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TISSUE ANALYSIS FOR BIOACCUMULATION
OF PCB AND METAL CONTAMINANTS
FOR THE NEW BEDFORD SUPERFUND SITE

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1. INTRODUCTION

The upper Acushnet River estuary is considered highly contaminated with PCBs and heavy metals. It is of importance to determine if these hazardous substances are incorporated and concentrated in mammals or birds at or near the top of the food chain.

The following report details the results of PCB and metal analyses conducted on selected tissue samples collected from the New Bedford Superfund Site in early spring (April) 1985. Tissue samples were collected from a variety of sources for the purpose of evaluating contaminant levels within trophic levels associated with two food chains: (1) mussels - ring-billed gull, and (2) arthropods, nuts, and fruits - white-footed mice.

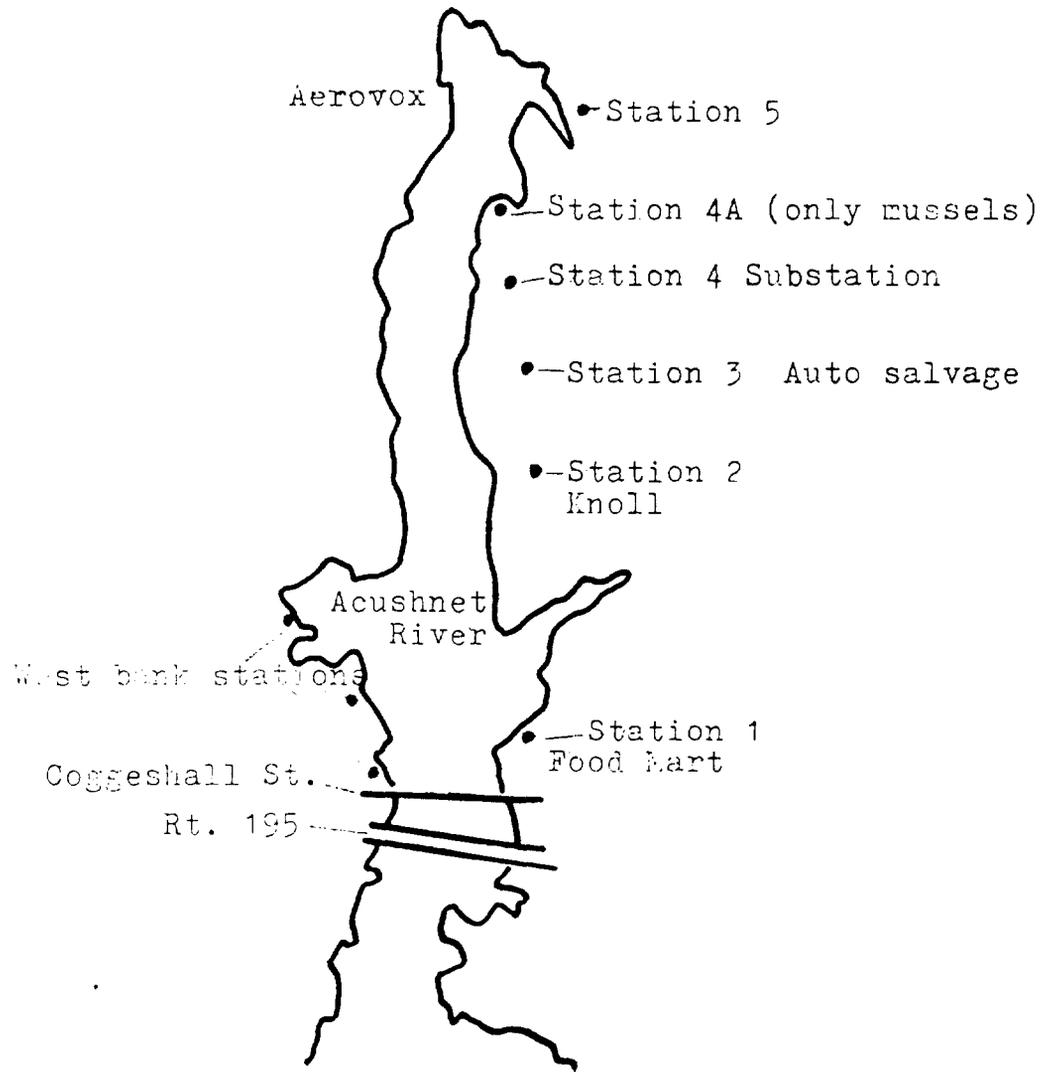
All chemical analyses were conducted by Resource Analysts, Incorporated.

2. SAMPLE COLLECTION

Mussel - Ring-Billed Gull

To determine the bioaccumulation of PCBs in the mussel - ring-billed gull food chain, twenty (20) ribbed mussels (Geukensia demissa) were collected on April 19 from each of five stations (1-4A) on the eastern shoreline of the upper Acushnet River estuary (Figure 2.1). All mussels were collected at random locations along a 15-meter transect located 1-2 meters below the seaward limit of salt marsh cordgrass (Spartina alterniflora) colonization, and placed in quart glass jars. These specimens were transported back to the lab on ice, and one-half were immediately frozen for any additional analyses needed in the future (e.g., histological). On the remaining mussels, whole wet weight, shell weight, meat wet weight, and length were measured. Shells were scrubbed clean of any debris before weighing. Shell length was measured with a caliper (0.05 millimeter), and meats were placed on filter paper for 2 minutes before weighing. A total of fifty (50) mussels were measured. Within each station, the meats of five (5) mussels were pooled to form two replicate samples for analysis from each of the five (5) stations. Ring-billed gulls also feed on amphipods. The amphipod (Orchestia grillus) is very abundant in the upper Acushnet River estuary. Orchestia were collected at Stations 1-5 (Figure 2.1) primarily under algal mats or wrack in the low marsh. An average of thirty-six (36) Orchestia were collected at each station and stored in glass vials.

Ten (10) ring-billed gulls were collected by Manomet Bird Observatory on April 15, 1985. State and federal collecting permits were obtained in advance of this work, and the use of a shotgun was cleared with the police departments of Acushnet, Fairhaven, and New Bedford. Due to the timing of the work, this



scale: 1" = 2000'

Figure 2.1. Collection Stations in Hot Spot Area - Upper Acushnet River Estuary, Massachusetts

late migrating winter species was present in reasonable numbers at a time when most of the ducks had left the study area on spring migration. Ring-billed gulls exhibit strong site tenacity and seldom, if ever, feed at nearby sanitary landfills as do herring and great black-backed gulls. Thus, the likelihood of injection of PCBs from sources other than the food chains in the study area was minimized. Specimens were chilled on ice until breast muscle and subcutaneous fat samples could be separated in the lab. These samples were stored in pre-cleaned glass containers and frozen pending later analysis. The birds were sexed, measured, weighed and frozen, and the guts preserved in 40% formaldehyde for possible future analysis. All specimens were frozen pending chemical analyses.

Arthropods, Seeds, Nuts - White-Footed Mice

The collection of white-footed mouse (Peromyscus leucopus) food was concentrated at the upland-marsh border where the mice were trapped. On April 29, 1985 at Stations 2 and 6, seeds of the salt marsh grasses (Distichlia spicata and Spartina alterniflora), bayberry fruits, insects (Orthoptera, Hemiptera, Coleoptera), isopods, millipedes, acorns, horse-brier fruits, rose fruits, and black grass shoots (Juncus gerardii) were collected and stored on ice in 2-ounce glass jars. The number of specimens in each sample were counted (excepting grass seeds and bayberry fruits), sample wet weight was measured, and the samples frozen.

On April 19 and 20, 1985, two hundred and six (206) snap-traps were randomly laid out primarily on the east side of the Acushnet River estuary in Stations 1-5 along the salt marsh upland border of grass shrubs (see Table 2.1 for more detail). One-hundred and fifty-two traps were baited with a mixture of oatmeal and peanut butter and fifty (50) with beef hotdogs. Traps were checked the following day, and captured mice were

Table 2.1. Trapping Information, April 19, 20, 1985

<u>Stations</u>	<u>Trap Number</u>	<u>Animals Caught</u>	<u>Habitat</u>
(East Side)			
1	80 Peanut Butter Oatmeal	3 House Mice (<u>Mus musculus</u>)	Salt marsh - upland border
	30 Beef Hotdog	1 Norway Rat (<u>Rattus norvegicus</u>) lot	Garbage bottom of rubble adjacent to Food Mart Parking
2	24 Peanut Butter Oatmeal	3 White-Footed Mice (<u>Peromyscus leucopus</u>)	Upland-marsh border with little blue stem sumac, marsh elder
3	24 Peanut Butter Oatmeal	4 White-Footed Mice	Upland-marsh border, upland grass, sparse shrubs above auto salvage
4	24 Peanut Butter Oatmeal	7 White-Footed Mice	Marsh elder, salt marsh grass
5	24 Peanut Butter Oatmeal	1 White-Footed Mouse	Marsh elder and salt marsh grass on marsh about 15 meters from upland
(West Side)			
	24 Beef Hotdog	0	Upland grass and shrub near factories, rubbish

Total trap nights = 206 trapping success for small mammals - 19/206 = 9.2%

placed in 4-ounce glass jars. The mice were transported back to the lab on ice, sexed, and their whole body weight recorded. One female mouse from Station 4 was dissected to determine if sufficient adipose tissue were present in an individual mouse for PCB analysis. The adipose wet weight was only 0.2 gram, an insufficient amount for PCB analysis. Therefore, whole animals were frozen for later homogenization.

3. ANALYTICAL METHODS

This section describes the analytical methodologies used for PCB and metals analyses. Additional information regarding these procedures are presented in Appendix A.

Polychlorinated Biphenyls in Tissue

A 5-10 gram sample is digested in a sealed 50 milliliter glass centrifuge tube by the addition of alcoholic potassium hydroxide and warming in an oven at 60 degrees C for 2 hours. The digest is extracted with hexane on a rotary shaken three times. The extracts are combined, dried through sodium sulfate, and concentrated to 1 milliliter. The concentrate is passed through a florisil cleanup column, reconcentrated to 1.0 milliliter, and analyzed by electron capture gas chromatography. A detection limit of 0.2 ug/ml for most sample extracts is possible. This translates to a 0.04 ug/g detection limit for the tissue.

Metals in Tissue

A 1-2 gram sample is placed in a pyrex beaker with 25 milliliters of fuming nitric acid. The beaker is covered and warmed gently on a hot plate for several hours. The heat is then raised and the samples evaporated to near dryness. Several milliliters of 50% hydrogen peroxide are added, and the sample is again evaporated to near dryness to oxidize any remaining organic material. The peroxide is added several times if necessary to clear the solution. The sample is then dissolved in acid and diluted to volume as appropriate for the analyses required.

4. RESULTS

PCB (Aroclors 1242 and 1254) and metals (Cr, Cu, Pb, and Zn) were detected in selected tissue samples collected from the study area. PCB and metals concentrations, expressed in terms of fresh weight, are presented in Table 4-1 and 4-2, respectively. Replicate analyses were conducted on selected samples, where allowed by sample size. The results of the quality control data are presented in Appendix 2.

Levels of PCB in tissue samples collected in Upper Achnusnet River Estuary indicate that PCB materials are incorporated in the tissue of selected organisms (Table 4-1). Aroclors 1242 and 1254 were detected in all of the ribbed mussel samples and the snail sample which comprise the lower trophic level of the mussel - ring billed gull food chain; and in selected fruit and composite animal food samples which comprise the lower trophic level of the arthropods, nuts, fruits - white-footed mice food chain. Only Aroclor 1254 was detected in the gull muscle and fat, and mice homogenate. Average PCB concentrations of Aroclor 1254 in ribbed mussels, ring-billed gull muscles, and ring billed gull fat samples were 10.6 ug/g, 13.99 ug/g and 153.67 ug/g, respectively. Average PCB concentrations of Aroclor 1254 in mouse food (including the snail) and whole mice were 4.31 ug/g and 22.33 ug/g, respectively. These results suggest that biomagnification of PCB materials may be taking place within the two food chains sampled.

Results of the metals (Cr, Cu, Pb, Zn) analysis for tissue samples are presented in Table 4-2. Detectable levels of each metal were present in each sample. Concentrations of metals appear to be comparable throughout the samples with some exceptions. Relatively high concentrations of copper and zinc were detected in the amphipod (Cu=36.0 ug/g; Zn=140 ug/g) and snail (Cu=25.0 ug/g; Zn=630 ug/g) samples. The snail sample also contained relatively high concentrations of lead (9.0 ug/g). The levels of zinc detected in the muscle and fat portions of the

ring-billed gull suggest that zinc may be concentrated in fat tissue. Although these data do indicate that certain metals may be selectively concentrated, they do not suggest transfer within the two food chains or biomagnification as do the PCB data.

Table 4-1. PCBs in Plant and Animal Tissues

<u>Sample Designation</u>	<u>PCB Aroclors</u>	
	<u>PCB 1242</u> <u>(ug/g)</u>	<u>PCB 1254</u> <u>(ug/g)</u>
Ring-billed Gulls No. 1 Muscles	BDL	2.00
Ring-billed Gulls No. 2 Muscles	BDL	1.00
Ring-billed Gulls No. 3 Muscles	BDL	9.30
Ring-billed Gulls No. 4 Muscles	BDL	4.60
Ring-billed Gulls No. 5 Muscles	BDL	12.00
Ring-billed Gulls No. 6 Muscles	BDL	0.96
Ring-billed Gulls No. 7 Muscles	BDL	25.00 ₃
Ring-billed Gulls No. 8 Muscles	BDL	27.00 ₃
Ring-billed Gulls No. 9 Muscles	BDL	20.00
Ring-billed Gulls No. 10 Muscles	BDL	38.00
Ring-billed Gulls Composite No. 1-5 fat	BDL	88.00
Ring-billed Gulls Composite No. 6-7 fat	BDL	33.00
Ring-billed Gulls Composite No. 8-10 fat	BDL	340.00
Mussel Meat Geukensia Station 1-M Rep. 1	14.00	7.60
Mussel Meat Geukensia Station 1-M Rep. 2	20.00	10.00
Mussel Meat Geukensia Station 2-M Rep. 1	21.00 ₃	11.00 ₃
Mussel Meat Geukensia Station 2-M Rep. 2	20.00 ₃	9.00 ₃
Mussel Meat Geukensia Station 3-M Rep. 1	24.00	8.10
Mussel Meat Geukensia Station 3-M Rep. 2	17.00	6.20
Mussel Meat Geukensia Station 4-M Rep. 1	18.00	5.70
Mussel Meat Geukensia Station 4-M Rep. 2	24.00	8.40
Mussel Meat Geukensia Station 5-M Rep. 1	69.00	23.00
Mussel Meat Geukensia Station 5-M Rep. 2	58.00	17.00
Amphipods Orchestia Composite No. 1A-5A	17.00	29.00
White-footed Mice Station 2-WFM Composite of 3	BDL	17.00
White-footed Mice Station 3-WFM Composite of 4	BDL	11.00 ₃
White-footed Mice Station 4-WFM Composite 6	BDL	5.30
White-footed Mice Station 5 Single Individual	BDL	56.00
Mouse Food Bayberry Fruits Station No. 2	0.08	0.05
Mouse Food Acorns Station No. 2	BDL	BDL
Mouse Food Smilax Fruits Station No. 2	BDL	0.05
Mouse Food Composite of Isopods, Millipedes, Weevil, Hemipteran Station No. 2	BDL	1.90
Mouse Food Bayberry Fruits Station No. 4	0.25	0.08
Mouse Food Melampus Station No. 4	2.40	3.20
Mouse Food Juncus Gerardi Station No. 4	BDL	BDL
Mouse Food Composite of 10 Orthopteran and Isopods Station No. 4	1.40	4.40

₃ = Average of duplicate values (See Appendix B).

Table 4-2. Metals in Plant and Animal Tissues

<u>Field Identification</u>	<u>Chromium (ug/g)</u>	<u>Copper (ug/g)</u>	<u>Lead (ug/g)</u>	<u>Zinc (ug/g)</u>
Ring-billed Gulls No. 1 Muscles	1.1	5.1	0.8	24
Ring-billed Gulls No. 2 Muscles	3.1	5.6	1.3	86
Ring-billed Gulls No. 3 Muscles	1.7	5.2	0.6	26
Ring-billed Gulls No. 4 Muscles	3.1	5.4	3.0	78
Ring-billed Gulls No. 5 Muscles	2.8	5.9	0.8	20
Ring-billed Gulls No. 6 Muscles	2.8	5.0	0.6	26
Ring-billed Gulls No. 7 Muscles	2.0	6.7	1.2	22
Ring-billed Gulls No. 8 Muscles	1.5	6.3	1.7	20
Ring-billed Gulls No. 9 Muscles	1.7	4.6	0.9	68
Ring-billed Gulls No. 10 Muscles	2.5	5.0	5.0	42
Ring-billed Gulls Composite No. 1-5 fat	2.9	3.0	2.9	130
Ring-billed Gulls Composite No. 6-7 fat	1.8	2.3	1.1	60
Ring-billed Gulls Composite No. 8-10 fat	4.0	3.5	1.3	110
Mussel Meat Geukensia Station 1-M Rep. 1	3.7	8.8	1.9	24
Mussel Meat Geukensia Station 1-M Rep. 2	2.1	6.0	1.1	140
Mussel Meat Geukensia Station 2-M Rep. 1	3.5	5.3	1.1	36
Mussel Meat Geukensia Station 2-M Rep. 2	2.2	6.5	0.9	130
Mussel Meat Geukensia Station 3-M Rep. 1	2.5	5.8	1.1	110
Mussel Meat Geukensia Station 3-M Rep. 2	4.1	6.8	1.0	25
Mussel Meat Geukensia Station 4-M Rep. 1	2.7	5.8	1.7	60
Mussel Meat Geukensia Station 4-M Rep. 2	2.3	5.8	1.1	52
Mussel Meat Geukensia Station 5-M Rep. 1	2.6	4.9	0.6	22
Mussel Meat Geukensia Station 5-M Rep. 2	2.5	6.0	1.1	23
Amphipods Orchestia Composite No. 1A-5A	2.8	36.0	1.3	140
White-footed Mice Station 2-WFM Composite of 3	2.7	8.4	2.1	91
White-footed Mice Station 3-WFM Composite of 4	3.7	6.9	3.9	49
White-footed Mice Station 4-WFM Composite of 6	2.5	8.3	1.5	33
White-footed Mice Station 5 Single Individual	3.0	5.5	1.5	56
Mouse Food Bayberry Fruits Station No. 2	2.4	3.4	3.5	42
Mouse Food Acorns Station No. 2	3.5	8.5	3.8	40
Mouse Food Melampus Station No. 4	2.5	25.0	9.0	630
Mouse Food Juncus Gerardi Station No. 4	2.2	6.8	0.7	37

APPENDIX A

ANALYTICAL METHODS
AND
PROCEDURES

Sample Preparation:

Since homogenous samples were desired from varying types of samples, the procedure for generating these representative samples differed for differing sample types as follows:

Mice: The mice were frozen in liquid nitrogen and placed into a high speed blender which contained dry ice. They were macerated at differing speeds until completely powdered. The resulting sample composites were mixed thoroughly and subsampled.

Seagull Muscle Tissue: The muscle tissue was ground using a mortar and pestle and the resulting homogenate subsampled.

Seagull Fat Tissue: These tissues were placed in a tissuemiser and homogenized. The resulting composites were subsampled.

Fresh Water Mussels: These samples were mixed thoroughly and directly subsampled.

Insects: These were ground with a mortar and pestle and the entire portion was analyzed for PCB's.

Grass: The grass was placed in a high speed blender, chopped finely and subsampled.

Acorns: These were ground with a mortar and pestle and subsampled.

Fruits: These were subsampled whole.

Resource Analysts, Incorporated

STANDARD OPERATING PROCEDURE

Procedure By/Date JEM / 4-14-86	TITLE: Metals Digestions 4: Tissues	Page 1 Of 2
Approved By/Date		Procedure No. 3050
Effective Date:		Reference: SW846

Comments: The procedure is carried out exactly according to the procedure with an additional pretreatment with Fuming Nitric acid and the following Exceptions, Protocols and Quality Control.

Approximately 1.00 g of tissue is added to a 12 mL glass/teflon screw-cap vial (acid-rinsed) and approximately 5 mL Fuming Nitric acid is added. (Do NOT pipet). Shake vial GENTLY periodically until all or most of the tissue undergoes dissolution. The sample is then transferred as quantitatively as possible to a 100 mL beaker with Type II water and evaporated to near dryness.

The sample is then digested exactly according to the method 3050 except that Nitric Acid is used as the final reflux acid for all samples as is specified for analysis by graphite furnace.

Quality control is maintained through the analysis of blanks, duplicates and spikes according to the following schedule, whenever practical, given amounts of available sample.

1. For every set of samples one blank consisting of Type II water is to be digested concurrently and analyzed for all metals included in that set of digestions.
2. For every 10 samples digested one will be digested in duplicate.
3. For every sample duplicated, one additional replicate will be spiked.
4. Unless very high metal concentrations are expected or recovery is to be determined at very low levels, the following guidelines are to be adhered to.

Resource Analysts, Incorporated

STANDARD OPERATING PROCEDURE

TITLE: Metals Digestions 4: Tissue

Page 2 of 2

<u>Metal(s)</u>	<u>Spike Protocol¹</u>	<u>Concentration In Tissue⁴</u>	<u>Concentration in Final Dilution⁵</u>
As, Se	(A) 1.00 ml of Std. ² to 100.0 mL Blank ³ . 0.5 mL Sol'n (A) to sample	5.0 ug/g	0.5 mg/L
Ag, Ba, Ca, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Tl	0.50 mL Std. ² to sample.	500 ug/g	50 mg/L
Sn	1 mL Std. ² to sample.	1000 ug/g	100 mg/L
Be, Cd, Mg, Zn	(A) 1.00 mL Std. ² to 10.0 mL Blank ³ . 0.50mL Sol'n (A) to sample.	50 ug/g	5 mg/L

¹ Dilution protocol: read as "Dilute x mL to a final volume of y mL with Blank."

² 1000 ug/ml commercial AA standard

³ 0.1 % HNO₃ in Type II water

⁴ assuming a 1. mL sample

⁵ Assuming 10 mL final dilution. Dilute when necessary prior to AA analysis!

Recoverable PCB's In Plant And Animal Tissue

Summary:

Approximately five grams of sample was placed in a 40 mL glass centrifuge tube with a teflon lined screw cap. To the sample 10 mL of 50% Aqueous potassium hydroxide and 10 mL of pesticide grade methanol was added. The tubes were sealed, mixed thoroughly by shaking, and then digested in an oven at 90°C for one hour. The cooled digestates were extracted with three 15 mL portions of petroleum ether. The extracts from samples 6467-14 through 6467-23 were back extracted with water to remove water soluble residues. The extracts were reduced to 1 mL in a K-D apparatus. The concentrates were cleaned up using florisil/alumina chromatography and re-concentrated to 1 mL. The samples were then analyzed by GC/ECD and GC/MS.

References:

Warner et al., 1976.

EPA SW846/8080, Second Edition.

APPENDIX B

QUALITY ASSURANCE DATA

1. PCB Precision and Accuracy Data
2. Metals Precision and Accuracy Data

I. Quality Control Data for PCB's

1.) Precision

Laboratory Number: 6467-2

Field Identification: Ring-billed Gulls No. 2 Muscles

Rep. 1		Rep. 2		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
<0.04	1.0	<0.04	0.97	-	3

Laboratory Number: 6467-7

Field Identification: Ring-billed Gulls No. 7 Muscles

Rep. 1		Rep. 2 (S)		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
<0.04	25	<0.04	25	-	-

Laboratory Number: 6467-8

Field Identification: Ring-billed Gulls No. 8 Muscles

Rep. 1		Rep. 2		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
<0.04	28	<0.04	26	-	7.4

Laboratory Number: 6467-15

Field Identification: Mussel Meat Geukensia Station 1-M Rep. 2

Rep. 1		Rep. 2 (S)		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
20	10	19	11	5.1	9.5

Laboratory Number: 6467-16

Field Identification: Mussel Meat Geukensia Station 2-M Rep. 1

Rep. 1		Rep. 2		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
22	10	20	10	9.5	-

Laboratory Number: 6467-21

Field Identification: Mussel Meat Geukensia Station 4-M Rep. 2

Rep. 1		Rep. 2 (S)		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
26	9.5	21	7.2	21.3	27.5

Laboratory Number: 6467-26

Field Identification: White Footed Mice Station 3-WFM Composite of 4

Rep. 1		Rep. 2		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
<0.04	11	<0.04	11	-	-

Laboratory Number: 6467-30

Field Identification: Mouse Food Acorns Station No. 2

Rep. 1		Rep. 2		% Relative Range	
<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)	<u>PCB 1242</u> (ug/g)	<u>PCB 1254</u> (ug/g)
<0.04	<0.04	<0.04	<0.04	-	-

2.) Accuracy

Four samples were spiked at the 0.5 ug/g level with PCB 1254. The concentrations of PCB's in the original samples were twenty to fifty times this value preventing the calculation of meaningful recovery data. The spike samples are included as replicates and are designated with (S).

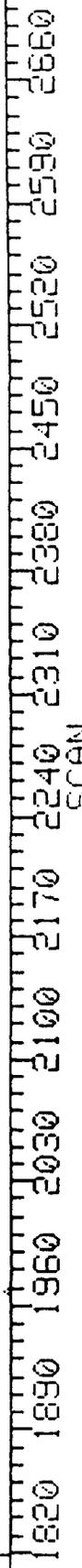
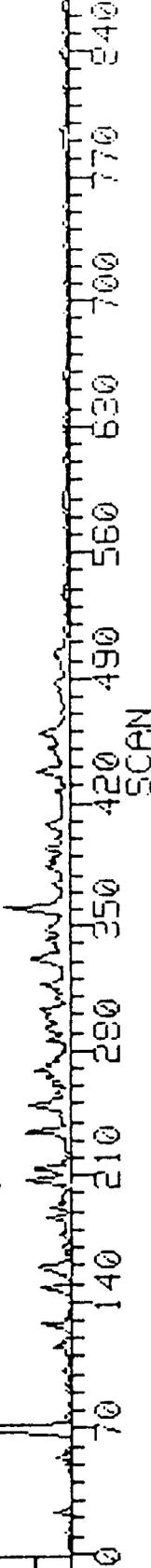
APPENDIX C

GC/MS CONFIRMATION OF PCB DATA

646722

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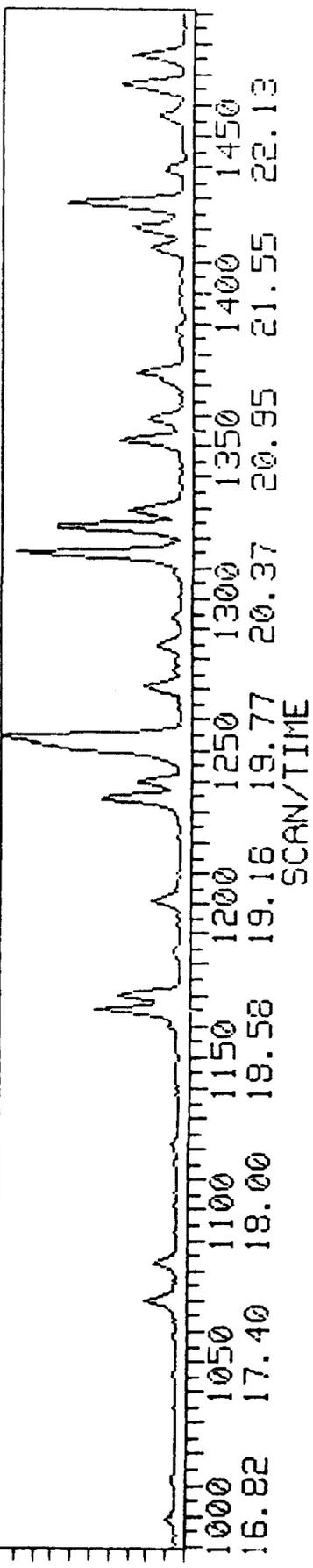
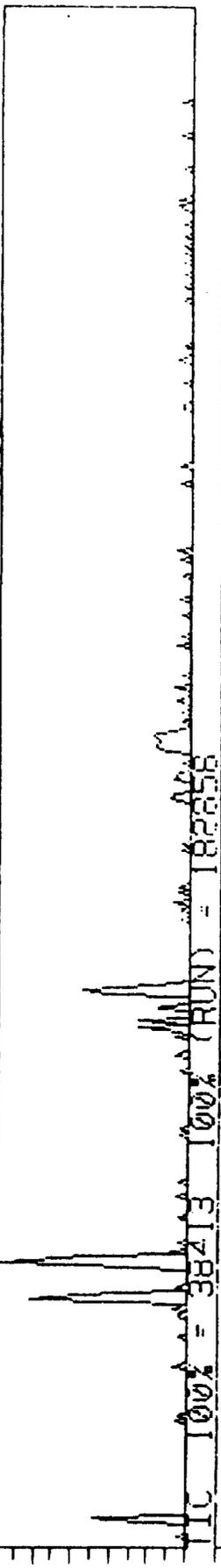
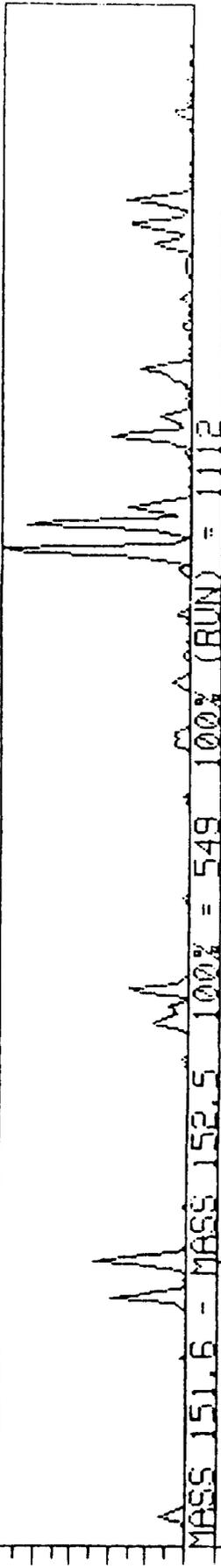
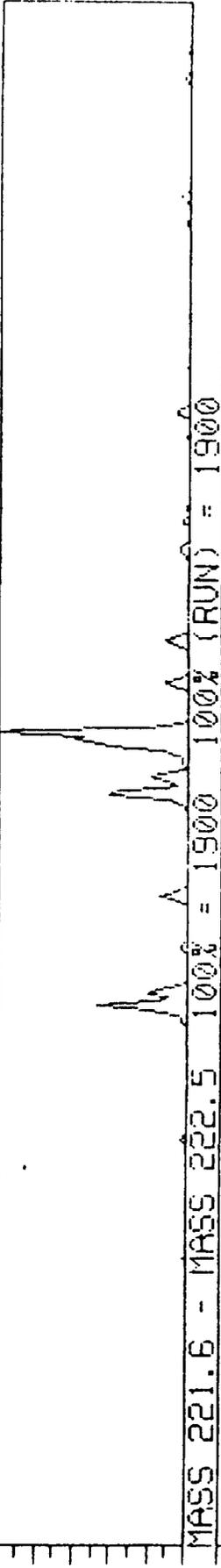
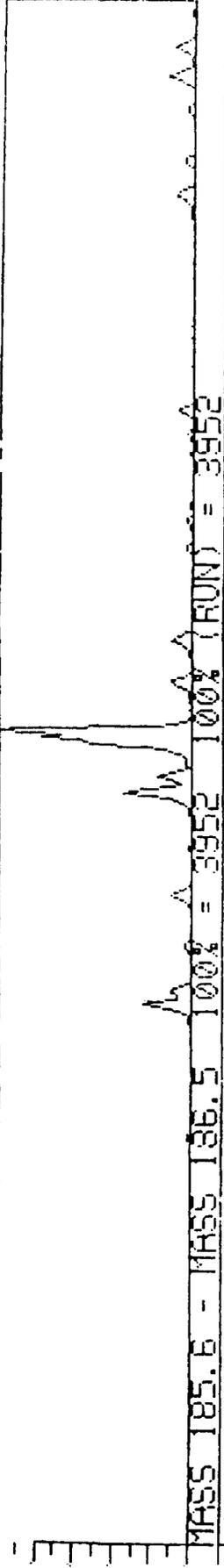
Mussel Meat Goekensia Station 5-M Rep 1.



646722

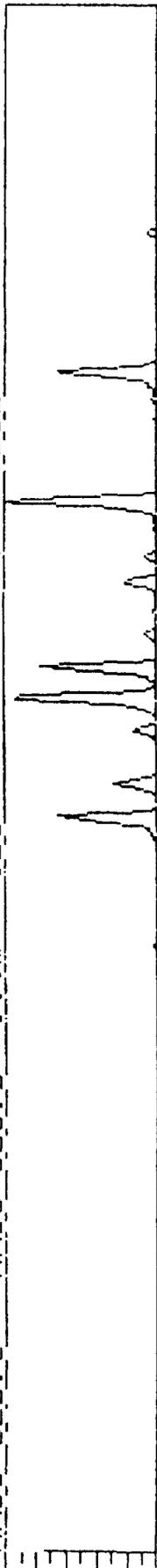
18-APR-86 13:17:52 RETENTION TIMES SPANNED 16.82-22.73 MINUTES

MASS 255.6 - MASS 256.5 100% = 8144 100% (RUN) = 8144



546722

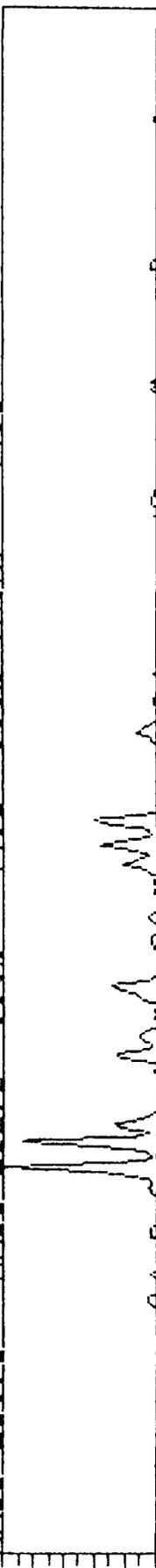
18-APR-86 13:17:52 RETENTION TIMES SPANNED 19.18-25.08 MINUTES
MASS 325.6 - MASS 326.5 100% = 1562 100% (RUN) = 1562



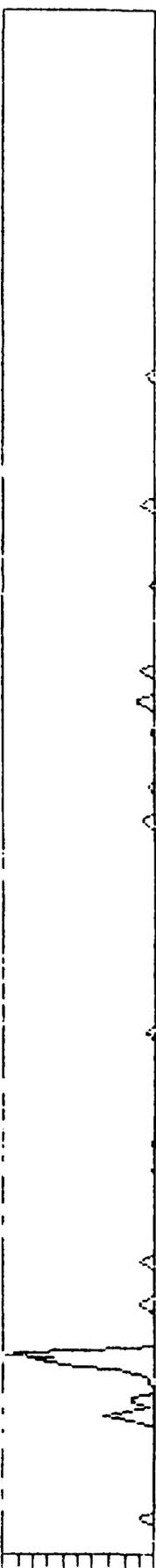
MASS 219.6 - MASS 220.5 100% = 3168 100% (RUN) = 3168



MASS 291.6 - MASS 292.5 100% = 4416 100% (RUN) = 4416



MASS 255.6 - MASS 256.5 100% = 8144 100% (RUN) = 8144



MASS 185.6 - MASS 186.5 100% = 3952 100% (RUN) = 3952

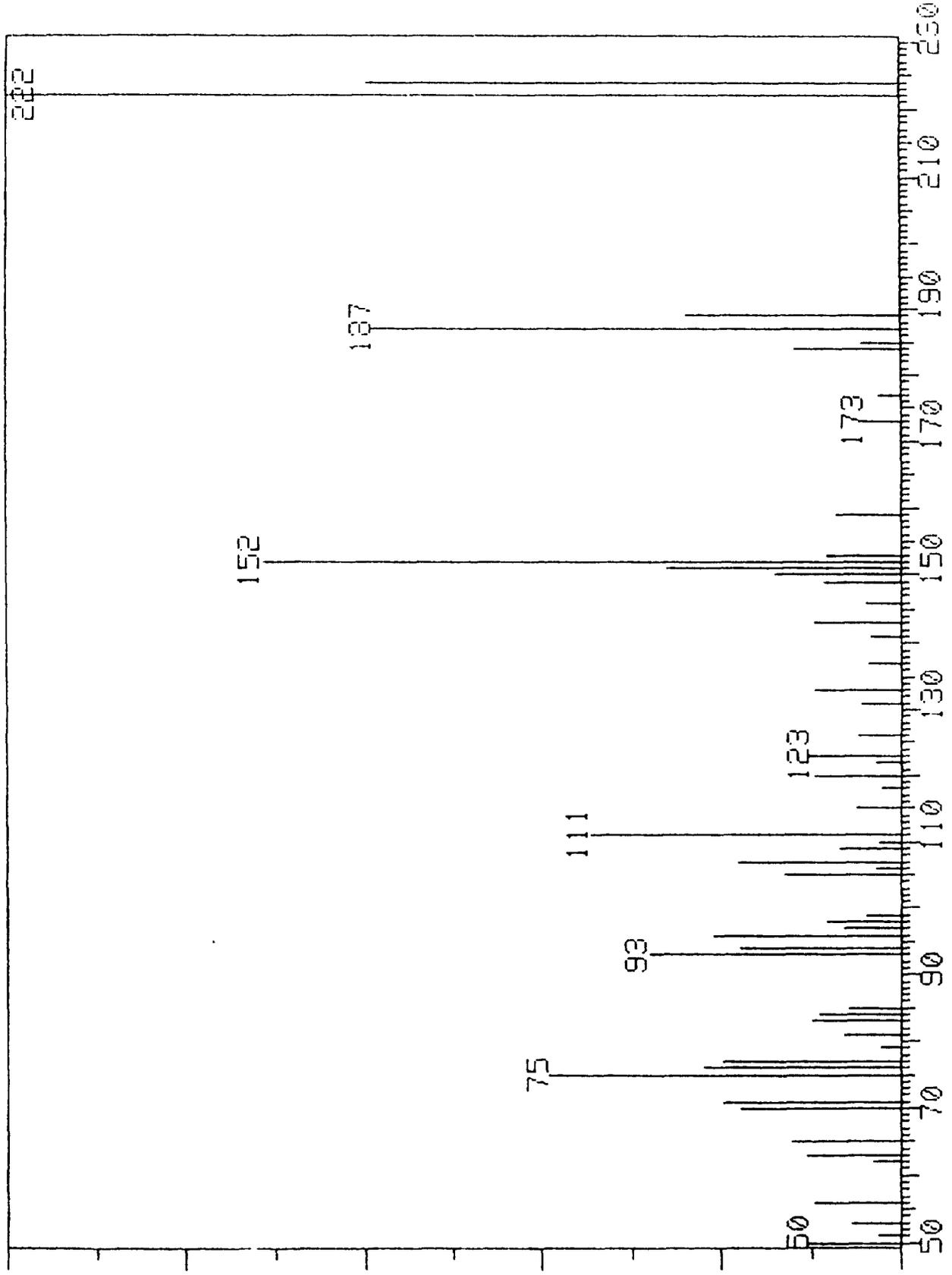


LIC 100% = 38413 100% (RUN) = 182858

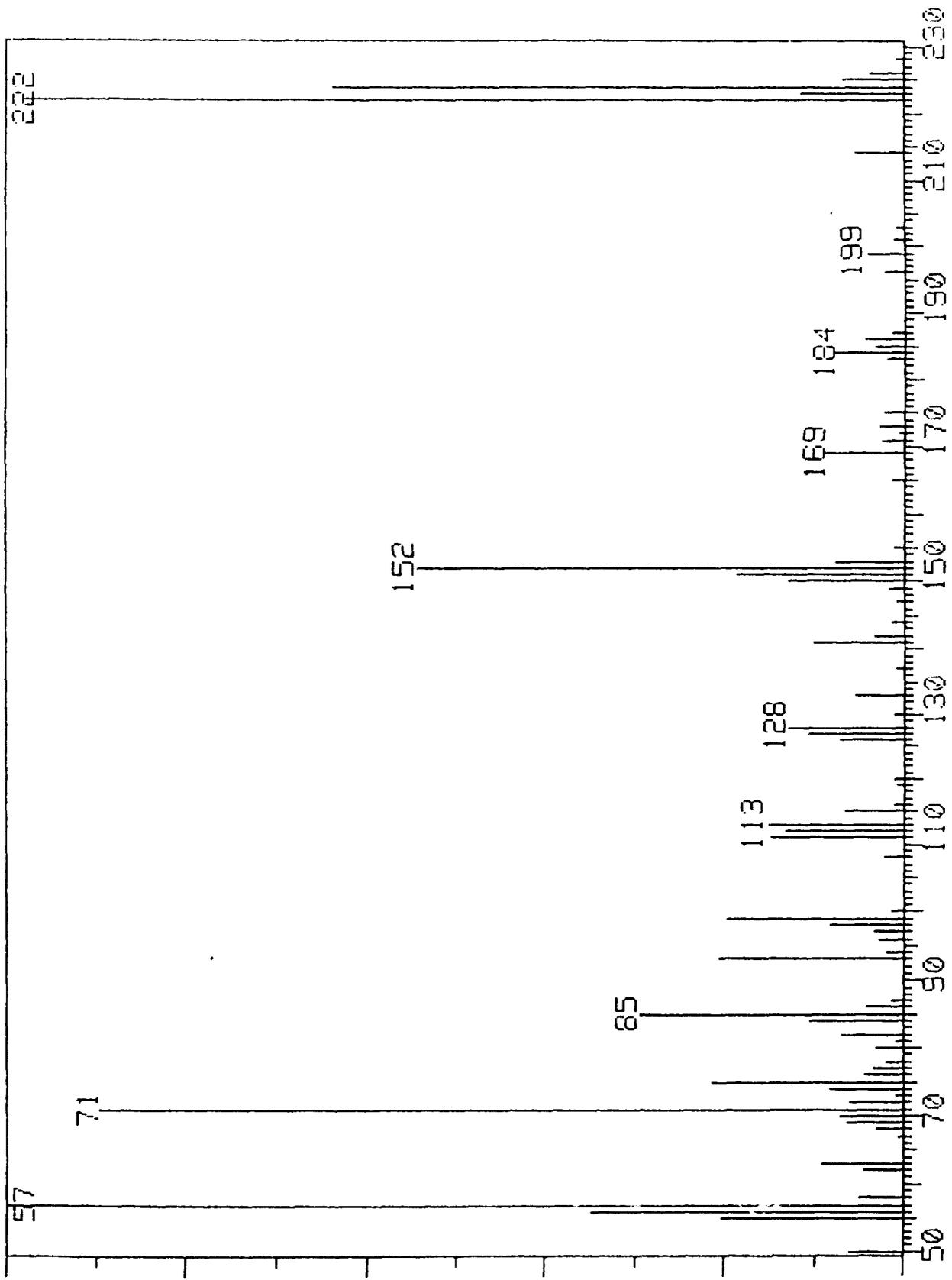


19.18 1250 1300 1350 1400 1450 1500 1550 1600 1650
20.37 20.95 21.55 22.13 22.73 23.32 23.92 24.50
SCAN/TIME

646722 18-APR-86 13:17:52 SCANS AVERAGED 1008-1011 TIME 16.93 MIN. TOTAL SCALE 1412 1*
BCKG SCANS * 1.00 1005 1013 100 % = 168

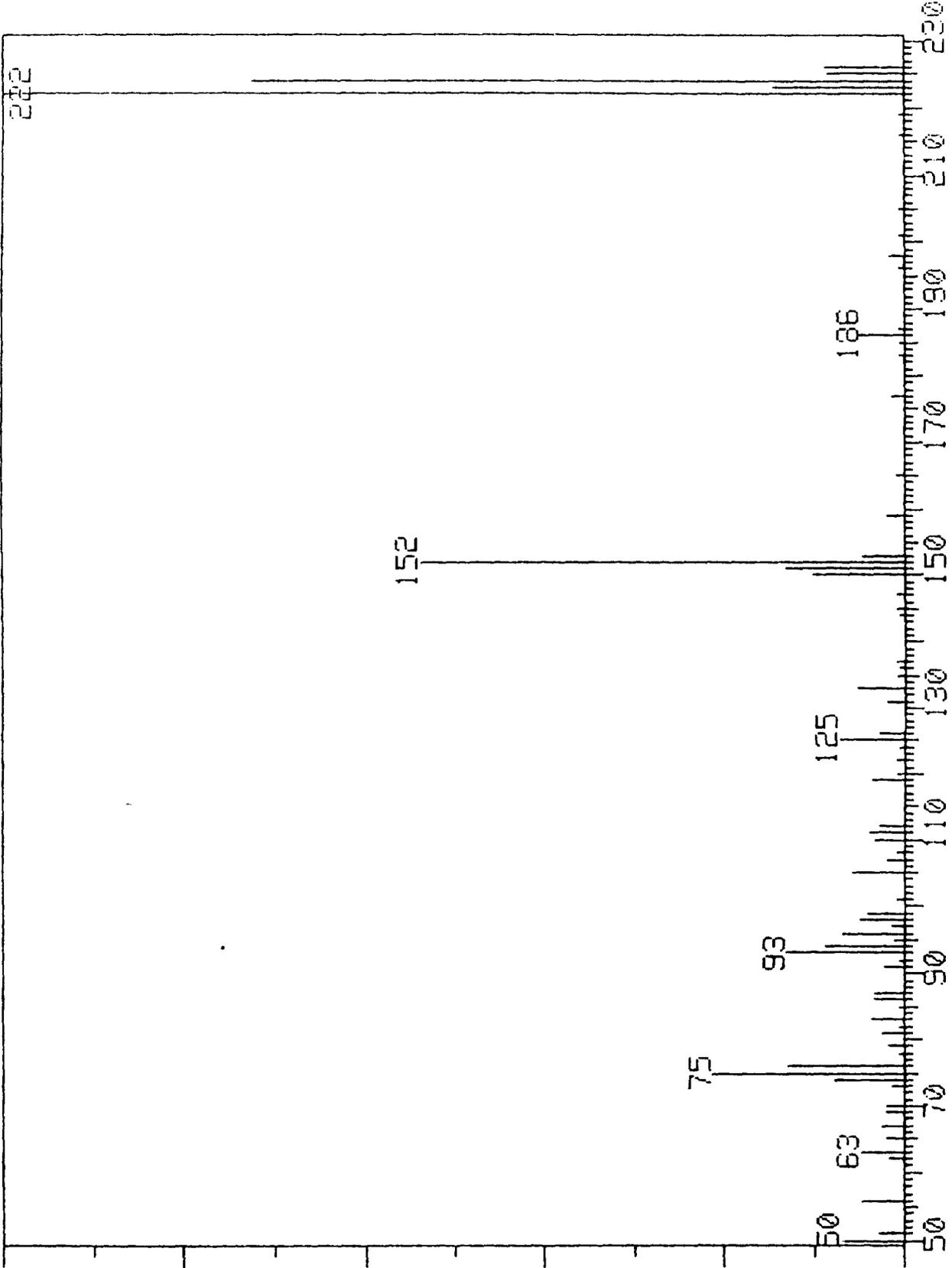


646722 18-APR-86 13:17:52 SCANS AVERAGED 1078-1083 TIME 17.77 MIN. TOTAL SCALE 3265 1*
BCKG SCANS * 1.00 1075 1087 100 % = 366



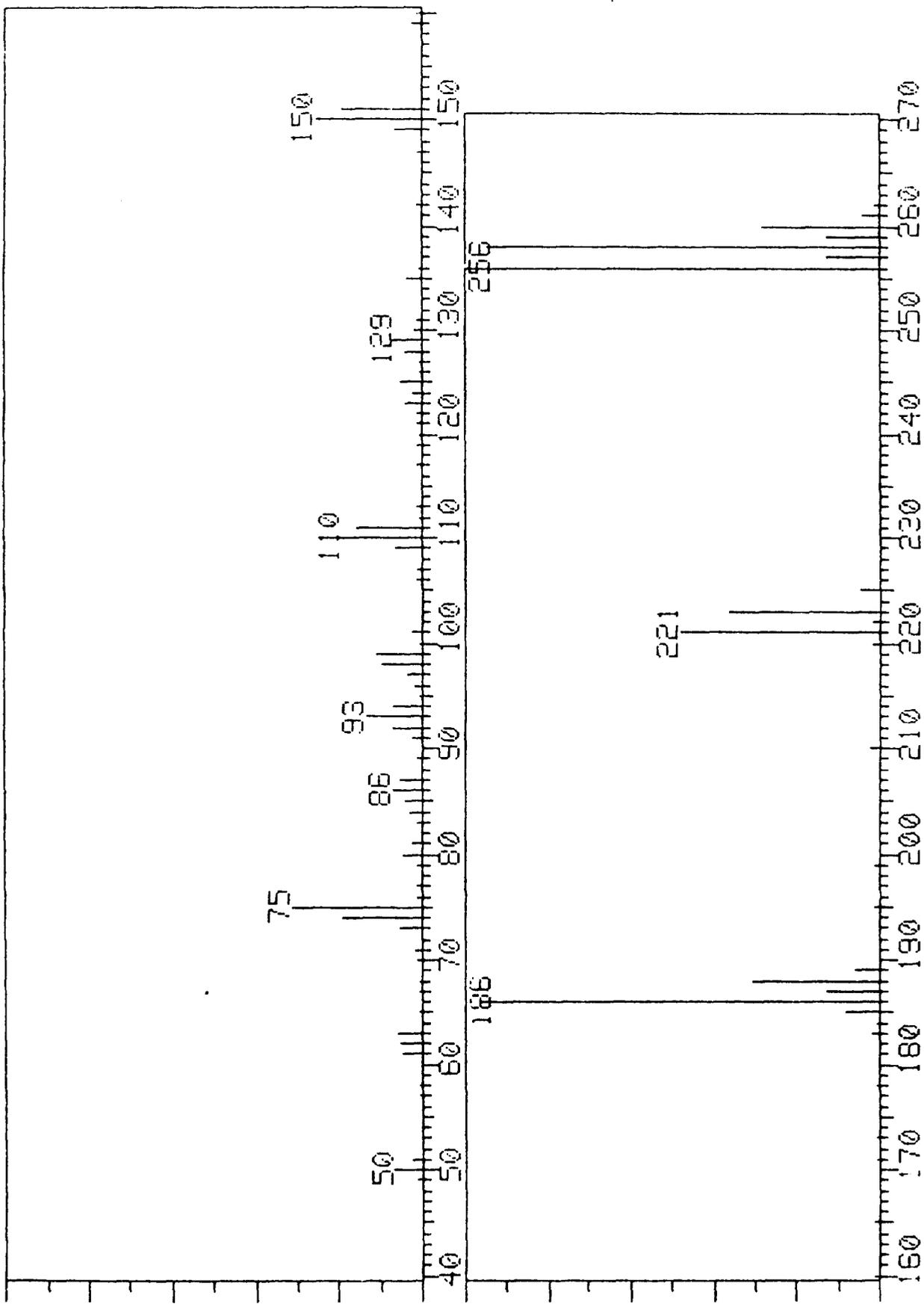
846722
18-APR-86 13:17:52 SCANS AVERAGED 1090-1095 TIME 17.91 MIN. TOTAL SCALE 2419 1*

BCKG SCANS * 1.00 1088 1098 100% = 499

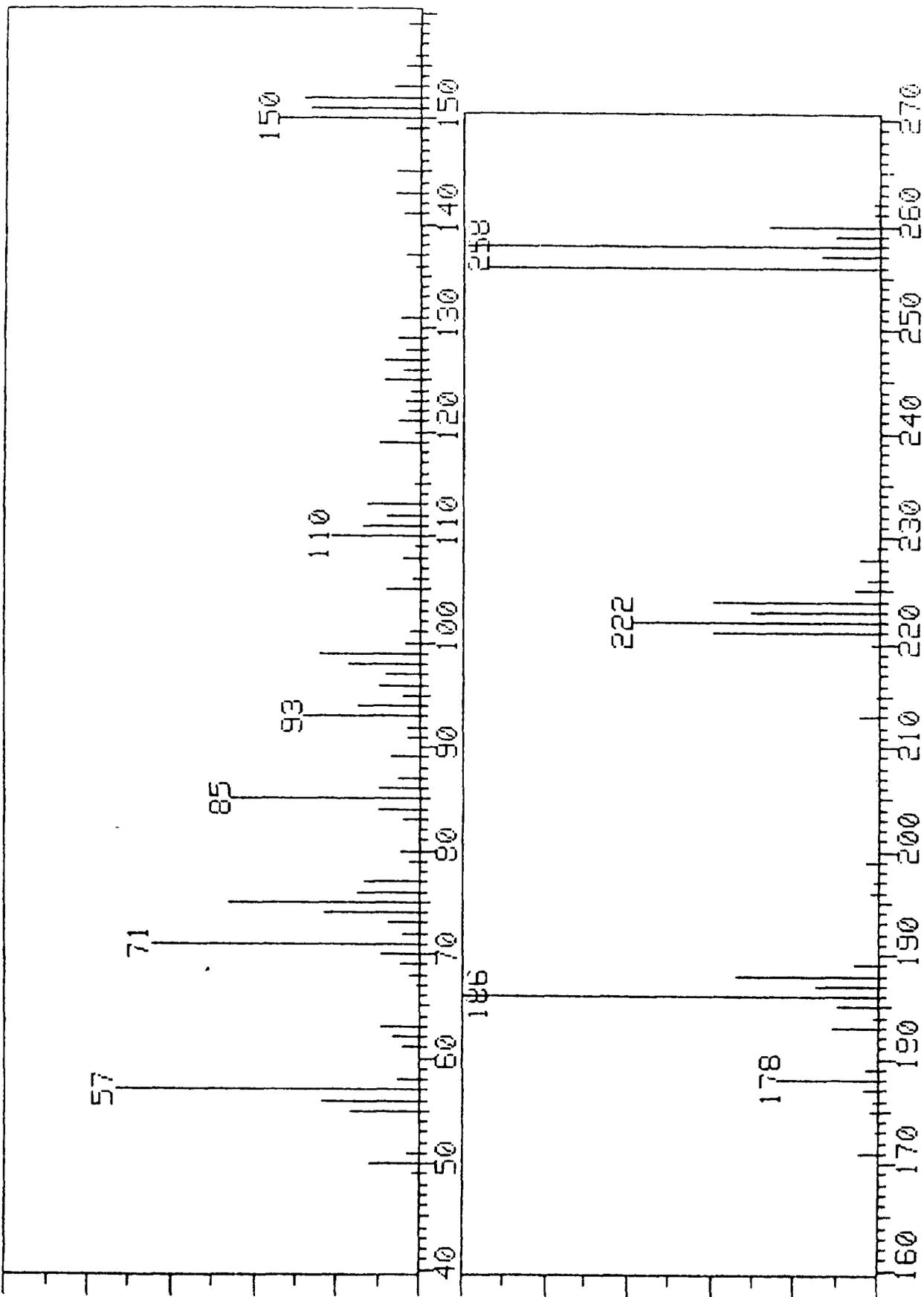


646722
18-APR-86 13:17:52 SCANS AVERAGED 1173-1177 TIME 18.88 MIN. 9435 1*
BCKG SCANS * 1.00 1171 1186 100 % = 1130

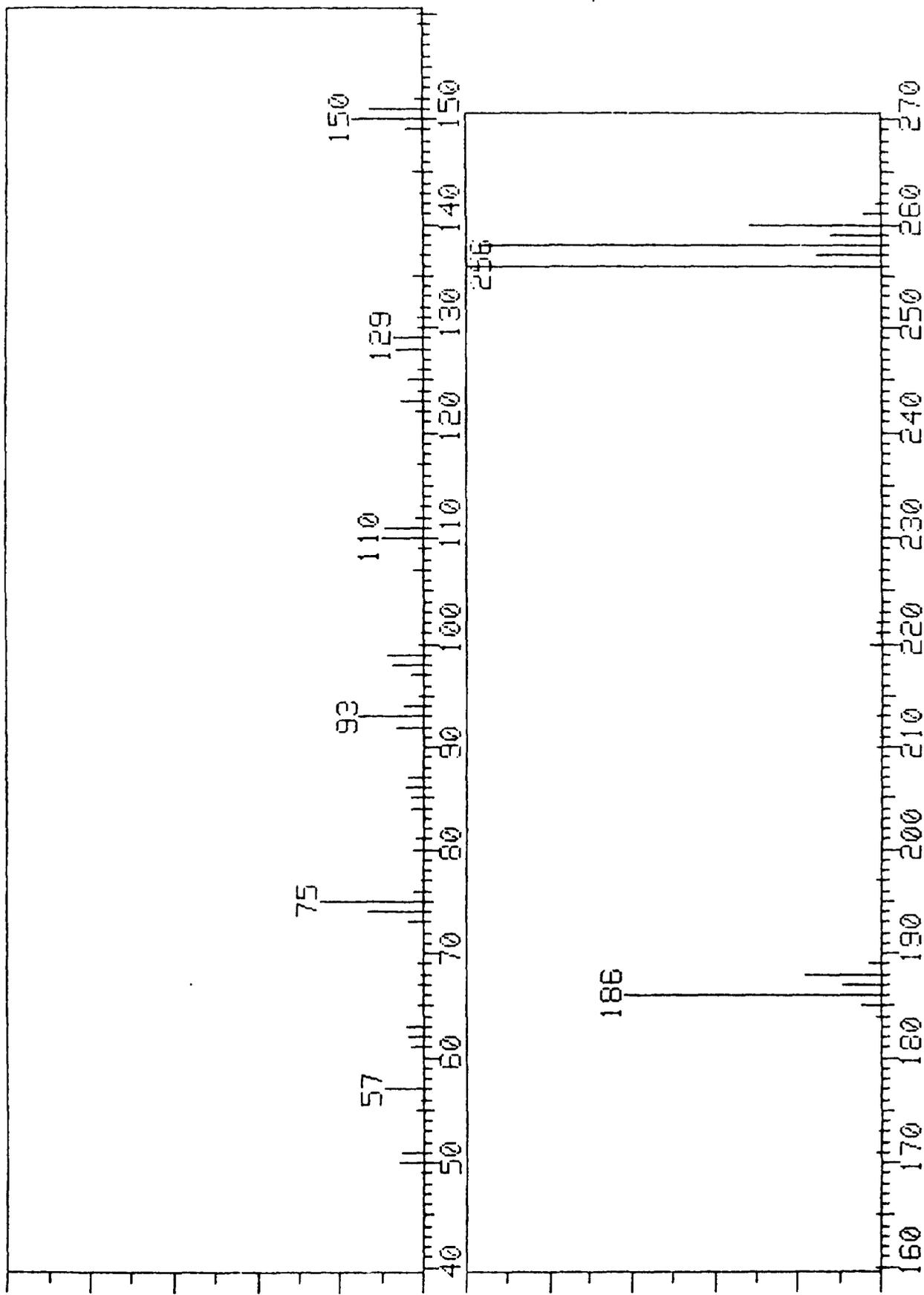
TOTAL SCALE



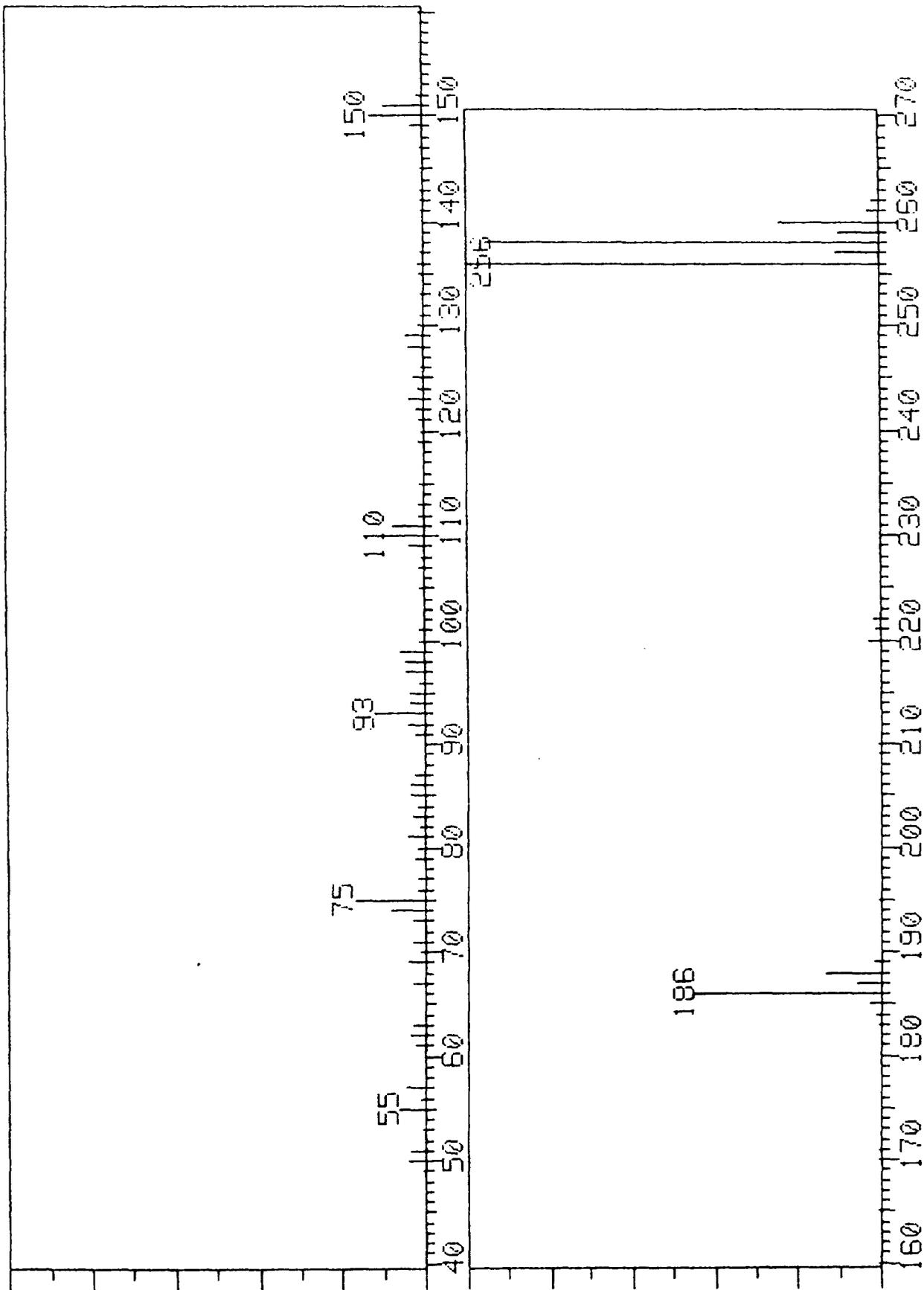
646722
18-APR-86 13:17:52 SCANS AVERAGED 1178-1182 TIME 18.94 MIN. TOTAL SCALE
BCKG SCANS * 1.00 1188 100 % = 522 7680 1*



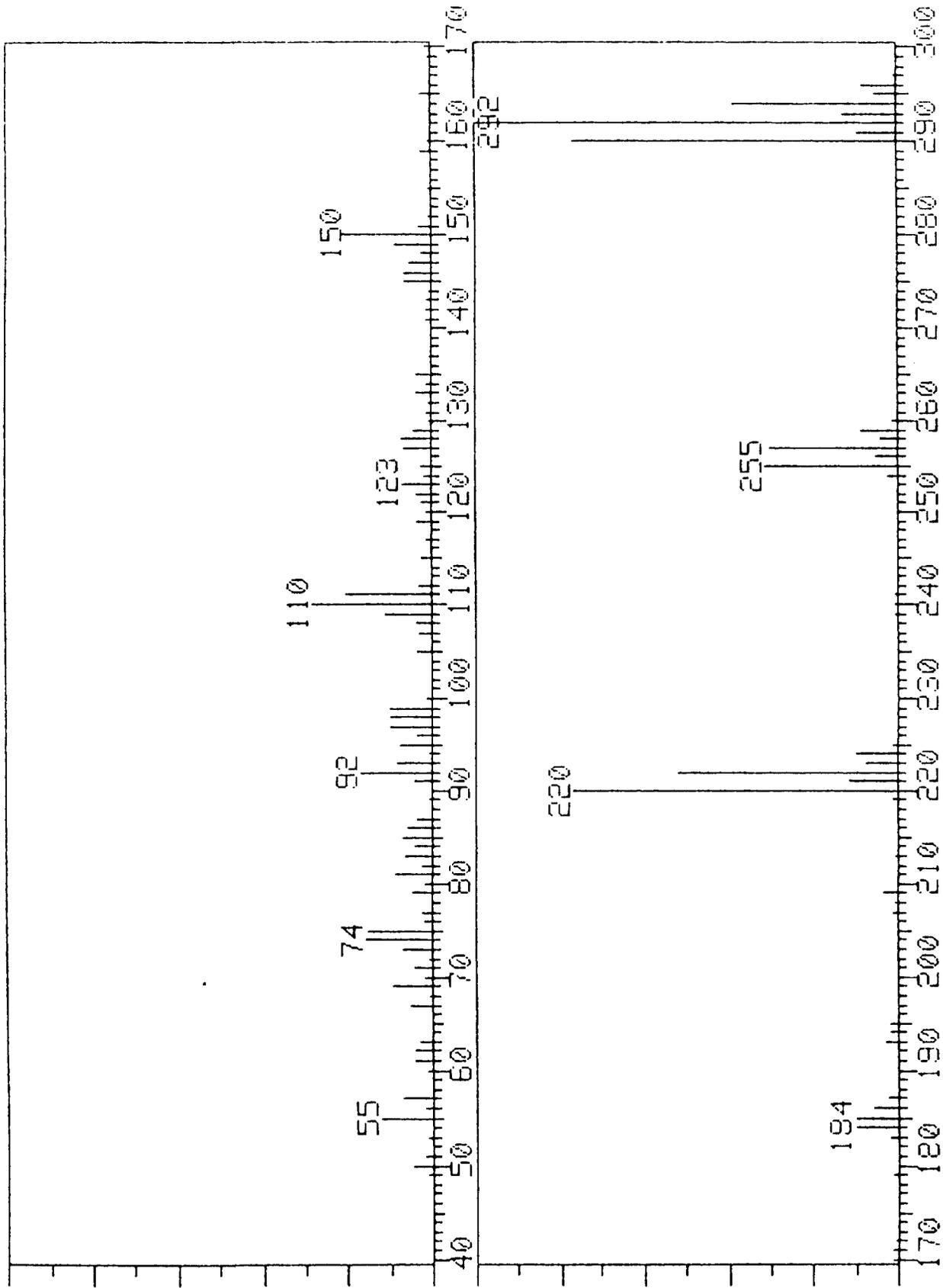
646722 TOTAL SCALE
18-APR-86 13:17:52 SCANS AVERAGED 1242-1246 TIME 19.70 MIN. 9862 1#
BCKG SCANS * 1.00 1238 100 % = 1564



646722 18-APR-86 13:17:52 SCANS AVERAGED 1257-1266 TIME 19.91 MIN. TOTAL SCALE 23131 1*
100 % = 4130



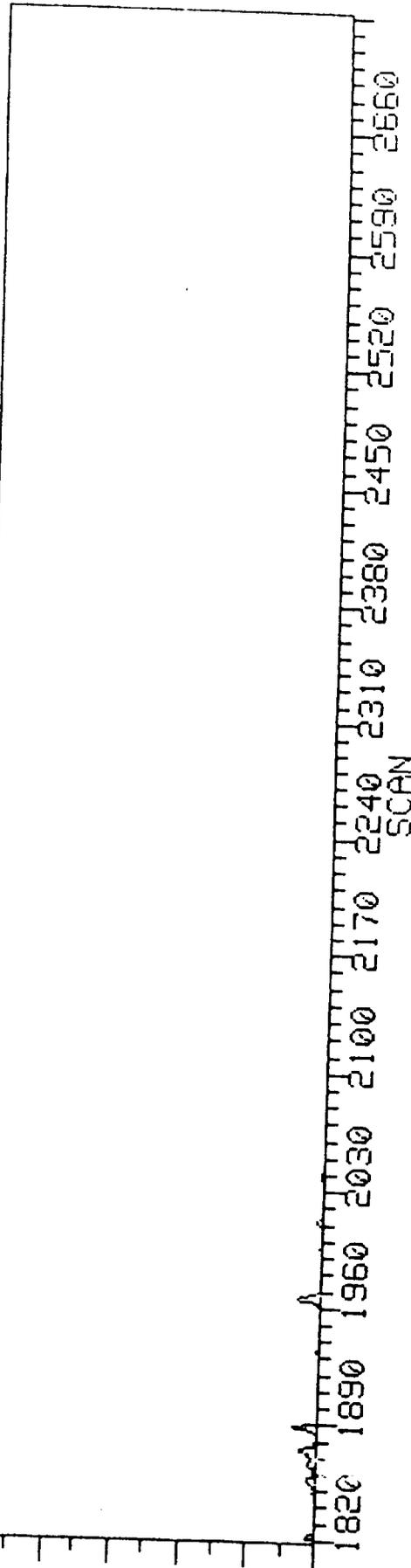
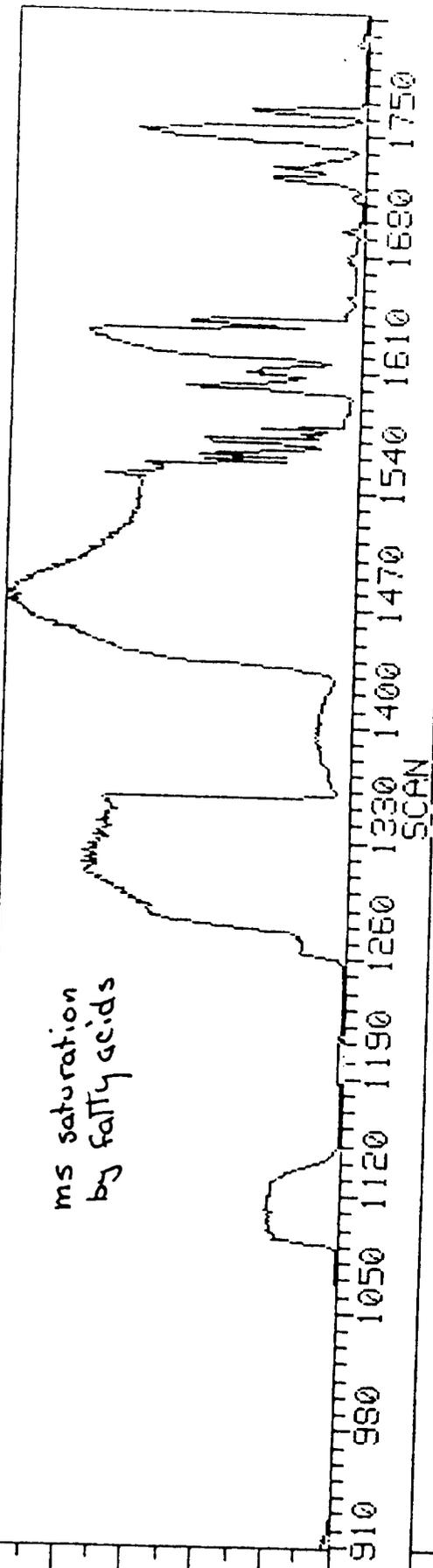
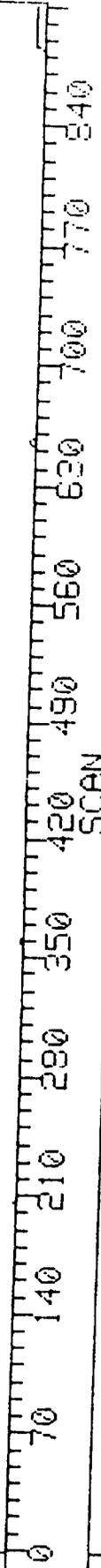
646722 18-APR-86 13:17:52 SCANS AVERAGED 1321-1327 TIME 20.65 MIN. TOTAL SCALE 16750 1*



67071E

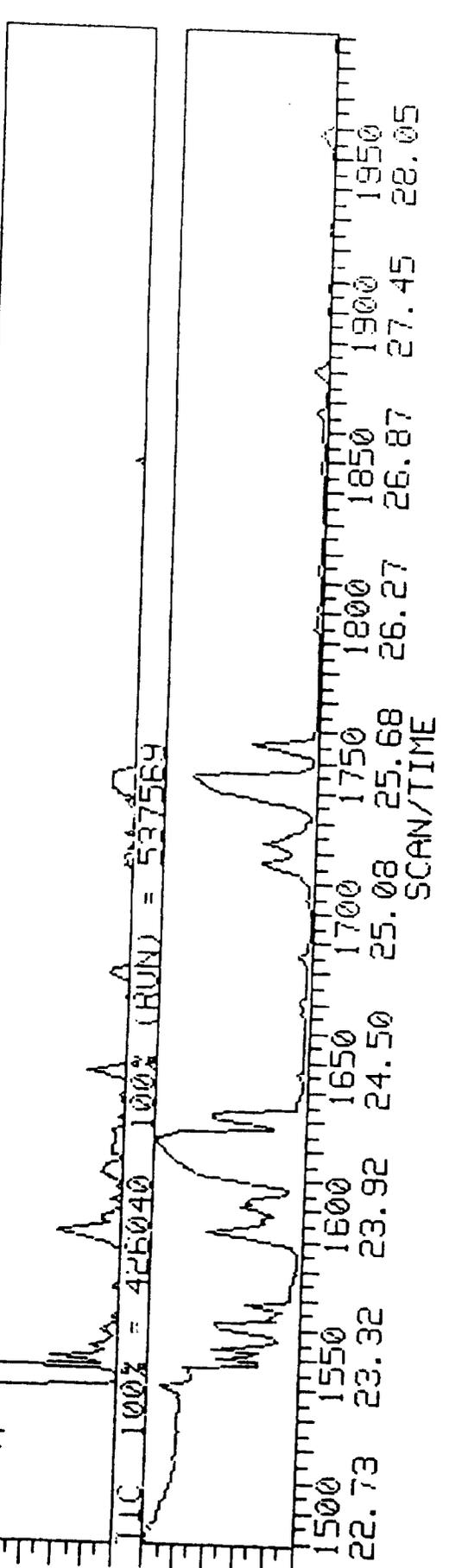
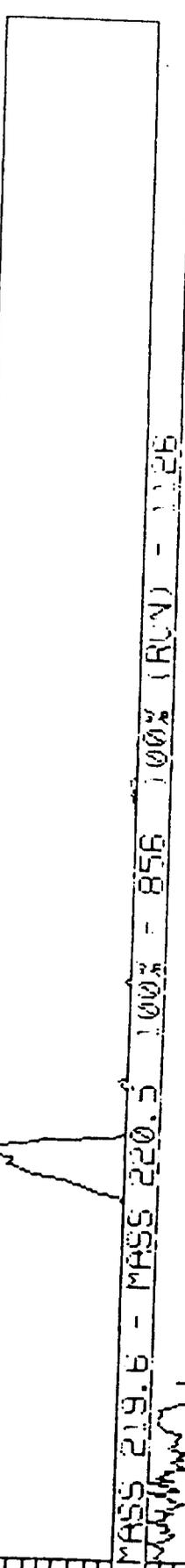
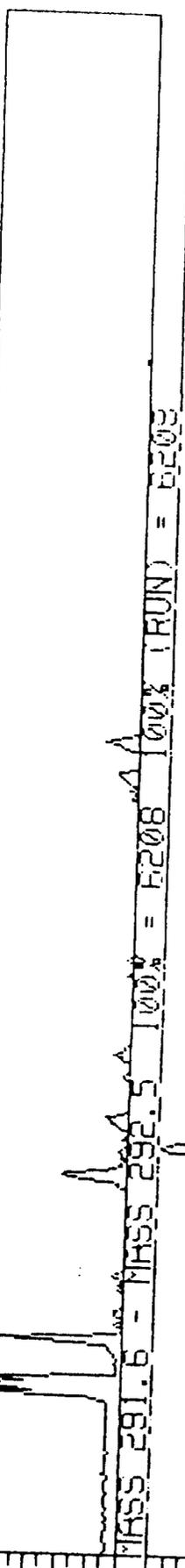
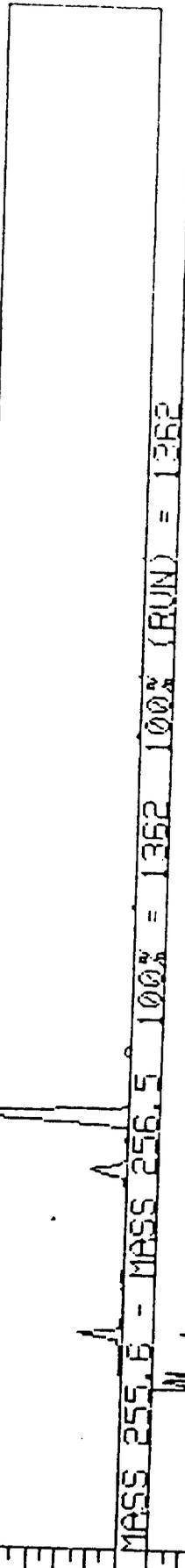
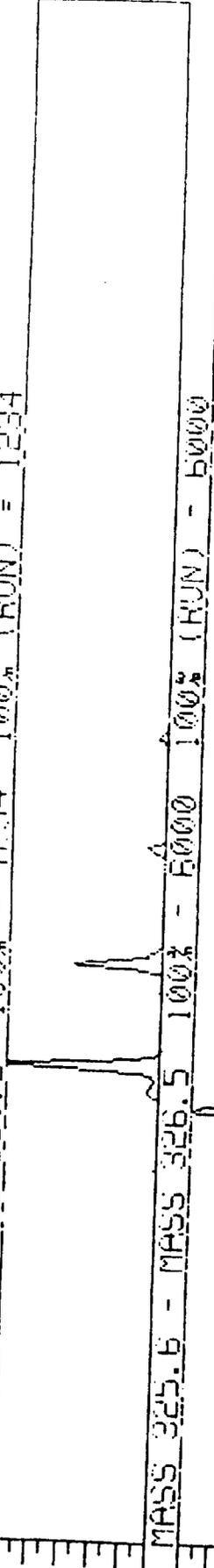
18-APR-86 10:45:22 TIC MAXIMUM CURRENT=537589

Ring-billed Gulls Composite No. 6-7 Fat

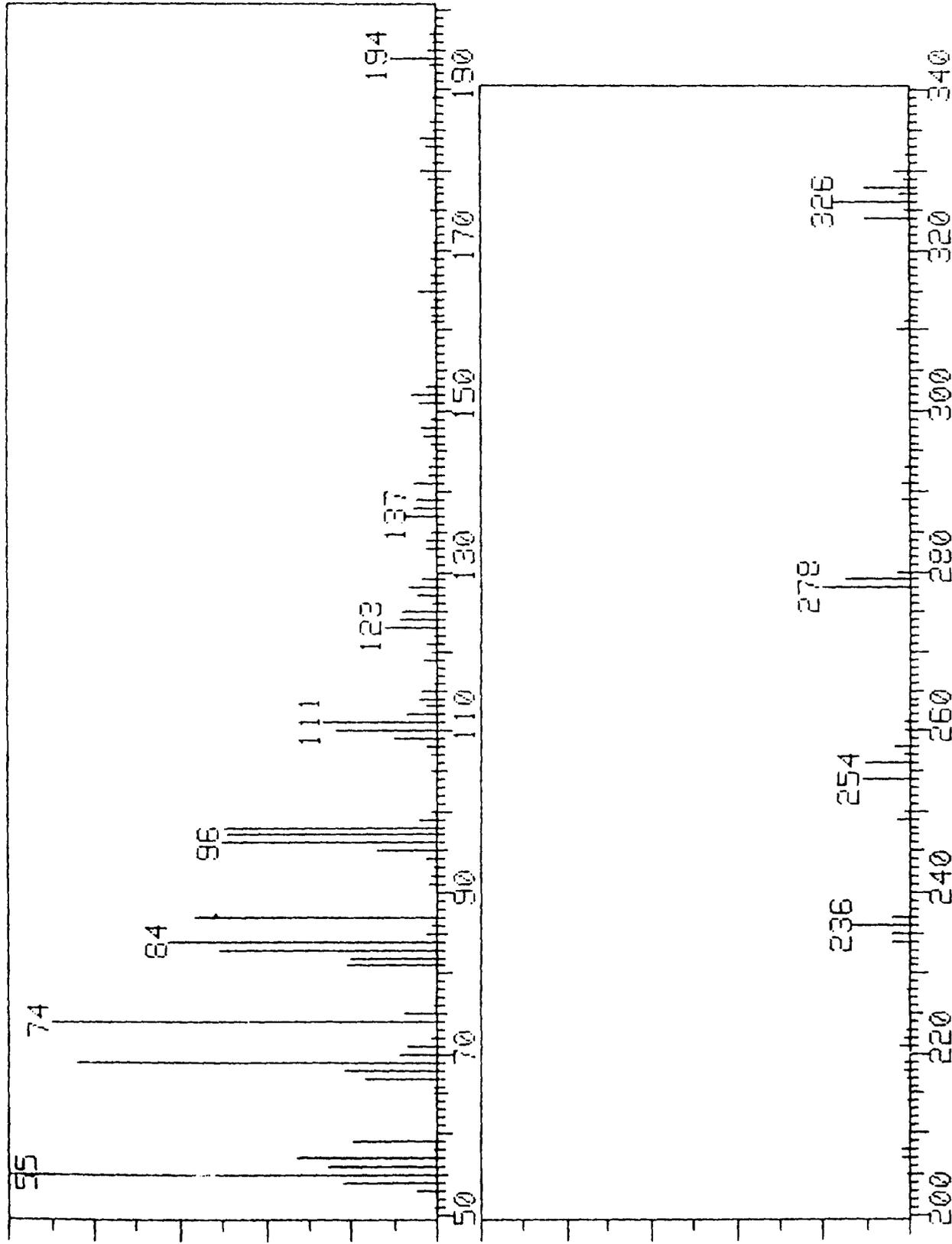


646712

18-APR-86 10:45:22 RETENTION TIMES SPANNED 22.73-28.63 MINUTES
MASS 359.6 - MASS 360.5 100% = 1234 100% (RUN) = 1234

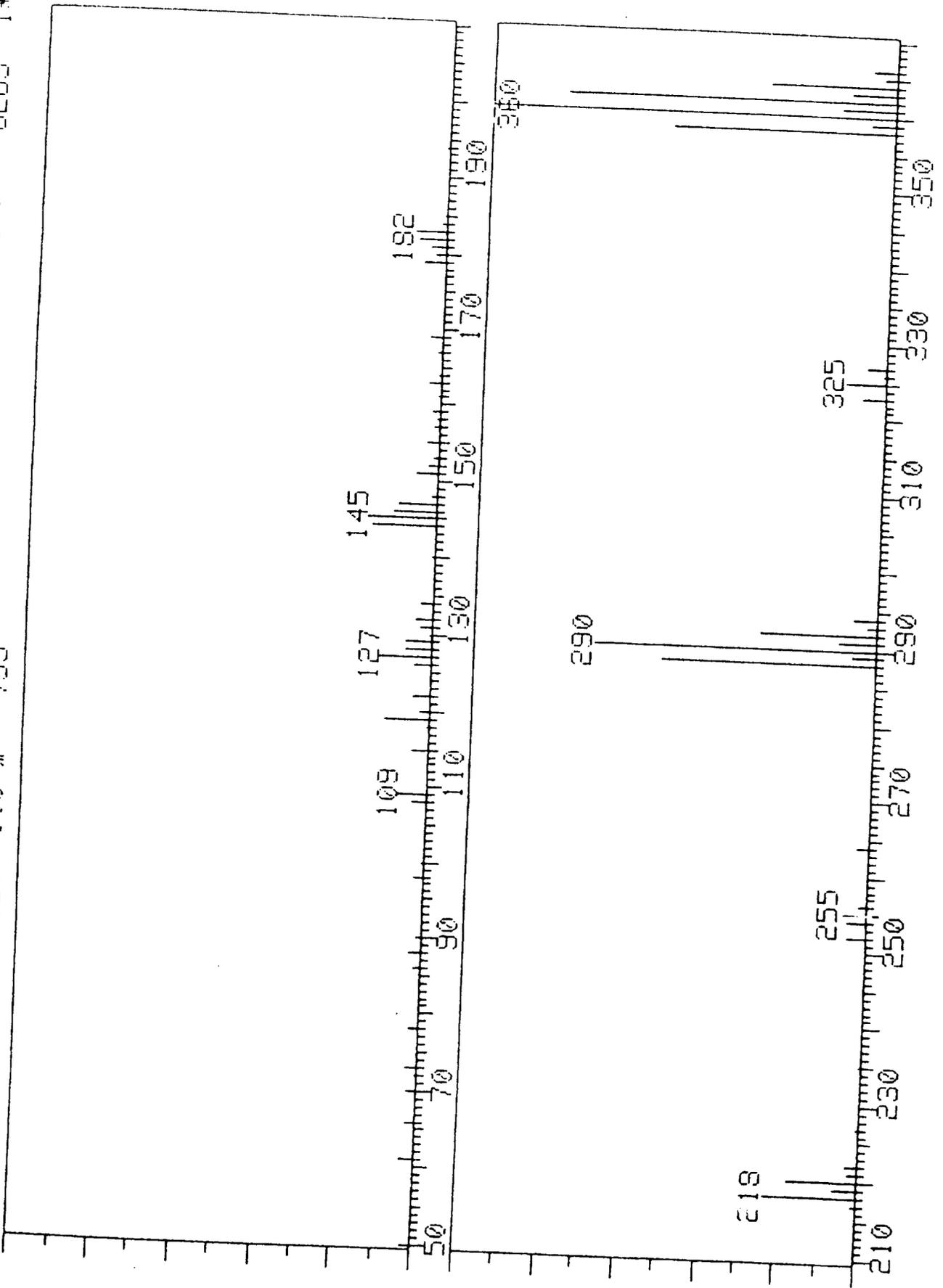


670716
18-APR-86 10:45:22 SCANS AVERAGED 1568-1570 TIME 23.54 MIN. TOTAL SCALE 74544 1*



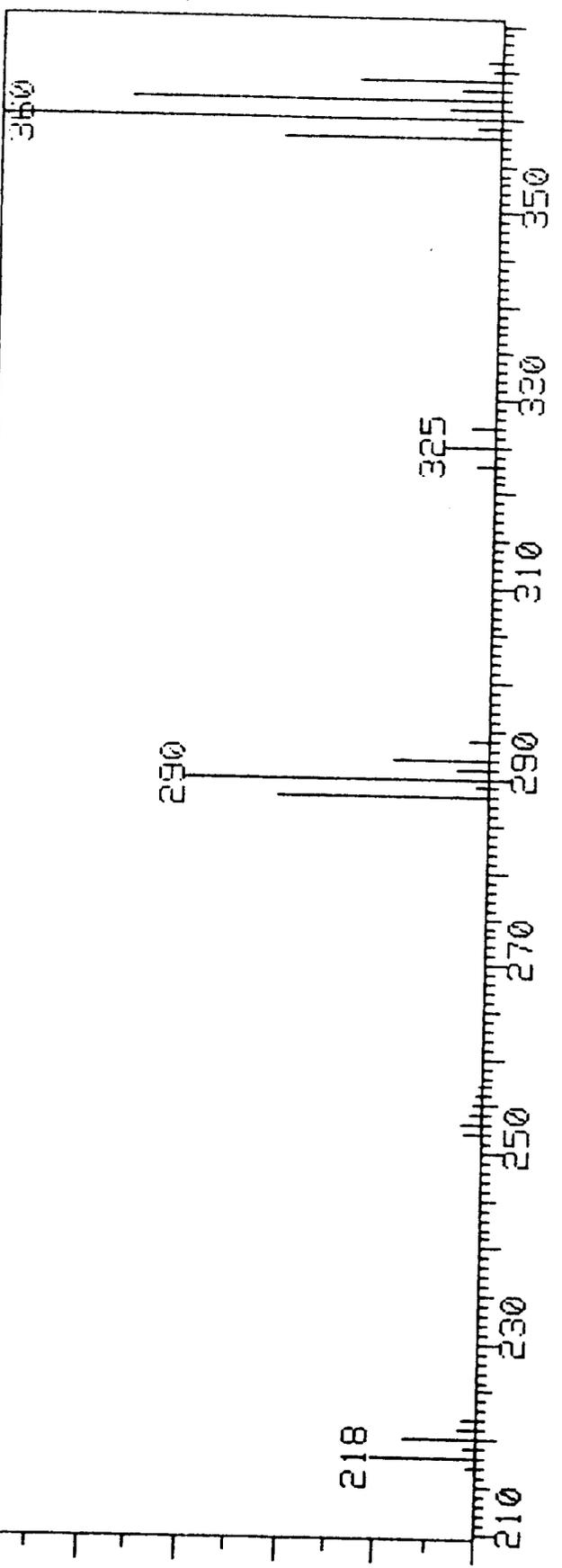
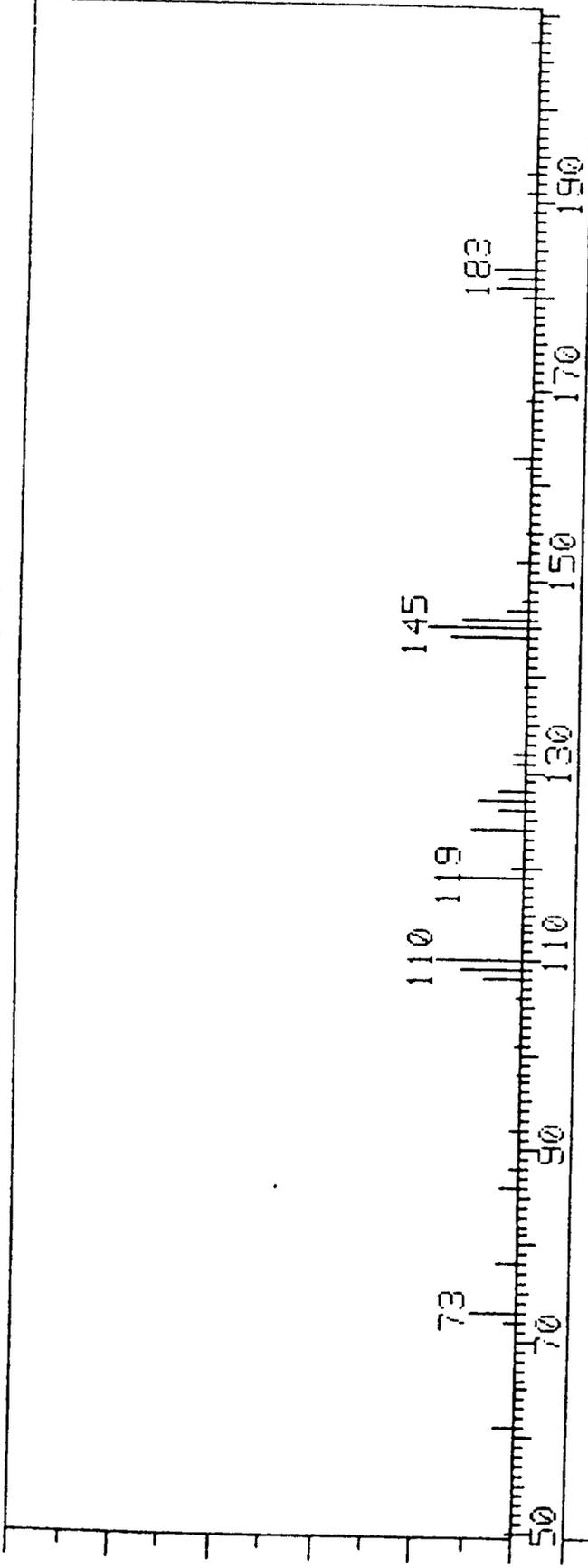
6.0712

18-APR-86 10:45:22 SCANS AVERAGED 1654-1657 TIME 24.57 MIN. TOTAL SCALE
BCKG SCANS * 1.00 1650 100% = 799 6263 1*



6.71c

18-APR-86 10:45:22 SCANS AVERAGED 1686-1691 TIME 24.96 MIN. TOTAL SCALE
BCKG SCANS * 1.00 1683 1703 1669 100% = 373 2601 1*



APPENDIX D

CHAIN OF CUSTODY DOCUMENTATION

Record No: 1
 Date: 15 April 1985

CHAIN OF CUSTODY RECORD

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
#1 <i>lb/musc</i>	PCB, <i>Methyl (om)</i>	Ring-billed Gull. Whole animal	Clean paper and ice	15 Apr. '85		William S. Brewster
#2 " "						
#3 " "						
#4 " "						
#5 " "						
#6 " "						
#7 " "						
#8 " "						
#9 " "						
#10 " "						

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
<i>L. L. L. L. L. L.</i>	<i>L. L. L. L. L. L.</i>	1985 Apr 8 8:30	Fresh shot
<i>L. L. L. L. L. L.</i>	<i>L. L. L. L. L. L.</i>	3/12/86	Frozen (Fat - Munch only)
<i>L. L. L. L. L. L.</i>	<i>L. L. L. L. L. L.</i>	3/12/86	Frozen (Fat - Munch only)

Record No: 31
 Date: 20 April 1985

CHAIN OF CUSTODY RECORD

SARLON No. - M-MUSSELS A-AMPHIRODS - SAMPLE NO.

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
1-M/1-2	PCBs	MUSSELS	ICE	20 April 85	10:41	CARROLLS COBURN
1-A	PCBs	AMPHIRODS	"	"	10:44	"
2-M/1-2	PCBs	MUSSELS	"	"	11:57	"
2-A	"	AMPHIRODS	"	"	12:20	"
3-M/1-2	"	MUSSELS	"	"	1:14	"
3-A	"	AMPHIRODS	"	"	1:29	"
4-M/1-2	"	MUSSELS	"	"	2:29	"
4-A	"	AMPHIRODS	"	"	2:42	ROBERT WILSON
5-M/1-2	"	MUSSELS	"	"	3:11	CARROLLS COBURN
5-A	"	AMPHIRODS	"	"	4:09	"

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
<i>Charles E. Coxworth</i>	<i>Robert W. Wilson</i>	3/14/86 1:27 PM	
<i>Robert W. Wilson</i>	<i>David M. Kease</i>	3/14/86 1655	
<i>David M. Kease</i>			

Balance of Sample:

WHITE FOOTED MOUSE FOOD

Record No: 34
 Date: 23 APRIL 85

CHAIN OF CUSTODY RECORD

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
2/EMILIAE	PCMB		ON ICE	23 APRIL 85	STATION 2 11:20 -	CARRACENT COASWELL
2/ALCANTARA	"		"		1:25	"
2/ISOPODS	"		"			"
2/MILLIPEDIDS	"		"			"
2/MYRIAPIDS	"		"			"
2/ROB MARIS PHUF	"		"			"
2/COLEOPTIL 4/INSECTICIDANON	"		"		STATION 4 1:57 -	"
4/ISOPODS	"		"		3:20	"
4/MILLIPEDIDS	"		"			"
4/MYRIAPIDS	"		"			"
4/ROSE HIPS	"		"			"
4/TUNCOS gerardi	"		"			"

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
<i>Charles W. Brown</i>	<i>Brunette Thomson</i>	3/14/86 1:27 PM	
<i>Charles W. Brown</i>	<i>Brunette Thomson</i>	3/14/86 1:55	
<i>Charles W. Brown</i>	<i>Brunette Thomson</i>	3/14/86	

X