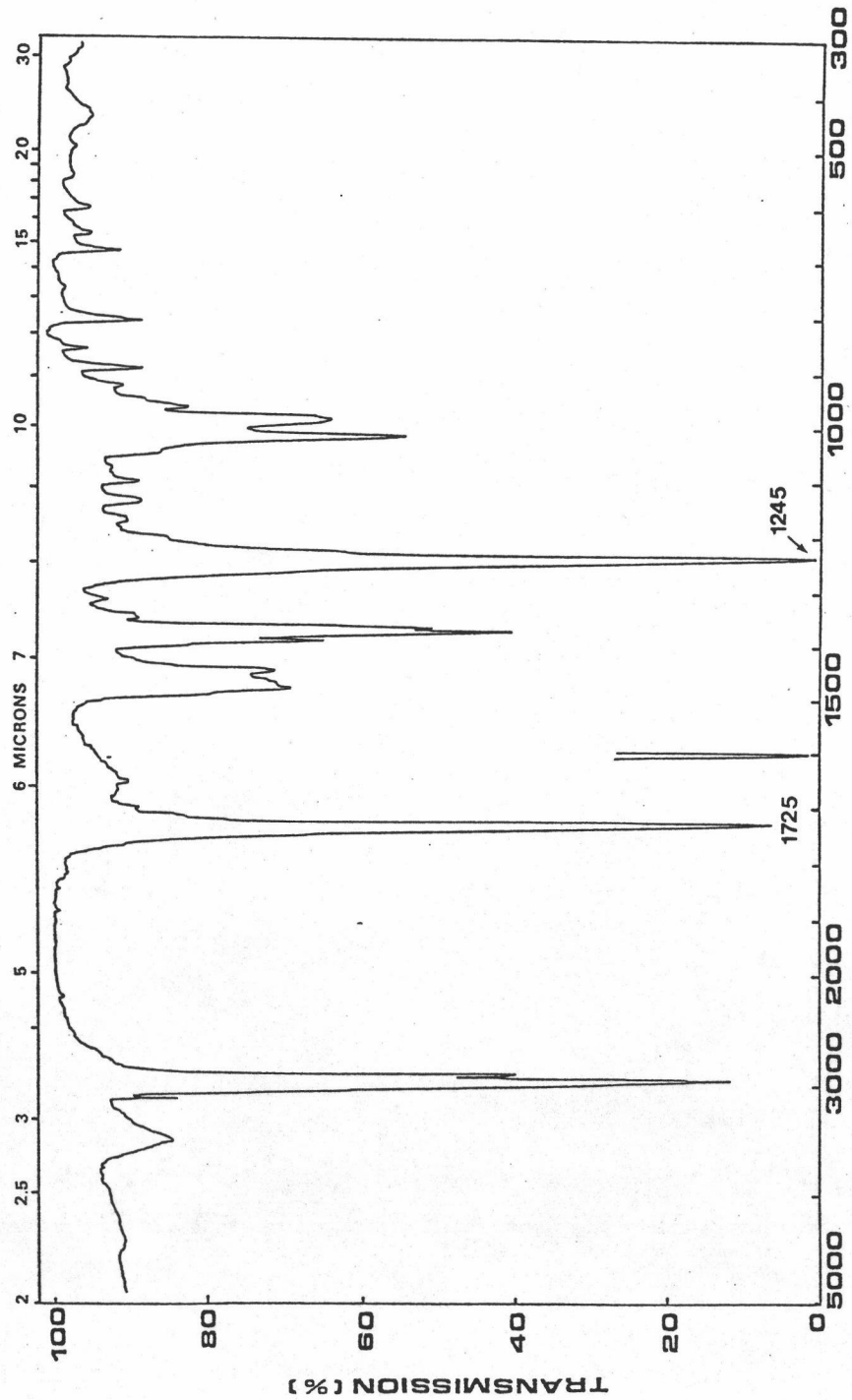


Figure 104 The IR spectrum of Compound 12A acetate

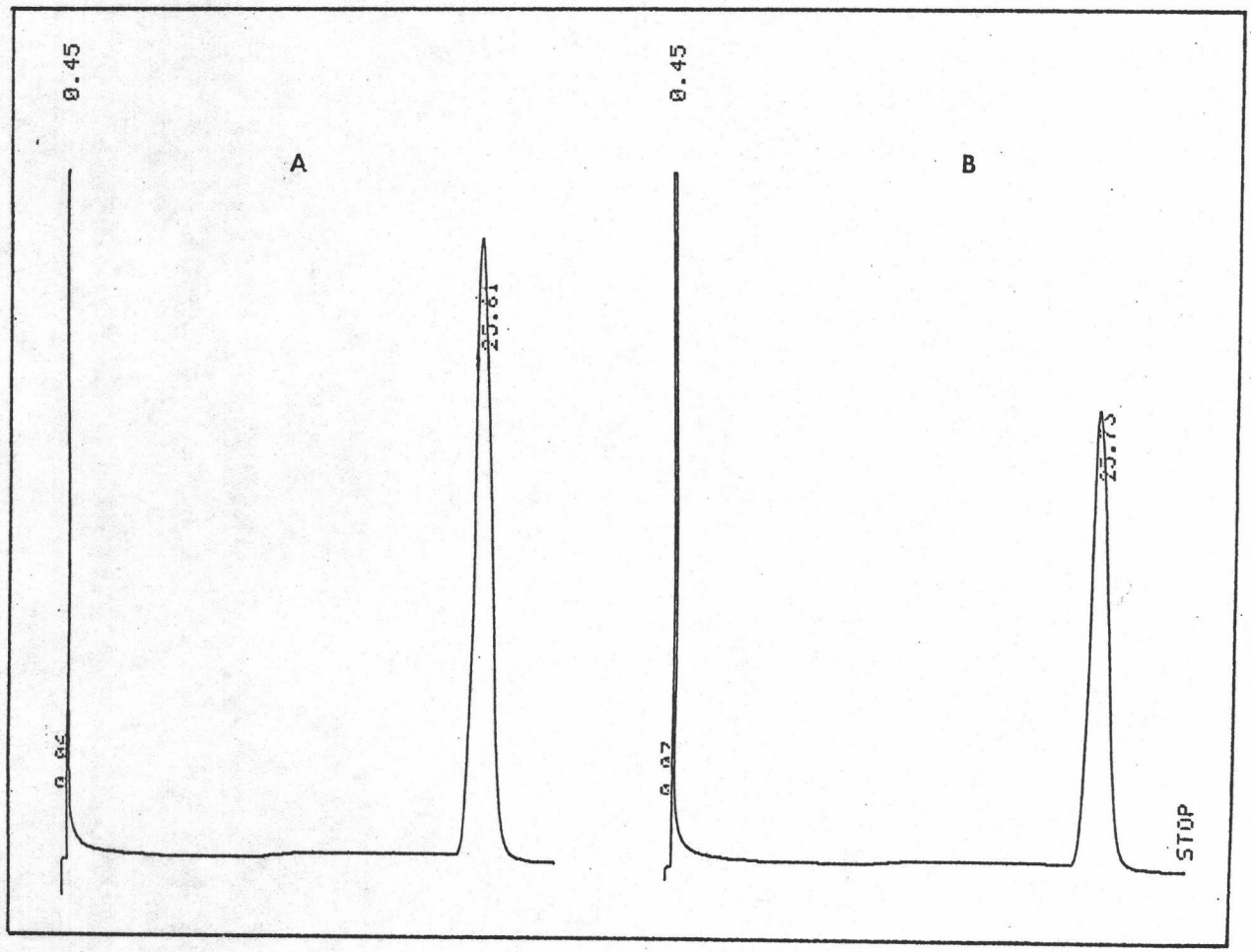


Figure 105 The GLC analysis results of

A) the authentic taraxerylacetate

B) Compound 12A acetate

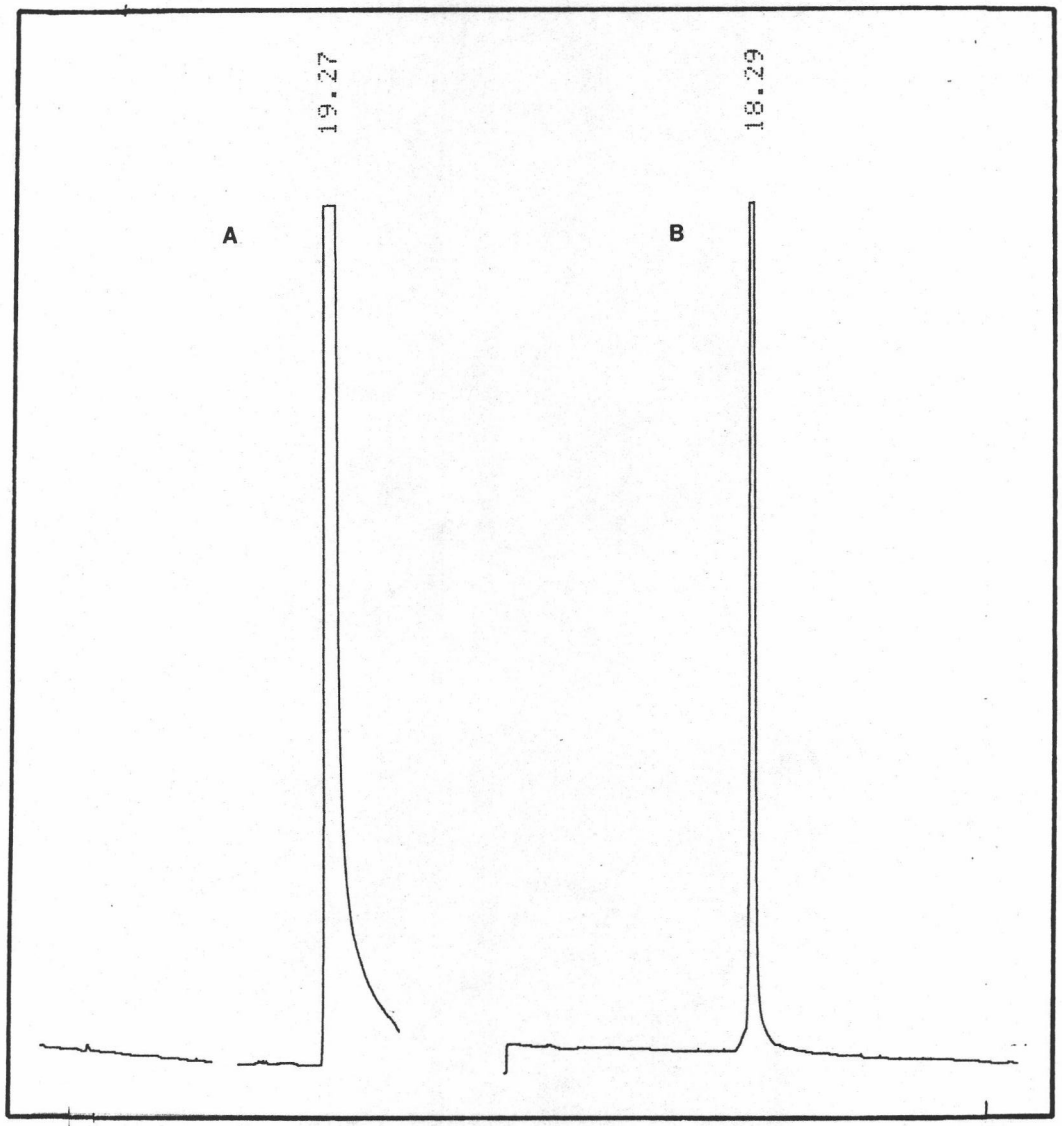


Figure 106 The HPLC analysis results of

A) the authentic trans-p-coumaric acid

B) Compound 12B

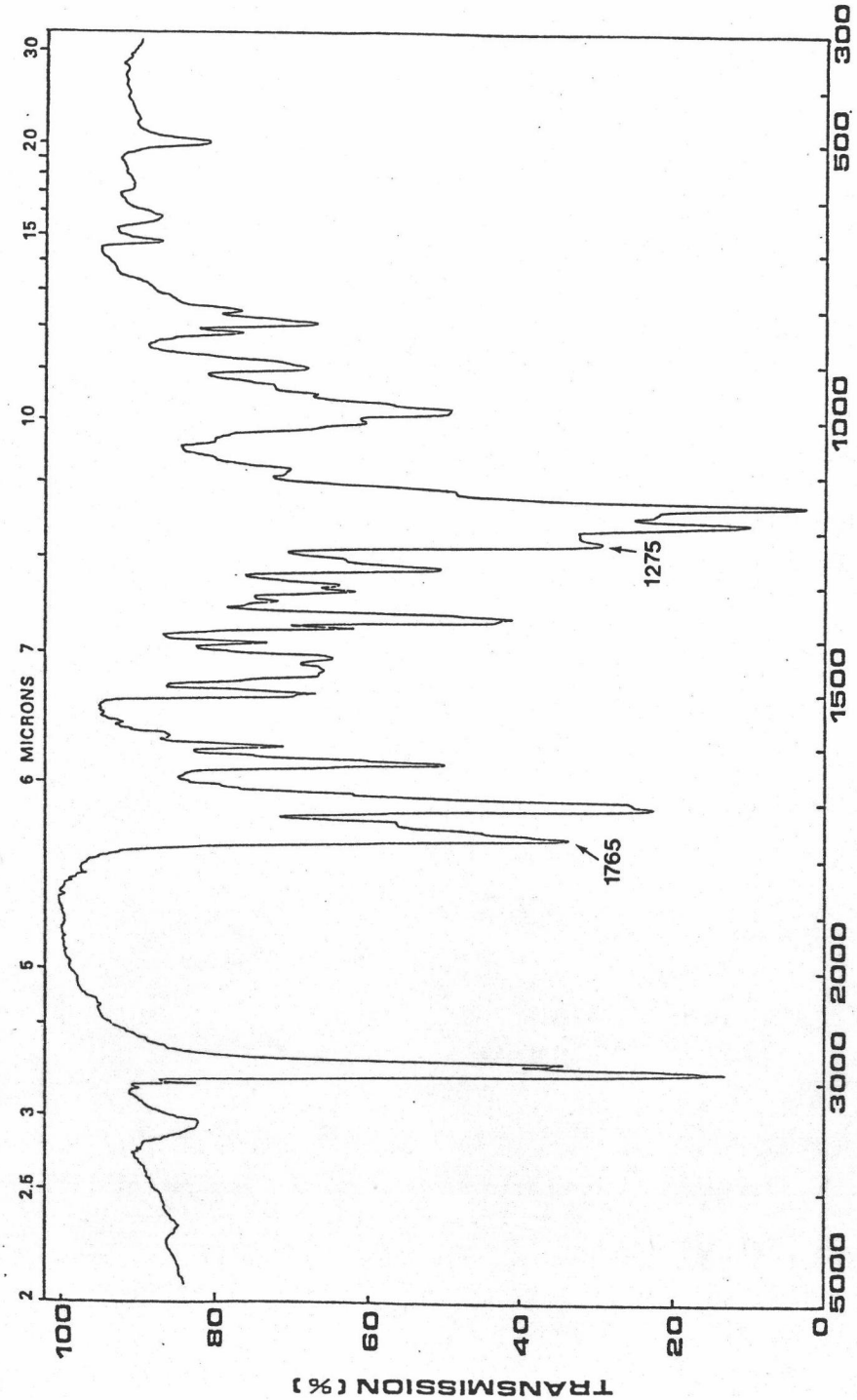


Figure 107 The IR spectrum of Compound 12 acetate

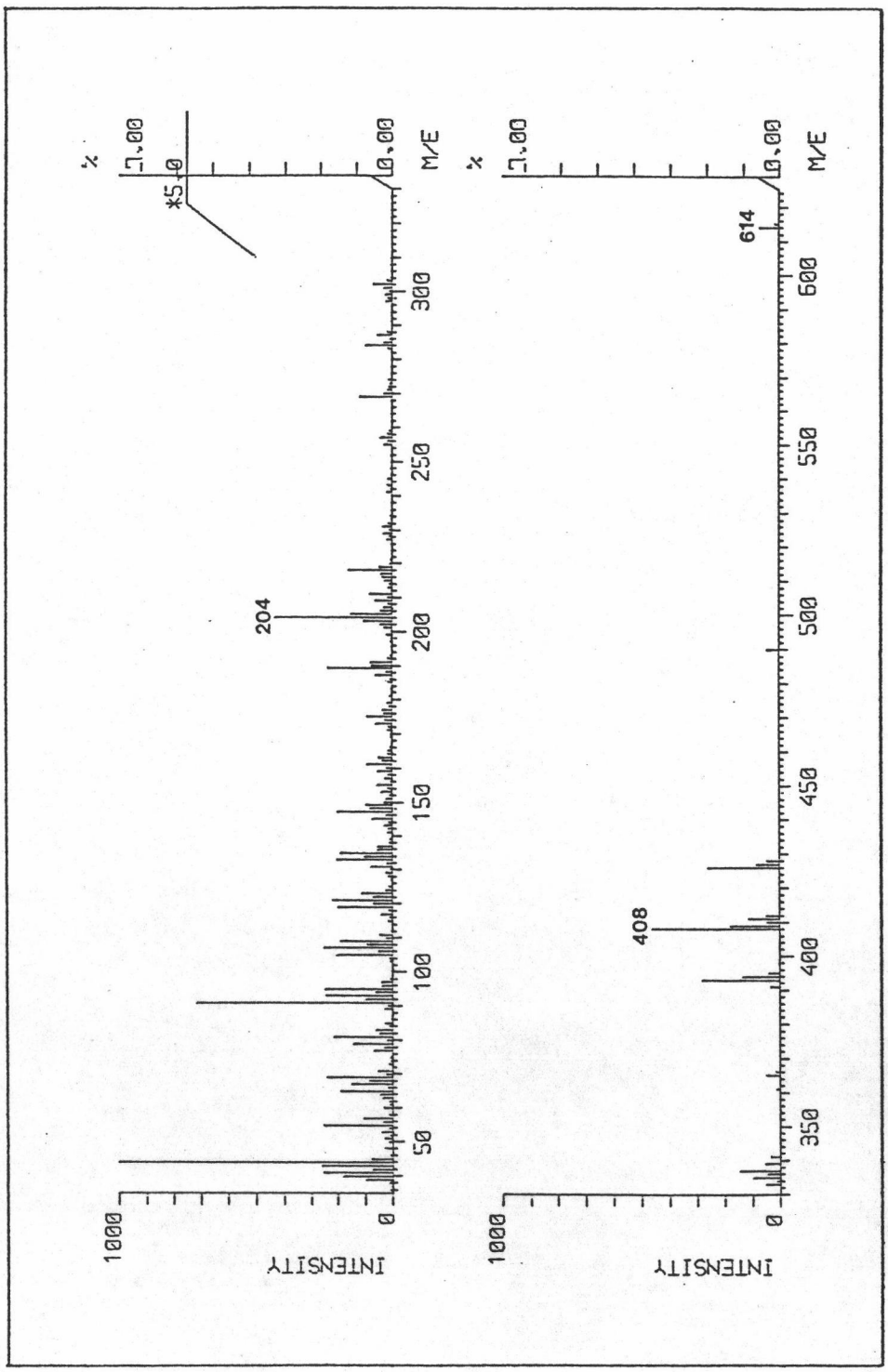


Figure 108 The mass spectrum of Compound 12 acetate

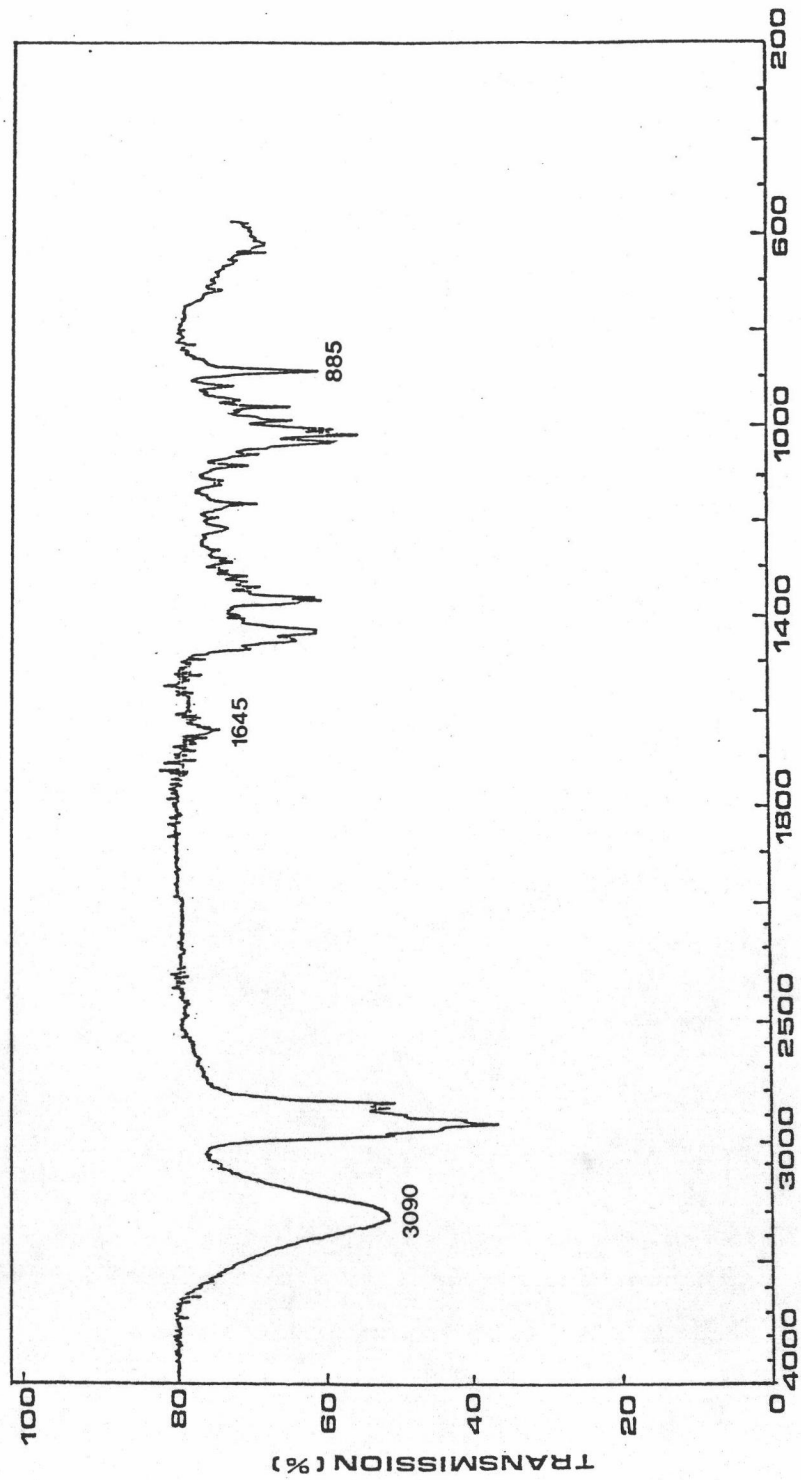


Figure 109 The IR spectrum of Compound 13

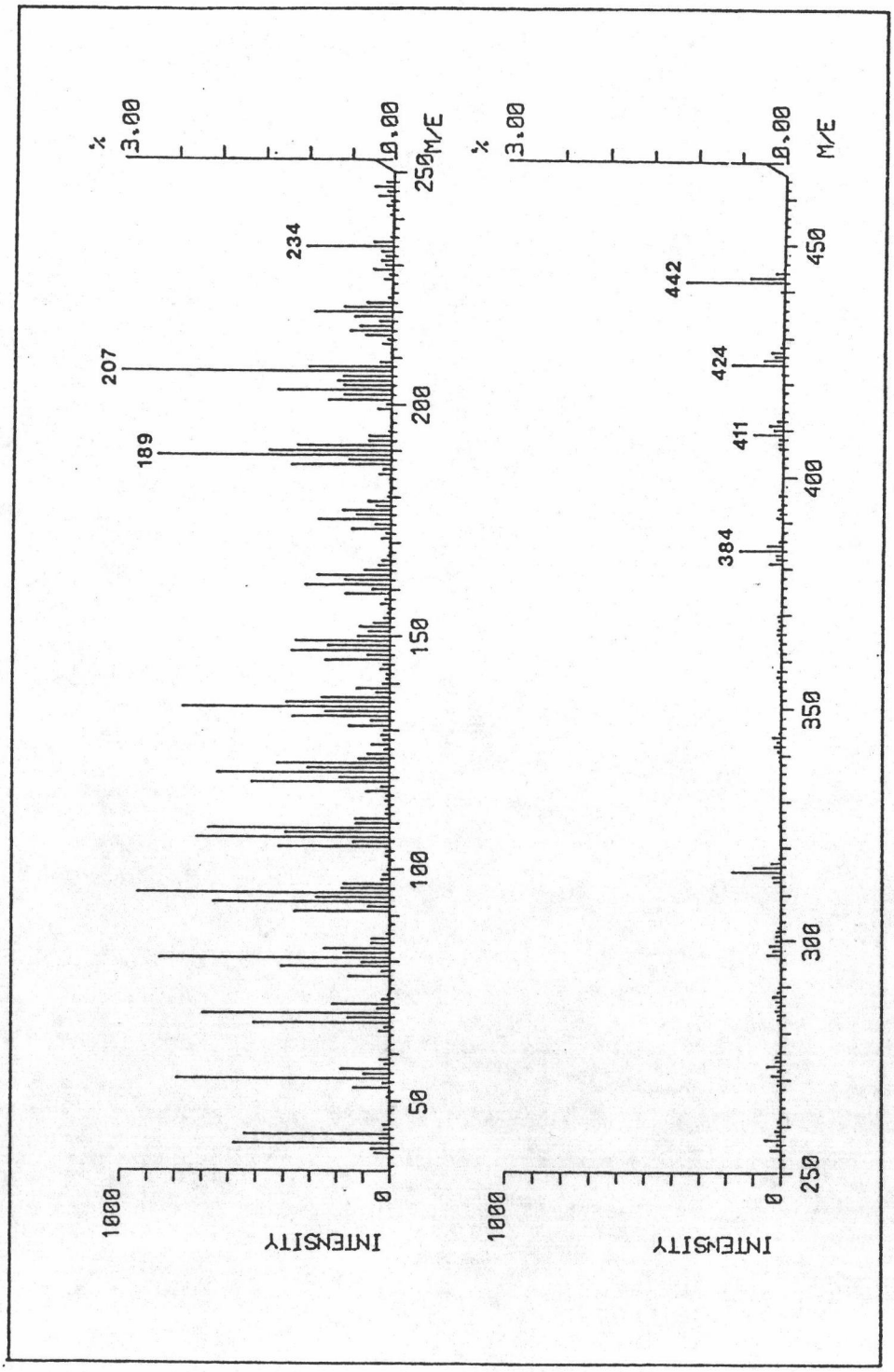


Figure 110 The mass spectrum of Compound 13

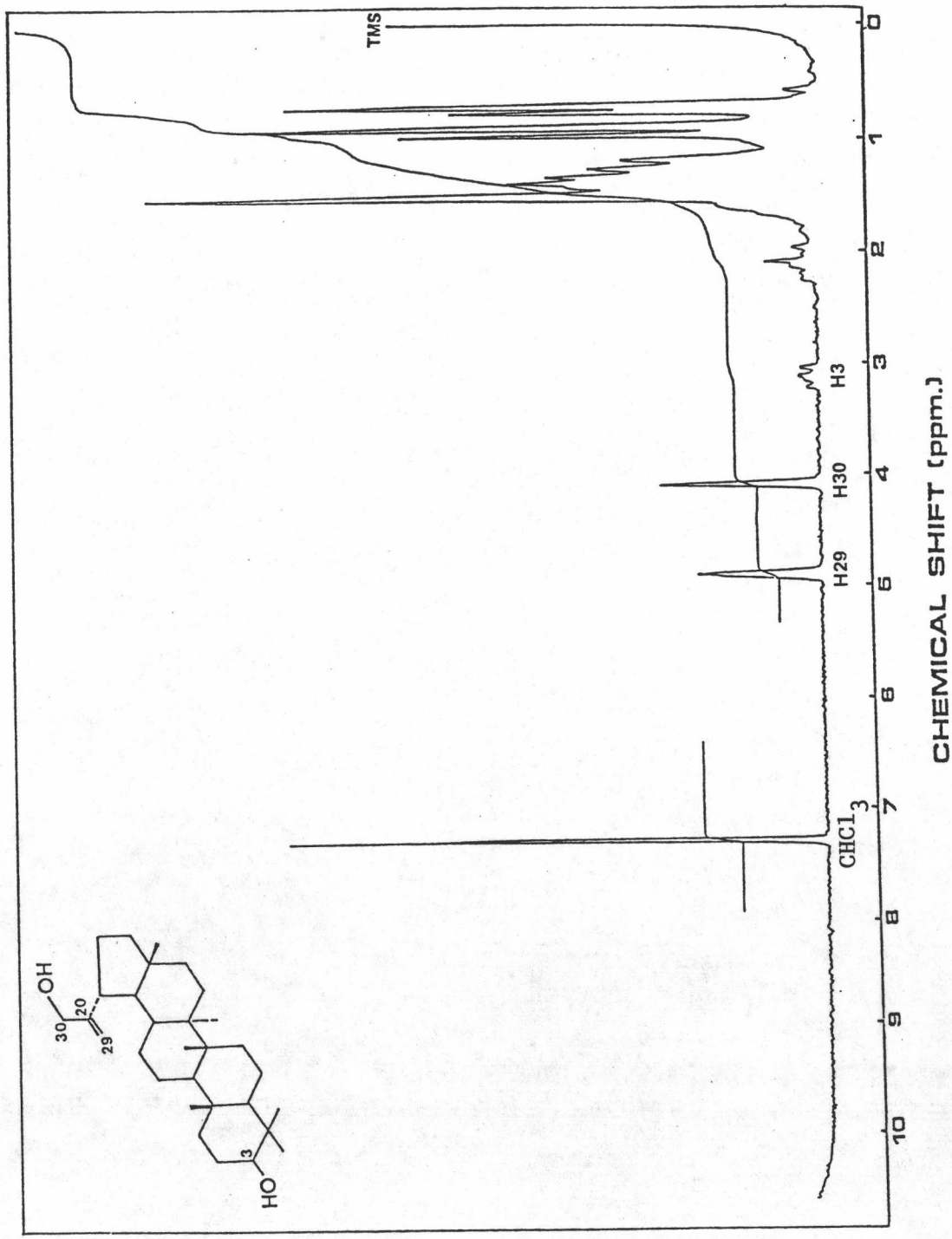


Figure 111 The ^{1}H NMR spectrum of Compound 13

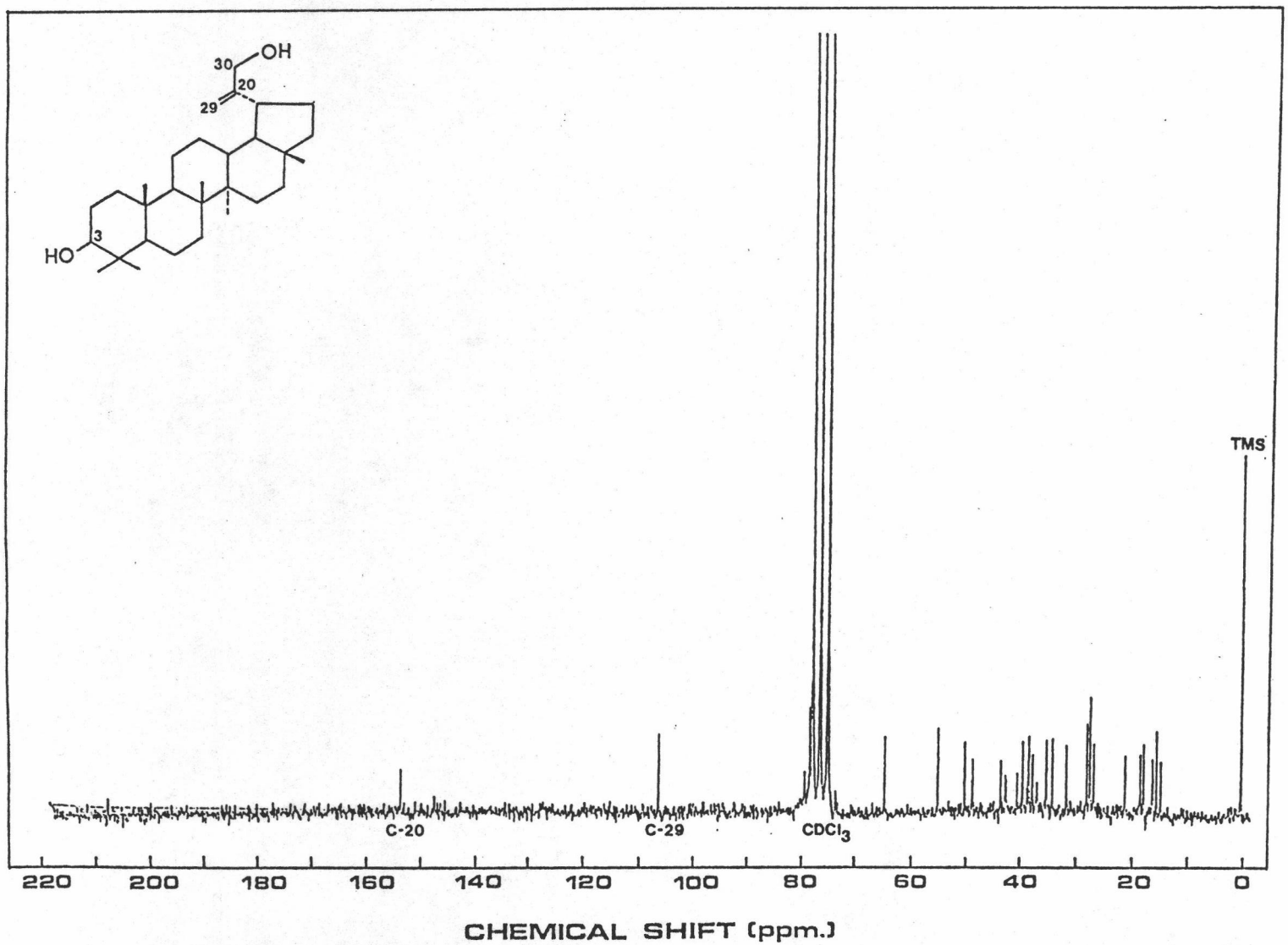


Figure 112 The ^{13}C NMR spectrum of Compound 13

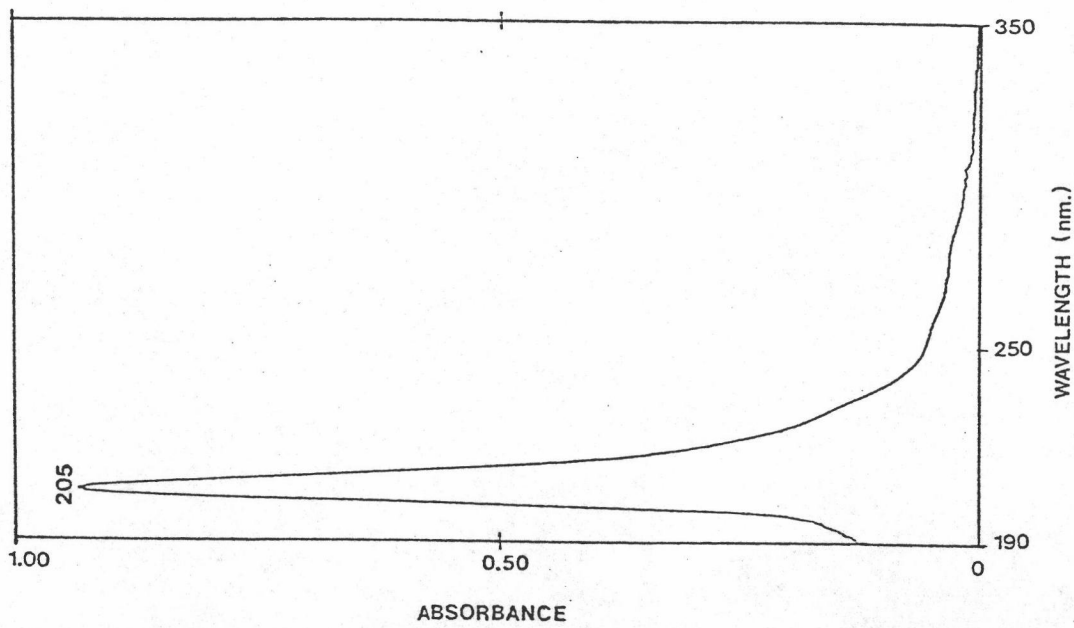


Figure 113 The UV spectrum of Compound 13

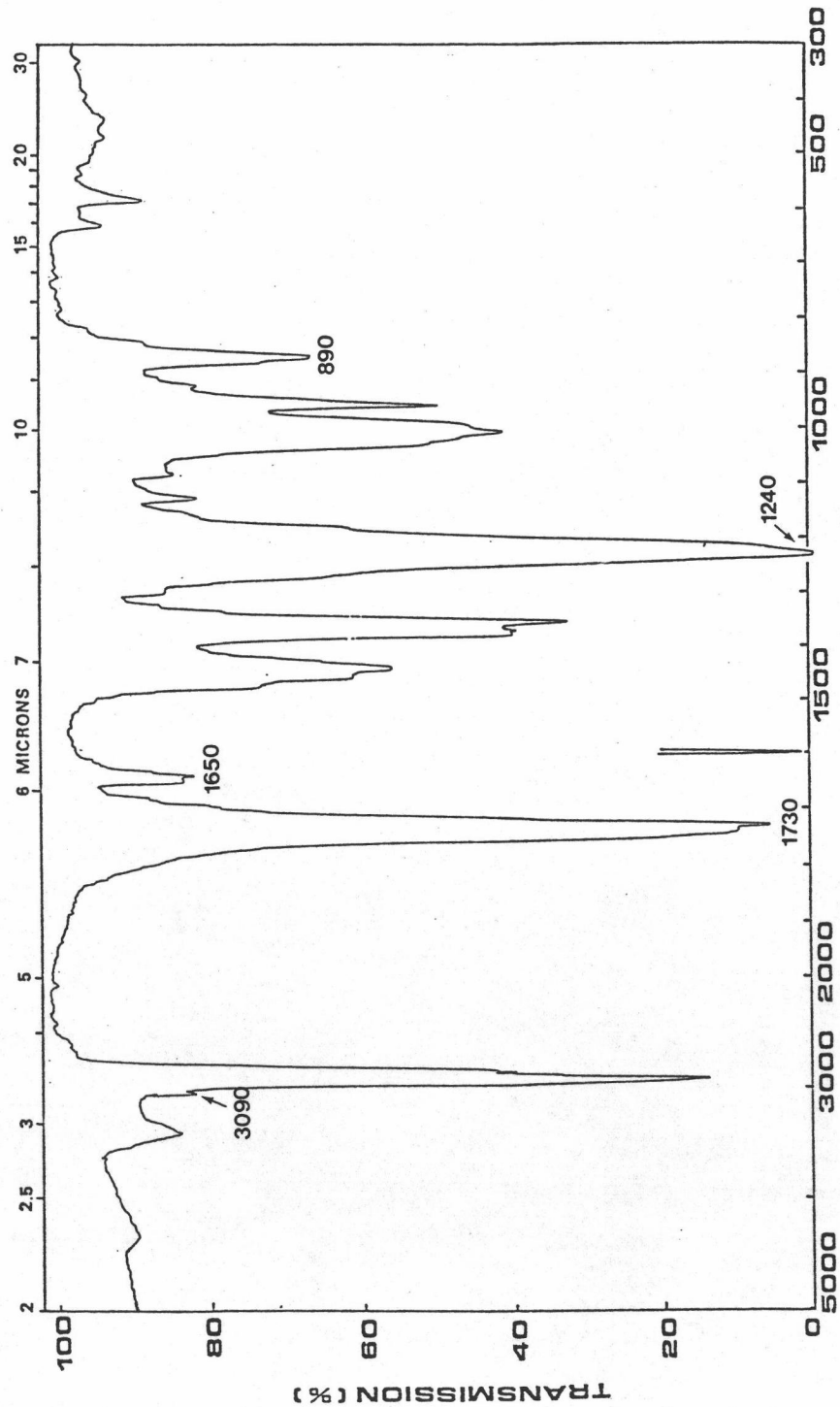


Figure 114 The IR spectrum of Compound 13 acetate

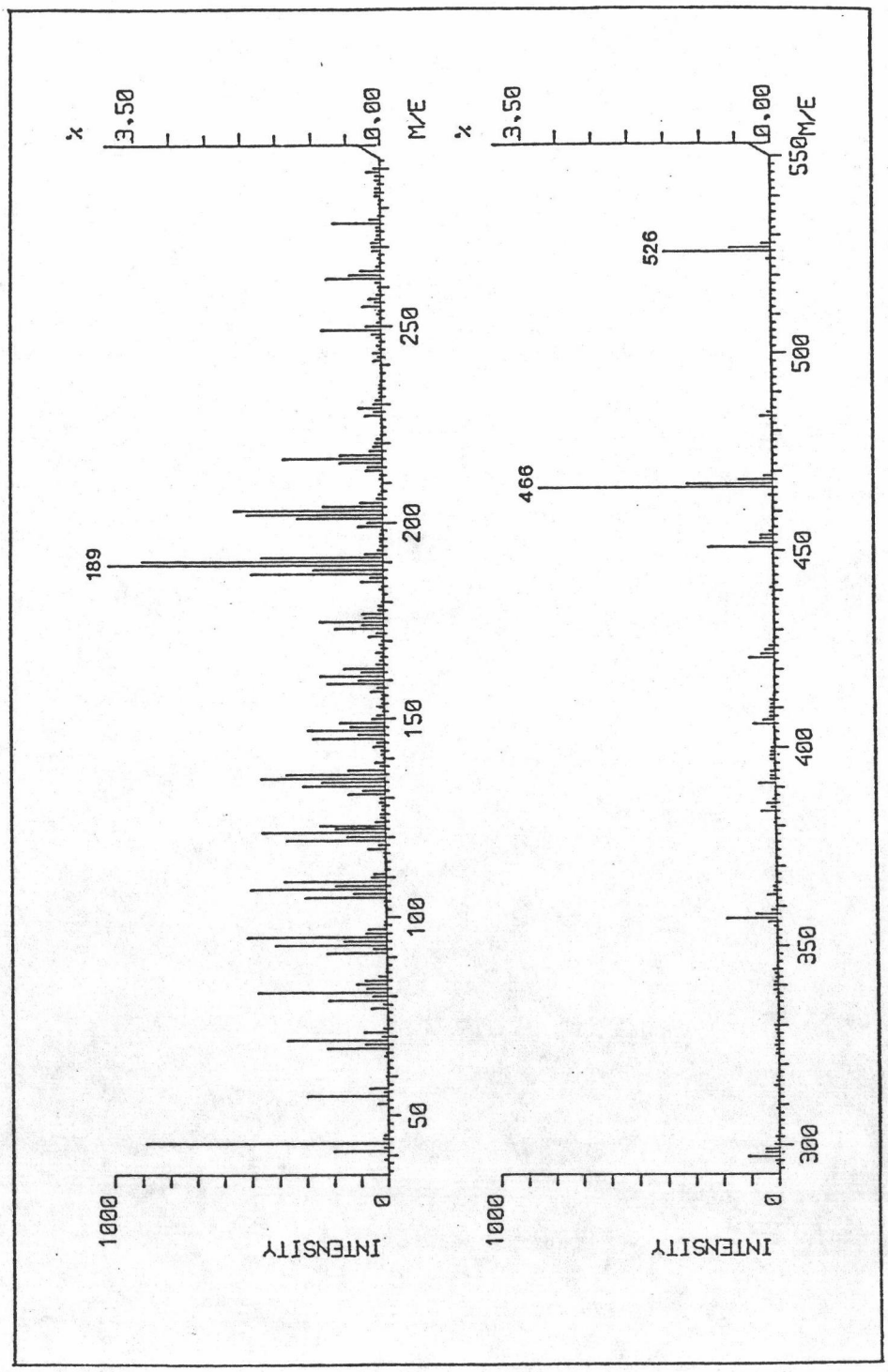


Figure 115 The mass spectrum of Compound 13 acetate

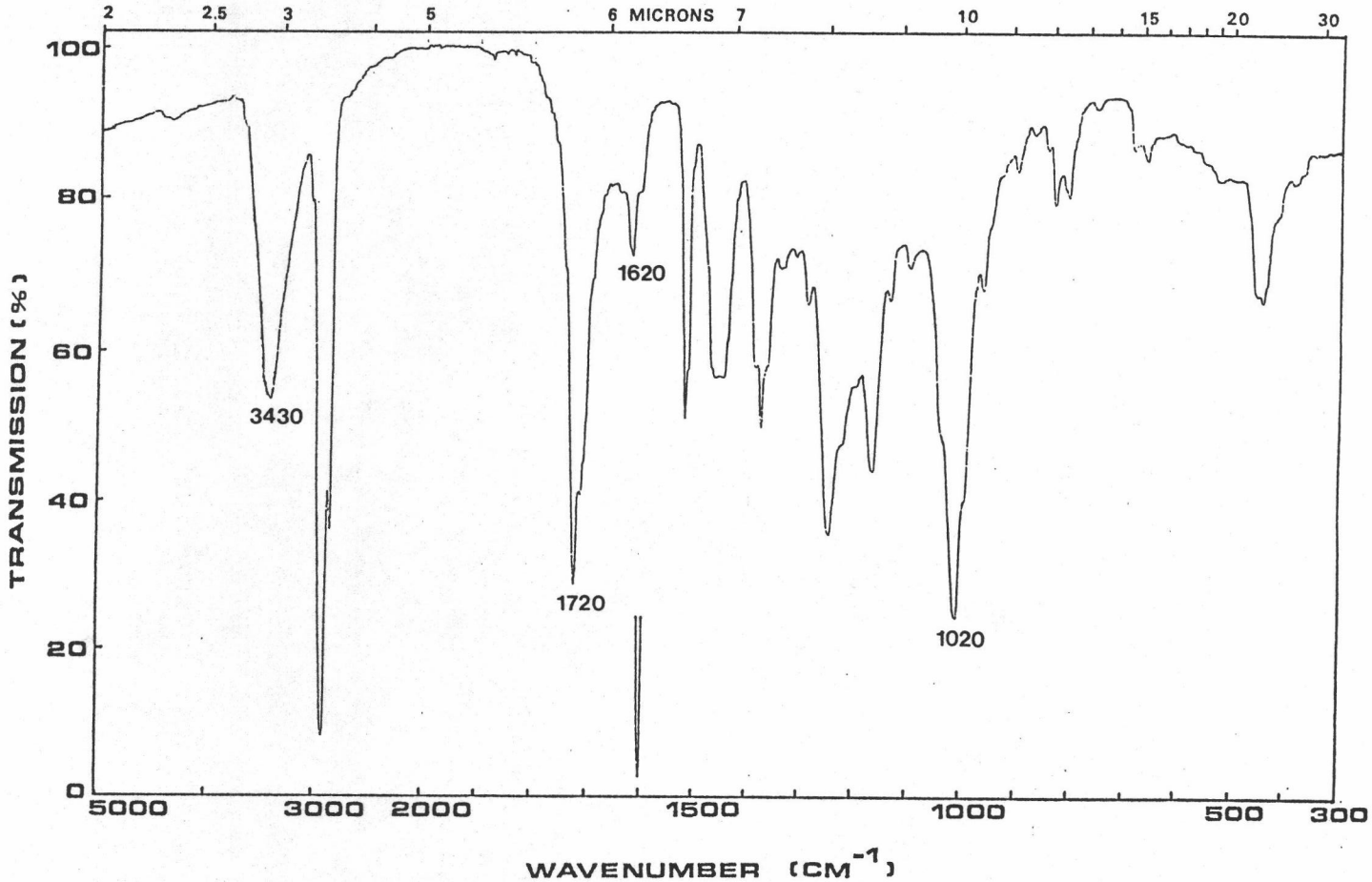


Figure 116 The IR spectrum of Compound A

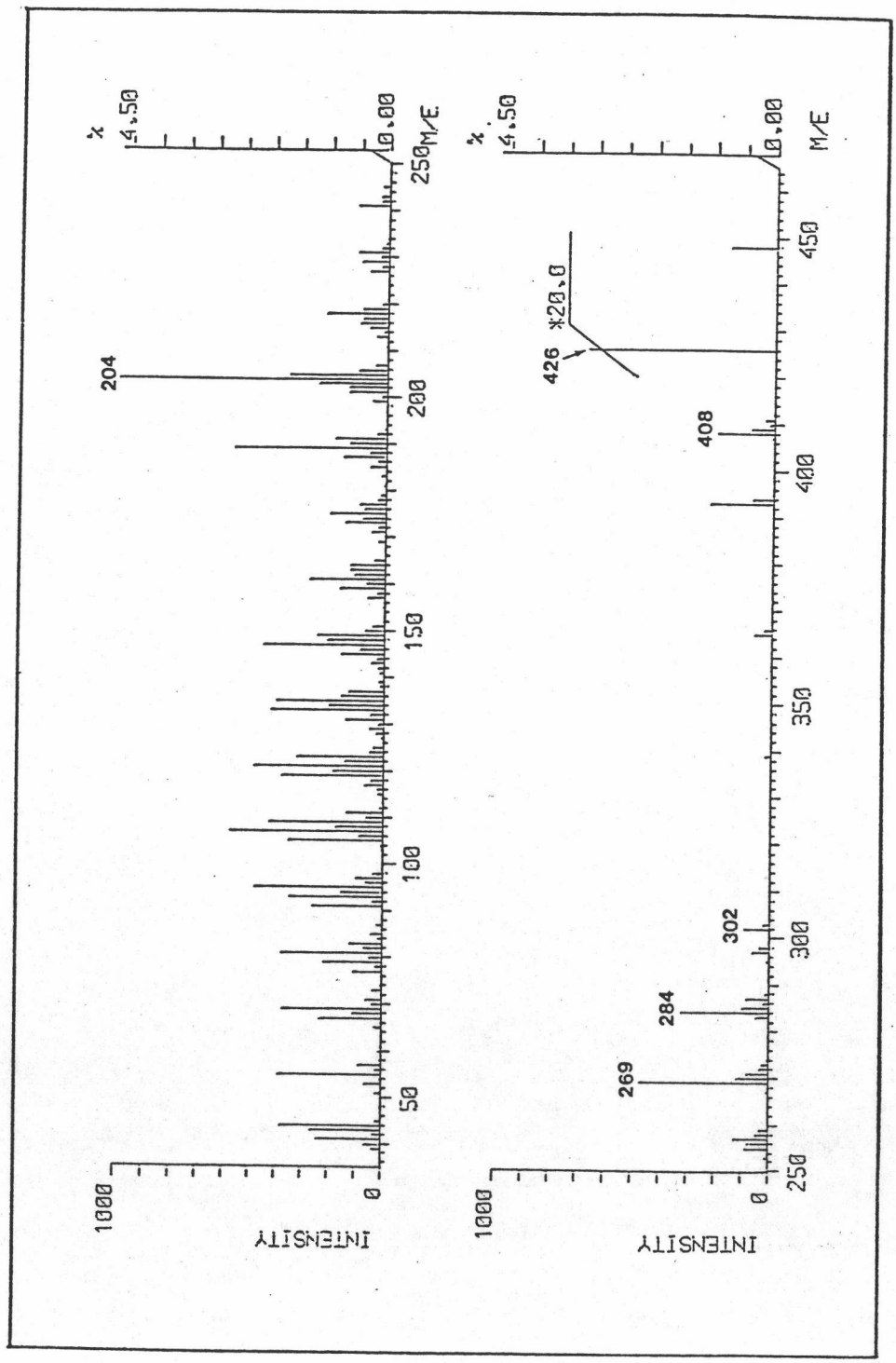


Figure 117 The mass spectrum of Compound A

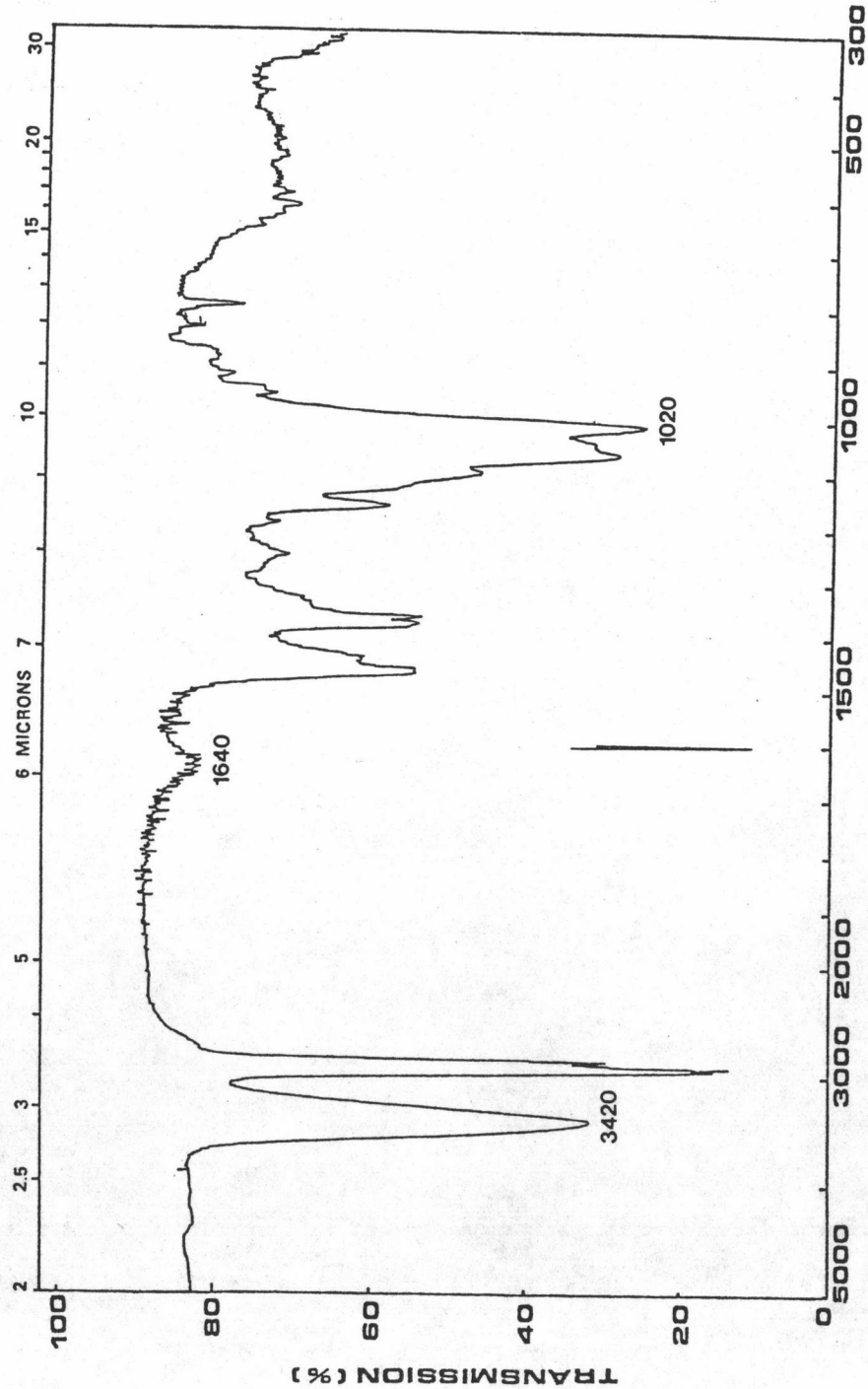


Figure 118 The IR spectrum of Compound 14

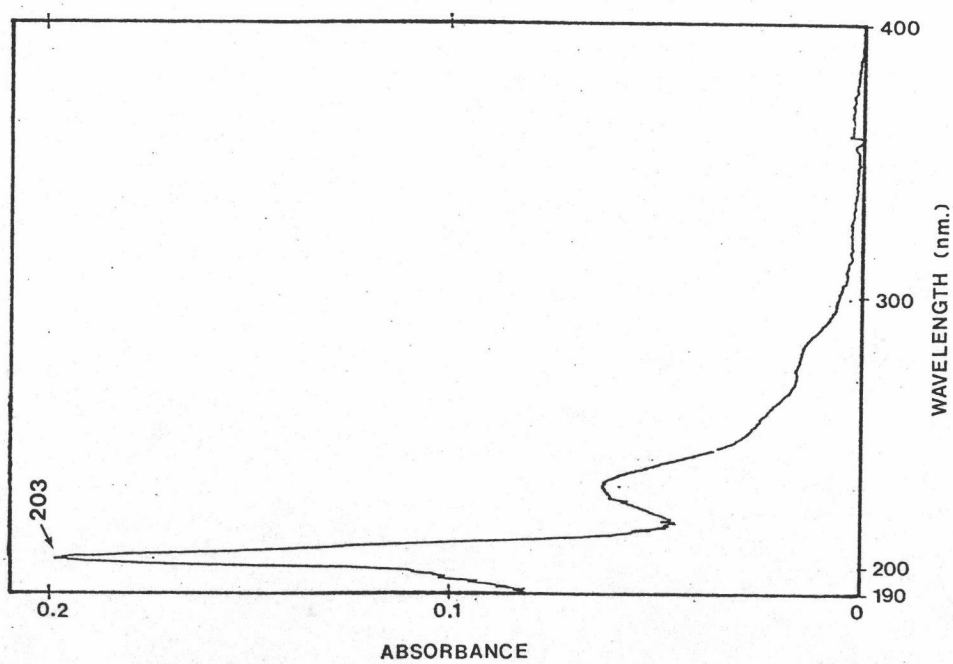


Figure 119 The UV spectrum of Compound 14

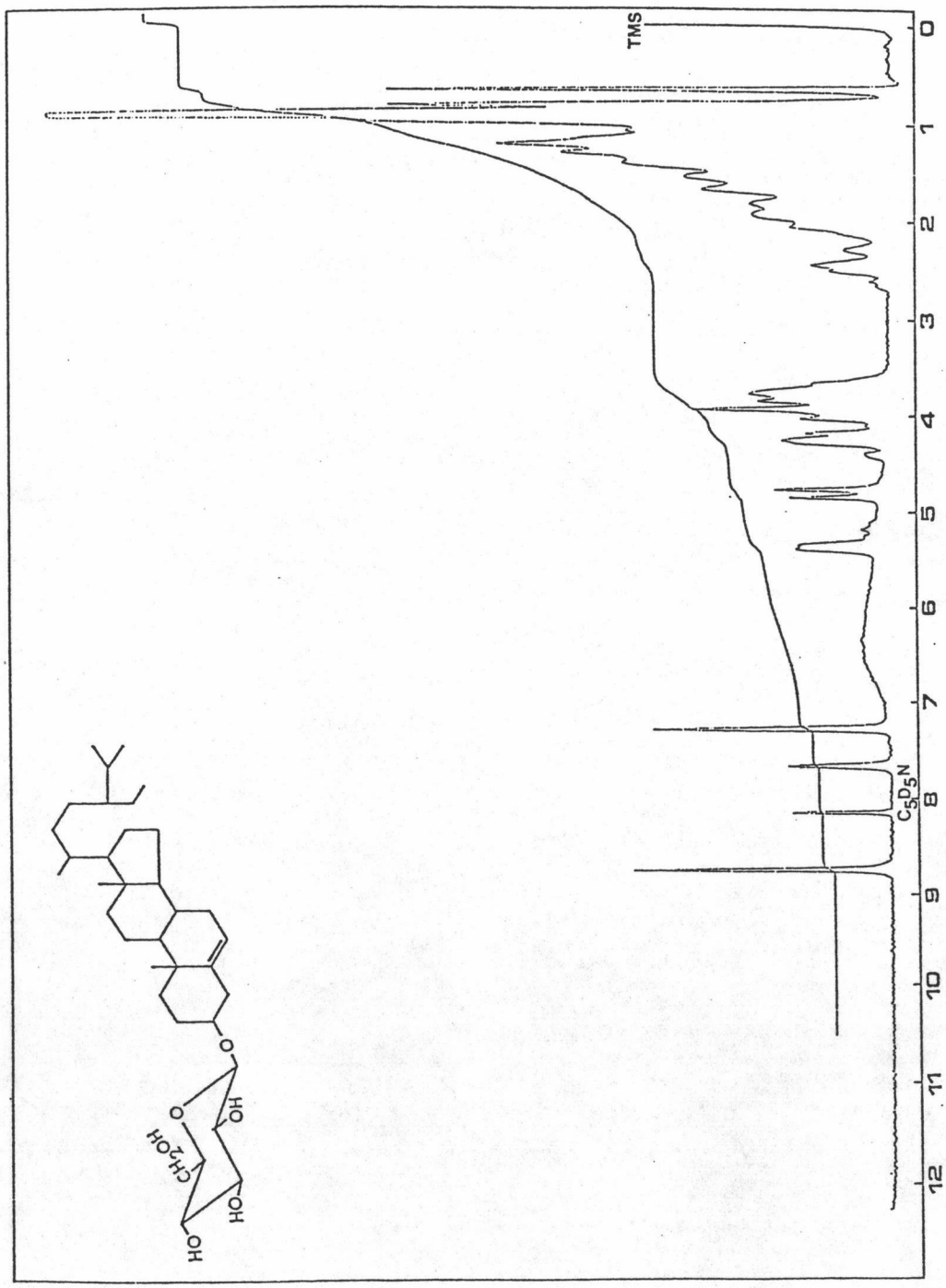


Figure 120 The ^1H NMR spectrum of Compound 14

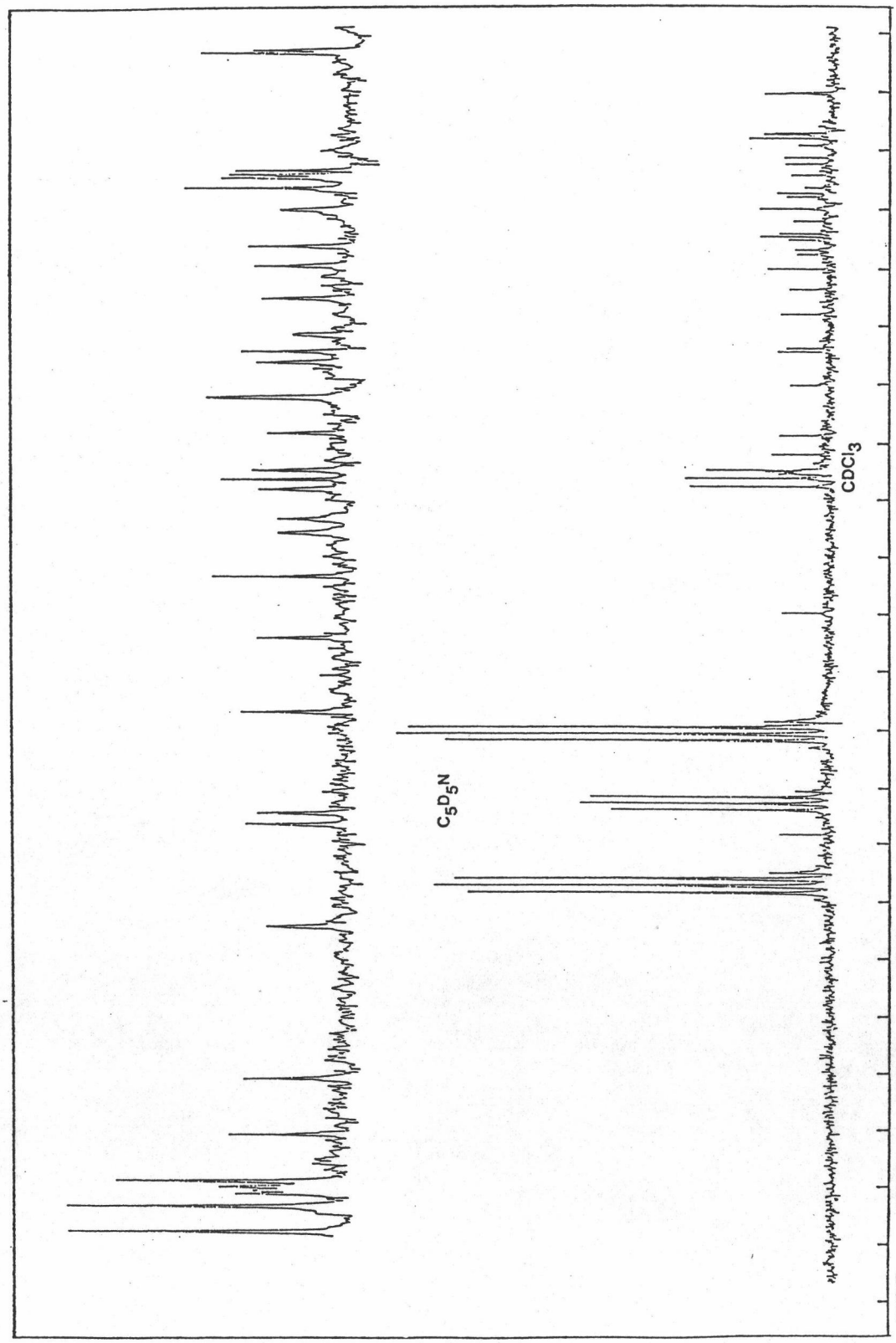


Figure 121 The ^{13}C NMR spectrum of Compound 14

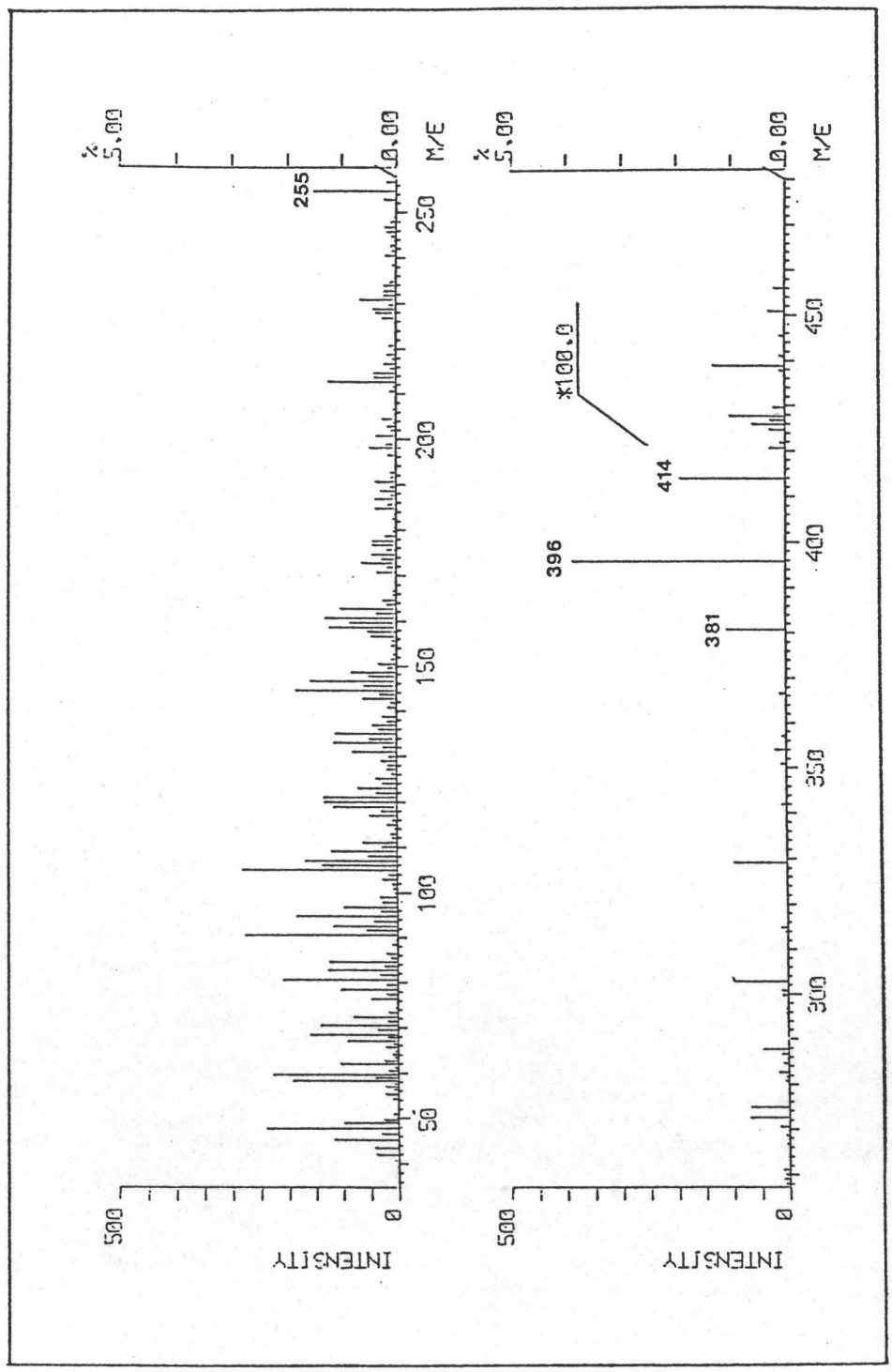


Figure 122 The mass spectrum of Compound 14

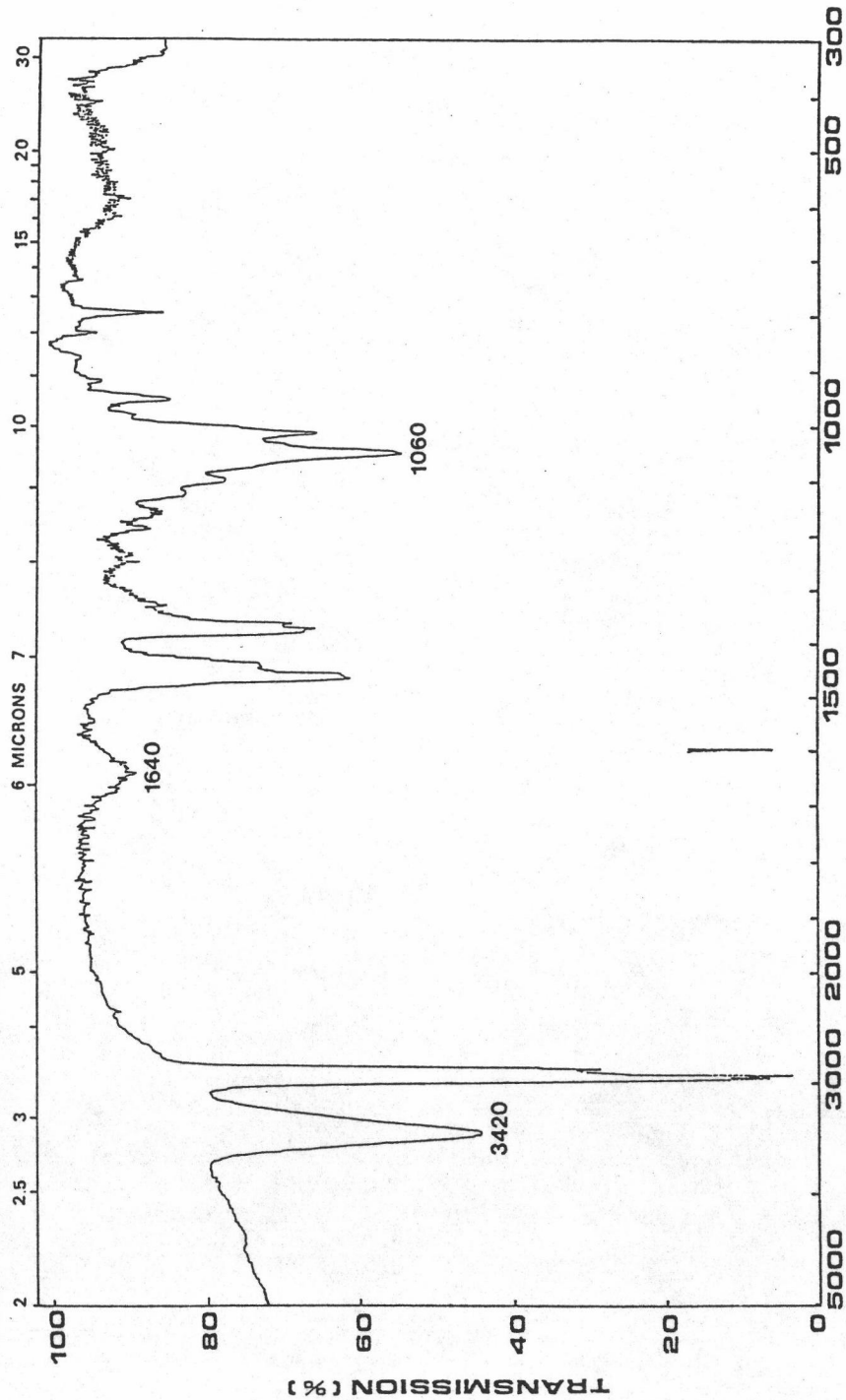


Figure 123 The IR spectrum of Compound 14A

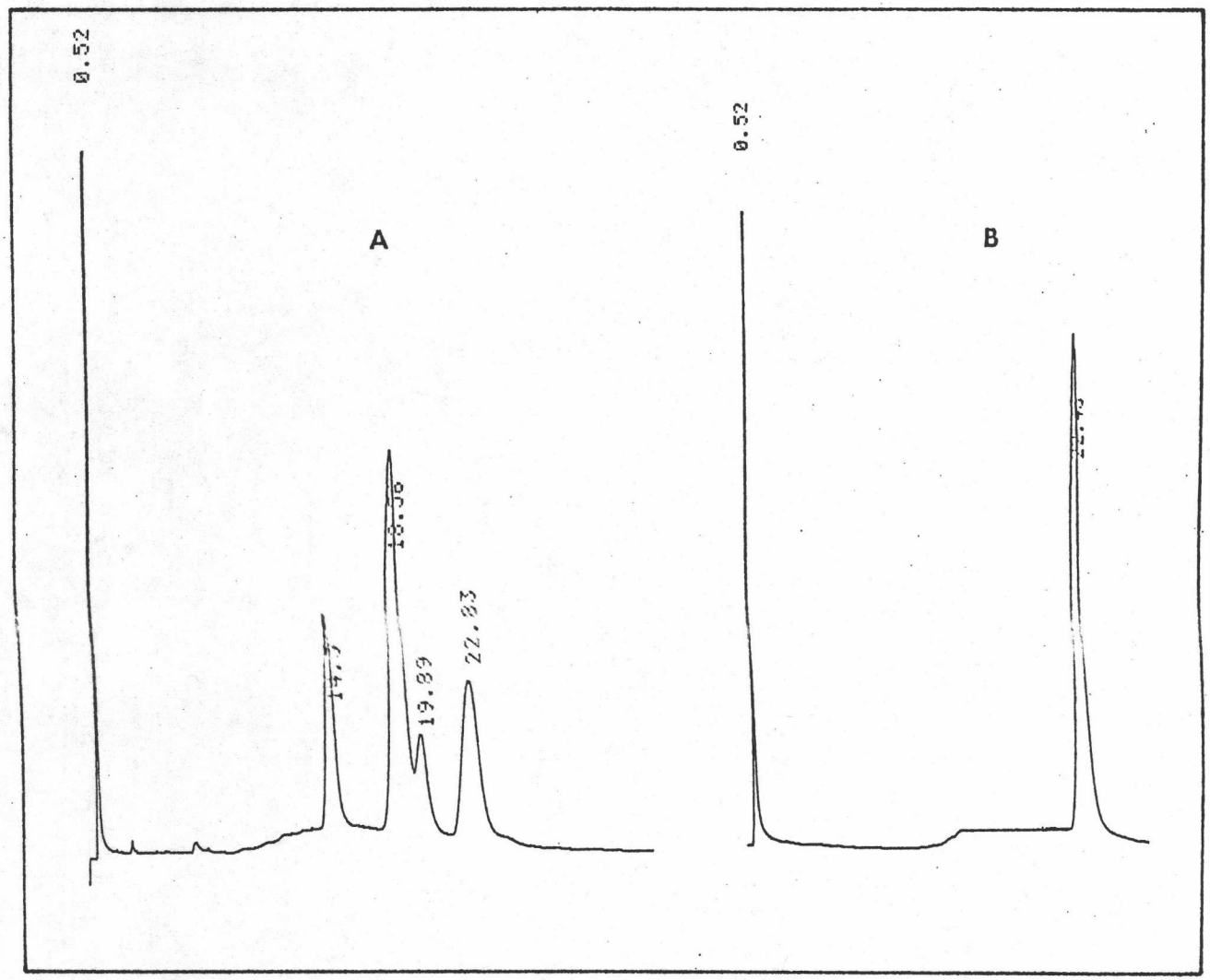


Figure 124 The GLC analysis results of

A) standard cholesterol, campesterol, stigmasterol and β-sitosterol

B) Compound 14B

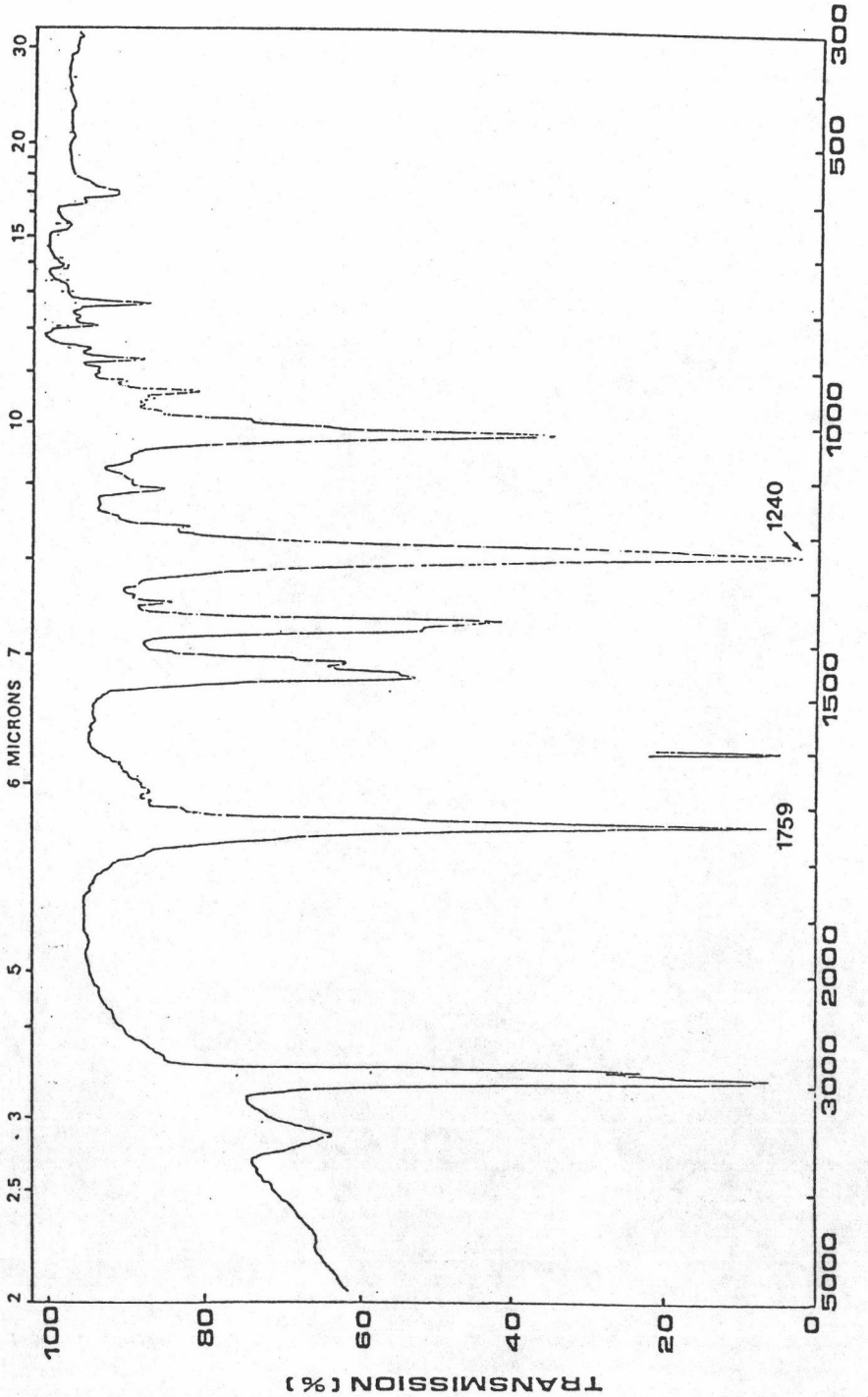
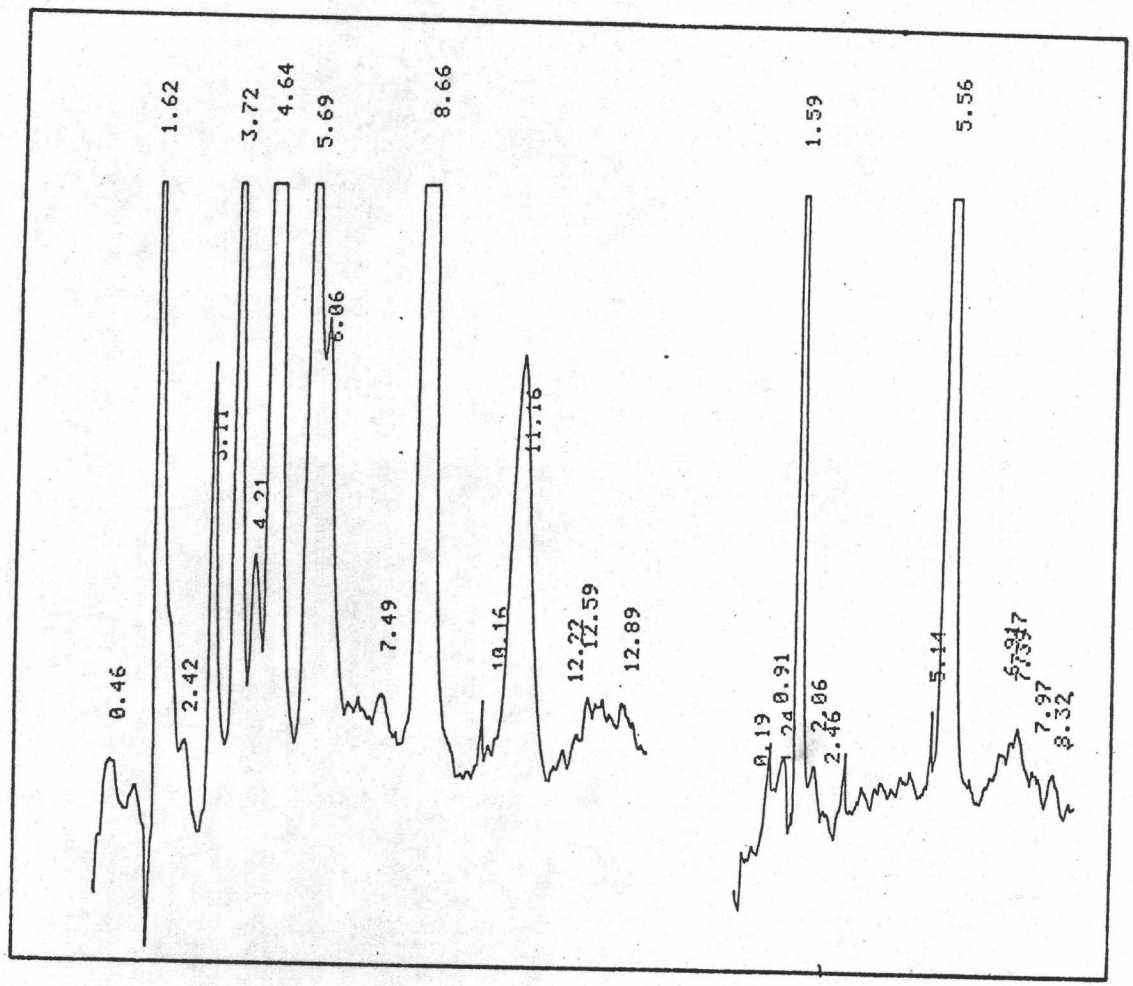


Figure 125 The IR spectrum of Compound 14A acetate



Samples	Rt (min.)
solvent (H_2O)	1.62
rhamnose	3.11
xylose	3.72
arabinose	4.21
fructose	4.64
glucose	5.69
galactose	6.06
sucrose	8.66
maltose	11.16

Figure 126 The HPLC analysis results of Compound 14B

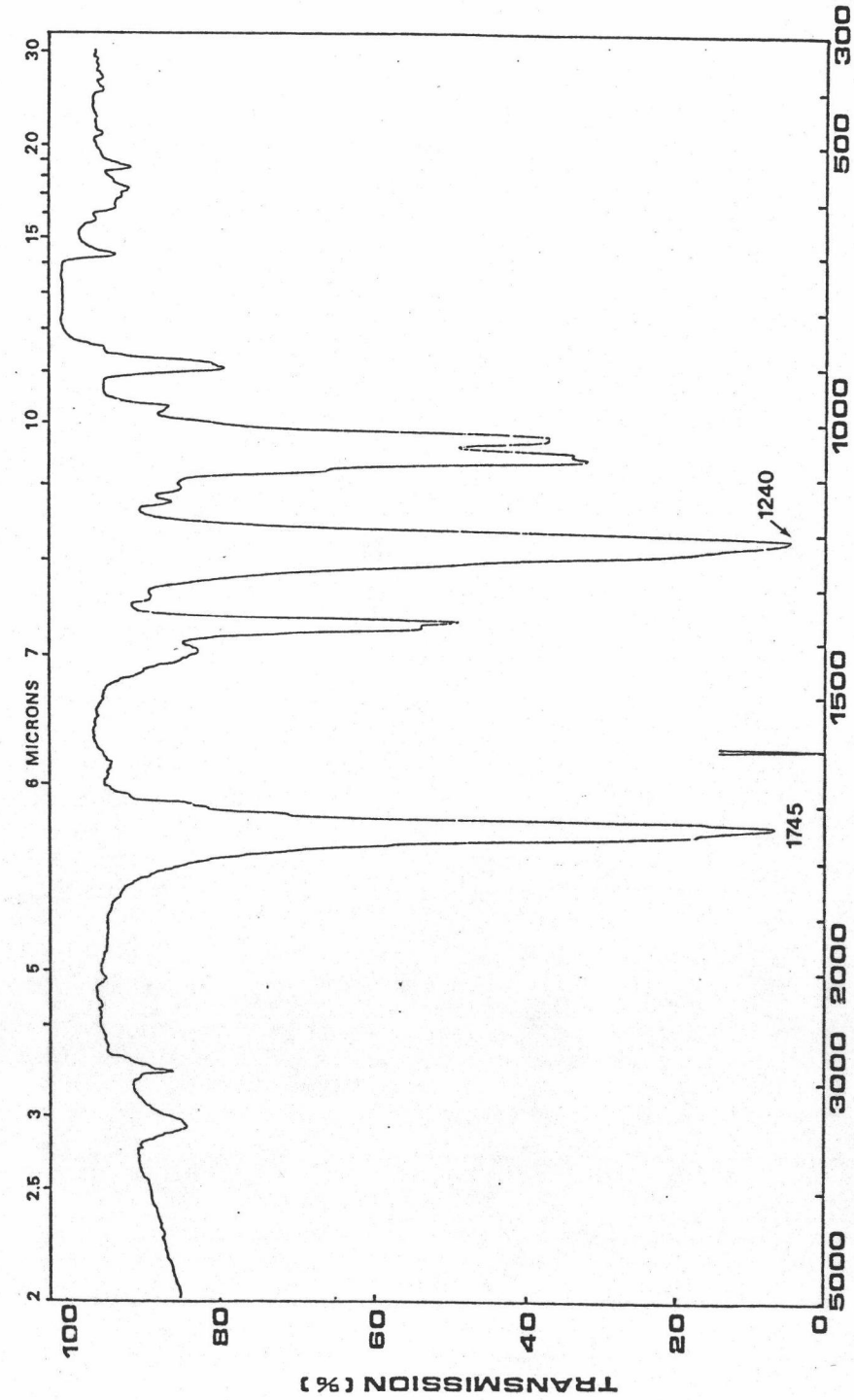


Figure 127 The IR spectrum of Compound 14B acetate

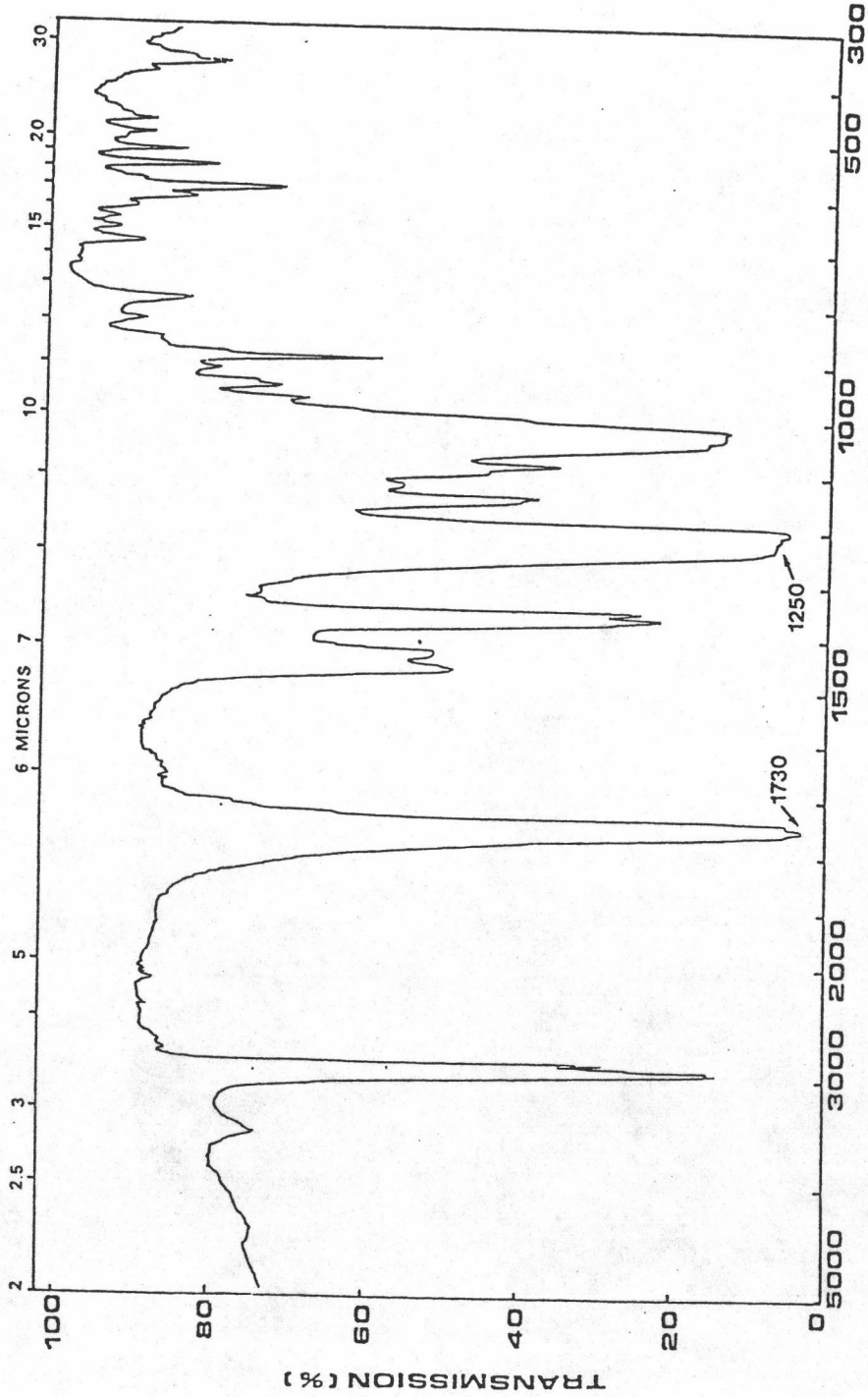


Figure 128 The IR spectrum of Compound 14' acetate

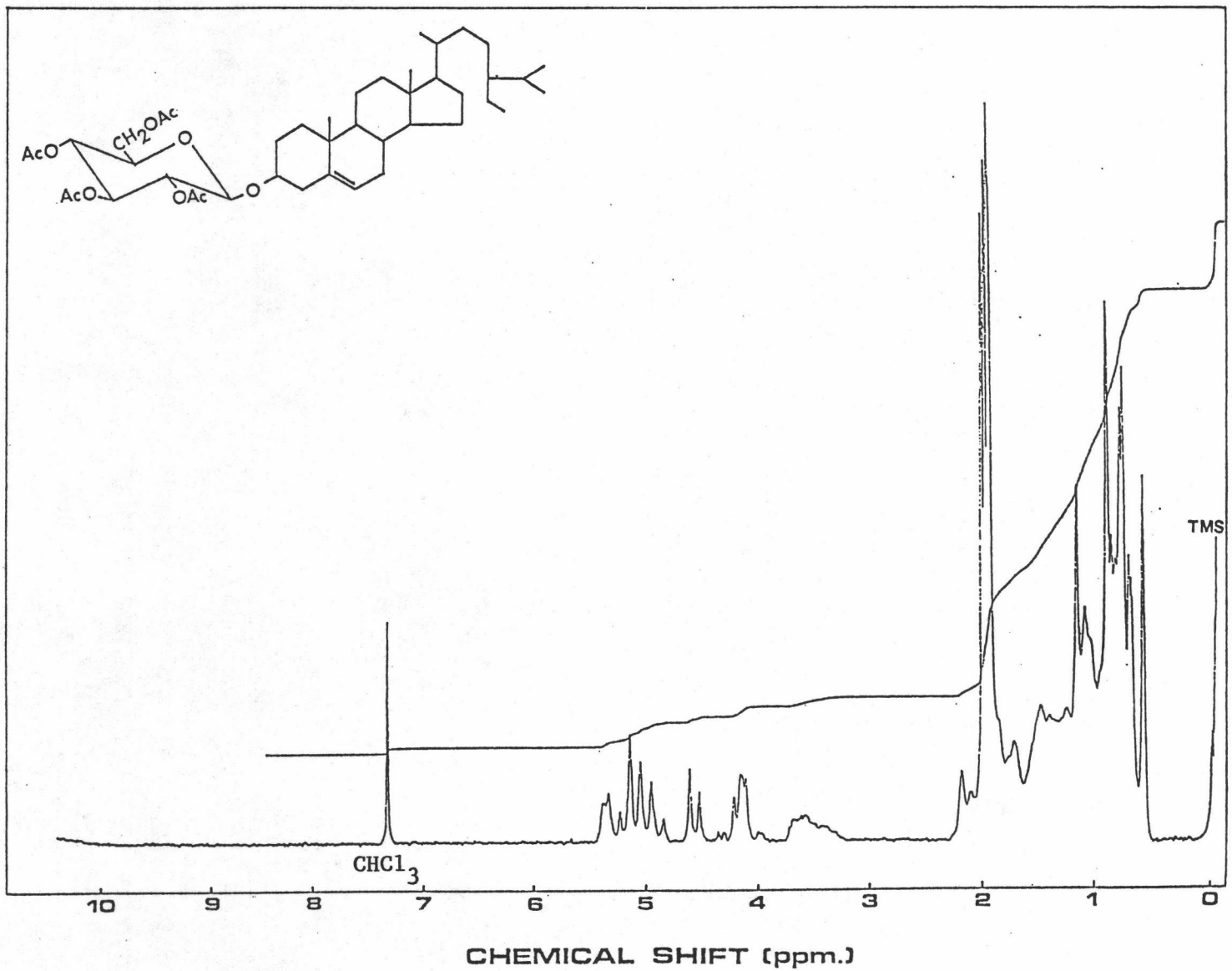


Figure 129 The ^{1}H NMR spectrum of Compound 14 acetate

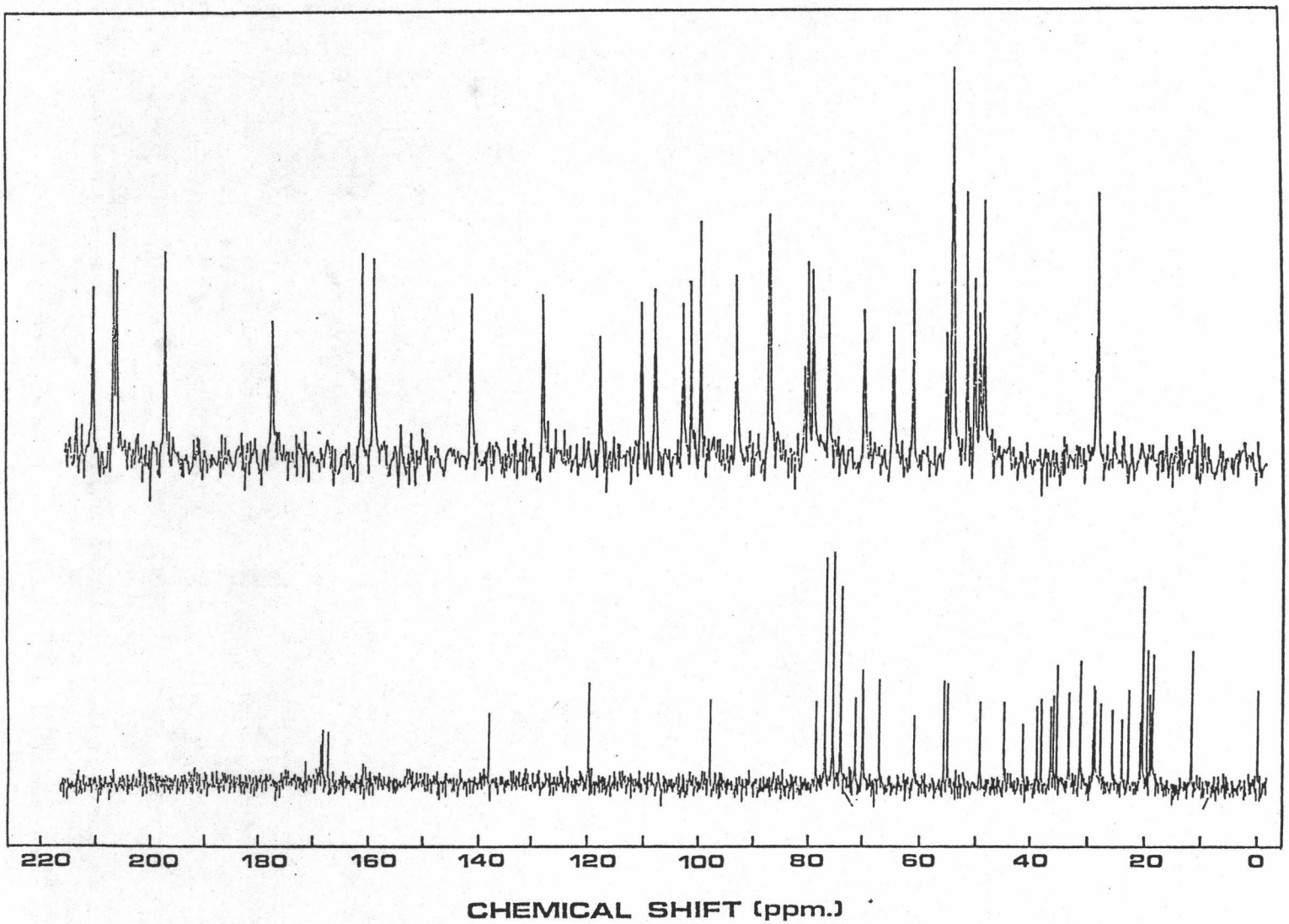


Figure 130 The ^{13}C NMR spectrum of Compound 14 acetate

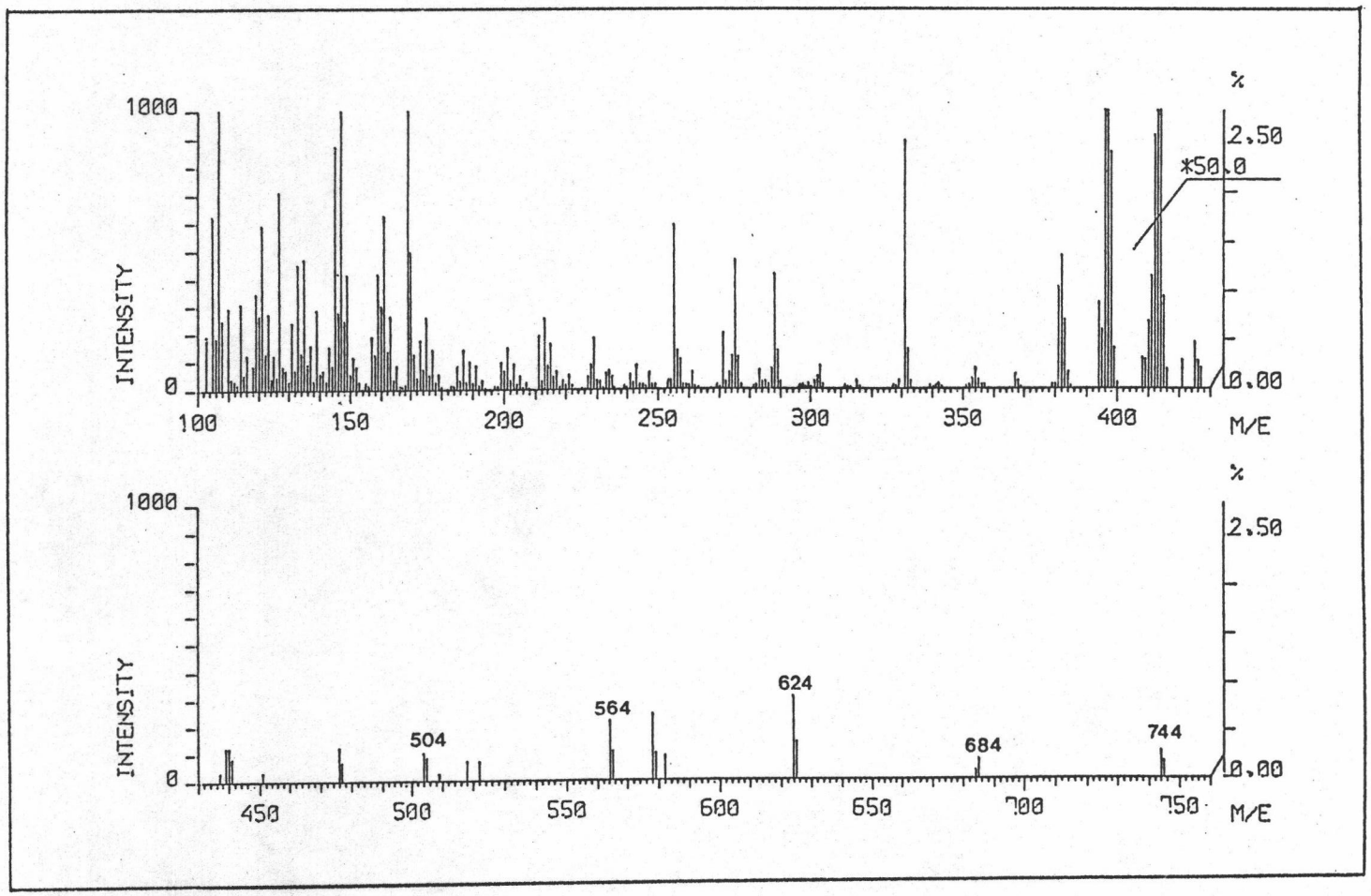


Figure 131 The mass spectrum of Compound 14 acetate

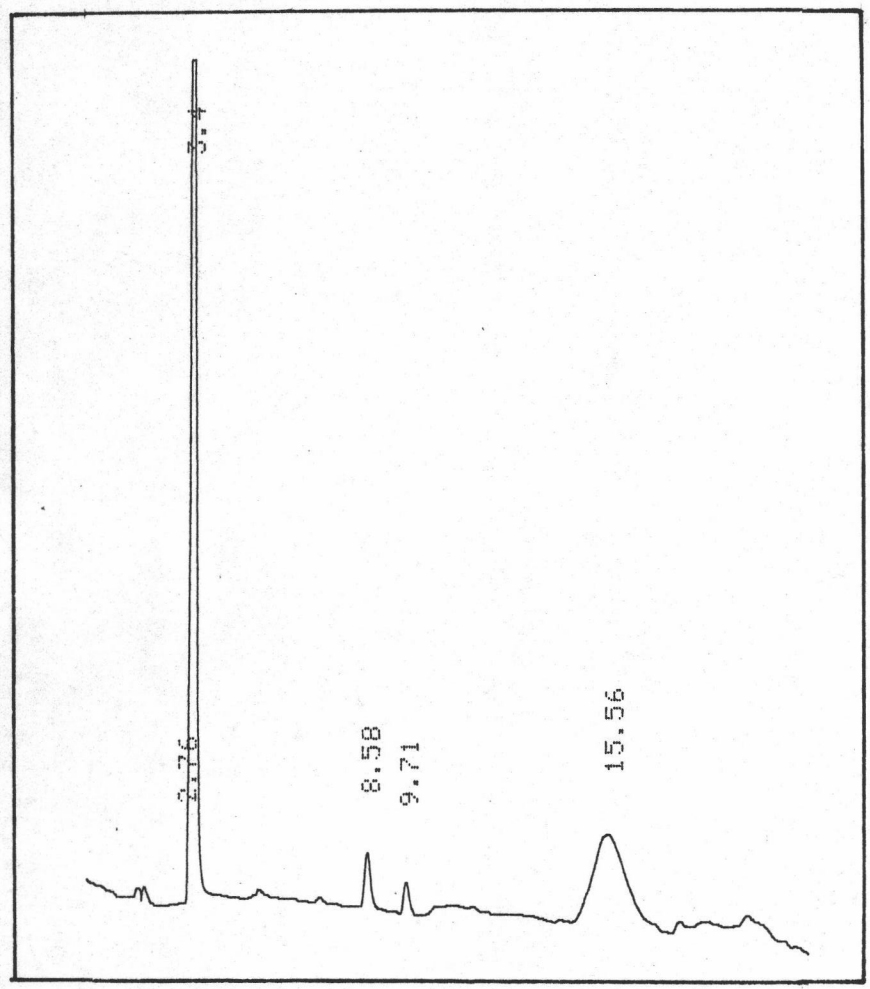


Figure 132 The HPLC analysis of the hydrolysis product of Fraction III

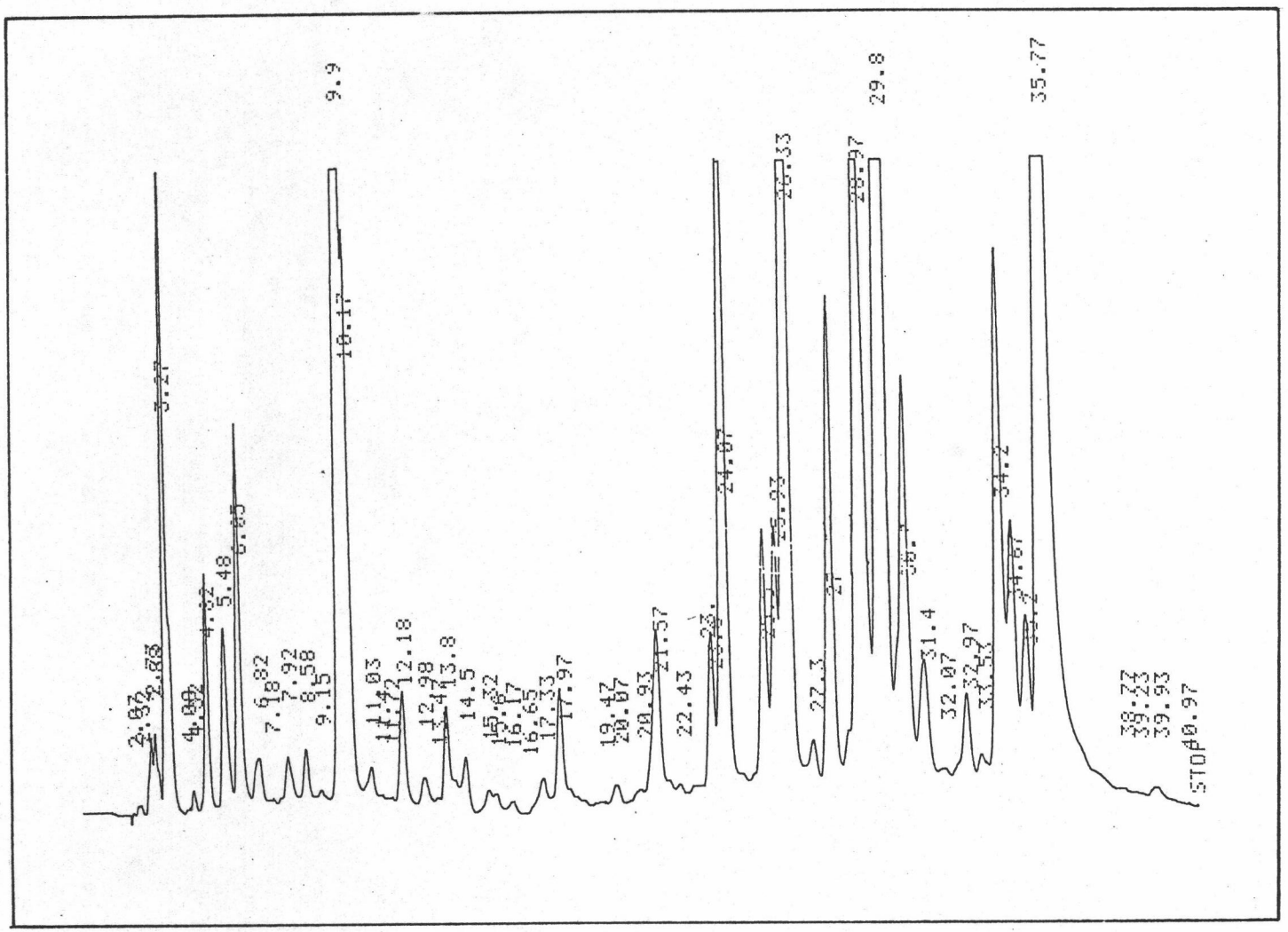


Figure 133 The HPLC analysis of Fraction VA (for phenolic compounds)

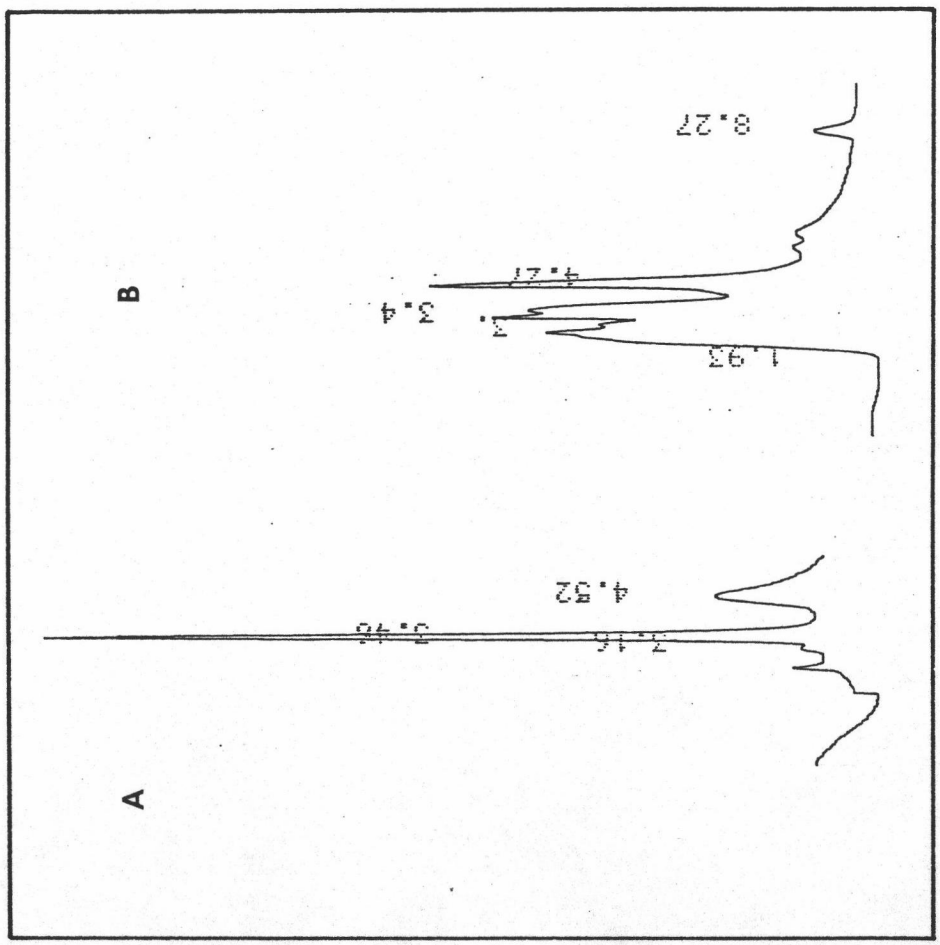


Figure 134 The HPLC analysis results of

A) the standard gibberrellin A_3

B) Fraction VA

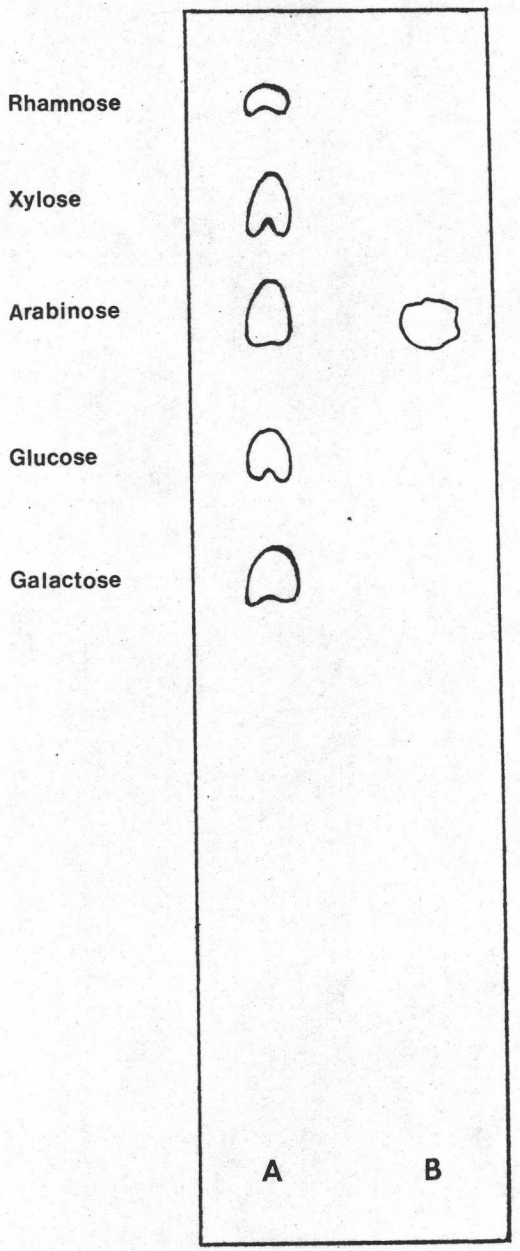
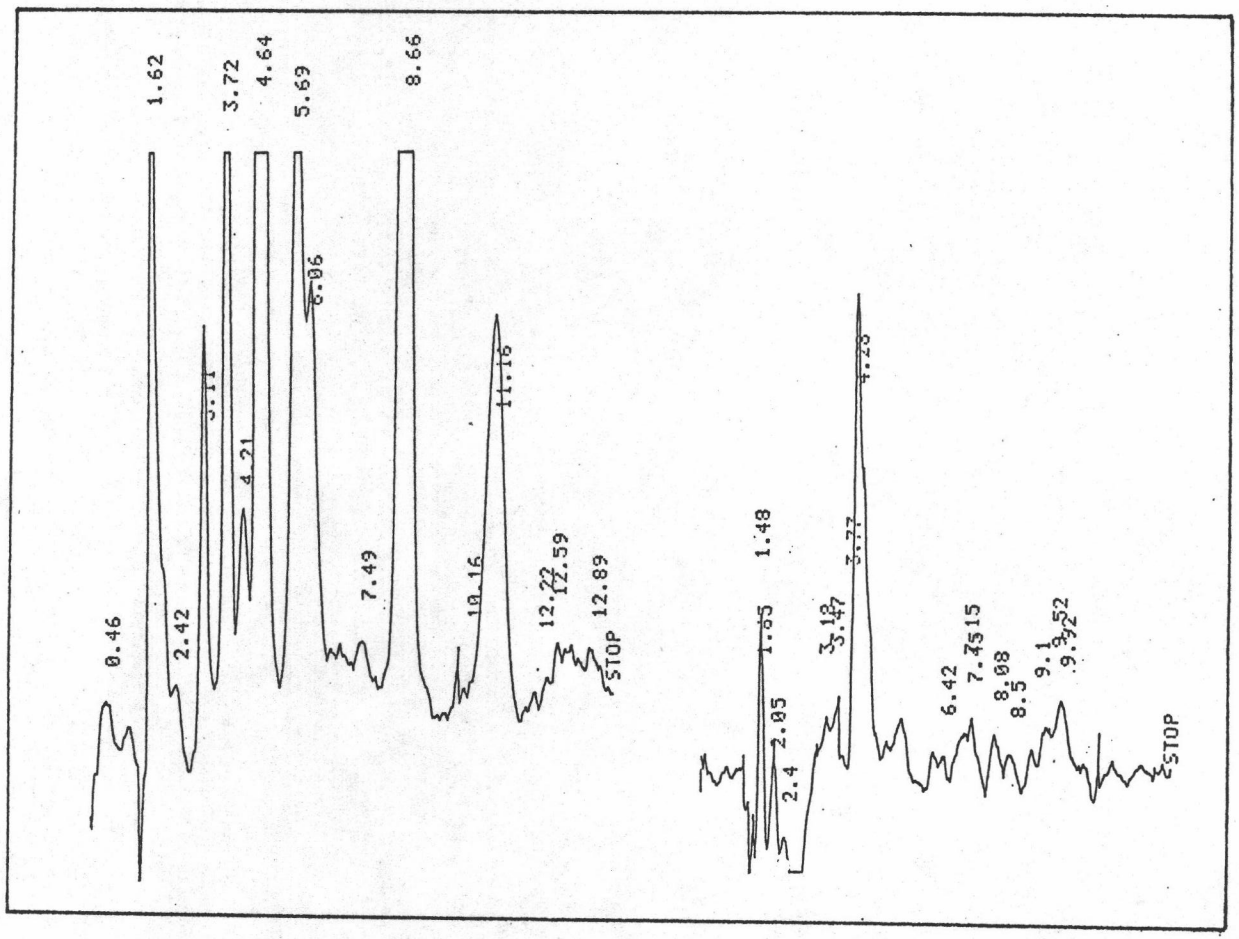


Figure 135 The paper chromatogram of

A) The standard sugars

B) Fraction VIA



Samples	Rt (min.)
solvent (H_2O)	1.62
rhamnose	3.11
xylose	3.72
arabinose	4.21
fructose	4.64
glucose	5.69
galactose	6.06
sucrose	8.66
maltose	11.16

Figure 136 The HPLC analysis results of Fraction VIA

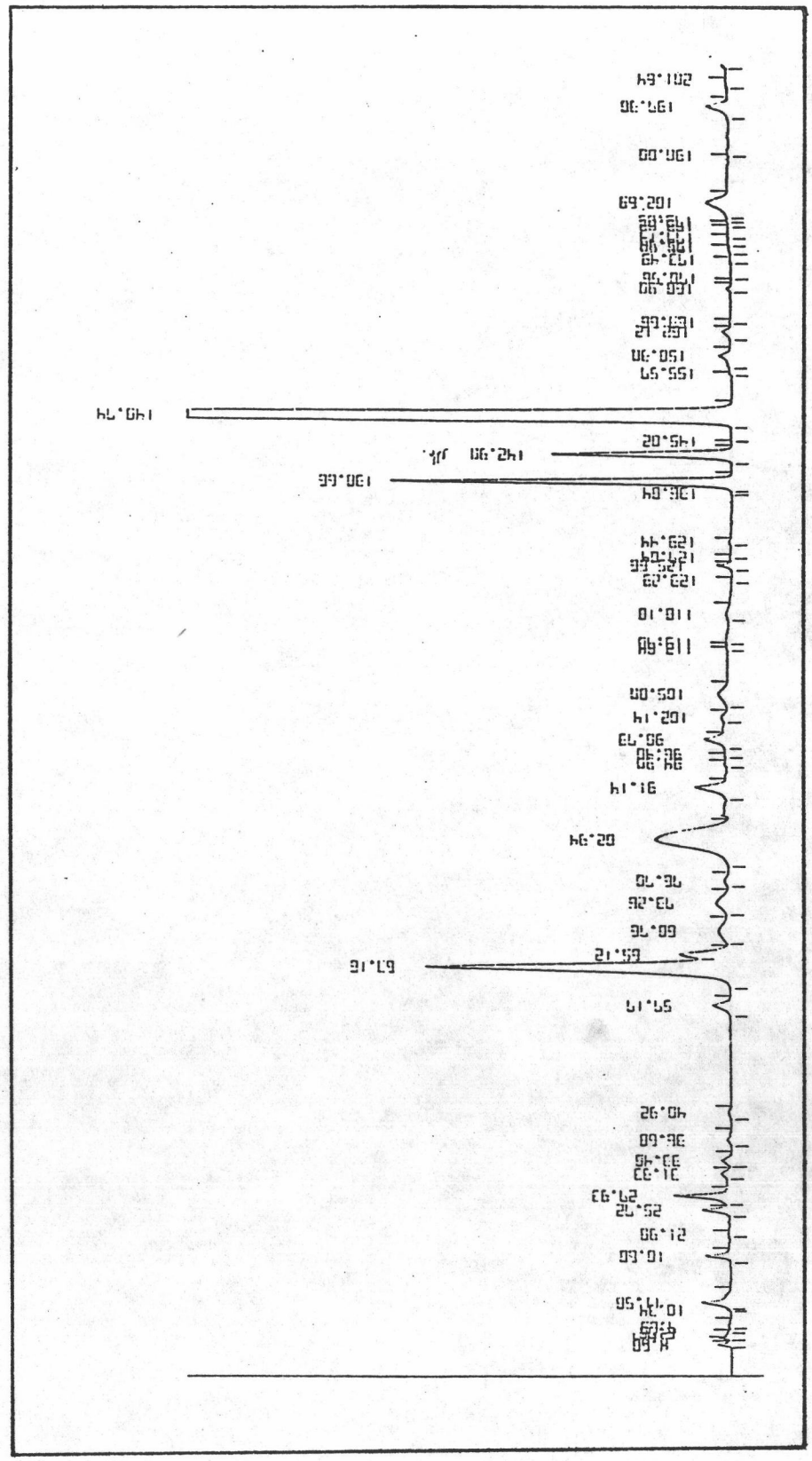


Figure 137 The amino analysis results of Fraction VIA

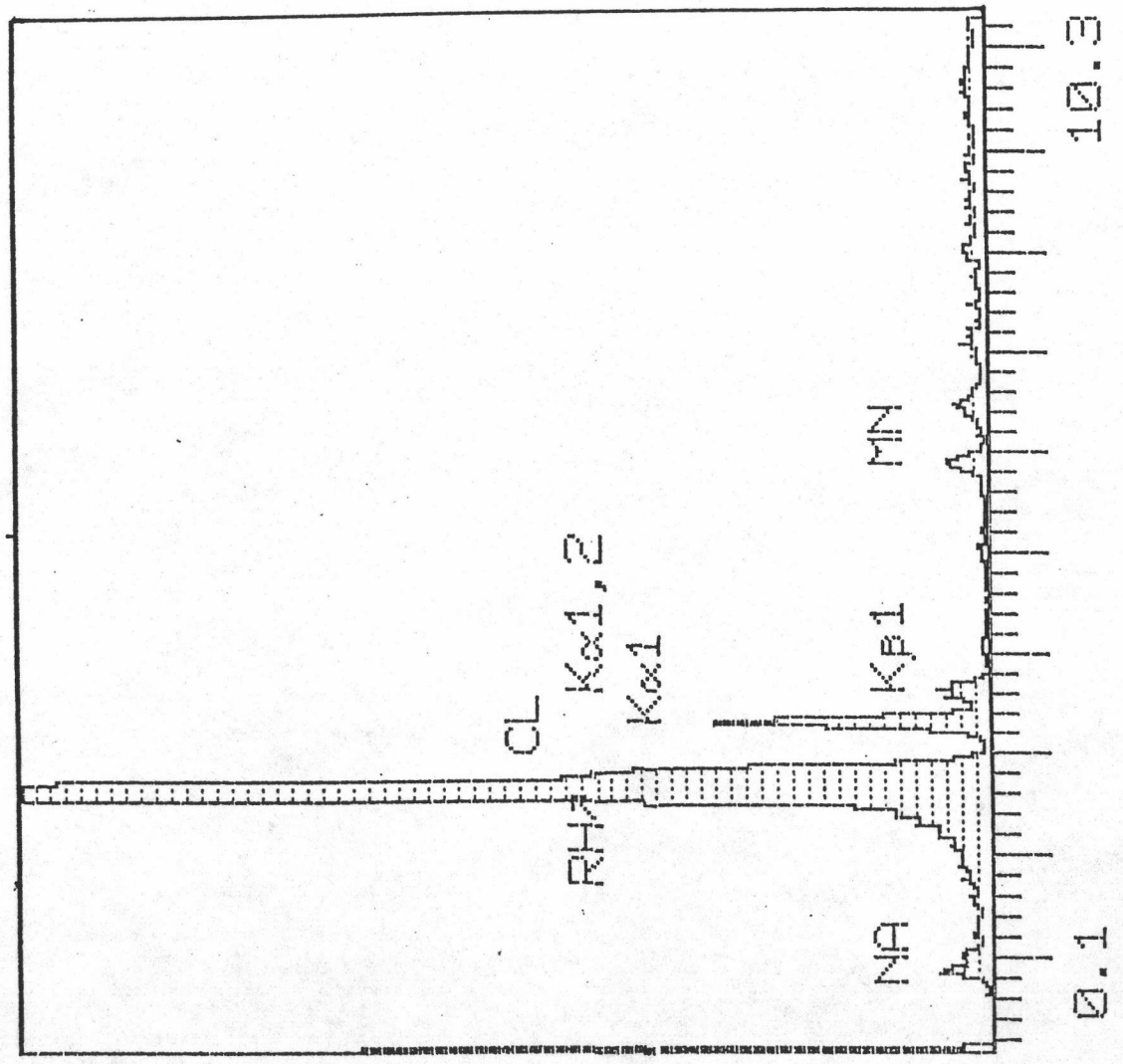


Figure 138 The X-ray fluoresence spectrum of Fraction VIB

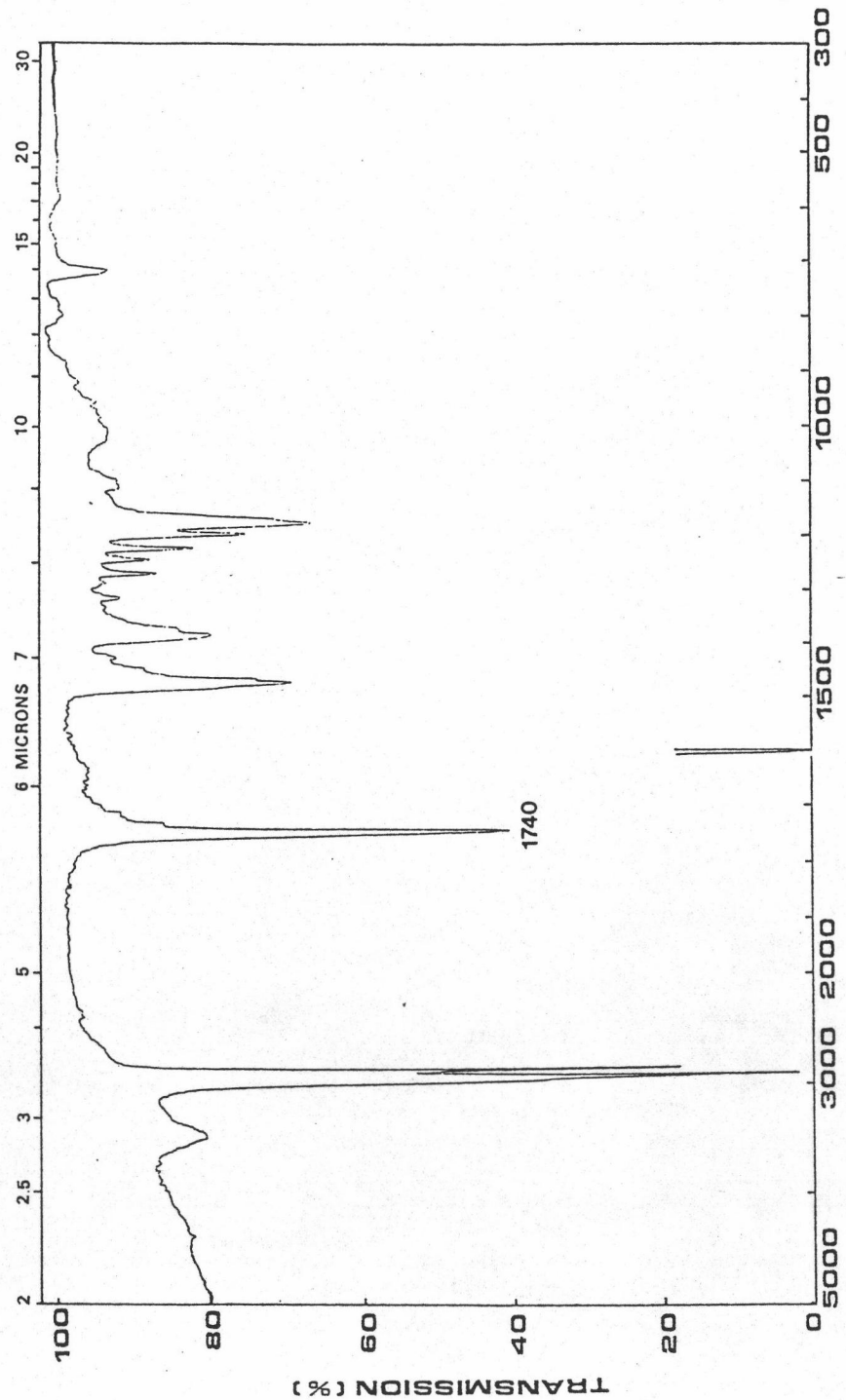


Figure 139 The IR spectrum of Compound 15

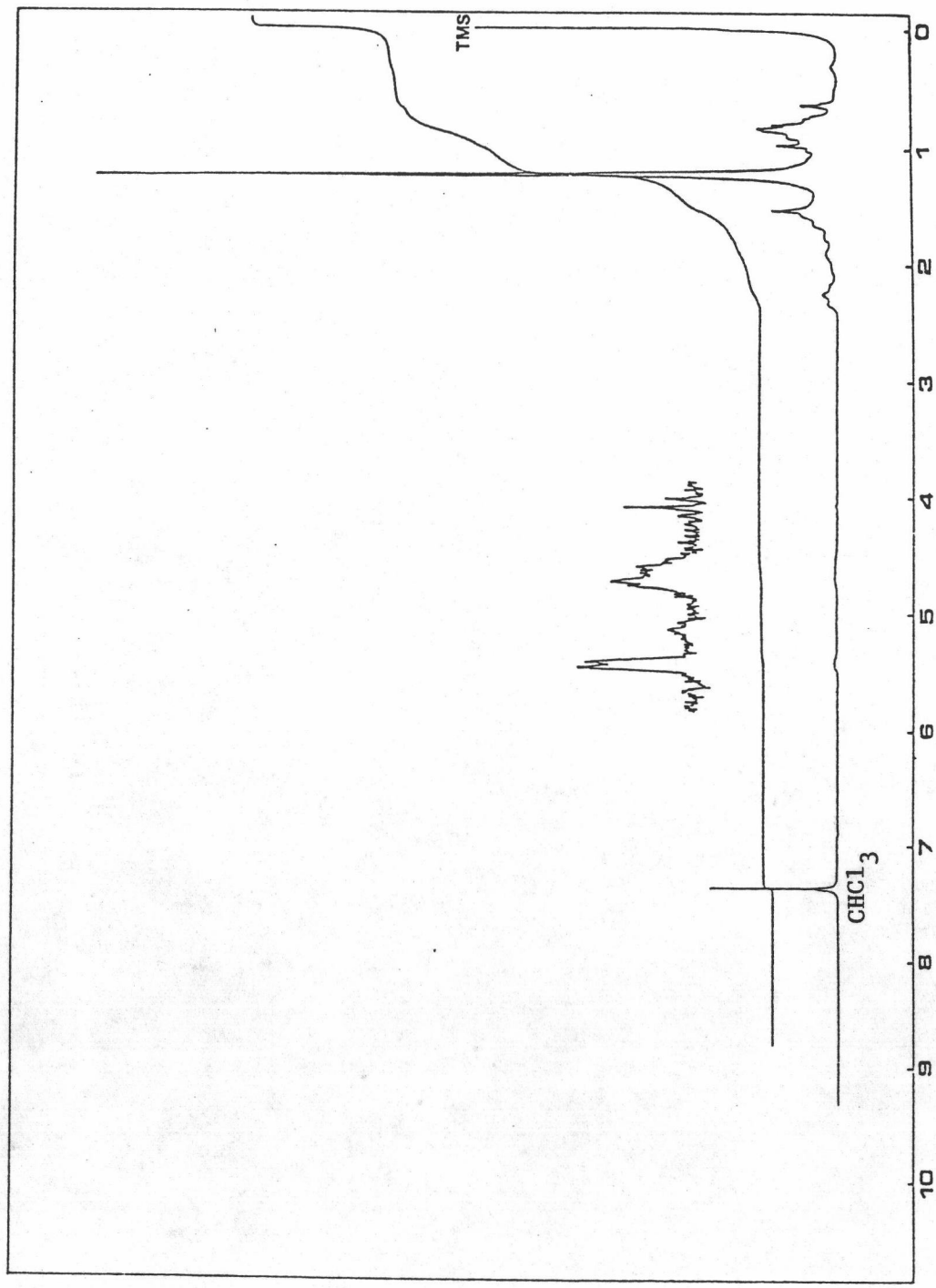


Figure 140 The ^1H NMR spectrum of Compound 15

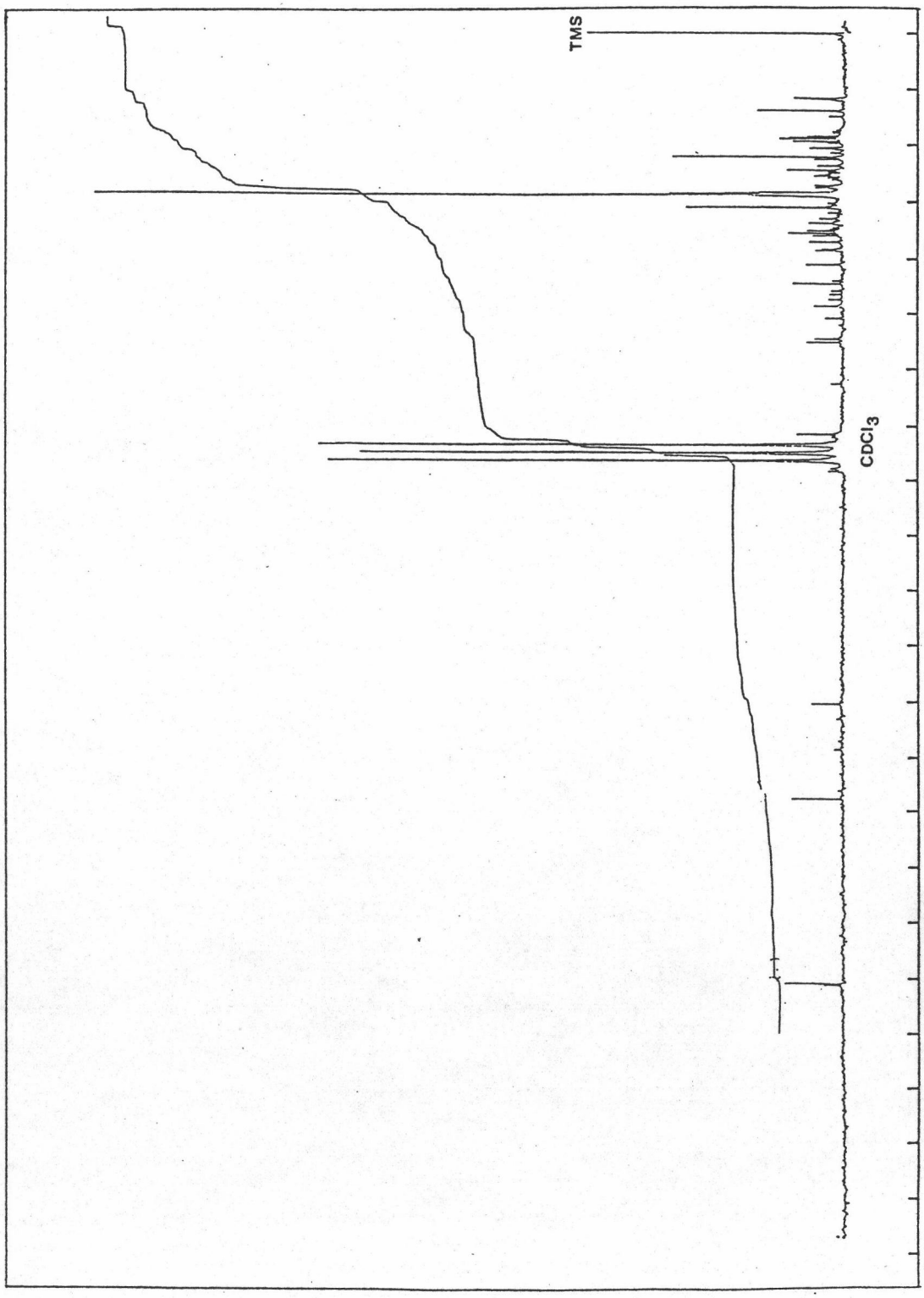


Figure 141 The ^{13}C NMR spectrum of Compound 15

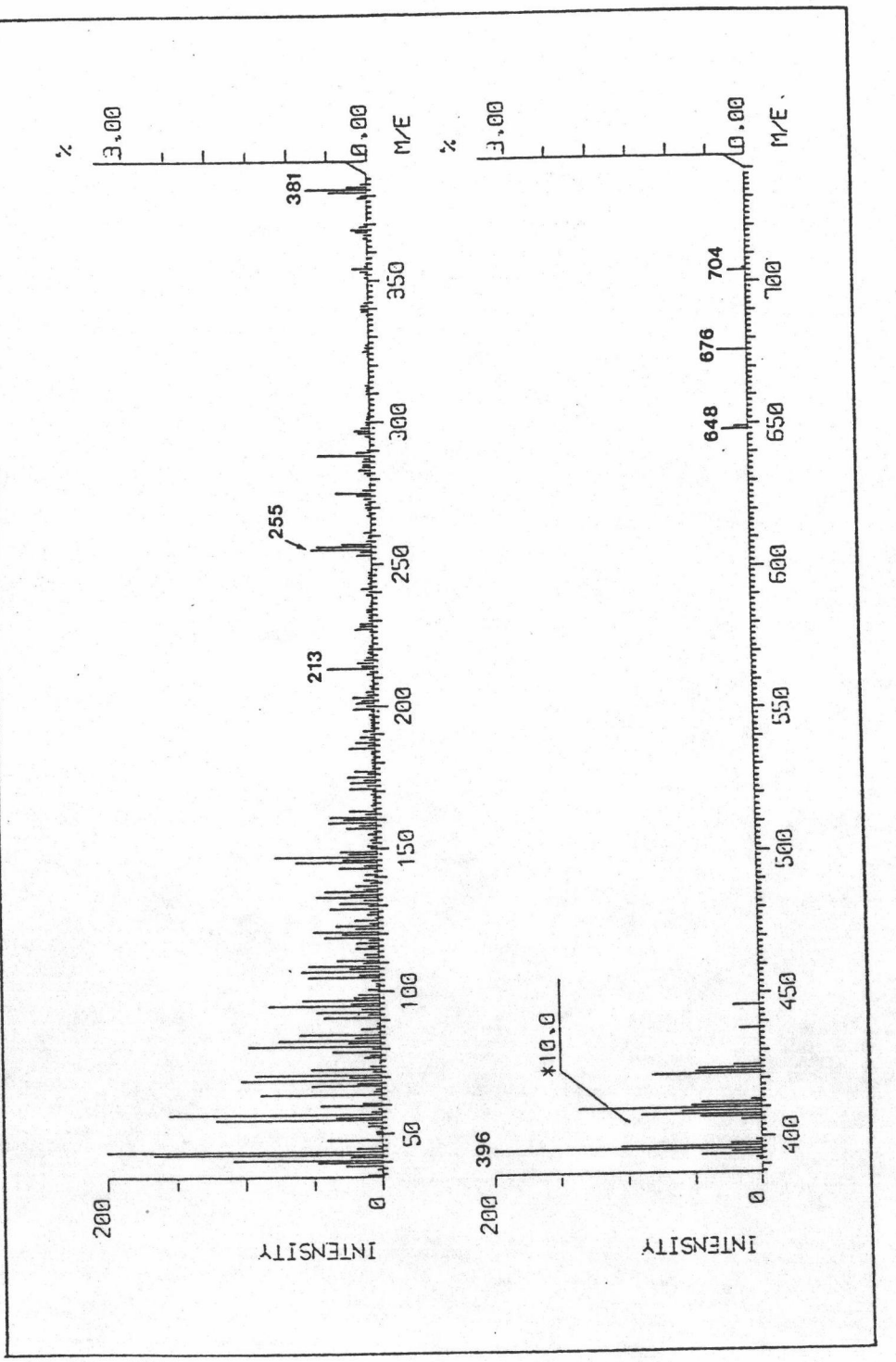


Figure 142 The mass spectrum of Compound 15

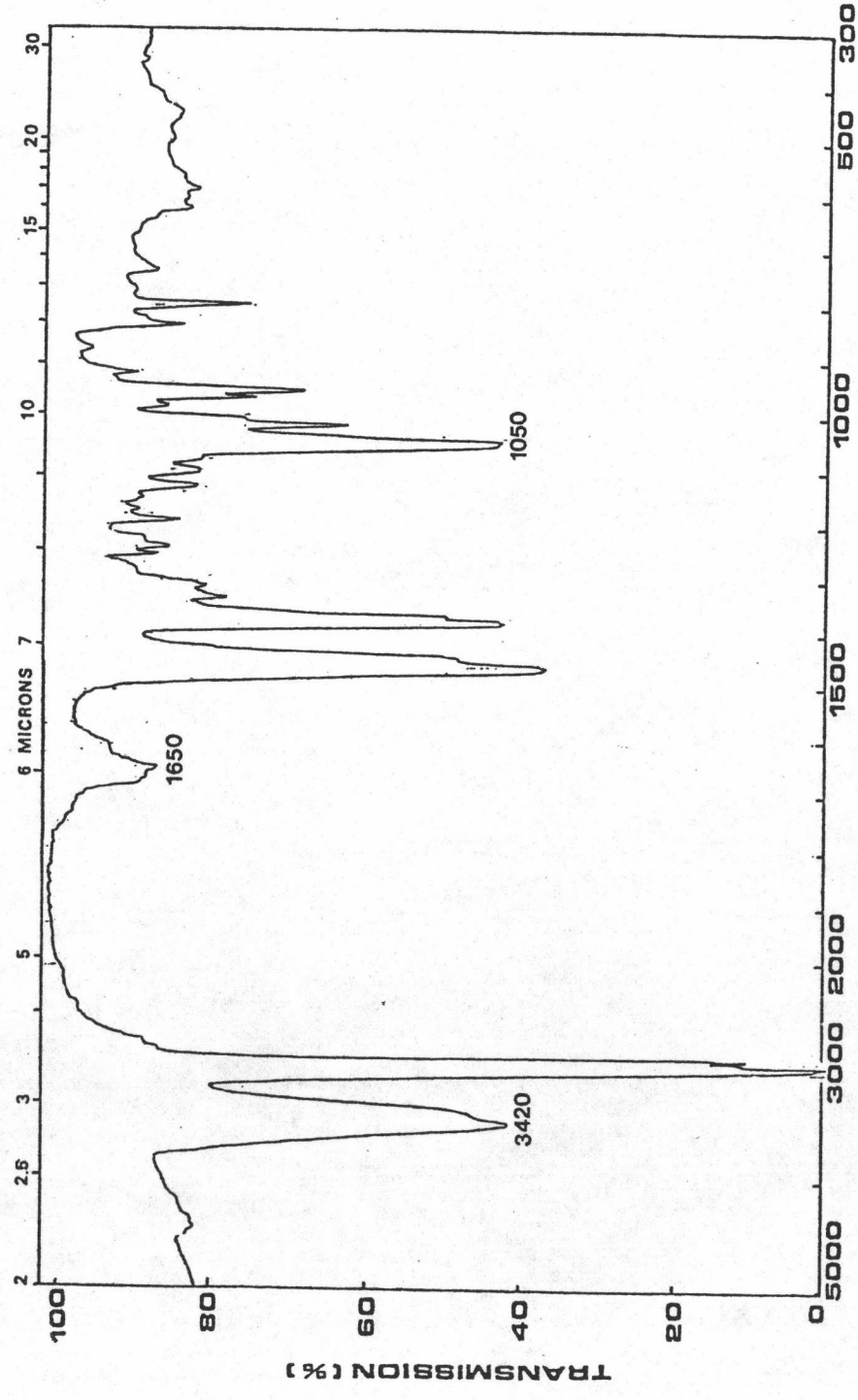


Figure 143 The IR spectrum of Compound 15A

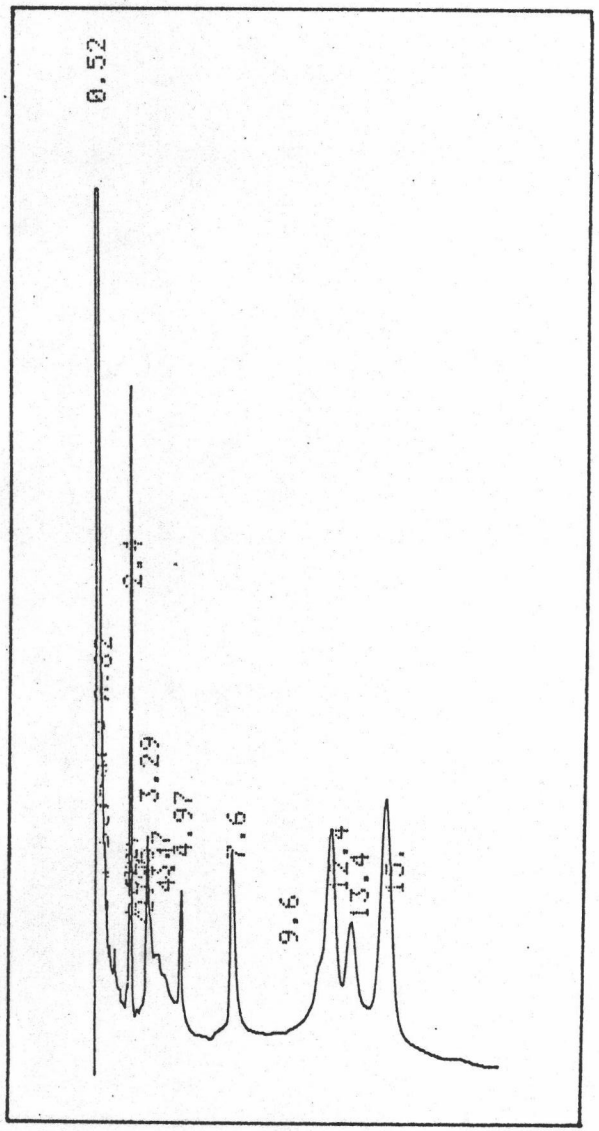


Figure 144 The GLC analysis of Compound 15A

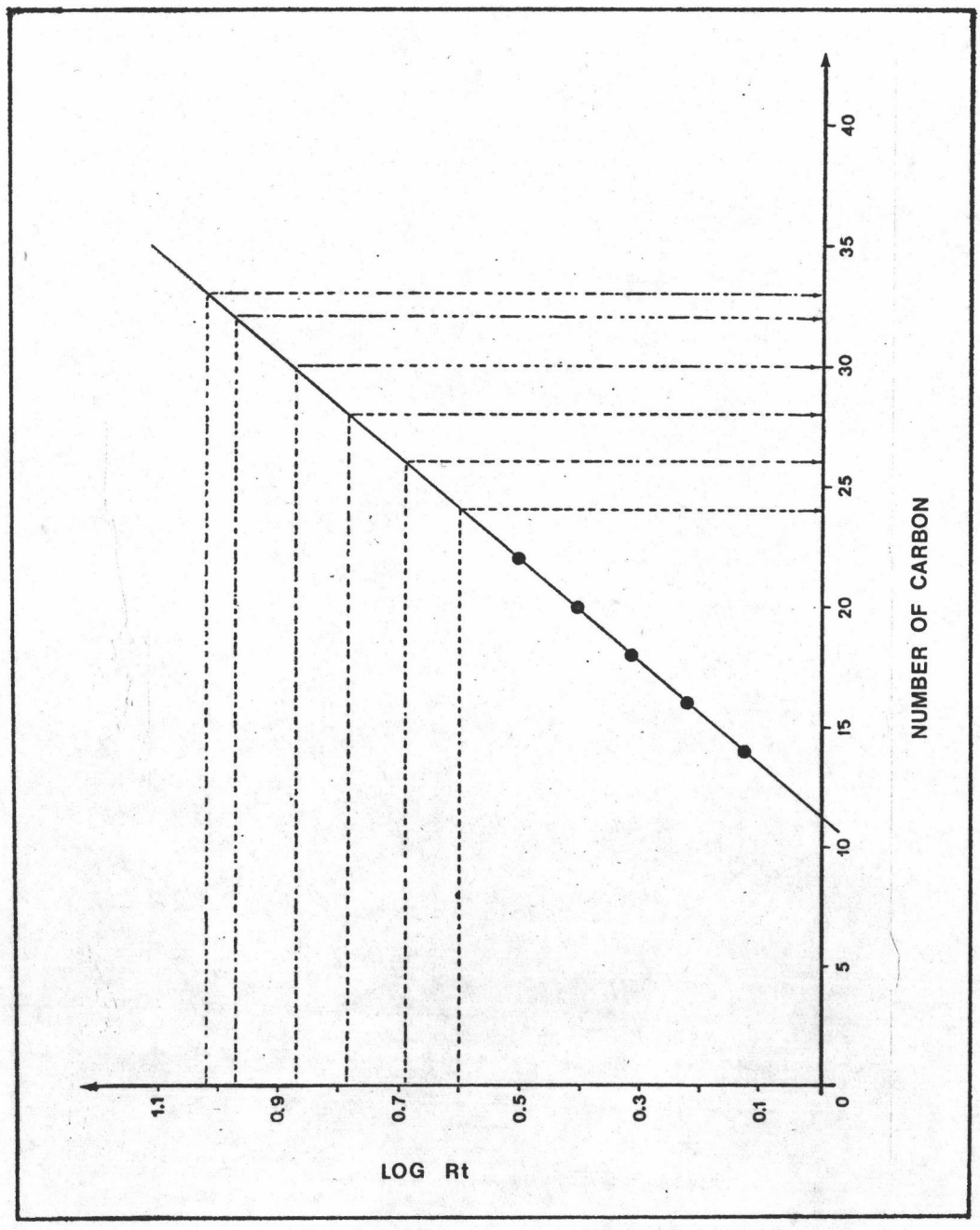


Figure 145 The standard correlation curve of Compound 15A

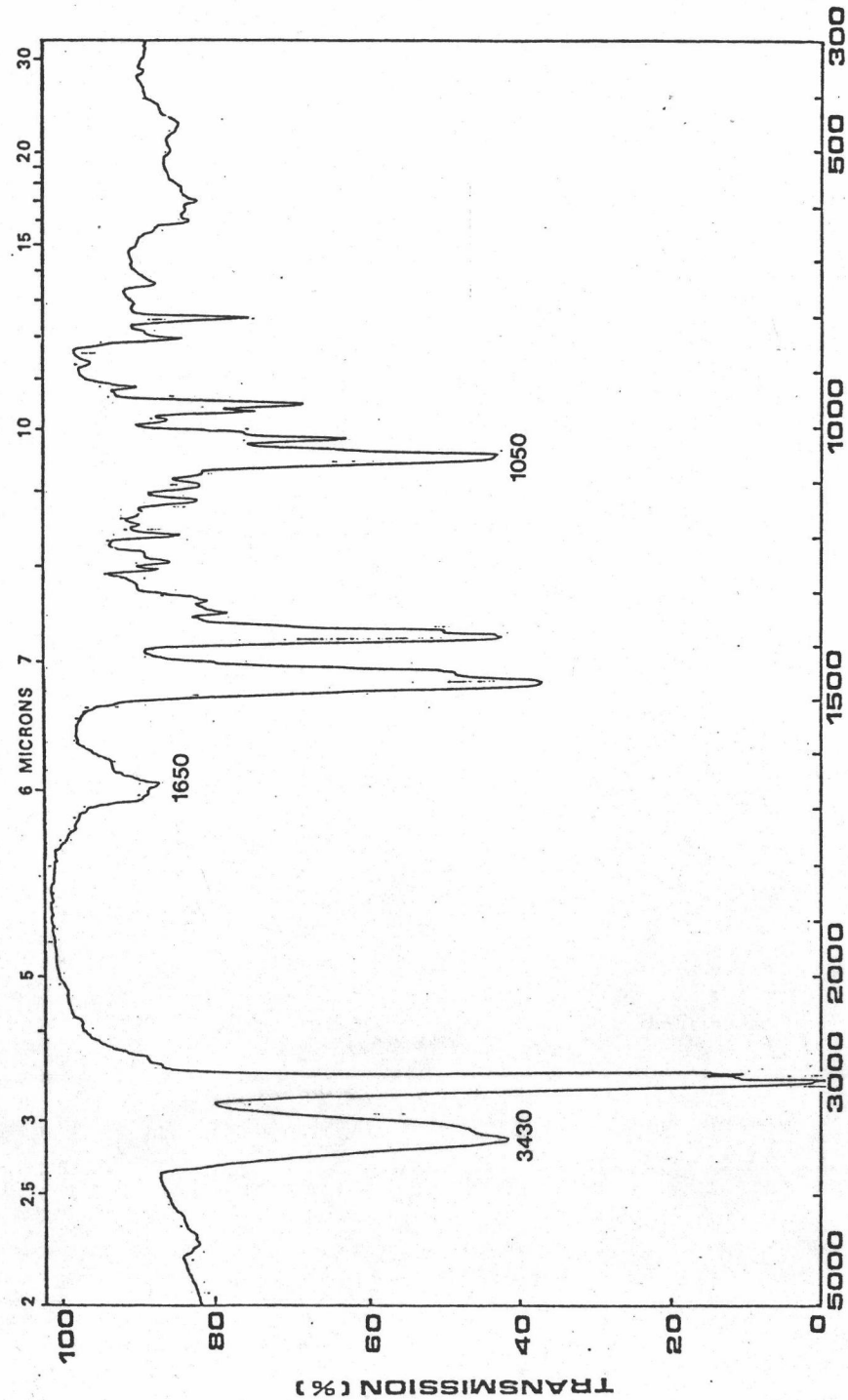


Figure 146 IR spectrum of Compound 15B

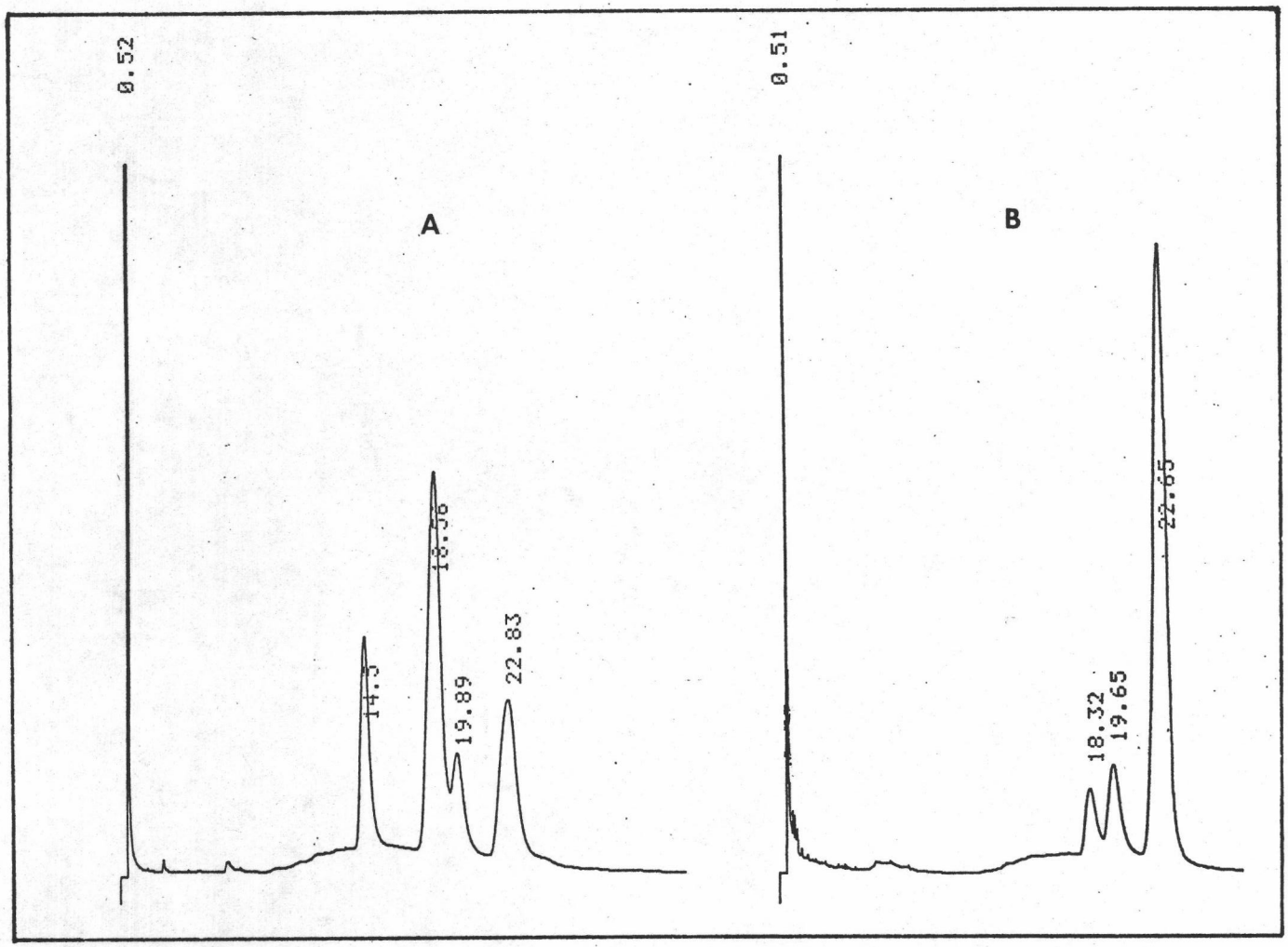


Figure 147 The GLC analysis of Compound 15B

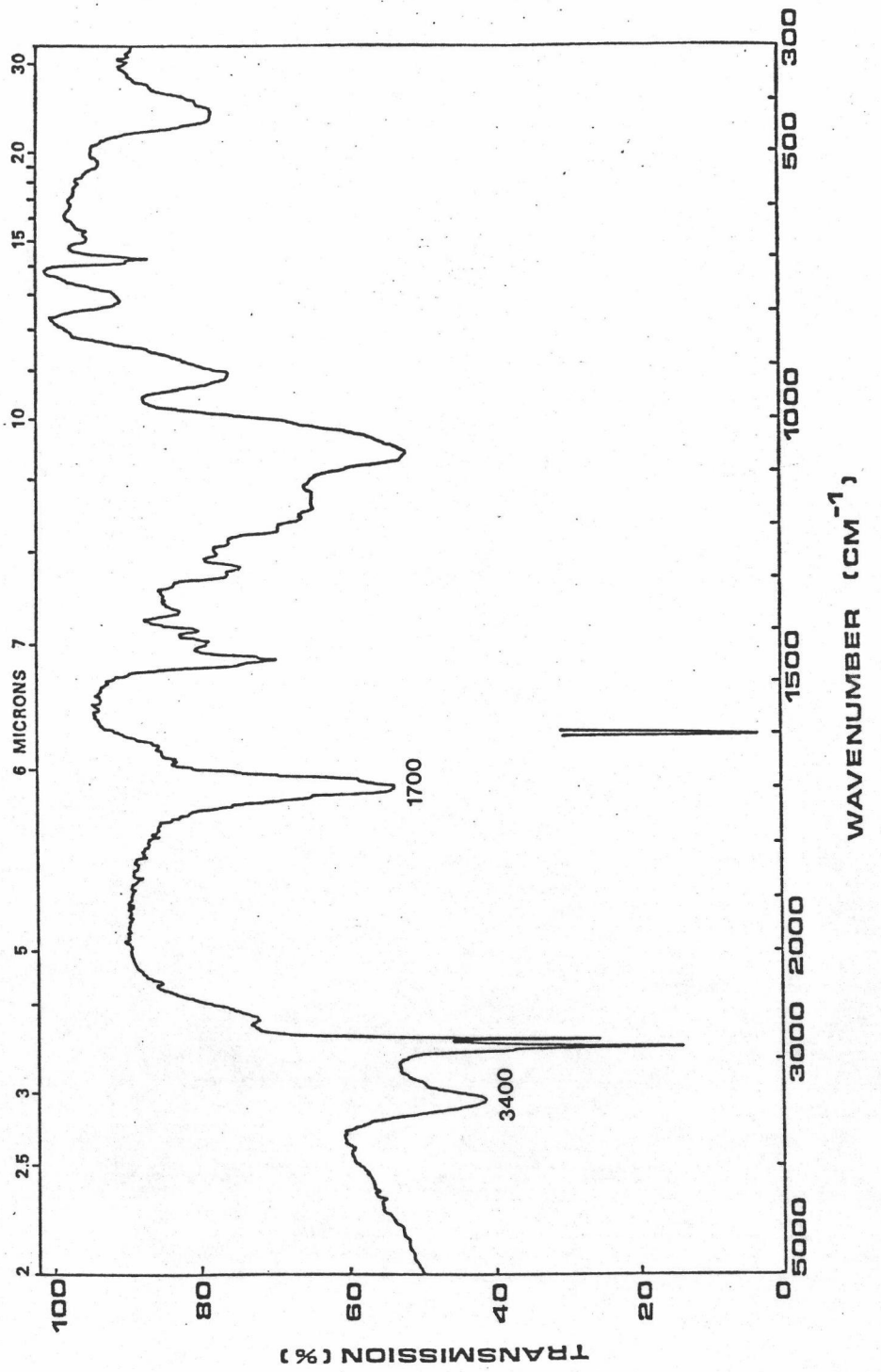


Figure 148 The IR spectrum of Compound 15C

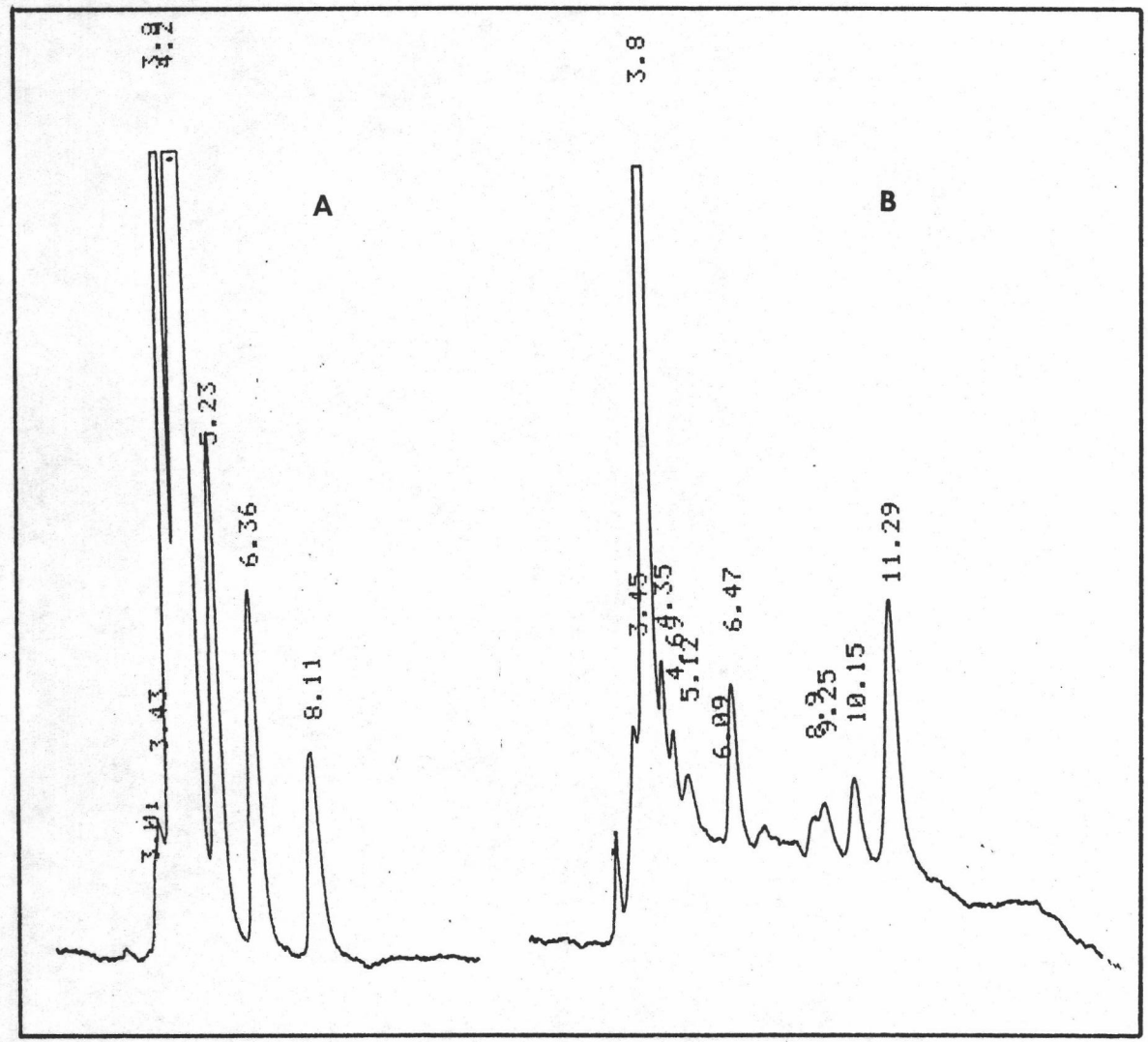


Figure 149 The HPLC analysis results of

A) the standard carboxylic acids : C_{12}, C_{14}, C_{16}, C_{18}

B) Compound 15C

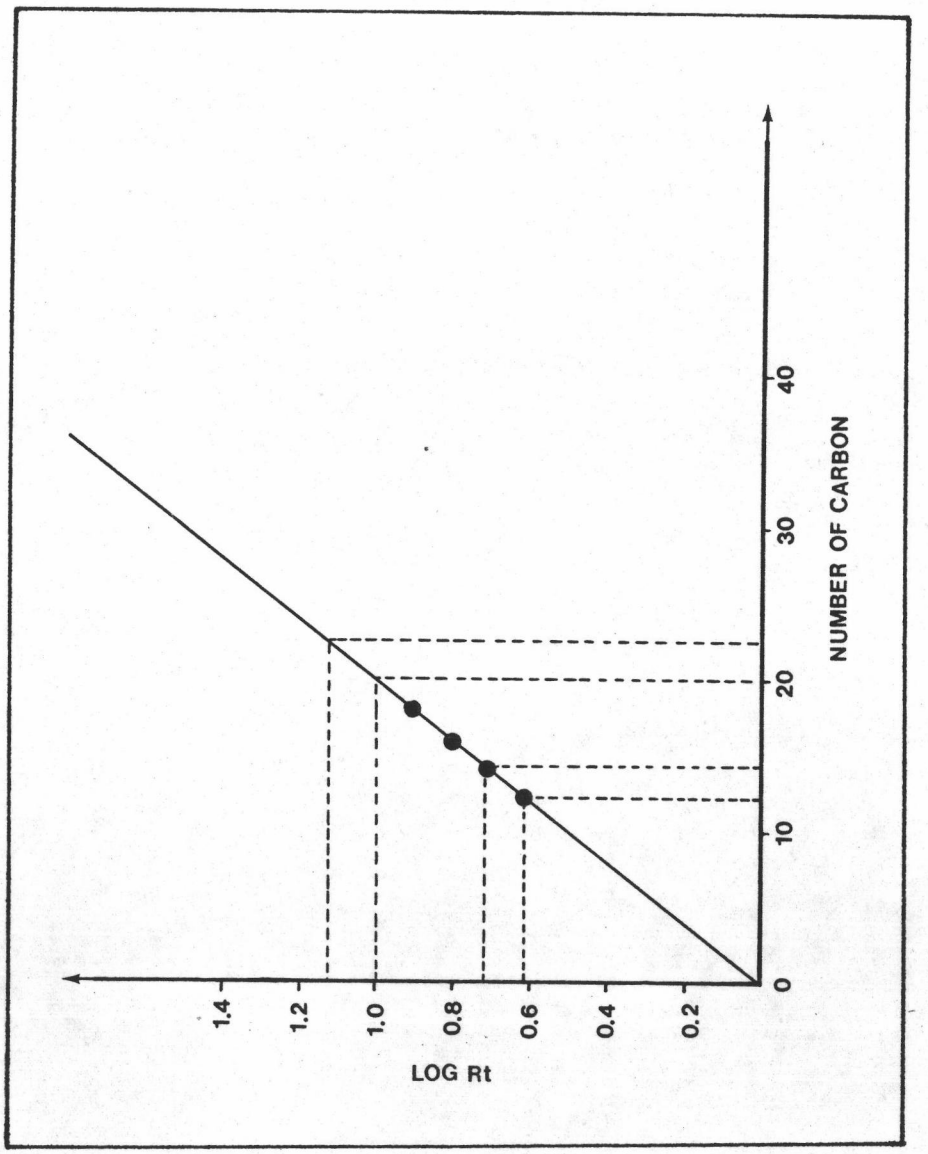


Figure 150 The standard correlation curve of Compound 15C

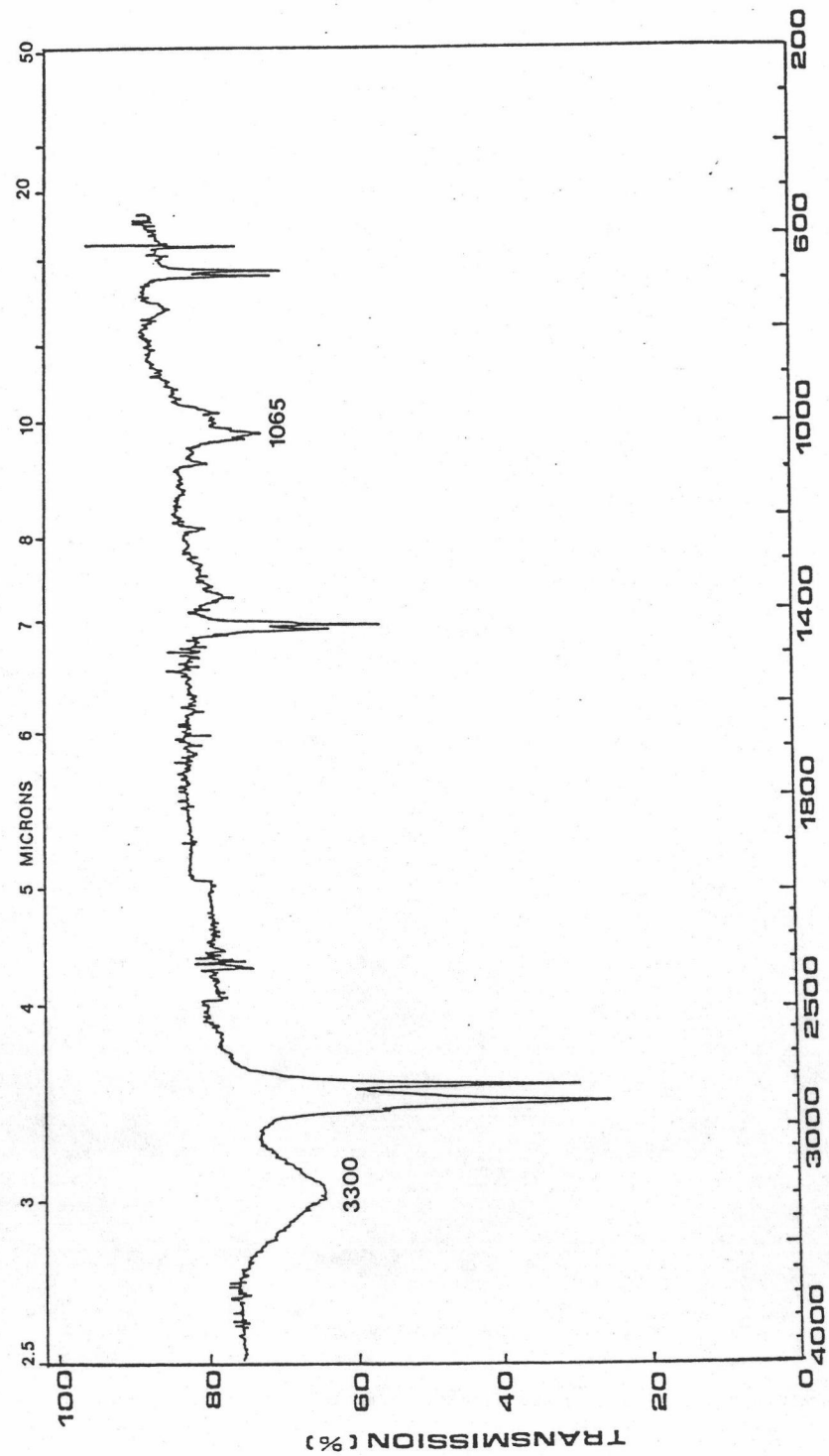


Figure 151 The IR spectrum of Compound 16

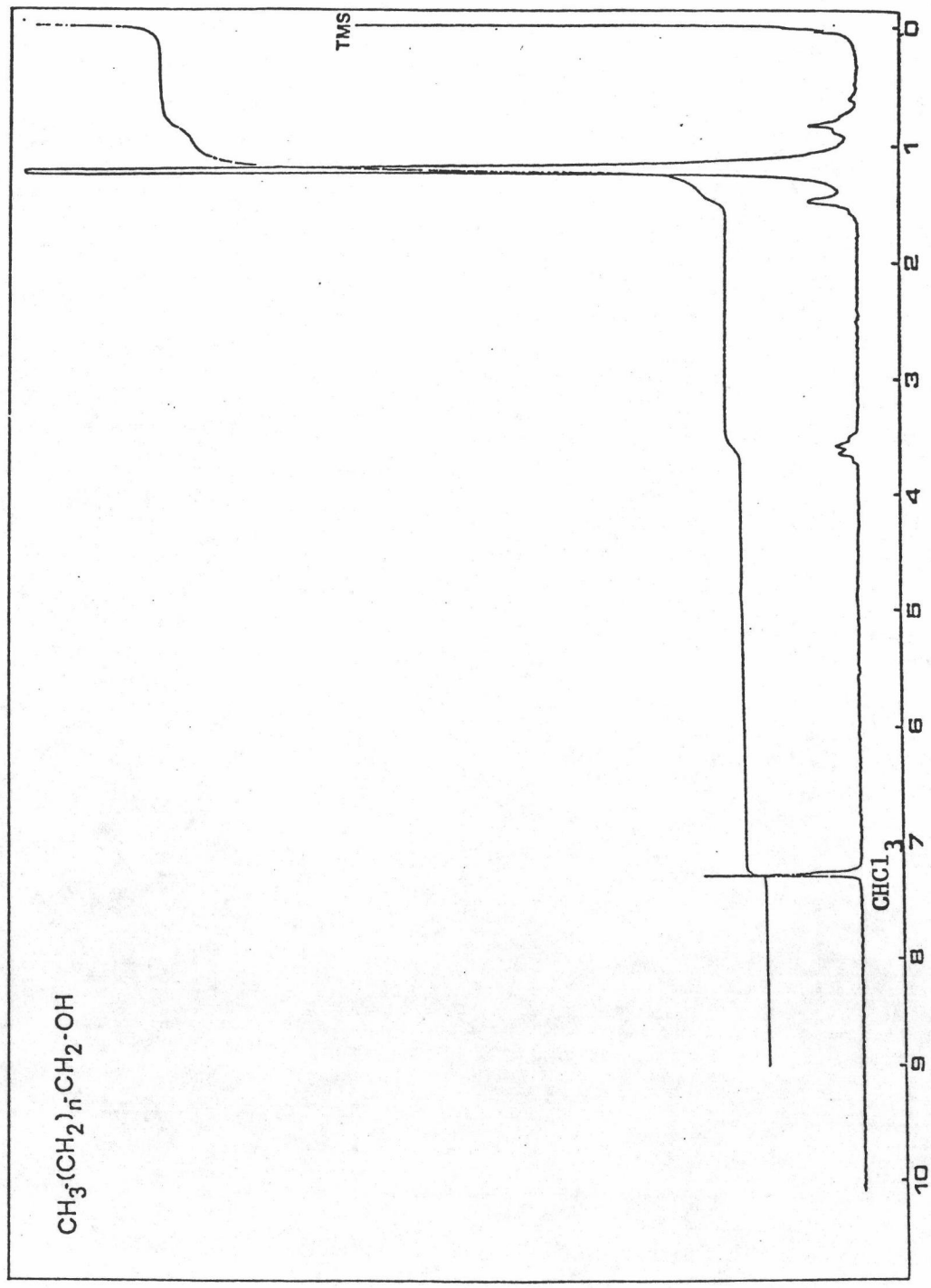


Figure 152 The ^1H NMR spectrum of Compound 16

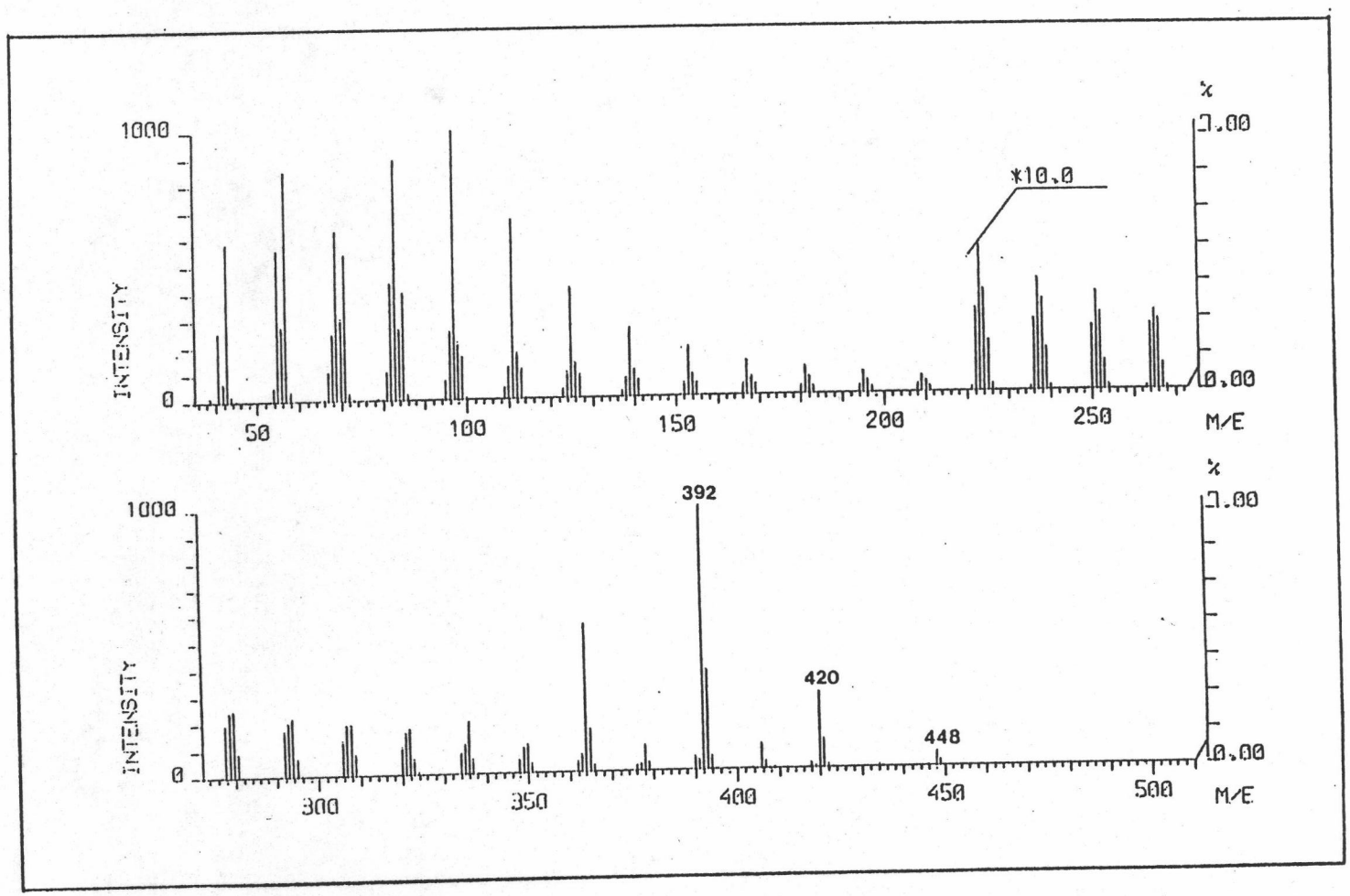


Figure 153 The mass spectrum of Compound 16

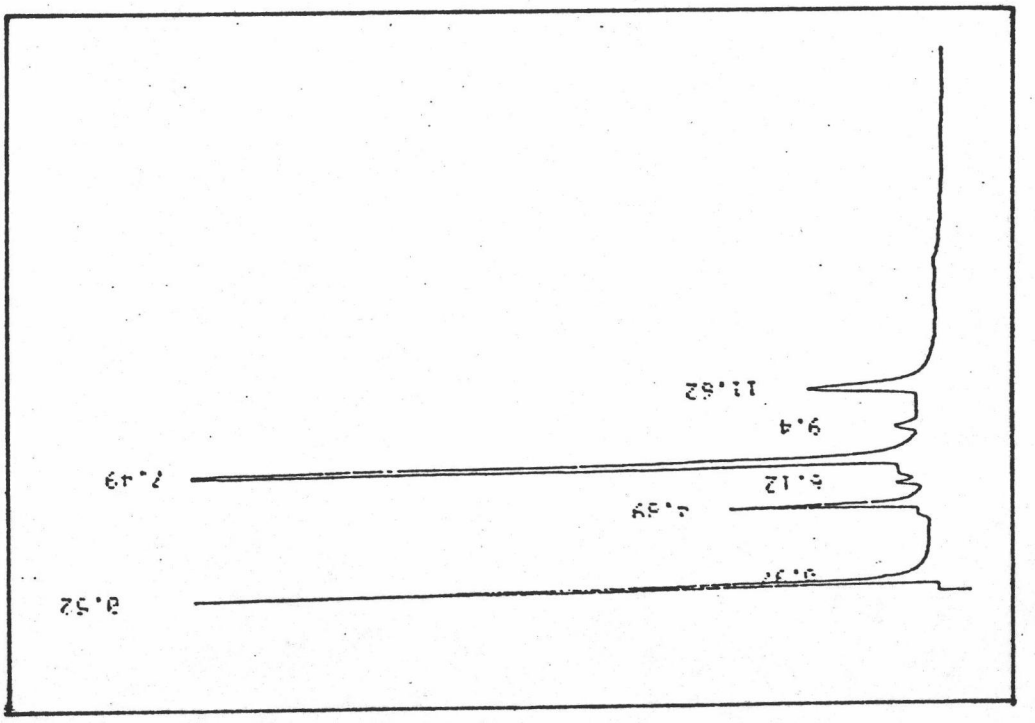


Figure 154 The GLC analysis of Compound 16

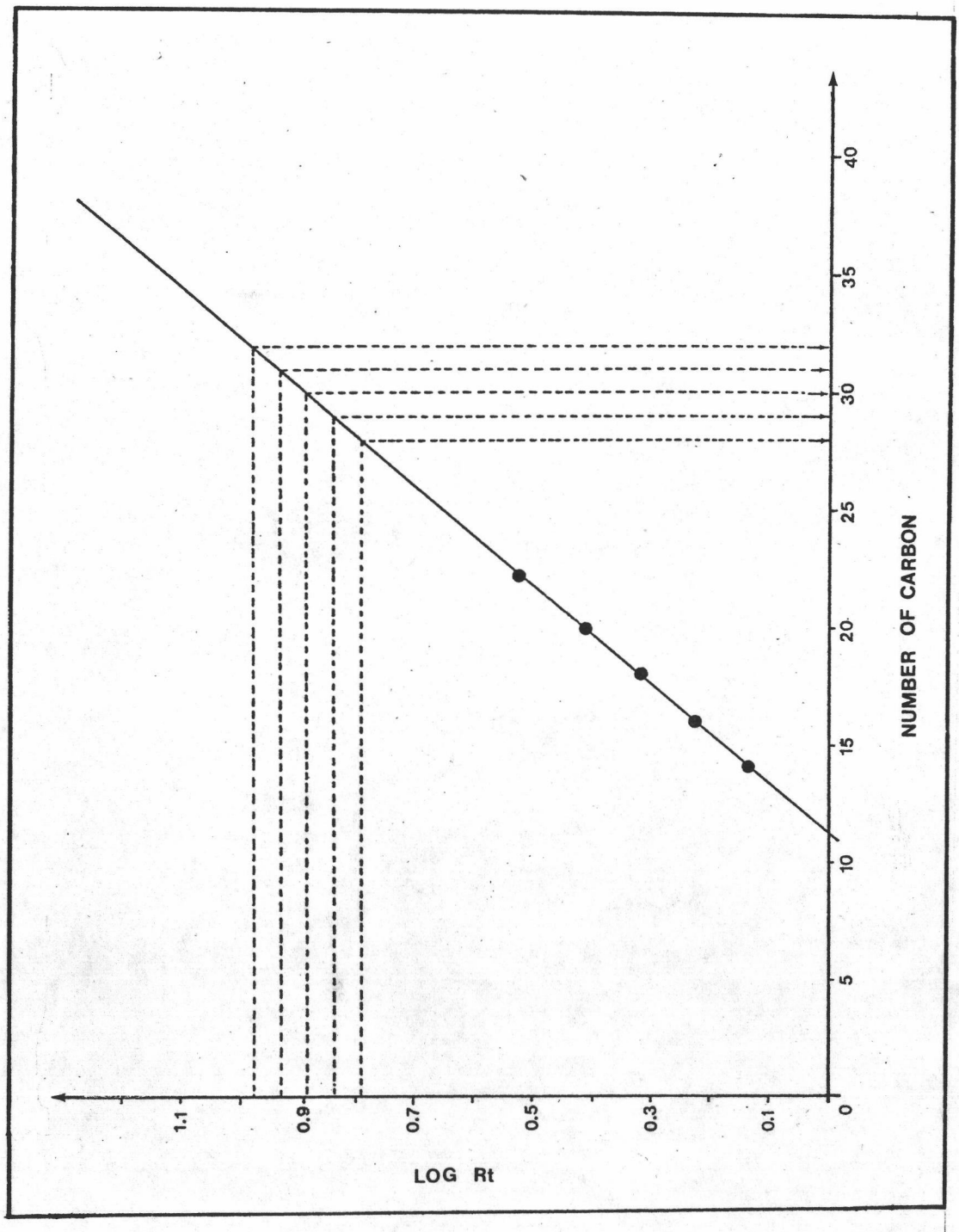


Figure 155 The standard correlation curve of Compound 16

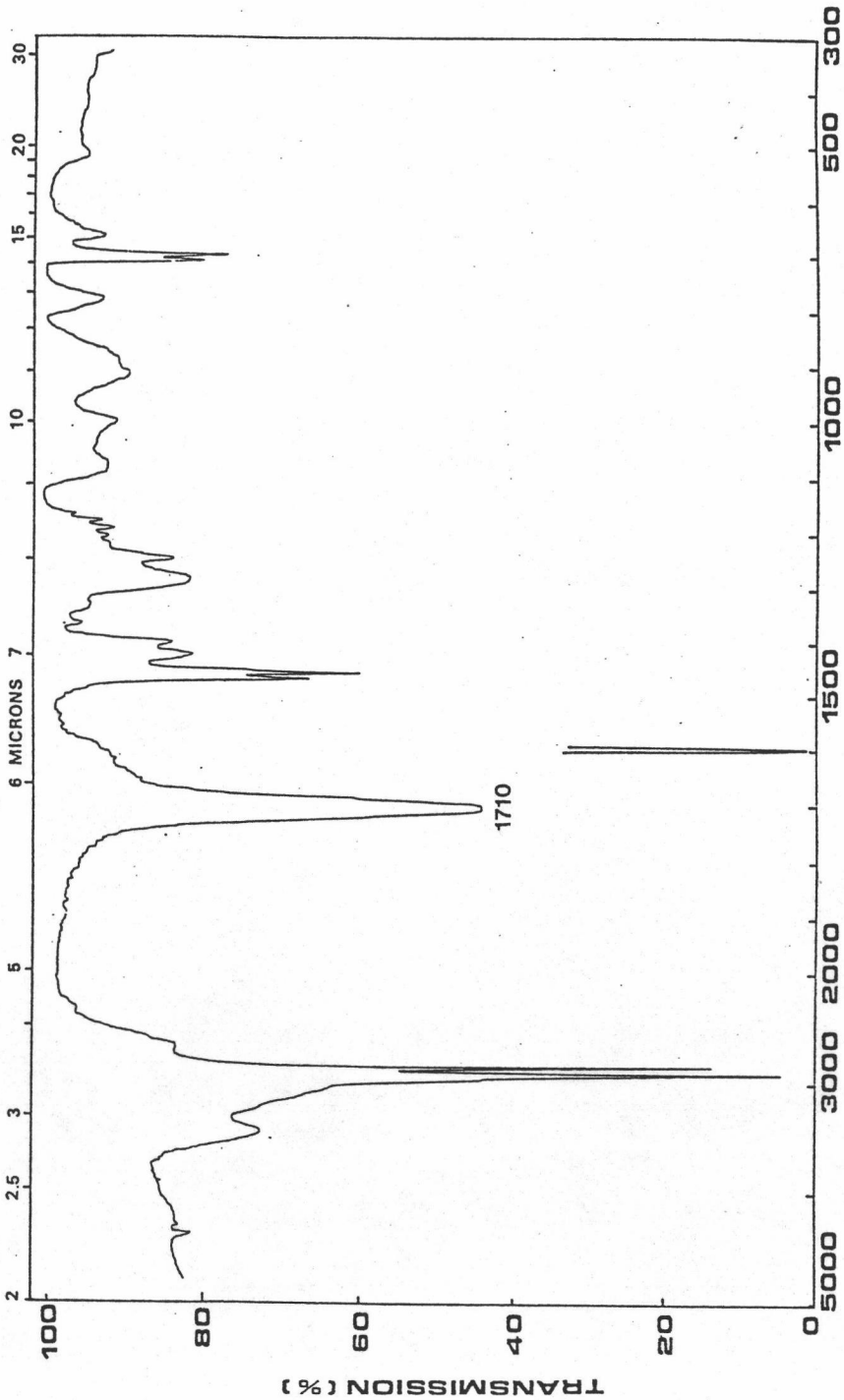


Figure 156 The IR spectrum of Compound 17

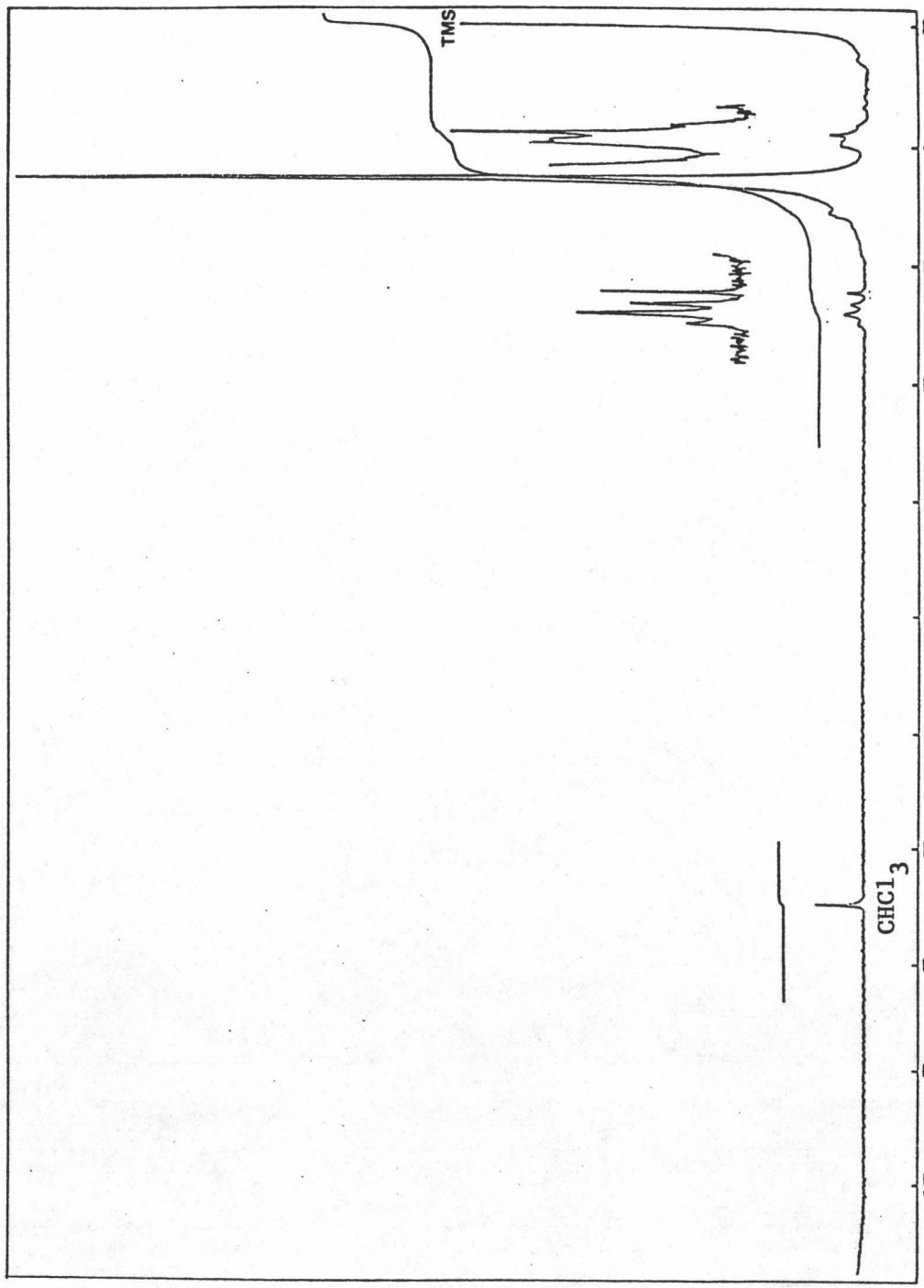


Figure 157 The ^{1}H NMR spectrum of Compound 17

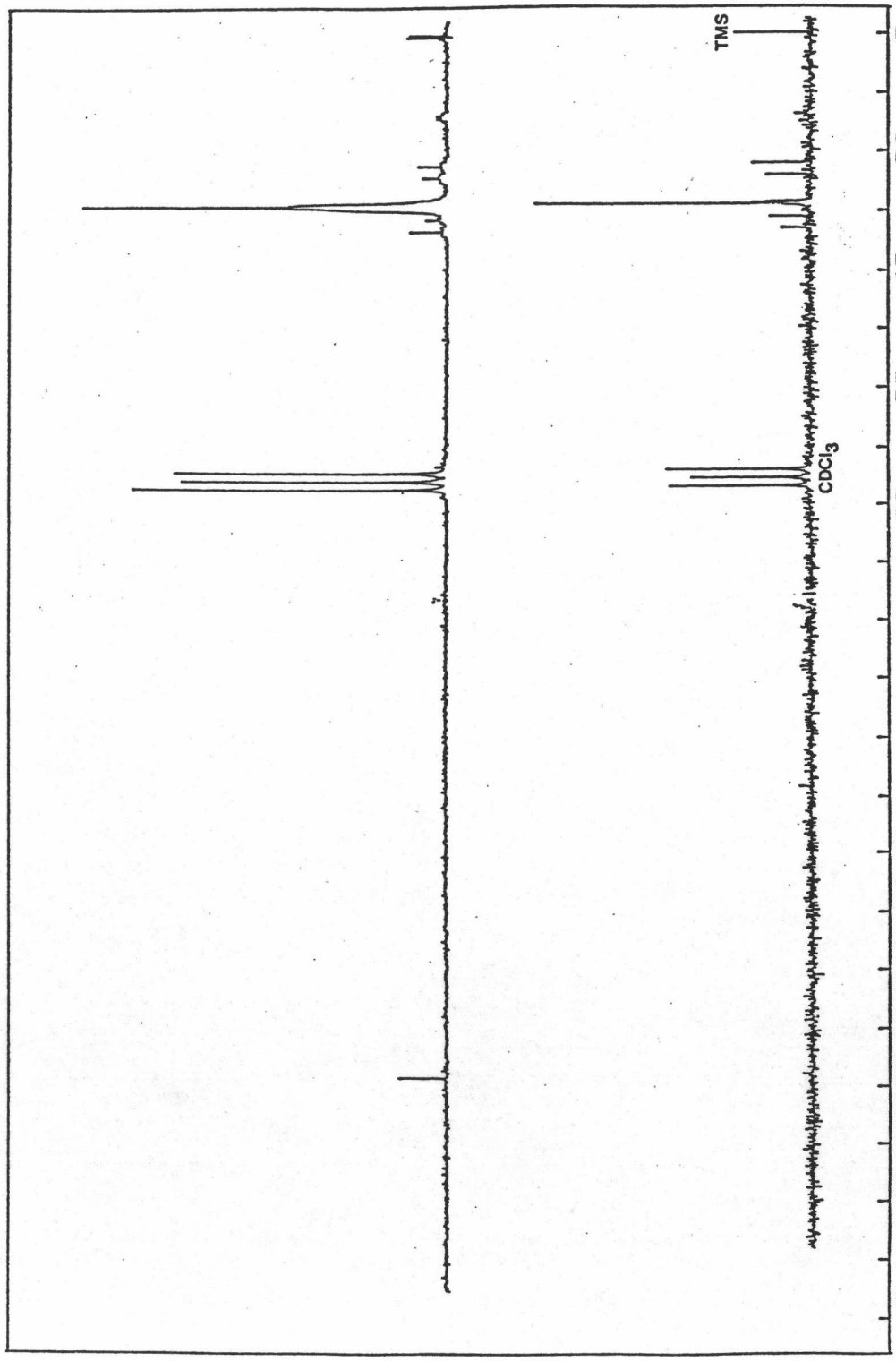


Figure 158 The ^{13}C NMR spectrum of Compound 17

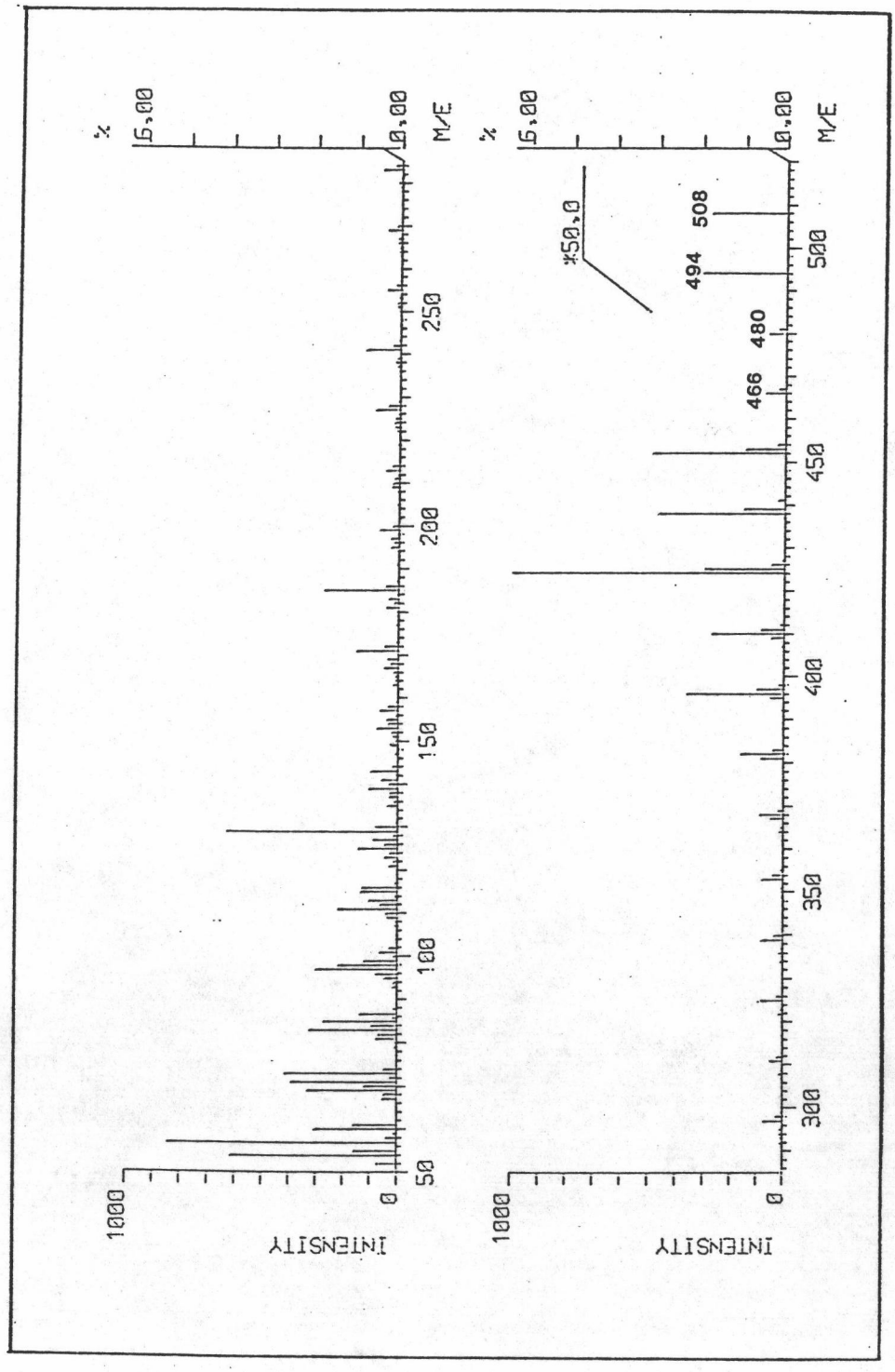


Figure 159 The mass spectrum of Compound 17

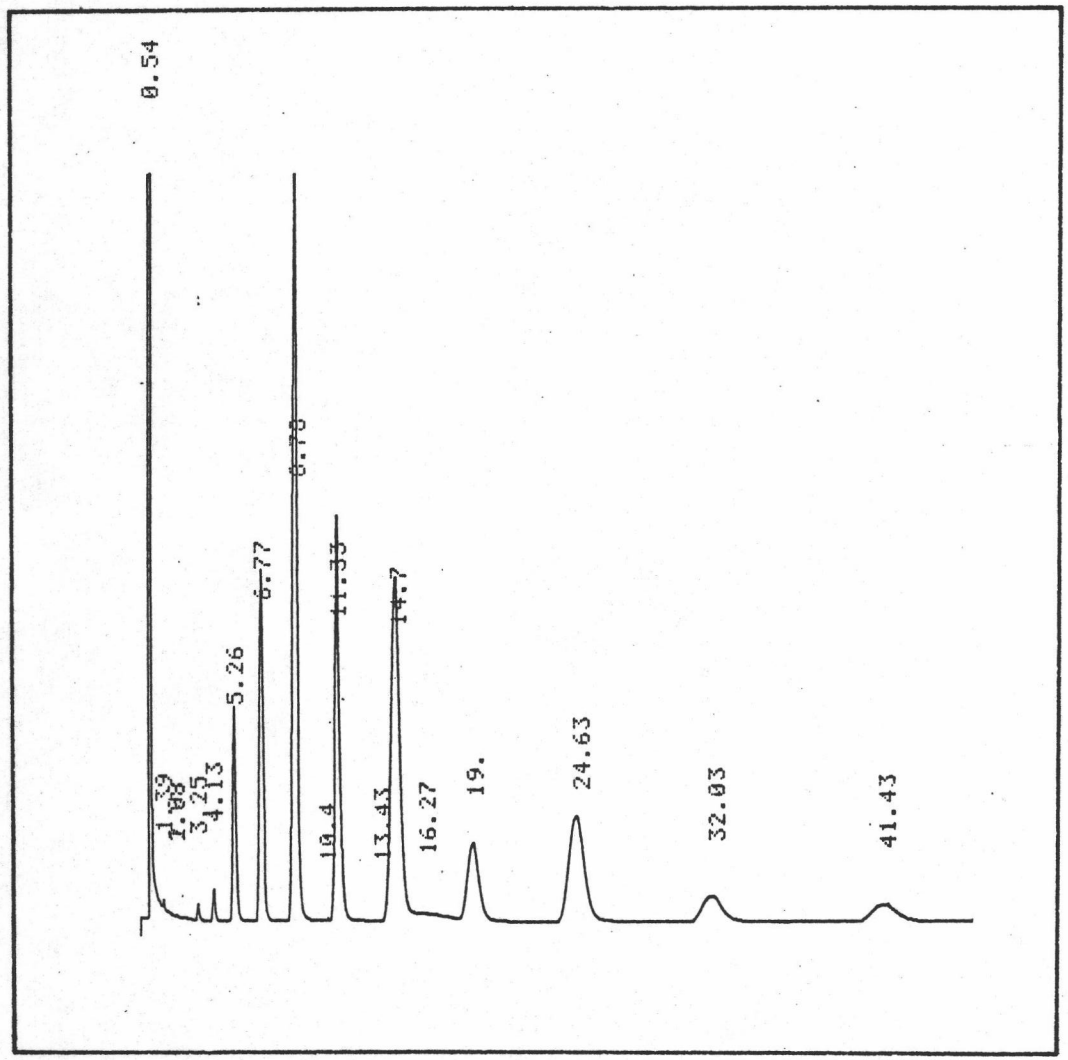


Figure 160 The GLC analysis results of Compound 17

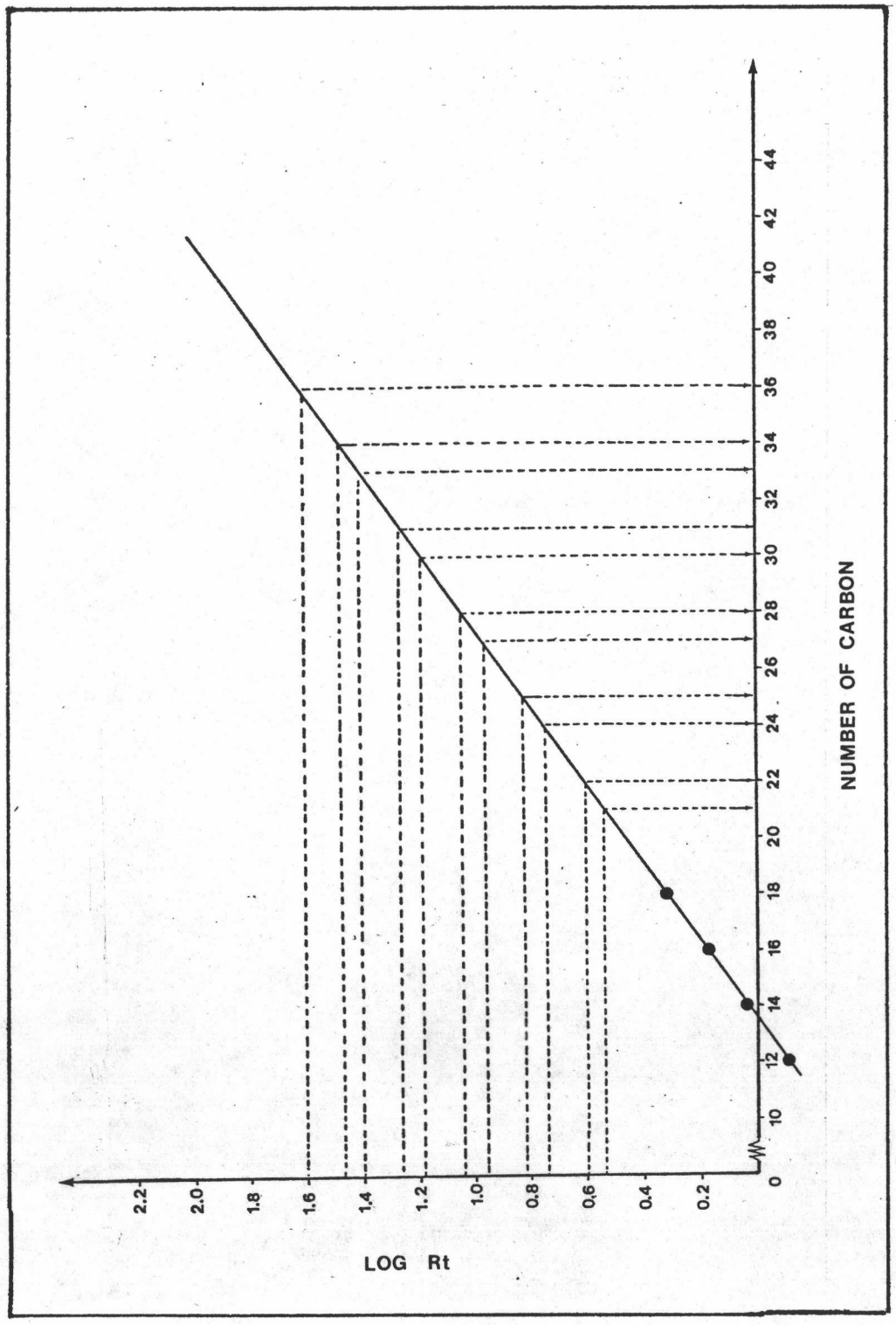


Figure 161 The standard correlation curve of Compound 17

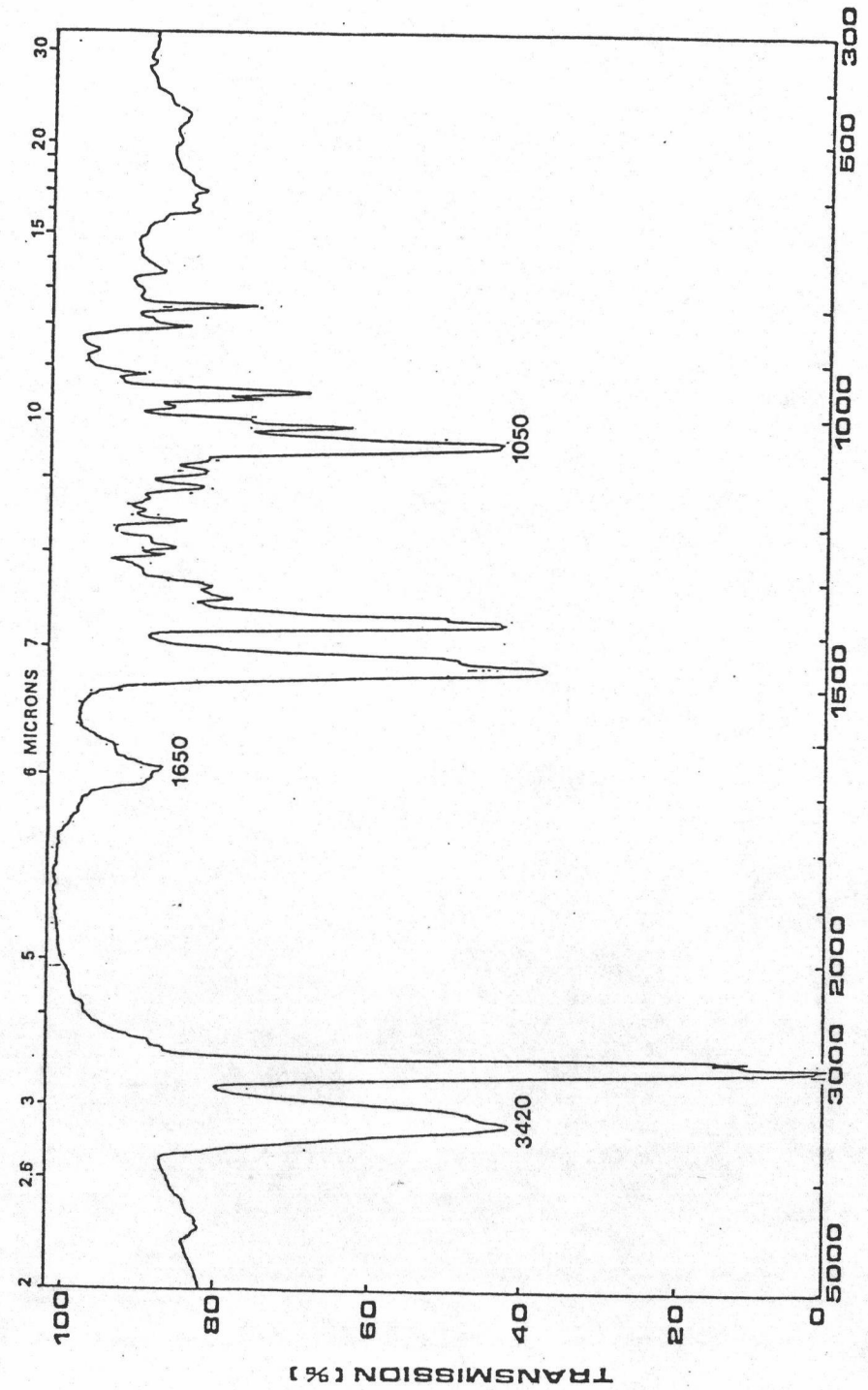


Figure 162 The IR spectrum of Compound 18

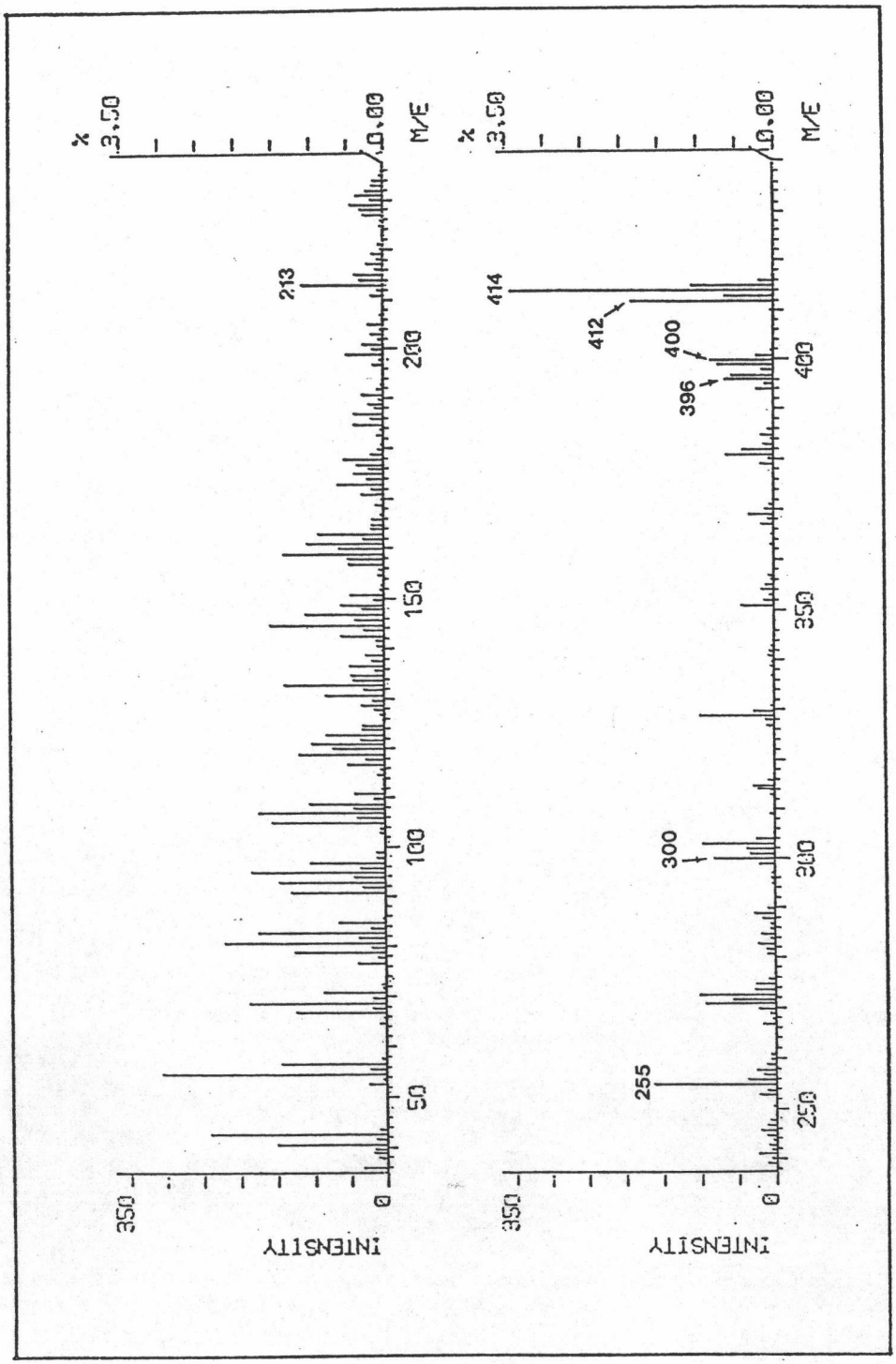


Figure 163 The mass spectrum of Compound 18

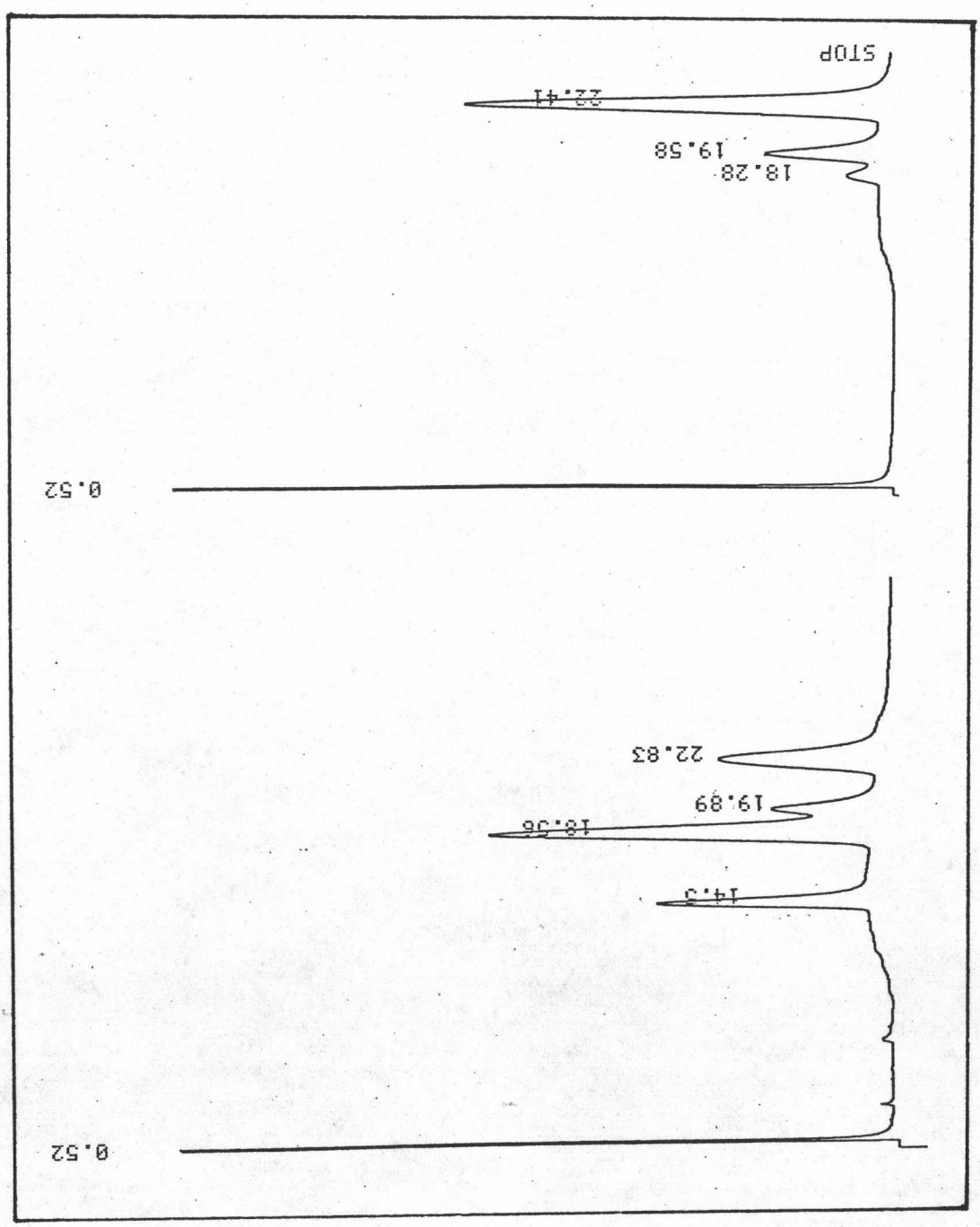


Figure 164 The GLC analysis of Compound 18

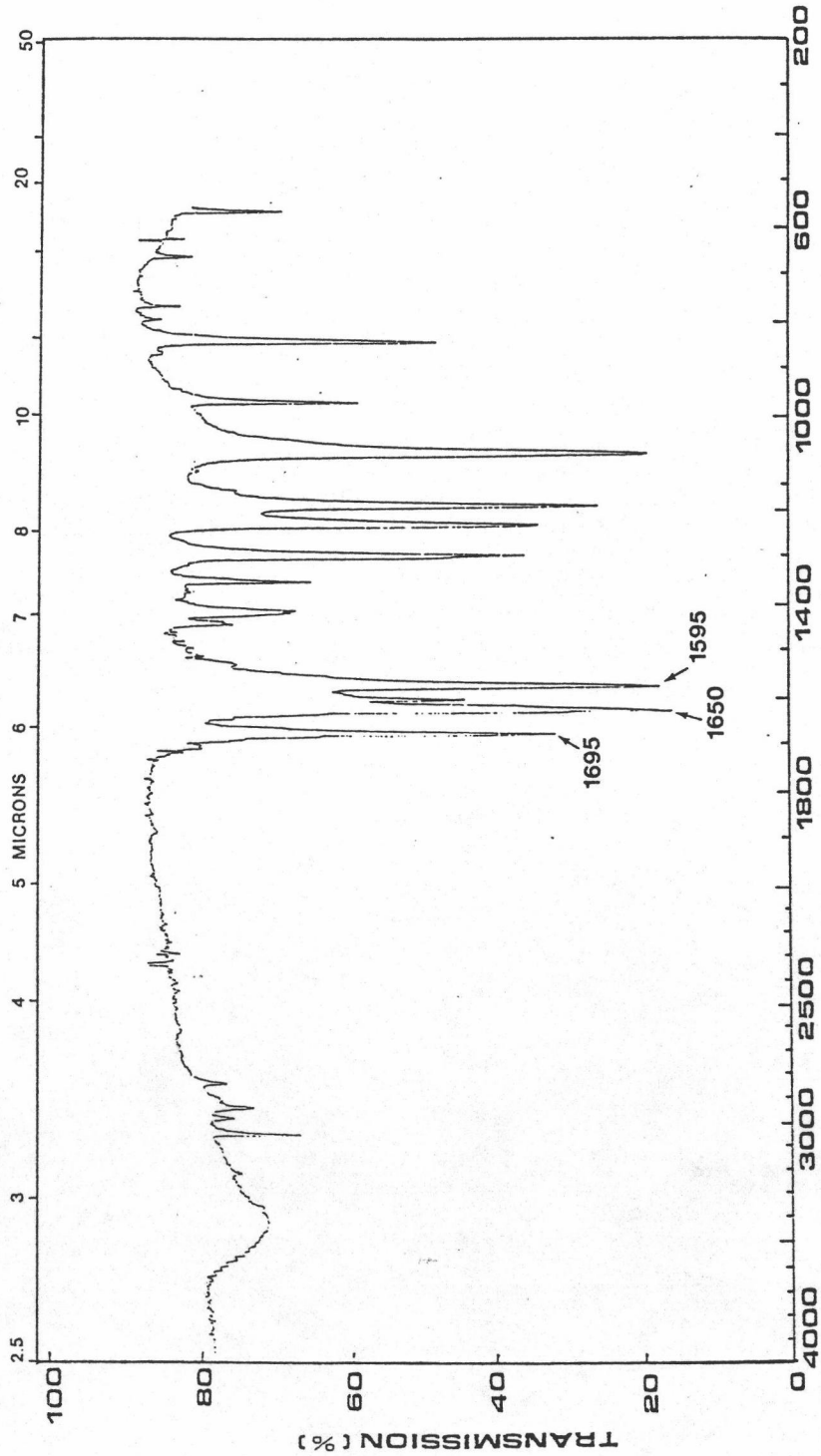


Figure 165 The IR spectrum of Compound 19

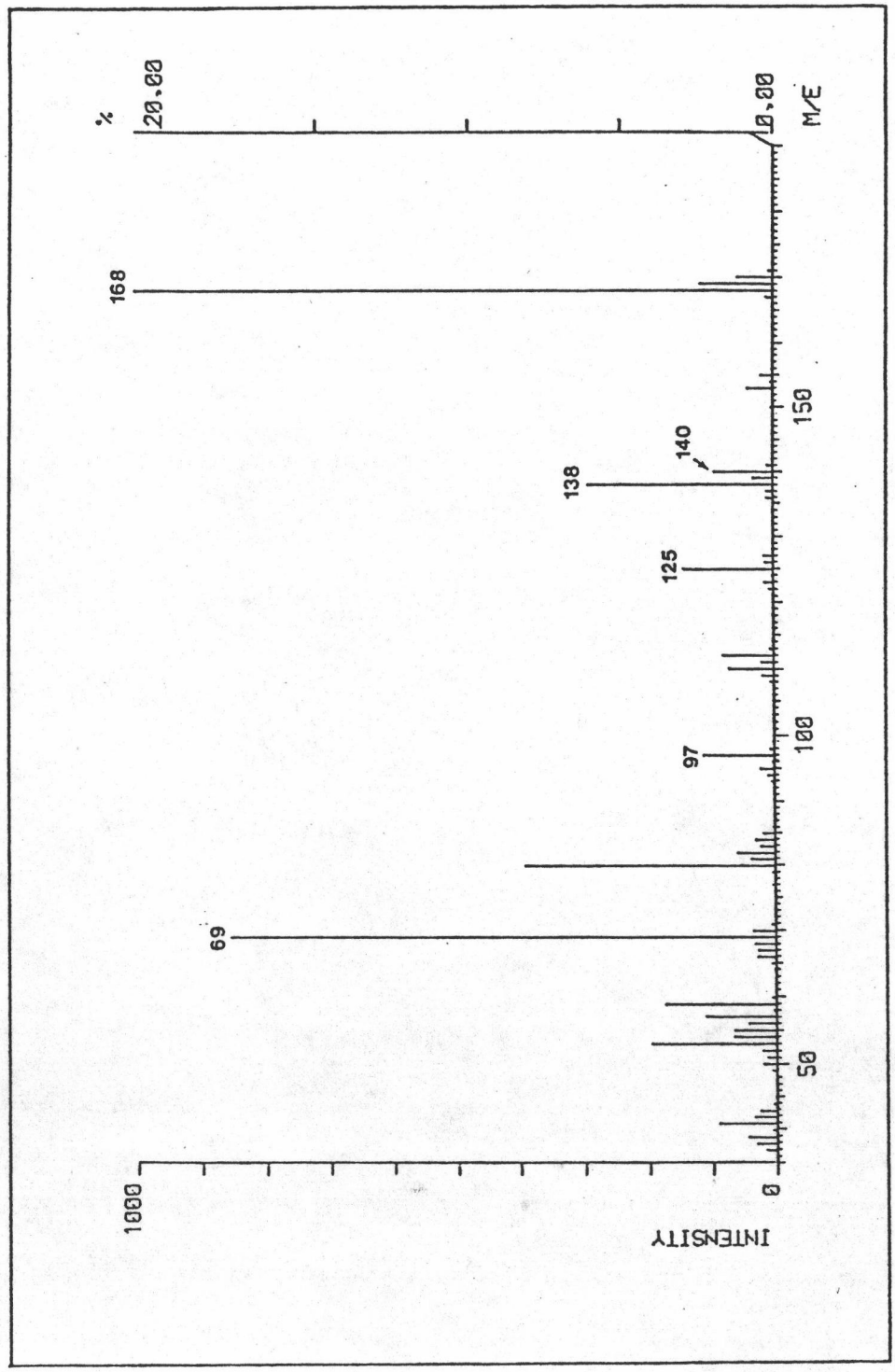


Figure 166 The mass spectrum of Compound 19

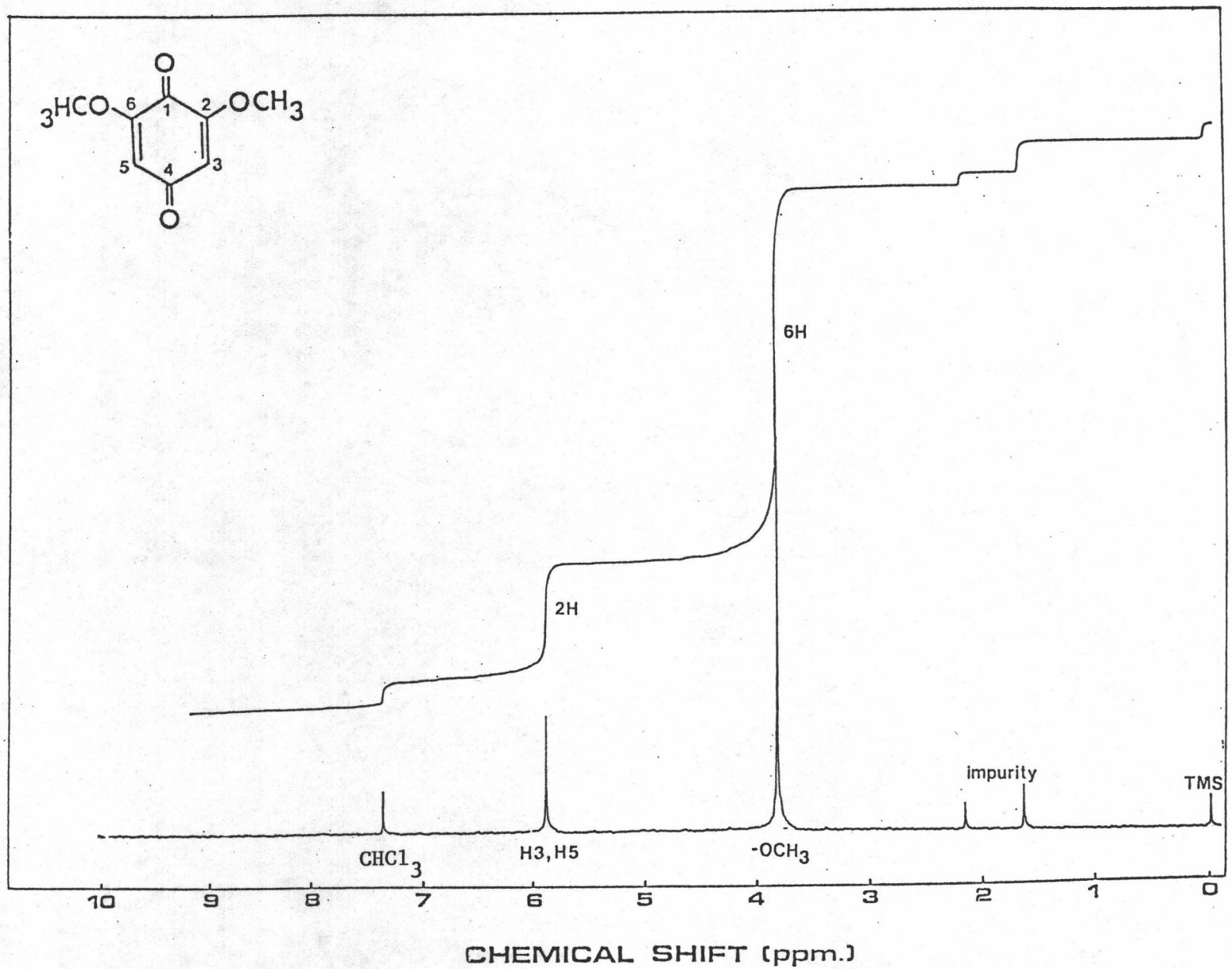


Figure 167 The ^{1}H NMR spectrum of Compound 19

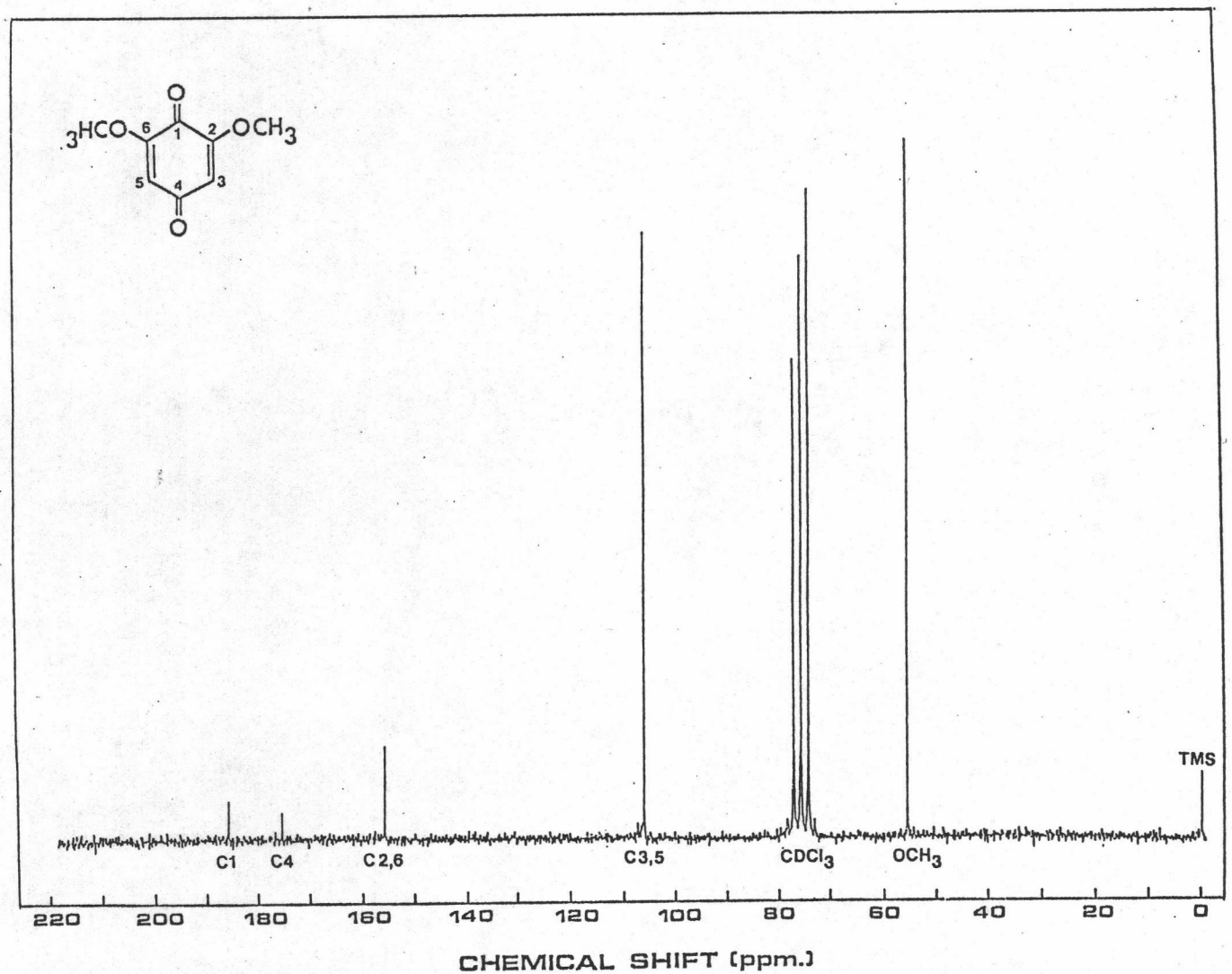


Figure 168 The ^{13}C NMR spectrum of Compound 19

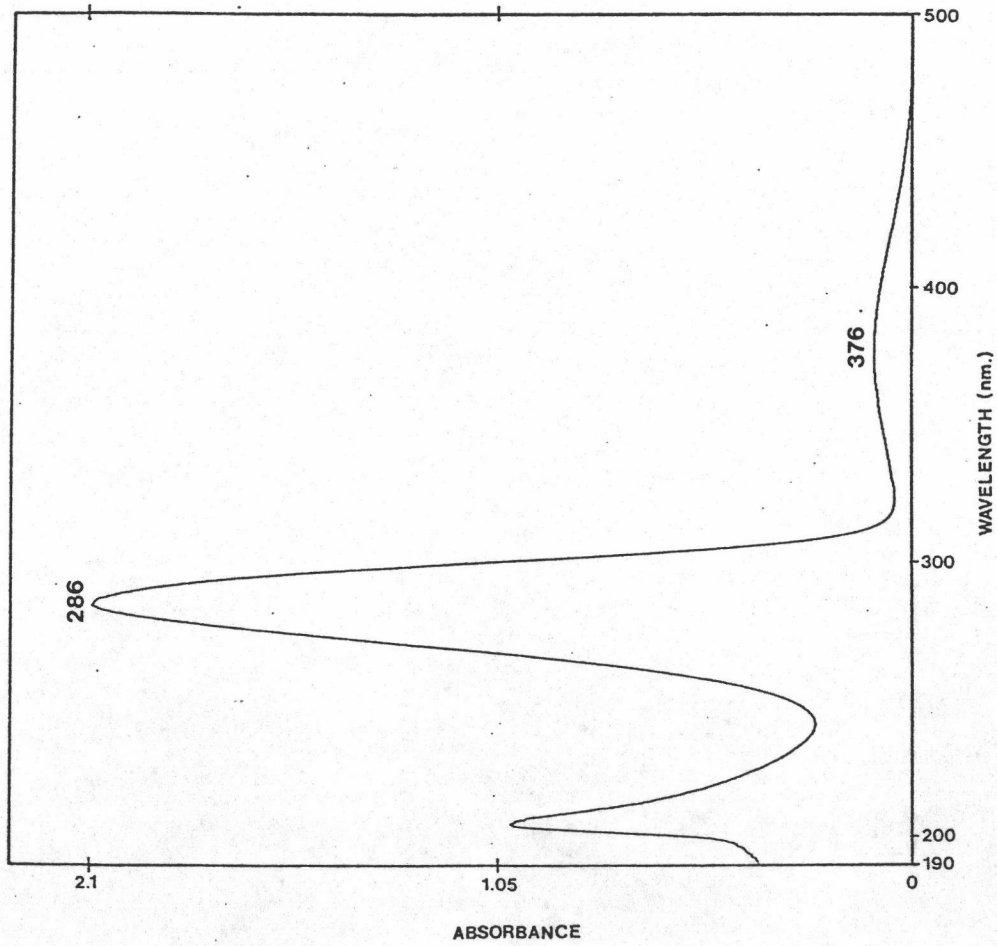


Figure 169 The UV spectrum of Compound 19

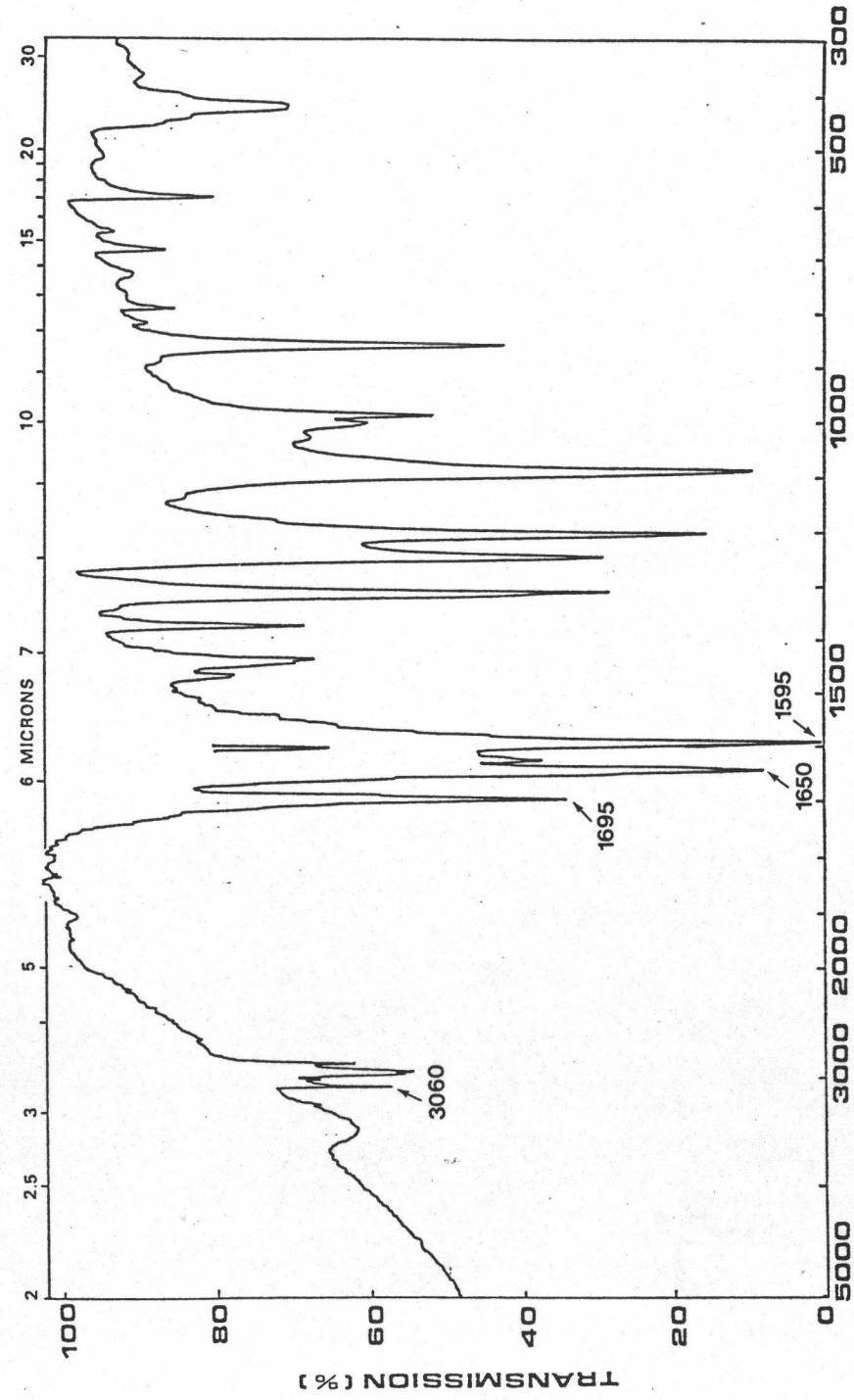


Figure 170 The IR spectrum of synthetic Compound 19

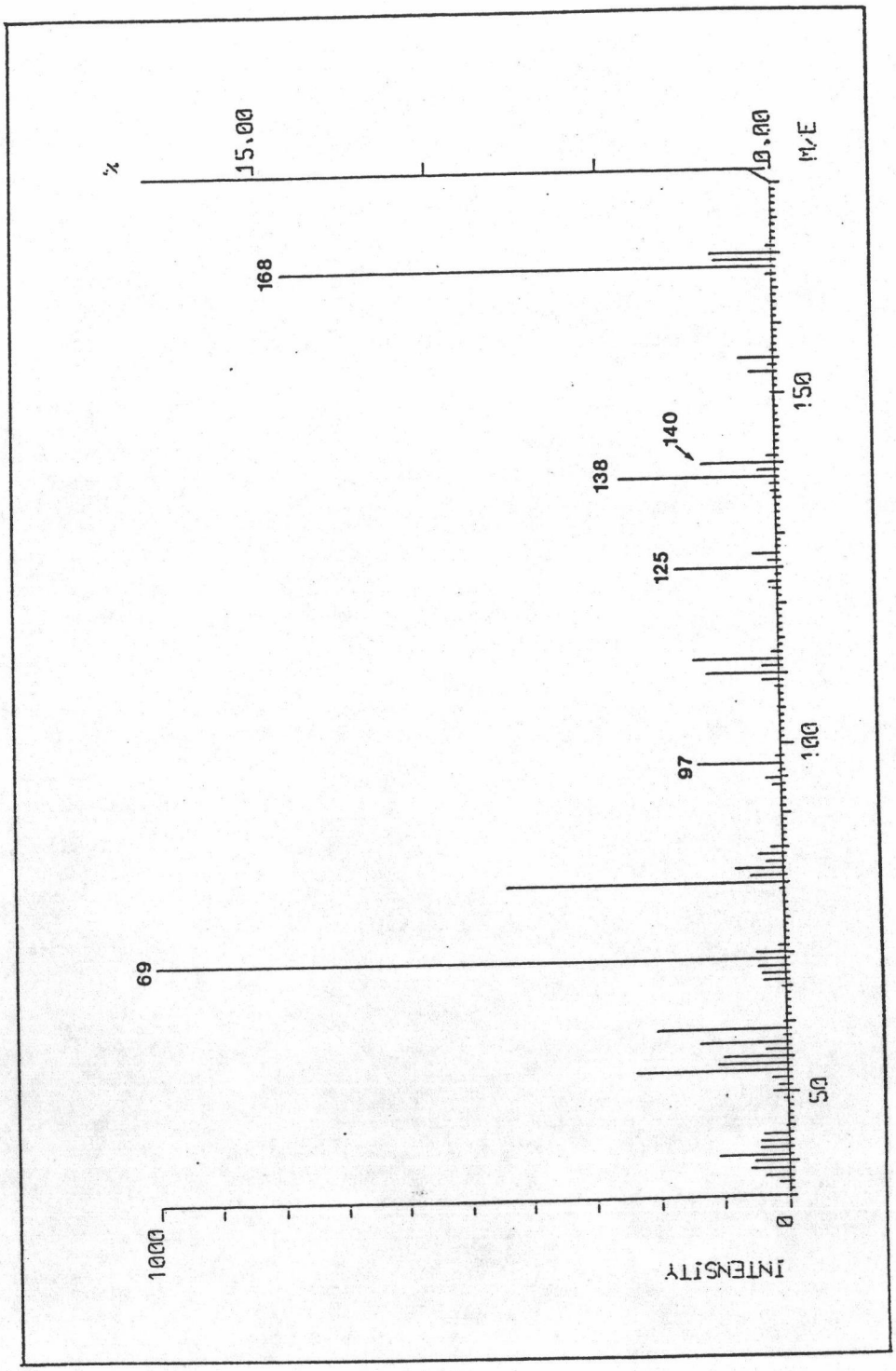


Figure 171 The mass spectrum of synthetic Compound 19

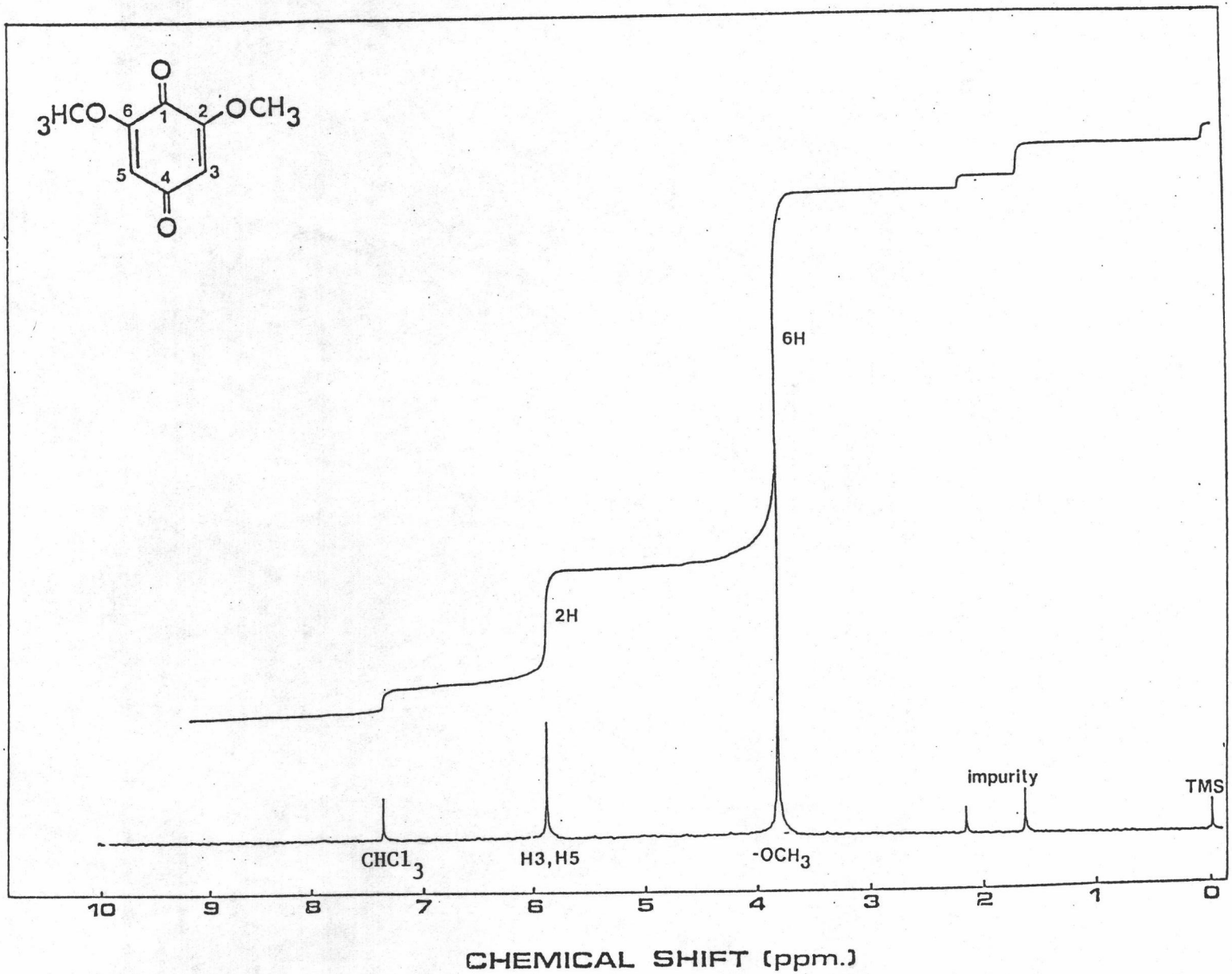


Figure 172 The ^{1}H NMR spectrum of synthetic Compound 19

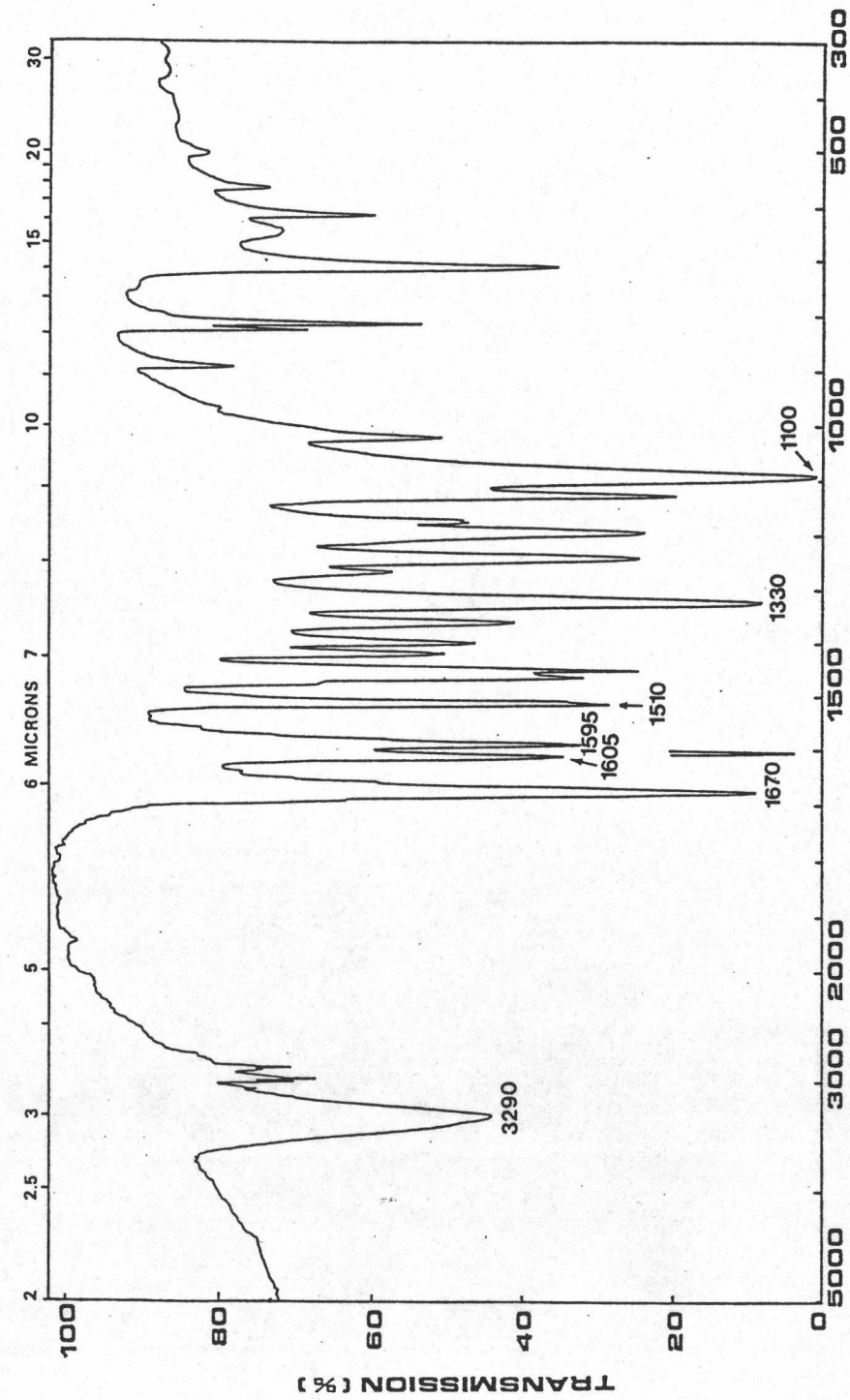


Figure 173 The IR spectrum of Compound 20

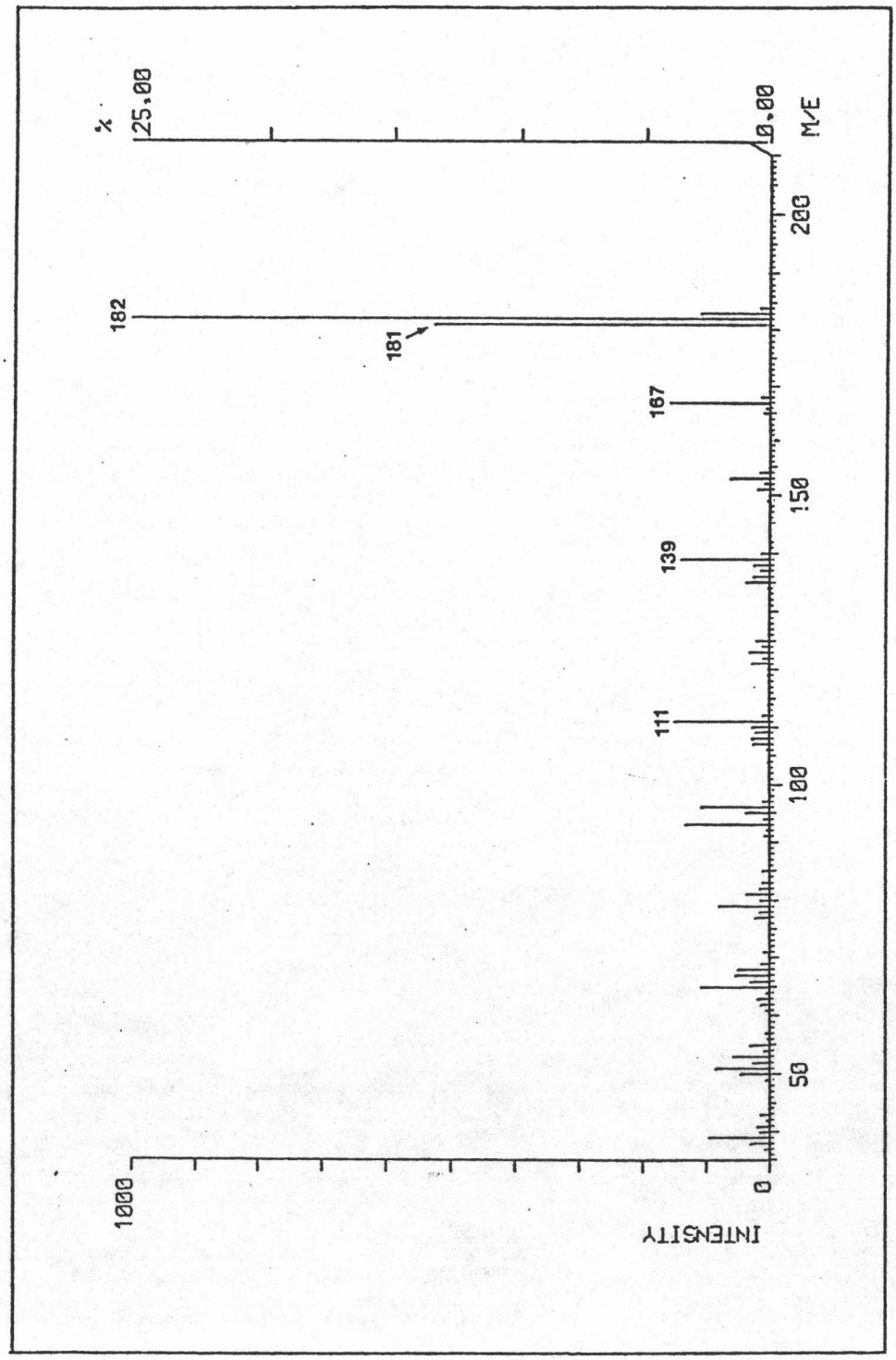


Figure 174 The mass spectrum of Compound 20

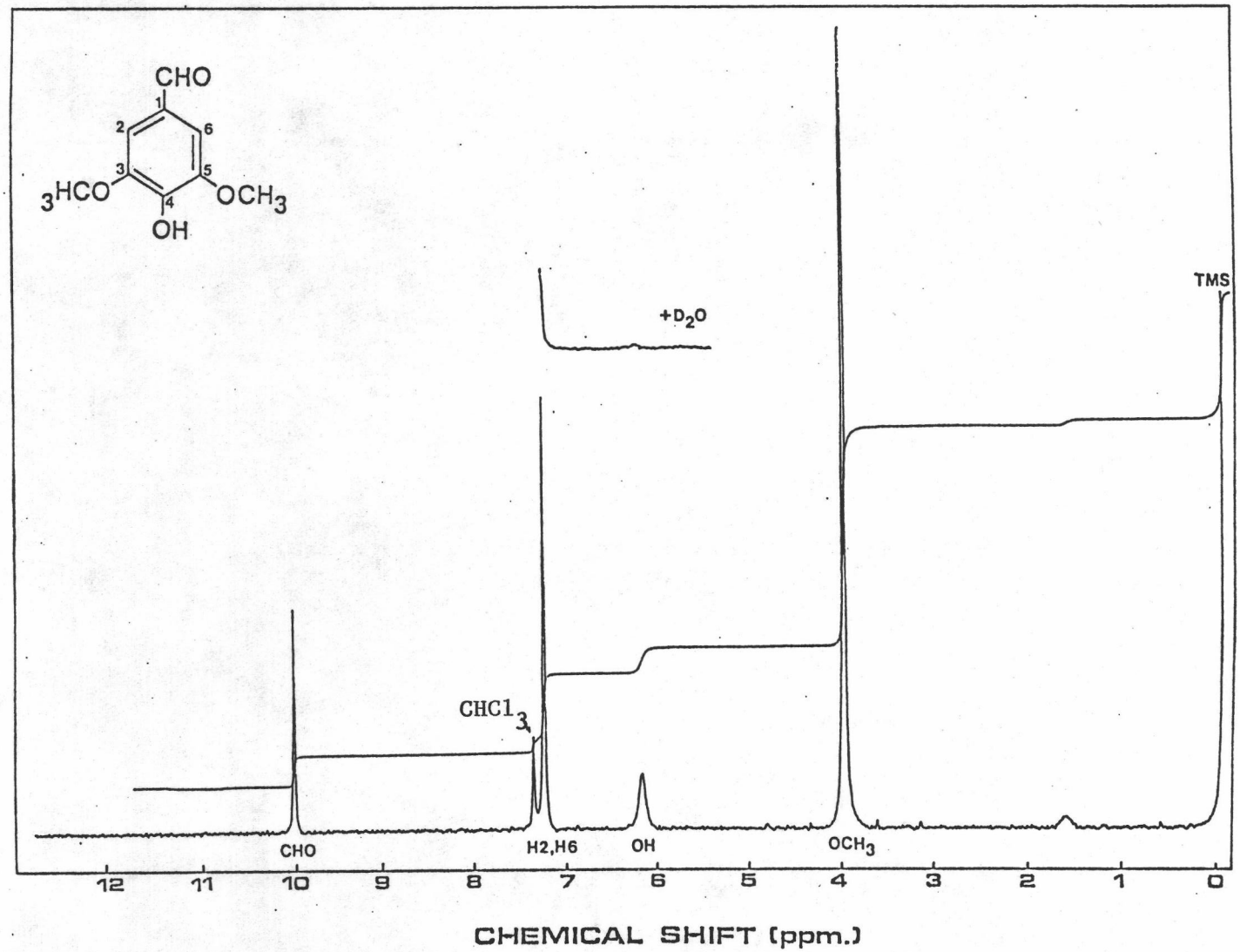


Figure 175 The ^{1}H NMR spectrum of Compound 20

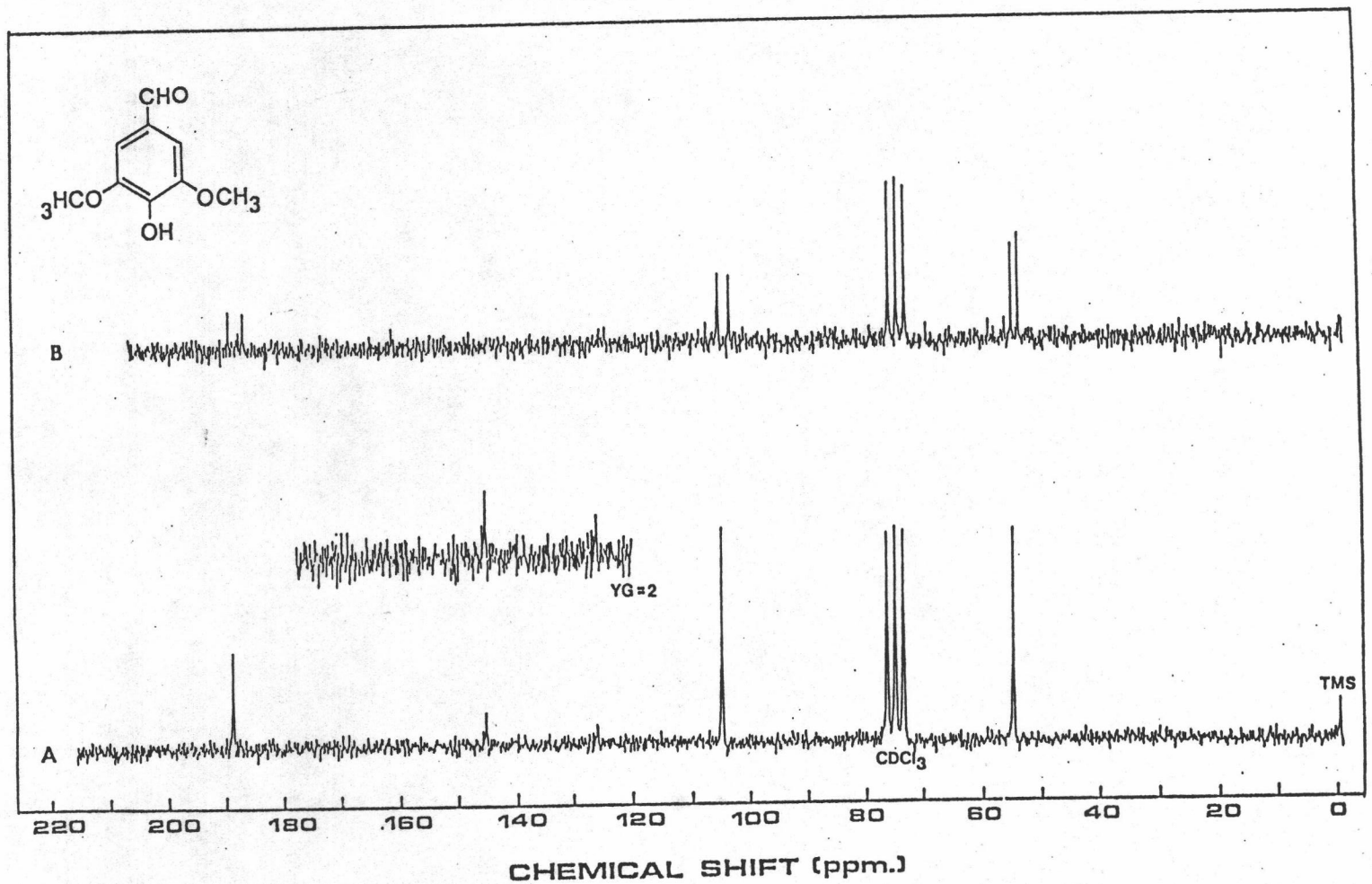


Figure 176 A) The ^{13}C NMR spectrum of Compound 20

B) The ^{13}C NMR off resonance spectrum of Compound 20

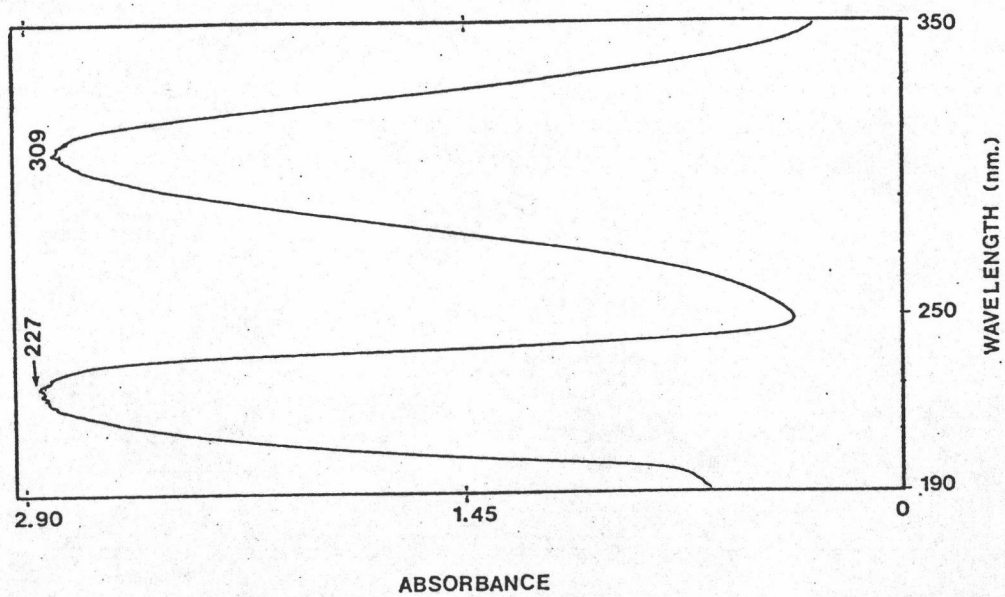


Figure 177 The UV spectrum of Compound 20

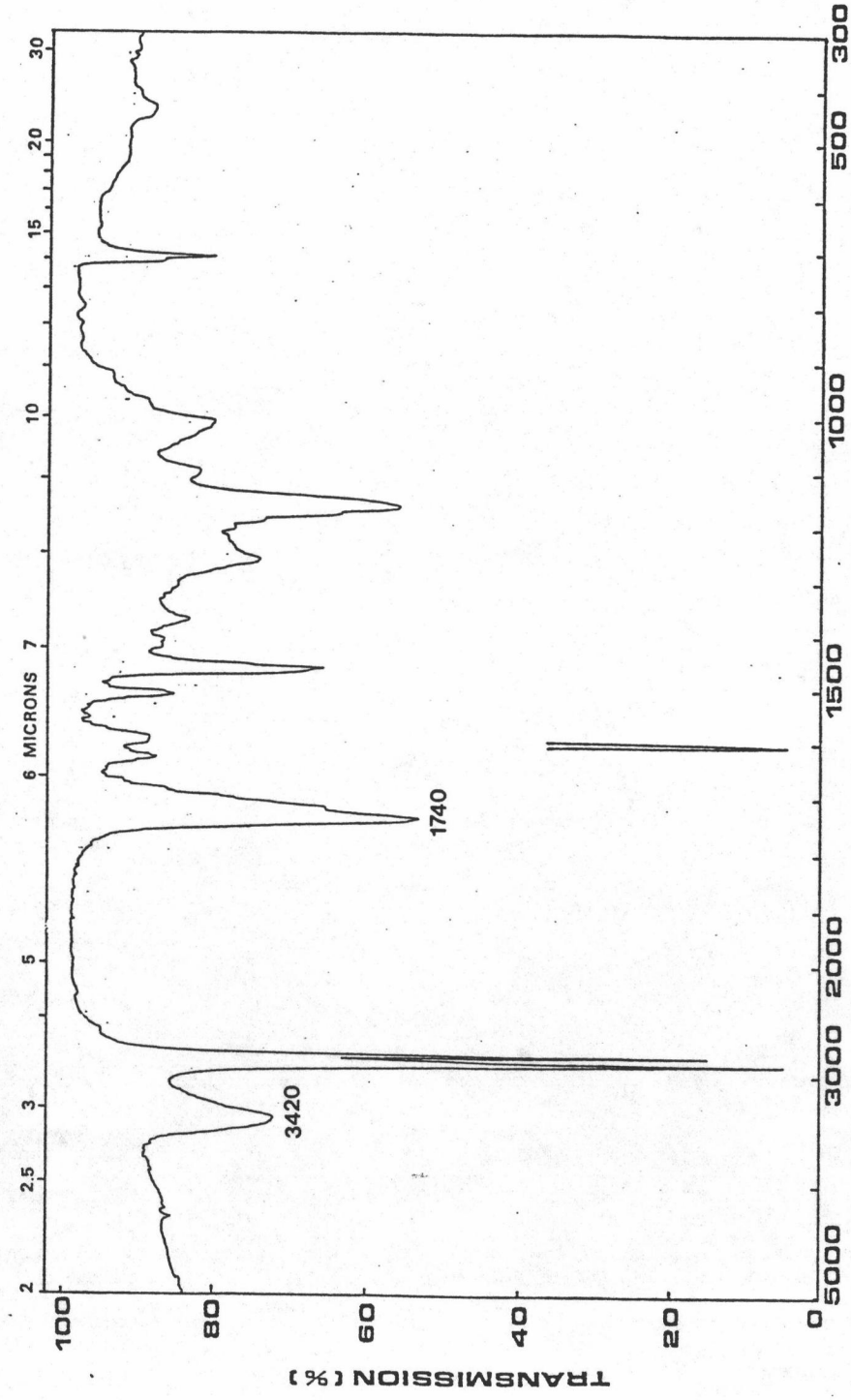


Figure 178 The IR spectrum of Compound 21

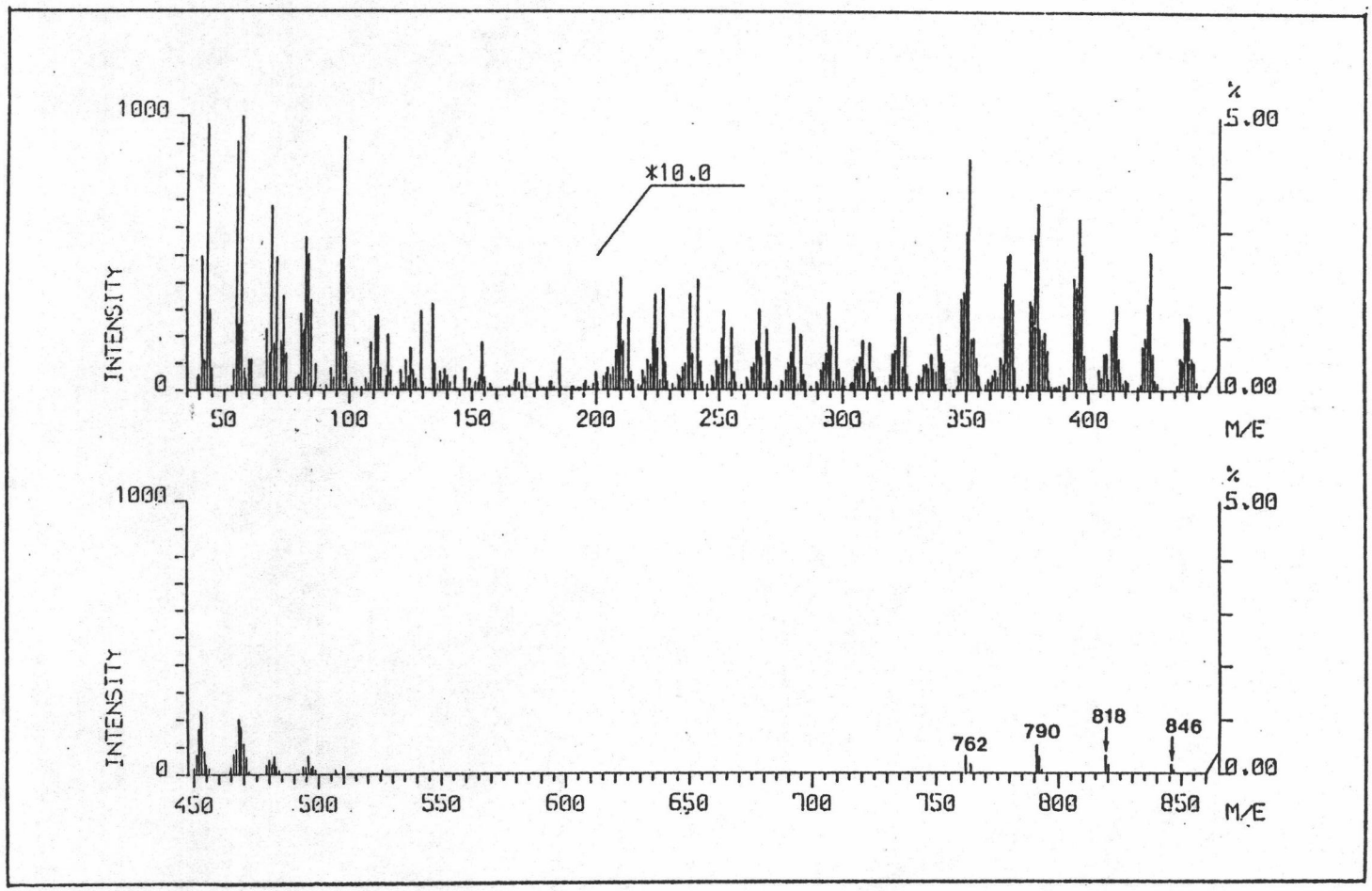


Figure 179 The mass spectrum of Compound 21

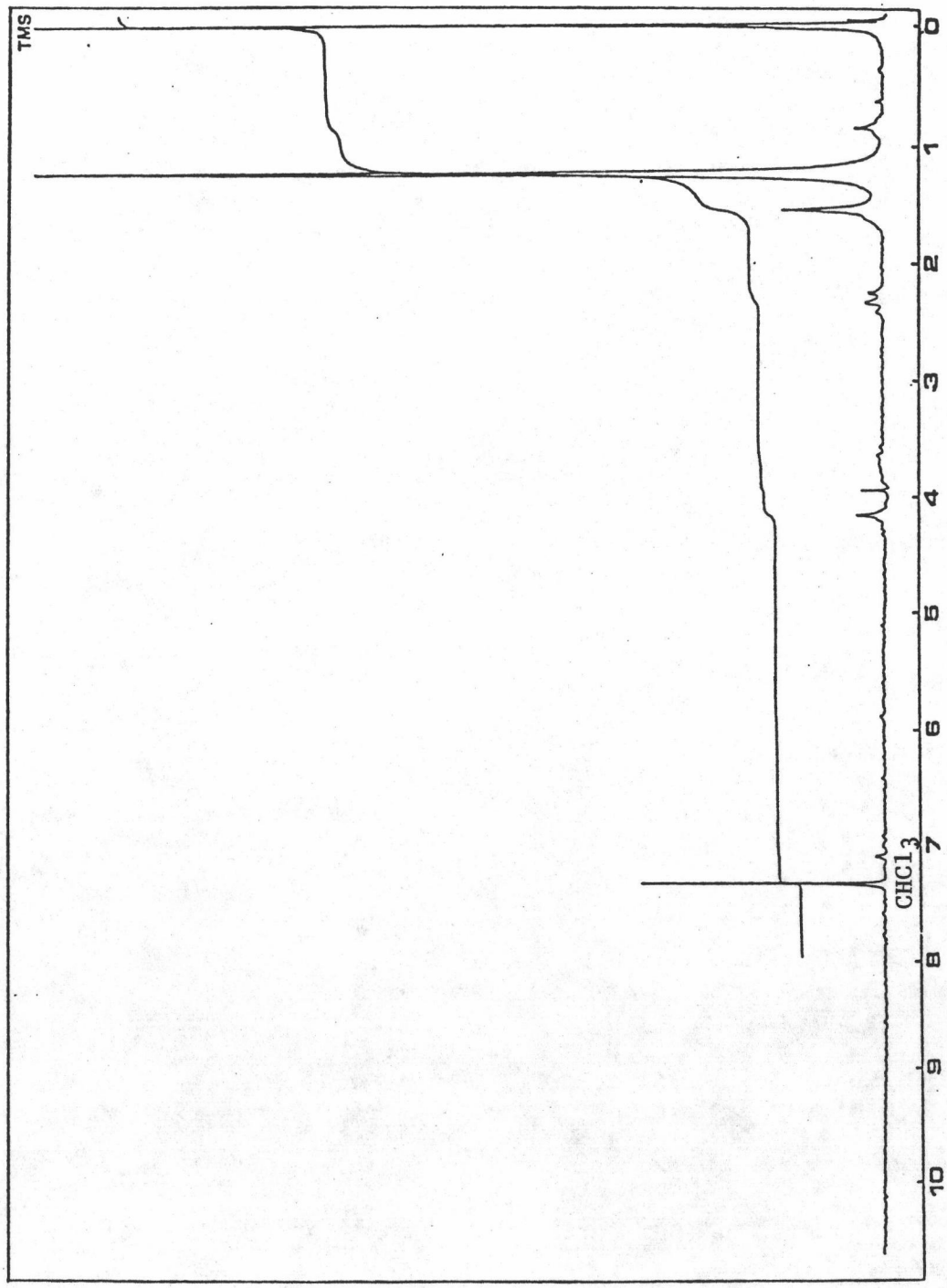


Figure 180 The ^{1}H NMR spectrum of Compound 21

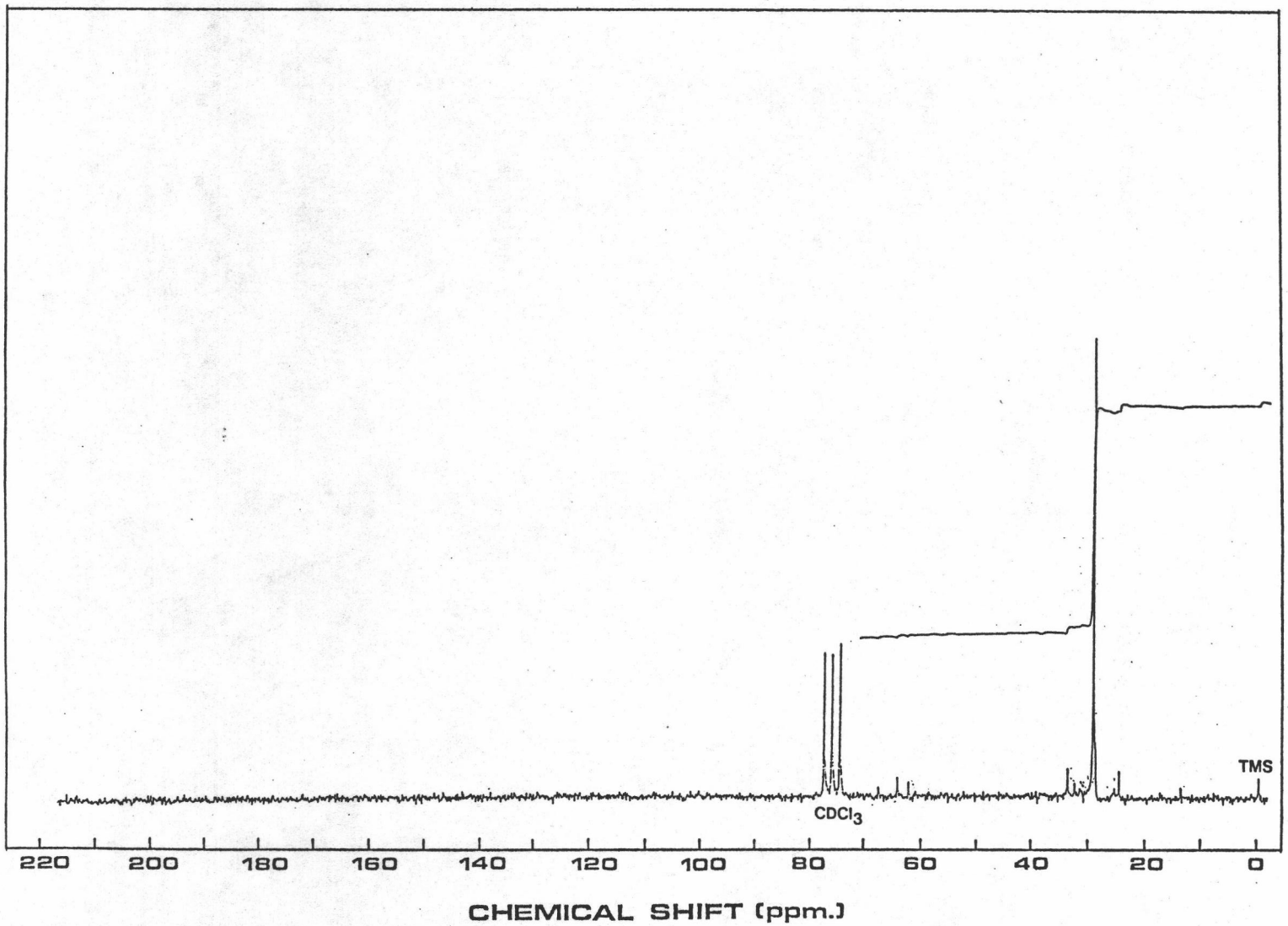


Figure 181 The ^{13}C NMR spectrum of Compound 21

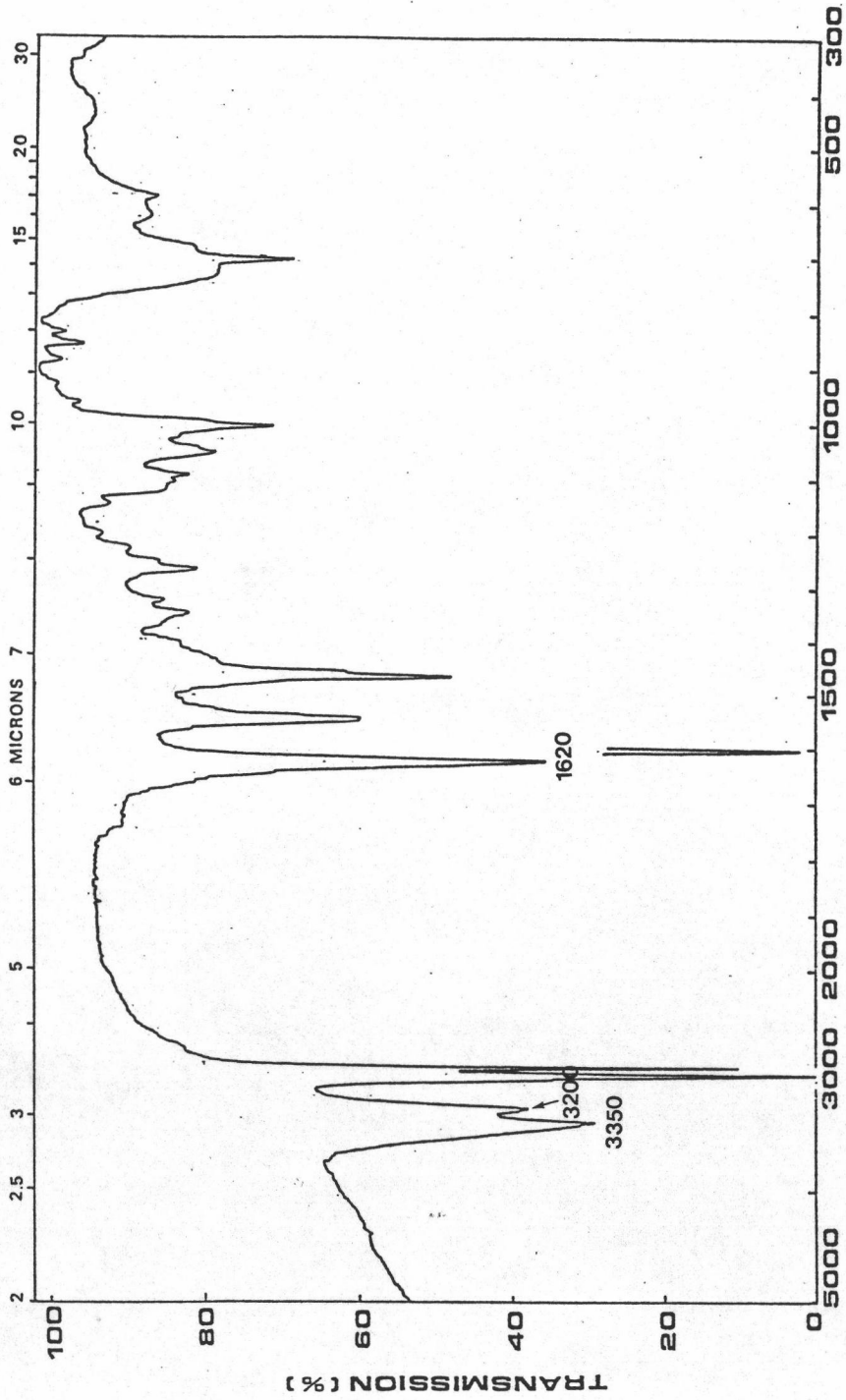


Figure 182 The IR spectrum of Compound 22

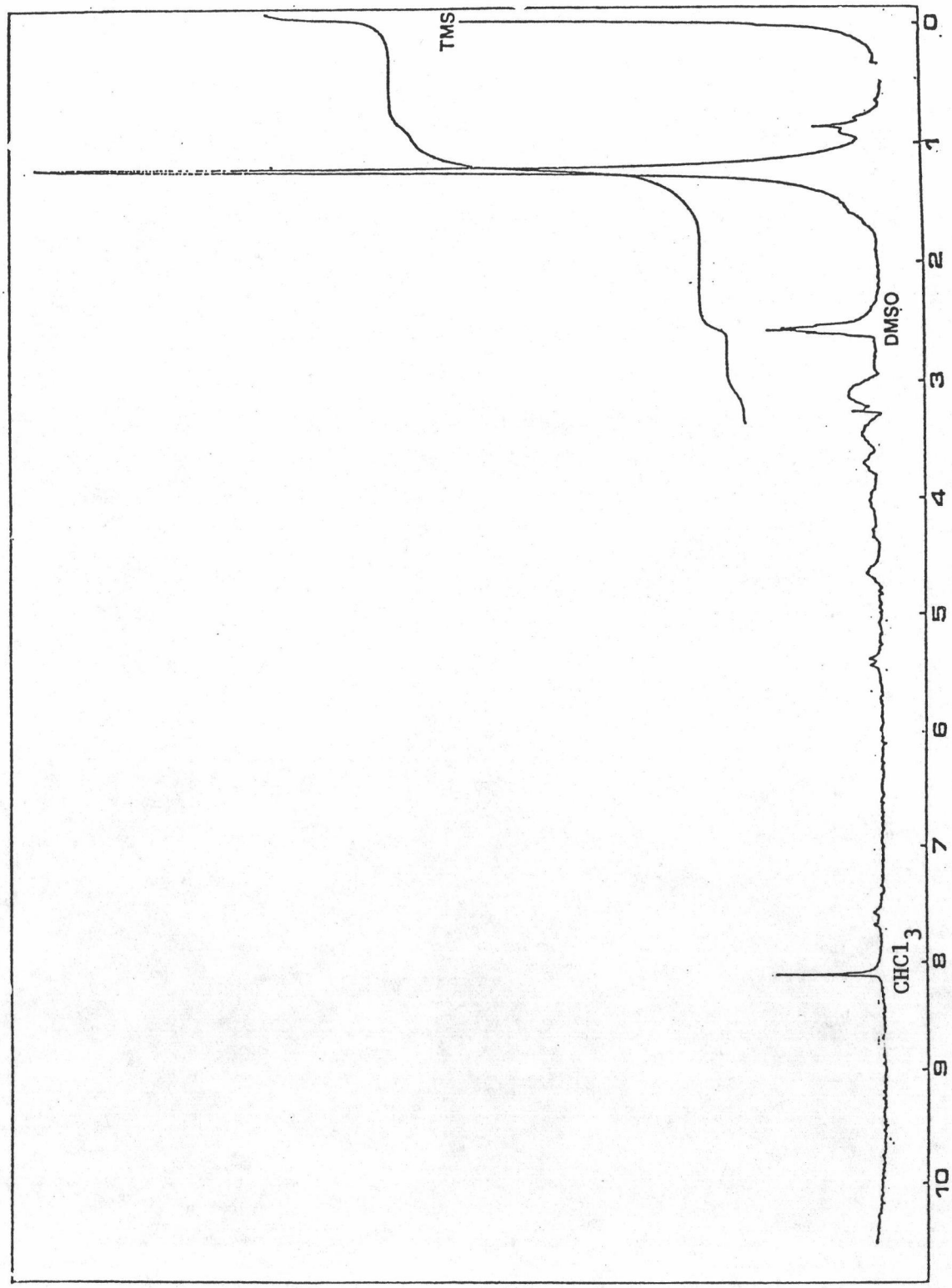


Figure 183 The ^1H NMR spectrum of Compound 22

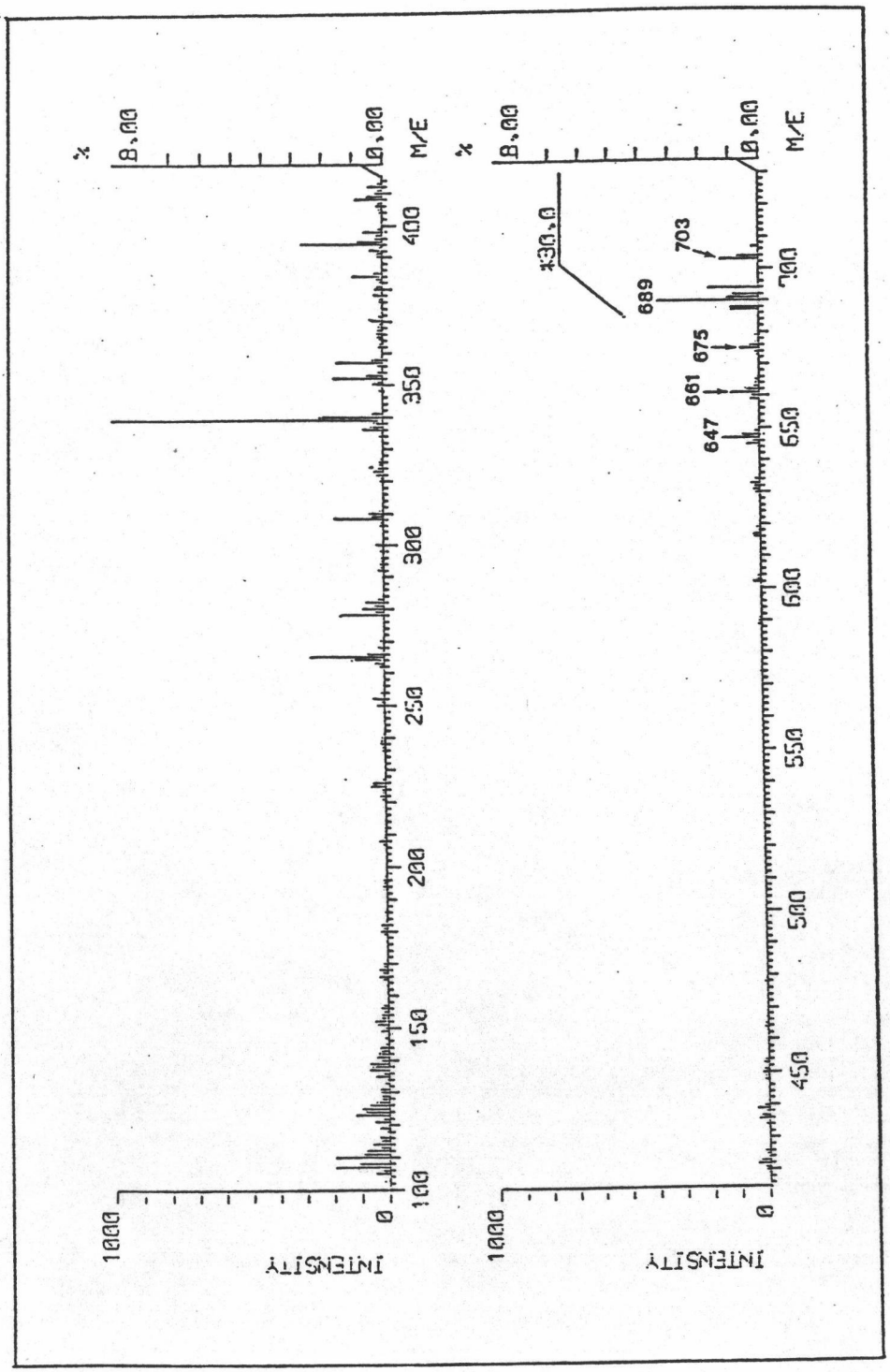


Figure 184 The mass spectrum of Compound 22

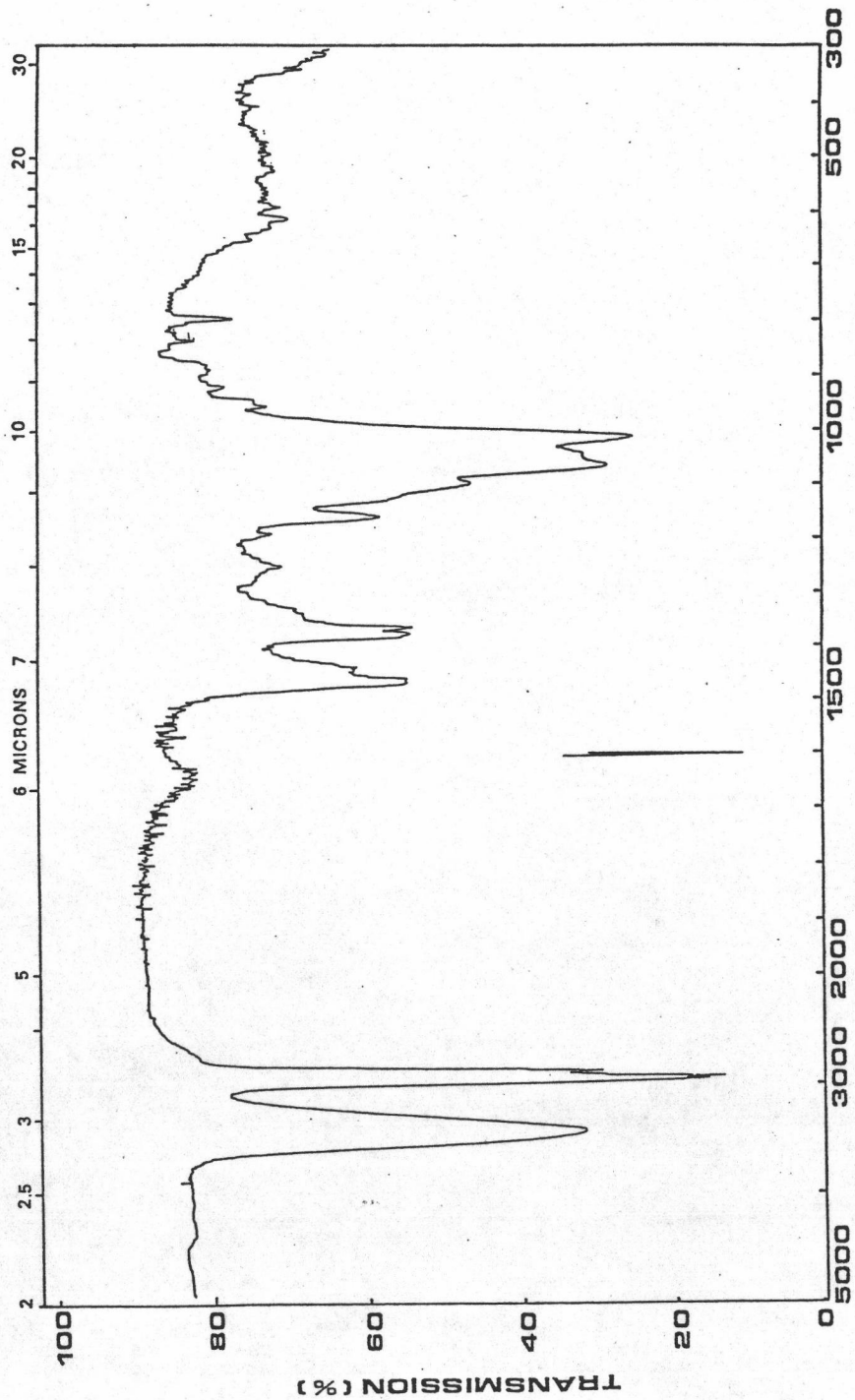


Figure 185 The IR spectrum of Compound 23

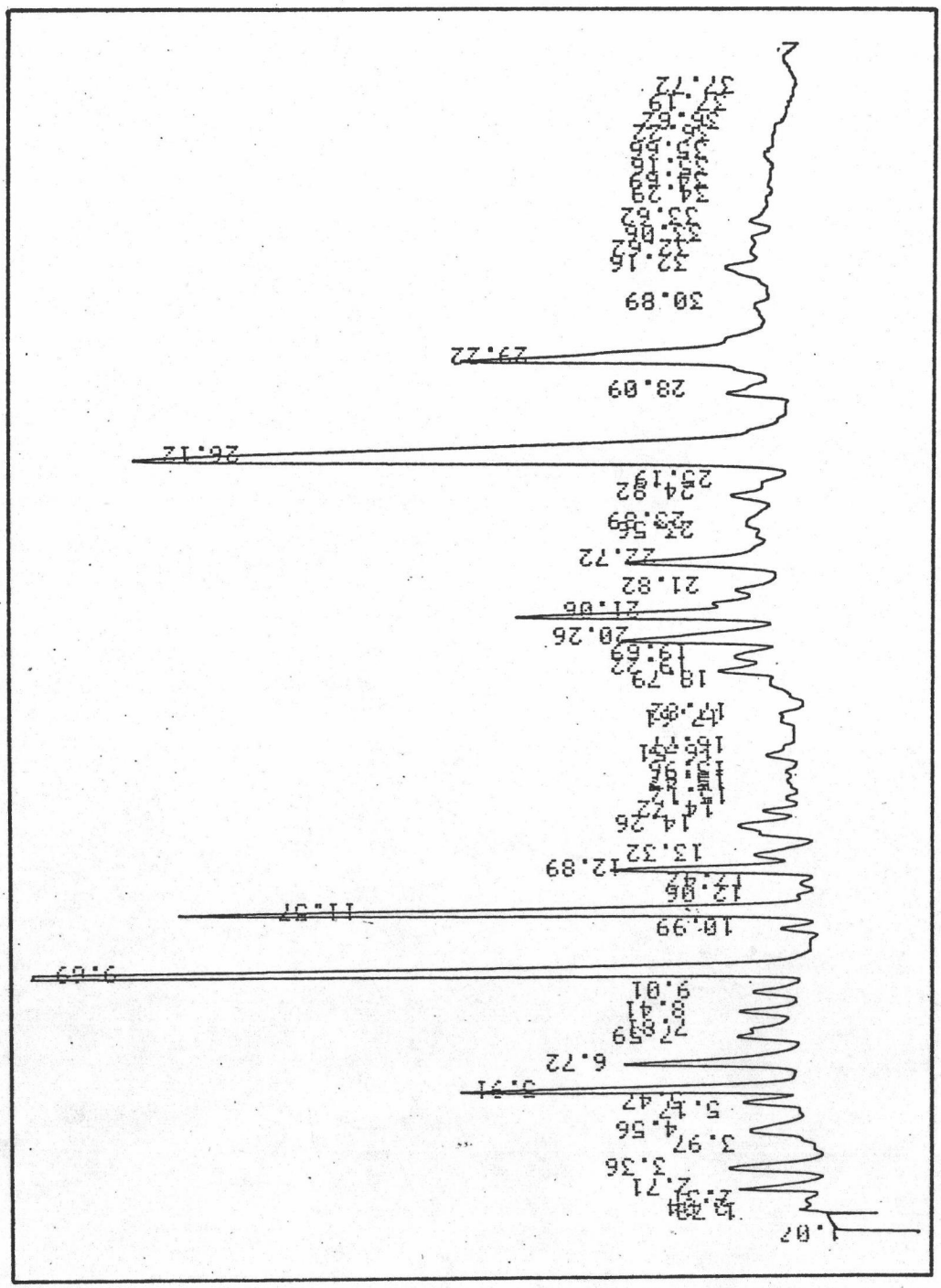


Figure 186 The HPLC analysis of Fraction XIA (for phenolic compounds)

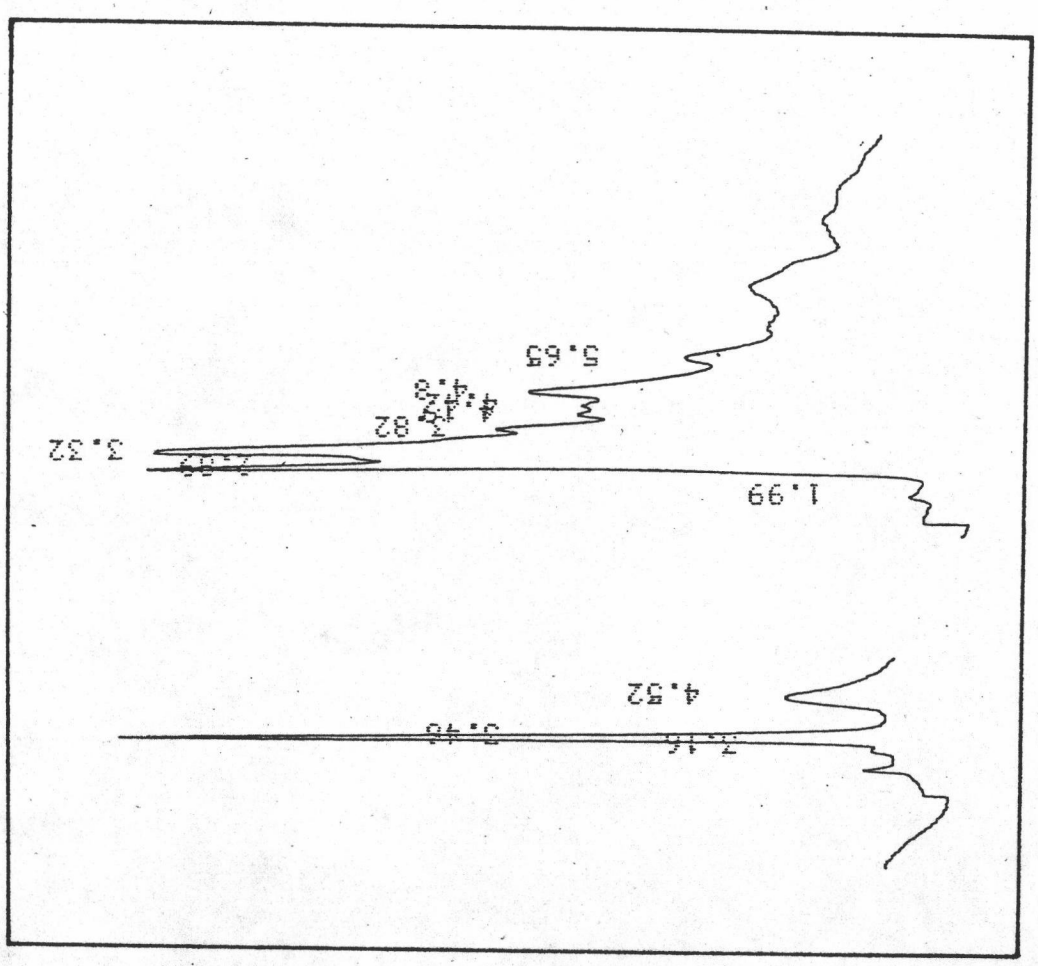


Figure 187 The HPLC analysis results of Fraction XIA (for gibberilins)

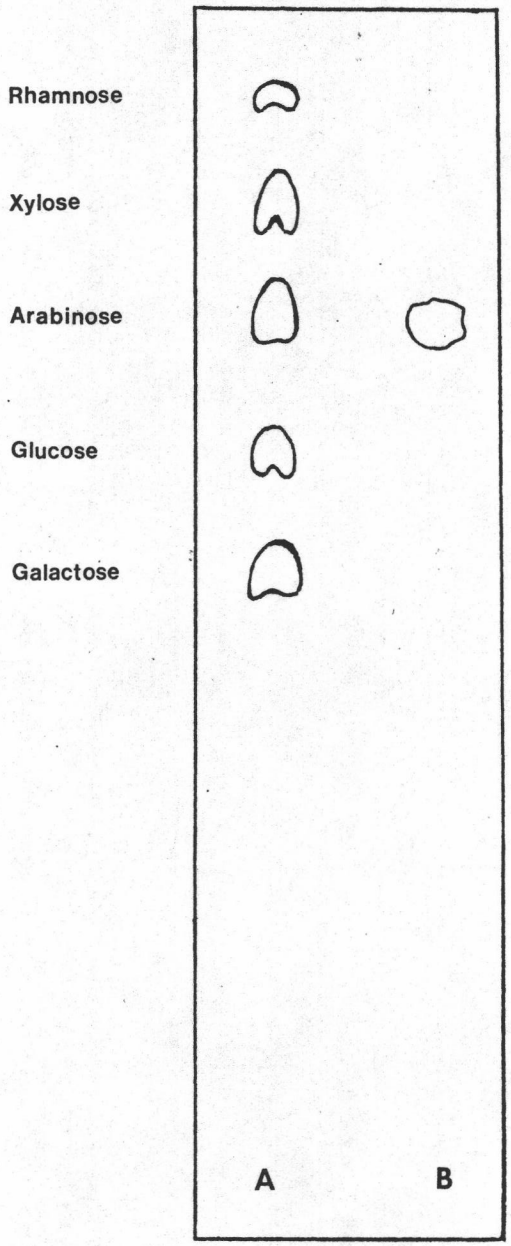
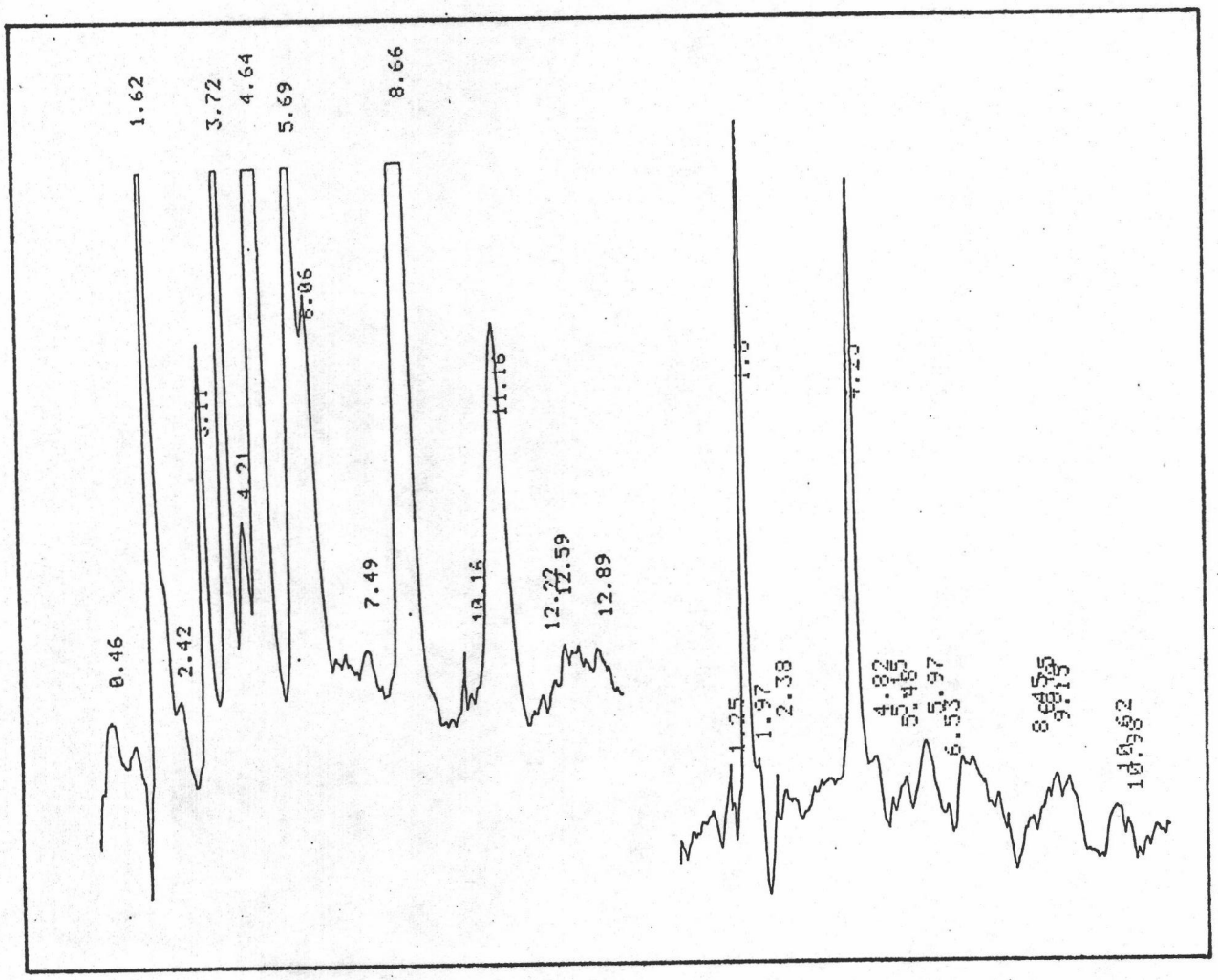


Figure 188 The paper chromatogram of

A) The standard sugars

B) Fraction XIIIA



Samples	Rt (min.)
solvent (H_2O)	1.62
rhamnose	3.11
xylose	3.72
arabinose	4.21
fructose	4.64
glucose	5.69
galactose	6.06
sucrose	8.66
maltose	11.16

Figure 189 The HPLC analysis results of Fraction XIIIA

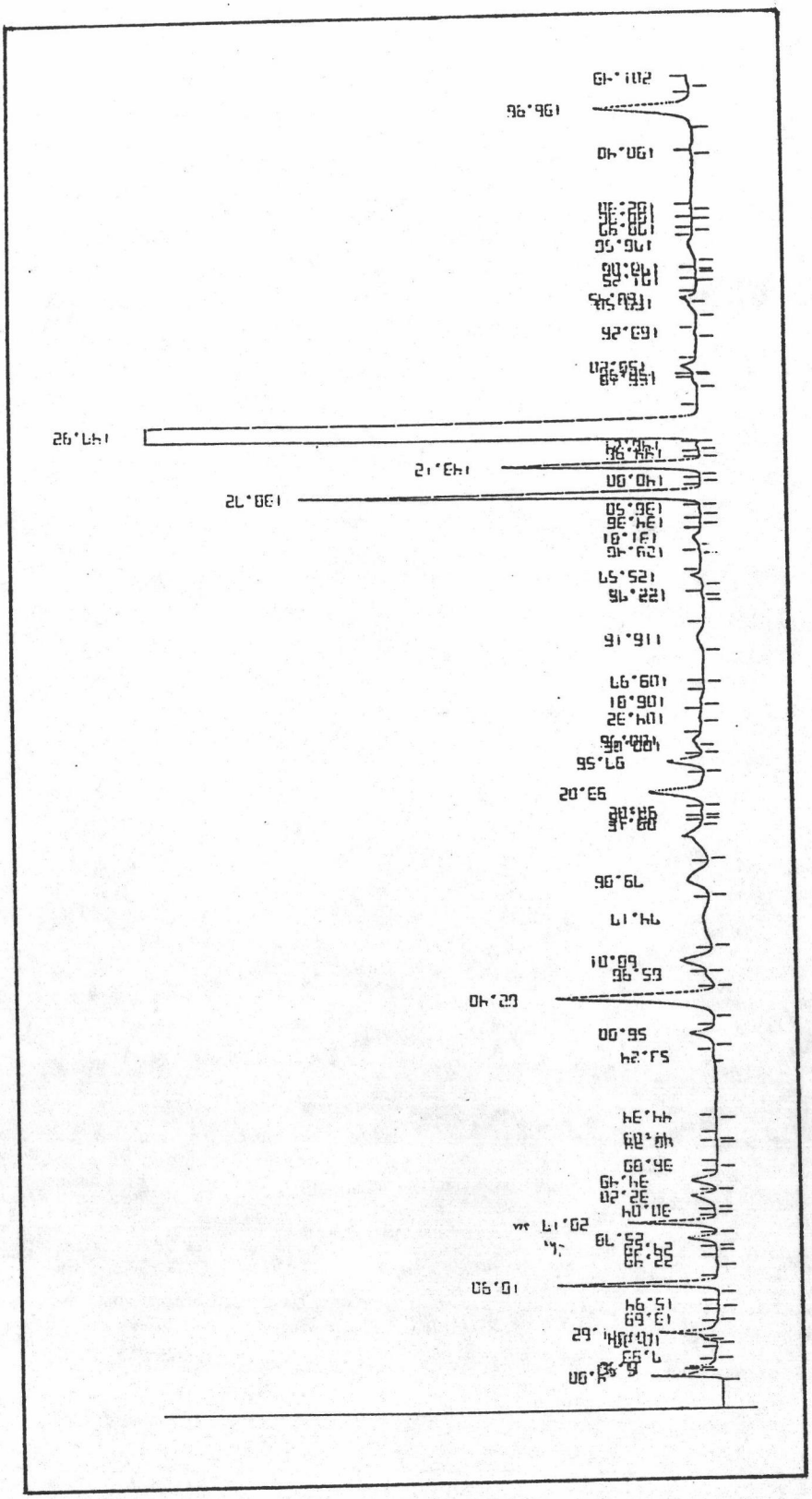


Figure 190 The amino analysis results of Fraction XIIIA

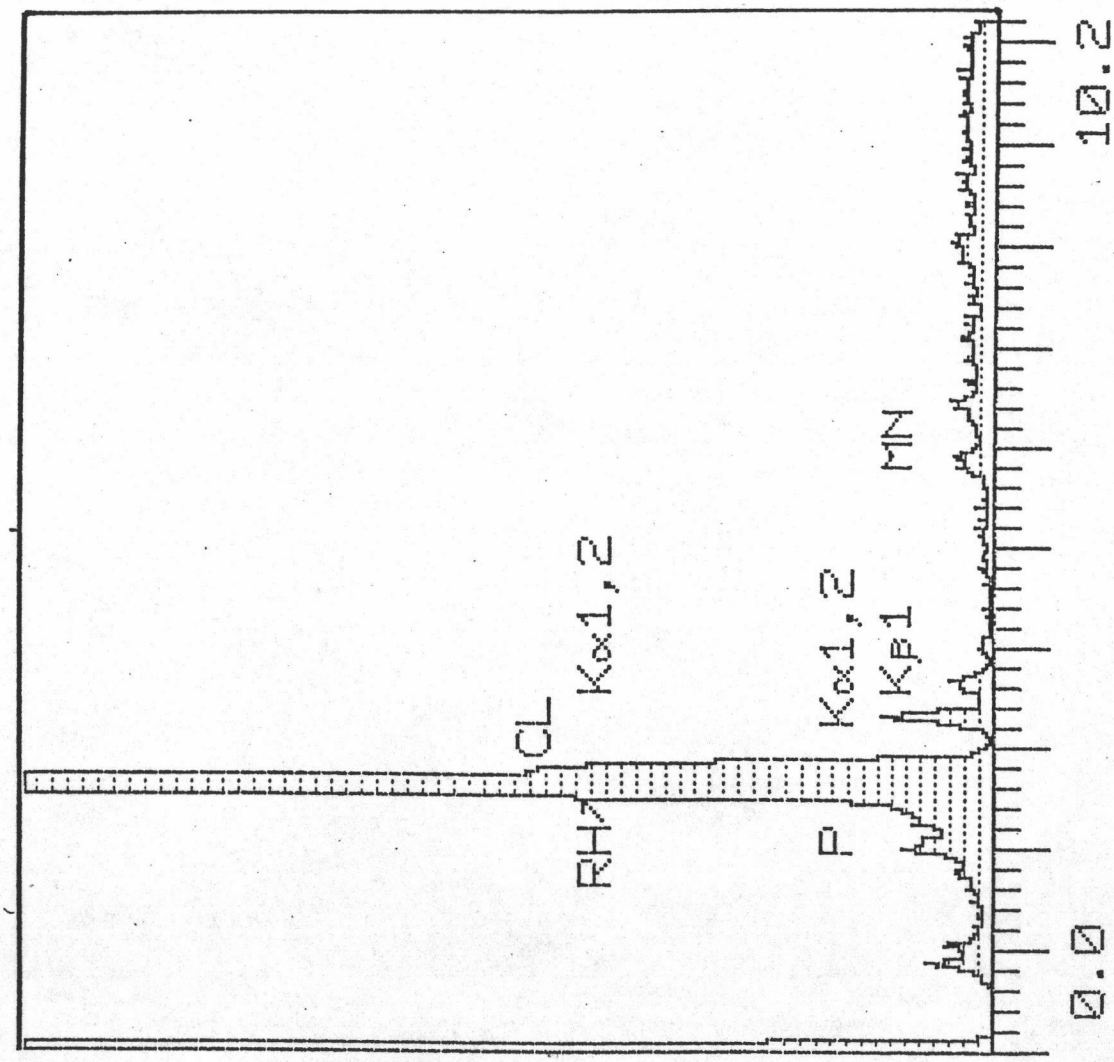


Figure 191 The X-ray fluoresence spectrum of Fraction XIIIA