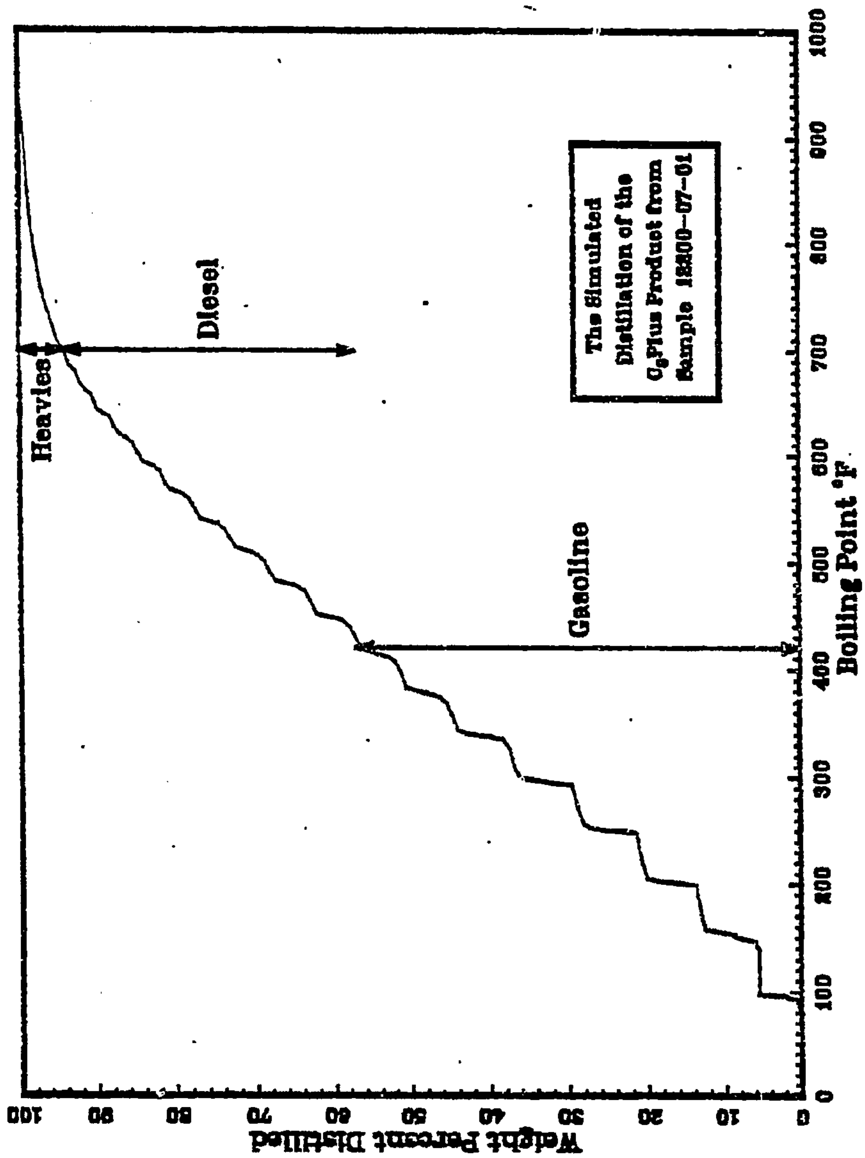

The Simulated Distillation of the C_6Plus Product from Sample 18800-07-01
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B101

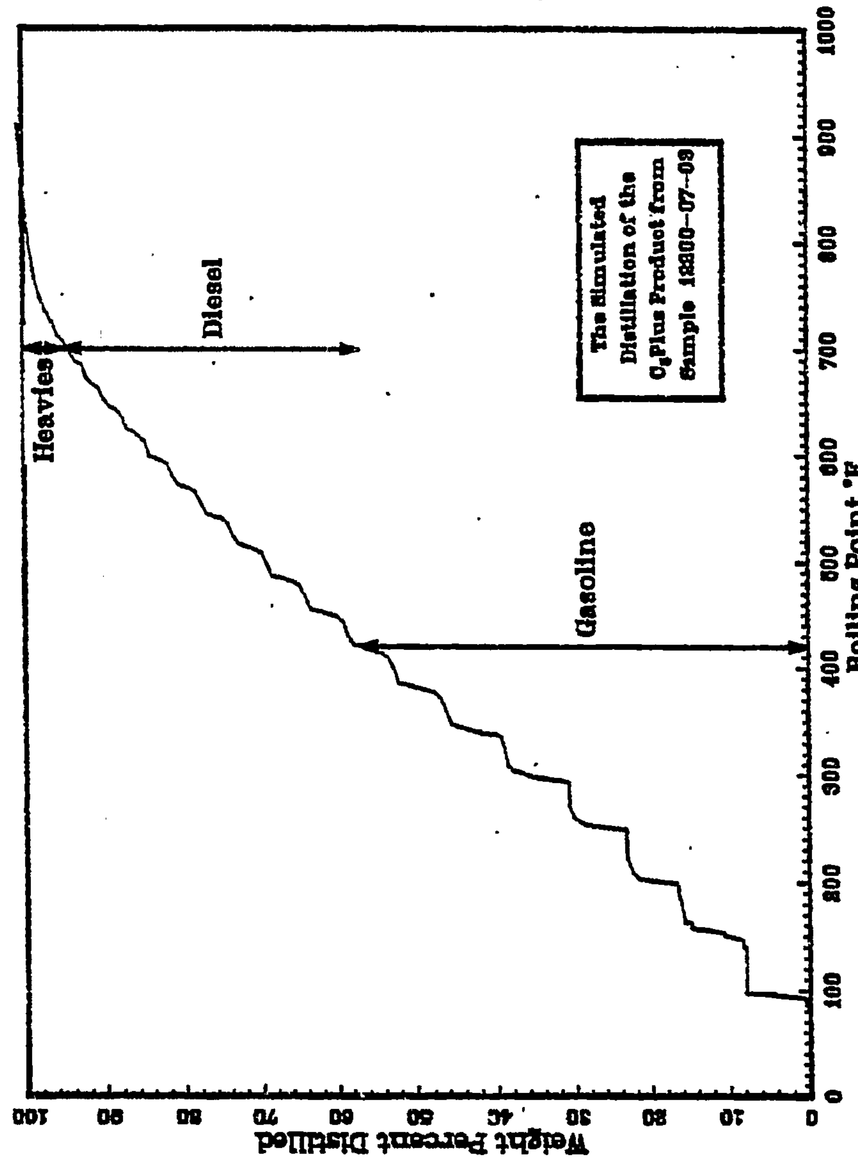

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B103

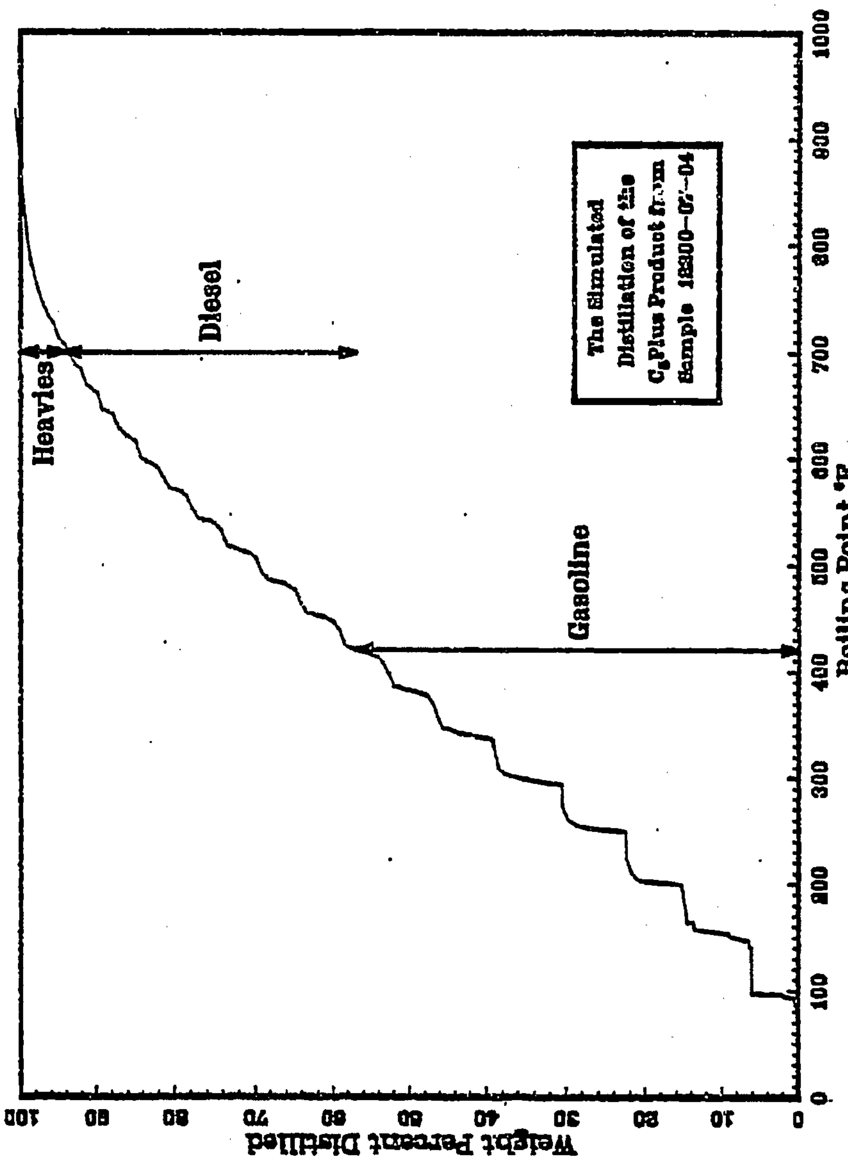

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Boiling Point °F
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B104

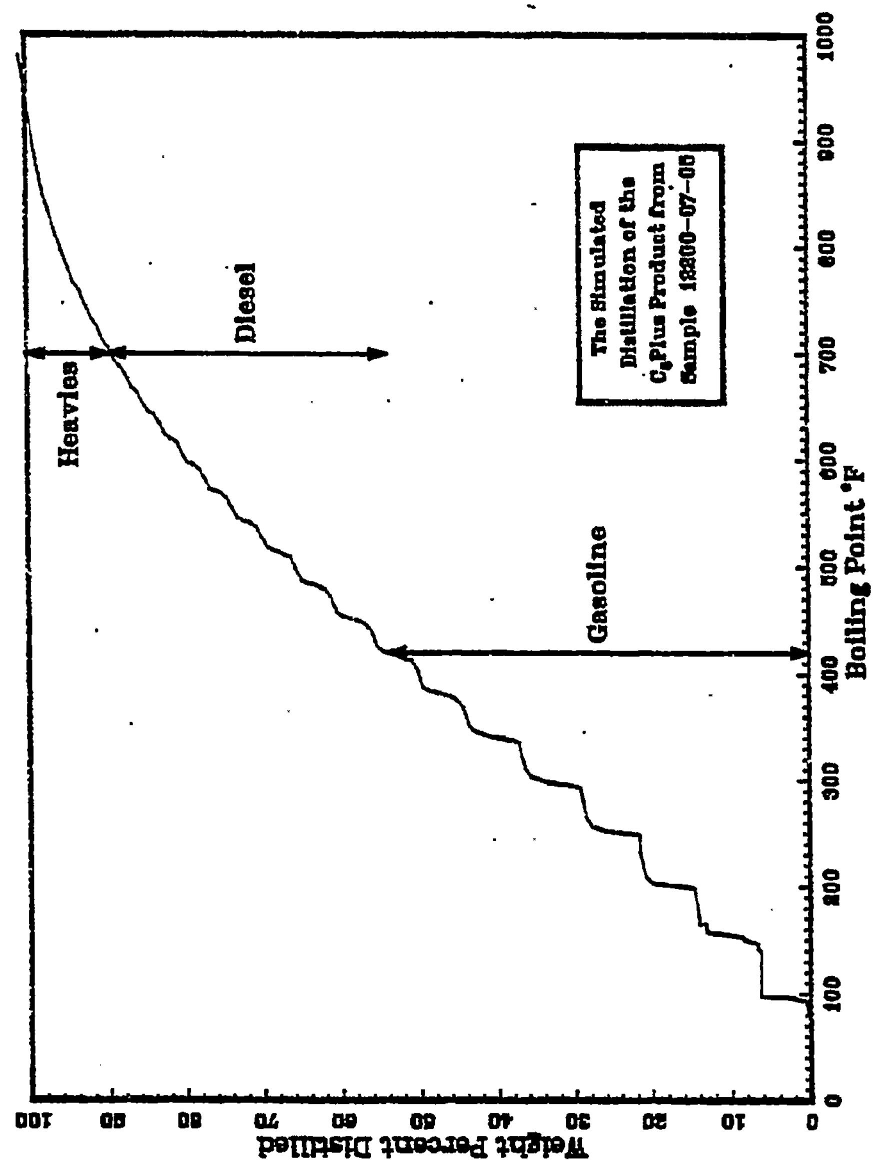

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Boiling Point °F
Weight Percent Distilled

Fig. B105

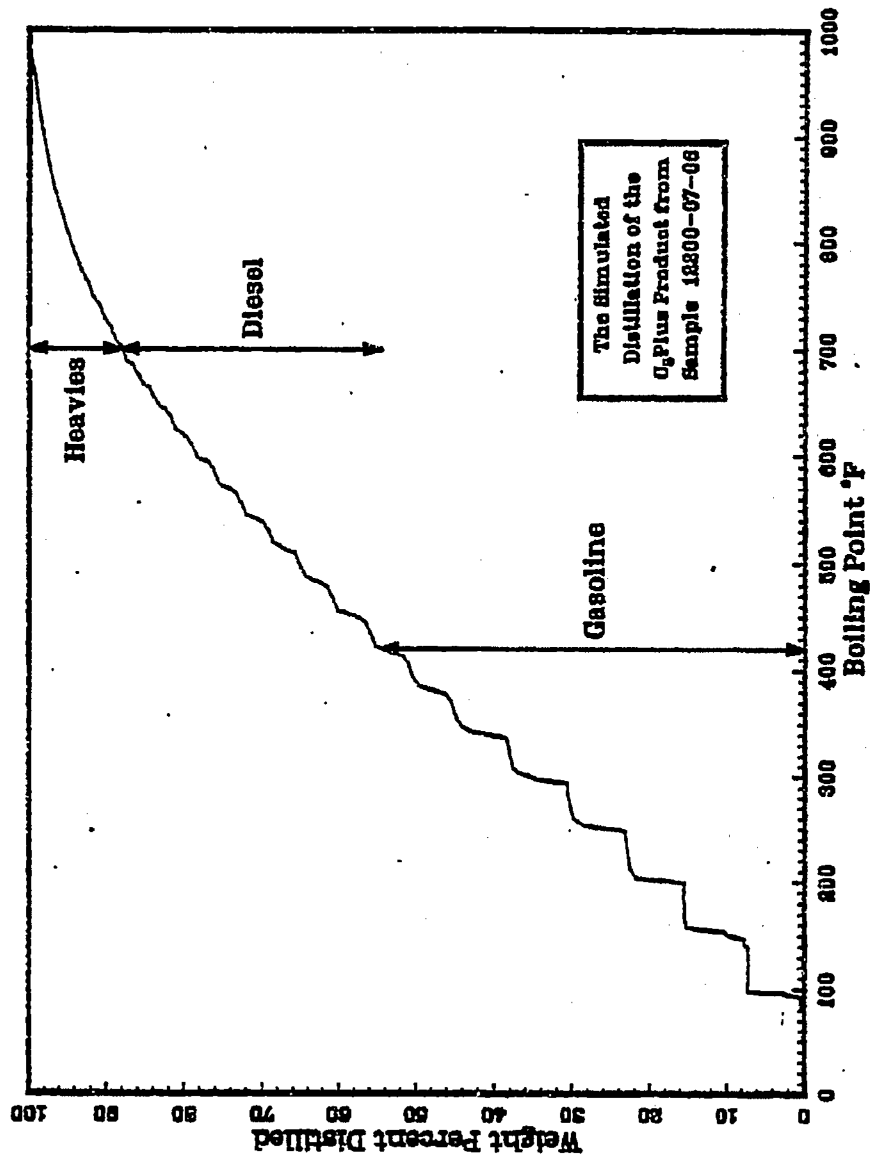

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Boiling Point °F
Weight Percent Distilled

Fig. B106

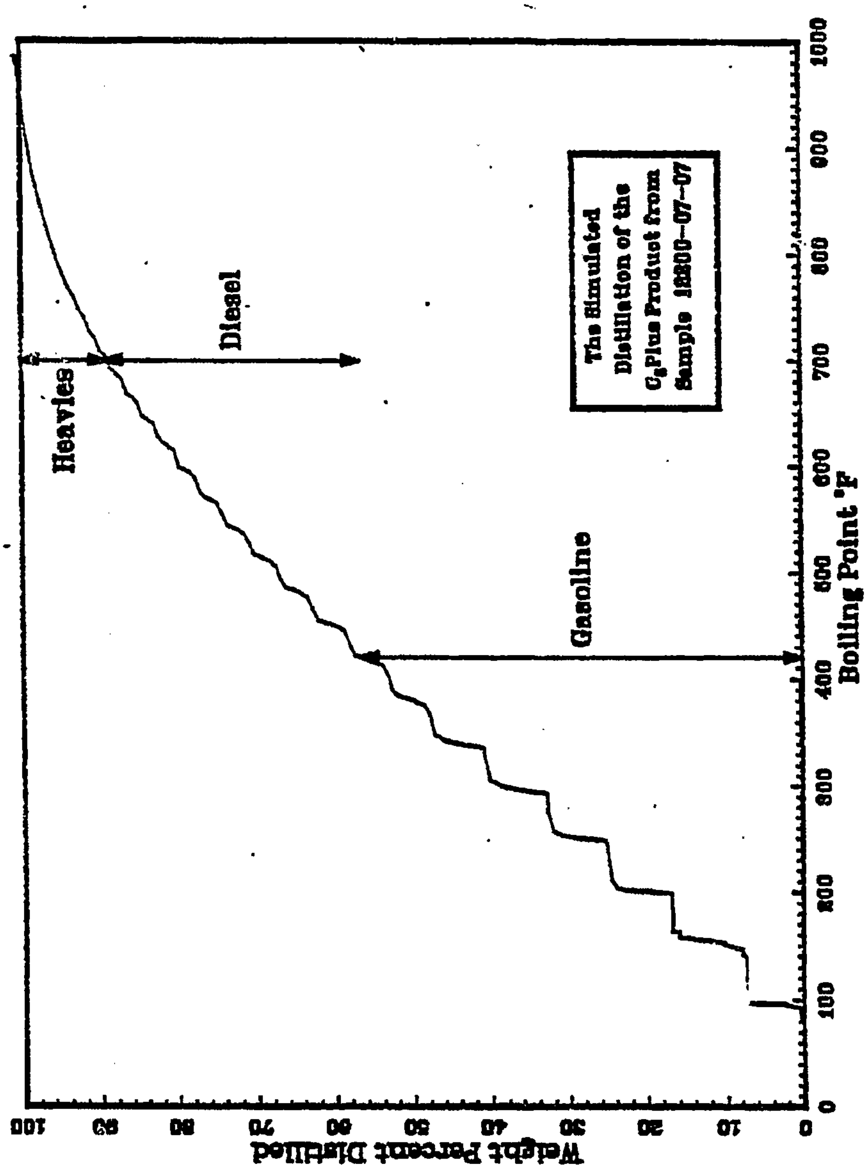

Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point °F

Fig. B107

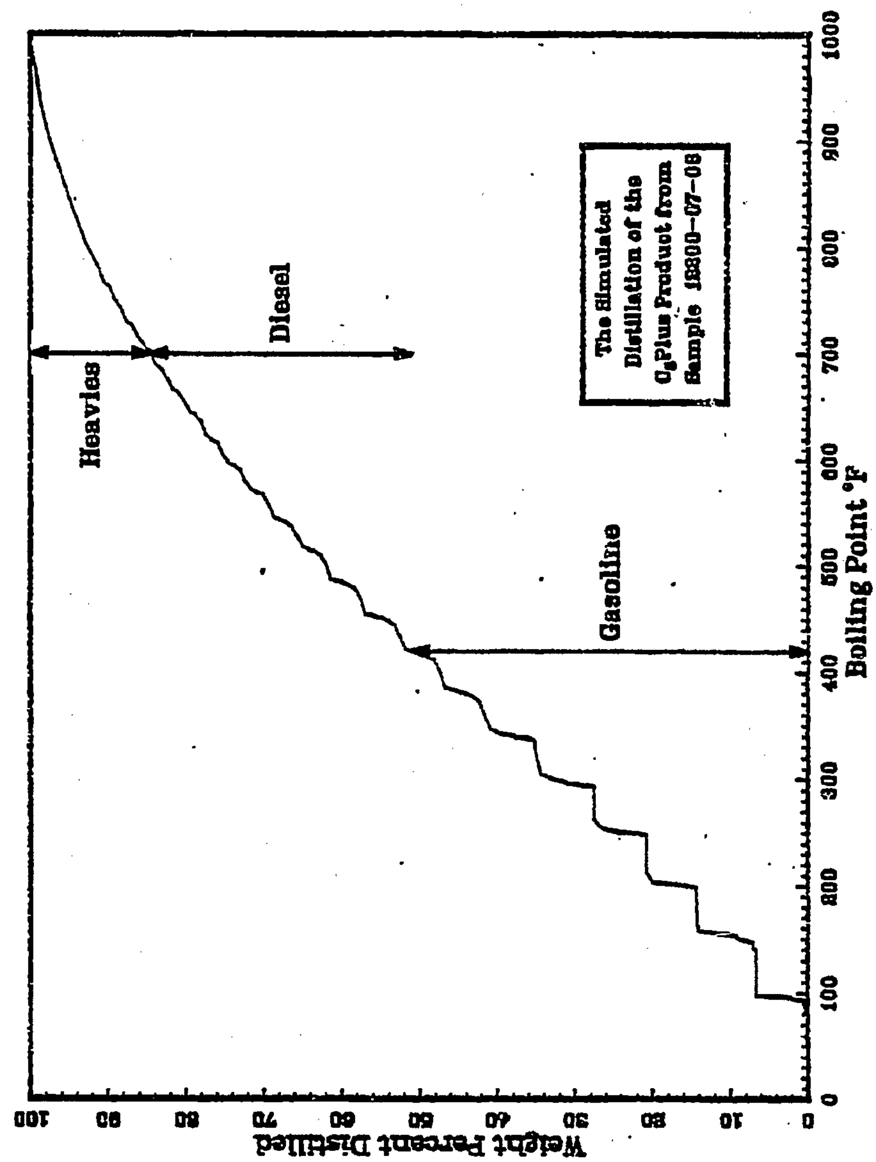

The Simulated
Distillation of the
C Plus Product from
Sample 18800-07-08
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B108

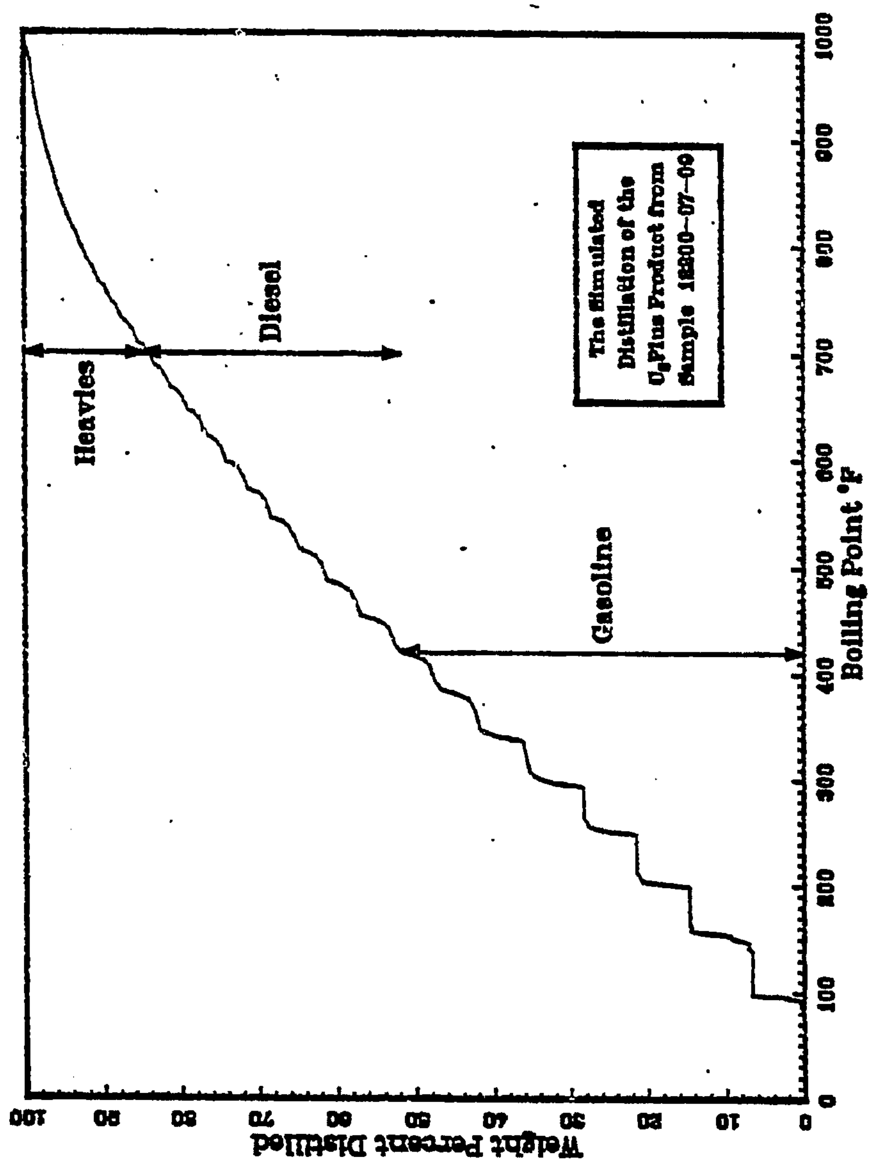
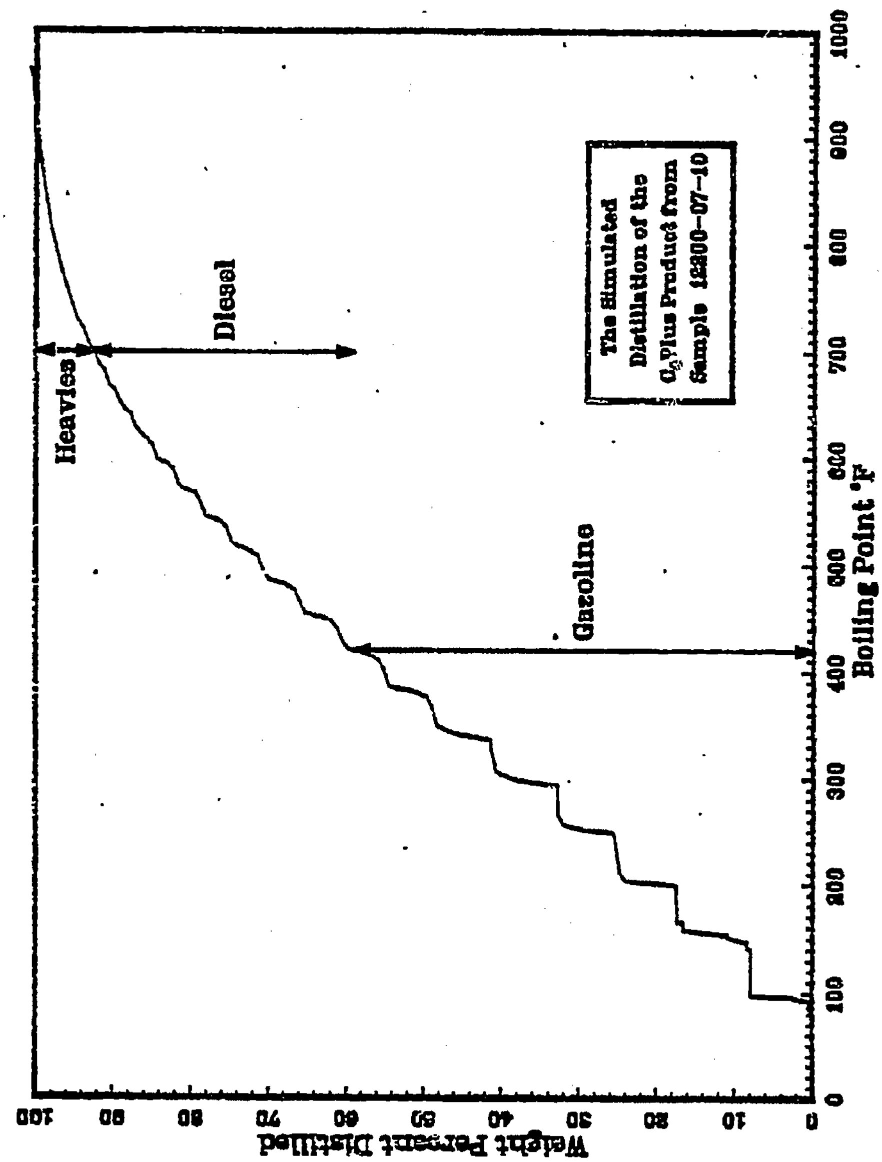
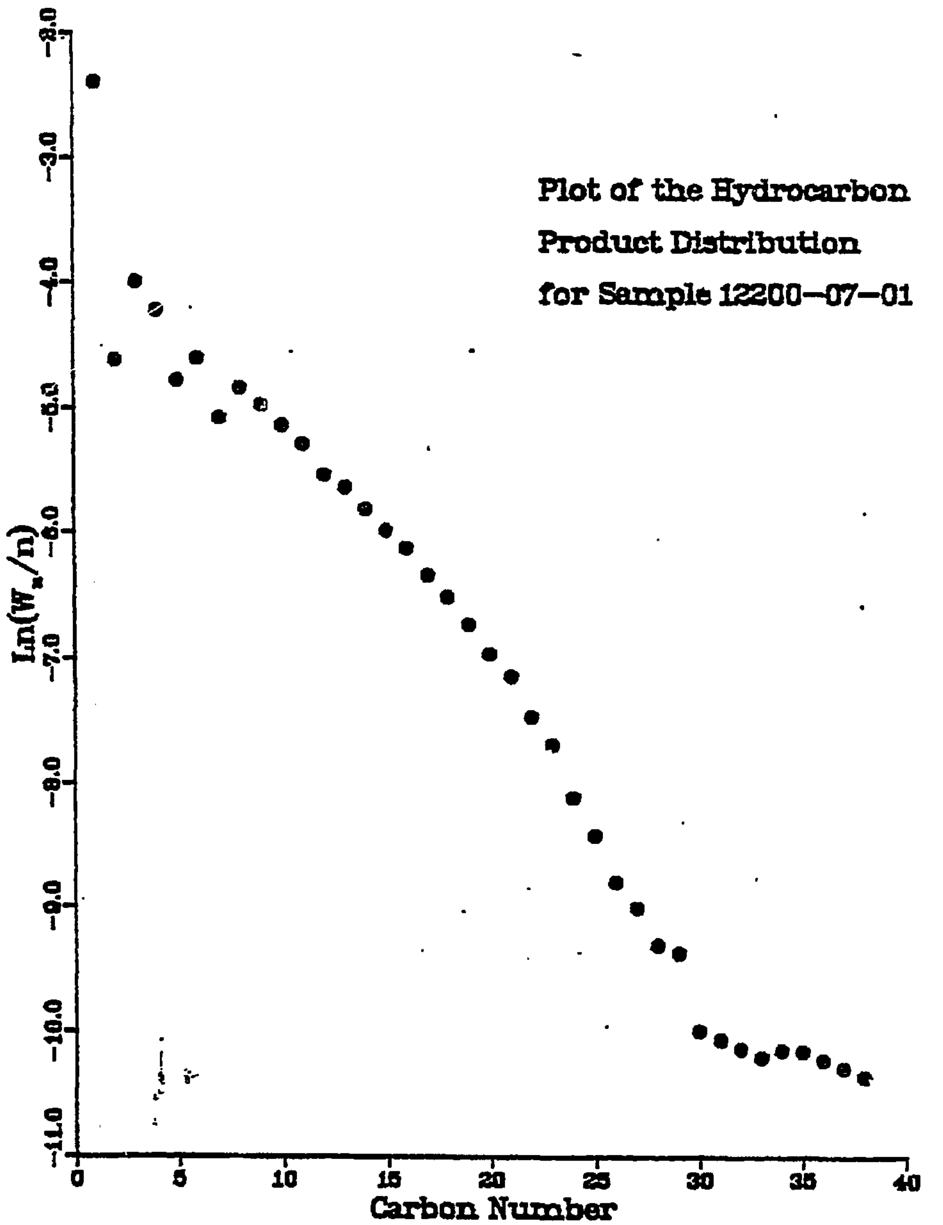

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

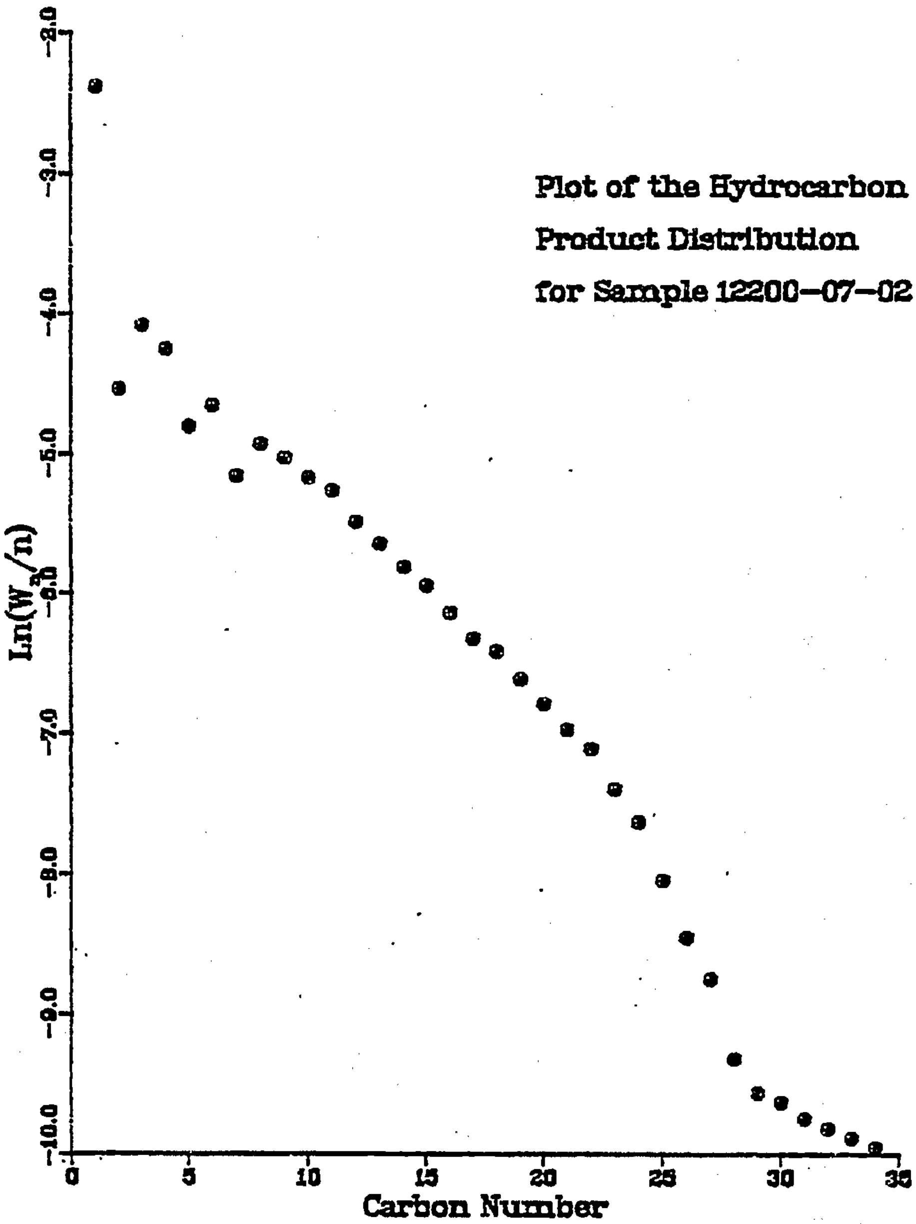
Fig. B109



The Simulated
Distillation of the
C_5 Plus Product from
Sample 12300-07-10
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

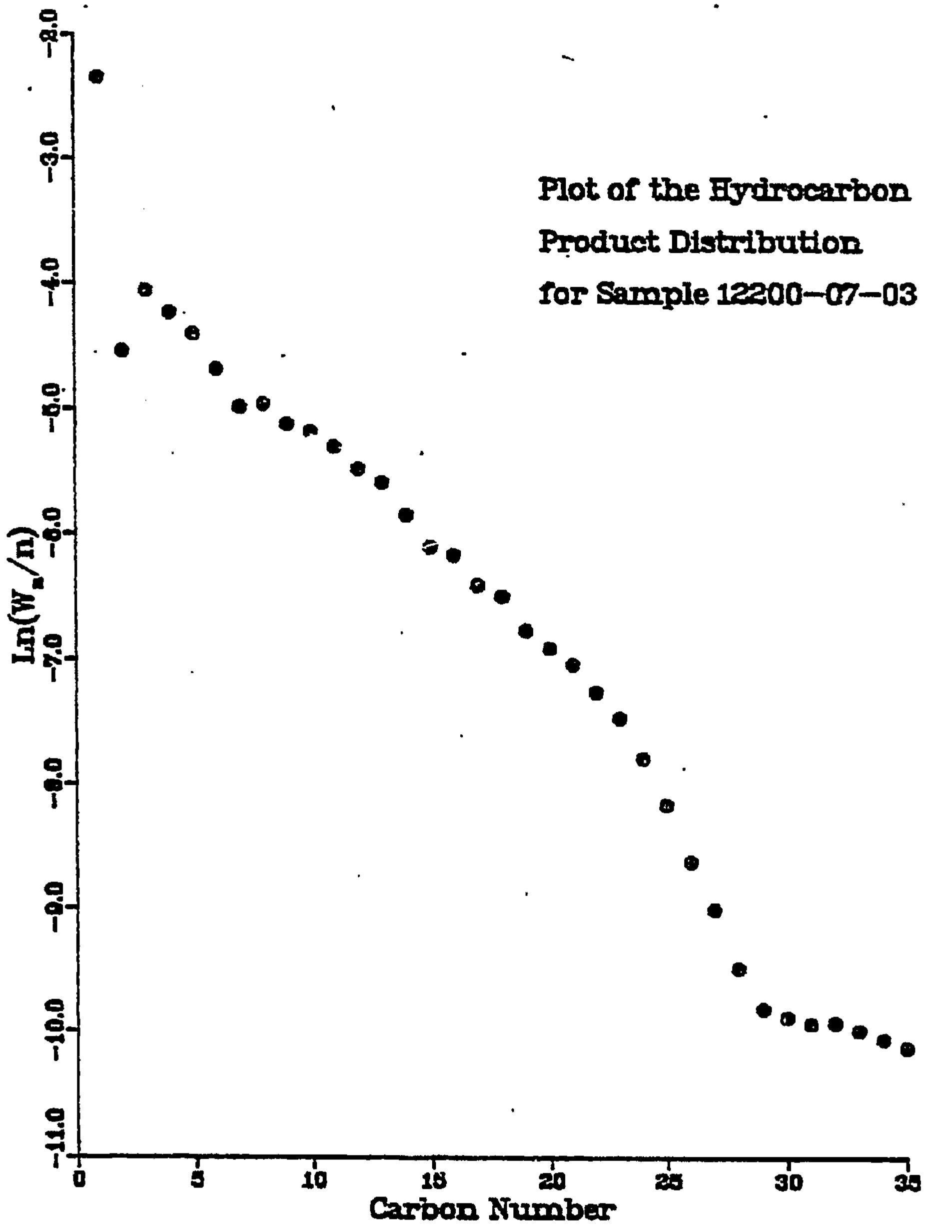
Fig. B110


Plot of the Hydrocarbon
Product Distribution
for Sample 12200-07-01
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number
Fig. B111



Plot of the Hydrocarbon
Product Distribution
for Sample 12200-07-02
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B112



Plot of the Hydrocarbon
Product Distribution
for Sample 12200-07-03
Ln(Wn/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B113

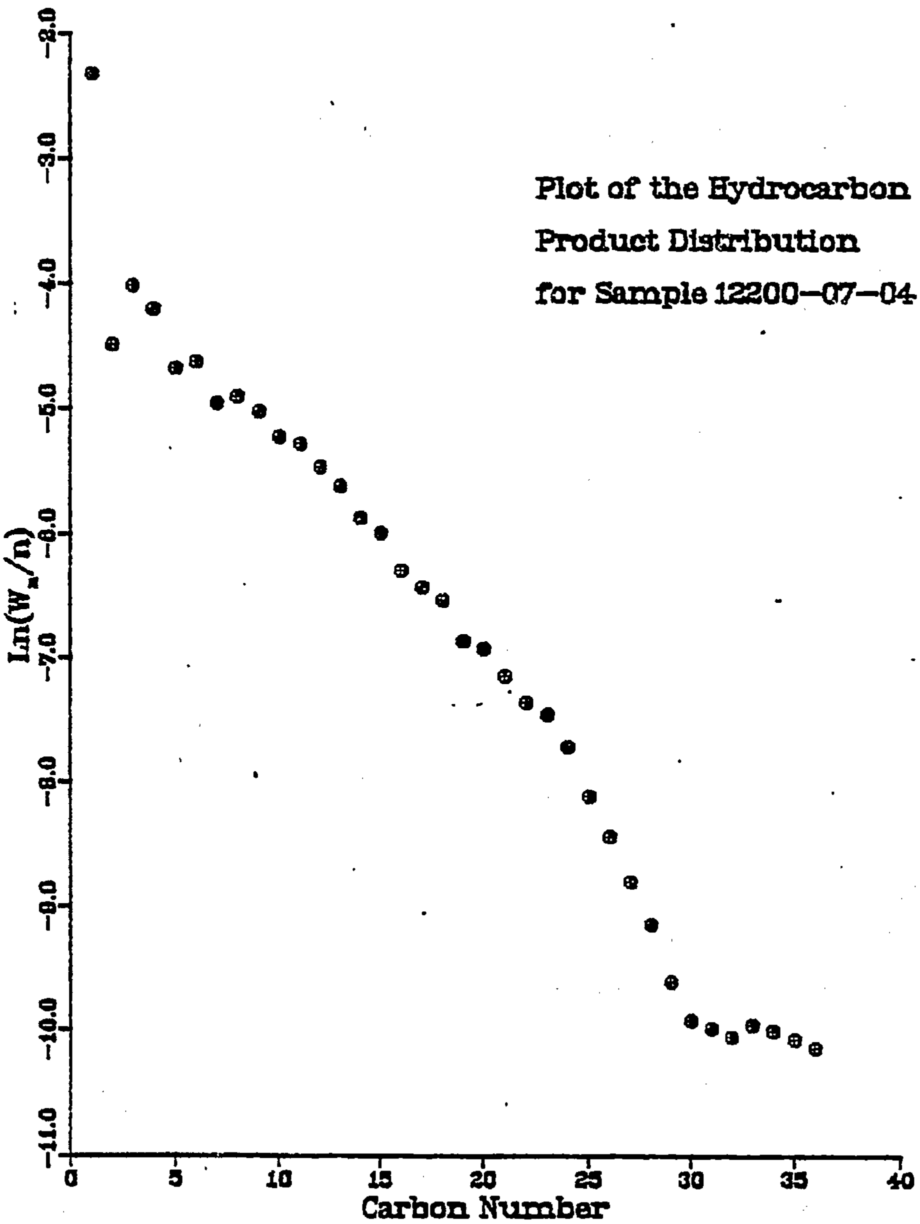
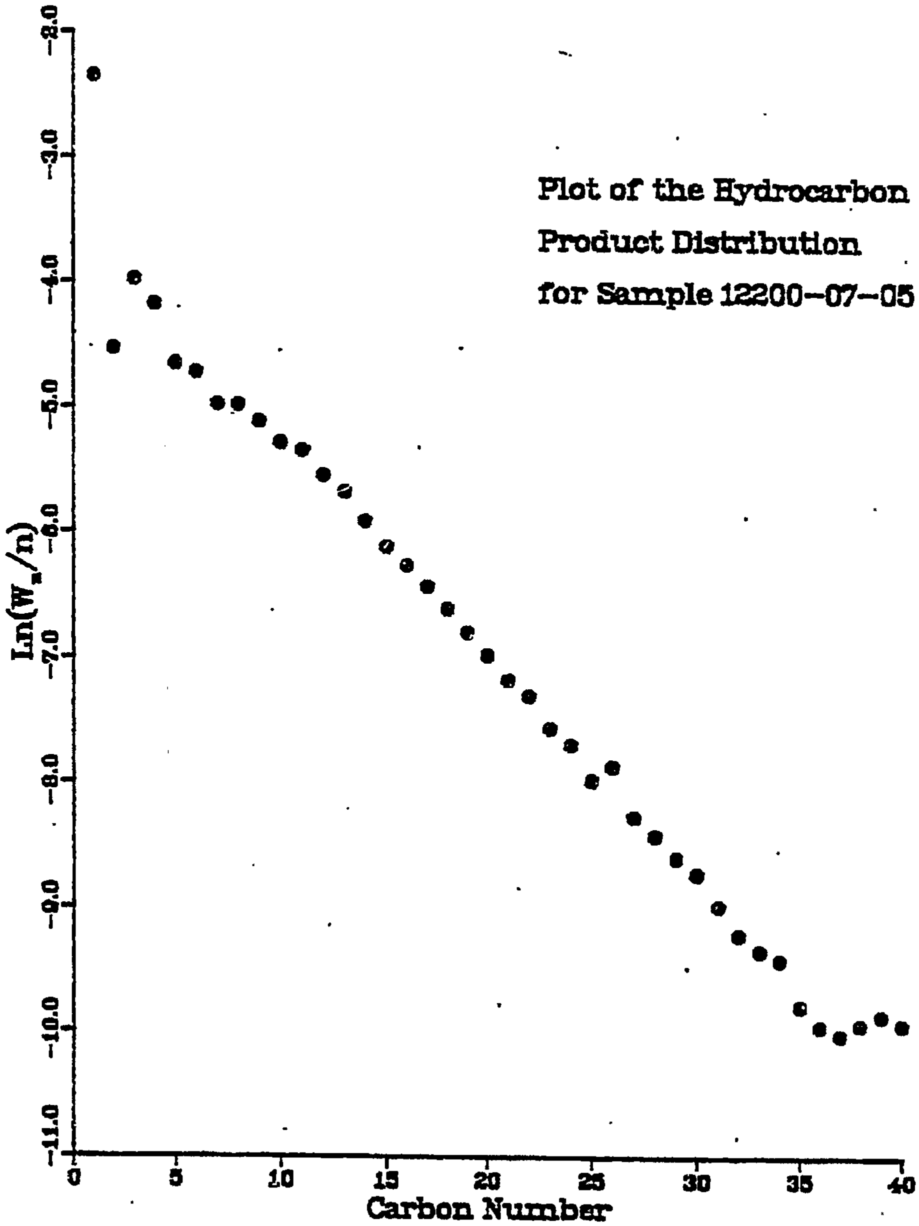

Plot of the Hydrocarbon
Product Distribution
for Sample 12200—07—04
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
Ln(W_n/n)
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B114



Plot of the Hydrocarbon
Product Distribution
for Sample 12200-07-05
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B115

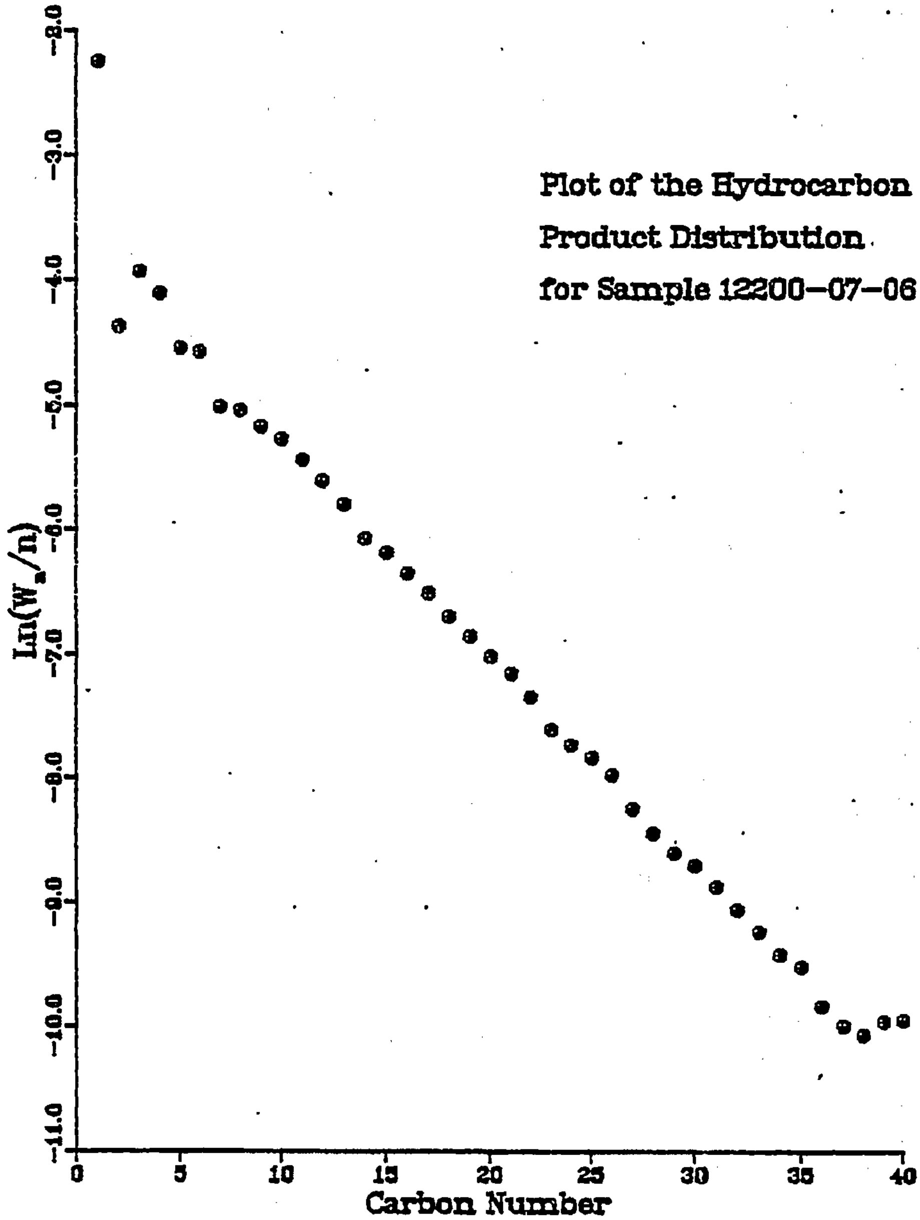

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-07-06
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B116

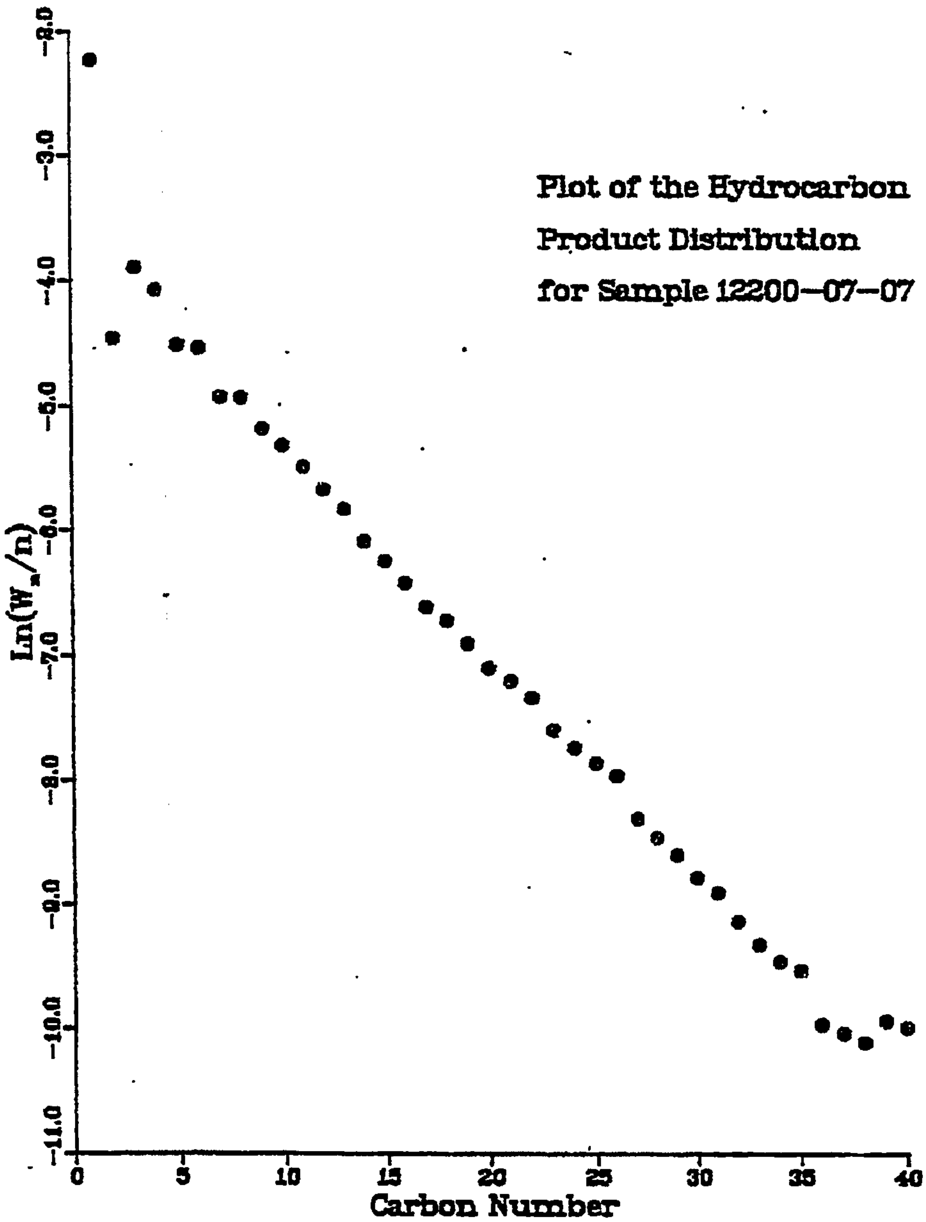

Plot of the Hydrocarbon
Product Distribution
for Sample 12200—07—07
Ln(W$_n$/n)
Carbon Number
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40

Fig. B117

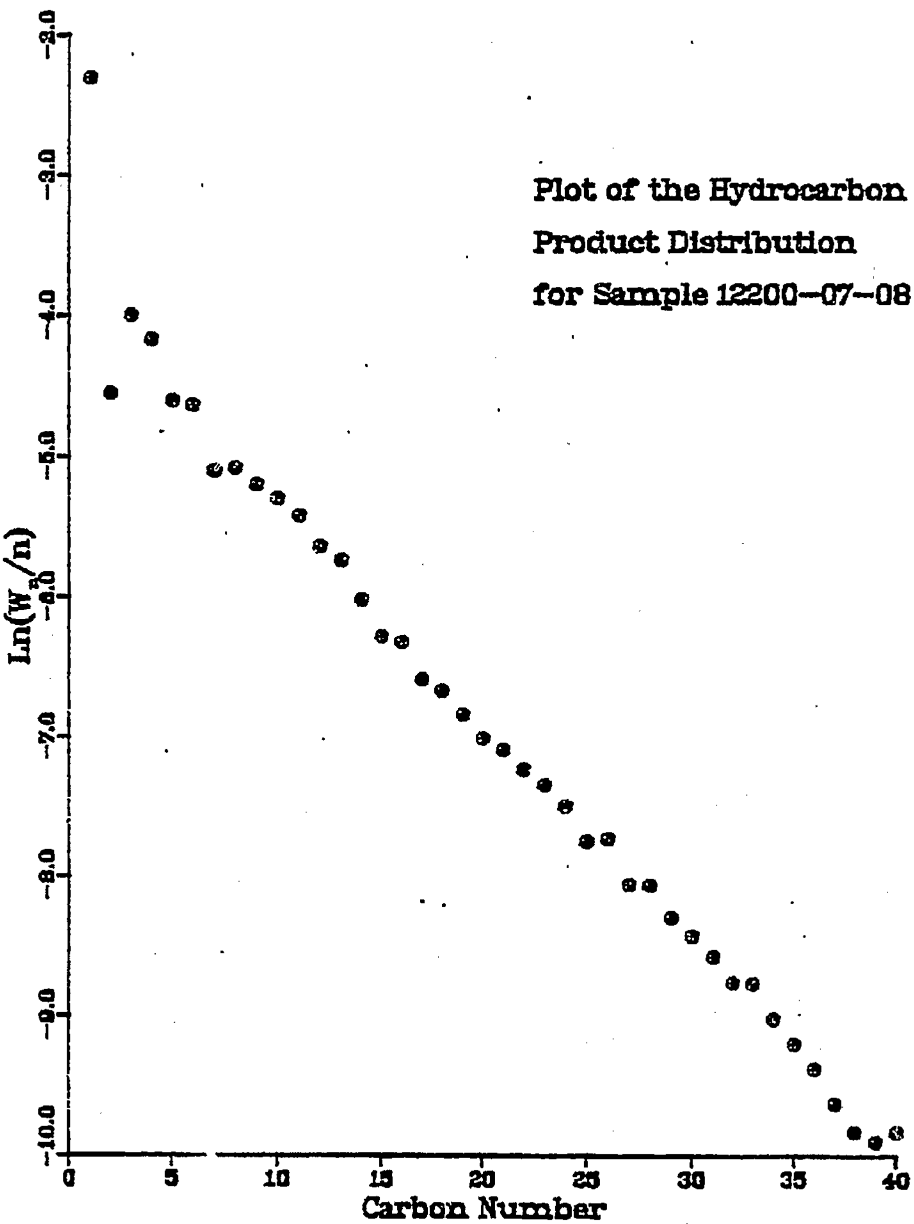
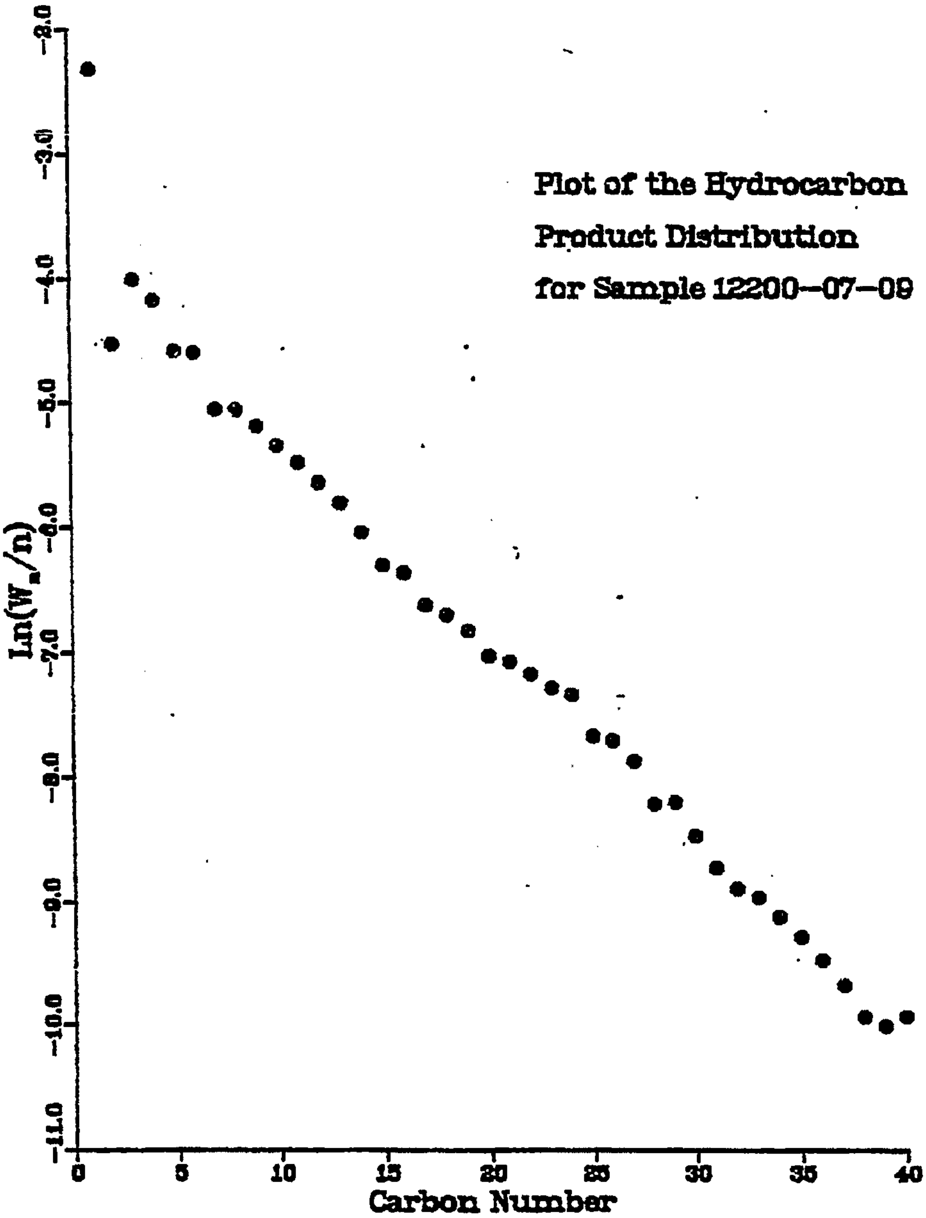

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-07-08
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
$Ln(W_n/n)$
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B118



Plot of the Hydrocarbon
Product Distribution
for Sample 12200--07--09
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B119

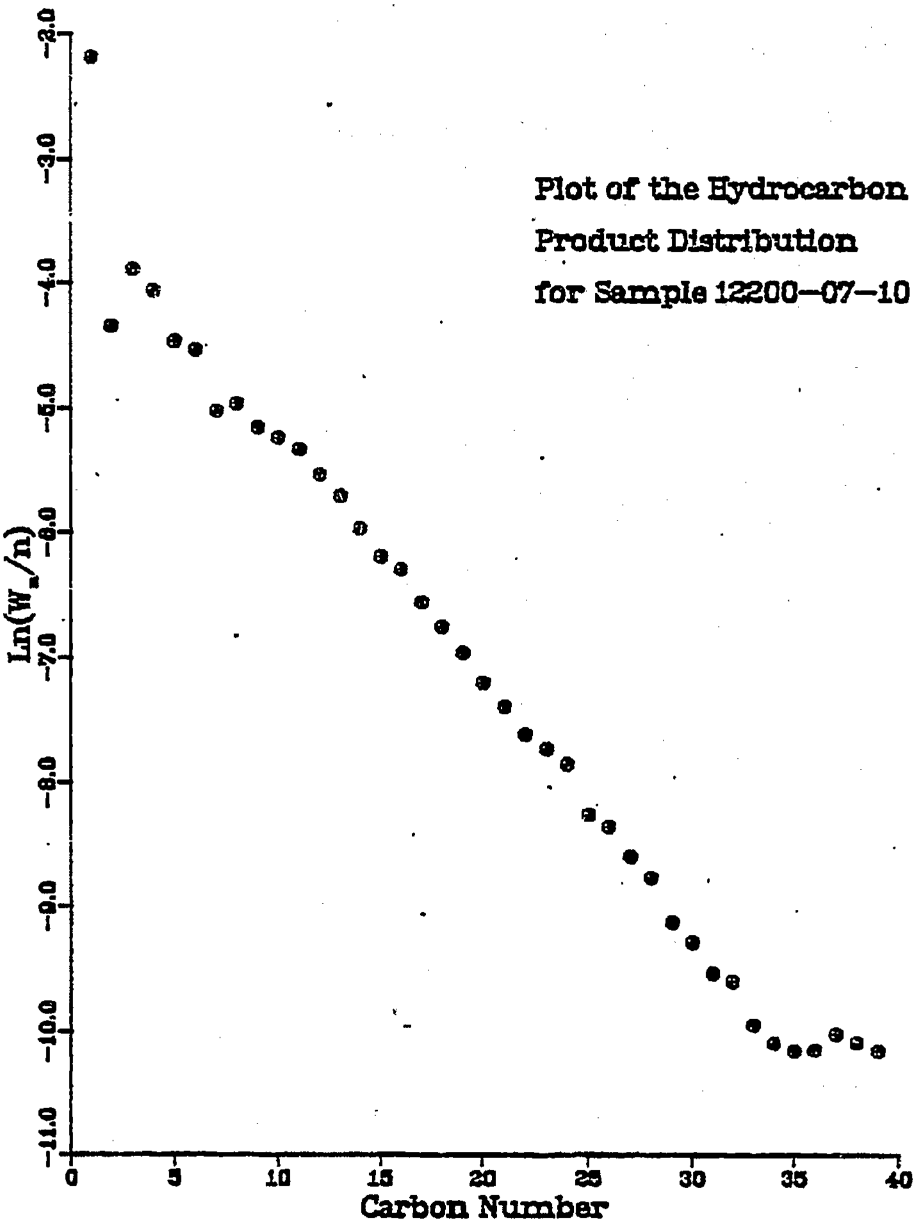

Plot of the Hydrocarbon
Product Distribution
for Sample 12200–07–10
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B120

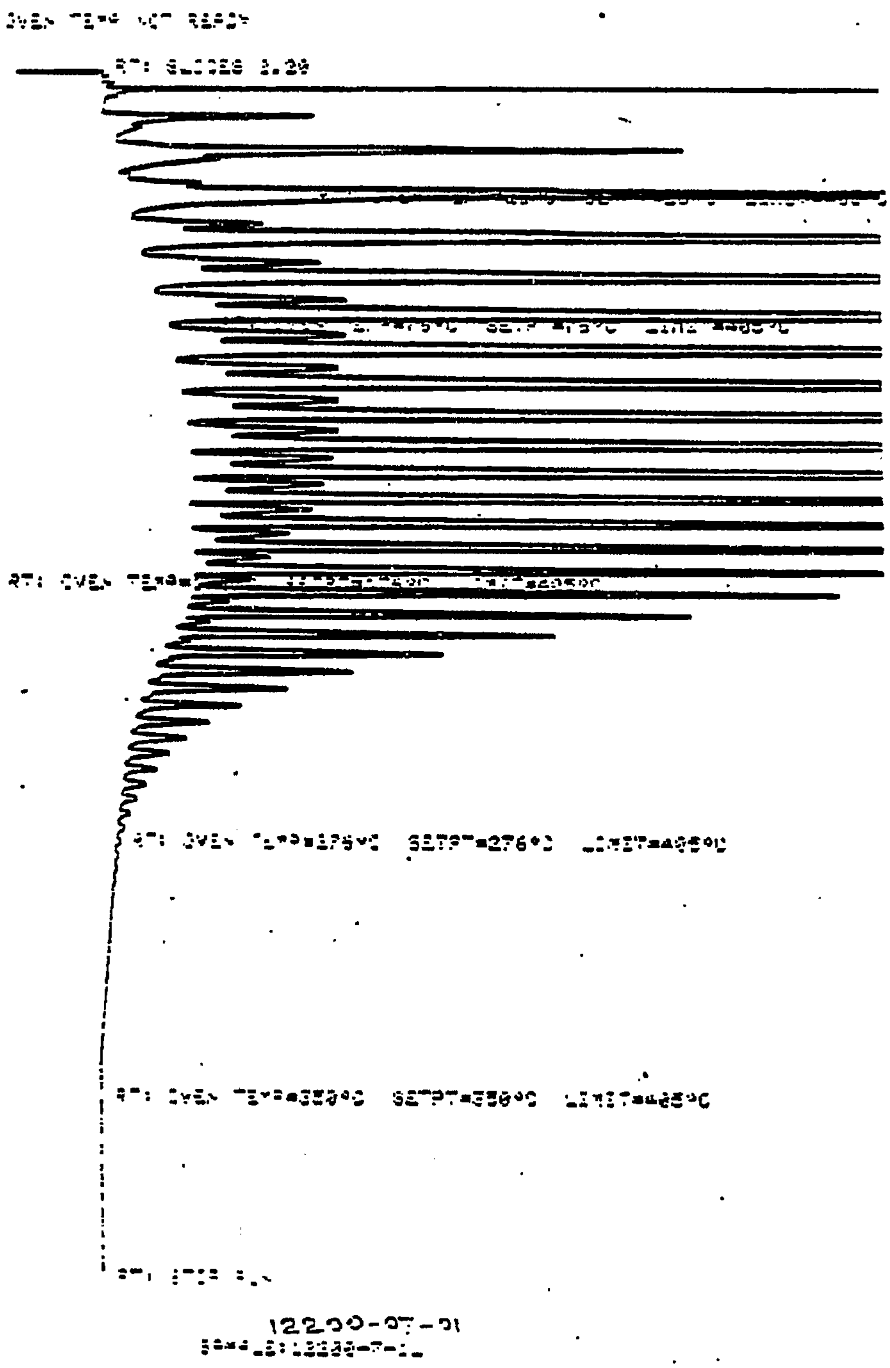


Fig. B121

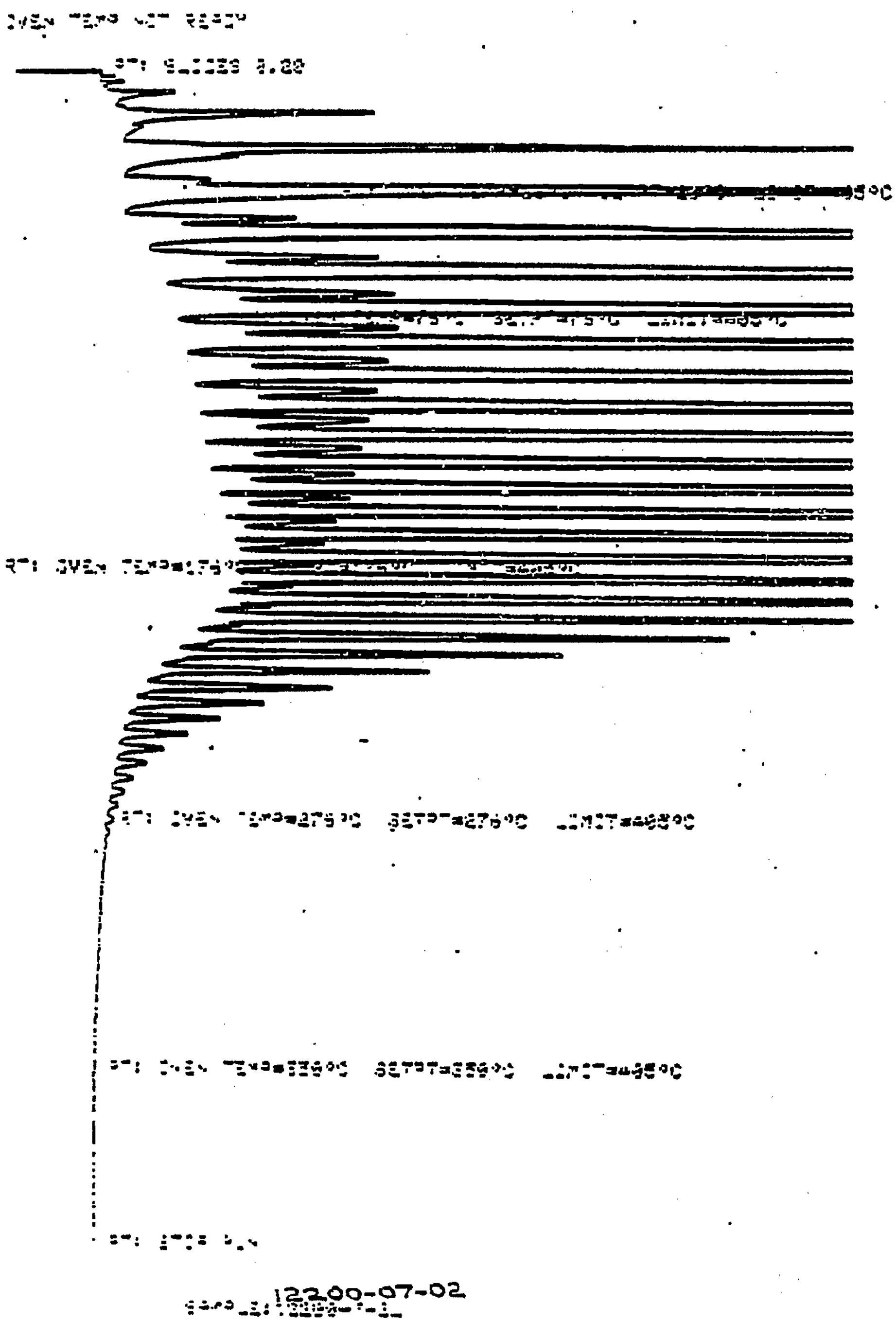
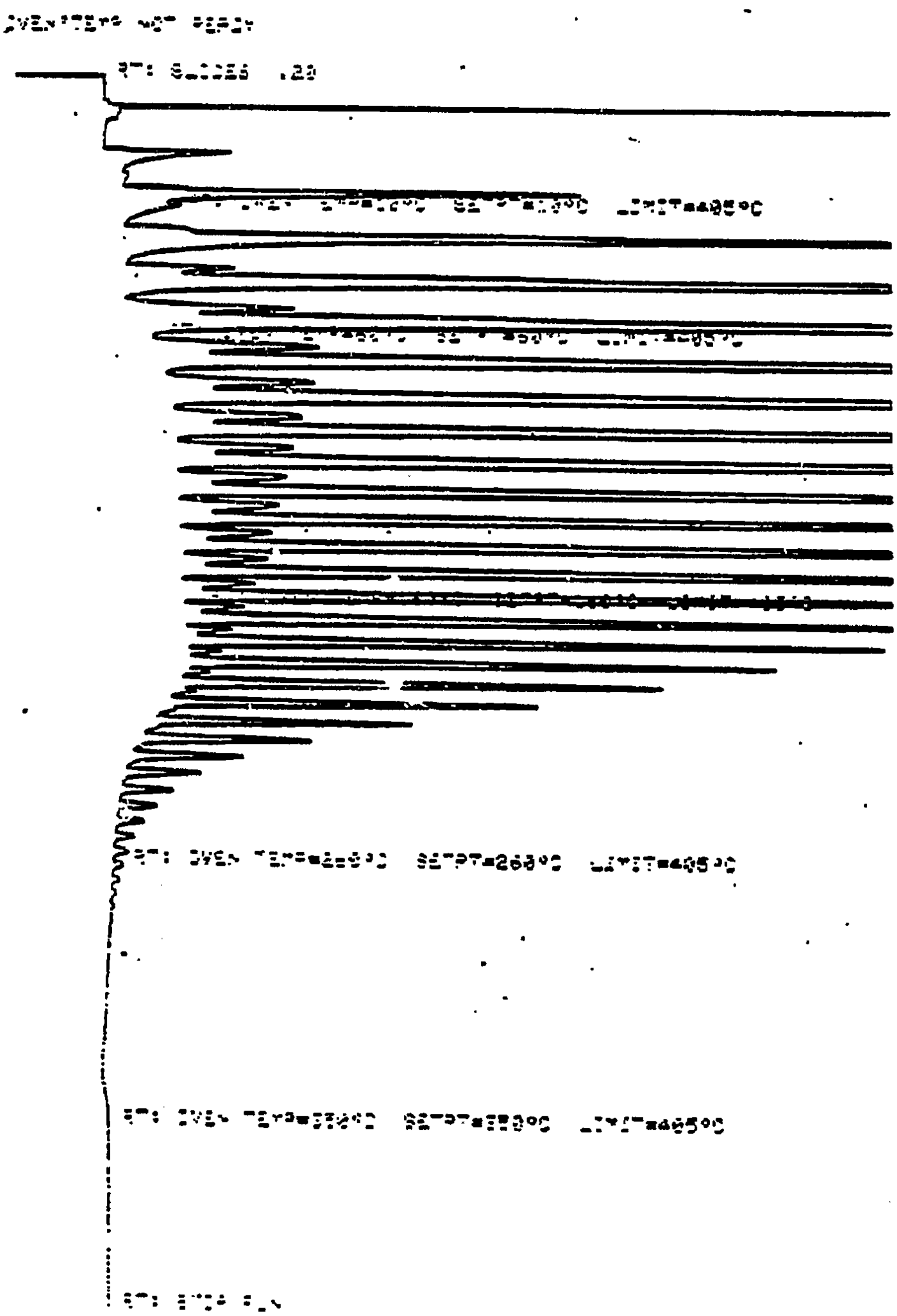
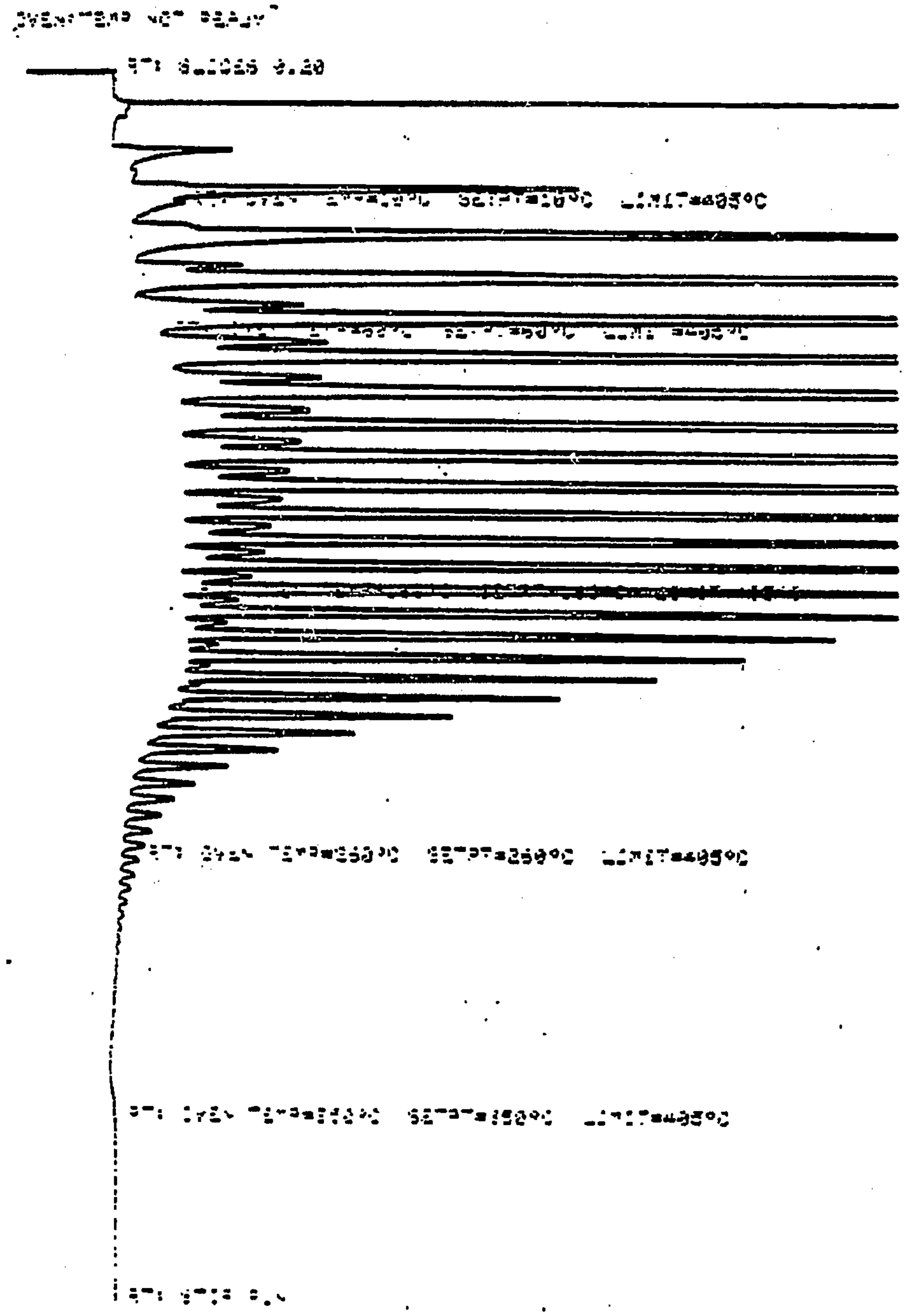


Fig. B122



12200-07-03

Fig. B123



12200-07-04

Fig. B124

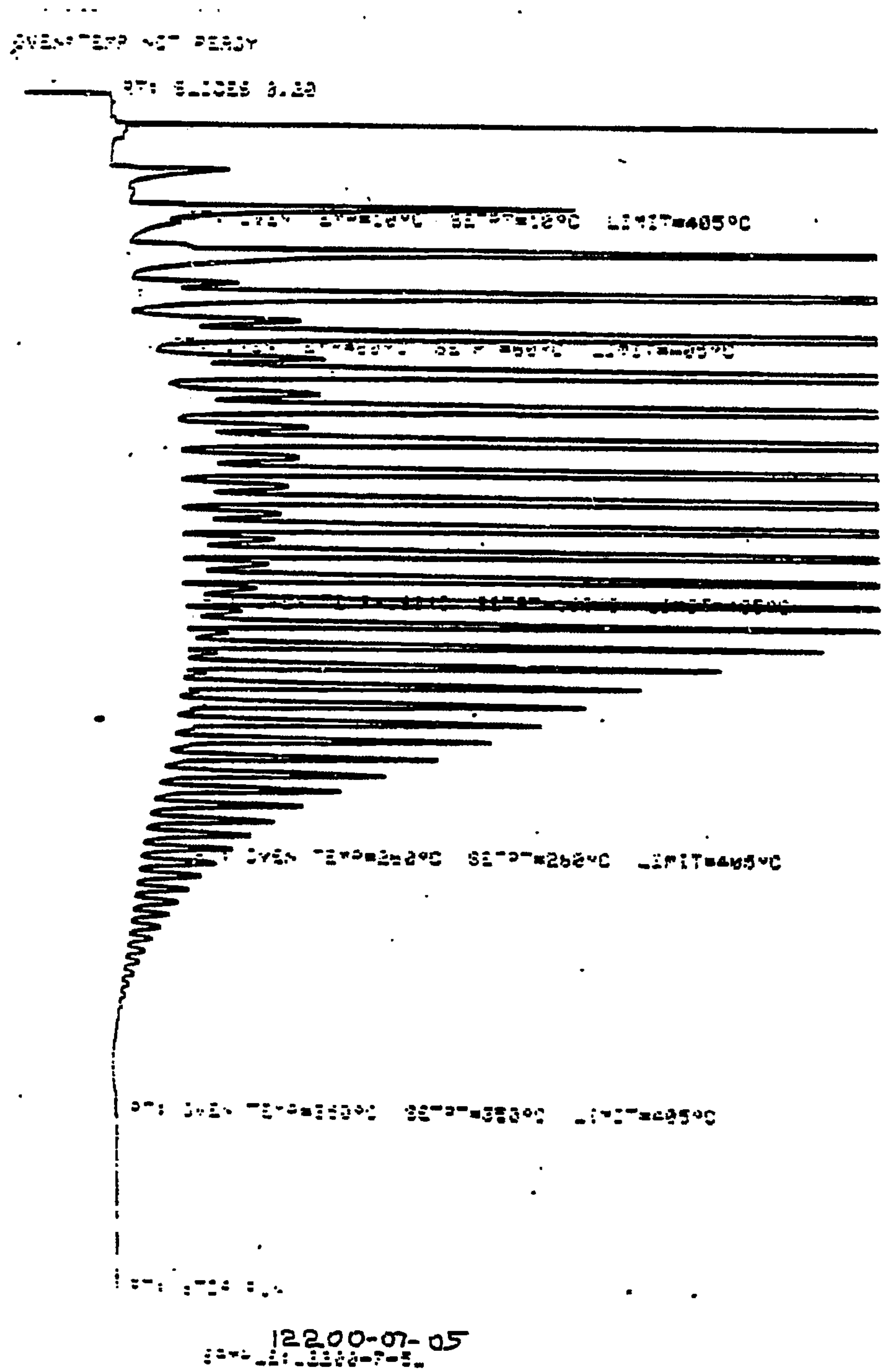


Fig. B125

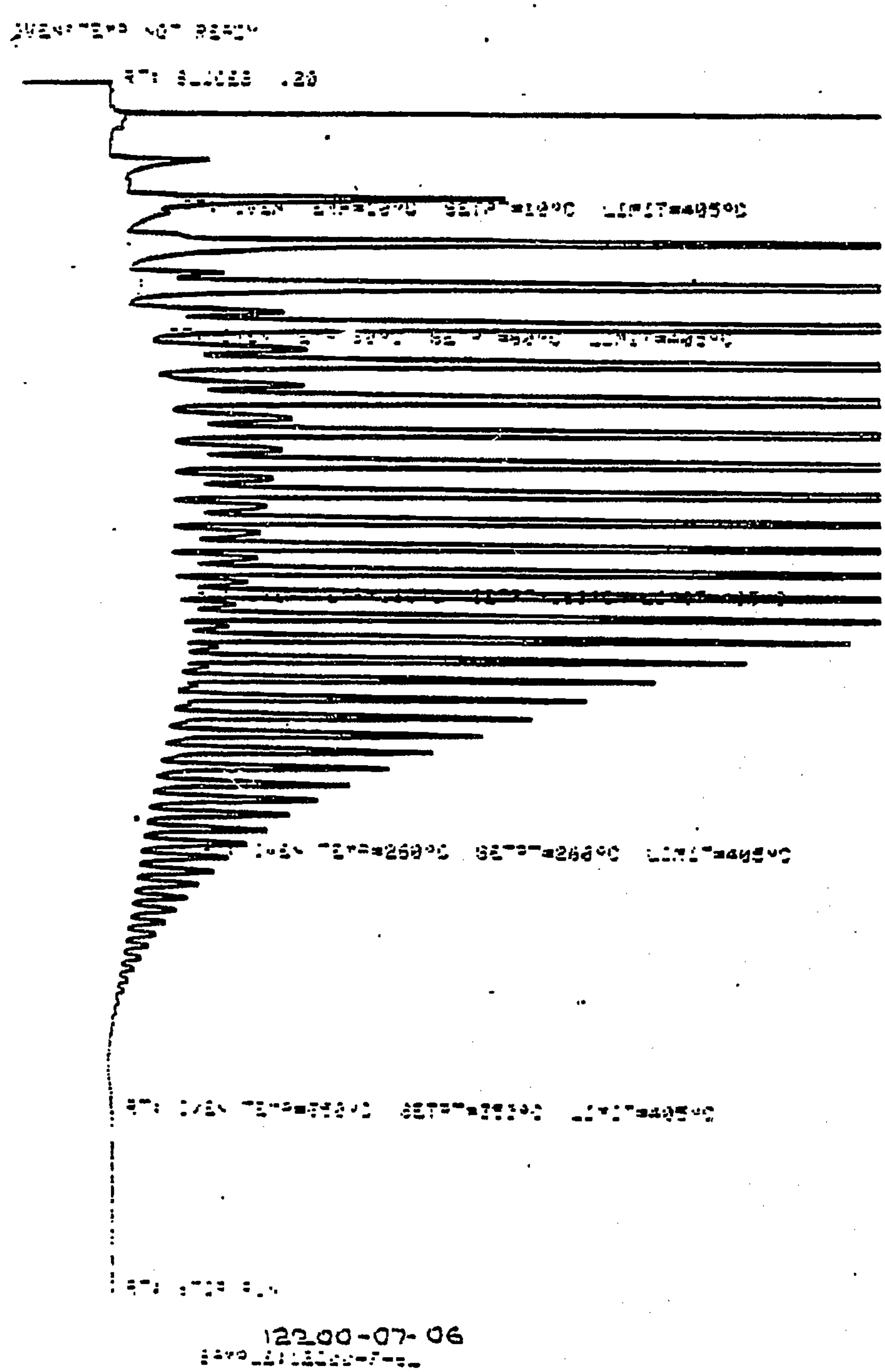


Fig. B126

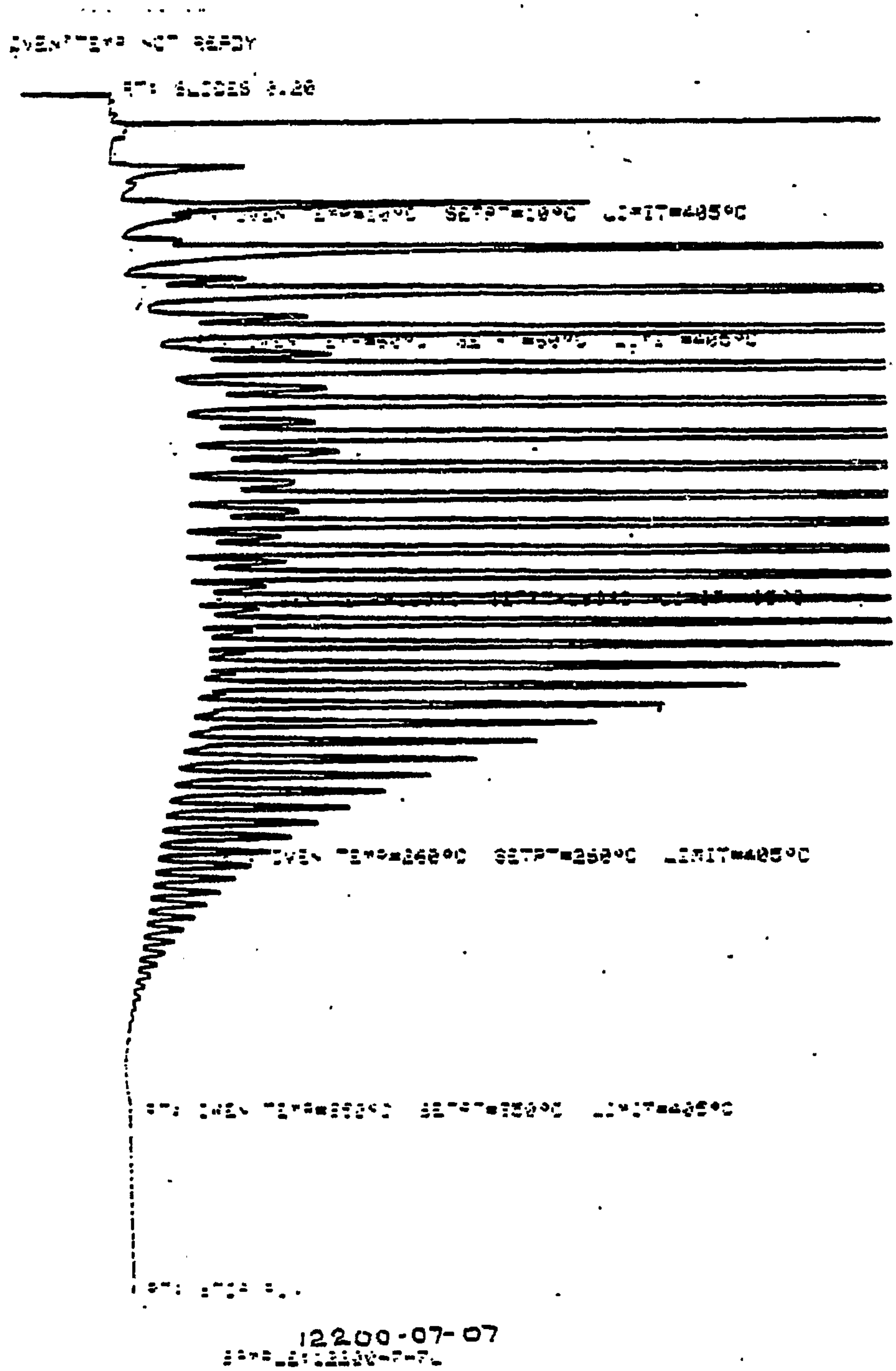
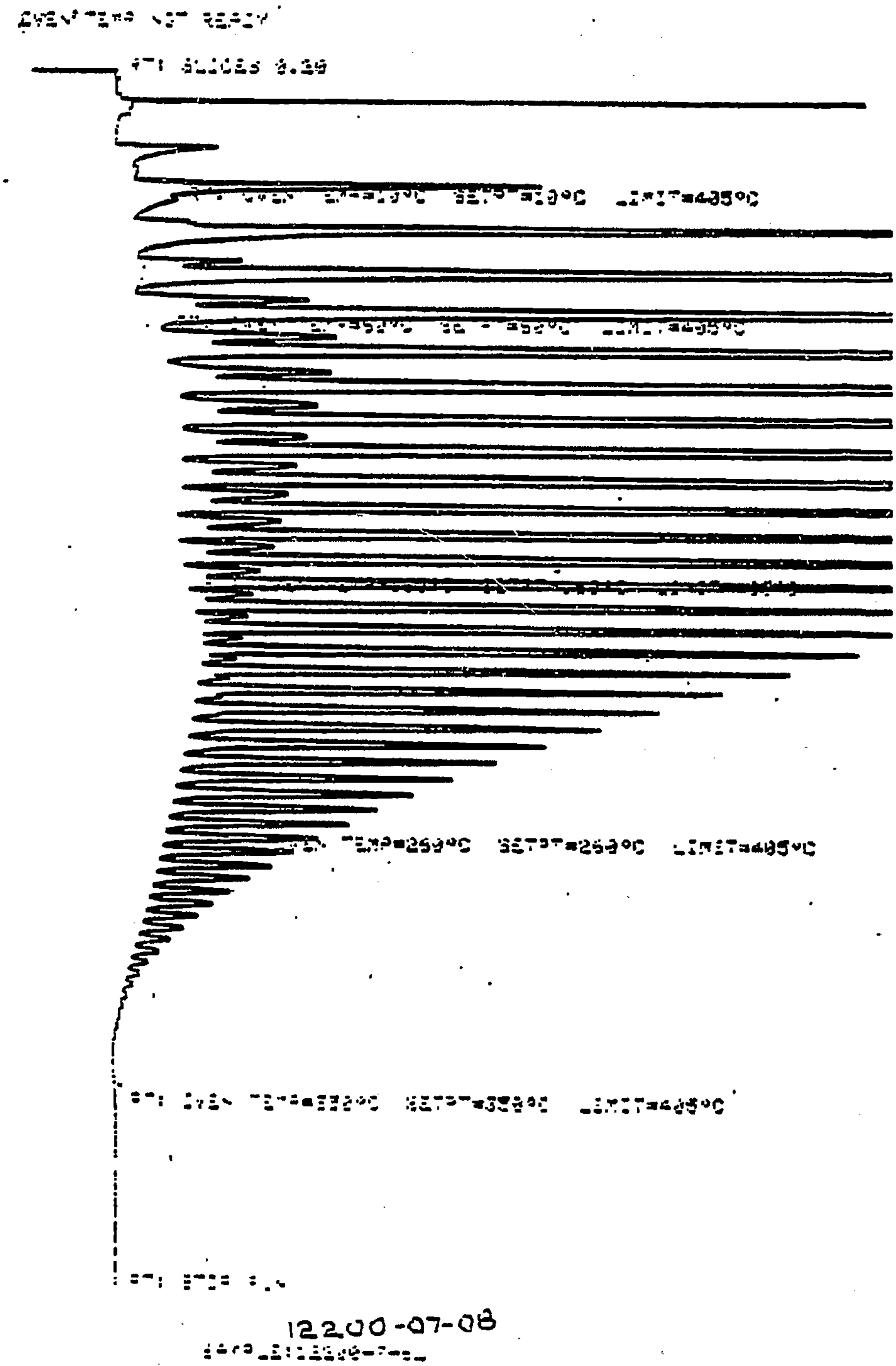


Fig. B127



12200-07-08

Fig. B128

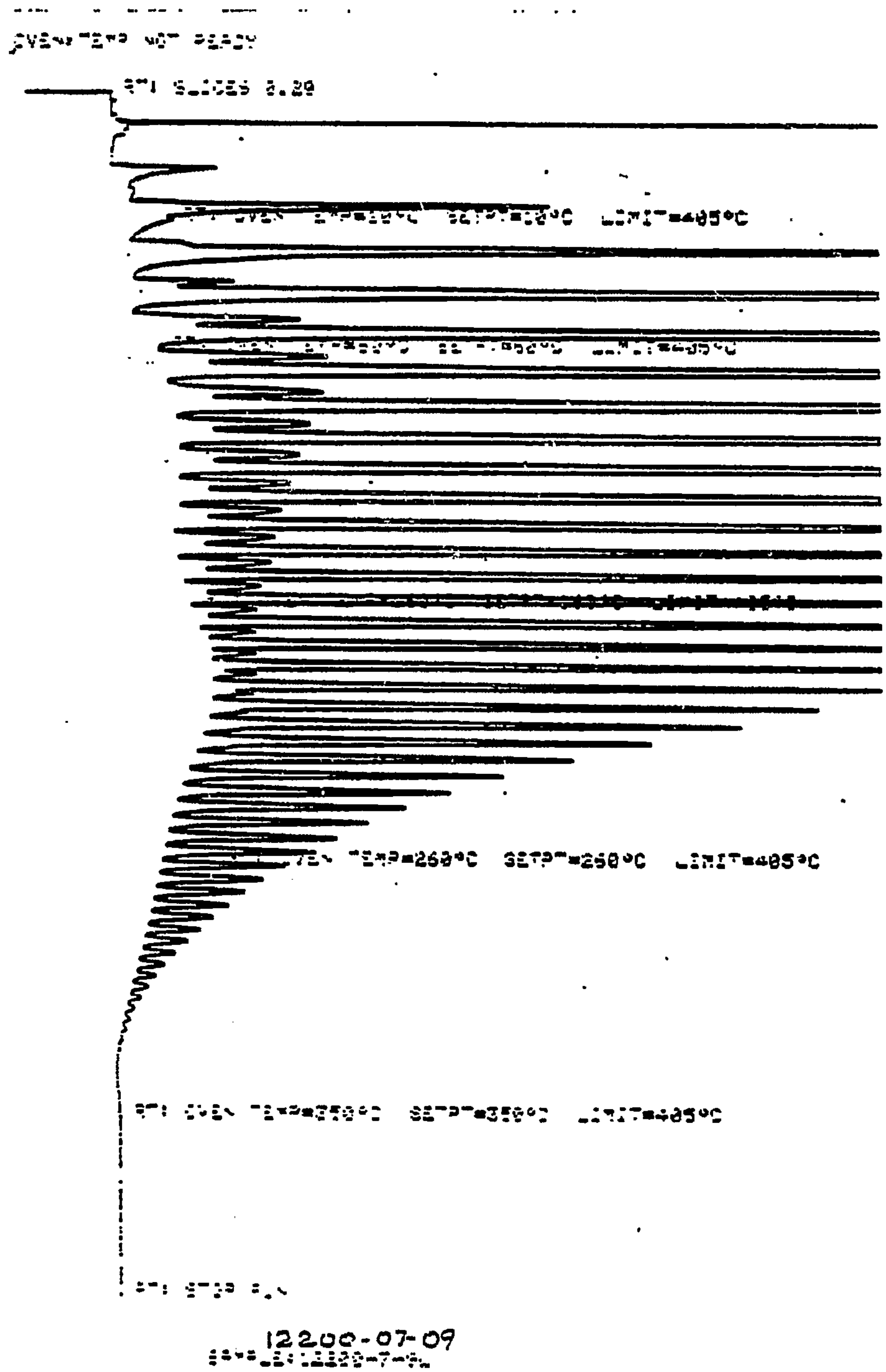
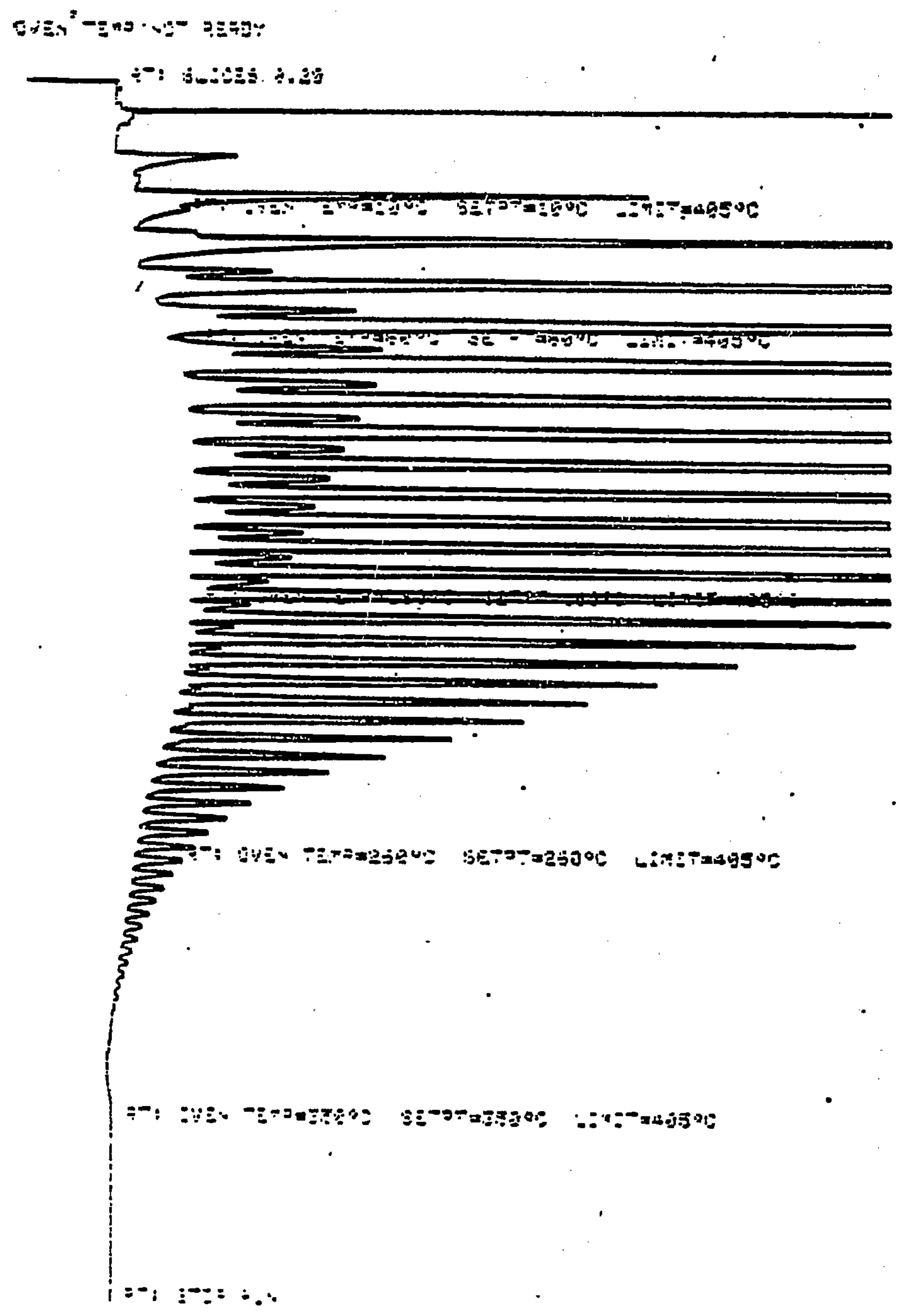


Fig. B129



12200-07-10

Fig. B130

RESULT OF SYNGAS OPERATION

RUN NO. 12200-07
CATALYST CO/TH/X4-U103 12006-62 80 CC 33.7 G (39.4 G AFTER RUN +5.7 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-07-01	200-07-02	200-07-03	200-07-04	200-07-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	20.0	43.5	67.5	91.5	116.5
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	260	259	258	259	258
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	20.00	23.50	24.00	24.00	25.00
EFFLNT GAS LITER	198.90	249.10	285.00	277.35	302.85
GM AQUEOUS LAYER	55.00	63.94	62.82	62.09	65.25
GM OIL	21.15	27.12	27.63	25.70	27.07
MATERIAL BALANCE					
GM ATOM CARBON %	83.15	86.67	95.27	90.68	92.24
GM ATOM HYDROGEN %	83.20	86.87	91.16	89.28	92.11
GM ATOM OXYGEN %	92.83	94.62	100.28	96.95	98.88
RATIO CHX/(H2O+CO2)	0.7329	0.7759	0.8542	0.8148	0.8041
RATIO X IN CHX	2.3024	2.3067	2.3108	2.3216	2.3199
USAGE H2/CO PRODT	2.0817	2.0863	2.0144	2.0644	2.1022
FEED H2/CO FRM EFFLNT	1.0006	1.0023	0.9569	0.9646	0.9986
RESIDUAL H2/CO RATIO	0.3811	0.4089	0.4128	0.4381	0.4689
RATIO CO2/(H2O+CO2)	0.1032	0.0895	0.0883	0.0861	0.0781
K SHIFT IN EFFLNT	0.0439	0.0402	0.0400	0.0413	0.0397
SPECIFIC ACTIVITY SA	2.4189	2.2093	2.2054	1.8771	1.7068
CONVERSION					
ON CO %	36.43	35.38	33.97	33.60	32.43
ON H2 %	75.79	73.64	71.52	70.45	68.27
ON CO+H2 %	56.11	54.53	52.33	51.88	50.34
PRDT SELECTIVITY,WT %					
CH4	9.20	9.22	9.54	9.81	9.59
C2 HC'S	1.99	2.14	2.13	2.25	2.15
C3H8	2.23	2.20	2.36	2.58	2.68
C3H6=	3.32	2.84	2.82	2.83	2.93
C4H10	2.27	2.30	2.43	2.65	2.82
C4H8=	3.65	3.37	3.35	3.34	3.32
C5H12	2.97	2.95	3.12	3.40	3.50
C5H10=	1.27	1.15	2.97	1.28	1.26
C6H14	3.34	3.28	3.59	3.86	3.81
C6H12= & CYCLO'S	2.40	1.97	1.95	2.04	1.52
C7+ IN GAS	11.10	9.28	10.30	11.13	10.37
LIQ HC'S	56.28	59.30	55.43	54.83	56.05
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B8

SUB-GROUPING					
C1 -C4	22.65	22.07	22.63	23.46	23.49
C5 -420 F	43.64	41.82	43.28	43.09	40.64
420-700 F	29.21	30.72	29.32	28.13	27.24
700-END PT	4.50	5.40	4.77	5.32	8.63
C5+-END PT	77.35	77.93	77.37	76.54	76.51
ISO/NORMAL MOLE RATIO					
C4	0.0291	0.0216	0.0205	0.0199	0.0256
C5	0.0609	0.0687	0.0659	0.0661	0.0666
C6	0.0883	0.0760	0.0792	0.0723	0.0717
C4=	0.0607	0.0642	0.0649	0.0685	0.0776
PARAFFIN/OLEFIN RATIO					
C3	0.6394	0.7378	0.7992	0.8698	0.8726
C4	0.5999	0.6603	0.7016	0.7672	0.8177
C5	2.2743	2.4993	1.0214	2.5807	2.7102
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8189	0.8326	0.8242	0.8282	0.8426
RATIO CH4/(1-A)**2	2.8063	3.2909	3.0864	3.3248	3.8713
ALPHA FRM CORRELATION	0.8578	0.8544	0.8540	0.8511	0.8478
ALPHA (EXPTL/CORR)	0.9547	0.9745	0.9651	0.9732	0.9939
W%CH4 FRM CORRELATION	11.9299	12.7643	12.6798	13.8095	14.6076
W%CH4 (EXPTL/CORR)	0.7711	0.7223	0.7522	0.7103	0.6566
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.748*	0.749*	0.7488*	0.7484*	0.7516*
N, REFRACTIVE INDEX	1.4198*	1.4205*	1.4207*	1.4207*	1.4222*
SIMULT'D DISTILATN					
10 WT % @ DEG F	294	294	297	297	298
16	327	331	330	330	338
50	473	479	478	476	485
84	637	648	646	647	694
90	681	688	688	697	759
RANGE(16-84 %)	310	317	316	317	356
WT % @ 420 F	40.10	39.10	38.50	39.00	36.00
WT % @ 700 F	92.00	90.90	91.40	90.30	84.60

Table B8, cont

RESULT OF SYNGAS OPERATION

RUN NO. 12200-07
CATALYST CO/TH/X4-U103 12006-62 80 CC 33.7 G (39.4 G AFTER RUN +5.7 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-07-06	200-07-07	200-07-08	200-07-09	200-07-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	139.5	164.5	188.5	212.5	236.5
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	258	258	258	258	258
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	23.00	25.00	24.00	24.00	24.00
EFFLNT GAS LITER	292.50	325.15	319.20	322.75	327.30
GM AQUEOUS LAYER	57.88	60.63	56.46	55.21	55.34
GM OIL	21.45	22.66	26.46	24.57	20.80
MATERIAL BALANCE					
GM ATOM CARBON %	92.76	94.02	98.13	97.20	95.86
GM ATOM HYDROGEN %	91.35	91.83	94.56	92.84	92.01
GM ATOM OXYGEN %	100.58	100.59	101.36	101.23	101.88
RATIO CHX/(H2O+CO2)	0.7633	0.7949	0.8964	0.8671	0.8025
RATIO X IN CHX	2.3428	2.3465	2.3304	2.3284	2.3594
USAGE H2/CO PRODT	2.1411	2.1042	2.0014	2.0470	2.1190
FEED H2/CO FRM EFFLNT	0.9848	0.9767	0.9636	0.9551	0.9598
RESIDUAL H2/CO RATIO	0.4862	0.4957	0.4951	0.4993	0.5082
RATIO CO2/(H2O+CO2)	0.0827	0.0838	0.0834	0.0770	0.0789
K SHIFT IN EFFLNT	0.0438	0.0453	0.0451	0.0416	0.0436
SPECIFIC ACTIVITY SA	1.4808	1.4304	1.5082	1.3946	1.2824
CONVERSION					
ON CO %	30.13	29.91	31.10	29.45	28.03
ON H2 %	65.51	64.43	64.60	63.12	61.89
ON CO+H2 %	47.68	46.96	47.54	45.90	44.61
PRDT SELECTIVITY,WT %					
CH4	10.58	10.76	9.93	9.83	11.20
C2 HC'S	2.53	2.31	2.11	2.16	2.59
C3H8	3.06	3.22	2.96	2.94	3.41
C3H6=	2.82	2.90	2.56	2.53	2.72
C4H10	3.09	3.26	3.02	2.96	3.44
C4H8=	3.47	3.55	3.18	3.21	3.43
C5H12	3.91	4.05	3.71	3.76	4.25
C5H10=	1.40	1.43	1.31	1.34	1.49
C6H14	4.18	4.50	4.06	4.24	4.55
C6H12= & CYCLO'S	1.98	1.91	1.76	1.82	1.91
C7+ IN GAS	10.85	11.90	9.73	10.29	11.14
LIQ HC'S	52.11	50.19	55.68	54.92	49.86
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B9

SUB-GROUPING					
C1 -C4	25.56	26.01	23.75	23.63	26.80
C5 -420 F	40.57	41.36	38.94	39.31	42.79
420-700 F	24.86	23.89	25.50	25.10	24.38
700-END PT	9.02	8.73	11.80	11.97	6.03
C5+-END PT	74.44	73.99	76.25	76.37	73.20
ISO/NORMAL MOLE RATIO					
C4	0.0189	0.0183	0.0229	0.0193	0.0210
C5	0.0718	0.0619	0.0636	0.0600	0.0654
C6	0.0823	0.0735	0.0793	0.0754	0.0784
C4=	0.0725	0.0786	0.0751	0.0776	0.0790
PARAFFIN/OLEFIN RATIO					
C3	1.0364	1.0614	1.1062	1.1084	1.1969
C4	0.8583	0.8867	0.9164	0.8902	0.9676
C5	2.7097	2.7453	2.7430	2.7180	2.7658
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8399	0.8383	0.8508	0.8528	0.8249
RATIO CH4/(1-A)**2	4.1286	4.1182	4.4606	4.5335	3.6506
ALPHA FRM CORRELATION	0.8460	0.8451	0.8452	0.8447	0.8439
ALPHA (EXPTL/CORR)	0.9928	0.9920	1.0067	1.0095	0.9775
WT%CH4 FRM CORRELATION	15.1540	15.4470	15.4278	15.5555	15.8247
WT%CH4 (EXPTL/CORR)	0.6983	0.6967	0.6435	0.6317	0.7074
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY (*40 C)	0.7521*	0.7524*	0.7832*	0.7791*	0.7484*
N, REFRACTIVE INDEX	1.4231*	1.4231*	1.4241*	1.4246*	1.4206*
SIMULT'D DISTILATN					
10 WT %.@ DEG F	300	299	301	301	298
16	340	339	341	341	337
50	496	493	513	515	477
84	708	709	743	744	664
90	771	769	802	798	722
RANGE(16-84 %)	368	370	402	403	327
WT % @ 420 F	35.00	35.00	33.00	32.50	39.00
WT % @ 700 F	82.70	82.60	78.80	78.20	87.90

Table B9, cont

VI. Run 14 (12200-08) with Catalyst 14 ($Co/Th/X_4/UCC-103$)

The purpose of this run was to test the feasibility of regenerating an intimately contacted UCC-103 catalyst with hydrogen.

The spent catalyst of Run 13 (12200-07), which had been exposed to syngas for 236.5 hours, was regenerated by exposure to hydrogen at 350C and 300 psig, similar to the initial activation process.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B131-134. Simulated distillations of the C_5^+ product are plotted in Figs. B135-137. Carbon number product distributions are plotted in Figs. B138-40. Chromatograms from simulated distillations are reproduced in Figs. B141-143. Detailed material balances appear in Table B10.

Before regeneration the catalyst's syngas conversion was 44.6 percent, for a calculated specific activity of 1.3. After regeneration the conversion was initially 48.6 percent (specific activity 1.7), then fell quickly to 45.6 percent (specific activity 1.3). The product selectivity was similar to that obtained at a comparable conversion rate before regeneration.

The attempt at regeneration with hydrogen was unsuccessful, resulting in only partial recovery of the catalyst's activity.

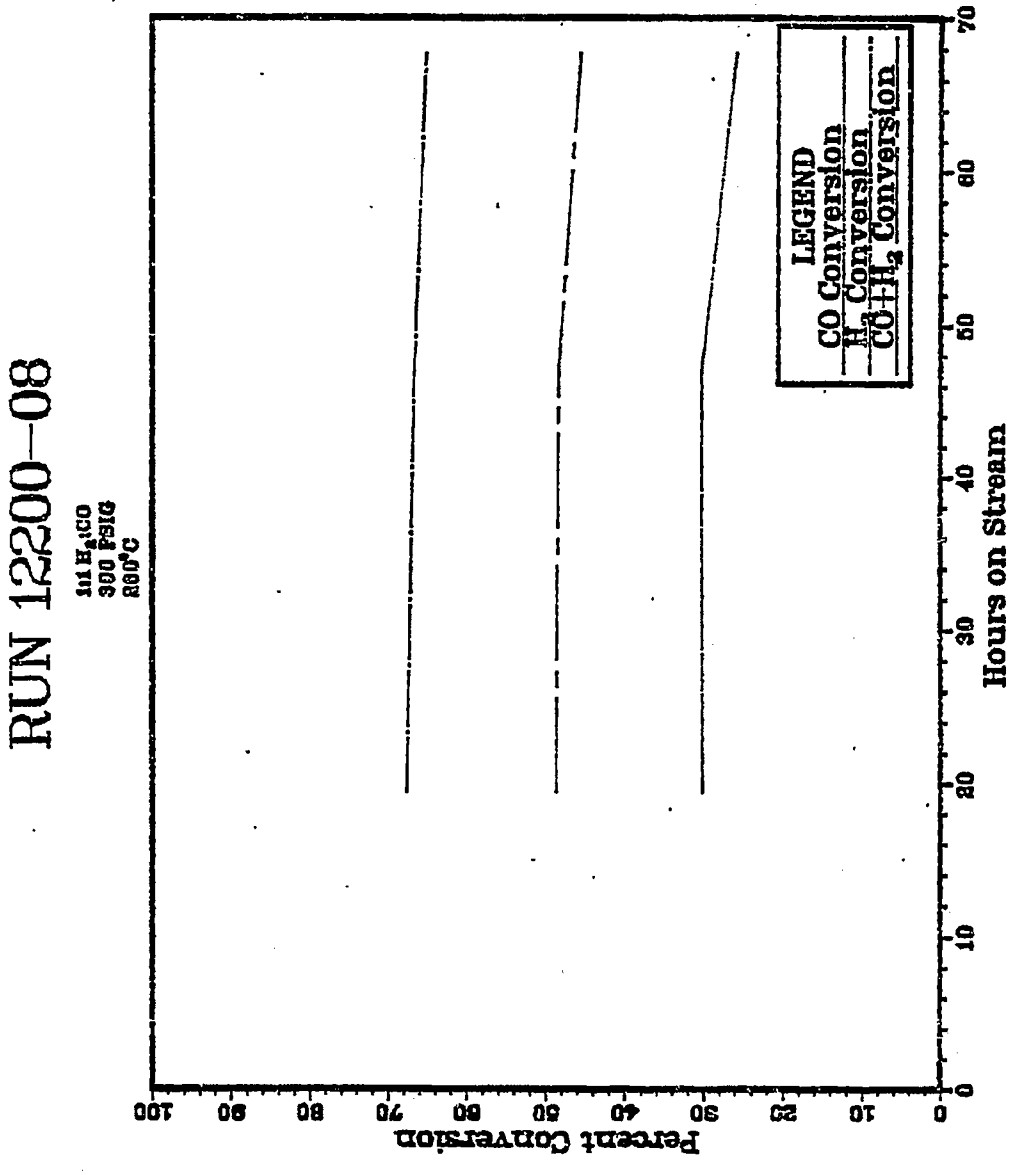

RUN 12200-08
1:1 H_2:CO
300 PSIG
280°C
LEGEND
CO Conversion
H_2 Conversion
CO+H_2 Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. B131

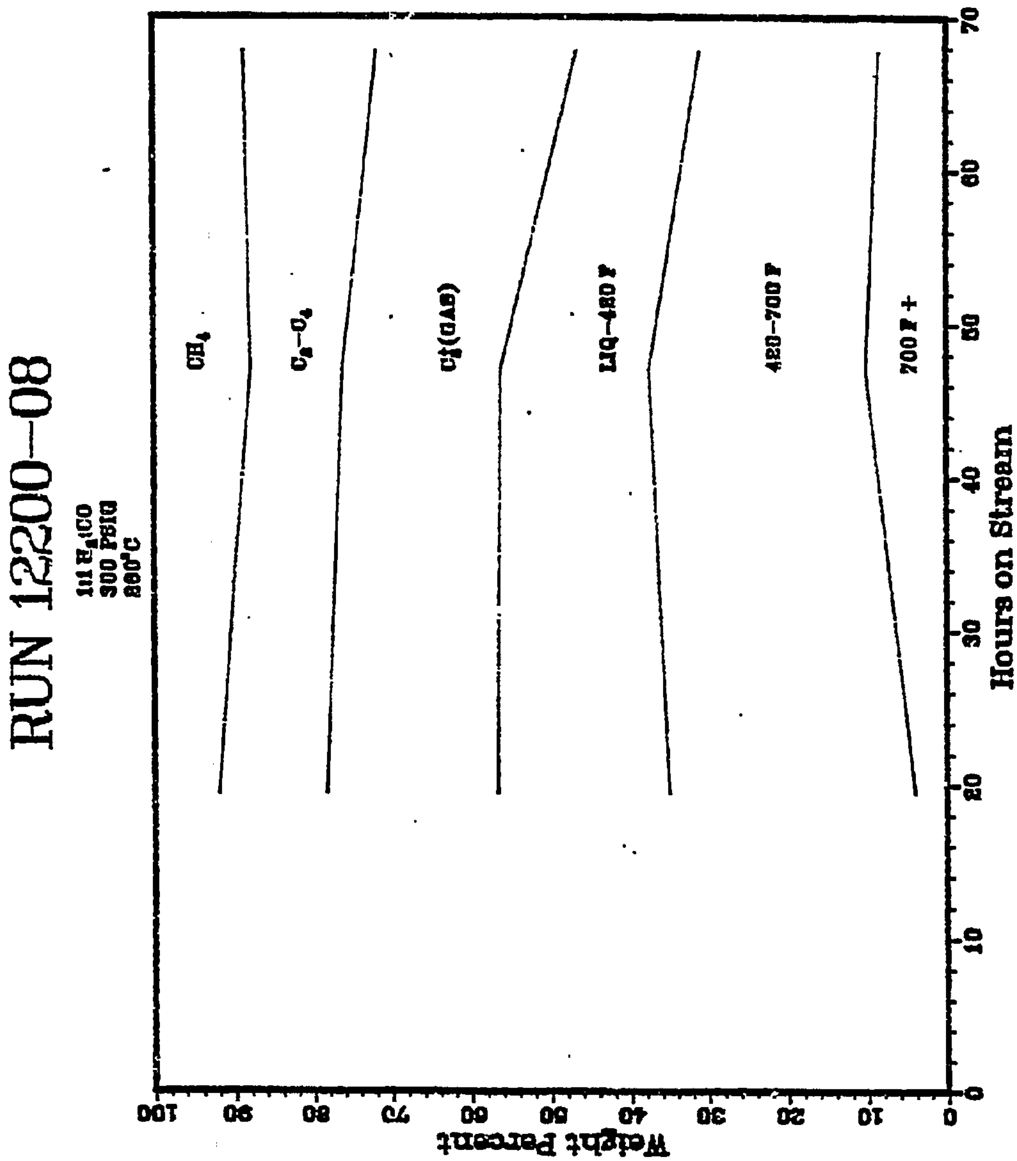

RUN 12200-08
300 PSIG
CH4
C2-C4
LIQ-480 F
480-700 F
700 F +
Hours on Stream
Weight Percent

Fig. B132

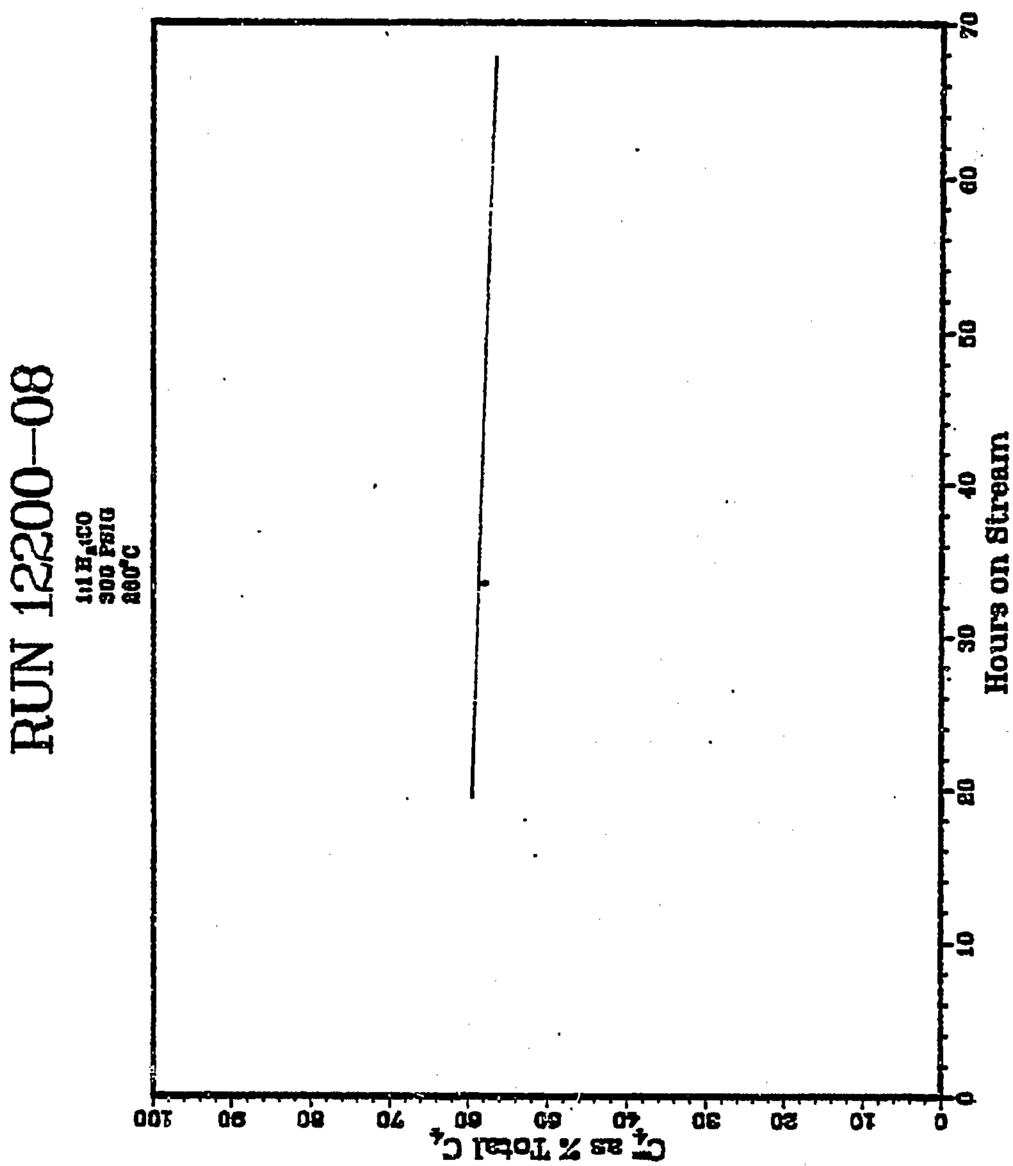

RUN 12200—08
1:1 H2:CO
300 PSIG
260°C
Hours on Stream
0
10
20
30
40
50
60
70
C4= as % Total C4
0
10
20
30
40
50
60
70
80
90
100

Fig. B133

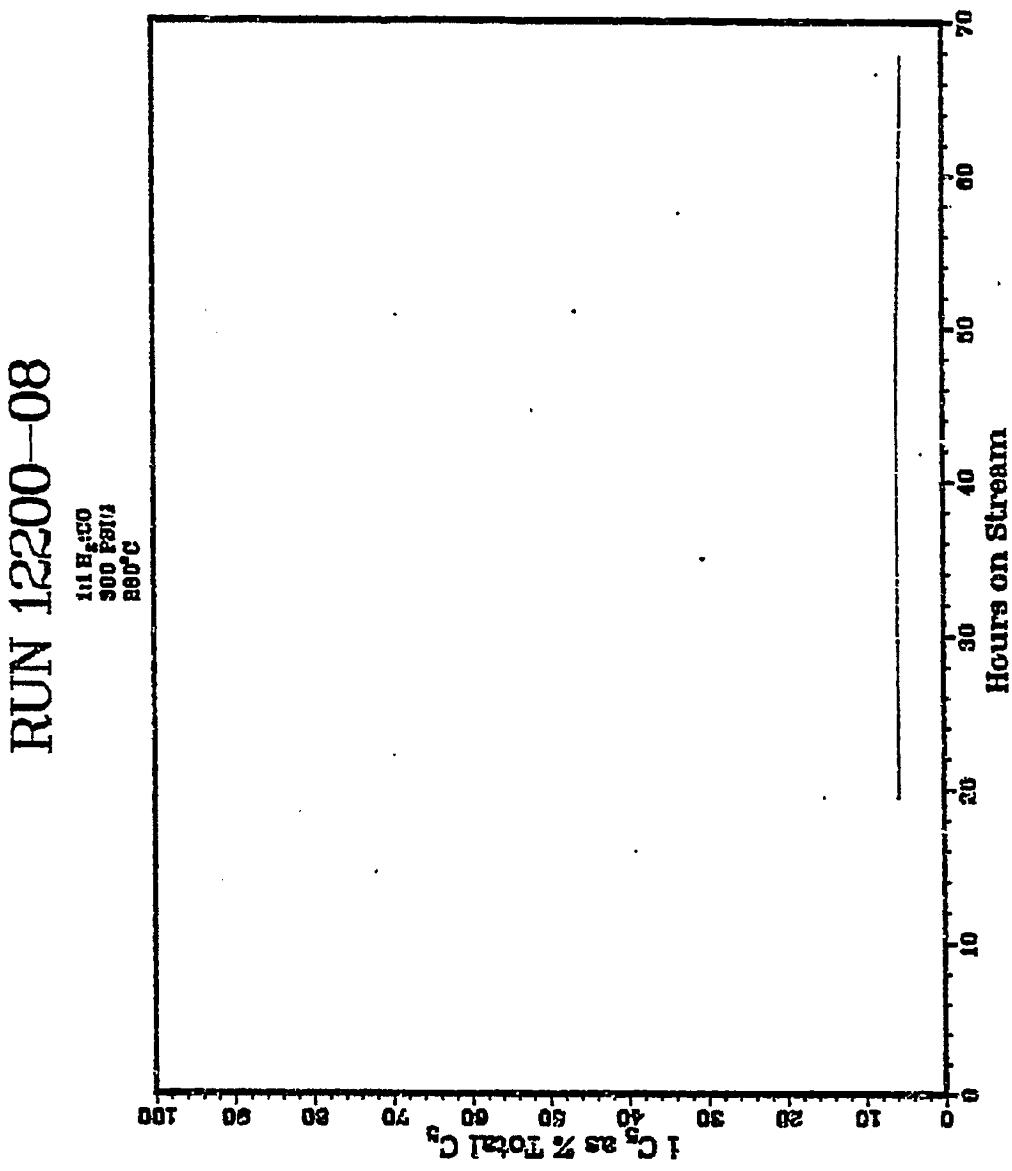


Fig. B134

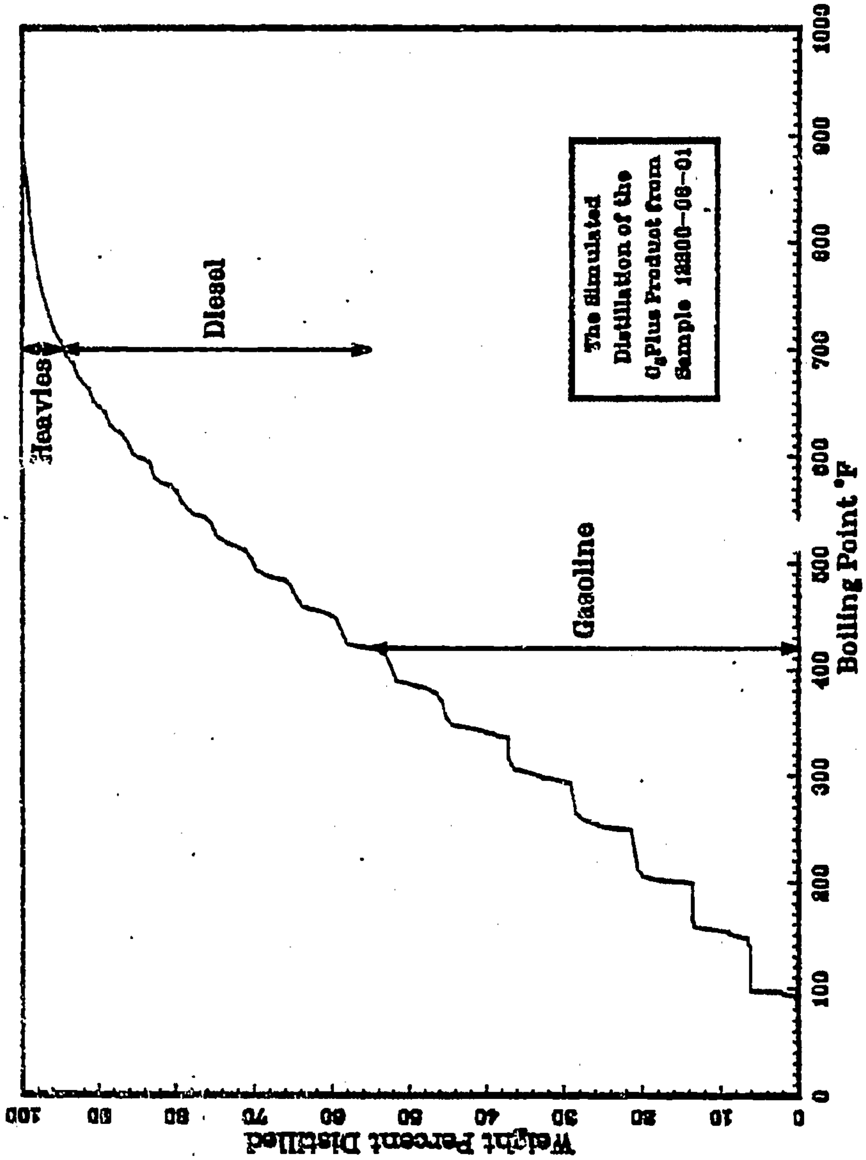
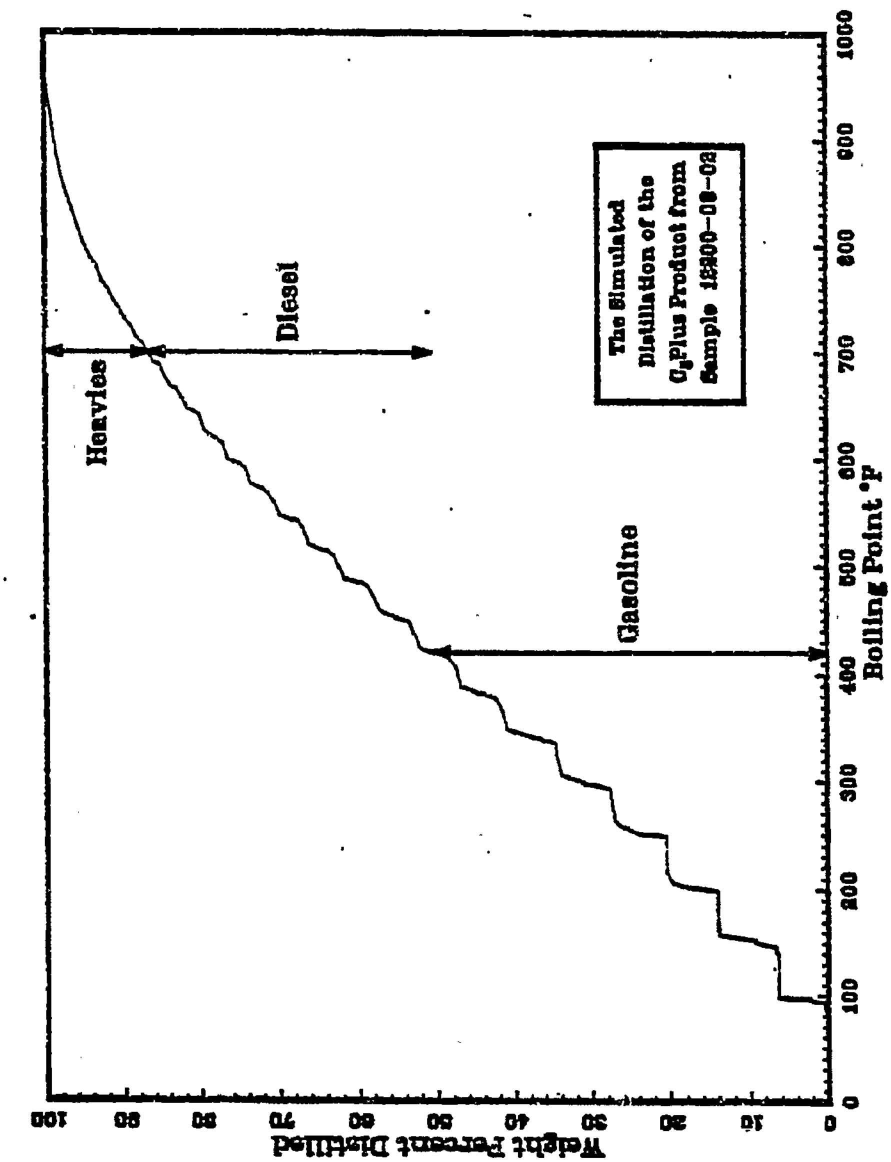
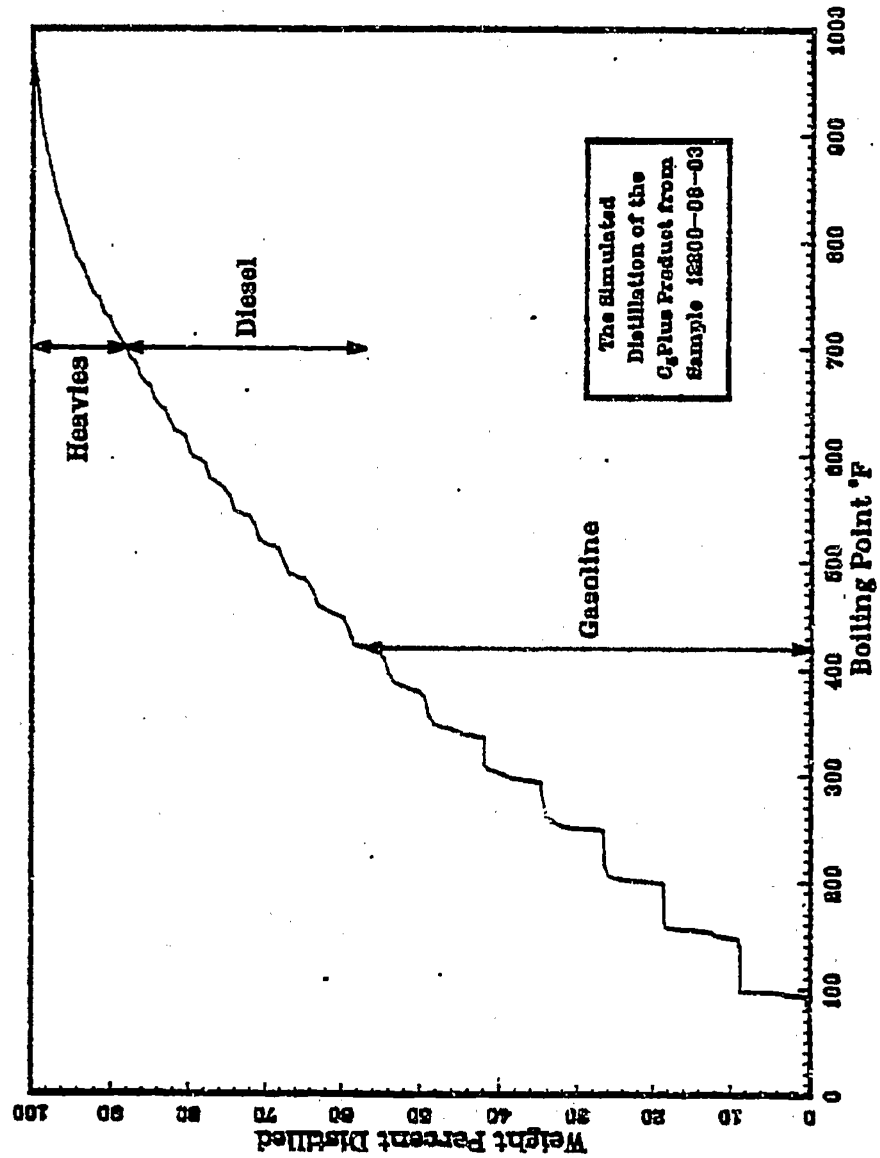

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Boiling Point °F
Weight Percent Distilled

Fig. B135



Heavies
Diesel
Gasoline
The Simulated
Distillation of the
C5Plus Product from
Boiling Point °F
Weight Percent Distilled

Fig. B136



Heavies
Diesel
Gasoline
The Simulated Distillation of the C_5Plus Product from Sample 12800-08-03
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B137

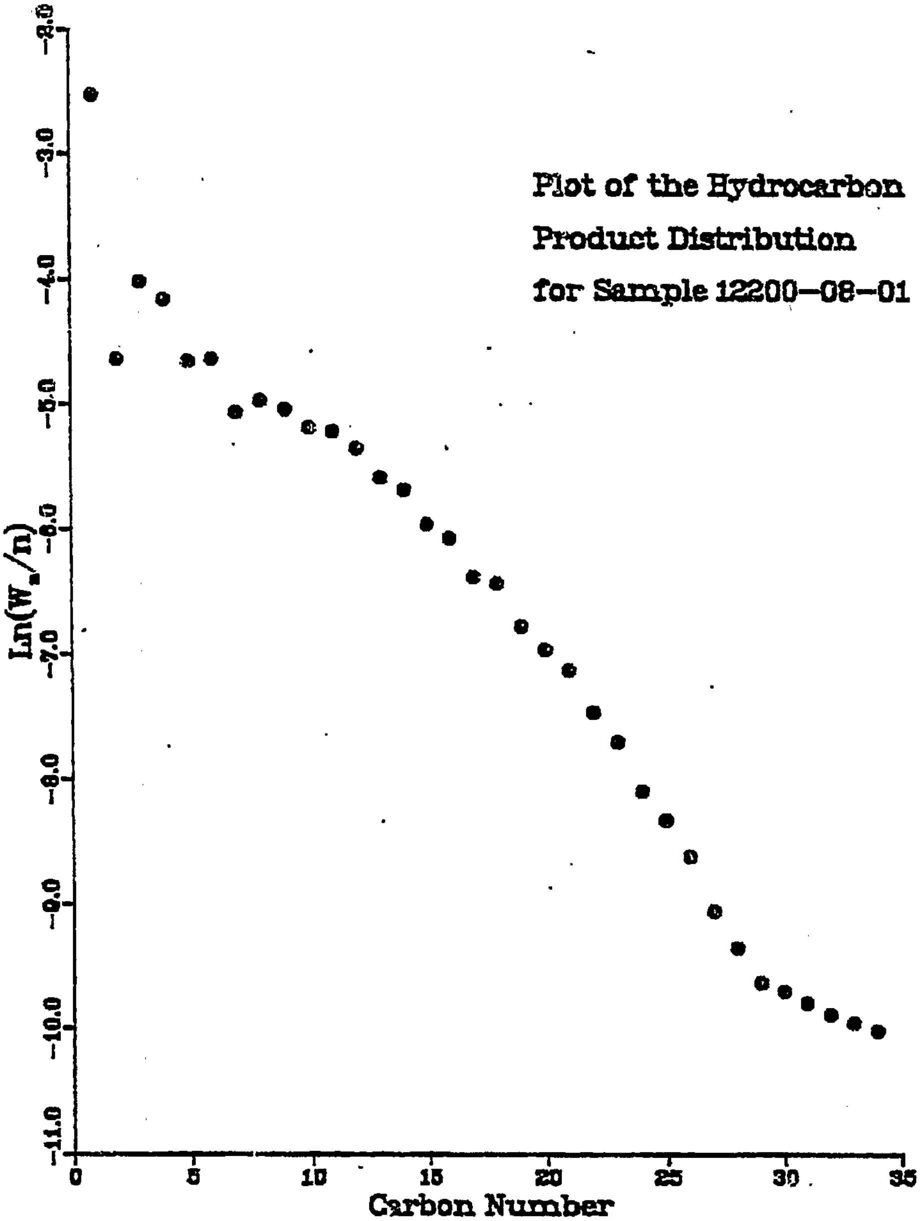

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-08-01
Ln(W_n/n)
Carbon Number
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35

Fig. B138

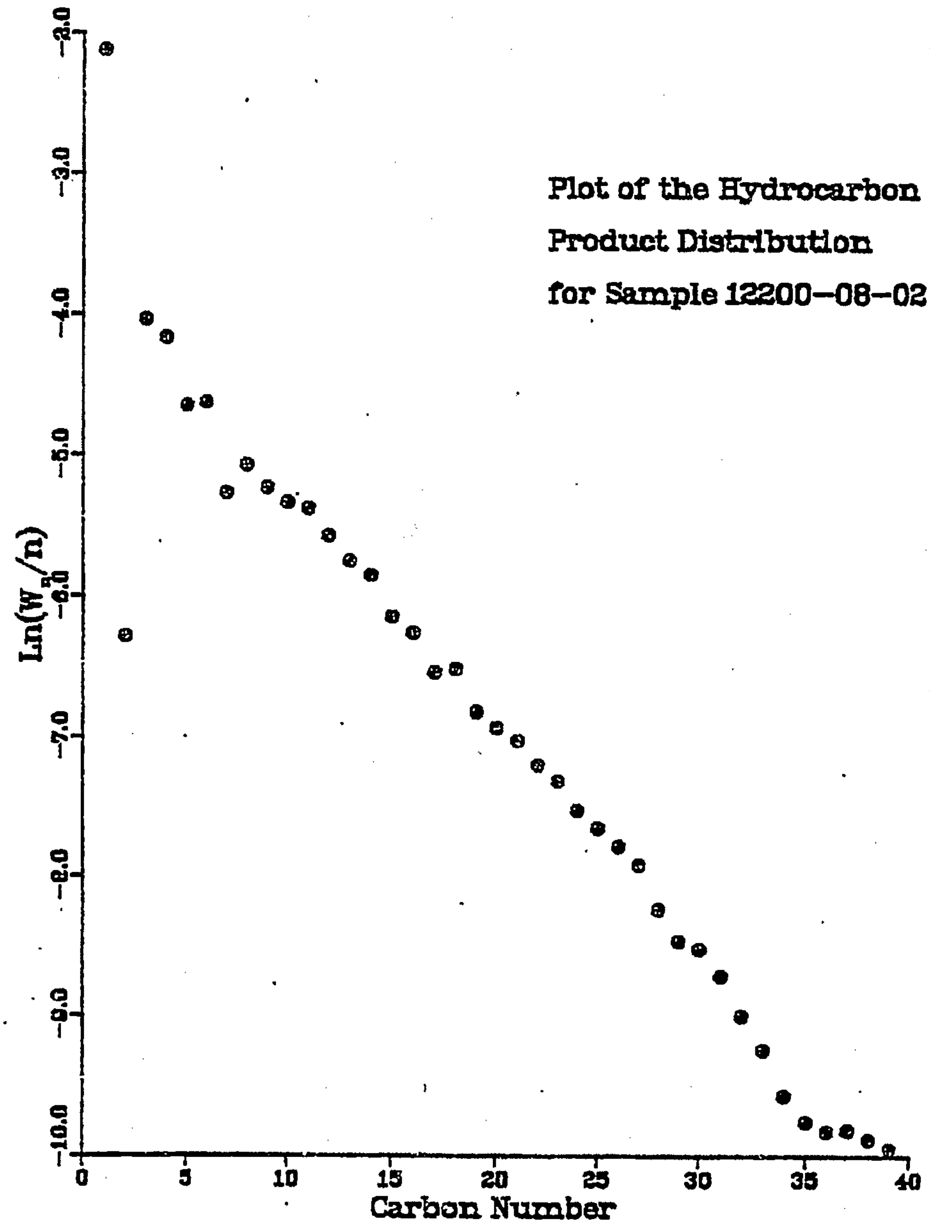
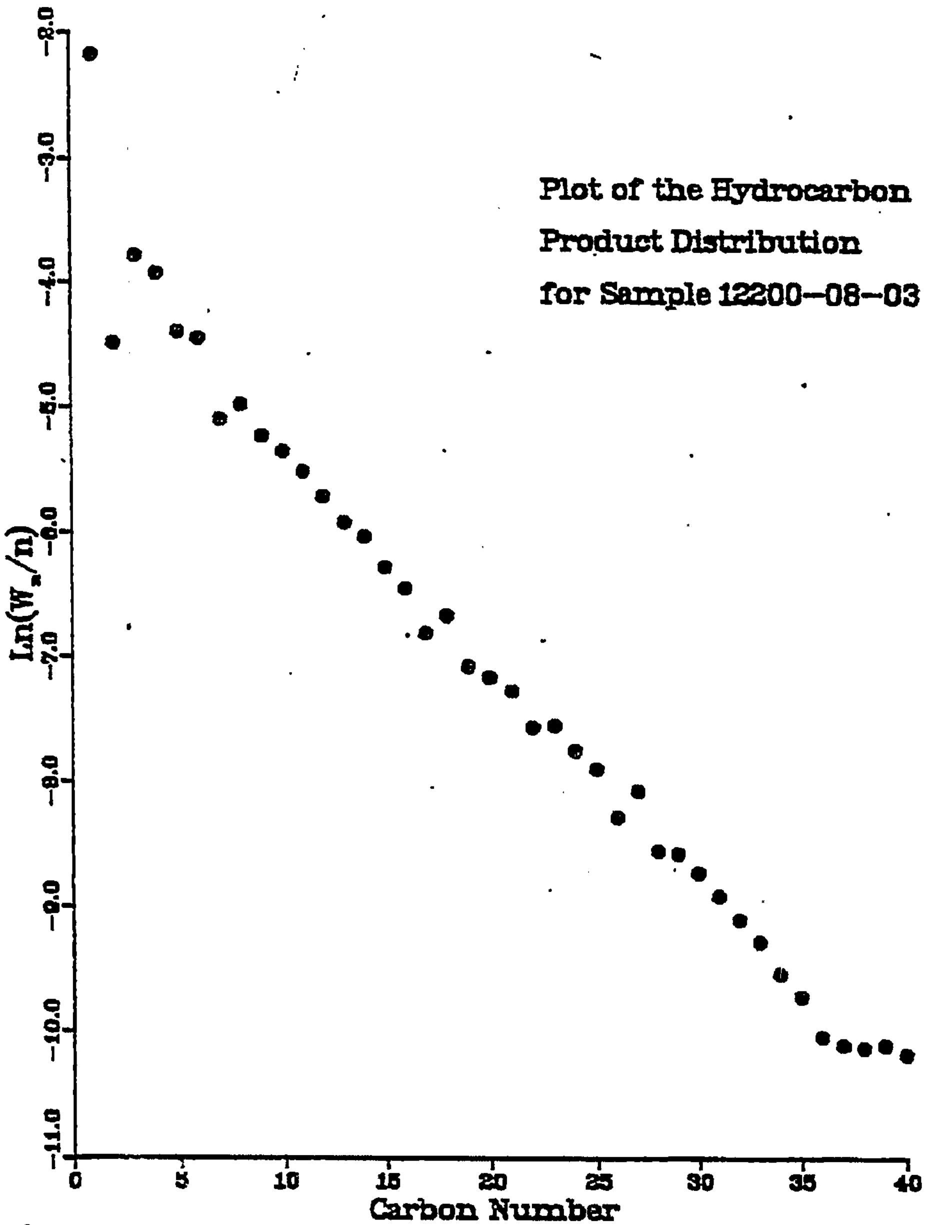

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-08-02
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B139



Plot of the Hydrocarbon
Product Distribution
for Sample 12200--08--03
Ln(W$_n$/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B140

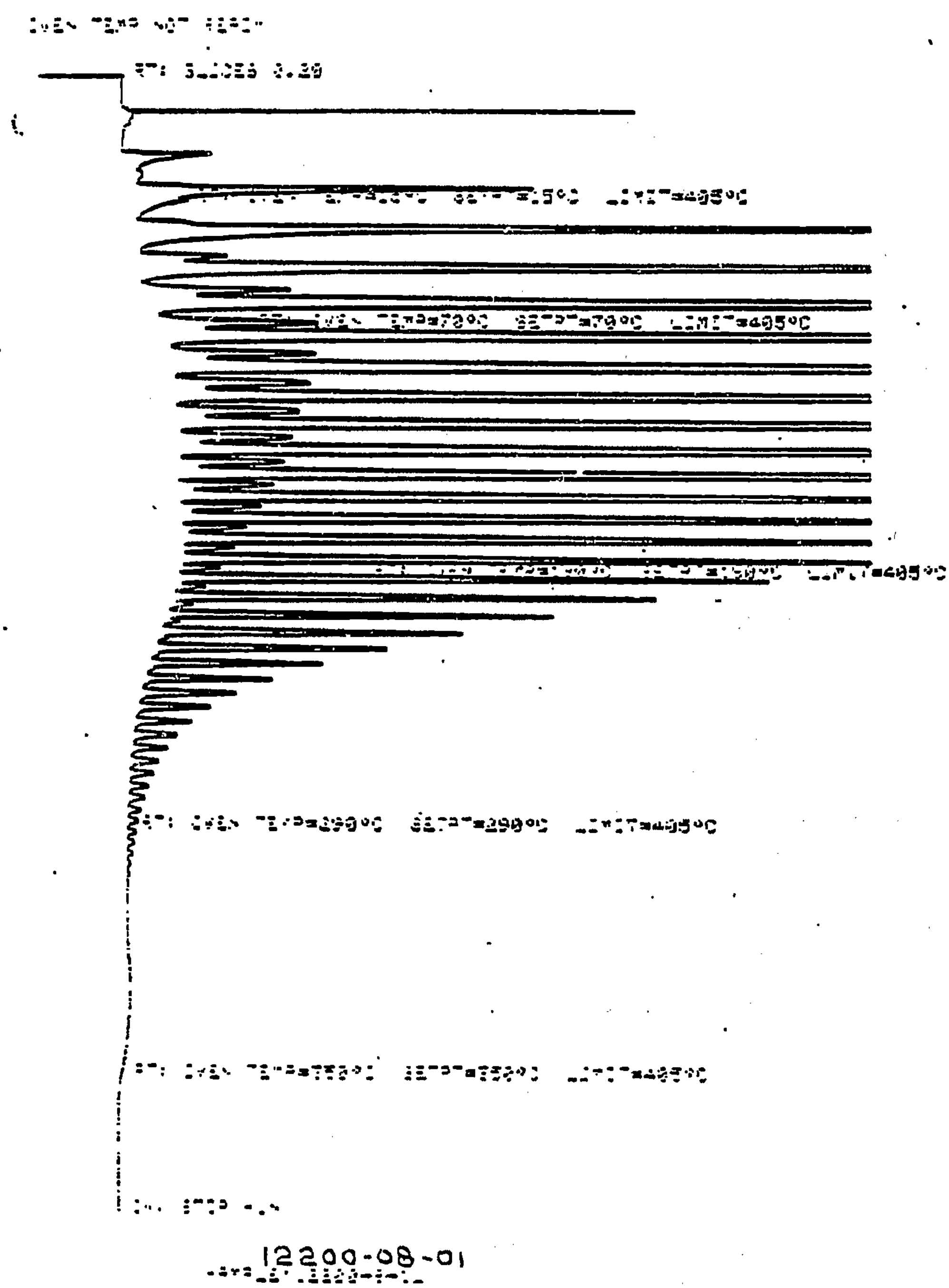


Fig. B141

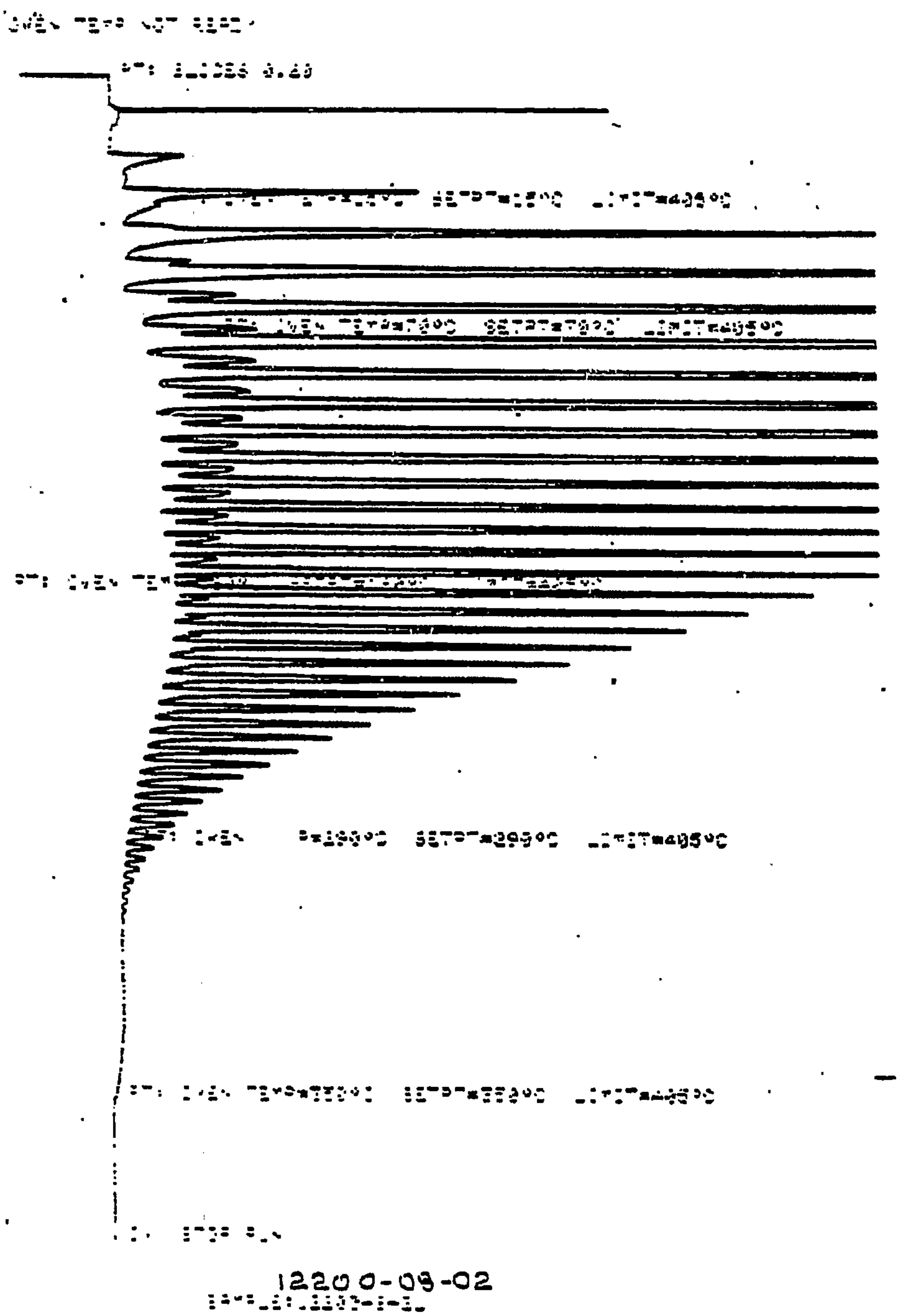
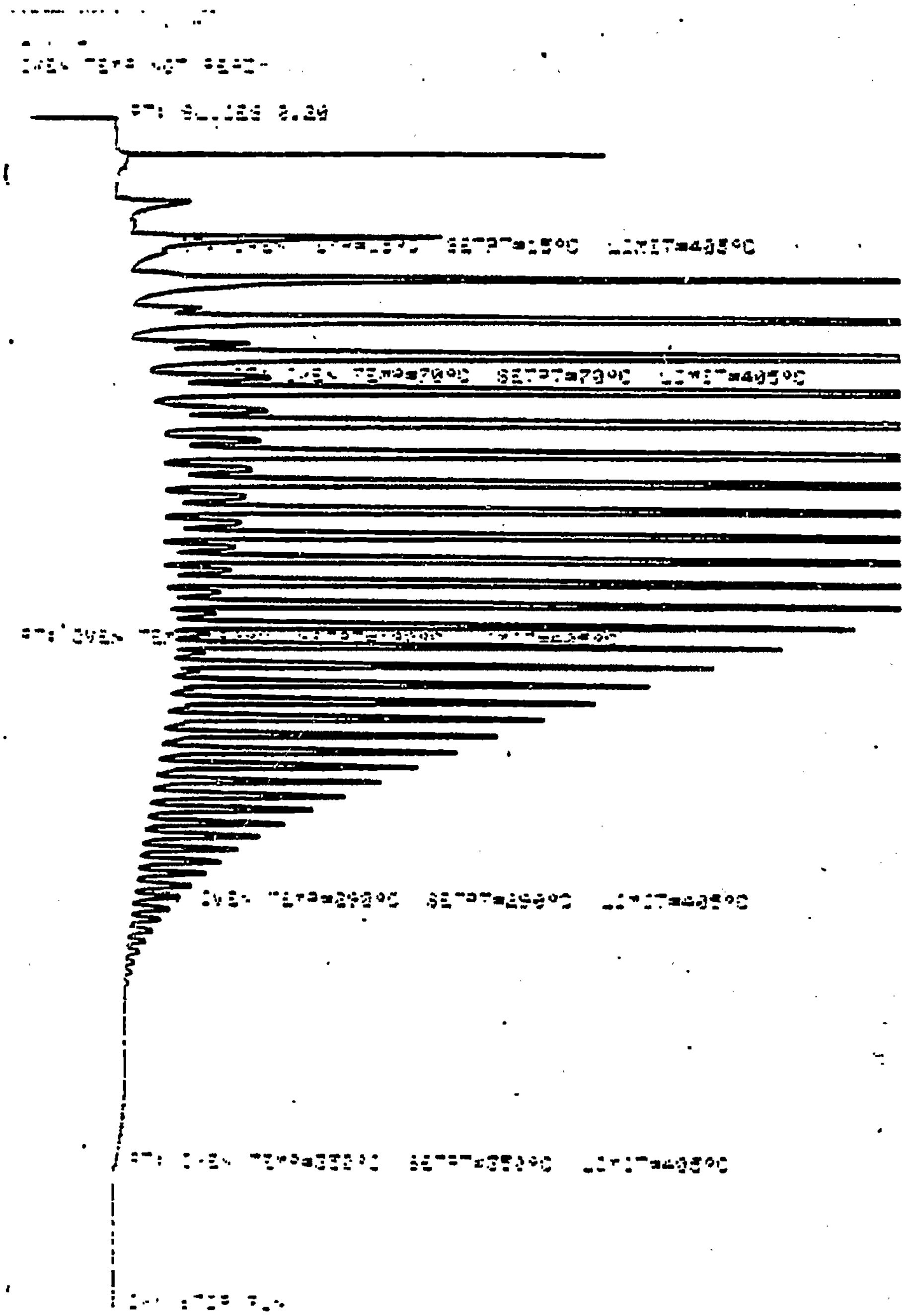


Fig. B142



12185-08-03

Fig. B143

RESULT OF SYNGAS OPERATION

RUN NO. 12200-08
CATALYST CO/TH/X4-U103 12006-62 80 CC 33.7 G (39.4 G AFTER RUN +5.7 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	20008.01	20008.02	20008.03
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	19.5	47.0	67.75
PRESSURE,PSIG	300	300	300
TEMP. C	258	258	258
FEED CC/MIN	400	400	400
HOURS FEEDING	19.50	27.50	20.75
EFFLNT GAS LITER	235.85	348.43	268.90
GM AQUEOUS LAYER	49.80	69.95	59.72
GM OIL	20.01	29.22	14.78
MATERIAL BALANCE			
GM ATOM CARBON %	91.67	94.31	90.99
GM ATOM HYDROGEN %	88.48	92.71	91.70
GM ATOM OXYGEN %	98.72	100.23	105.79
RATIO CHX/(H2O+CO2)	0.7842	0.8182	0.5930
RATIO X IN CHX	2.2855	2.3446	2.3545
USAGE H2/CO PRODT	2.1648	2.1604	2.5404
FEED H2/CO FRM EFFLNT	0.9652	0.9830	1.0079
RESIDUAL H2/CO RATIO	0.4465	0.4699	0.4730
RATIO CO2/(H2O+CO2)	0.0627	0.0606	0.0541
K SHIFT IN EFFLNT	0.0299	0.0303	0.0271
SPECIFIC ACTIVITY SA	1.6950	1.5642	1.2704
CONVERSION			
ON CO %	30.19	30.35	25.87
ON H2 %	67.70	66.71	65.21
ON CO+H2 %	48.61	48.37	45.62
PRDT SELECTIVITY,WT %			
CH4	8.02	11.99	11.31
C2 HC'S	1.94	0.37	2.26
C3H8	2.40	2.49	3.31
C3H6=	3.04	2.83	3.50
C4H10	2.60	2.69	3.51
C4H8=	3.67	3.55	4.39
C5H12	3.31	3.43	4.28
C5H10=	1.44	1.36	1.93
C6H14	3.80	3.82	4.64
C6H12= & CYCLO'S	2.03	2.05	2.44
C7+ IN GAS	11.08	9.25	11.94
LIQ HC'S	56.66	56.17	46.49
TOTAL	100.00	100.00	100.00

Table B10

SUB-GROUPING			
C1 -C4	21.67	23.91	28.28
C5 -420 F	43.20	38.46	40.80
420-700 F	30.99	27.52	22.46
700-END PT	4.14	10.11	8.46
C5+-END PT	78.33	76.09	71.72
ISO/NORMAL MOLE RATIO			
C4	0.0266	0.0236	0.0222
C5	0.0604	0.0623	0.0551
C6	0.0631	0.0651	0.0351
C4=	0.0598	0.0636	0.0640
PARAFFIN/OLEFIN RATIO			
C3	0.7550	0.8411	0.9015
C4	0.6837	0.7315	0.7702
C5	2.2436	2.4513	2.1550
SCHULZ-FLORY DISTRBTN			
ALPHA (EXP(SLOPE))	0.8193	0.8517	0.8329
RATIO CH4/(1-A)**2	2.4574	5.4533	4.0533
ALPHA FRM CORRELATION	0.8502	0.8477	0.8474
ALPHA (EXPTL/CORR)	0.9637	1.0048	0.9829
W%CH4 FRM CORRELATION	13.8681	14.6391	14.7387
W%CH4 (EXPTL/CORR)	0.5784	0.8189	0.7677
LIQ HC COLLECTION			
PHYS. APPEARANCE	WAX OIL	WAX OIL	WAX OIL
DENSITY (* 40 C)	0.7466*	0.7534*	0.7575*
N, REFRACTIVE INDEX	1.4196*	1.4230*	1.4241*
SIMULT'D DISTILATN			
10 WT % @ DEG F	301	302	302
16	337	343	342
50	459	510	500
84	629	714	716
90	674	767	778
RANGE(16-84 %)	292	371	374
WT % @ 420 F	38.00	33.00	33.50
WT % @ 700 F	92.70	82.00	81.80

Table B10, cont

VII. Run 15 (12185-08) with Catalyst 15 ($Co/X_9/X_{10}/X_4$/UCC-103)

The purpose of this run was to test the replacement of the slightly radioactive thoria in the successful $Co/Th/X_4$/UCC-103 type of catalyst system. The catalyst is to be compared with the very stable Catalyst 11677-11 ($Co/Th/X_4$/UCC-103+UCC-101).

Cobalt oxide, promoted with X_9 and X_{10}, was formed in close contact with UCC-103, then further promoted with X4. The resulting powder, after bonding with 15 percent silica, was extruded to 1/8-inch pellets. The final catalyst contained 8.4 percent cobalt, 0.4 percent X_9, 0.5 percent X_{10} and 0.8 percent X_4.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B144-147. Simulated distillations of the C_5^+ product are plotted in Figs. B148-158. Carbon number product distributions are plotted in Figs. B159-177. Chromatograms from simulated distillations are reproduced in Figs. B178-196. Detailed material balances appear in Tables B11-14.

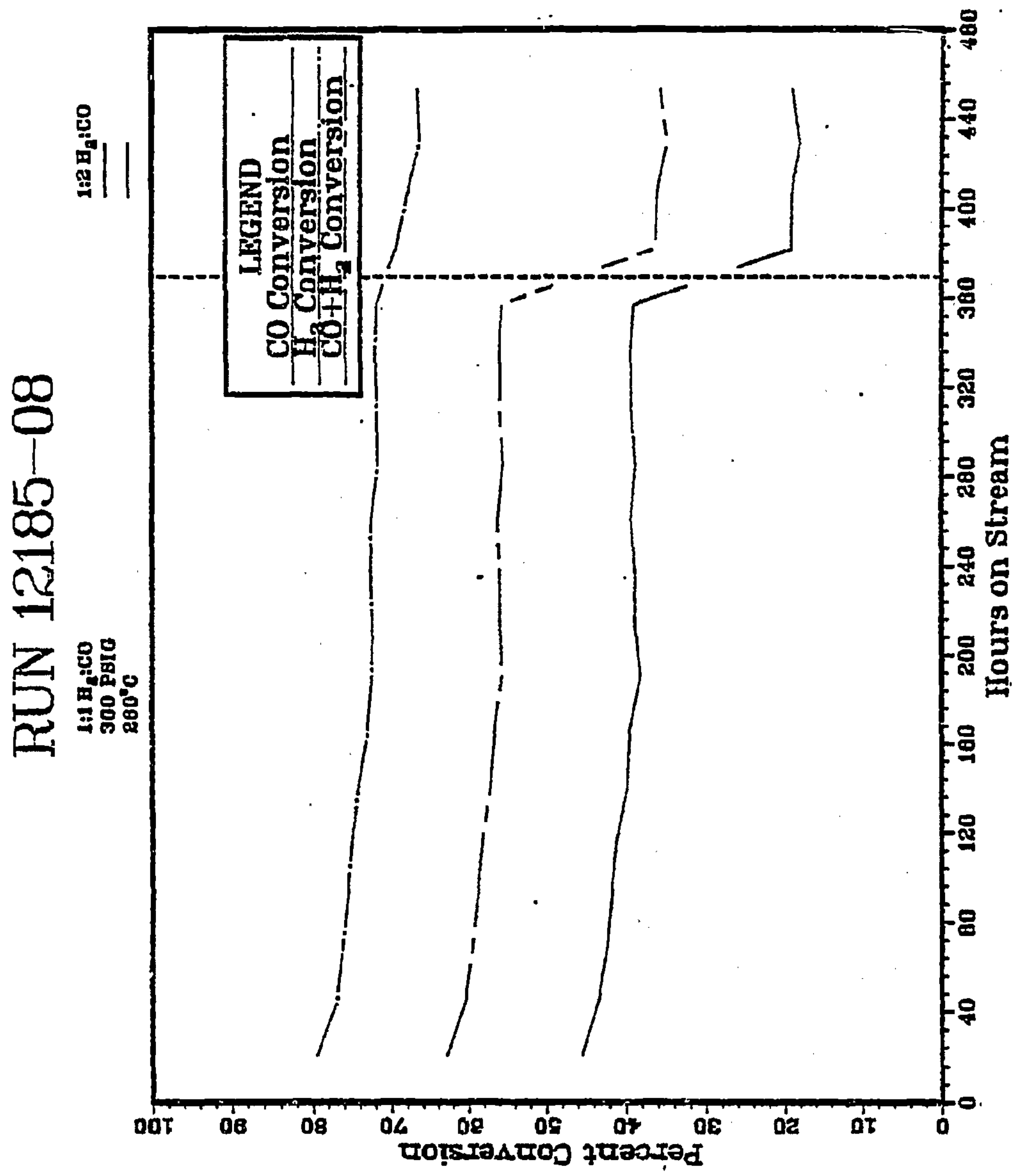
The conversion of syngas was 62.9 percent initially (calculated specific activity 2.6), then dropped during the first 166 hours on stream to 56.6 percent (specific activity 2.1). During the remaining 191 hours of the run, the conversion was exceedingly stable, decreasing at a rate, as estimated by least squares analysis, of one percentage point every 2400 hours on stream, with specific activity dropping from 1.99 to 1.86.

The product selectivity was excellent, and highly stable as well. At 166 hours on stream the methane production was 11.9 percent, and increased thereafter at an estimated rate of one percentage point every 1300 hours. The ratio of experimental to expected methane as calculated from a mathematical model was 0.80.

Production of C_5^+ was 72.2 percent at 166 hours, and decreased during the rest of the run at an estimated rate of one percentage point every 251 hours. Olefin content of the C_4 fraction ranged from 45 to 52 percent. Aside from the usual excess of methane, the Schulz-Flory plots show a fairly linear product distribution. On lowering the H_2:CO ratio to 33.4:66.7, resulting in a heavier product, there was still no indication of a significant carbon number cutoff.

Altogether this is the most active and most stable catalyst developed to date, surpassing in most respects the catalyst of Run 11677-11 which has been the benchmark since it was developed in the Third Quarter of the previous contract. Catalyst 11677-11, after the first 75 hours on stream, deactivated at a rate of one percentage point every 1400 hours (vs. 2400 hours for this catalyst). Its estimated specific activity at a similar metal load would range from 1.73 to 1.68 (vs. 2.1 to 1.86). Its ratio of experimental to expected methane was 0.91 (vs. 0.80). The olefin content of its C_4 product, however, was higher at 55 to 60 percent (vs. 45 to 52); this might be improved in the present catalyst by raising the level of X4, which has been shown to promote a more olefinic product.

The superior product of this catalyst demonstrates that radioactive thoria can be successfully replaced by a combination of the additives X_9 and X_{10}.



RUN 12185-08
1:1 H$_2$:CO
300 PSIG
260°C
1:2 H$_2$:CO
LEGEND
CO Conversion
H$_2$ Conversion
CO+H$_2$ Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
40
80
120
160
200
240
280
320
360
400
440
480

Fig. B144

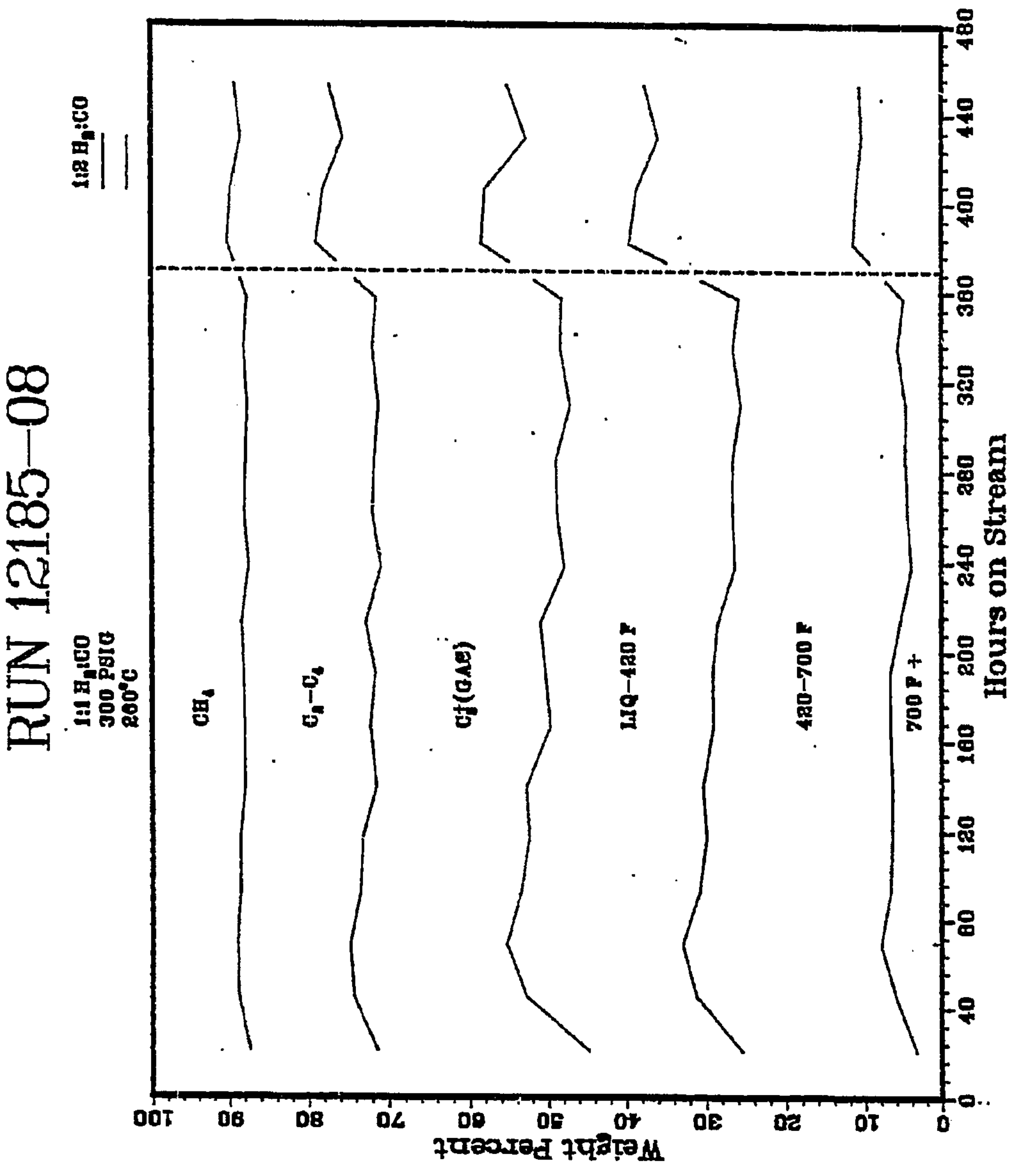

RUN 12185–08
1:1 H2:CO
300 PSIG
260°C
1:2 H2:CO
CH4
C2–C4
C5+(GAS)
LIQ–420 F
420–700 F
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
40
80
120
160
200
240
280
320
360
400
440
480

Fig. B145

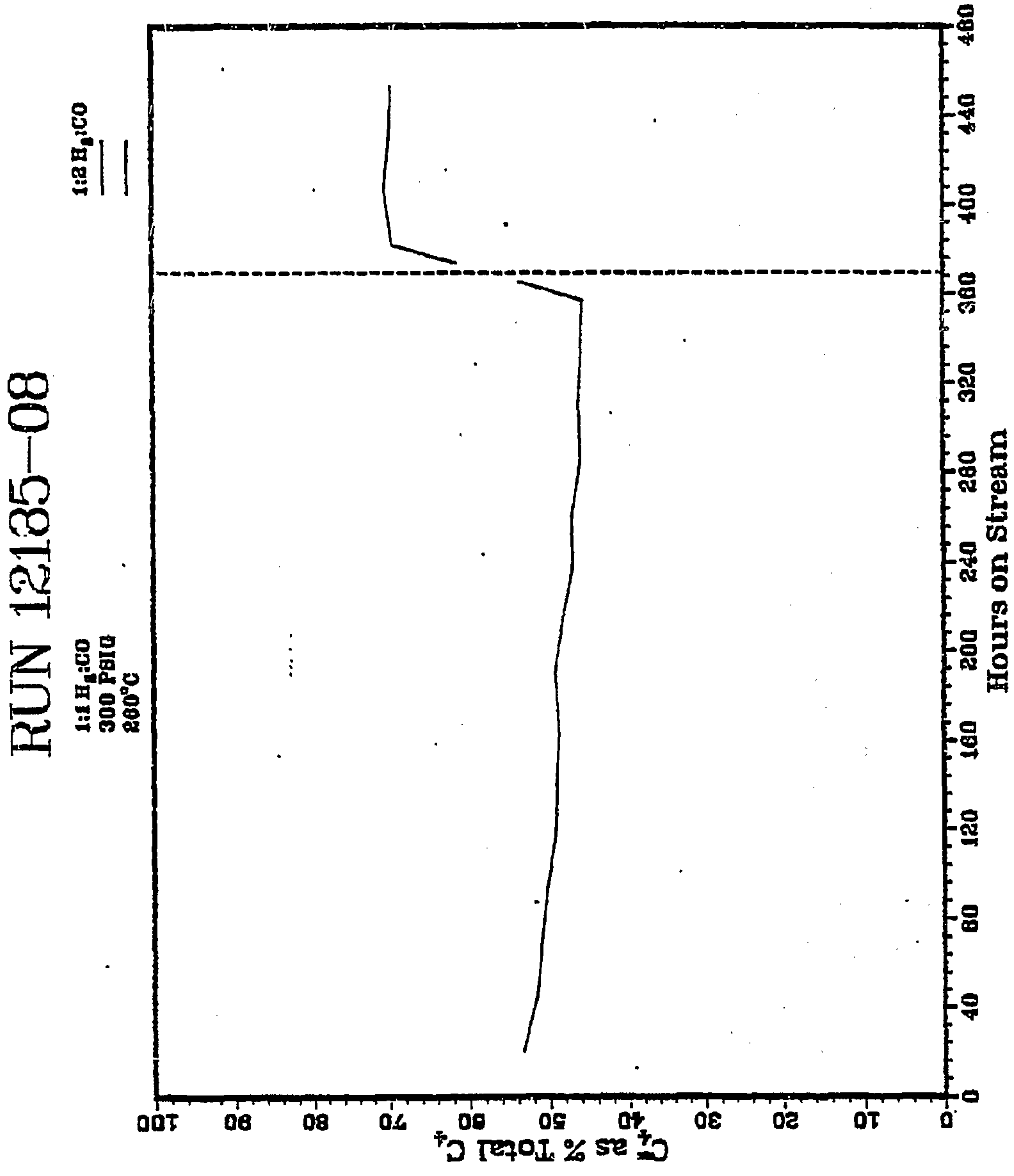

RUN 12135-08
1:1 H_2:CO
300 PSIG
280°C
1:2 H_2:CO
Hours on Stream
$C_4^=$ as % Total C_4
0
10
20
30
40
50
60
70
80
90
100
0
40
80
120
160
200
240
280
320
360
400
440
480

Fig. B146

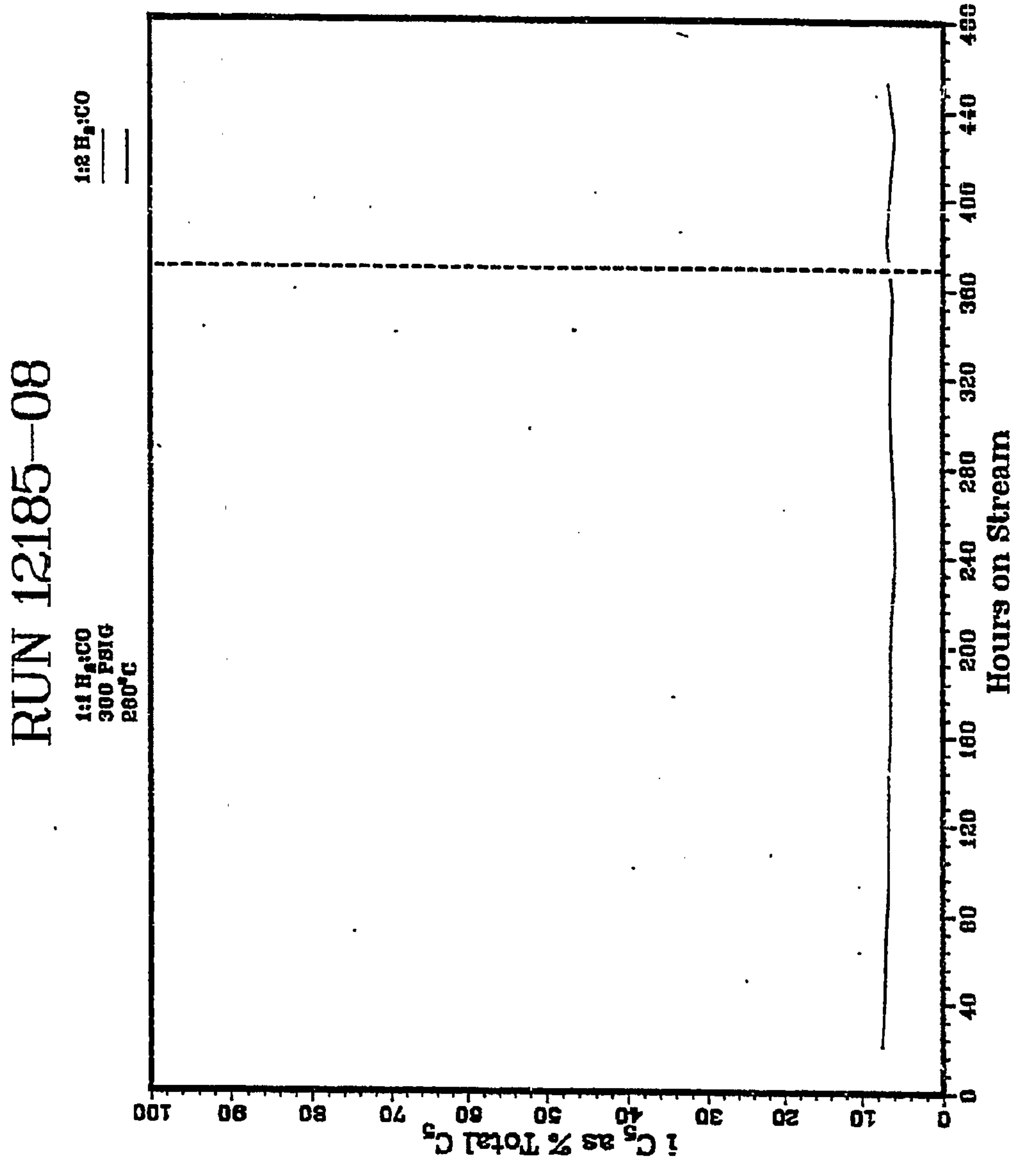

RUN 12185—08
1:1 H2:CO
300 PSIG
260°C
1:2 H2:CO
Hours on Stream
0
40
80
120
160
200
240
280
320
360
400
440
480
i C5 as % Total C5
0
10
20
30
40
50
60
70
80
90
100

Fig. B147

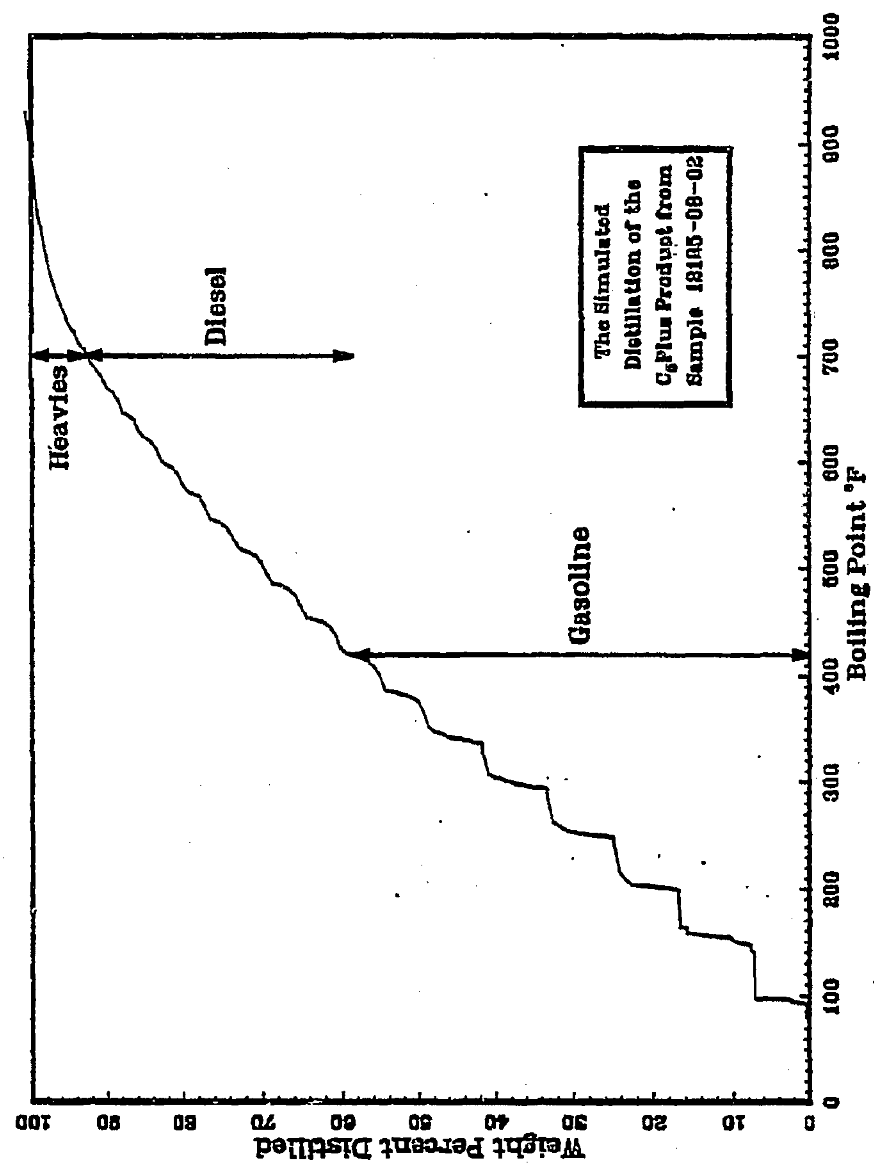

The Simulated
Distillation of the
C_6Plus Product from
Sample
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B148

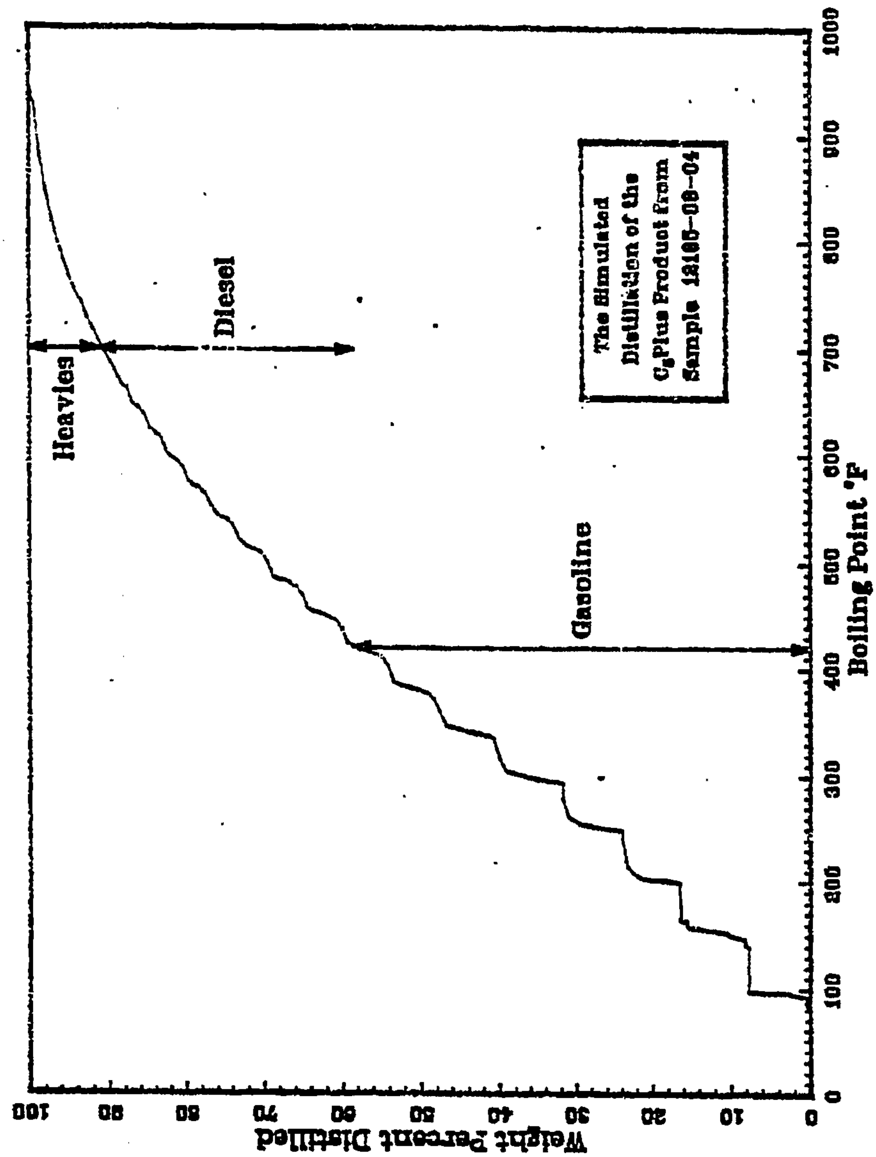
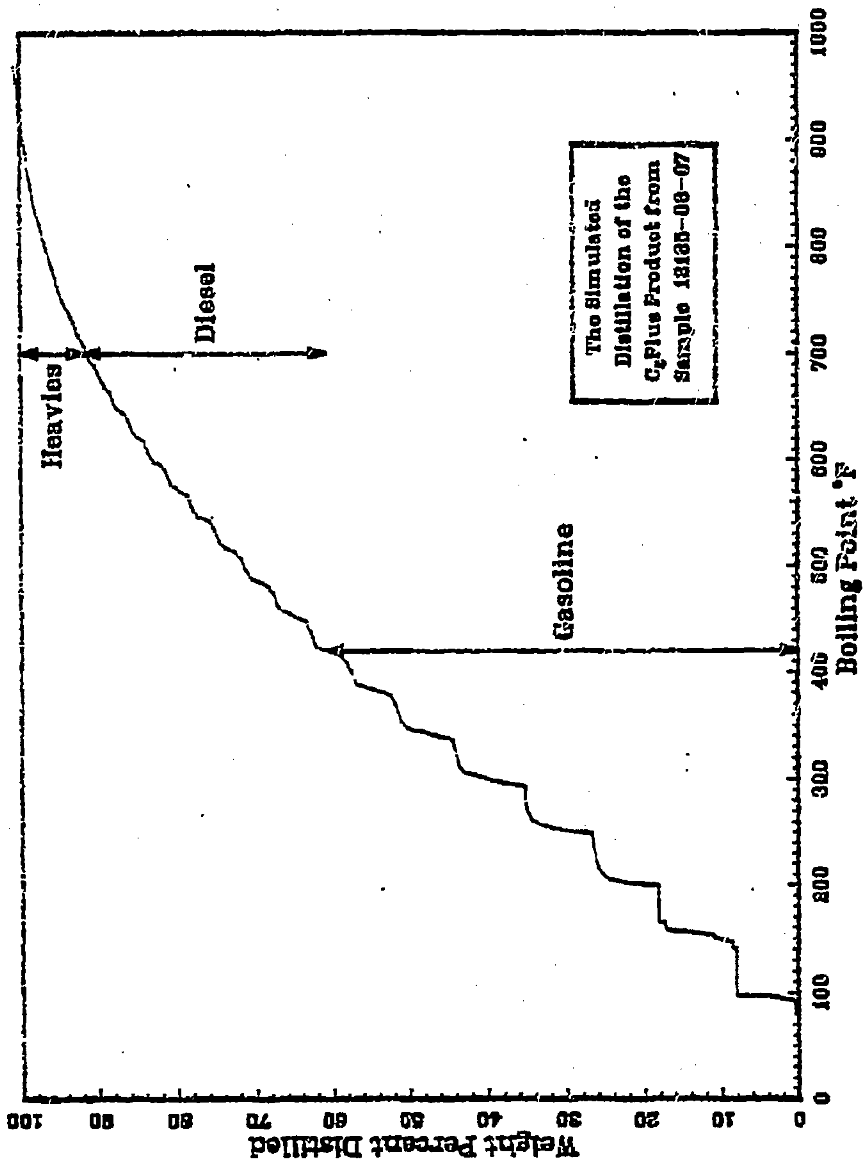
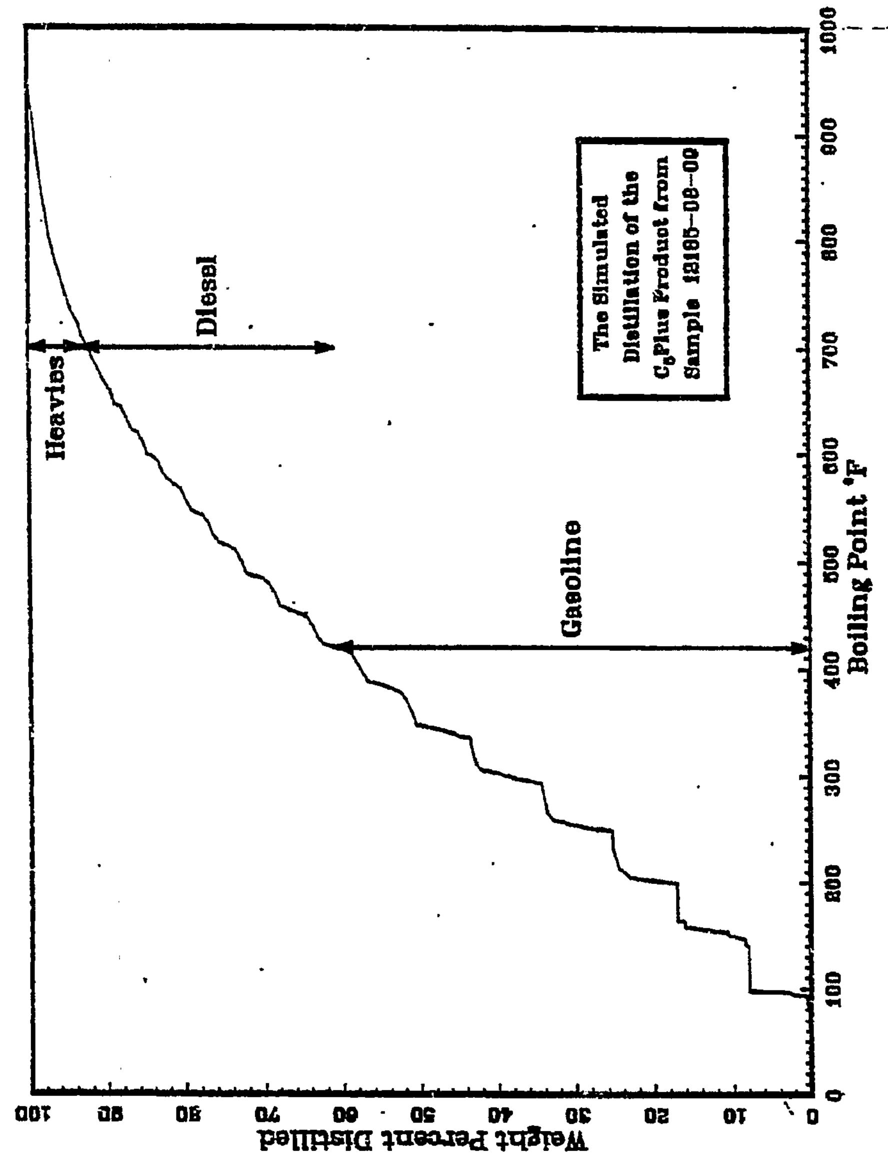

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
The Simulated
Distillation of the
Product from

Fig. B149



The Simulated Distillation of the C_5Plus Product from Sample 18135-08-07
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B150



The Simulated
Distillation of the
C_5Plus Product from
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90

Fig. B151

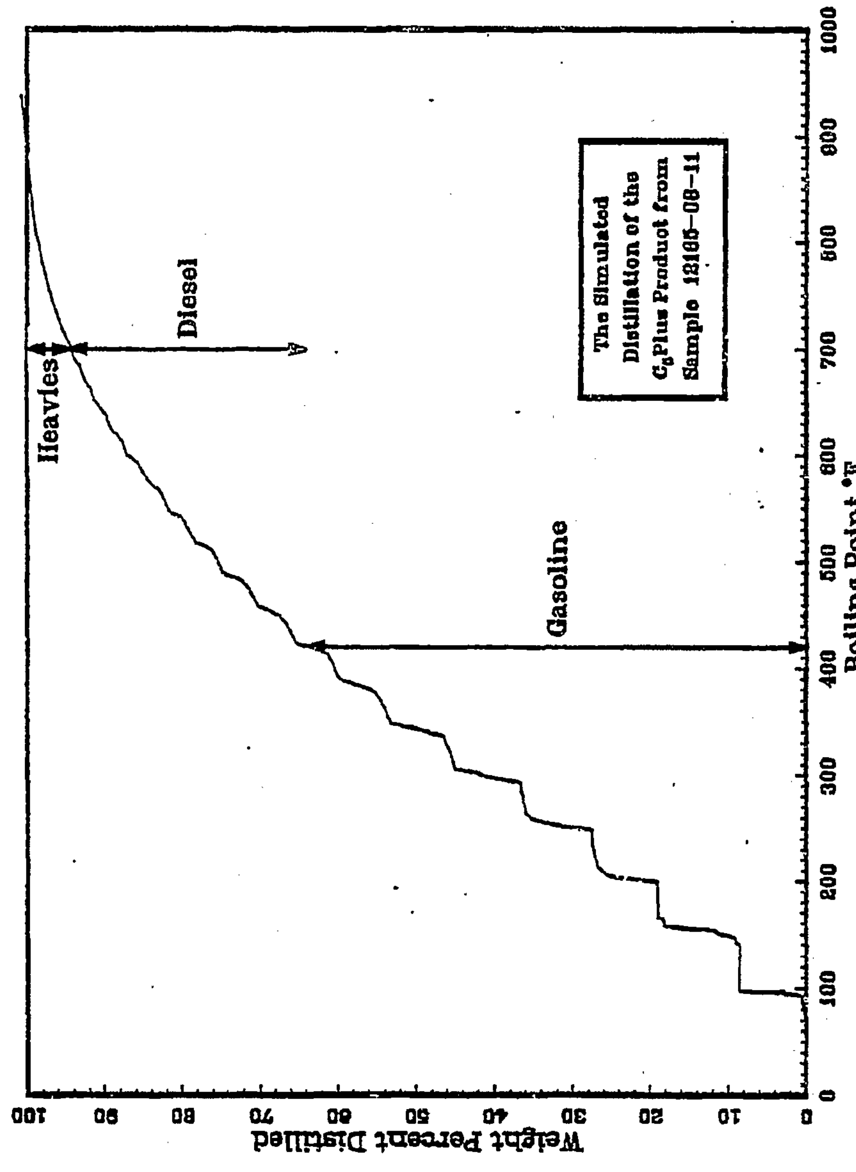

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Plus Product from
Sample
Weight Percent Distilled
Boiling Point °F

Fig. B152

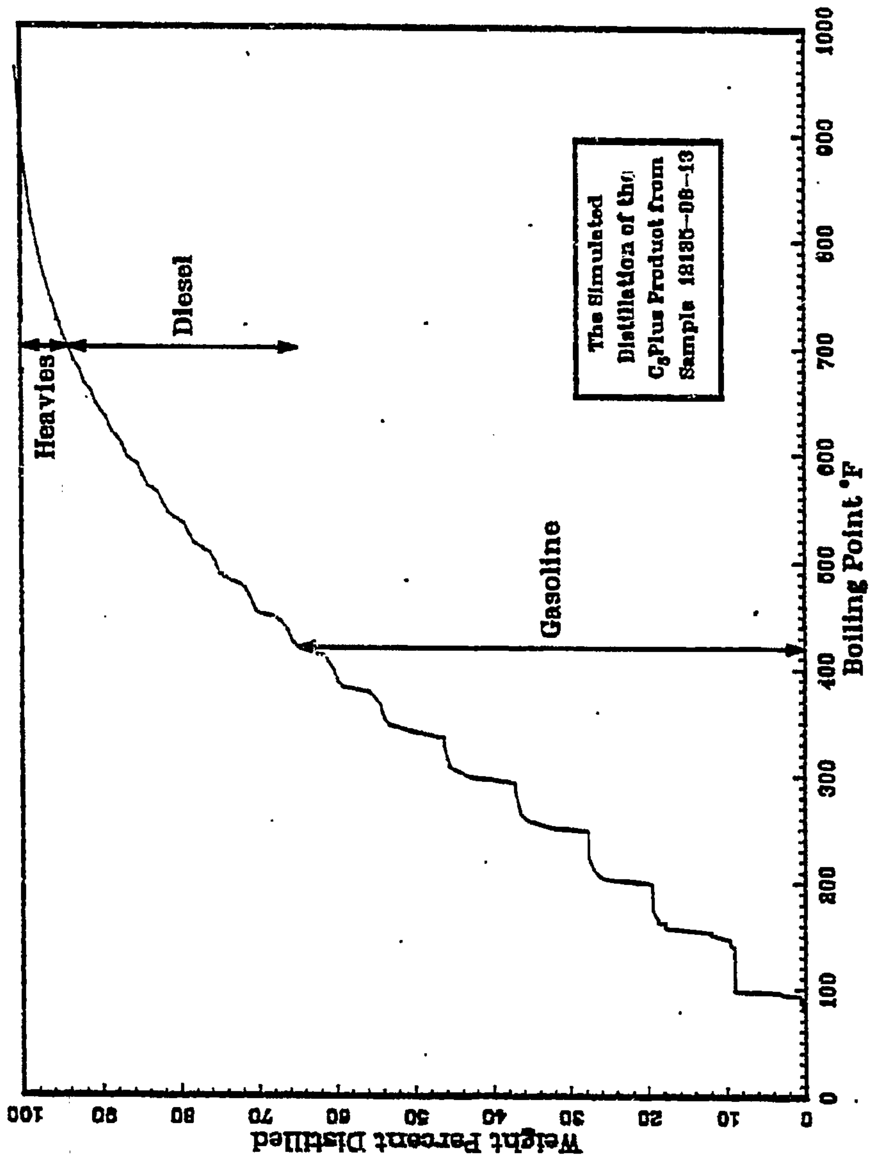

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B153

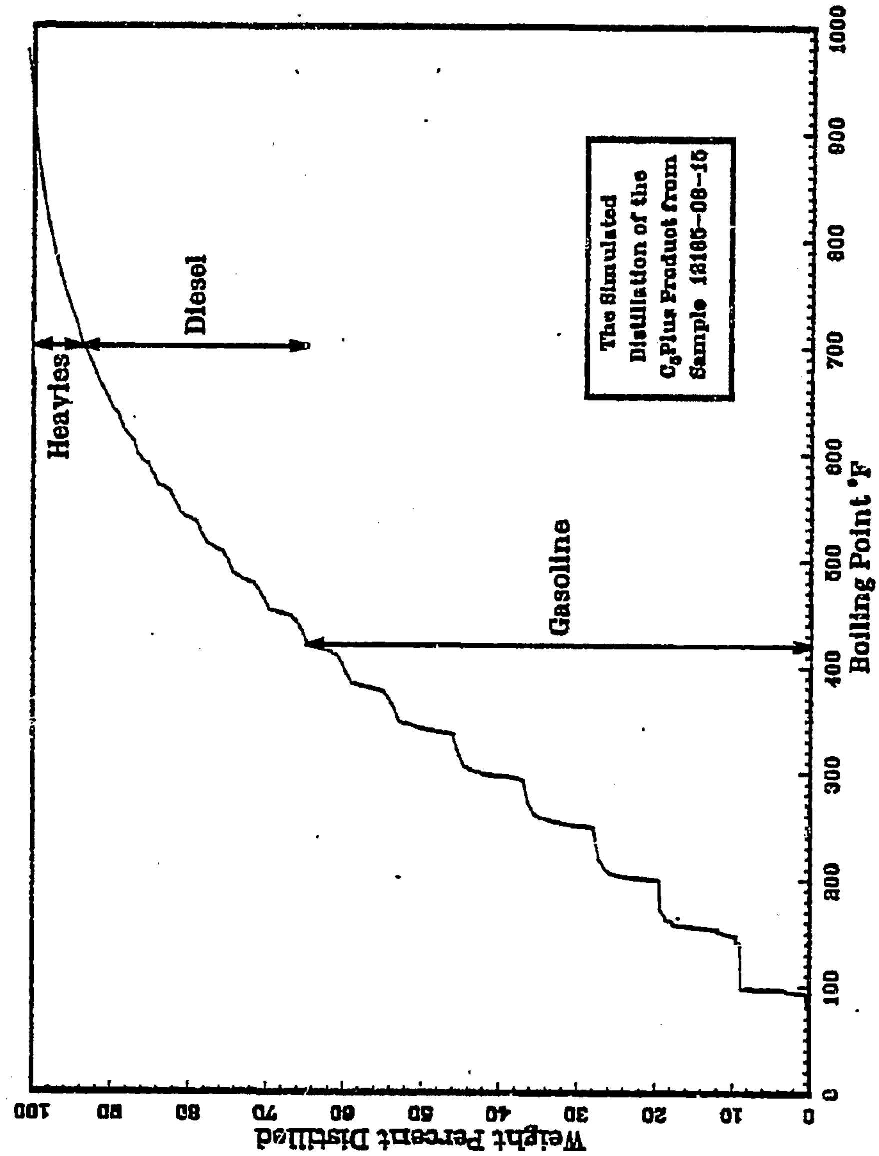

The Simulated
Distillation of the
C_6Plus Product from
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
0
10
20
30
40
50
60
70
80
90
100

Fig. B154

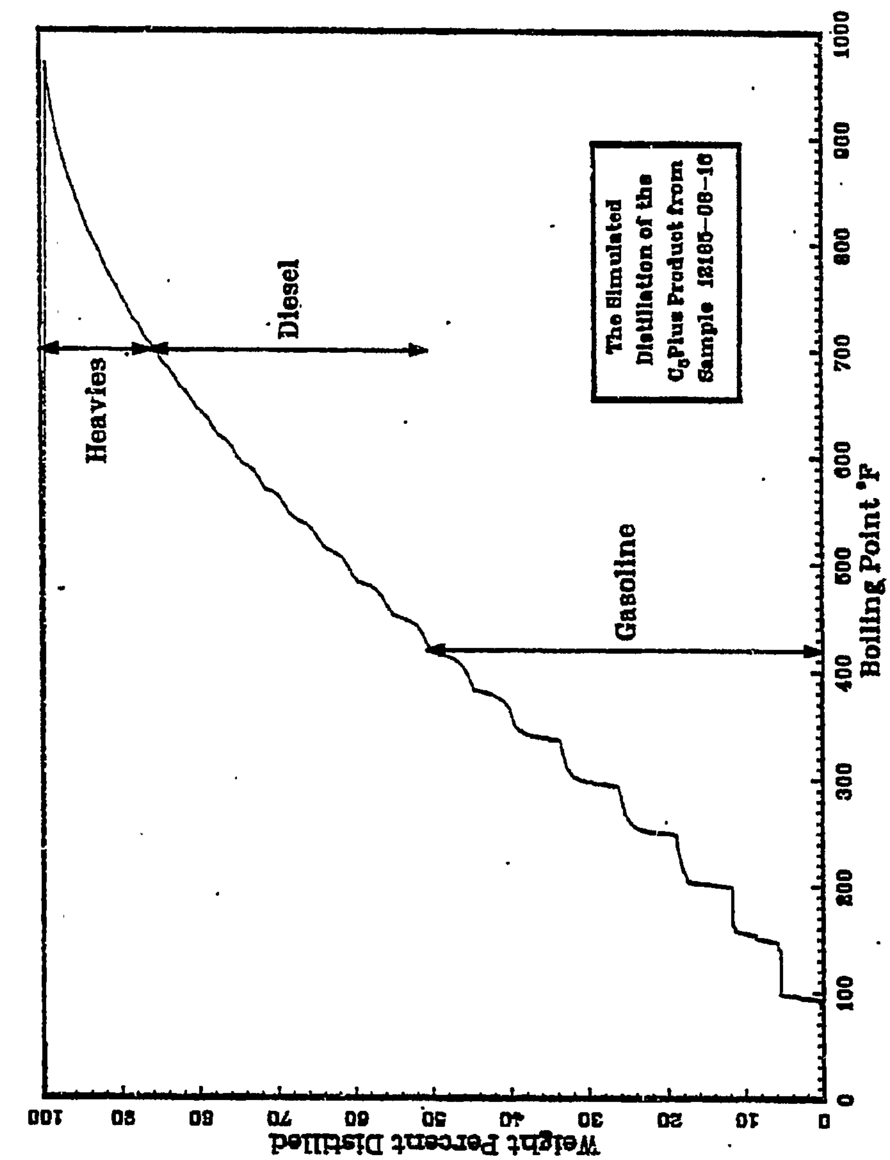

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B155

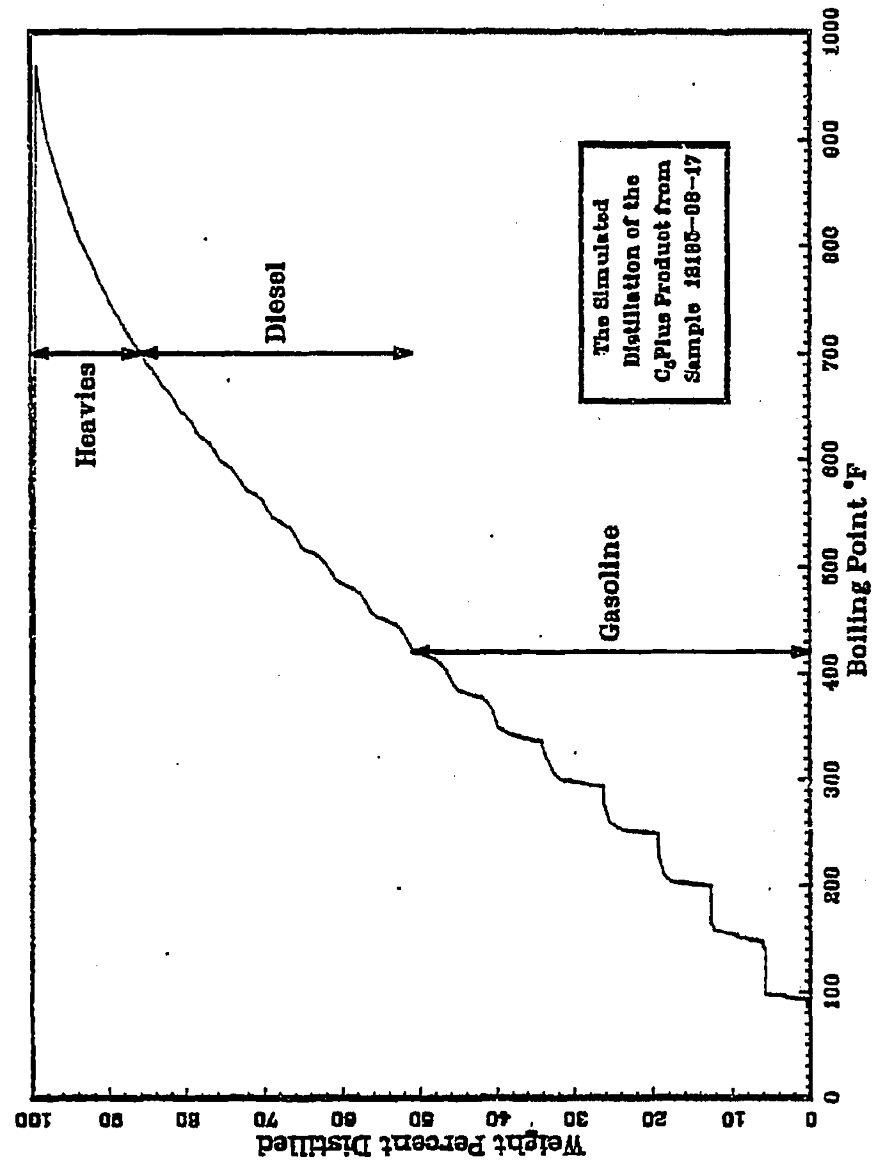

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
The Simulated Distillation of the

Fig. B156

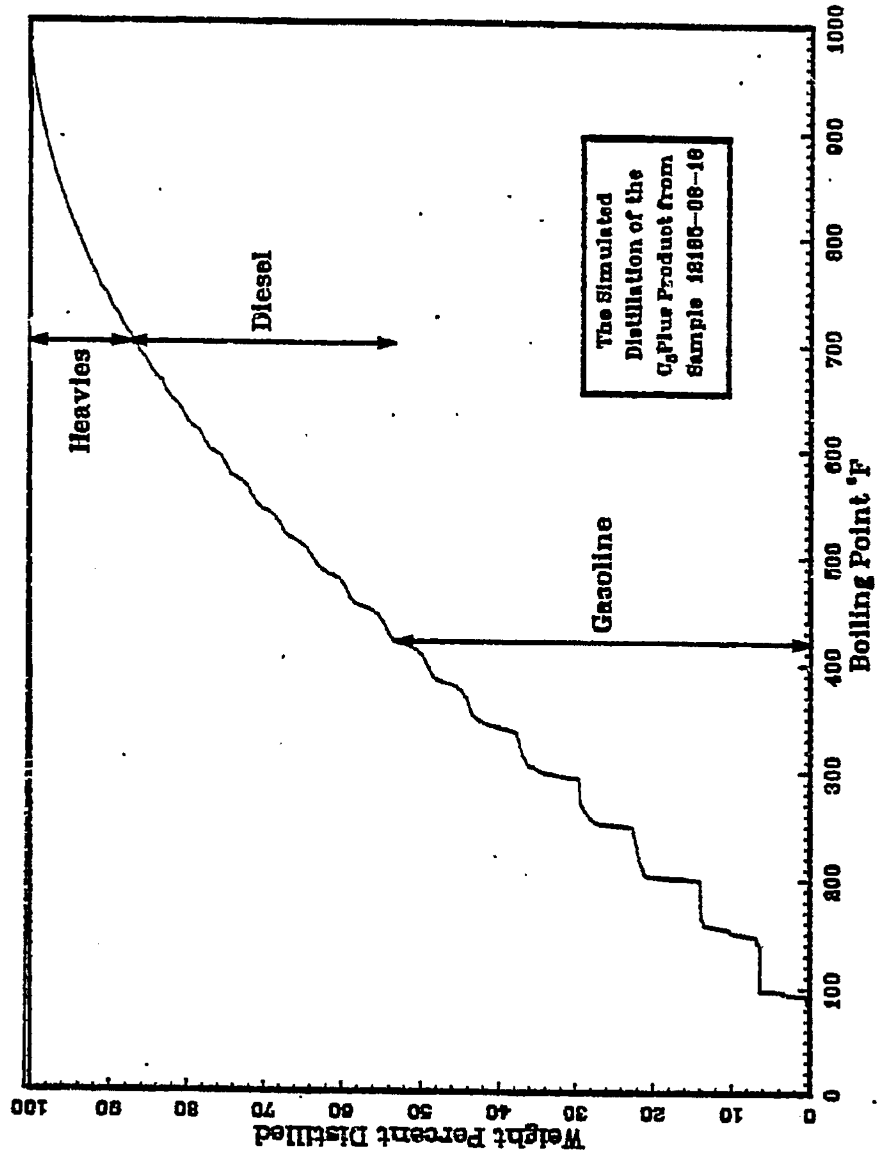

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B157

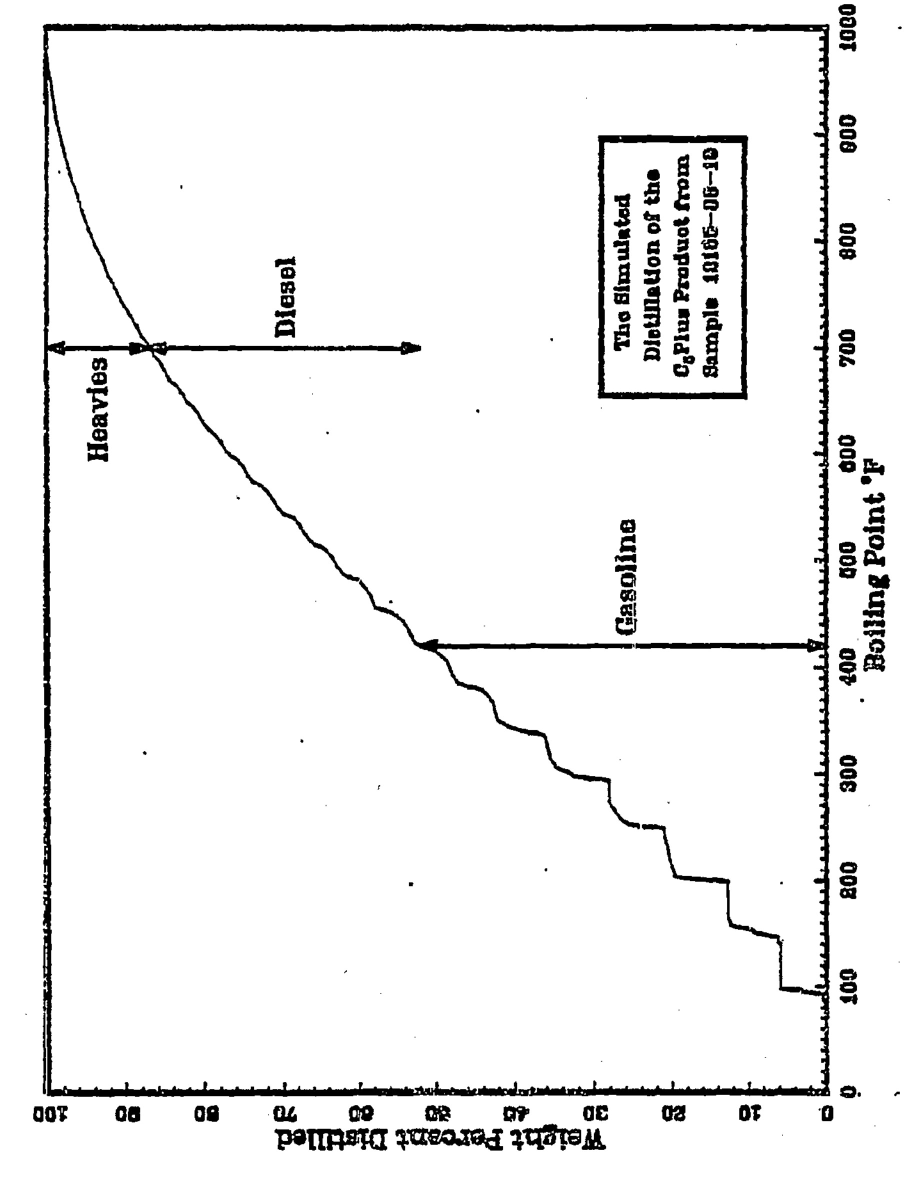

The Simulated
Distillation of the
C_5Plus Product from
Sample
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B158

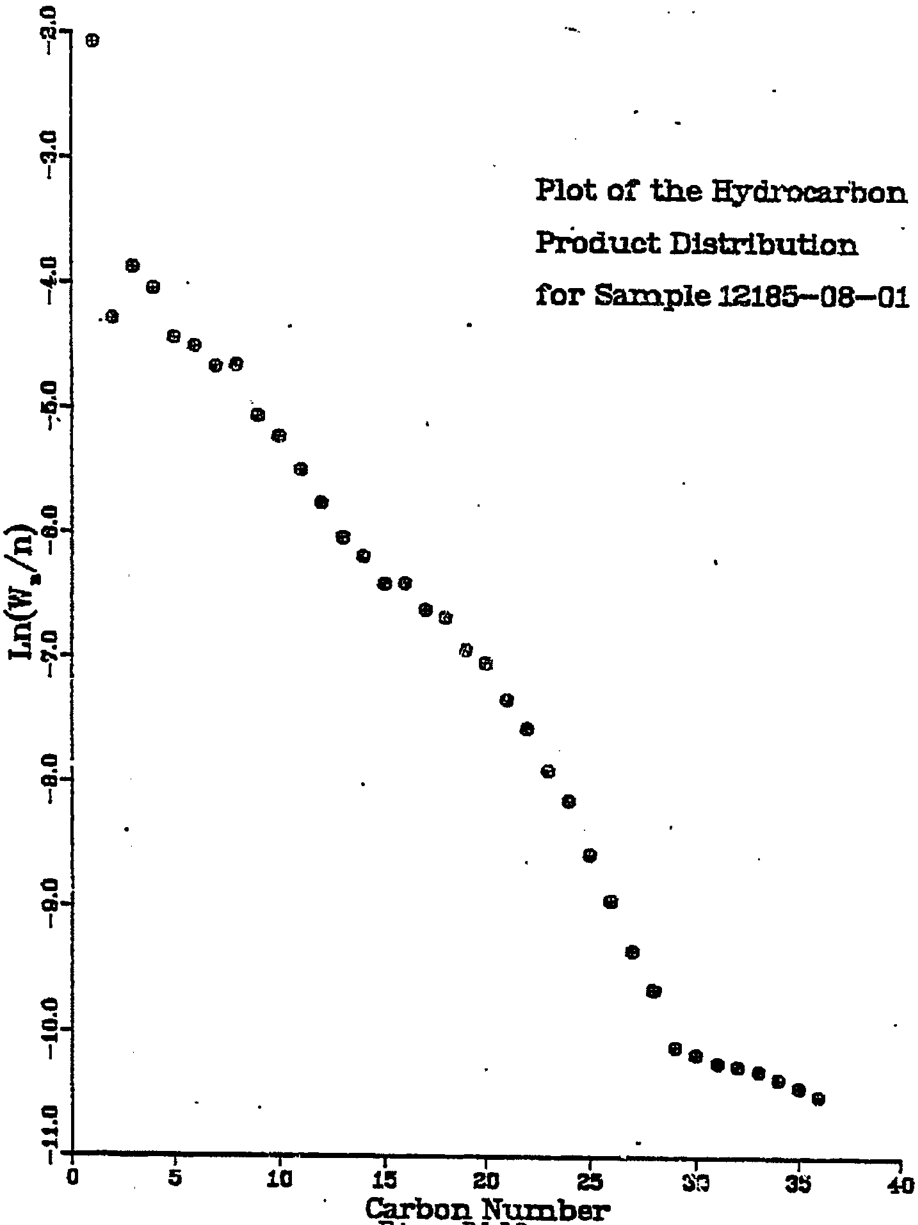

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-01
Ln(W/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B159

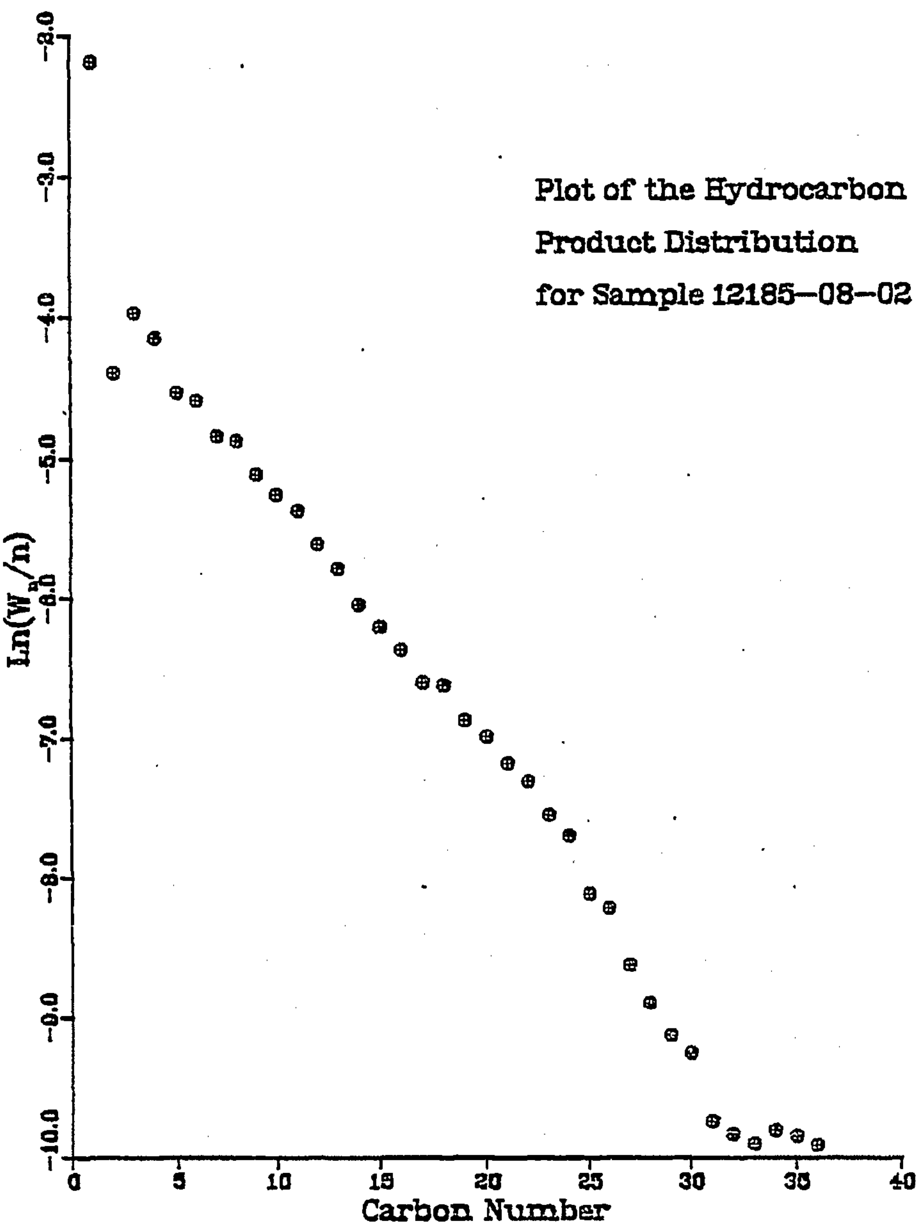

Plot of the Hydrocarbon
Product Distribution
for Sample 12185—08—02
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B160

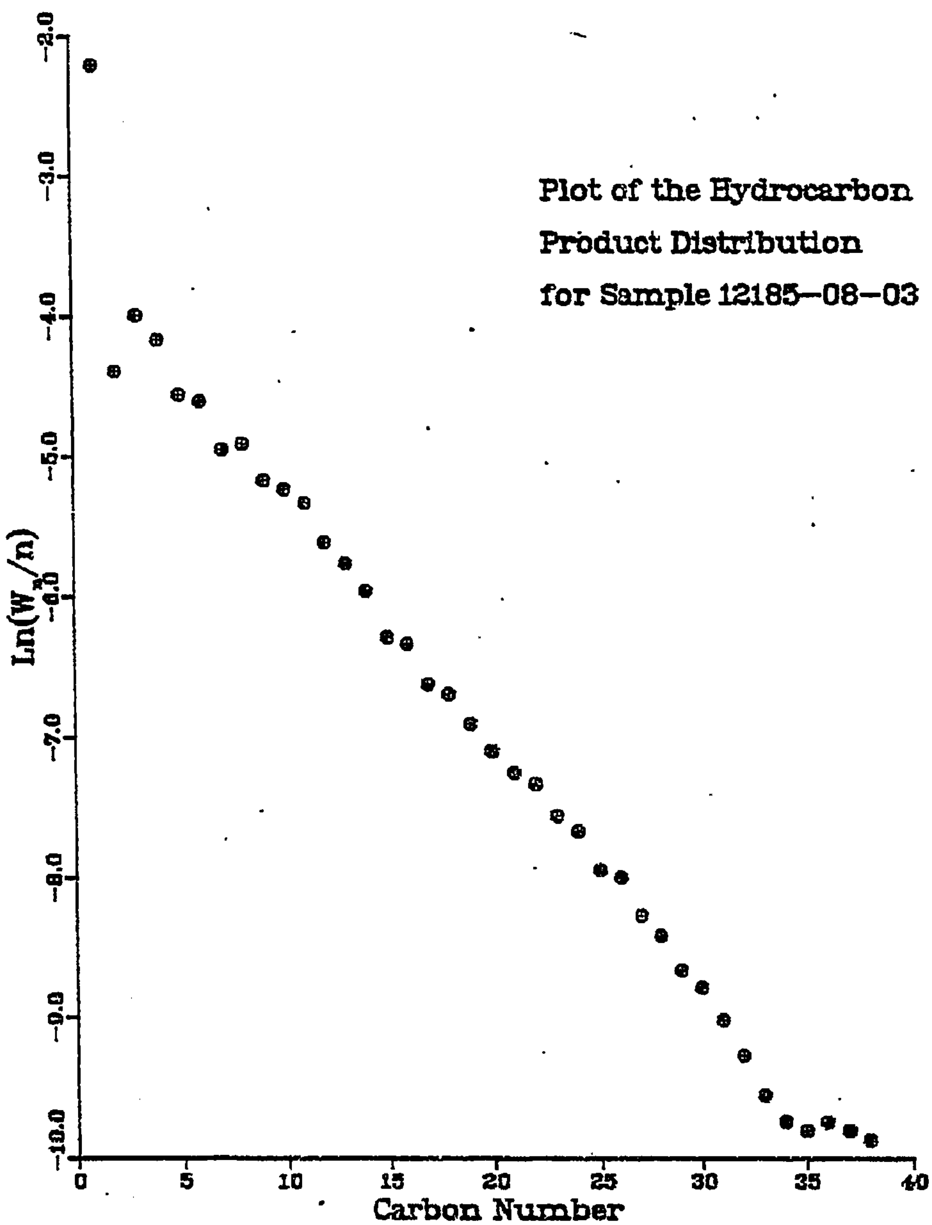

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-03
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B161

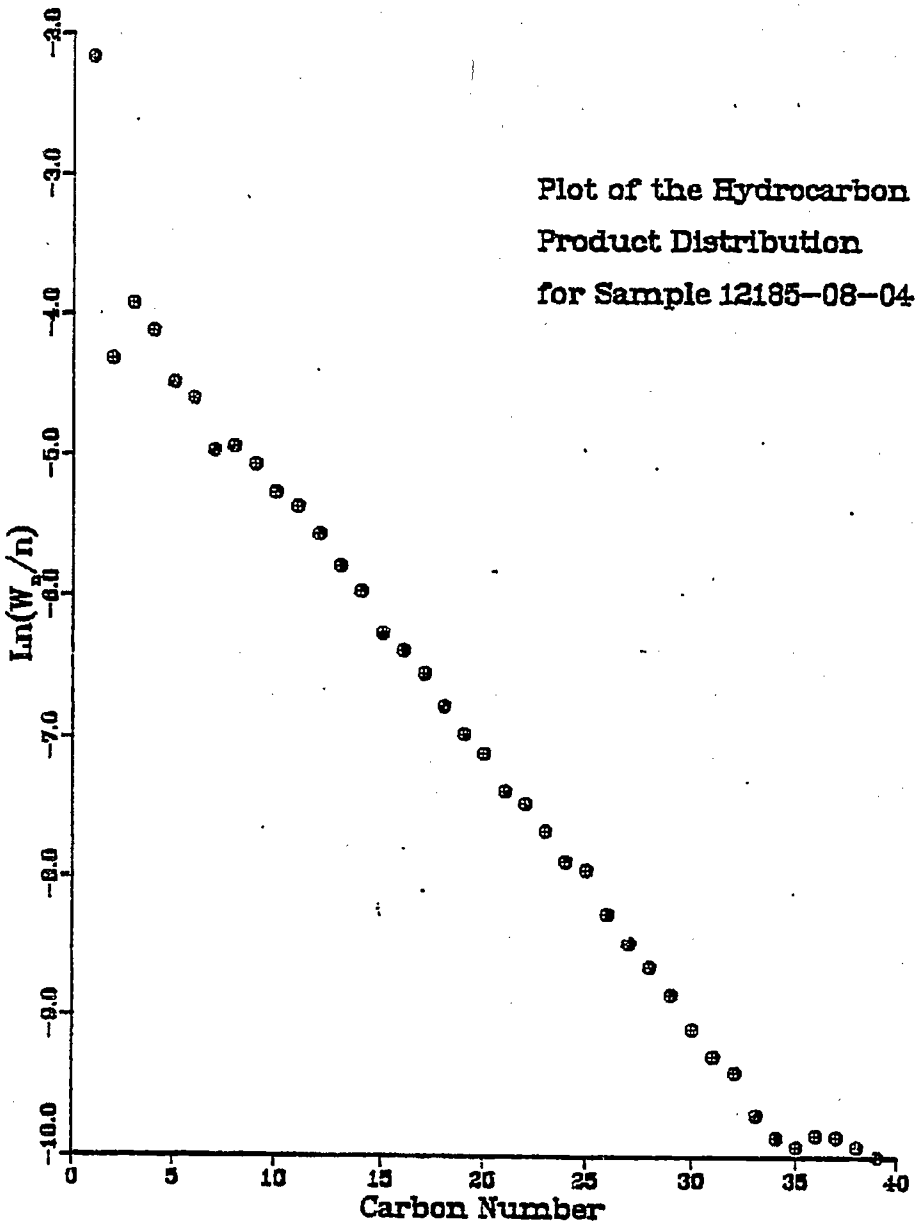

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-04
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B162

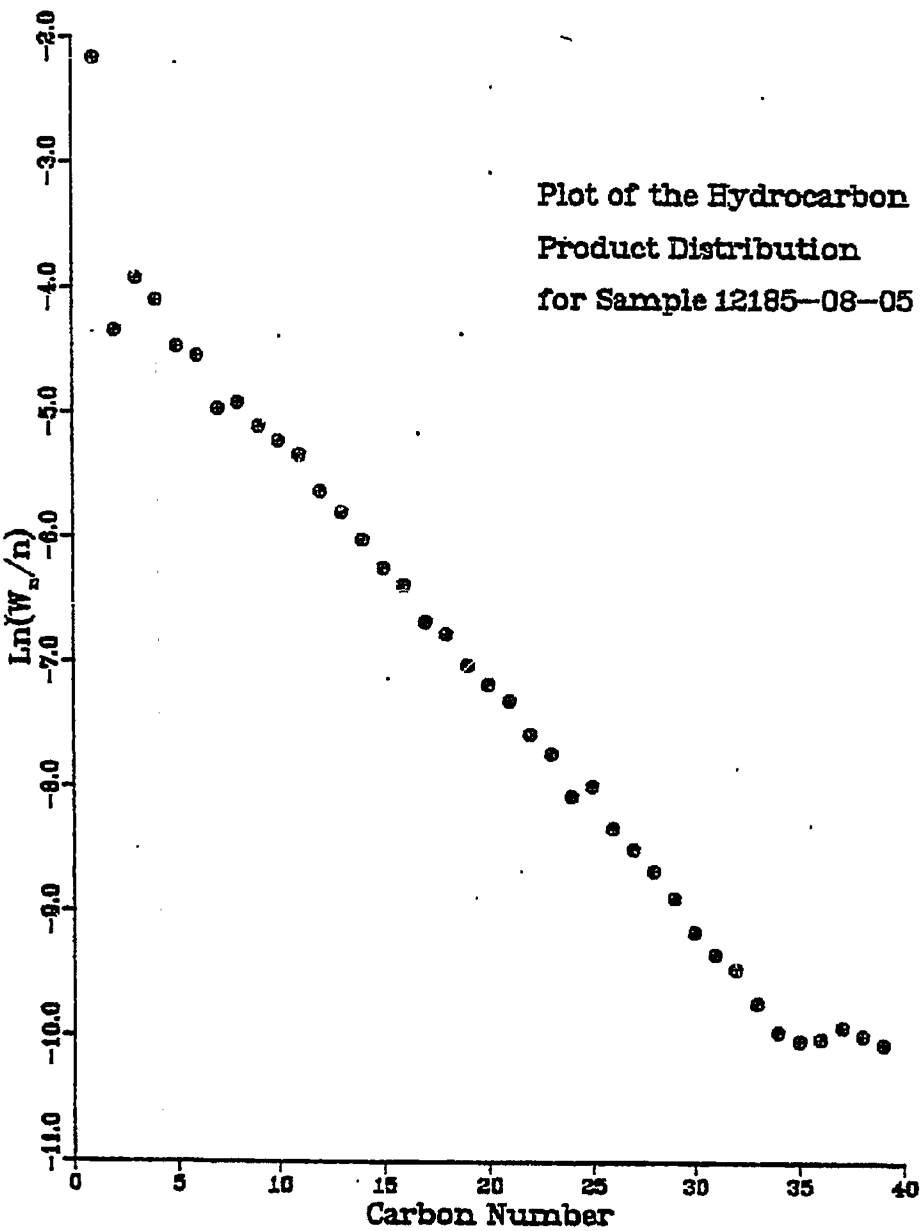
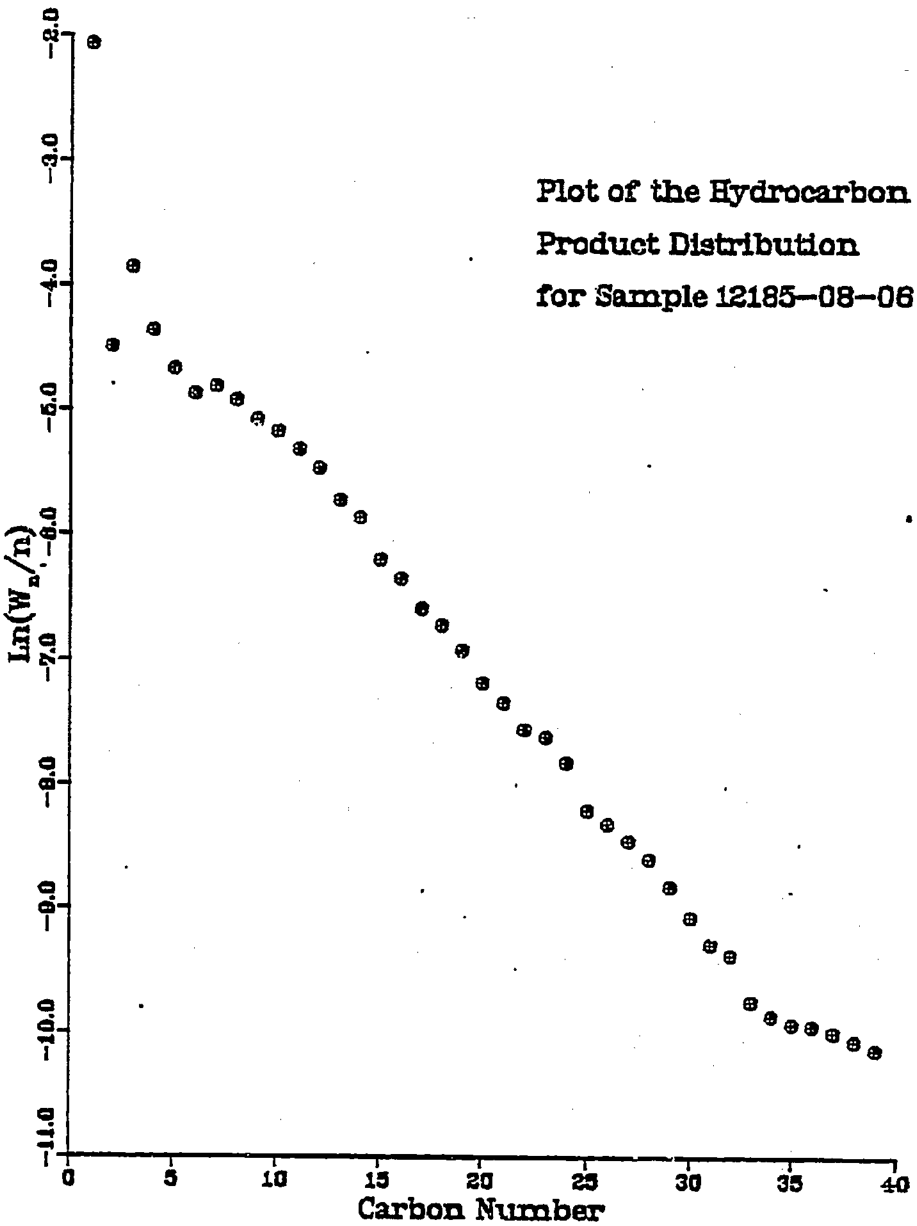
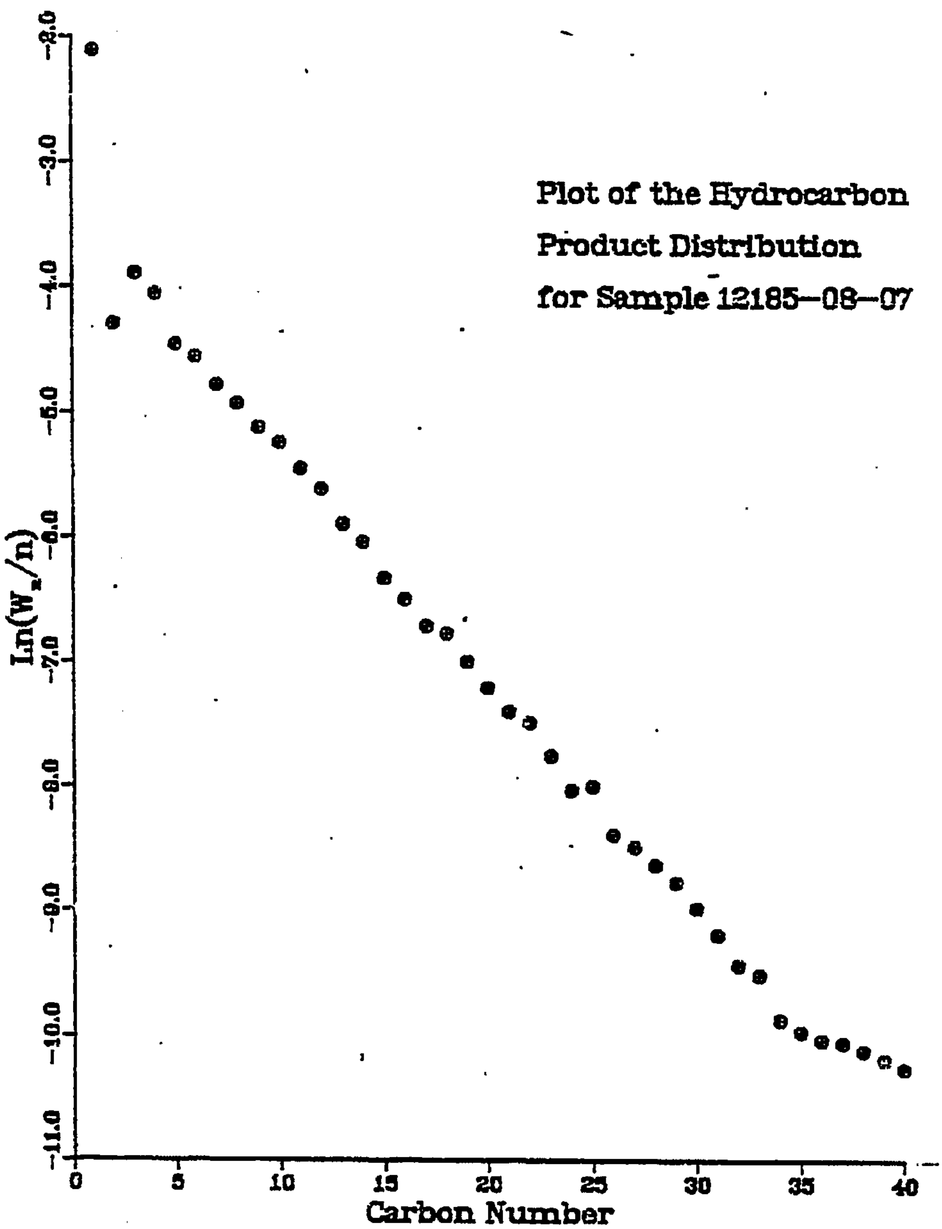

Plot of the Hydrocarbon
Product Distribution
for Sample 12185—08—05
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B163



Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-06
$Ln(W_n/n)$
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B164



-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
Ln(W_n/n)
0
5
10
15
20
25
30
35
40
Carbon Number
Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-07

Fig. B165

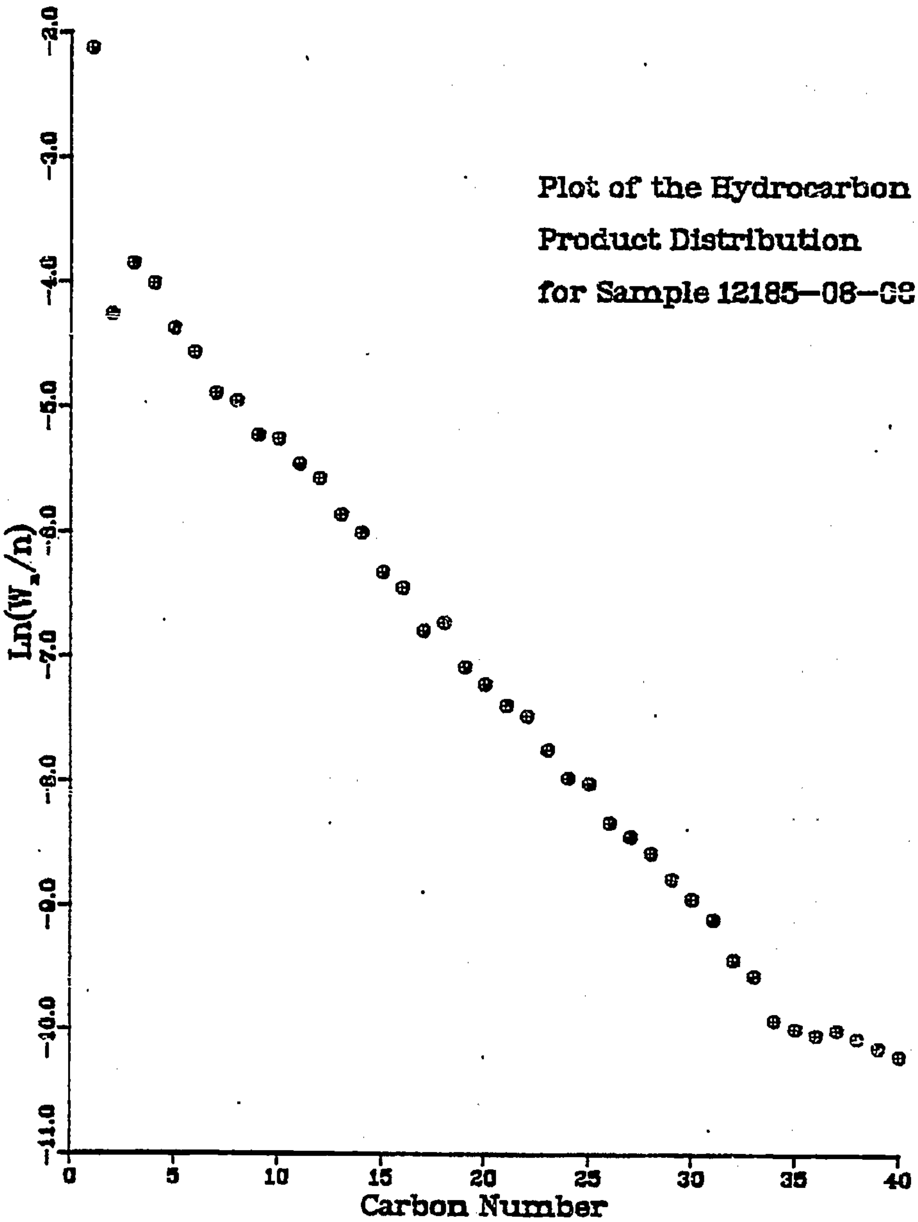
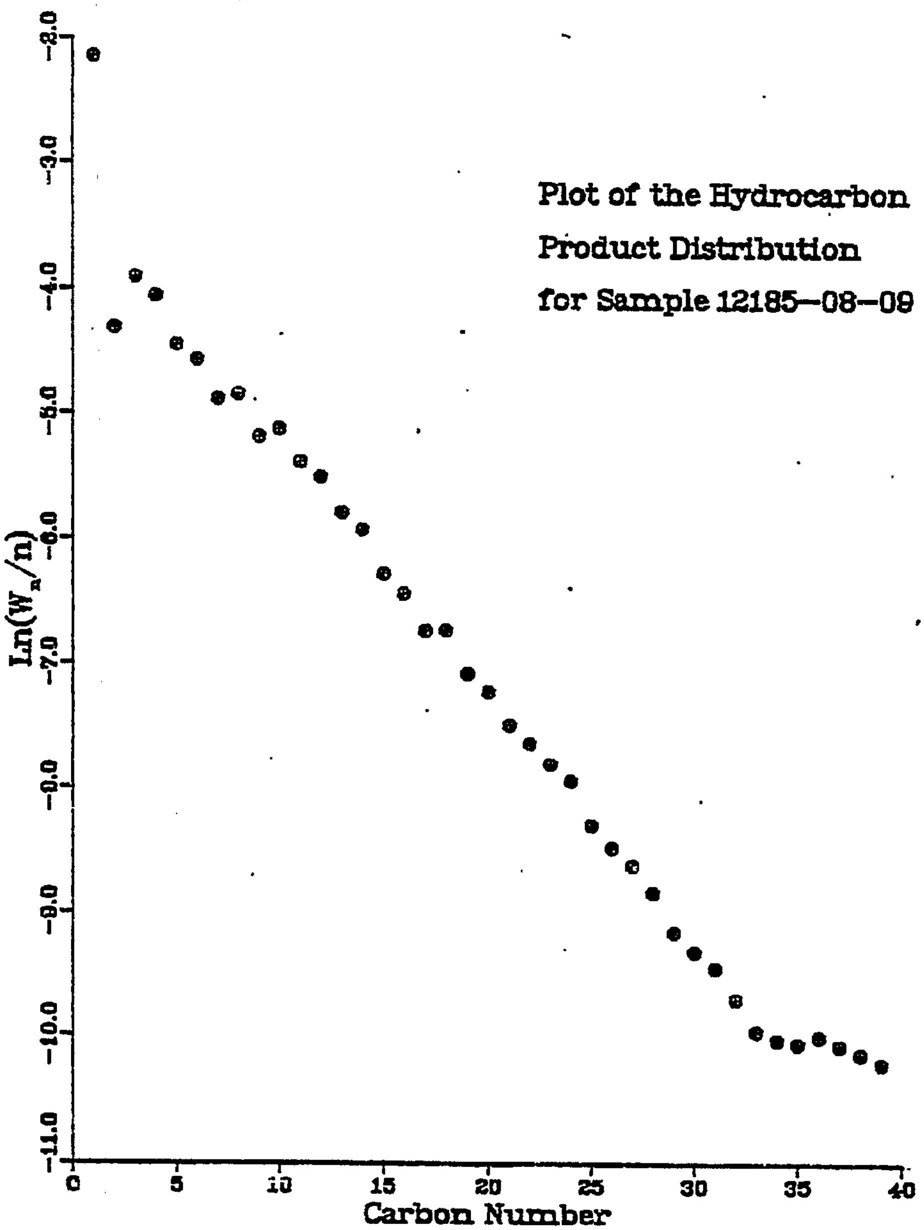

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-CS
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B166



Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-09
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B167

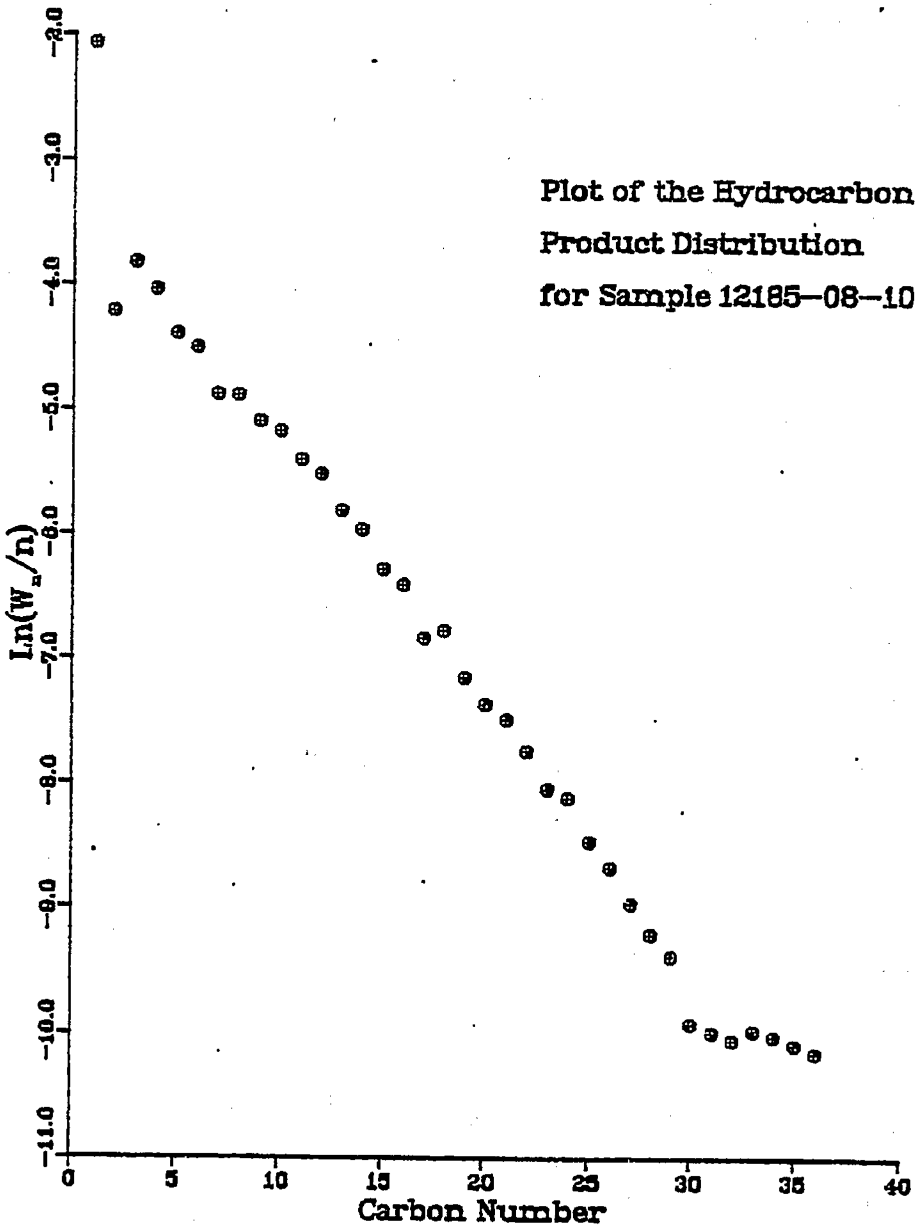

Plot of the Hydrocarbon
Product Distribution
for Sample 12185—08—10
Ln(Wn/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B168

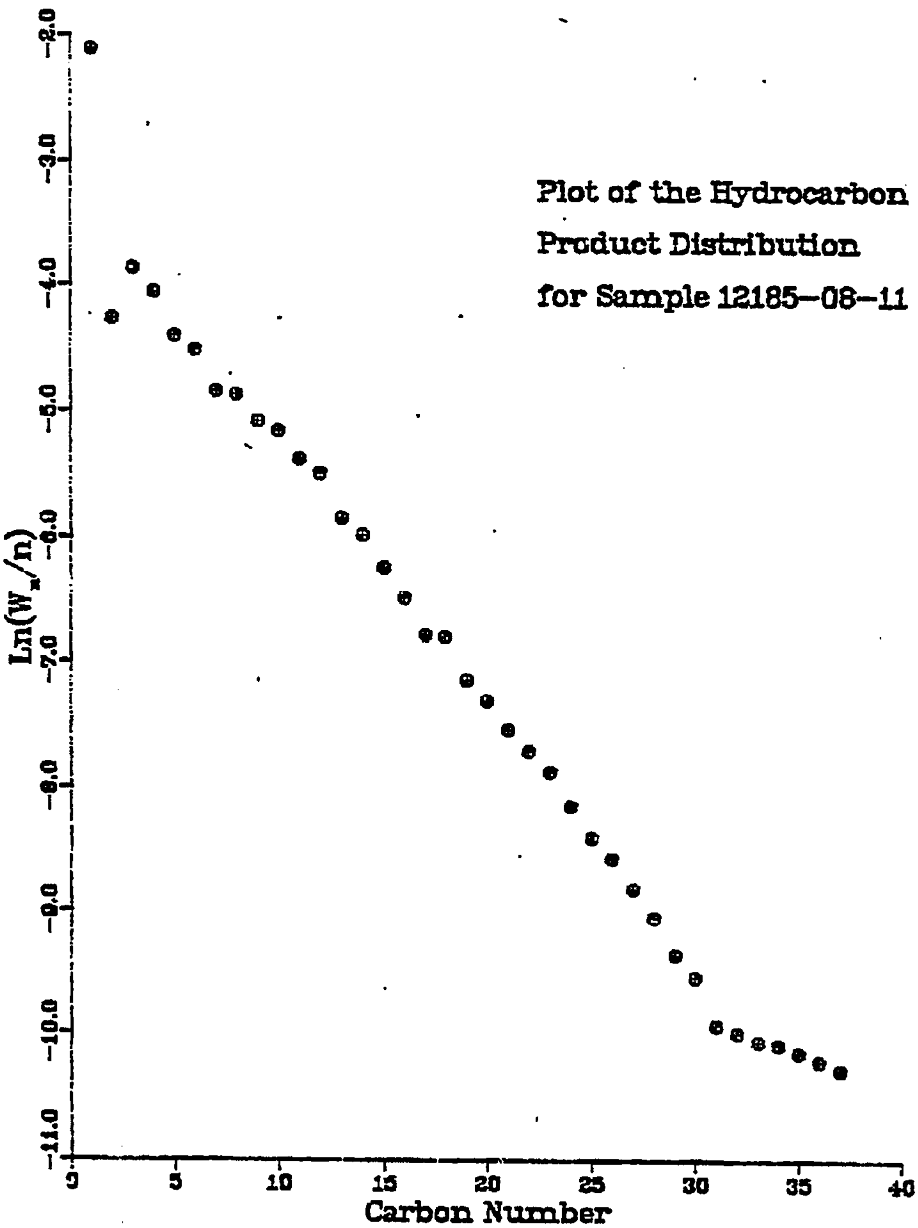
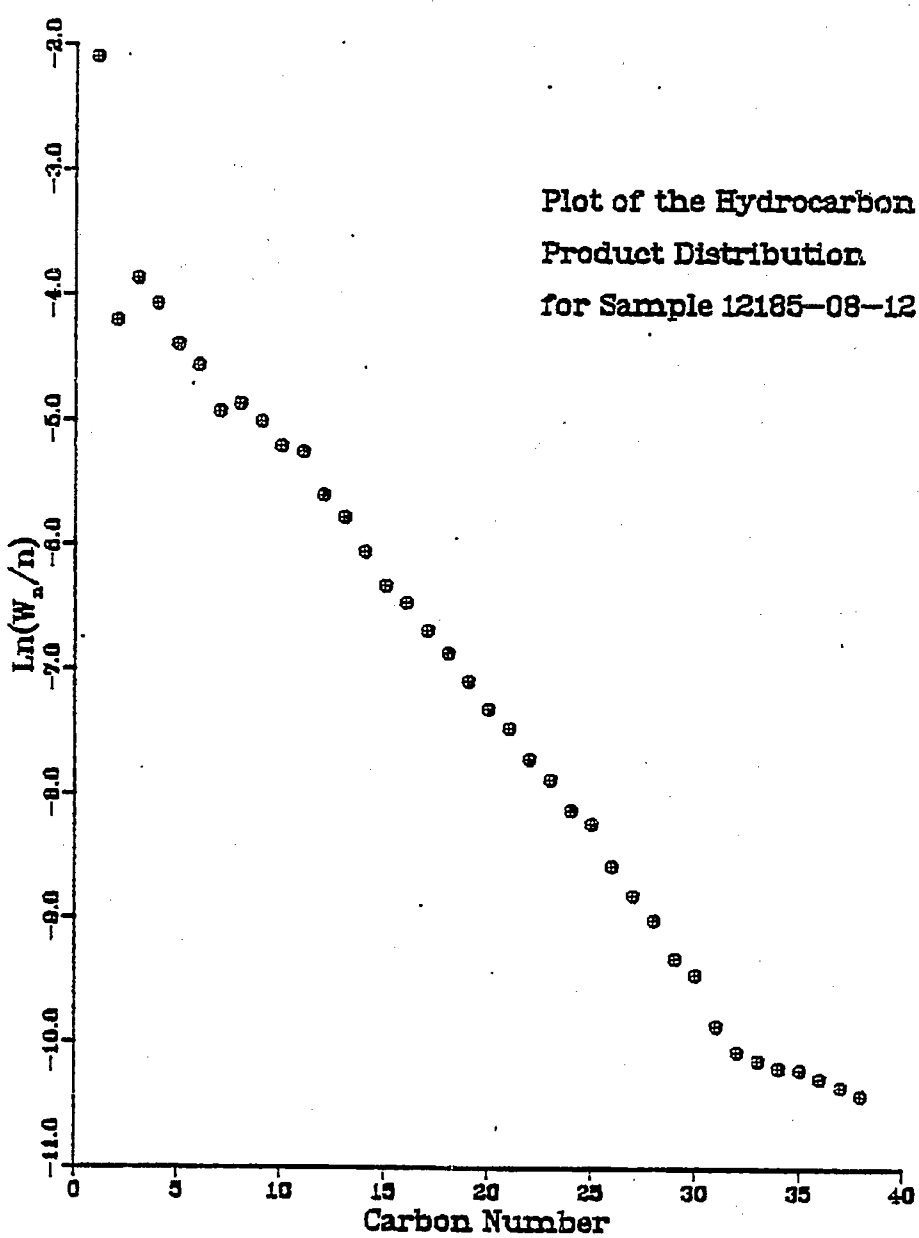
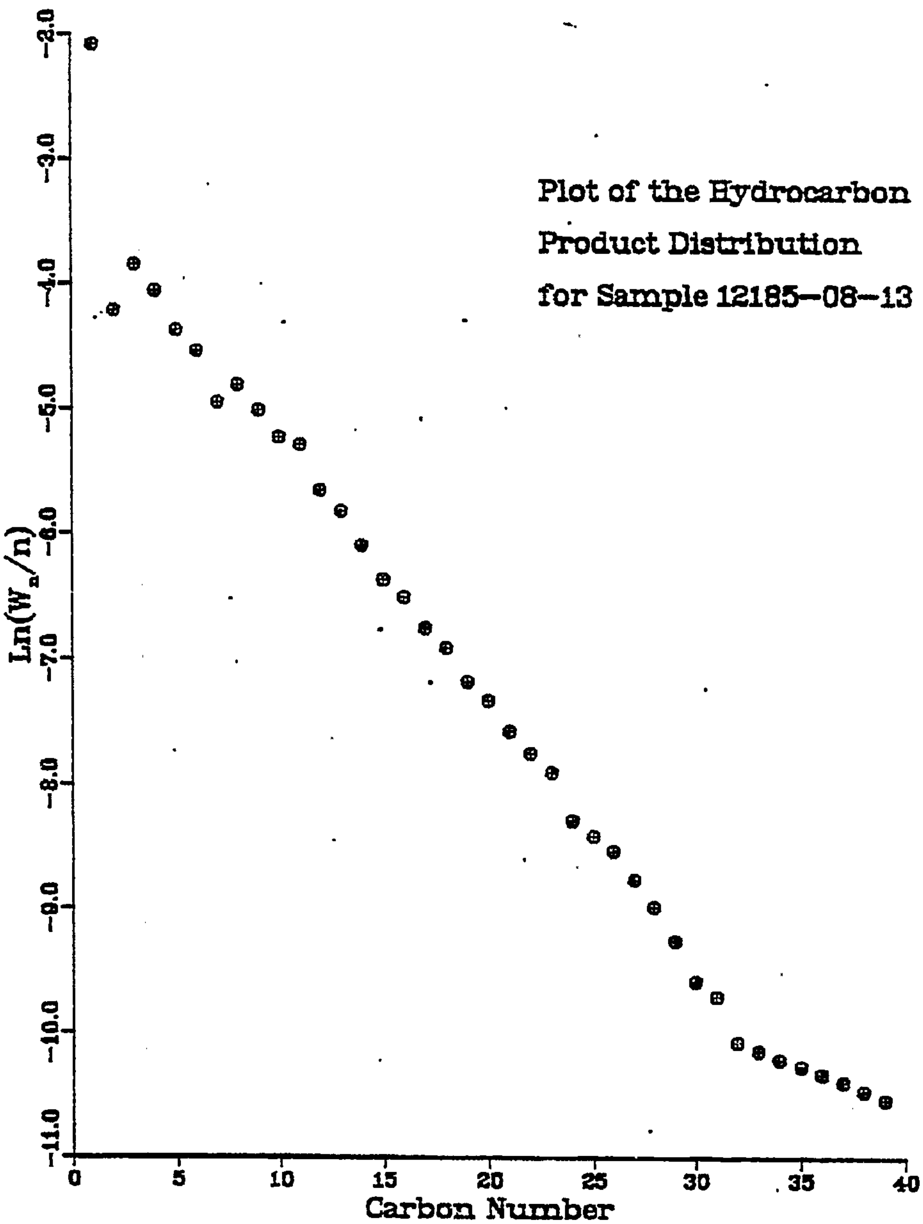

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-11
Ln(W_n/n)
Carbon Number

Fig. B169


Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-12
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number
Fig. B170


Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-13
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number
Fig. B171

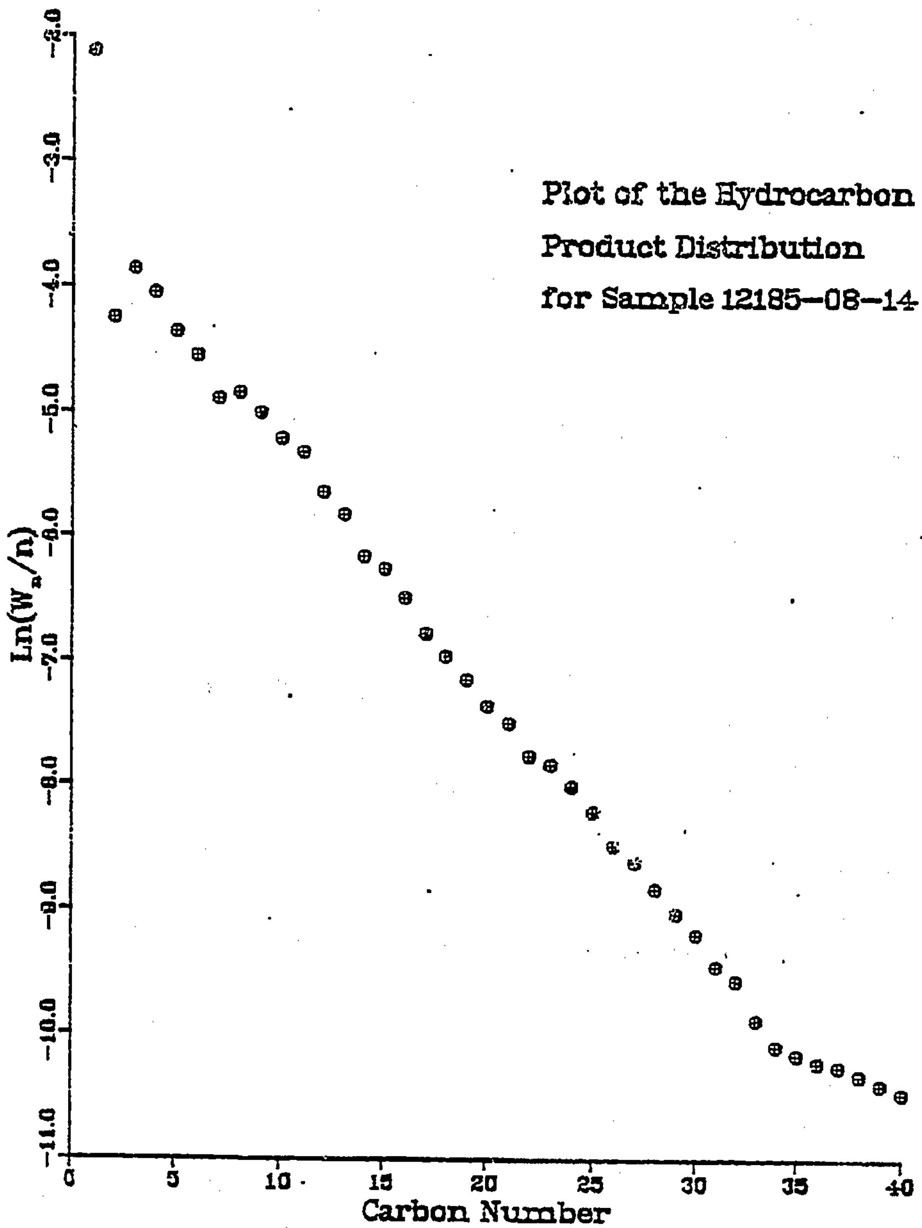

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-14
Ln(W_n/n)
Carbon Number

Fig. B172

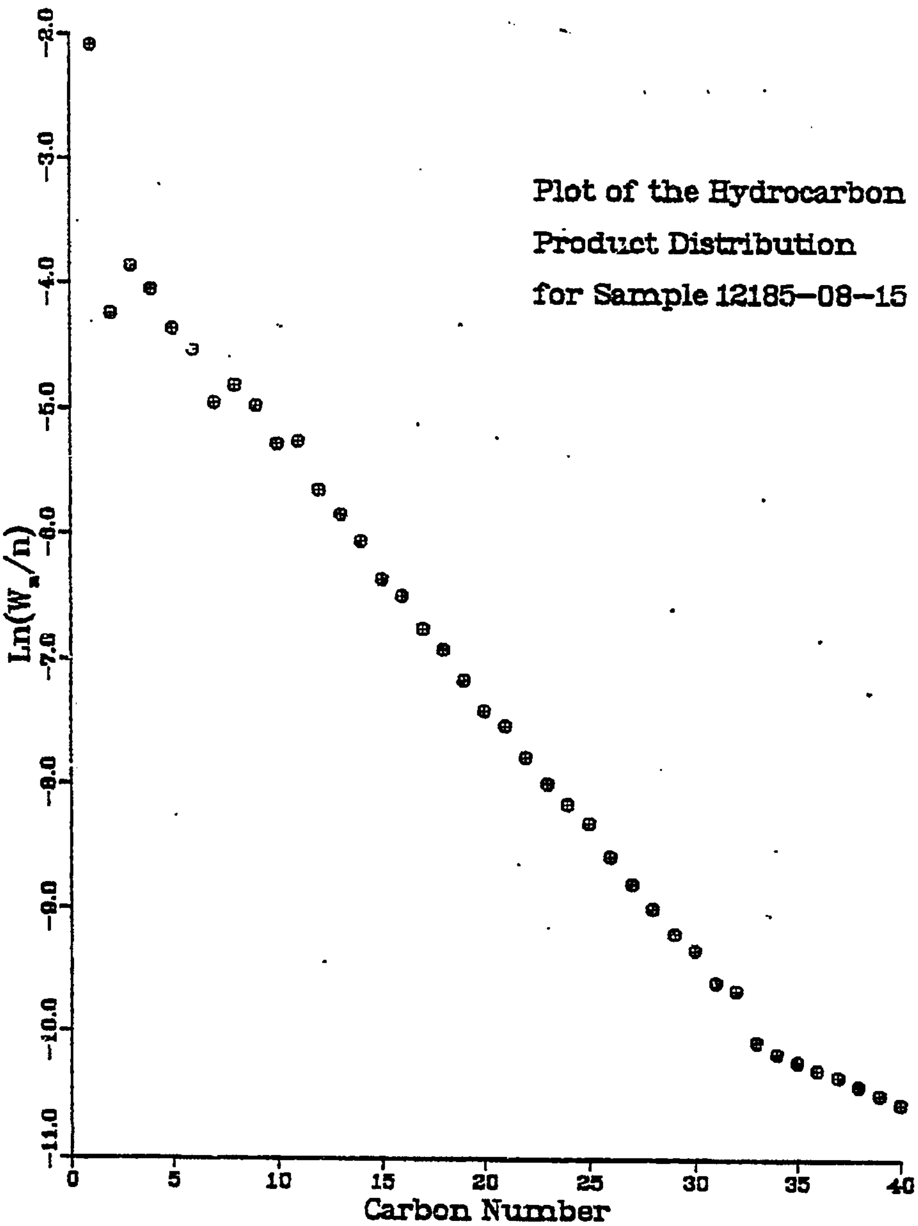
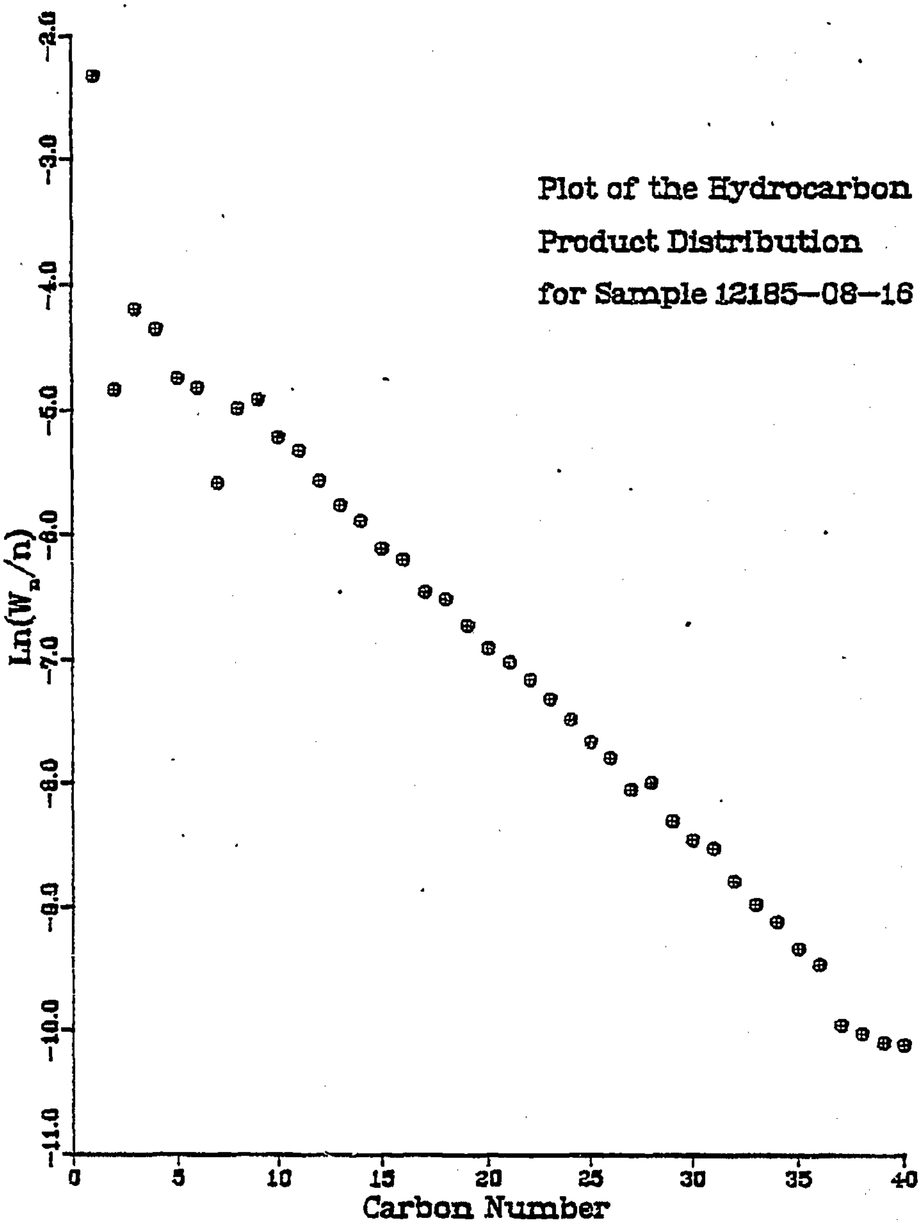
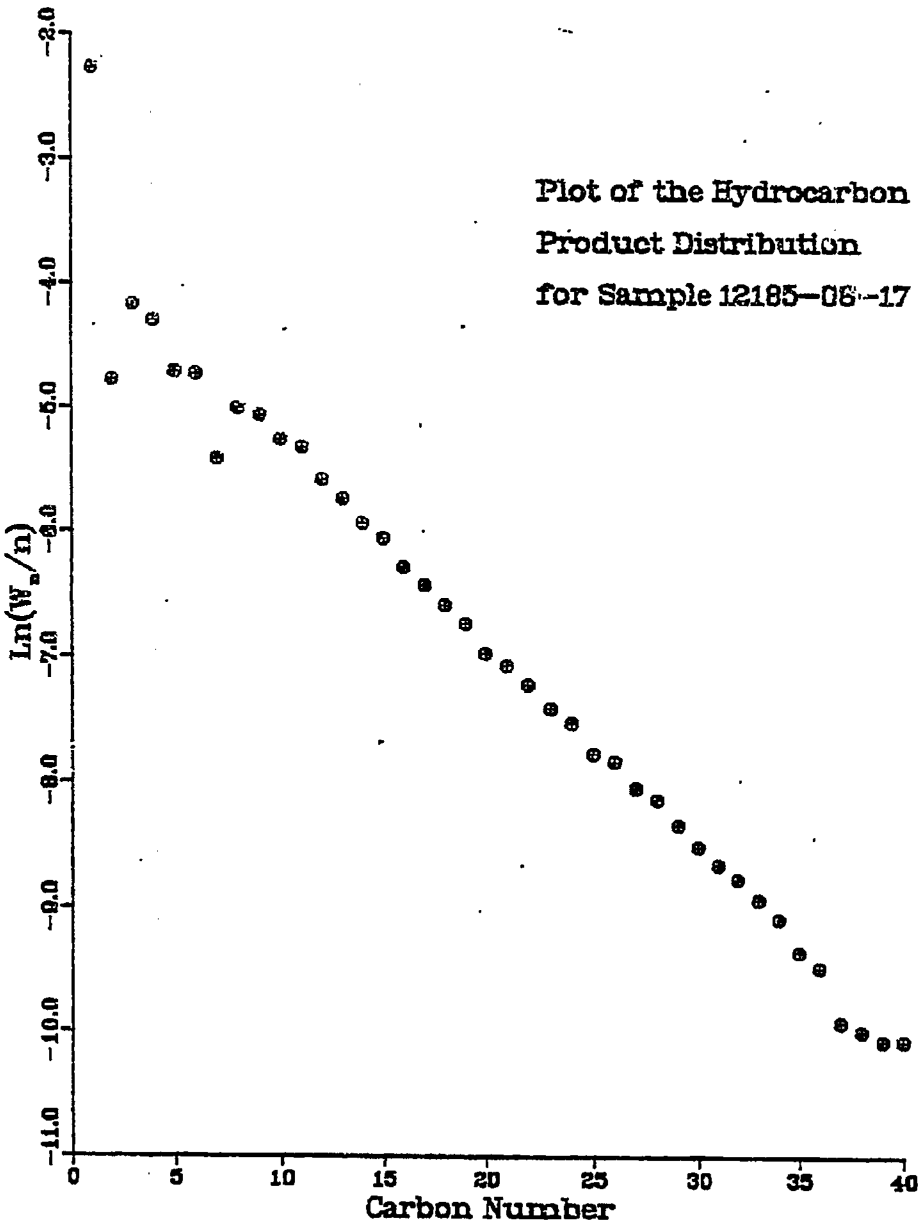

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-15
Ln(W_n/n)
Carbon Number
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40

Fig. B173



Plot of the Hydrocarbon
Product Distribution
for Sample 12185—08—16
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B174



Plot of the Hydrocarbon
Product Distribution
for Sample 12185—06—17
$Ln(W_n/n)$
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B175

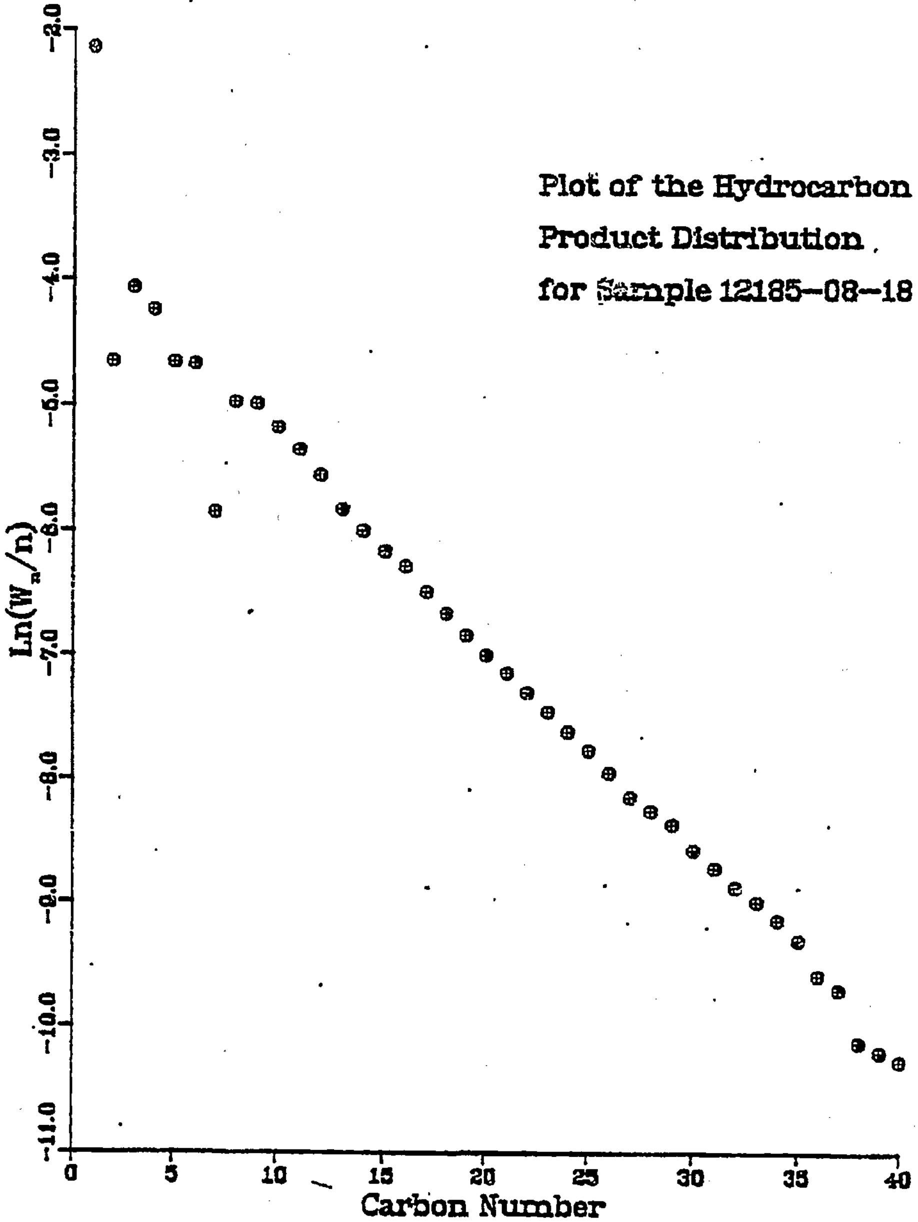

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-18
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B176

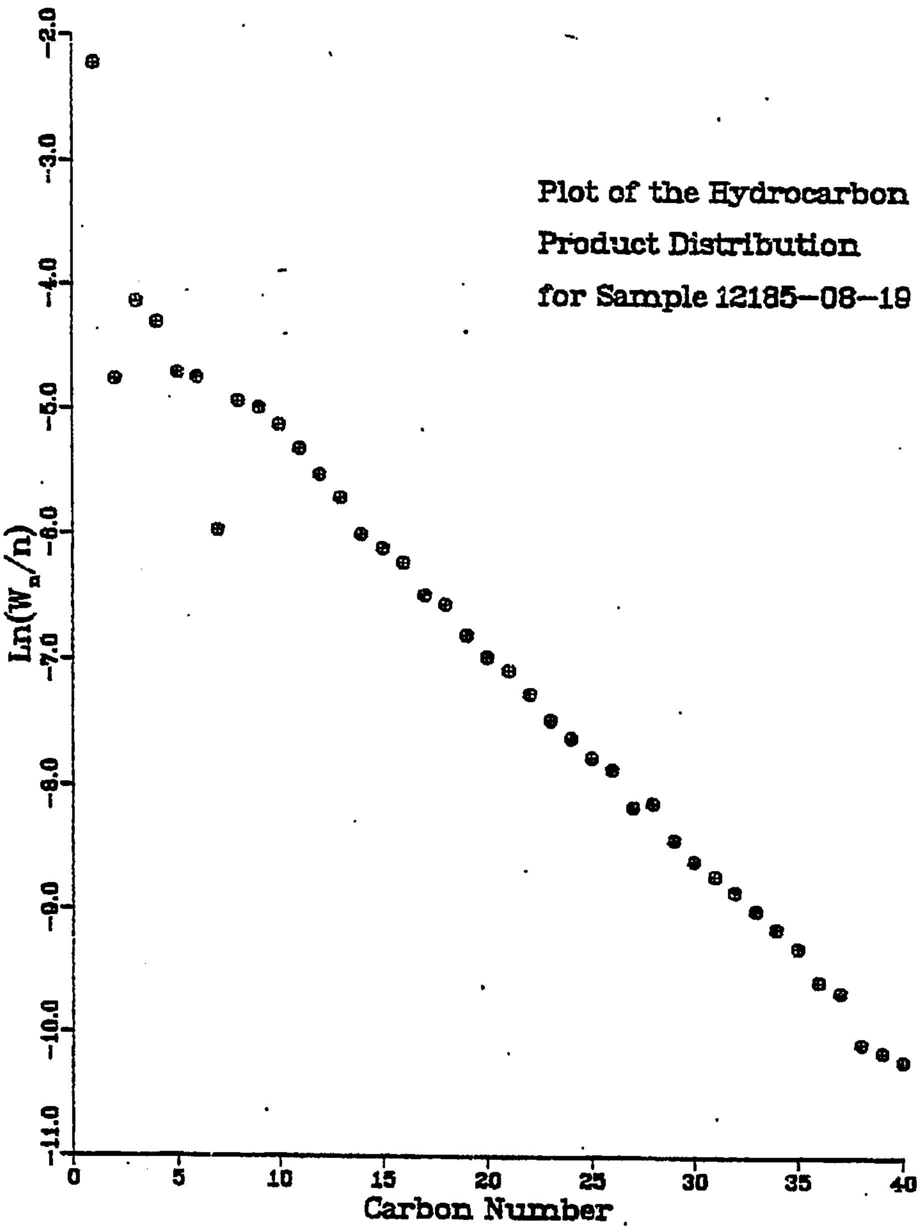
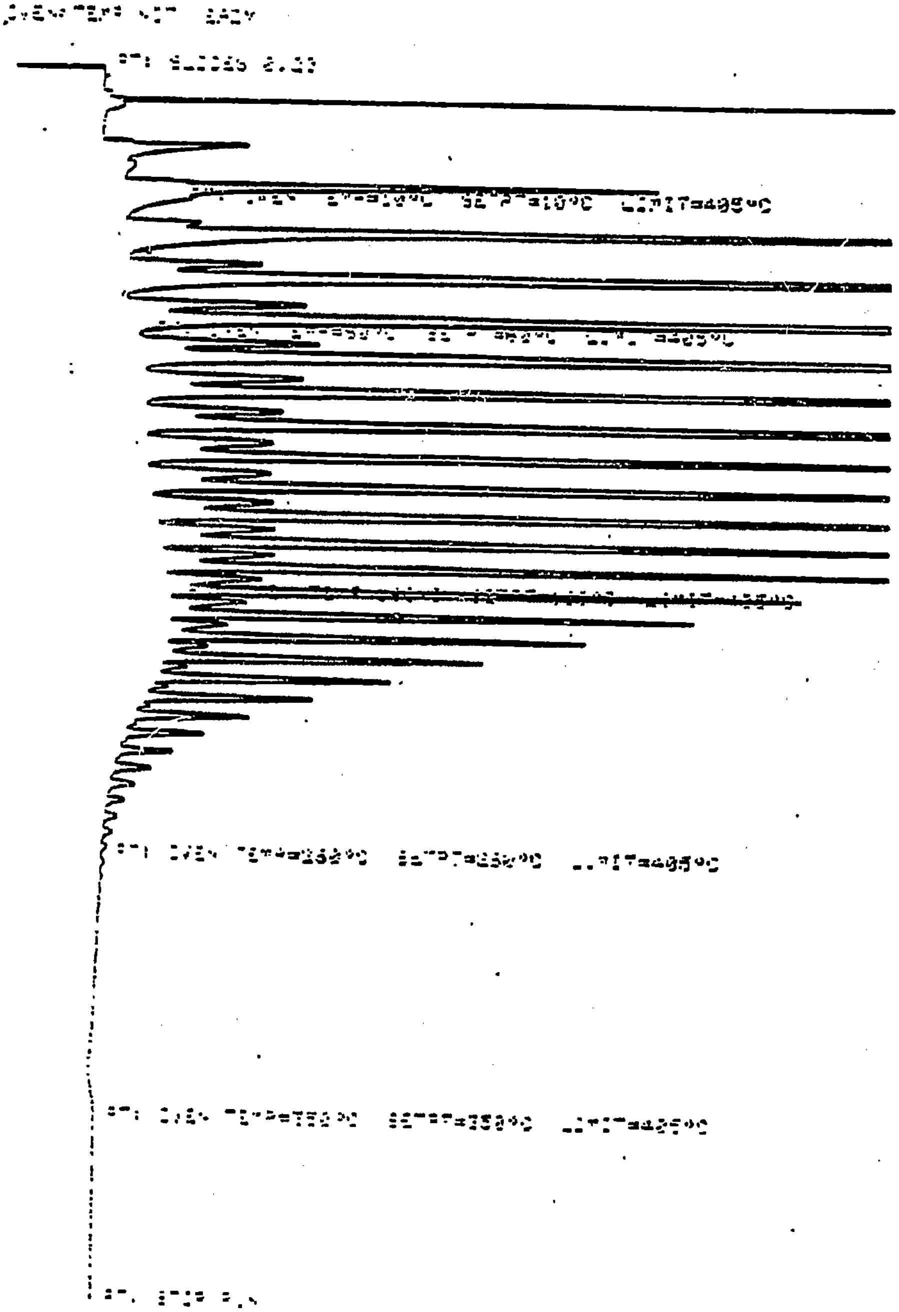

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-08-19
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B177



12185-08-01

Fig. B178

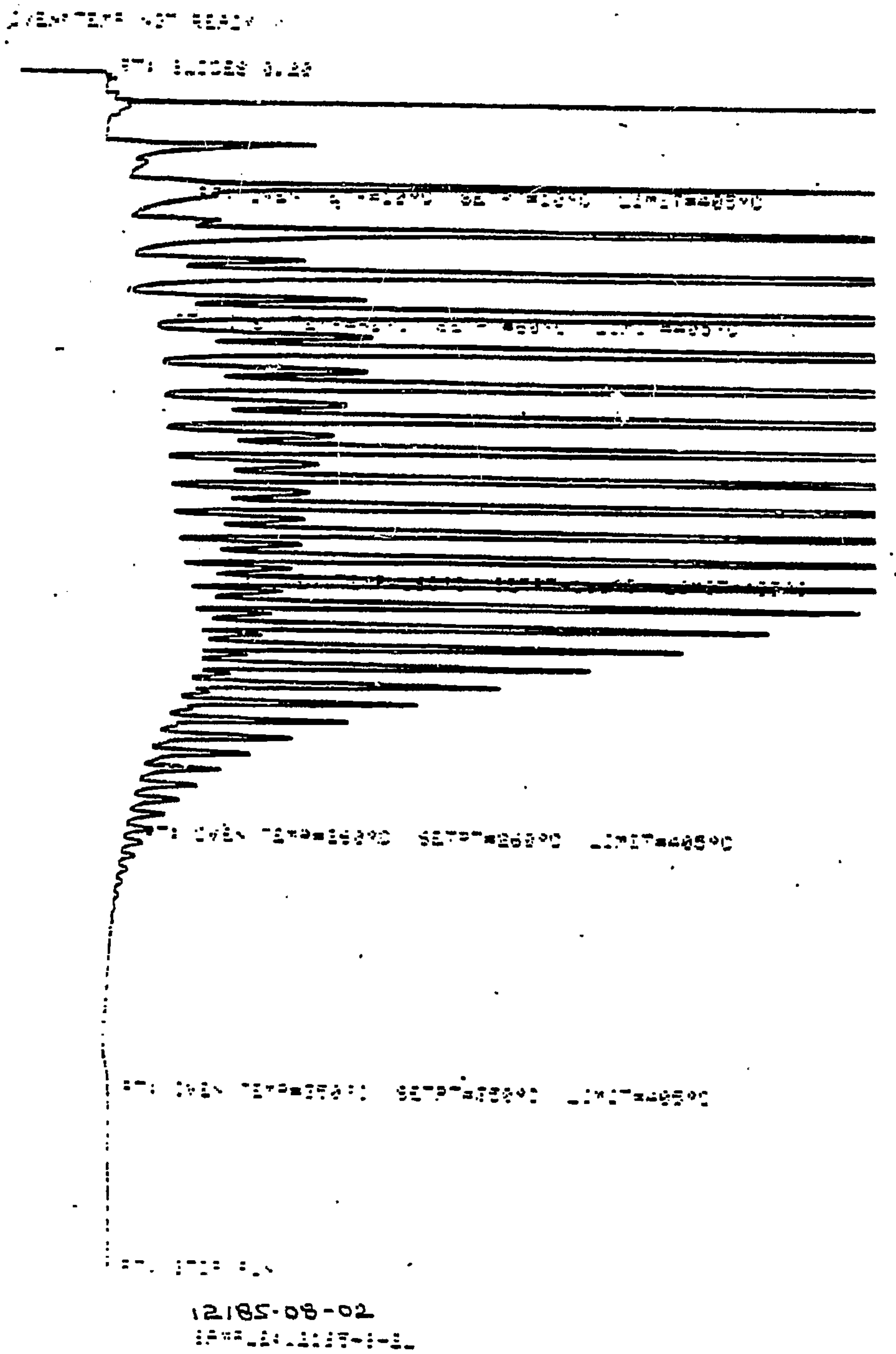


Fig. B179

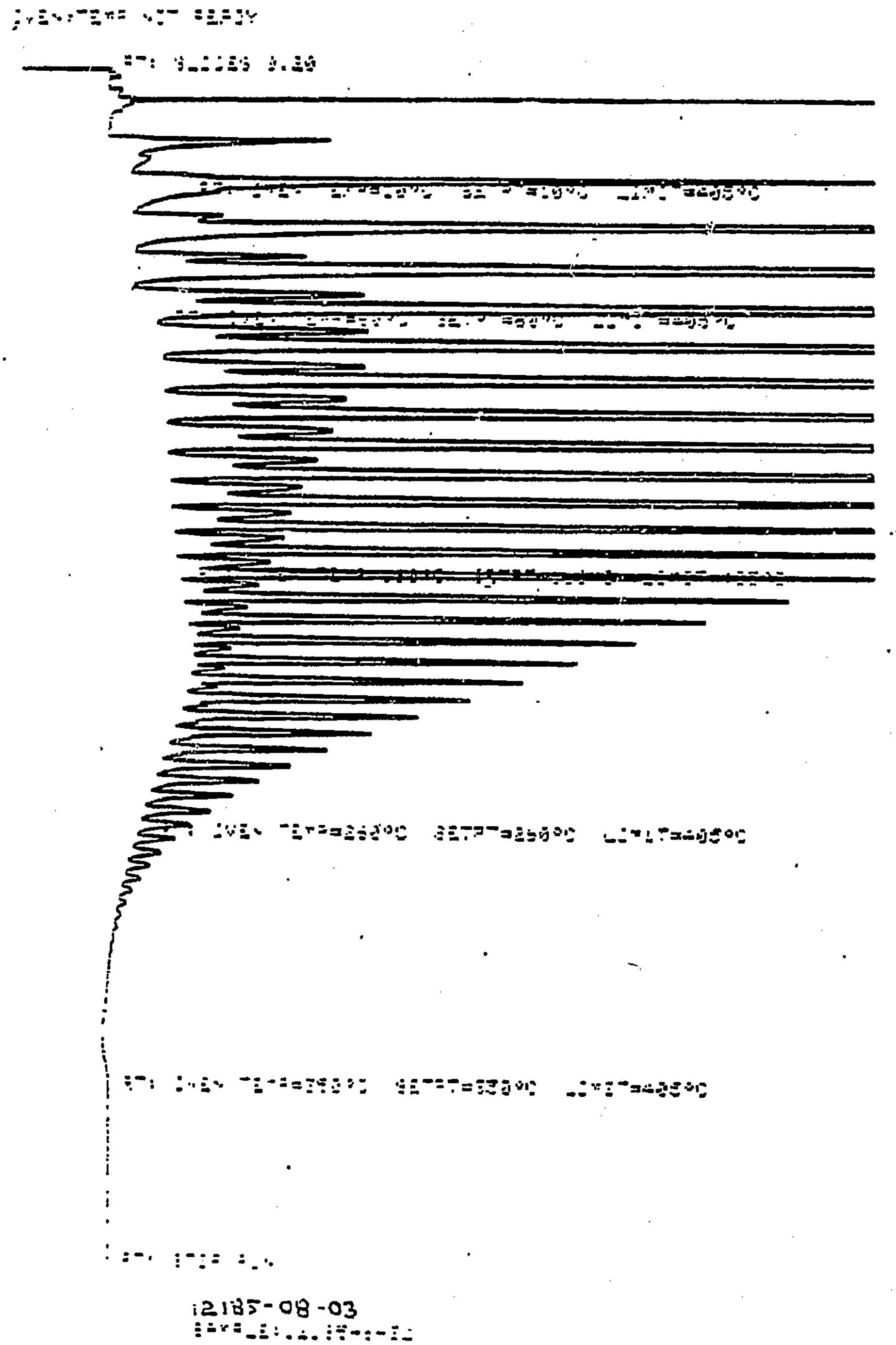


Fig. B180

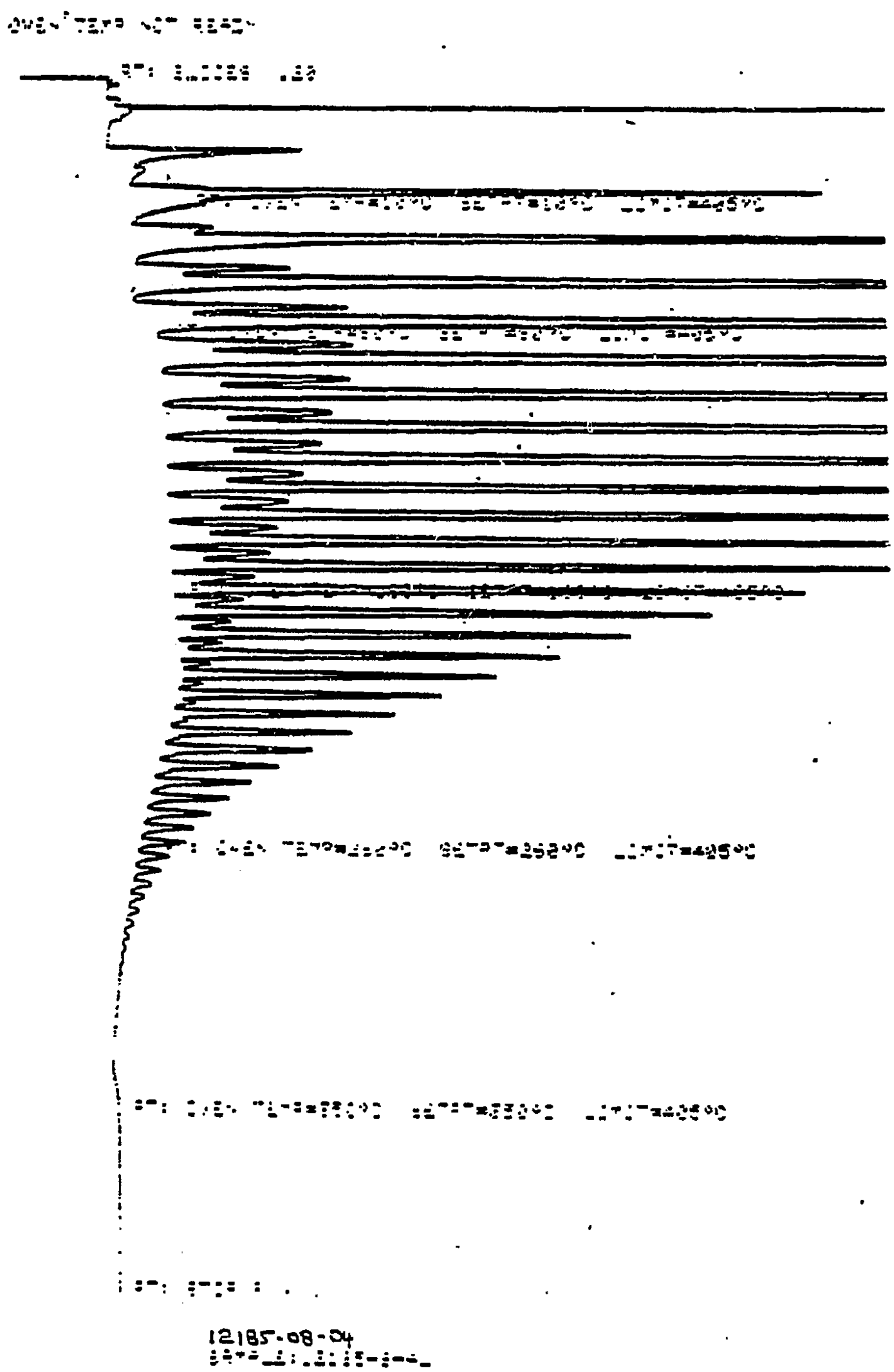
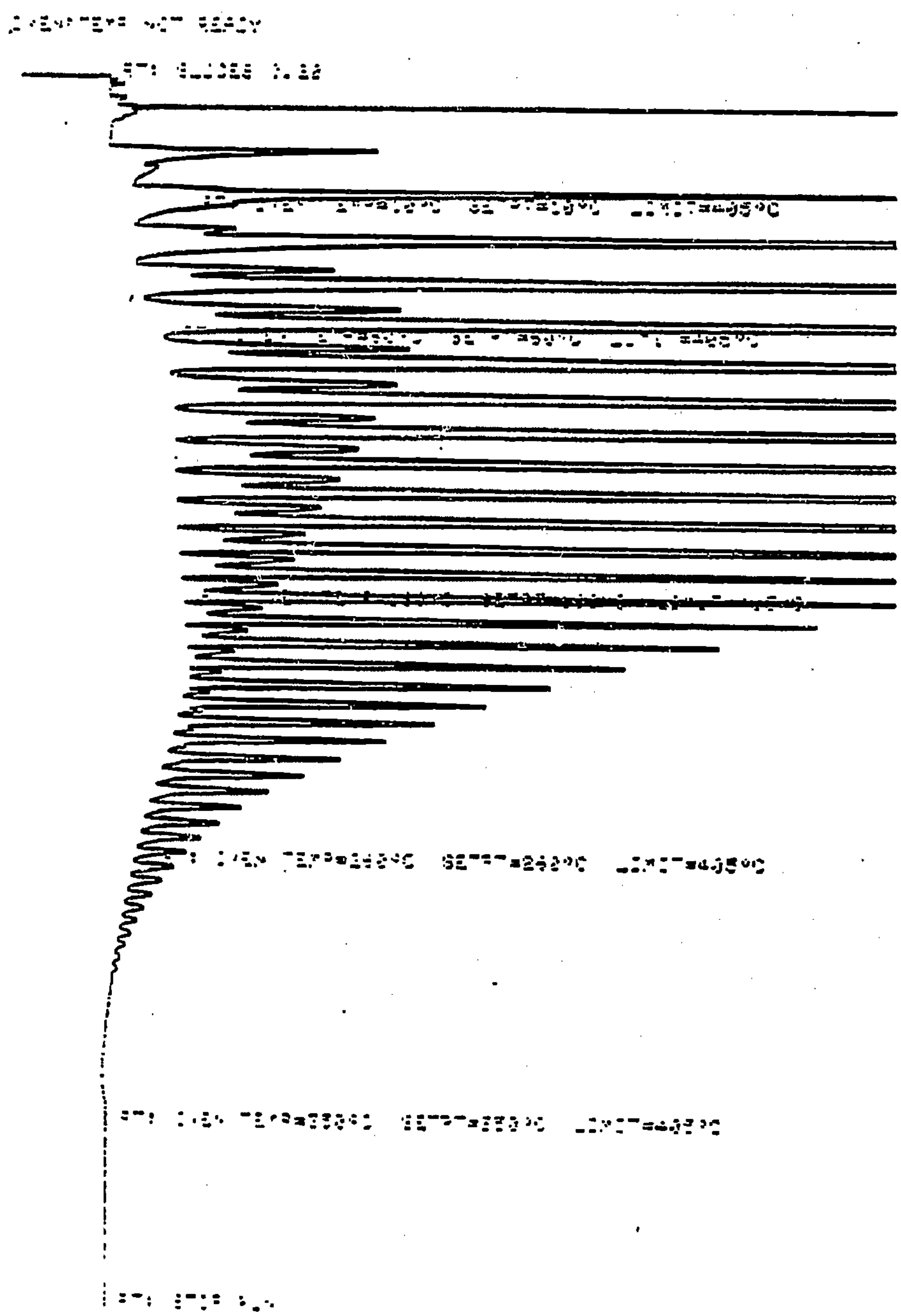


Fig. B181



12185-08.05

[illegible] Fig. B182

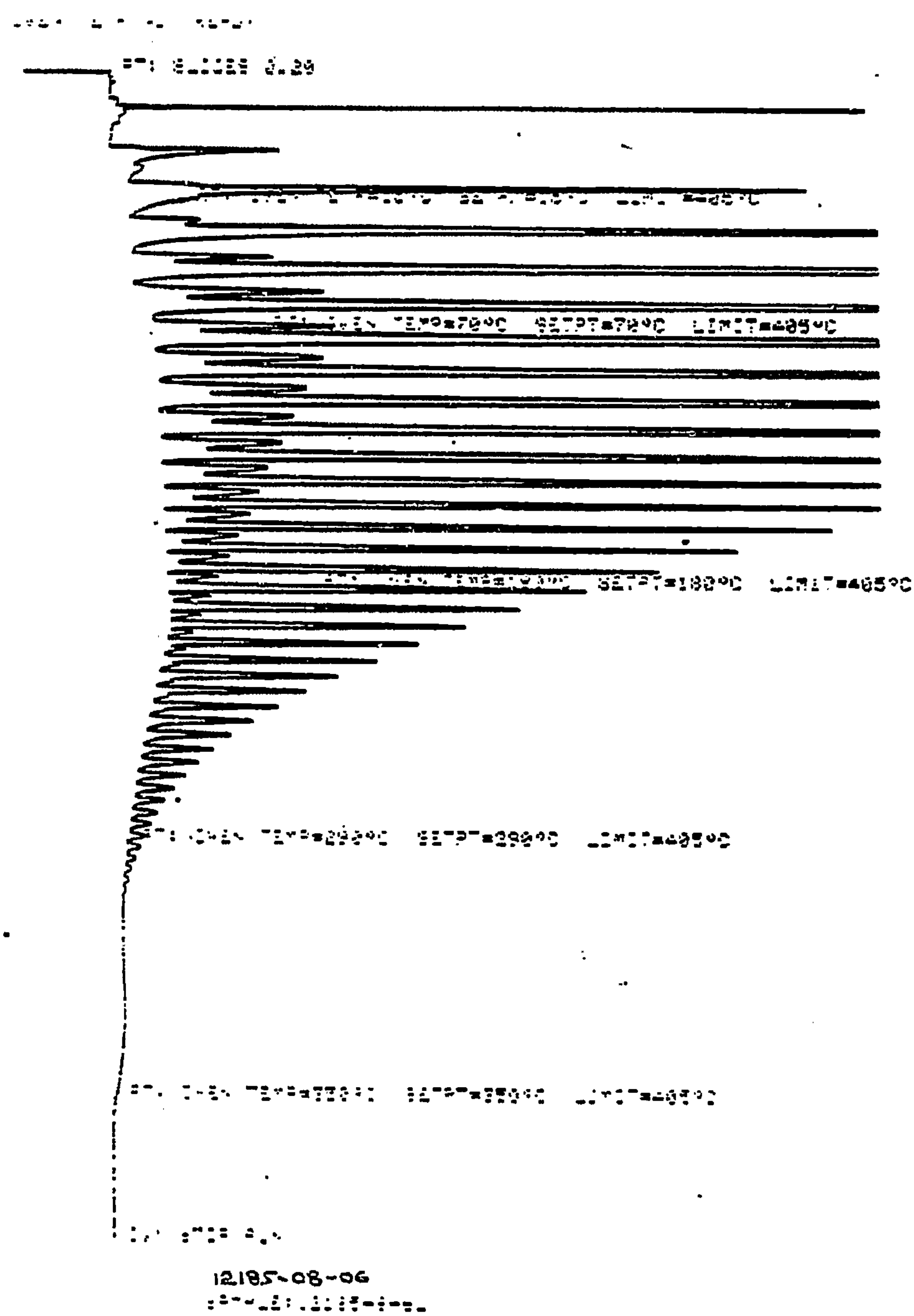


Fig. B183

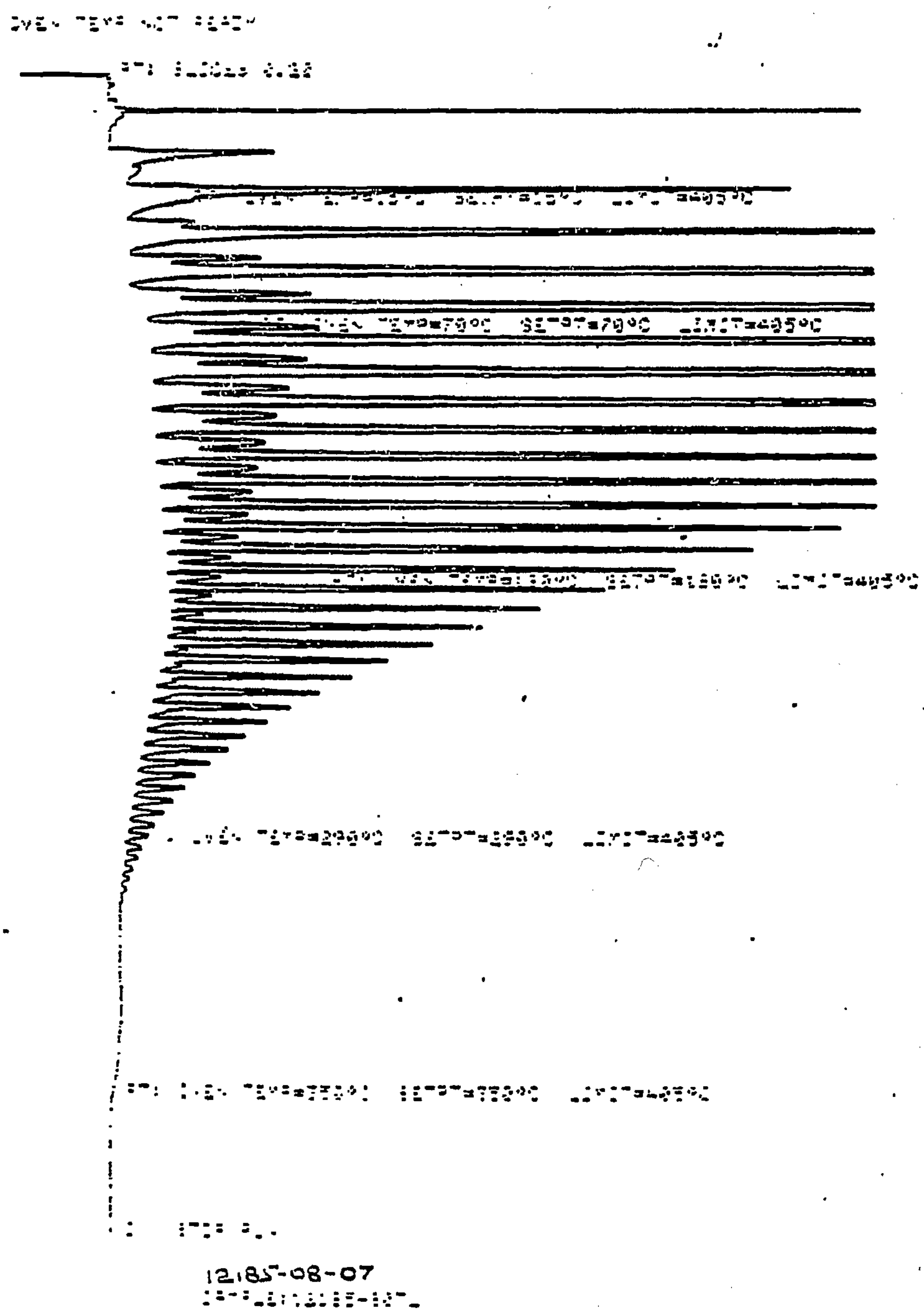


Fig. B184

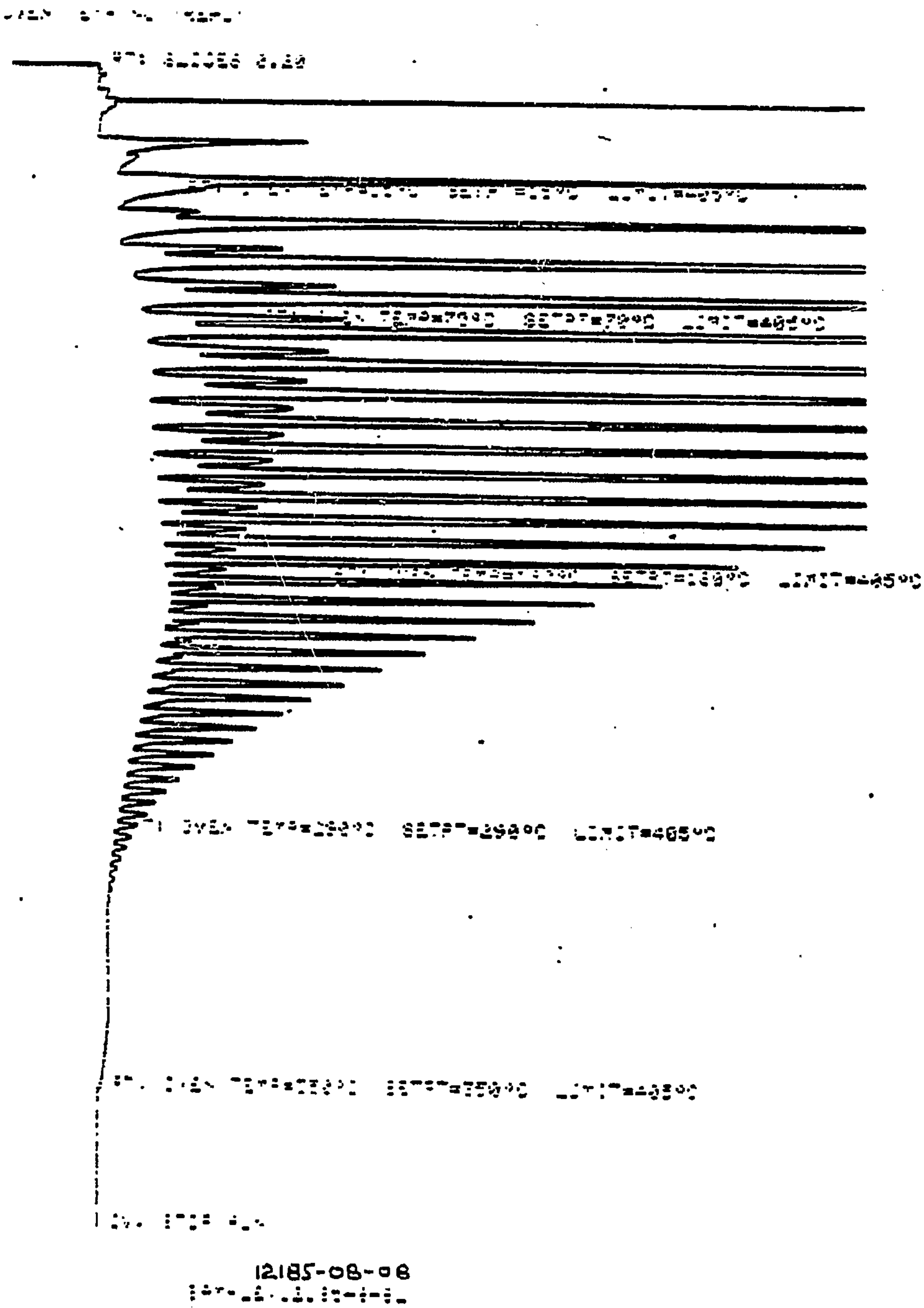


Fig. B185

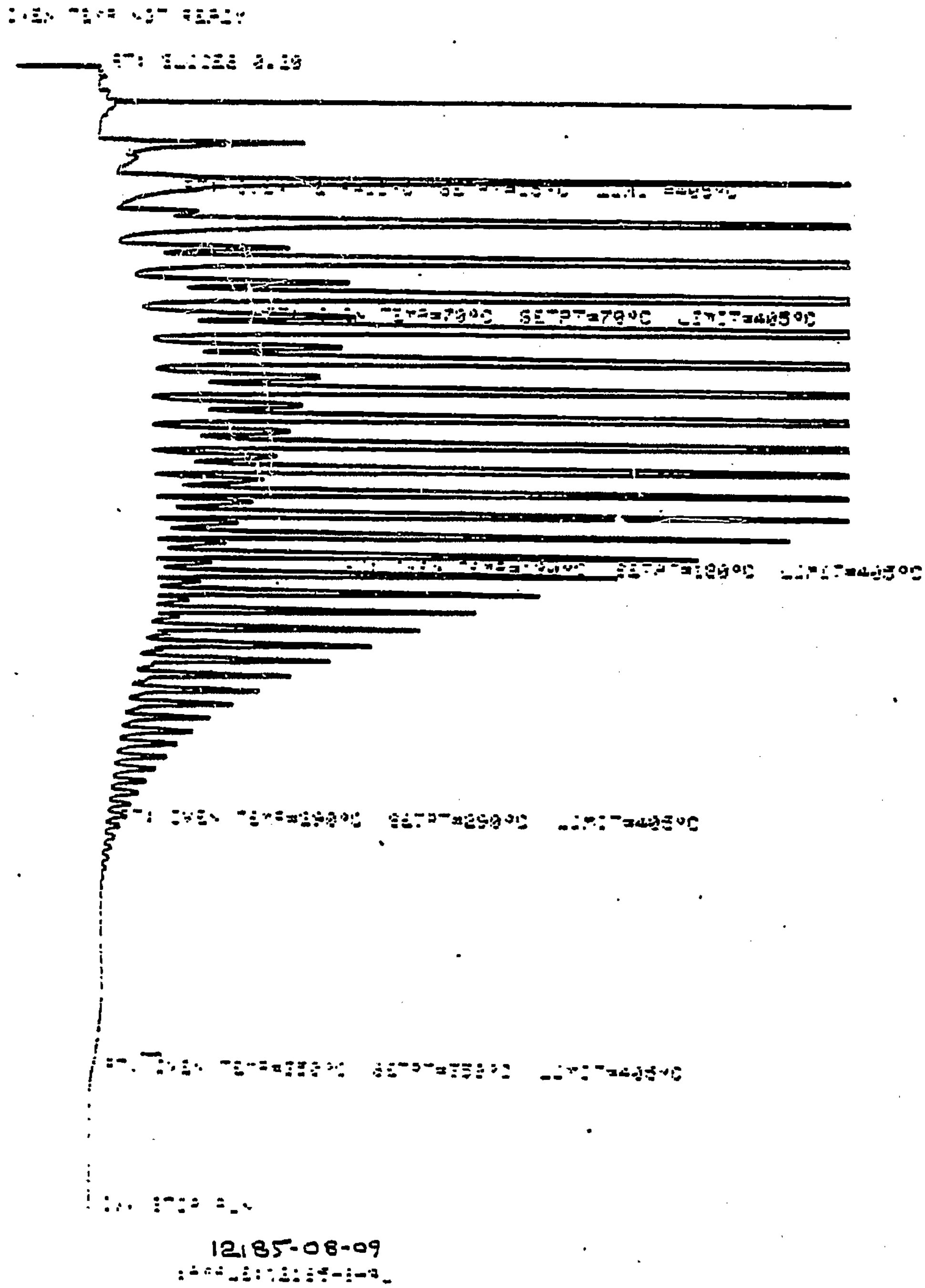
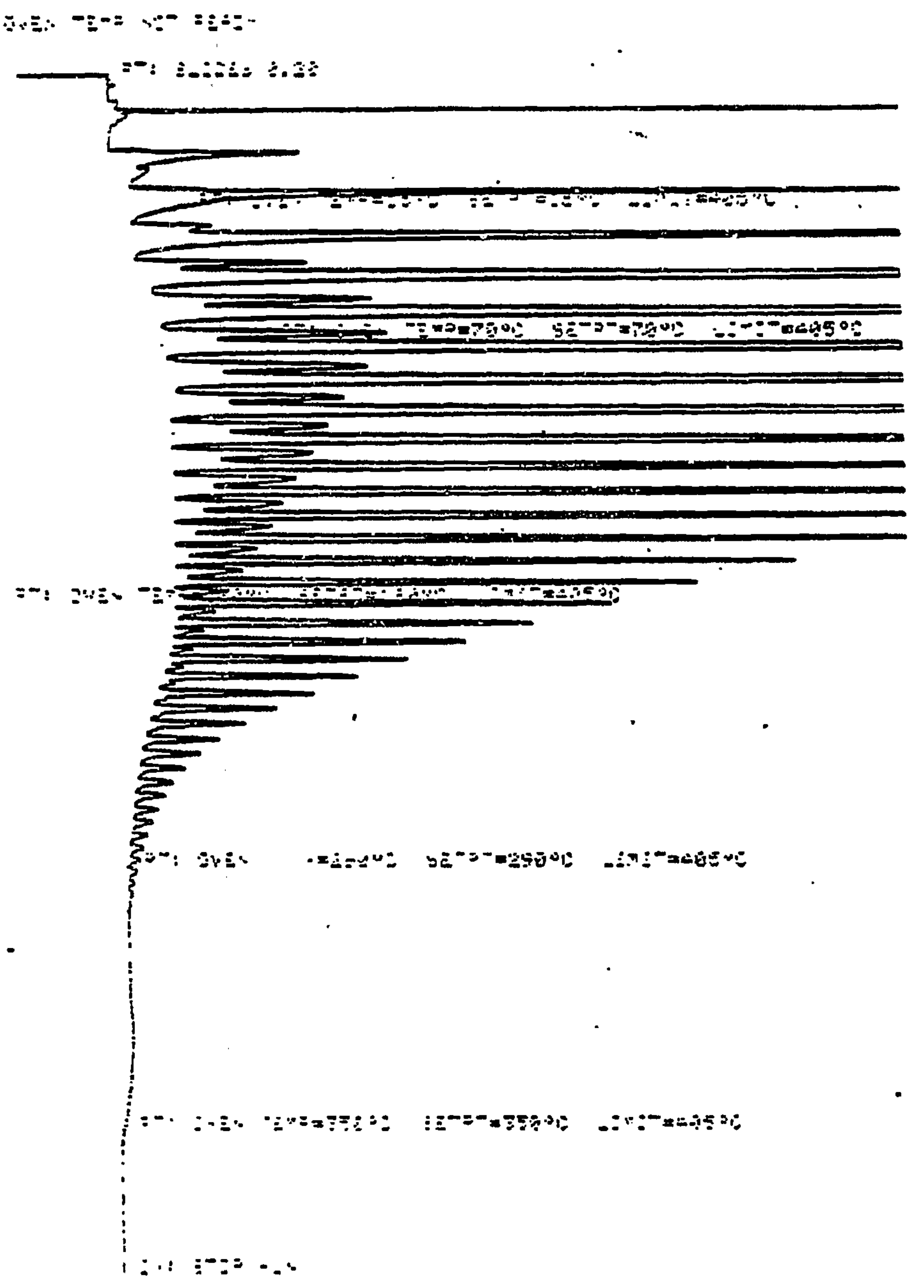
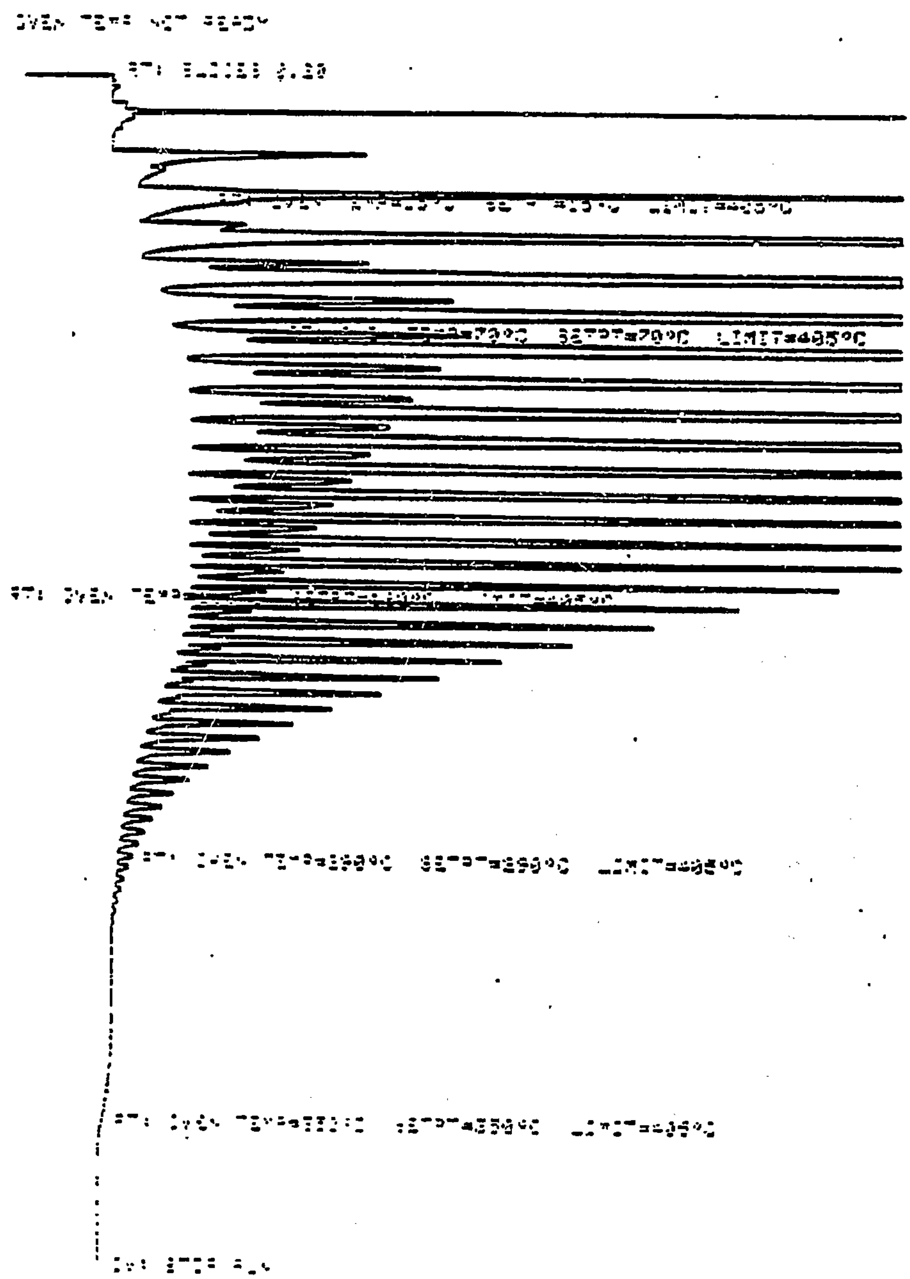


Fig. B186



12185-08-10

Fig. B187



12185-08-11

Fig. B188

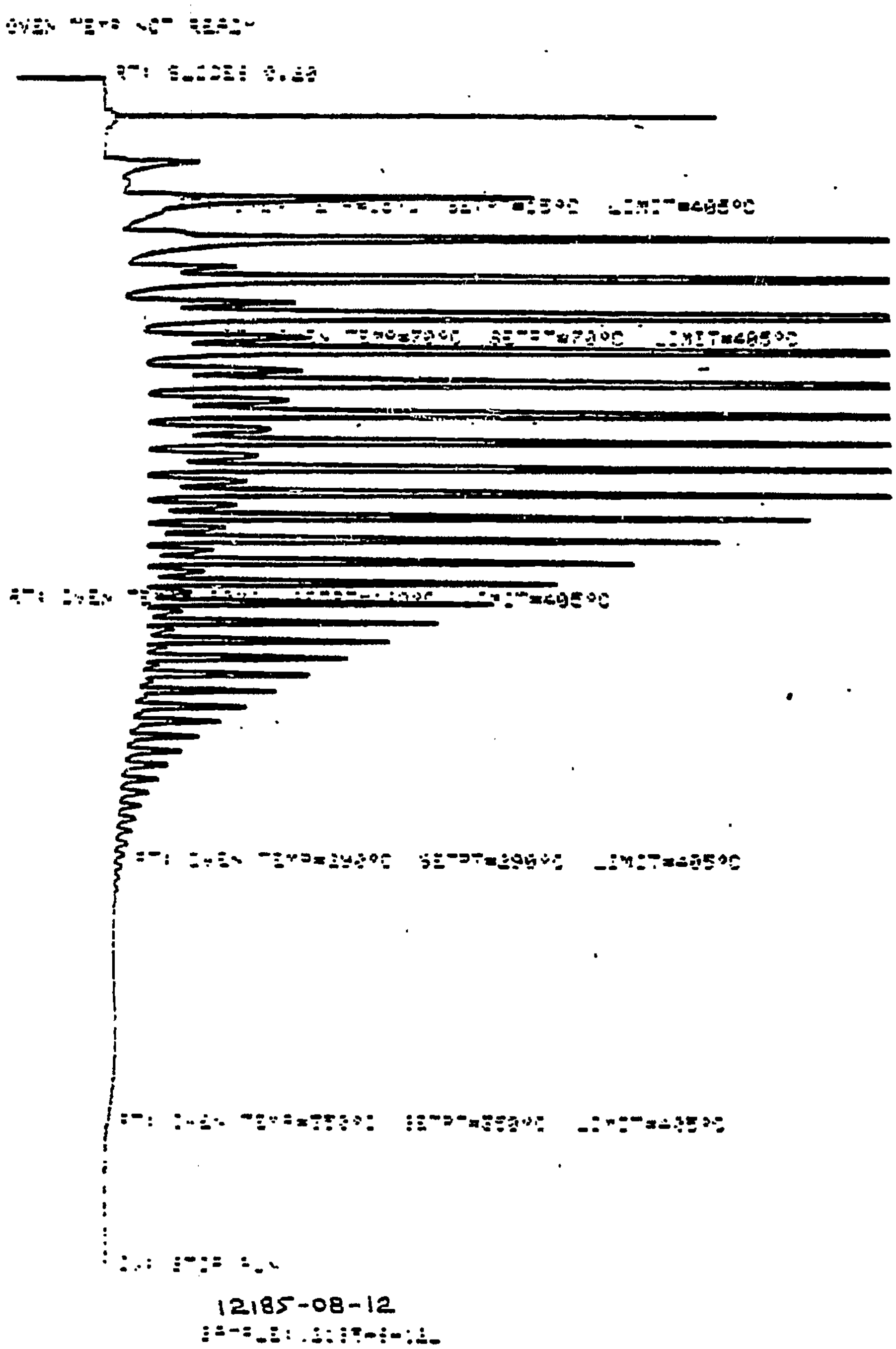


Fig. B189

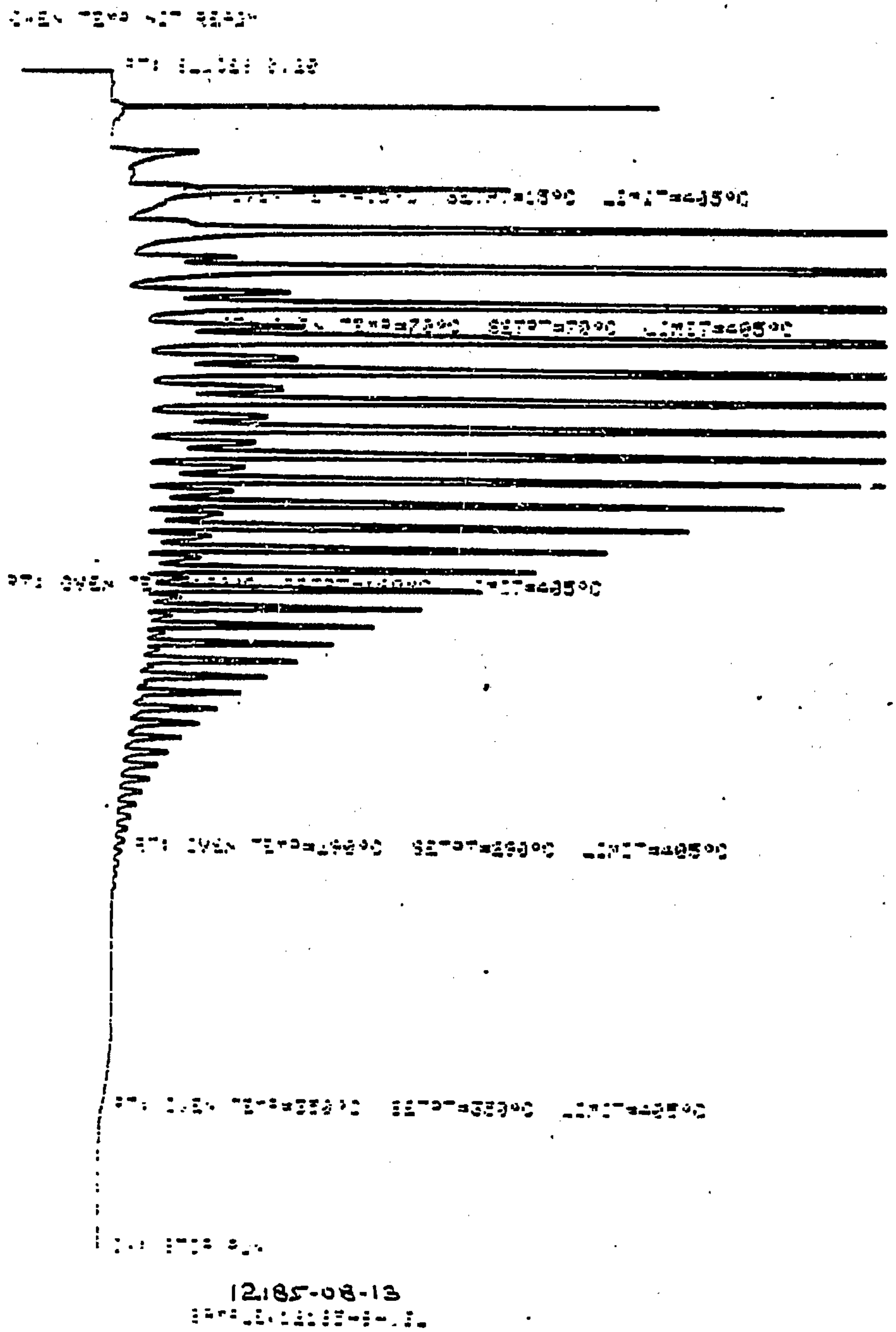
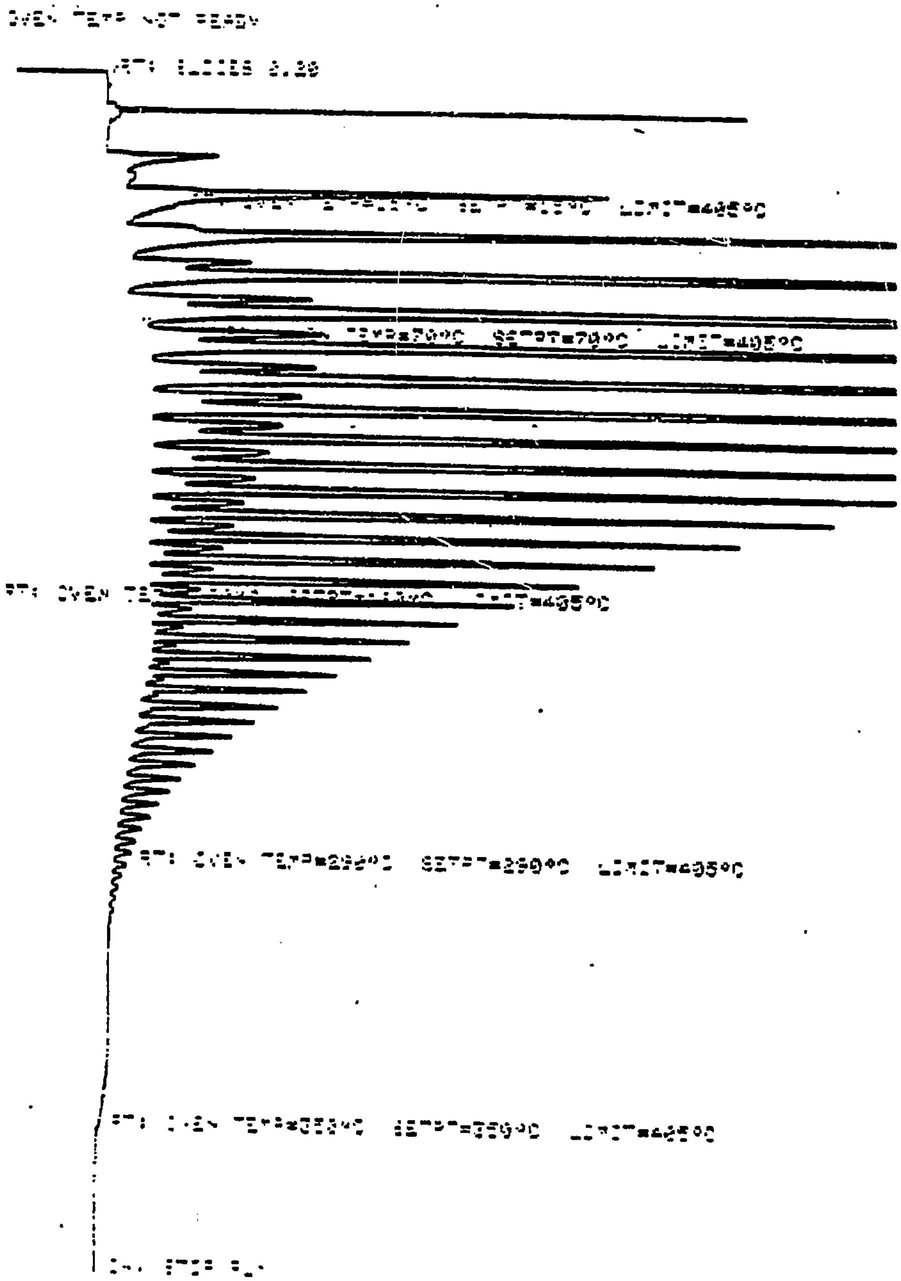


Fig. B19C



12185-08-14

Fig. B191

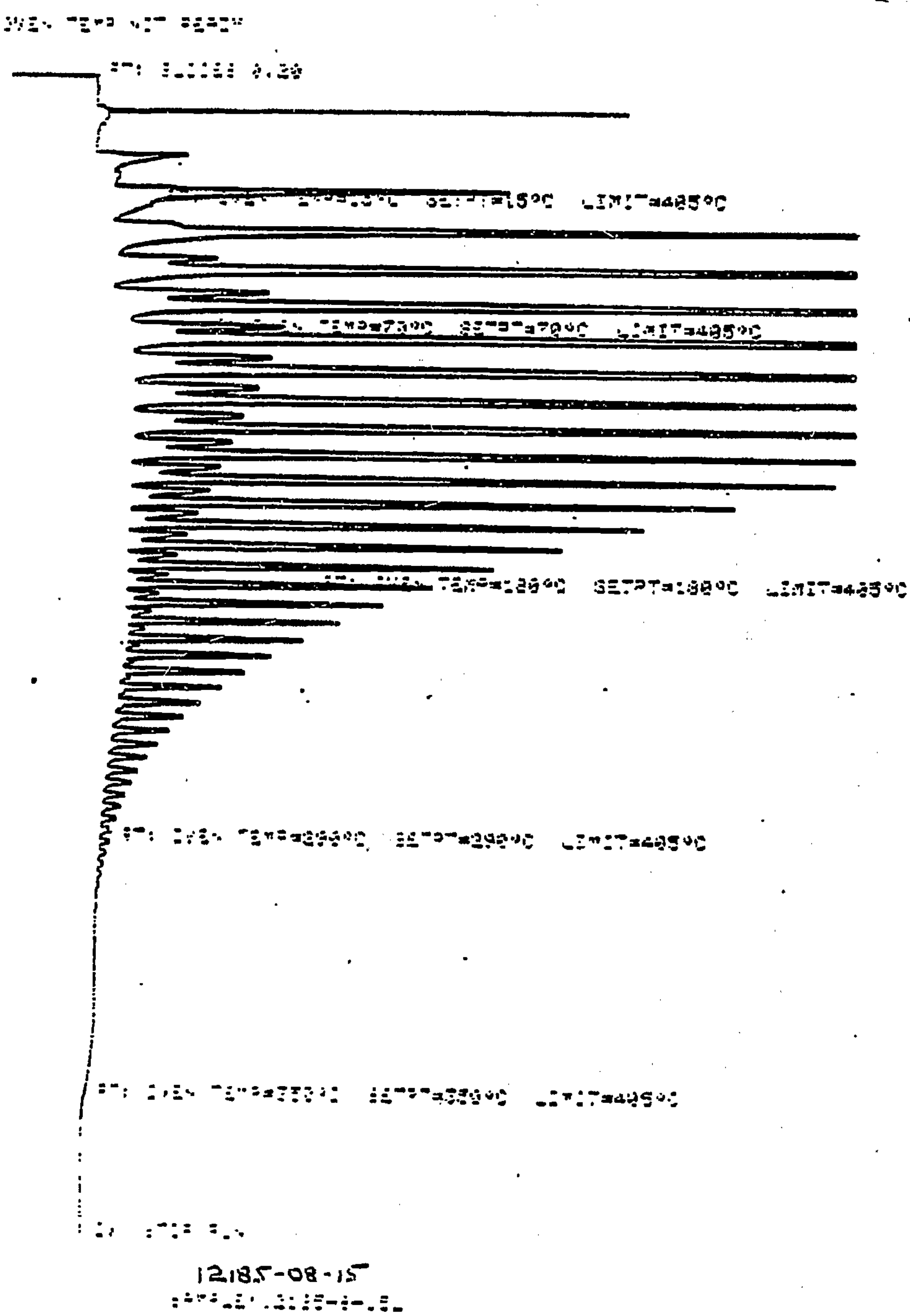


Fig. B192

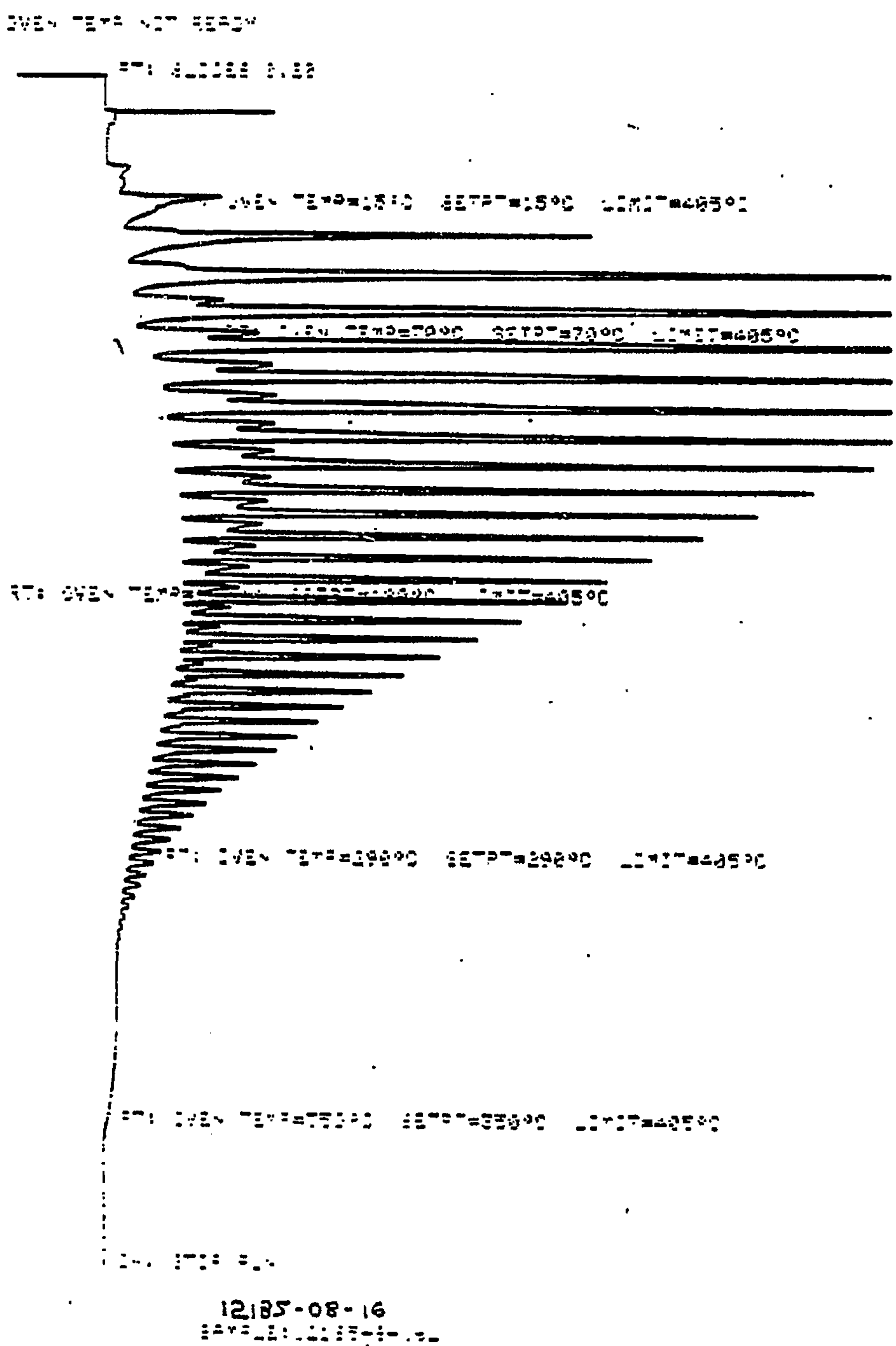
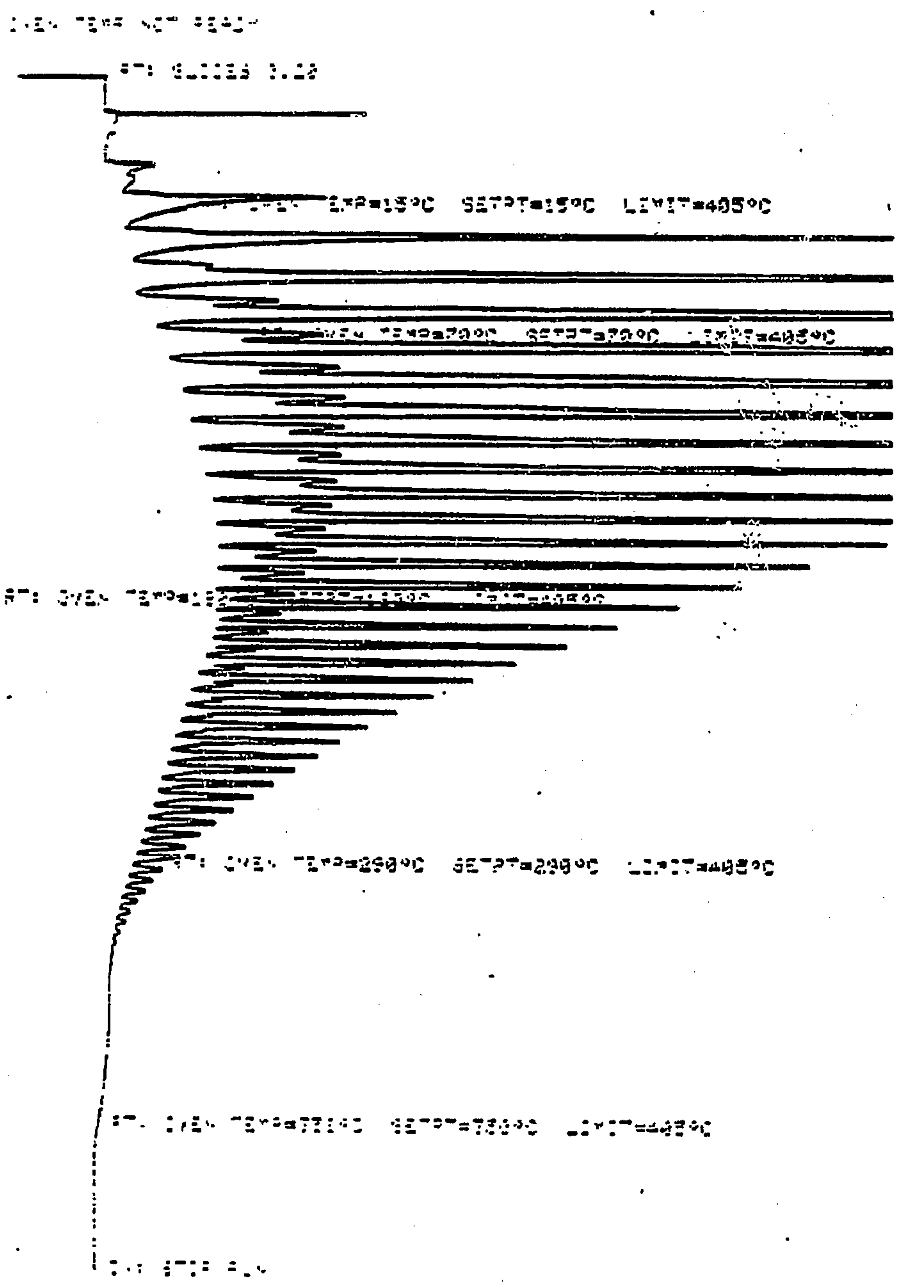


Fig. B193



12185-08-17

Fig. B194

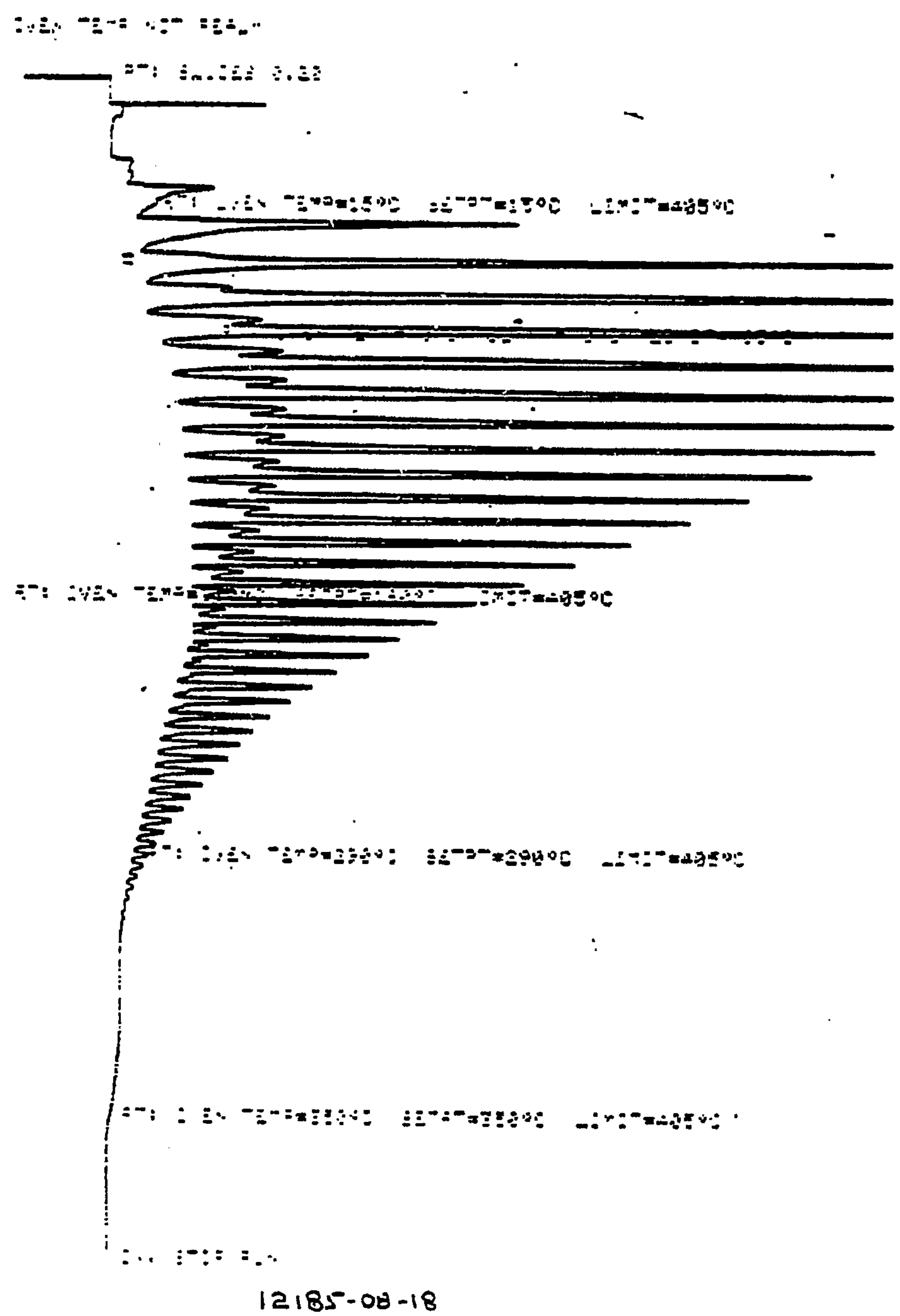
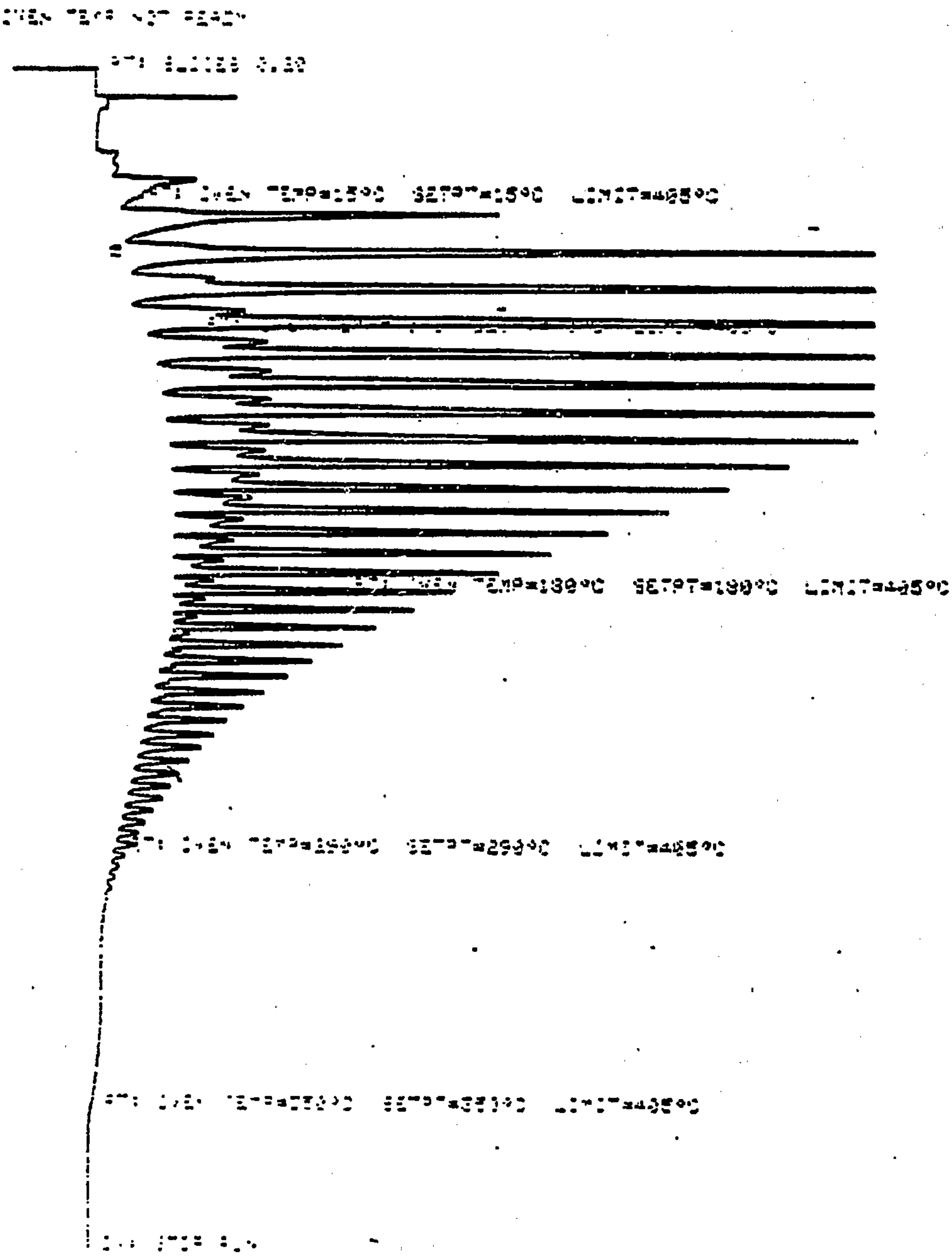


Fig. B195



12185-08-19

Fig. B196

RESULT OF SYNGAS OPERATION

RUN NO. 12185-08
CATALYST CO/X9/X10/X4-U103 12251-1 250 CC 103.9 G (TO 145.7 G +41.8G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12185-08-01	185-08-02	185-08-03	185-08-04	185-08-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	21.0	45.0	69.0	93.0	117.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	264	262	261	261	261
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	21.00	24.00	24.00	24.00	24.00
EFFLNT GAS LITER	632.80	808.90	828.80	842.20	857.90
GM AQUEOUS LAYER	186.73	213.68	214.38	211.29	208.33
GM OIL	66.09	98.39	103.17	98.78	97.64
MATERIAL BALANCE					
GM ATOM CARBON %	84.40	93.11	94.44	94.69	95.88
GM ATOM HYDROGEN %	88.87	96.64	97.89	97.86	98.44
GM ATOM OXYGEN %	93.25	97.66	98.63	98.66	98.89
RATIO CHX/(H2O+CO2)	0.7802	0.8840	0.8924	0.8964	0.9200
RATIO X IN CHX	2.3784	2.3571	2.3565	2.3668	2.3692
USAGE H2/CO PRODT	1.8386	1.8392	1.8627	1.8691	1.8685
FEED H2/CO FRM EFFLNT	1.0530	1.0379	1.0365	1.0334	1.0267
RESIDUAL H2/CO RATIO	0.3976	0.4235	0.4294	0.4351	0.4371
RATIO CO2/(H2O+CO2)	0.1738	0.1465	0.1360	0.1343	0.1293
K SHIFT IN EFFLNT	0.0836	0.0727	0.0676	0.0675	0.0649
SPECIFIC ACTIVITY SA	2.5586	2.4148	2.4038	2.3120	2.2590
CONVERSION					
ON CO %	45.48	43.40	42.36	41.72	41.19
ON H2 %	79.42	76.90	76.12	75.46	74.96
ON CO+H2 %	62.89	60.47	59.54	58.87	58.30
PRDT SELECTIVITY,WT %					
CH4	12.59	11.24	11.10	11.49	11.56
C2 HC'S	2.75	2.48	2.46	2.67	2.62
C3H8	3.47	3.19	3.17	3.41	3.59
C3H6=	2.77	2.50	2.37	2.53	2.42
C4H10	3.33	3.12	3.09	3.29	3.45
C4H8=	3.67	3.21	3.11	3.22	3.23
C5H12	4.11	3.86	3.74	4.06	4.18
C5H10=	1.78	1.52	1.46	1.56	1.57
C6H14	4.41	4.07	3.98	4.08	4.19
C6H12= & CYCLO'S	2.08	1.93	1.77	1.76	1.82
C7+ IN GAS	14.31	10.04	8.41	8.44	8.90
LIQ HC'S	44.73	52.85	55.33	53.49	52.45
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B11

SUB-GROUPING					
C1 -C4	28.58	25.73	25.30	26.61	26.88
C5 -420 F	45.92	43.09	41.78	42.63	43.22
420-700 F	22.10	25.10	24.90	24.02	23.45
700-END PT	3.40	6.08	8.02	6.74	6.45
C5+-END PT	71.42	74.27	74.70	73.39	73.12
ISO/NORMAL MOLE RATIO					
C4	0.0209	0.0179	0.0202	0.0182	0.0194
C5	0.0812	0.0767	0.0762	0.0725	0.0720
C6	0.1028	0.0918	0.1010	0.0882	0.0867
C4=	0.1045	0.1037	0.1024	0.1042	0.1069
PARAFFIN/OLEFIN RATIO					
C3	1.1951	1.2180	1.2778	1.2852	1.4176
C4	0.8754	0.9365	0.9592	0.9865	1.0313
C5	2.2400	2.4724	2.4944	2.5282	2.5864
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8076	0.8316	0.8401	0.8304	0.8274
RATIO CH4/(1-A)**2	3.4022	3.9659	4.3386	3.9959	3.8789
ALPHA FRM CORRELATION	0.8555	0.8525	0.8519	0.8513	0.8511
ALPHA (EXPTL/CORR)	0.9440	0.9755	0.9861	0.9755	0.9722
W%CH4 FRM CORRELATION	13.4718	13.9789	13.9601	14.1610	14.2300
W%CH4 (EXPTL/CORR)	0.9349	0.8042	0.7950	0.8116	0.8122
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLR OIL	CLD OIL	OIL WAX	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.7425*	0.7458*	0.7463*	0.7453*	0.7452*
N, REFRACTIVE INDEX	1.4189*	1.4200*	1.4204*	1.4195*	1.4197*
SIMULT'D DISTILATN					
10 WT % @ DEG F	260	263	262	261	260
16	301	303	303	302	302
50	454	465	470	454	453
84	640	666	687	667	665
90	681	711	745	728	727
RANGE(16-84 %)	339	363	384	365	363
WT % @ 420 F	43.00	41.00	40.50	42.50	43.00
WT % @ 700 F	92.40	88.50	85.50	87.40	87.70

Table B11, cont

RESULT OF SYNGAS OPERATION

RUN NO. 12185-08
CATALYST CO/X9/X10/X4-U103 12251-1 250 CC 103.9 G (TO 145.7 G +41.8 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12185-08-06	185-08-07	185-08-08	185-08-09	185-08-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	139.5	166.2	190.2	213.2	237.2
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	261	260	260	260	261
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	22.50	26.75	24.00	23.00	24.00
EFFLNT GAS LITER	816.43	984.84	887.13	856.55	894.05
GM AQUEOUS LAYER	194.62	230.13	208.58	196.49	204.25
GM OIL	88.71	99.41	86.39	87.12	84.12
MATERIAL BALANCE					
GM ATOM CARBON %	95.61	95.34	94.40	95.84	95.40
GM ATOM HYDROGEN %	97.44	98.88	97.67	99.02	98.11
GM ATOM OXYGEN %	99.81	98.92	99.56	99.08	99.53
RATIO CHX/(H2O+CO2)	0.8881	0.9029	0.8609	0.9111	0.8875
RATIO X IN CHX	2.3763	2.3784	2.3797	2.3732	2.3941
USAGE H2/CO PRODT	1.8950	1.9122	1.9614	1.9239	1.9189
FEED H2/CO FRM EFFLNT	1.0191	1.0372	1.0347	1.0331	1.0285
RESIDUAL H2/CO RATIO	0.4378	0.4629	0.4602	0.4655	0.4603
RATIO CO2/(H2O+CO2)	0.1286	0.1192	0.1134	0.1123	0.1231
K SHIFT IN EFFLNT	0.0646	0.0627	0.0589	0.0589	0.0646
SPECIFIC ACTIVITY SA	2.1539	2.0700	1.9887	2.0080	1.9409
CONVERSION					
ON CO %	39.89	39.62	38.27	38.92	38.95
ON H2 %	74.18	73.05	72.54	72.48	72.68
ON CO+H2 %	57.20	56.64	55.70	55.97	56.05
PRDT SELECTIVITY,WT %					
CH4	12.08	12.04	11.94	11.68	12.61
C2 HC'S	2.20	2.74	2.83	2.67	2.95
C3H8	3.71	3.71	3.82	3.77	4.08
C3H6=	2.37	2.39	2.54	2.27	2.45
C4H10	3.55	3.60	3.74	3.64	3.79
C4H8=	3.30	3.32	3.50	3.27	3.24
C5H12	4.19	4.20	4.41	4.21	4.48
C5H10=	1.59	1.62	1.90	1.59	1.70
C6H14	4.12	4.45	4.29	4.30	4.68
C6H12= & CYCLO'S	1.81	1.86	1.80	1.73	1.89
C7+ IN GAS	9.13	10.38	8.91	9.98	10.25
LIQ HC'S	52.81	49.69	50.31	50.91	47.87
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B12

SUB-GROUPING					
C1 -C4	28.56	27.80	28.37	27.29	29.13
C5 -420 F	41.07	43.13	42.45	44.20	44.54
420-700 F	23.92	22.36	22.39	22.96	22.26
700-END PT	6.44	6.71	6.79	5.55	4.07
C5+-END PT	71.44	72.20	71.63	72.71	70.87
ISO/NORMAL MOLE RATIO					
C4	0.0167	0.0180	0.0189	0.0192	0.0188
C5	0.0725	0.0693	0.0690	0.0670	0.0623
C6	0.0920	0.0874	0.0392	0.0911	0.0948
C4=	0.1120	0.1118	0.1147	0.1130	0.1141
PARAFFIN/OLEFIN RATIO					
C3	1.4920	1.4821	1.4321	1.5833	1.5905
C4	1.0355	1.0489	1.0291	1.0725	1.1268
C5	2.2107	2.5155	2.2573	2.5759	2.5611
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8294	0.8278	0.8283	0.8222	0.8102
RATIO CH4/(1-A)**2	4.1484	4.0593	4.0511	3.6933	3.5017
ALPHA FRM CORRELATION	0.8510	0.8483	0.8486	0.8480	0.8485
ALPHA (EXPTL/CORR)	0.9798	0.9758	0.9761	0.9695	0.9548
W%CH4 FRM CORRELATION	14.2527	14.8704	14.7811	14.9539	15.0091
W%CH4 (EXPTL/CORR)	0.8845	0.8099	0.8077	0.7808	0.8404
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.7451*	0.7459*	0.7453*	0.7440*	0.7424*
N, REFRACTIVE INDEX	1.4194*	1.4201*	1.4199*	1.4191*	1.4184*
SIMULT'D DISTILATN					
10 WT % @ DEG F	261	262	260	259	259
16	303	303	303	303	302
50	454	457	456	451	443
84	666	677	677	647	624
90	725	740	739	709	685
RANGE(16-84 %)	363	374	374	344	322
WT % @ 420 F	42.50	41.50	42.00	44.00	45.00
WT % @ 700 F	87.80	86.50	86.50	89.10	91.50

Table B12, cont

RESULT OF SYNGAS OPERATION

RUN NO. 12185-08
CATALYST CO/X9/X10/X4-U103 12251-1 250 CC 103.9 G (TO 145.7 G +41.8 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12185-08-11	185-08-12	185-08-13	185-08-14	185-08-15
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	261.2	285.2	309.2	335.0	357.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	261	261	261	261	261
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	24.00	24.00	24.00	25.75	22.00
EFFLNT GAS LITER	901.55	913.75	914.90	979.80	842.45
GM AQUEOUS LAYER	202.57	200.22	200.82	213.02	182.96
GM OIL	88.64	88.22	85.76	95.69	80.74
MATERIAL BALANCE					
GM ATOM CARBON %	96.76	97.03	97.11	97.74	97.74
GM ATOM HYDROGEN %	99.56	99.84	100.53	100.29	100.54
GM ATOM OXYGEN %	99.39	99.50	99.52	99.26	99.61
RATIO CHX/(H2O+CO2)	0.9279	0.9312	0.9336	0.9576	0.9478
RATIO X IN CHX	2.3834	2.3880	2.3917	2.3836	2.3924
USAGE H2/CO PRODT	1.8943	1.8969	1.8862	1.8722	1.8904
FEED H2/CO FRM EFFLNT	1.0289	1.0290	1.0351	1.0261	1.0287
RESIDUAL H2/CO RATIO	0.4660	0.4753	0.4810	0.4739	0.4755
RATIO CO2/(H2O+CO2)	0.1202	0.1193	0.1232	0.1213	0.1183
K SHIFT IN EFFLNT	0.0637	0.0644	0.0676	0.0654	0.0638
SPECIFIC ACTIVITY SA	1.9381	1.8521	1.8514	1.8971	1.8616
CONVERSION					
ON CO %	39.41	38.95	39.44	39.49	39.10
ON H2 %	72.56	71.80	71.86	72.05	71.85
ON CO+H2 %	56.22	55.61	55.93	55.98	55.71
PRDT SELECTIVITY,WT %					
CH4	12.11	12.28	12.48	12.01	12.47
C2 HC'S	2.80	2.98	2.98	2.83	2.86
C3H8	3.95	4.05	4.18	4.18	4.19
C3H6=	2.32	2.23	2.23	2.16	2.15
C4H10	3.72	3.73	3.81	3.82	3.83
C4H8=	3.20	3.08	3.16	3.13	3.11
C5H12	4.42	4.39	4.52	4.51	4.51
C5H10=	1.71	1.75	1.82	1.84	1.85
C6H14	4.64	4.55	4.62	4.61	4.66
C6H12= & CYCLO'S	1.90	1.70	1.87	1.72	1.83
C7+ IN GAS	10.44	10.34	11.24	10.82	10.39
LIQ HC'S	48.80	48.93	47.08	48.38	48.15
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B13

SUB-GROUPING					
C1 -C4	28.09	28.34	28.84	28.12	28.61
C5 -420 F	45.31	45.09	45.59	45.27	45.53
420-700 F	22.01	21.77	20.86	20.81	20.80
700-END PT	4.59	4.79	4.71	5.81	5.06
C5+-END PT	71.91	71.66	71.16	71.88	71.39
ISO/NORMAL MOLE RATIO					
C4	0.0179	0.0210	0.0194	0.0212	0.0196
C5	0.0632	0.0670	0.0707	0.0688	0.0667
C6	0.0842	0.0858	0.0963	0.0888	0.0886
C4=	0.1160	0.1164	0.1178	0.1160	0.1166
PARAFFIN/OLEFIN RATIO					
C3	1.6250	1.7366	1.7871	1.8475	1.8590
C4	1.1219	1.1713	1.1630	1.1772	1.1892
C5	2.5178	2.4323	2.4197	2.3878	2.3701
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8144	0.8158	0.8137	0.8189	0.8136
RATIO CH4/(1-A)**2	3.5131	3.6187	3.5943	3.5620	3.5901
ALPHA FRM CORRELATION	0.8479	0.8470	0.8464	0.8471	0.8470
ALPHA (EXPTL/CORR)	0.9604	0.9632	0.9614	0.9667	0.9607
W%CH4 FRM CORRELATION	15.1978	15.4967	15.6742	15.4511	15.5015
W%CH4 (EXPTL/CORR)	0.7965	0.7922	0.7960	0.7770	0.8043
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.7431*	0.7430*	0.7430*	0.7440*	0.7429*
N, REFRACTIVE INDEX	1.4174*	1.4174*	1.4174*	1.4179*	1.4172*
SIMULT'D DISTILATN					
10 WT % @ DEG F	259	263	264	262	261
16	302	301	301	301	300
50	444	448	448	449	447
84	638	639	640	660	642
90	691	698	701	723	705
RANGE(16-84 %)	336	338	339	359	342
WT % @ 420 F	45.50	45.70	45.70	45.00	46.30
WT % @ 700 F	90.60	90.20	90.00	88.00	89.50

Table B13, cont

RESULT OF SYNGAS OPERATION

RUN NO. 12185-08
CATALYST CO/X9/X10/X4-U103 12251-1 250 CC 103.9 G (TO 145.7 G +41.8 G)
FEED H2:CO OF 33.4:66.7 @1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12185-08-16	185-08-17	185-08-18	185-08-19
FEED H2:CO:AR	33:66: 0	33:66: 0	33:66: 0	33:66: 0
HRS ON STREAM	382.0	406.0	429.5	453.0
PRESSURE,PSIG	300	300	300	300
TEMP. C	260	261	261	261
FEED CC/MIN	1260	1260	1260	1260
HOURS FEEDING	20.50	24.00	23.50	23.50
EFFLNT GAS LITER	1017.85	1162.55	1139.30	1164.05
GM AQUEOUS LAYER	104.30	120.16	114.85	115.71
GM OIL	57.94	64.59	53.24	60.91
MATERIAL BALANCE				
GM ATOM CARBON %	95.00	91.45	89.89	92.69
GM ATOM HYDROGEN %	98.46	97.67	95.38	99.67
GM ATOM OXYGEN %	96.18	93.00	92.27	93.92
RATIO CHX/(H2O+CO2)	0.9326	0.9097	0.8588	0.9276
RATIO X IN CHX	2.2993	2.3094	2.3351	2.3182
USAGE H2/CO PRODT	1.8723	1.8923	1.9452	1.8759
FEED H2/CO FRM EFFLNT	0.5198	0.5356	0.5321	0.5393
RESIDUAL H2/CO RATIO	0.1971	0.2123	0.2181	0.2216
RATIO CO2/(H2O+CO2)	0.1135	0.1138	0.1128	0.1165
K SHIFT IN EFFLNT	0.0252	0.0273	0.0277	0.0292
SPECIFIC ACTIVITY SA	3.4225	2.8890	2.6069	2.7007
CONVERSION				
ON CO %	19.26	19.25	18.18	19.20
ON H2 %	69.38	68.00	66.46	66.80
ON CO+H2 %	36.40	36.25	34.95	35.88
PRDT SELECTIVITY,WT %				
CH4	9.86	10.29	11.73	10.88
C2 HC'S	1.59	1.69	1.93	1.72
C3H8	1.62	1.72	1.93	1.82
C3H6=	2.91	2.93	3.20	3.00
C4H10	1.61	1.64	1.78	1.70
C4H8=	3.54	3.78	3.99	3.75
C5H12	2.10	2.26	2.42	2.28
C5H10=	2.24	2.23	2.37	2.24
C6H14	2.39	2.51	2.80	2.58
C6H12= & CYCLO'S	2.44	2.80	2.87	2.65
C7+ IN GAS	11.33	10.23	12.29	12.26
LIQ HC'S	58.37	57.91	52.70	55.14
TOTAL	100.00	100.00	100.00	100.00

Table B14

SUB-GROUPING				
C1 -C4	21.13	22.06	24.56	22.87
C5 -420 F	39.35	39.32	39.60	39.64
420-700 F	27.96	27.50	25.35	26.80
700-END PT	11.56	11.12	10.49	10.70
C5+-END PT	78.87	77.04	75.44	77.13
ISO/NORMAL MOLE RATIO				
C4	0.0279	0.0277	0.0000	0.0000
C5	0.0754	0.0694	0.0640	0.0733
C6	0.1048	0.1133	0.1082	0.0983
C4=	0.0596	0.0649	0.0646	0.0473
PARAFFIN/OLEFIN RATIO				
C3	0.5320	0.5615	0.5754	0.5789
C4	0.4391	0.4192	0.4319	0.4371
C5	0.9137	0.9867	0.9946	0.9905
SCHULZ-FLORY DISTRBTN				
ALPHA (EXP(SLOPE))	0.8554	0.8521	0.8453	0.8486
RATIO CH4/(1-A)**2	4.7143	4.7039	4.8993	4.7509
ALPHA FRM CORRELATION	0.8899	0.8863	0.8849	0.8842
ALPHA (EXPTL/CORR)	0.9612	0.9615	0.9552	0.9598
W%CH4 FRM CORRELATION	1.9662	3.3114	3.7231	3.9630
W%CH4 (EXPTL/CORR)	5.0157	3.1077	3.1508	2.7464
LIQ HC COLLECTION				
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.7577*	0.7578*	0.7582*	0.7572*
N, REFRACTIVE INDEX	1.4260*	1.4260*	1.4263*	1.4255*
SIMULT'D DISTILATN				
10 WT % @ DEG F	303	301	306	306
16	342	341	345	345
50	512	509	514	513
84	729	726	732	730
90	793	790	798	794
RANGE(16-84 %)	387	385	387	385
WT % @ 420 F	32.30	33.30	32.00	32.00
WT % @ 700 F	80.20	80.80	80.10	80.60

Table B14, cont

VIII. Run 16 (12200-09) with Catalyst 16 ($Co/X_9/X_{10}/X_4$/UCC-103)

The purpose of this run was to test the effect of incorporating the additives X_9, X_{10} and X_4, which were used so successfully in Catalyst 15, into the cobalt/UCC-103 formulation of Catalyst 11, which demonstrated high but unstable activity.

Cobalt oxide, promoted with with X_9 and X_{10}, was formed in close contact with UCC-103 by the new method employed in Catalyst 11, then further promoted with X_4. The resulting powder, after bonding with 15 percent silica, was formed in 1/8-inch pellets. The final catalyst contained 8.4 percent cobalt, 0.4 percent X_9, 0.5 percent X_{10} and 0.8 percent X_4.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B197-200. Simulated distillations of the C_5^+ product are plotted in Figs. B201-202. Carbon number product distributions are plotted in Figs. B203-204. Chromatograms from simulated distillations are reproduced in Figs. B205-206. Detailed material balances appear in Table B15.

The initial conversion of syngas was very low at 28.7 percent, with a calculated specific activity of 0.29. The water gas shift activity was also low, with only about two percent of oxygen converted to CO_2. The initial performance was so poor, and so far inferior to that of Catalyst 11, that the run was terminated at 42.5 hours, and no useful data were obtained regarding stability.

This first attempt at incorporating additives into a catalyst prepared by the new method has been unsuccessful.

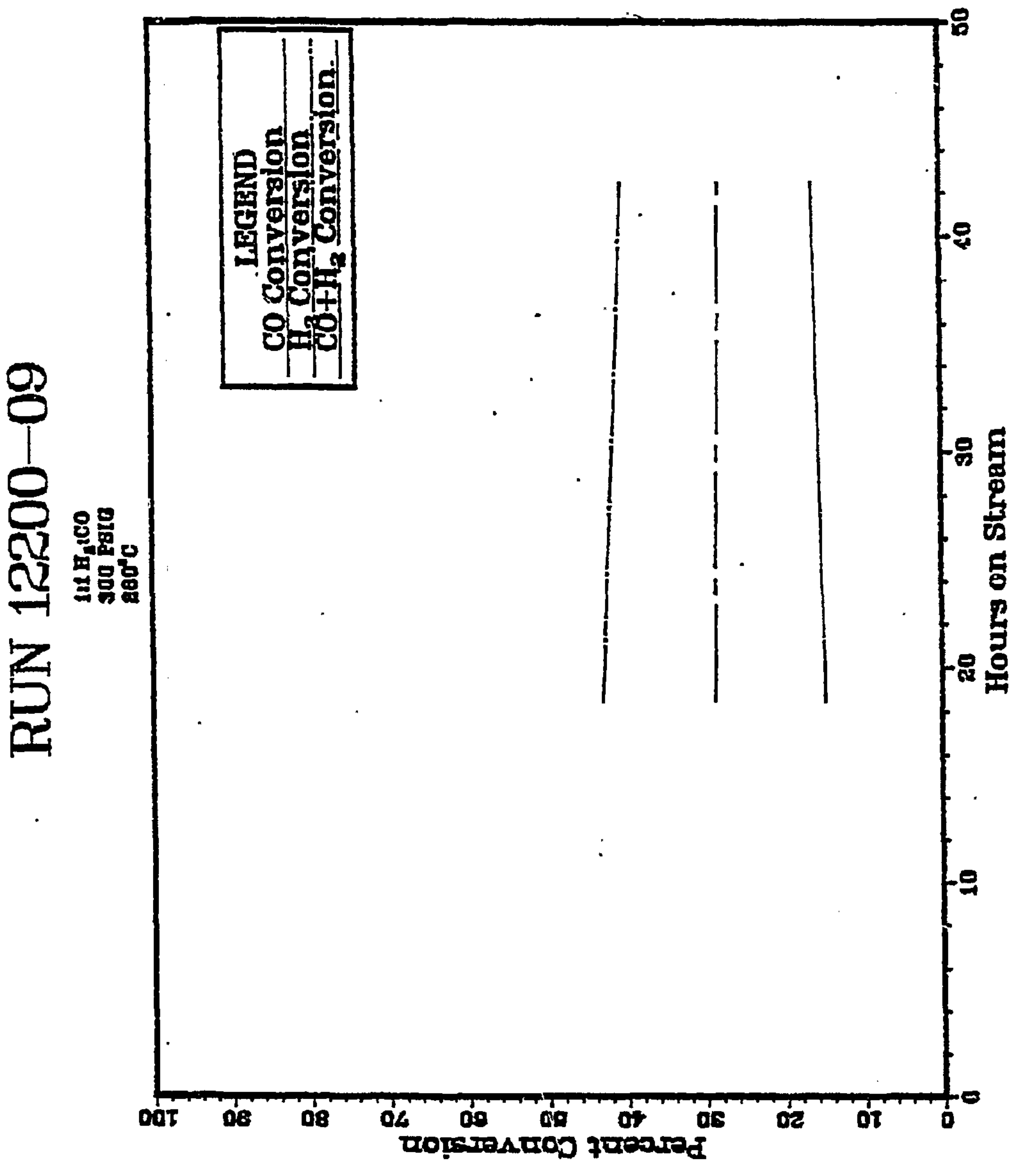

RUN 12200—09
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion
Hours on Stream
Percent Conversion

Fig. B197

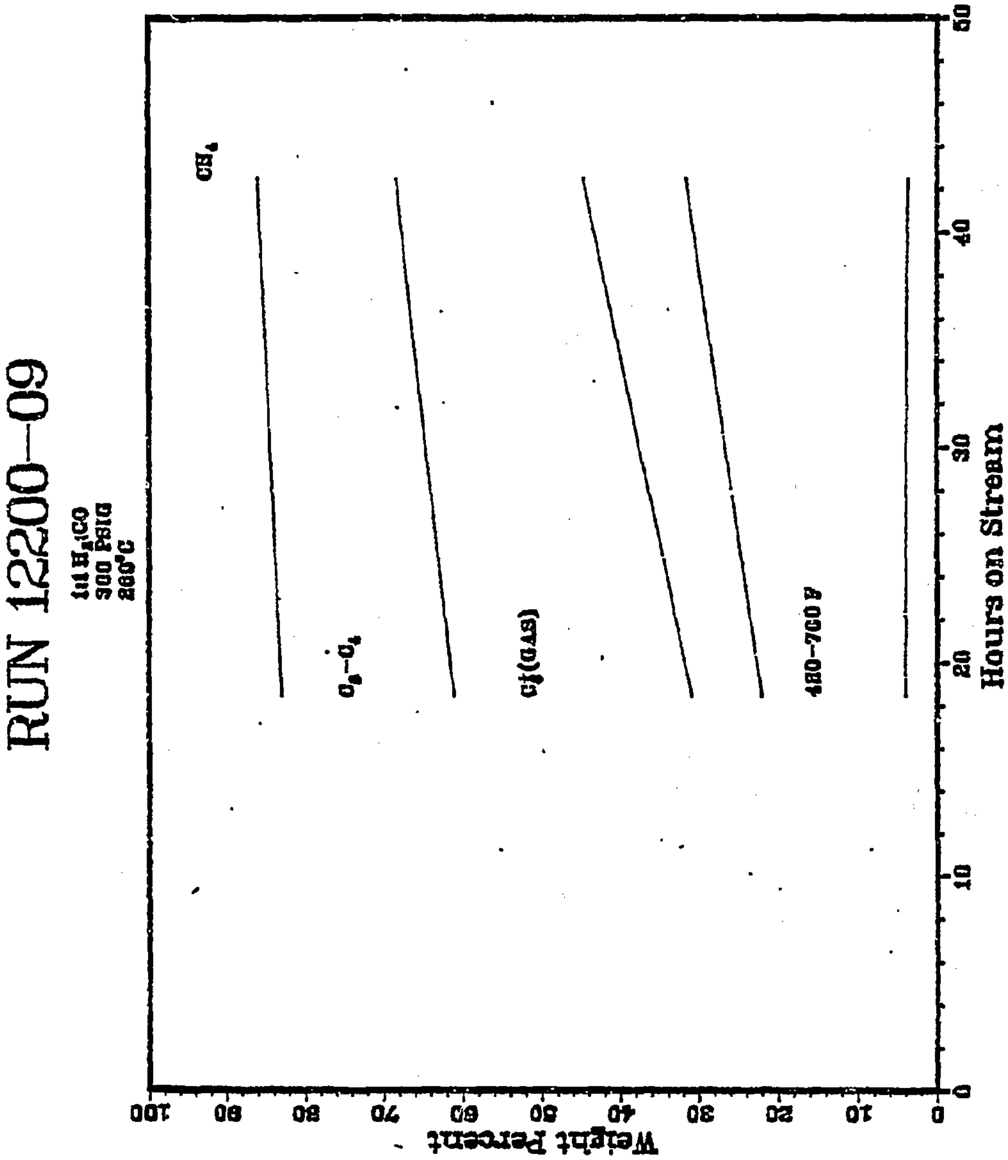

RUN 12200—09
CH4
Hours on Stream
Weight Percent
0
10
20
30
40
50
60
70
80
90
100

Fig. B198