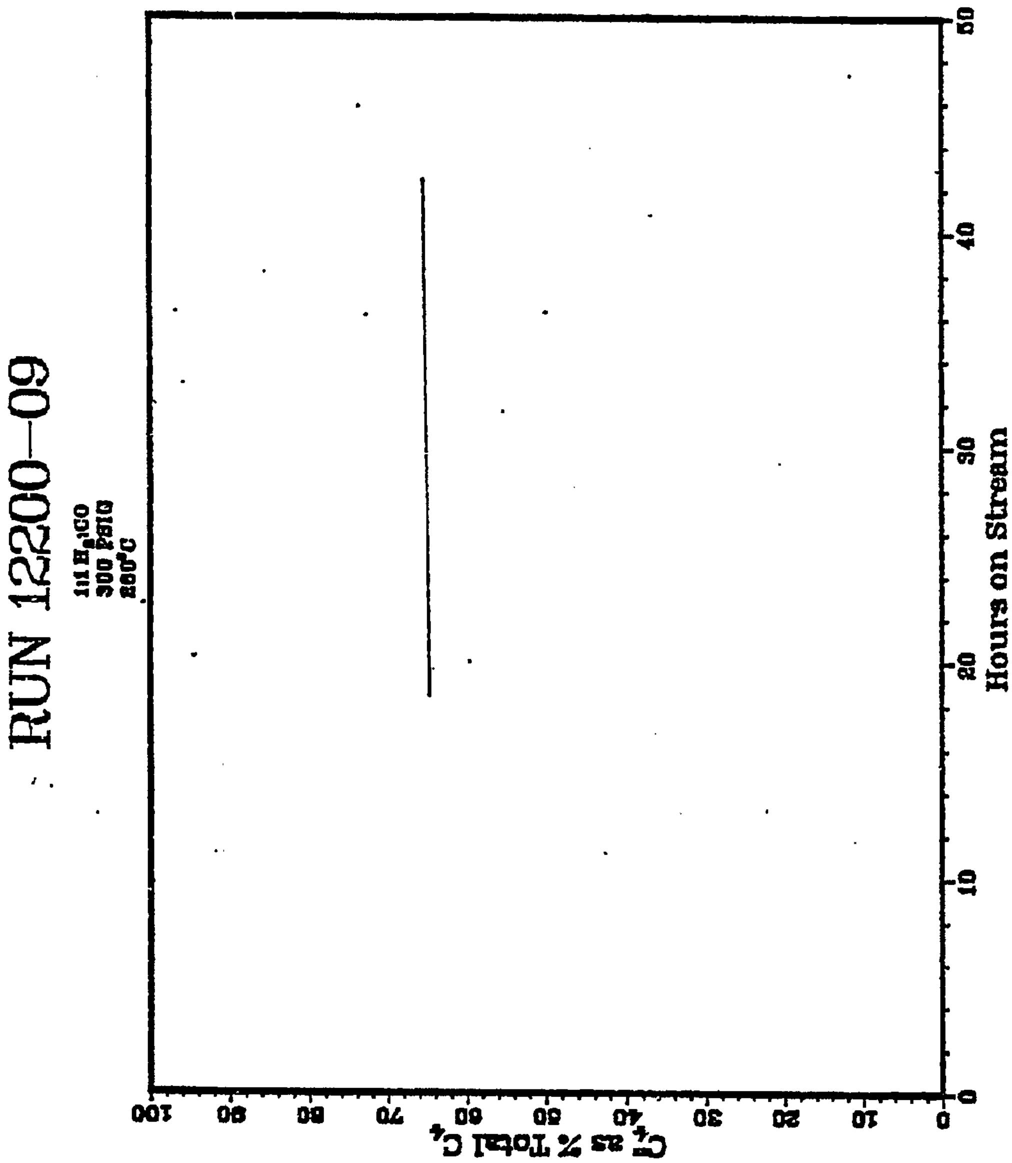

RUN 12200—09
Hours on Stream
0
10
20
30
40
50
100
90
80
70
60
50
40
30
20
10
0

Fig. B199

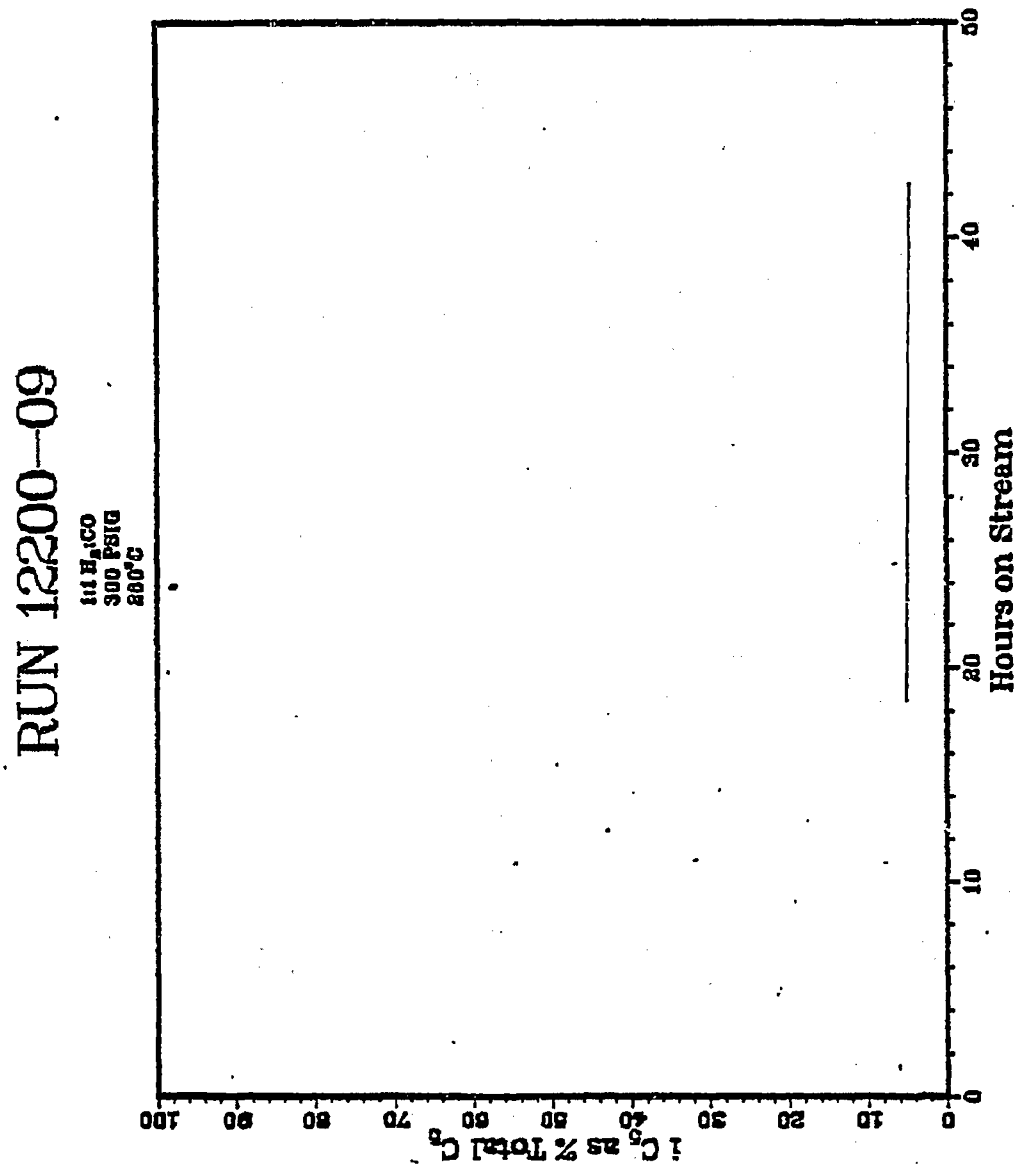

RUN 12200—09
Hours on Stream
0
10
20
30
40
50
i C5 as % Total C5
0
10
20
30
40
50
60
70
80
90
100

Fig. B200

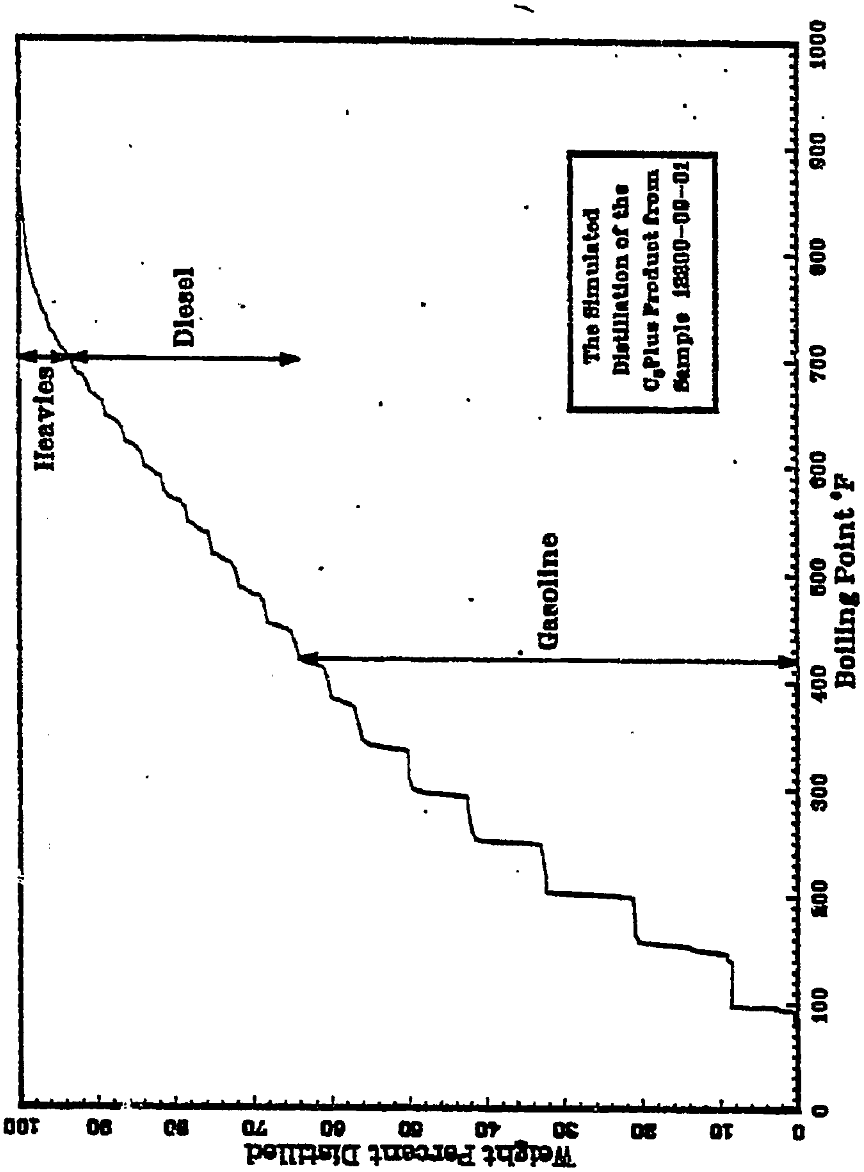

Weight Percent Distilled
Boiling Point °F
Heavies
Diesel
Gasoline
The Simulated
Distillation of the
C_6 Plus Product from
Sample

Fig. B201

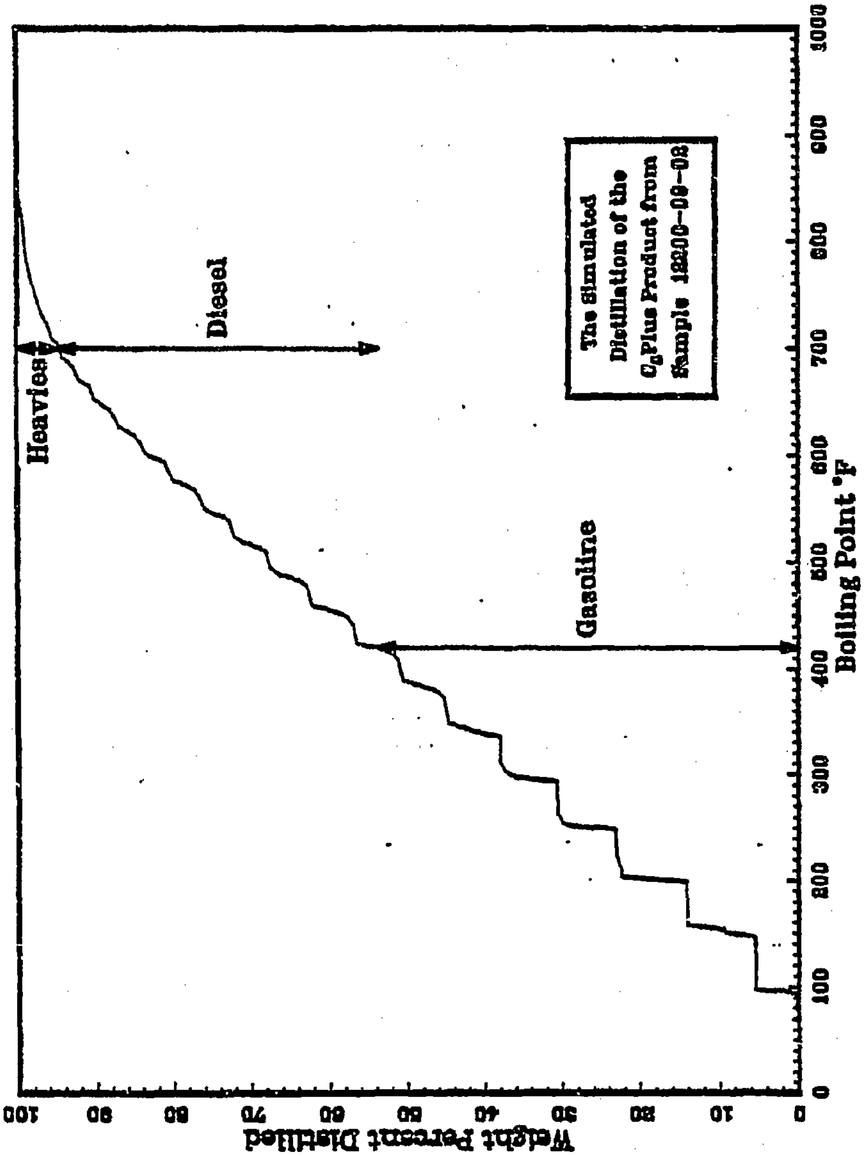

The Simulated
Distillation of the
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B202

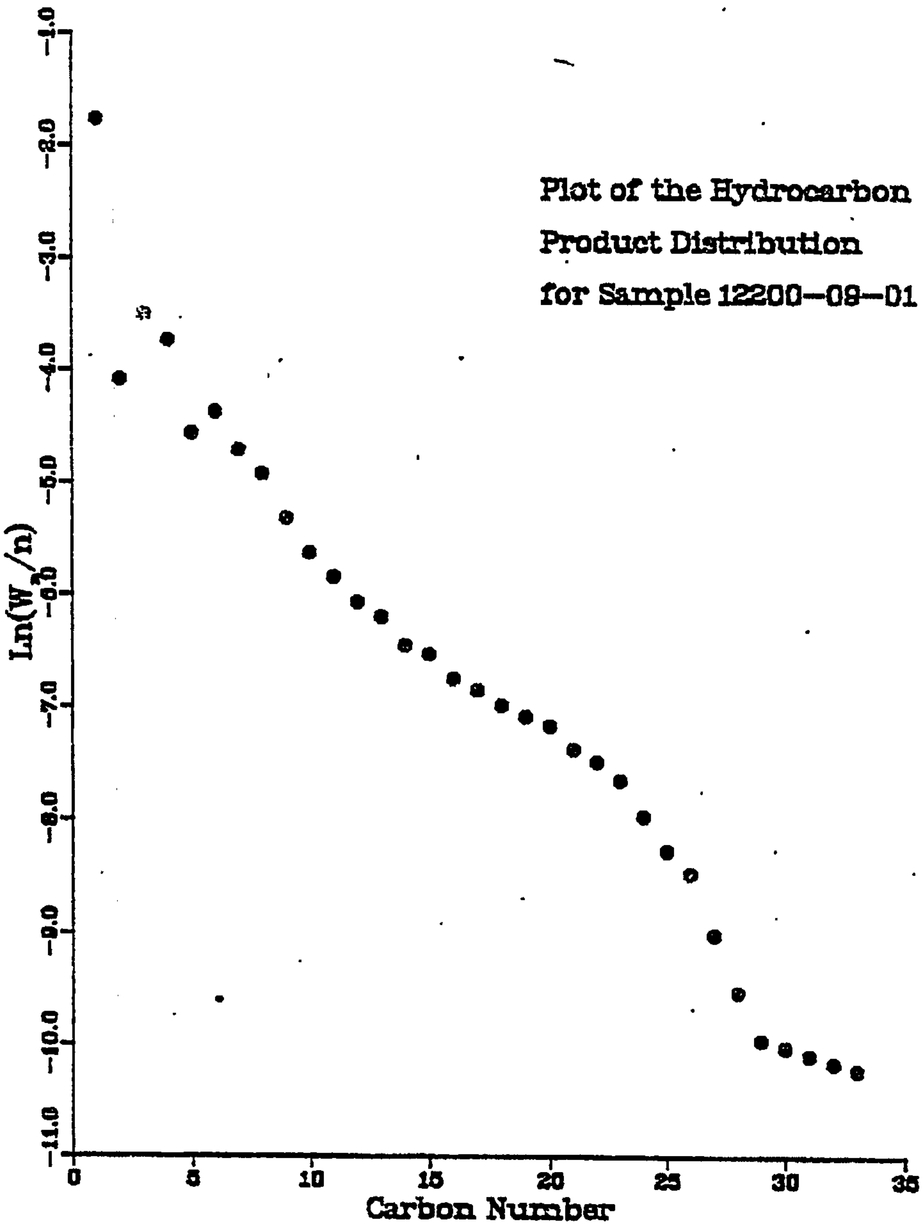

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-09-01
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B203

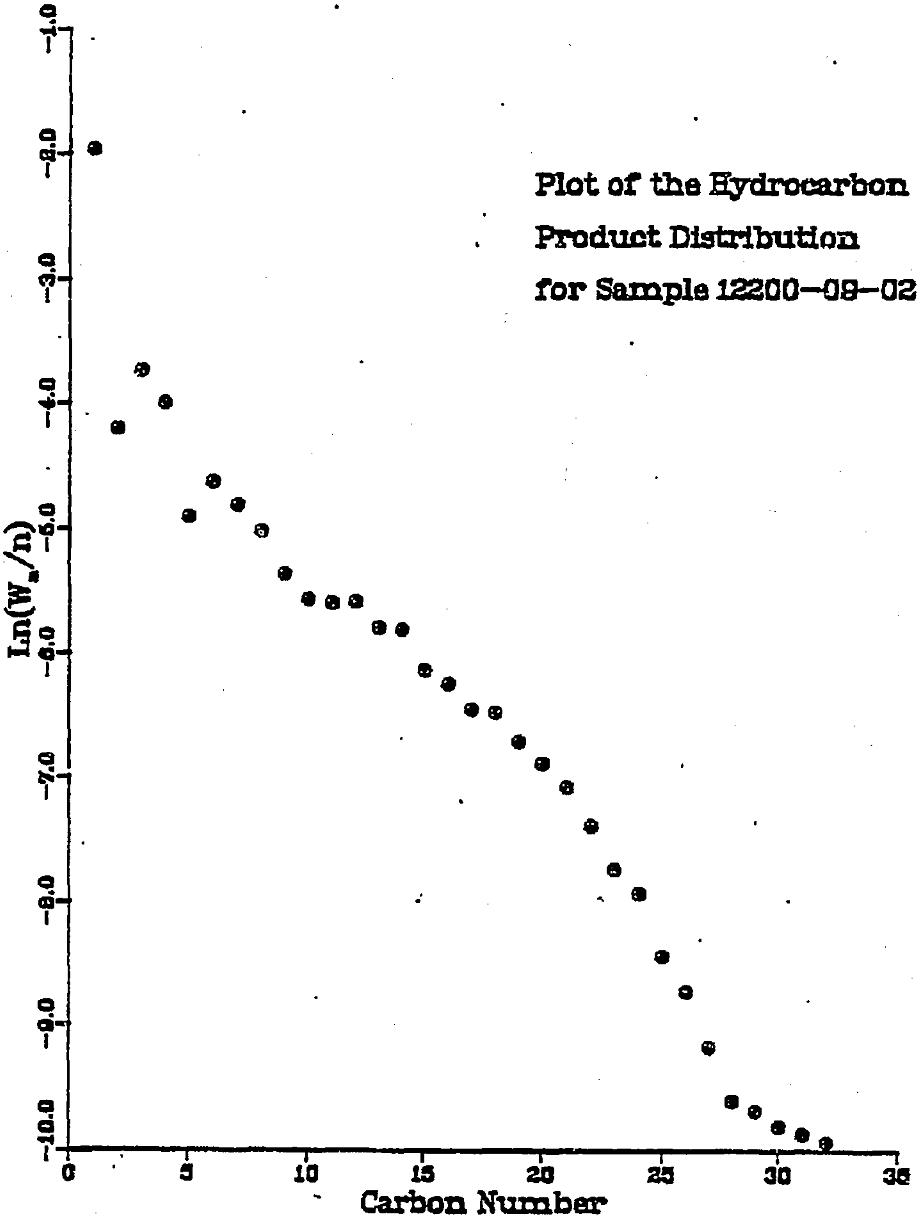
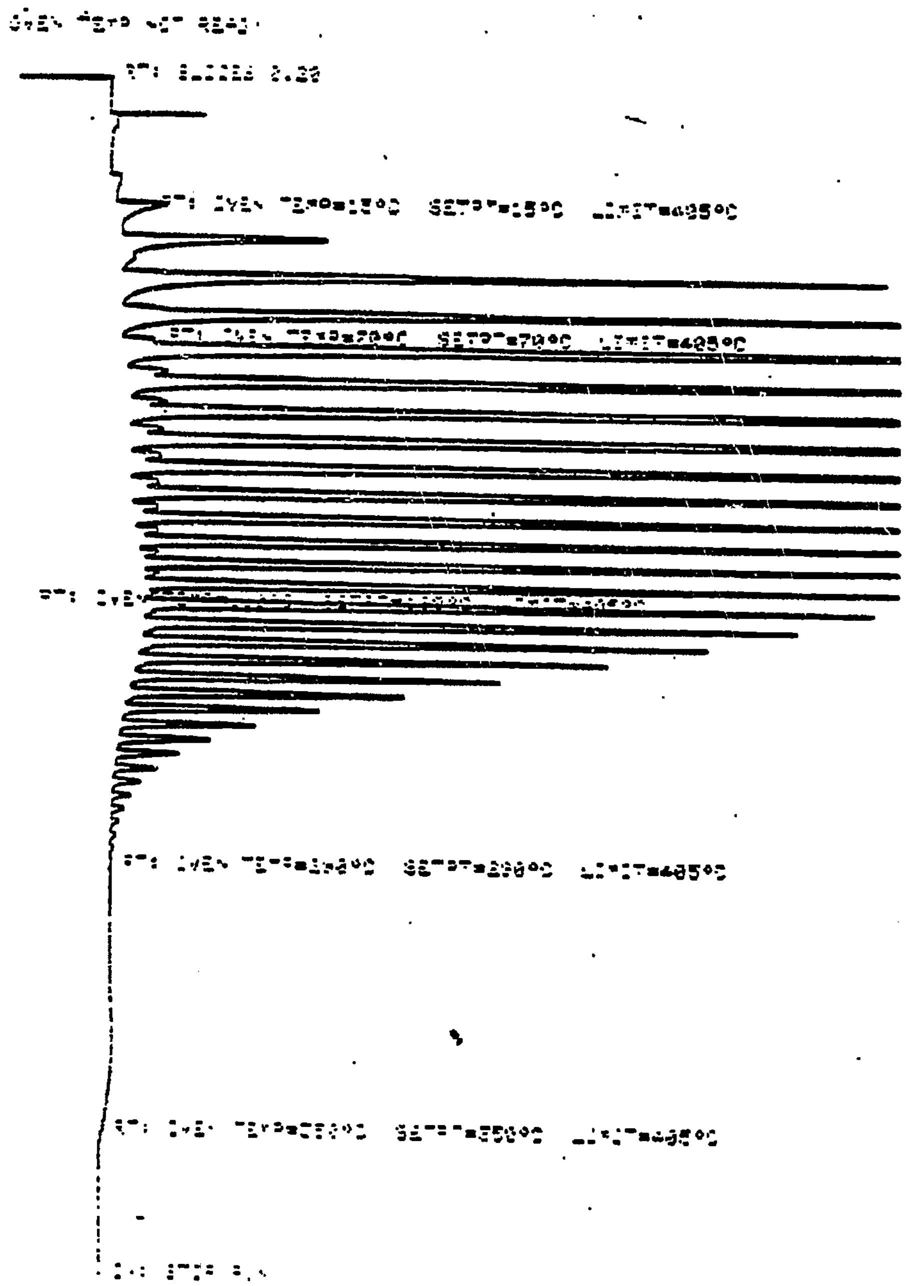
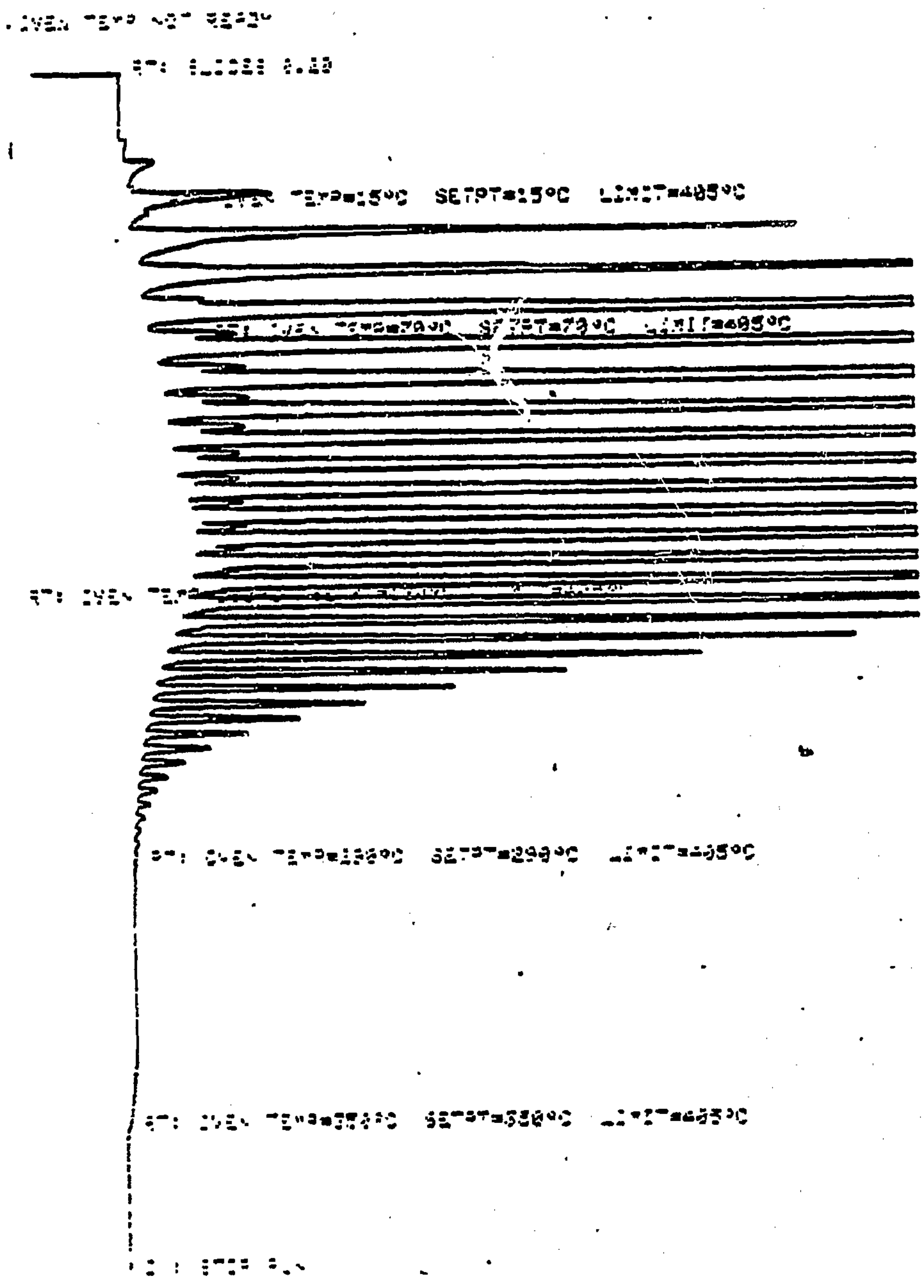

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-09-02
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B204



12200-09-01

Fig. B205



12200-09-02

Fig. B206

RESULT OF SYNGAS OPERATION

RUN NO. 12200-09
CATALYST CO/X9/X10/X4-U103 12251-10 80CC 37 G (WT CHANGE + 6 G)
FEED H2:CO OF 50:50 @ 400CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-09-01	200-09-02
FEED H2:CO:AR	50:50: 0	50:50: 0
HRS ON STREAM	18.5	42.5
PRESSURE,PSIG	300	300
TEMP. C	264	260
FEED CC/MIN	400	400
HOURS FEEDING	18.50	24.00
EFFLNT GAS LITER	284.95	407.40
GM AQUEOUS LAYER	30.66	34.18
GM OIL	5.04	11.48
MATERIAL BALANCE		
GM ATOM CARBON %	86.42	95.67
GM ATOM HYDROGEN %	84.13	91.03
GM ATOM OXYGEN %	95.79	99.90
RATIO CHX/(H2O+CO2)	0.5677	0.7806
RATIO X IN CHX	2.4414	2.3846
USAGE H2/CO PRODT	2.7951	2.3424
FEED H2/CO FRM EFFLNT	0.9736	0.9515
RESIDUAL H2/CO RATIO	0.6536	0.6796
RATIO CO2/(H2O+CO2)	0.0280	0.0306
K SHIFT IN EFFLNT	0.0188	0.0214
SPECIFIC ACTIVITY SA	0.2906	0.3789
CONVERSION		
ON CO %	14.94	16.35
ON H2 %	42.90	40.26
ON CO+H2 %	28.73	28.01
PRDT SELECTIVITY,WT %		
CH4	17.02	14.05
C2 HC'S	3.35	3.00
C3H8	3.12	2.46
C3H6=	5.89	4.67
C4H10	3.43	2.60
C4H8=	6.05	4.75
C5H12	3.92	3.21
C5H10=	1.30	0.50
C6H14	4.46	3.26
C6H12= & CYCLO'S	3.10	2.64
C7+ IN GAS	17.37	14.23
LIQ HC'S	30.98	44.64
TOTAL	100.00	100.00

Table B15

SUB-GROUPING		
C1 -C4	38.86	31.52
C5 -420 F	38.99	36.78
420-700 F	18.12	27.99
700-END PT	4.03	3.70
C5+-END PT	61.14	68.48
ISO/NORMAL MOLE RATIO		
C4	0.0311	0.0000
C5	0.0537	0.0490
C6	0.0736	0.0000
C4=	0.0000	0.0000
PARAFFIN/OLEFIN RATIO		
C3	0.5061	0.5029
C4	0.5464	0.5280
C5	2.9310	6.1712
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))	0.8159	0.8209
RATIO CH4/(1-A)**2	5.0213	4.3803
ALPHA FRM CORRELATION	0.8313	0.8296
ALPHA (EXPTL/CORR)	0.9815	0.9895
WTCH4 FRM CORRELATION	20.9859	20.6718
WTCH4 (EXPTL/CORR)	0.8112	0.6798
LIQ HC COLLECTION		
PHYS. APPEARANCE	CLR OIL	OIL WAX
DENSITY (* 40 C)	0.7516*	0.7565*
N, REFRACTIVE INDEX	1.4221*	1.4236*
SIMULT'D DISTILATN		
10 WT % @ DEG F	340	340
16	378	373
50	517	495
84	684	650
90	716	688
RANGE(16-84 %)	306	277
WT % @ 420 F	28.50	29.00
WT % @ 700 F	87.00	91.70

Table B15, cont

IX. Run 17 (12200-10) with Catalyst 17 (Fe/K/UCC-103)

The purpose of this run was to test the use of iron as the Fischer-Tropsch active metal in intimate contact with UCC-103. Because iron has been found to be generally less reactive than cobalt, the catalyst was formulated using the method employed in Catalyst 11, whose initial activity was so extraordinarily high.

Iron oxide was promoted with potassium, then formed in close contact with UCC-103 by the method used in Catalyst 11. The resulting powder, after bonding with 15 percent silica, was extruded to 1/8-inch pellets. The final catalyst, containing 8.5 percent iron and 0.2 percent potassium, was activated by CO reduction at 270C for 16 hours.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B207-210. Simulated distillations of the C_5^+ product are plotted in Figs. B211-213. Carbon number product distributions are plotted in Figs. B214-217. Chromatograms from simulated distillations are reproduced in Figs. B218-221. Detailed material balances appear in Table B16.

The first three samples were invalidated by a leak in the reactor at the beginning of the run. In Sample 4, at 41.5 hours on stream, the syngas conversion was a very poor 23.1 percent. Total motor fuels and C_5^+ were considerably lower than with cobalt systems. The run was too short to yield any useful data on stability.

The catalyst demonstrated two desirable properties in comparison with the cobalt systems: a reduced methane yield, and a substantially higher olefin content of the C_4's, on the order of 75 percent as against the 60 percent generally obtained with cobalt. The overall activity, however, is unacceptably low.

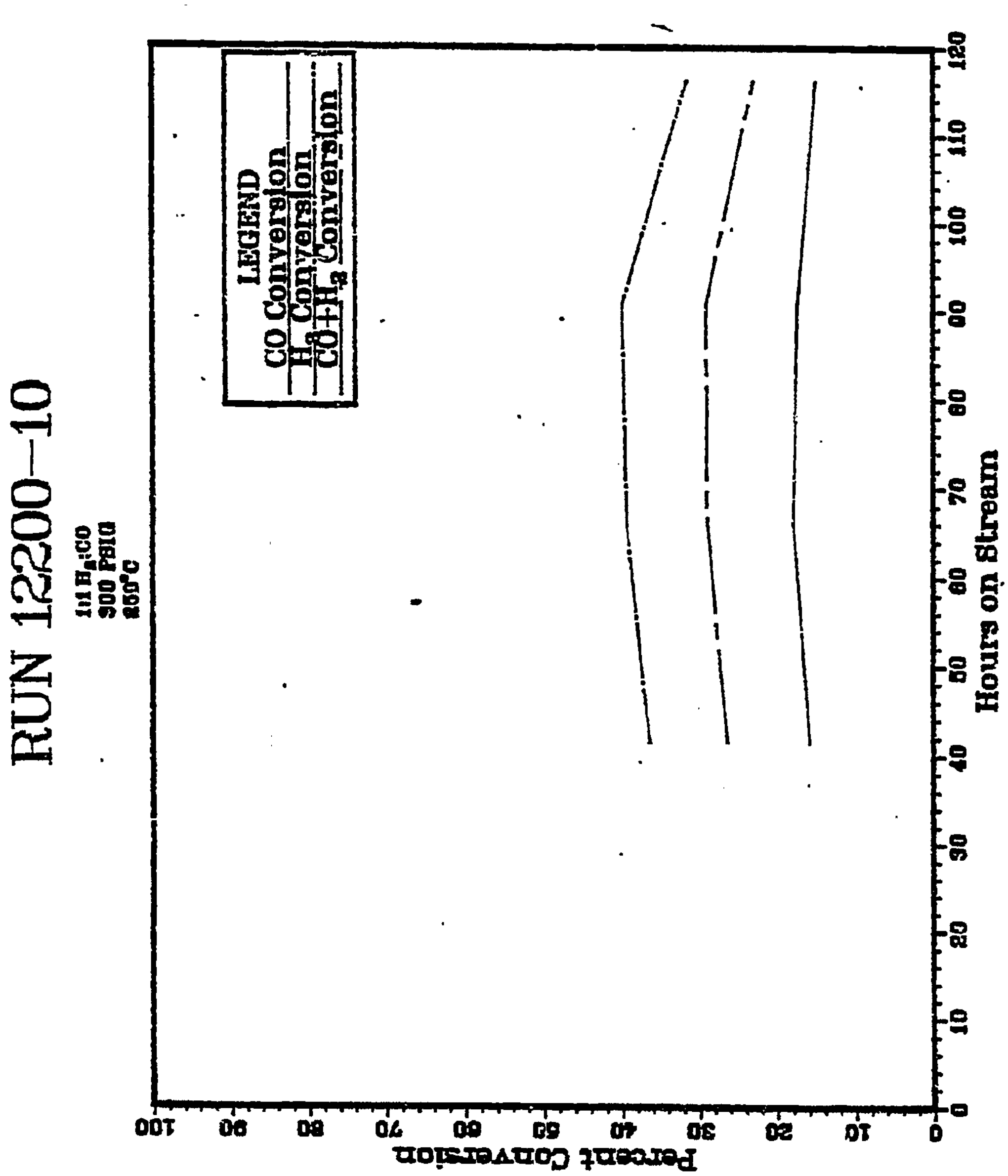

RUN 12200–10
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion
Hours on Stream
Percent Conversion
0
10
20
30
40
50
60
70
80
90
100
110
120

Fig. B207

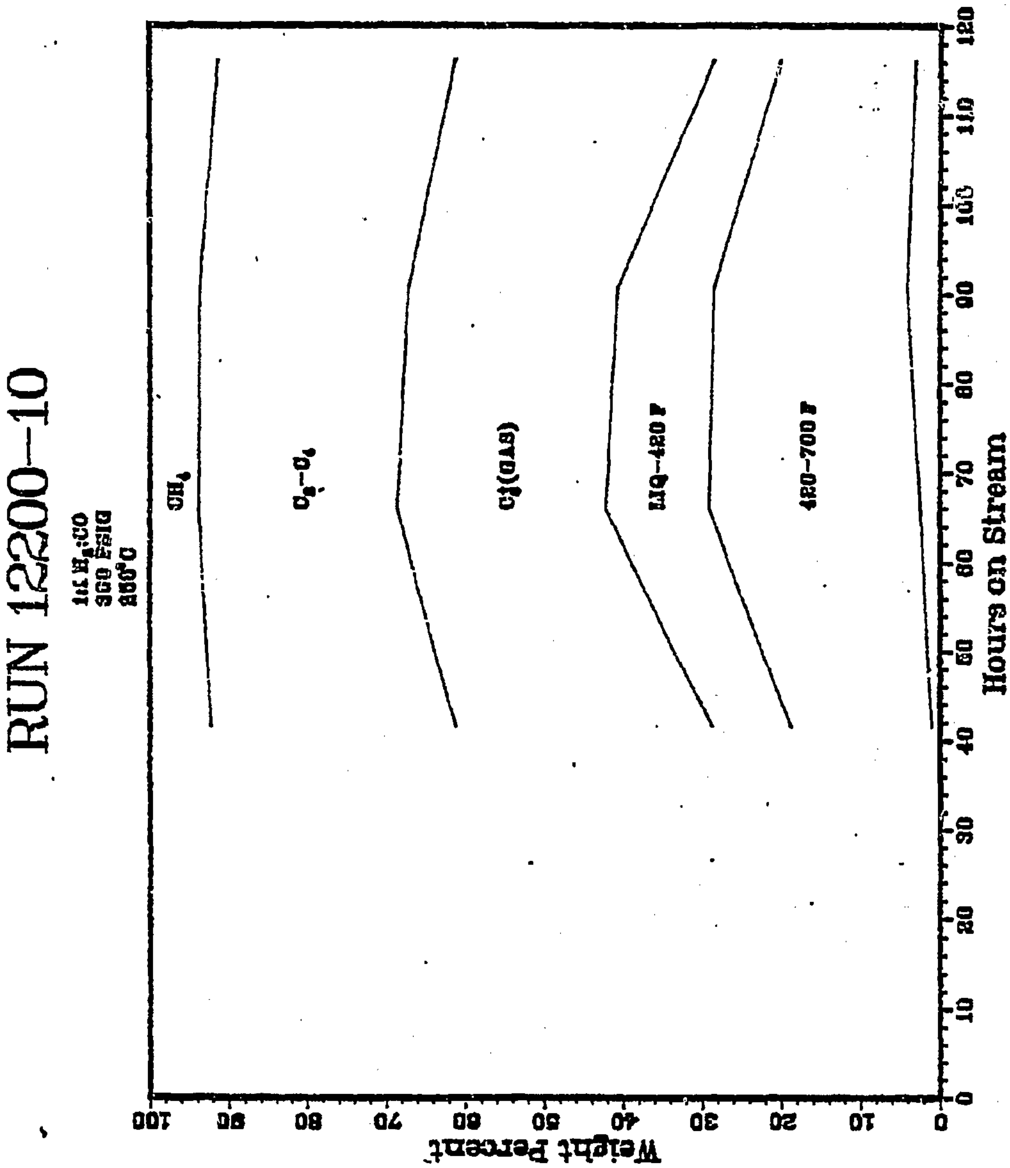

RUN 12200—10
Hours on Stream
Weight Percent
LIQ-420 F
420-700 F

Fig. B208

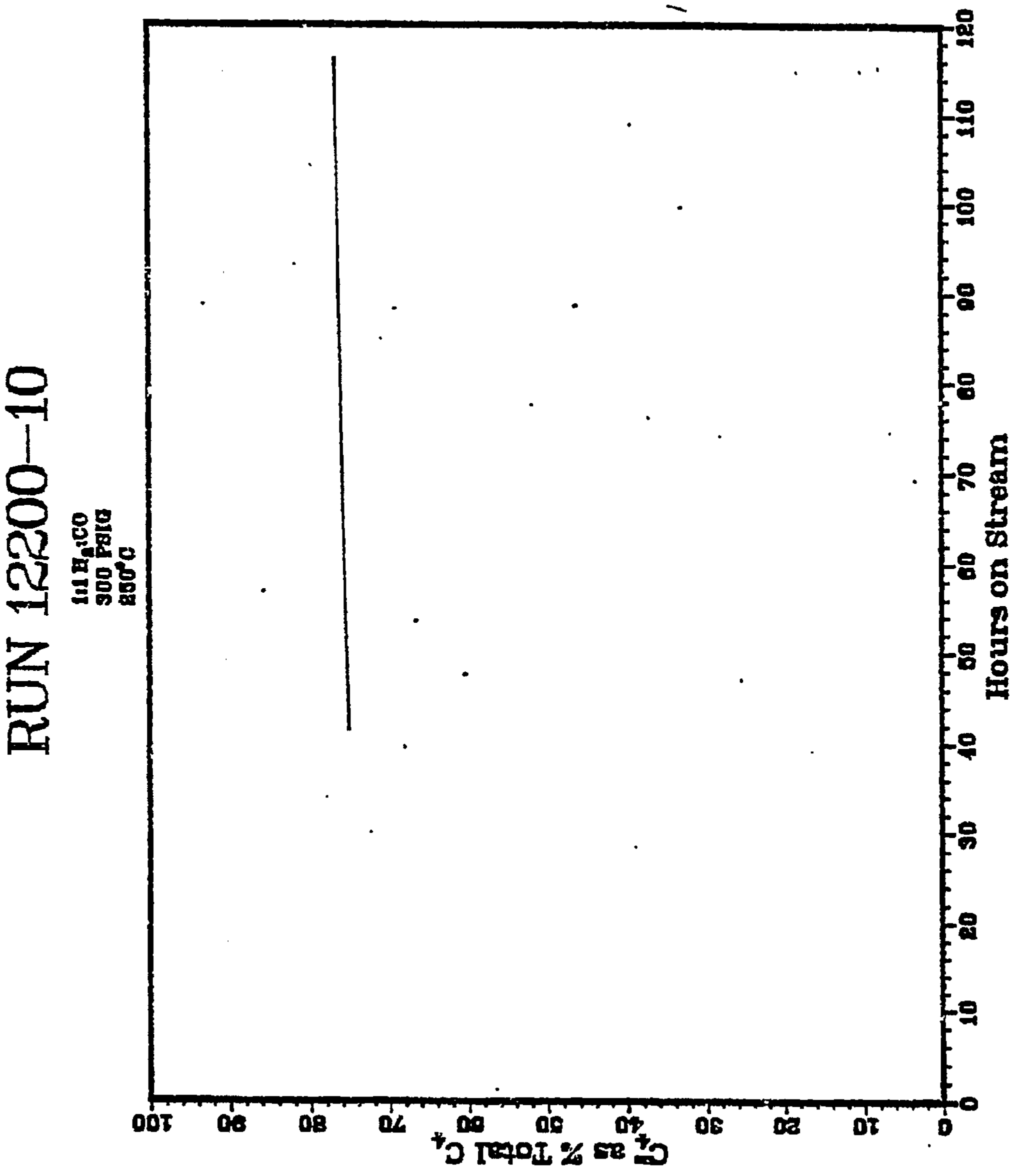

RUN 12200—10
1:1 H$_2$:CO
300 PSIG
250°C
Hours on Stream
$C_4^=$ as % Total C_4
0
10
20
30
40
50
60
70
80
90
100
110
120

Fig. B209

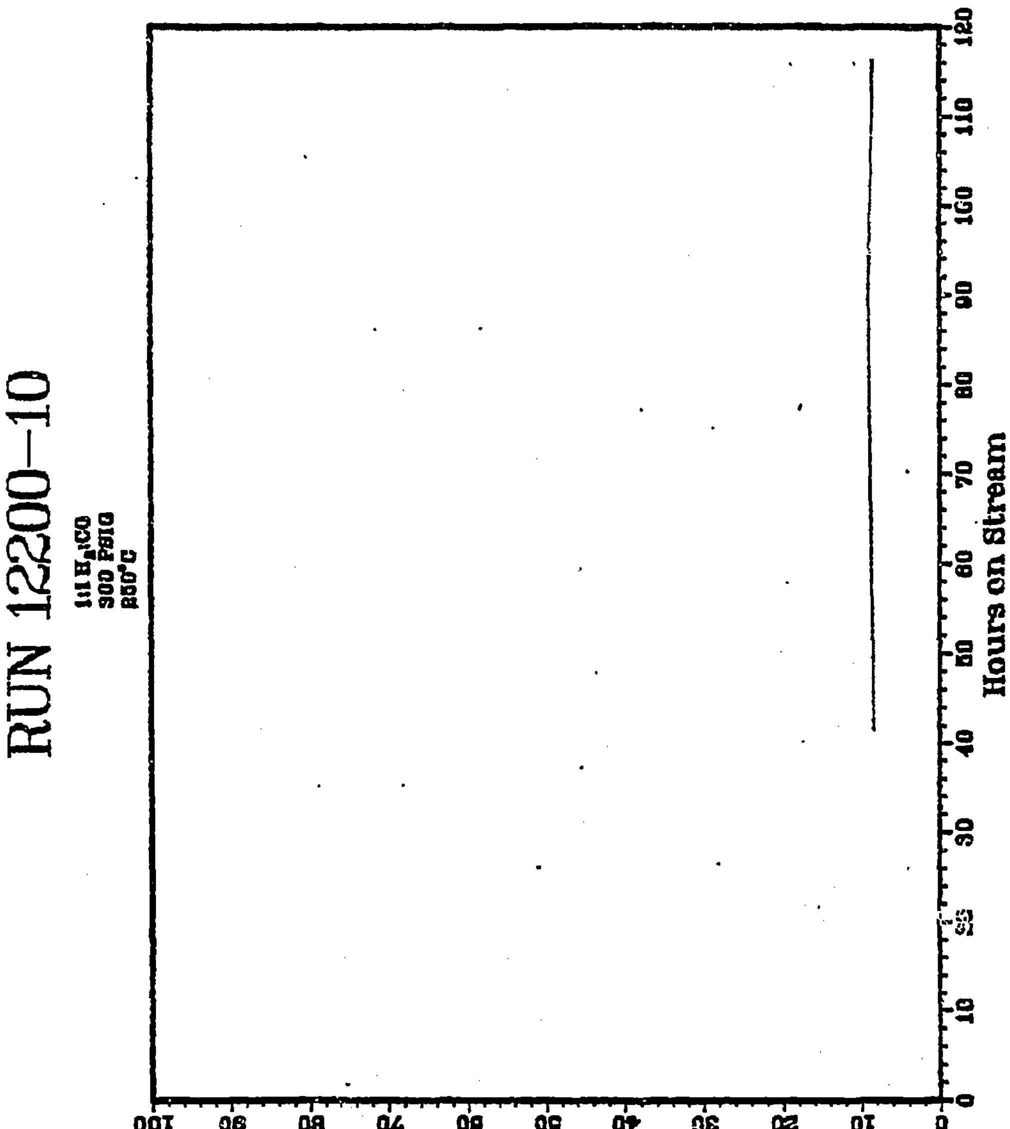


Fig. B210

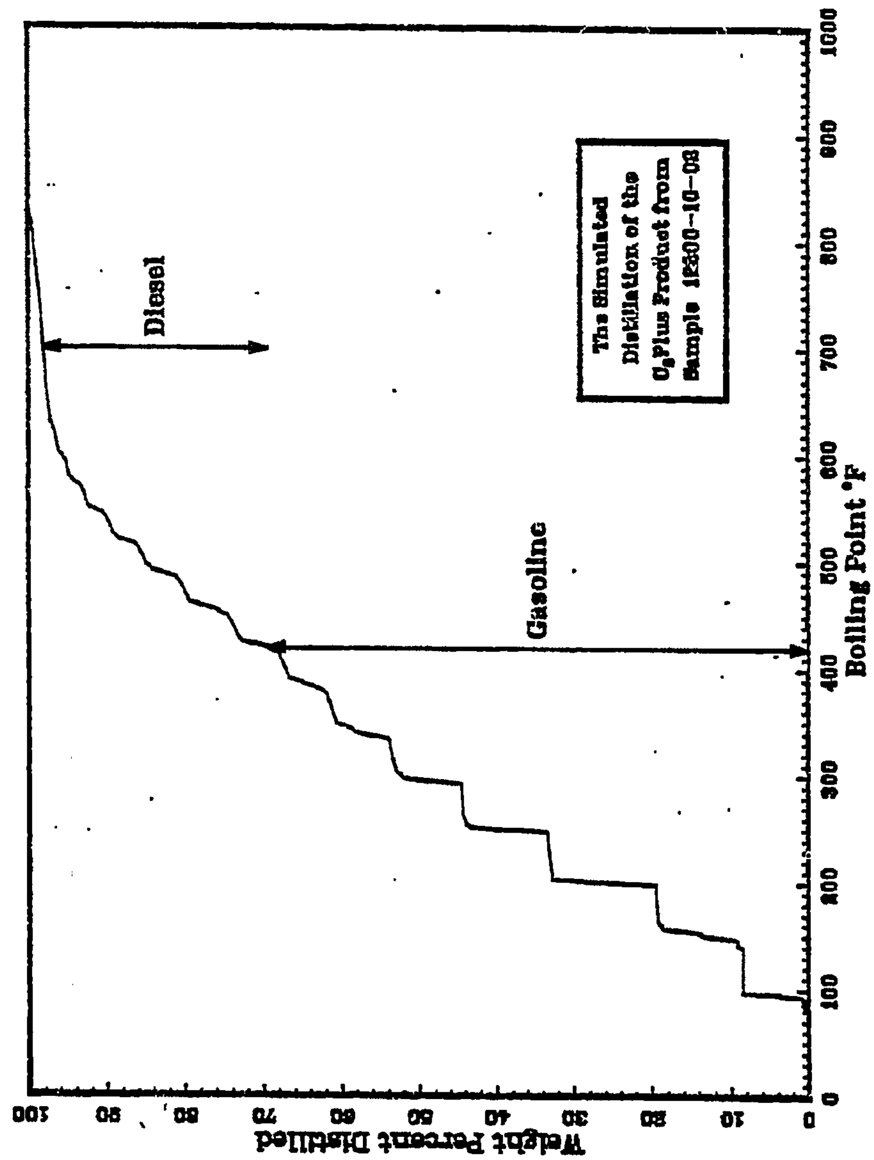

The Simulated
Distillation of the
C_6 Plus Product from
Diesel
Gasoline
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B211

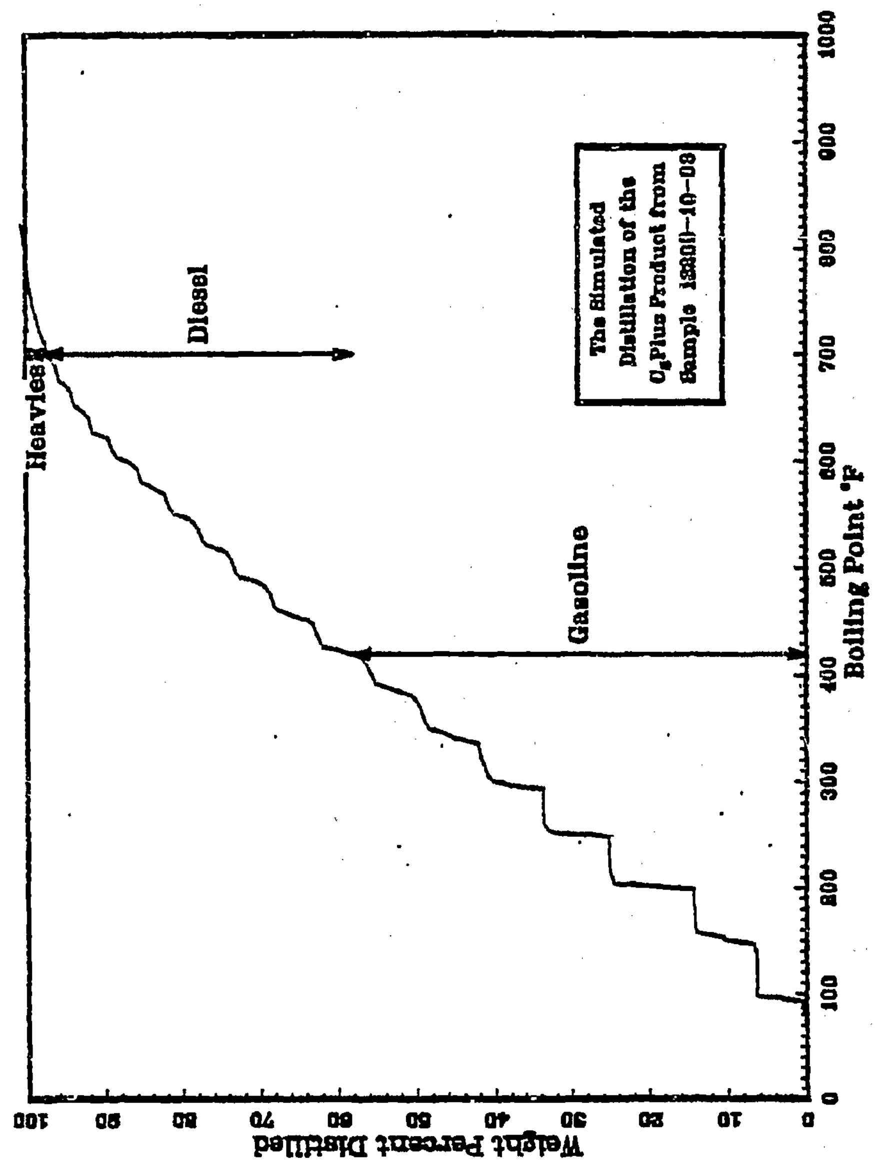

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B212

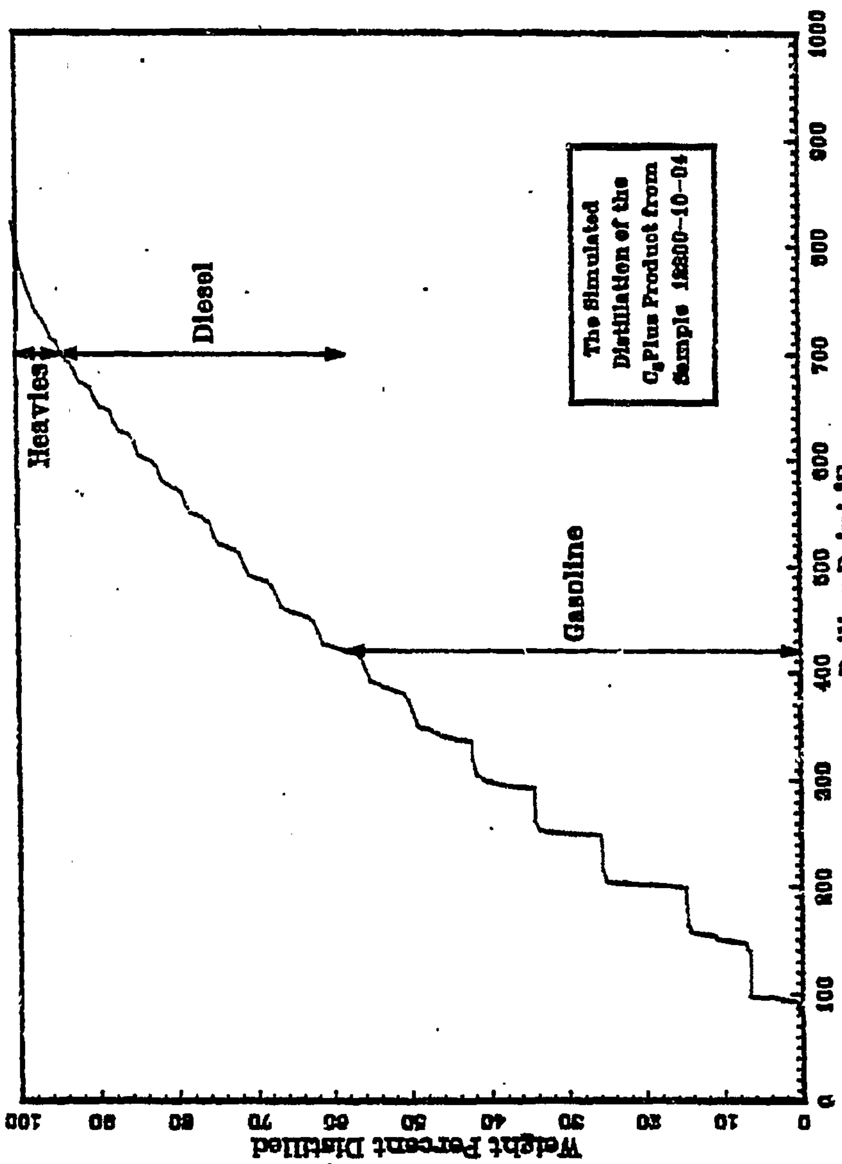

Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B213

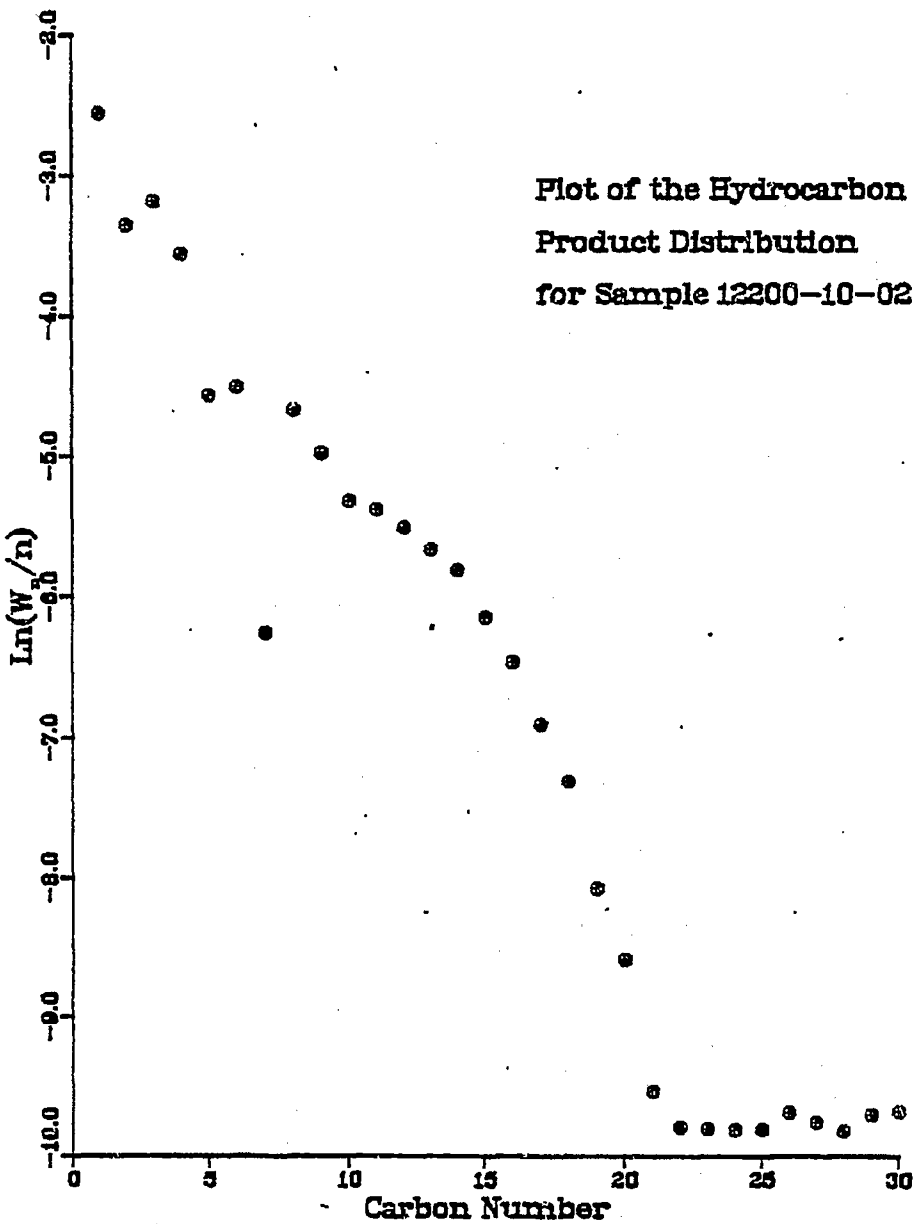

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-10-02
$Ln(W_n/n)$
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B214

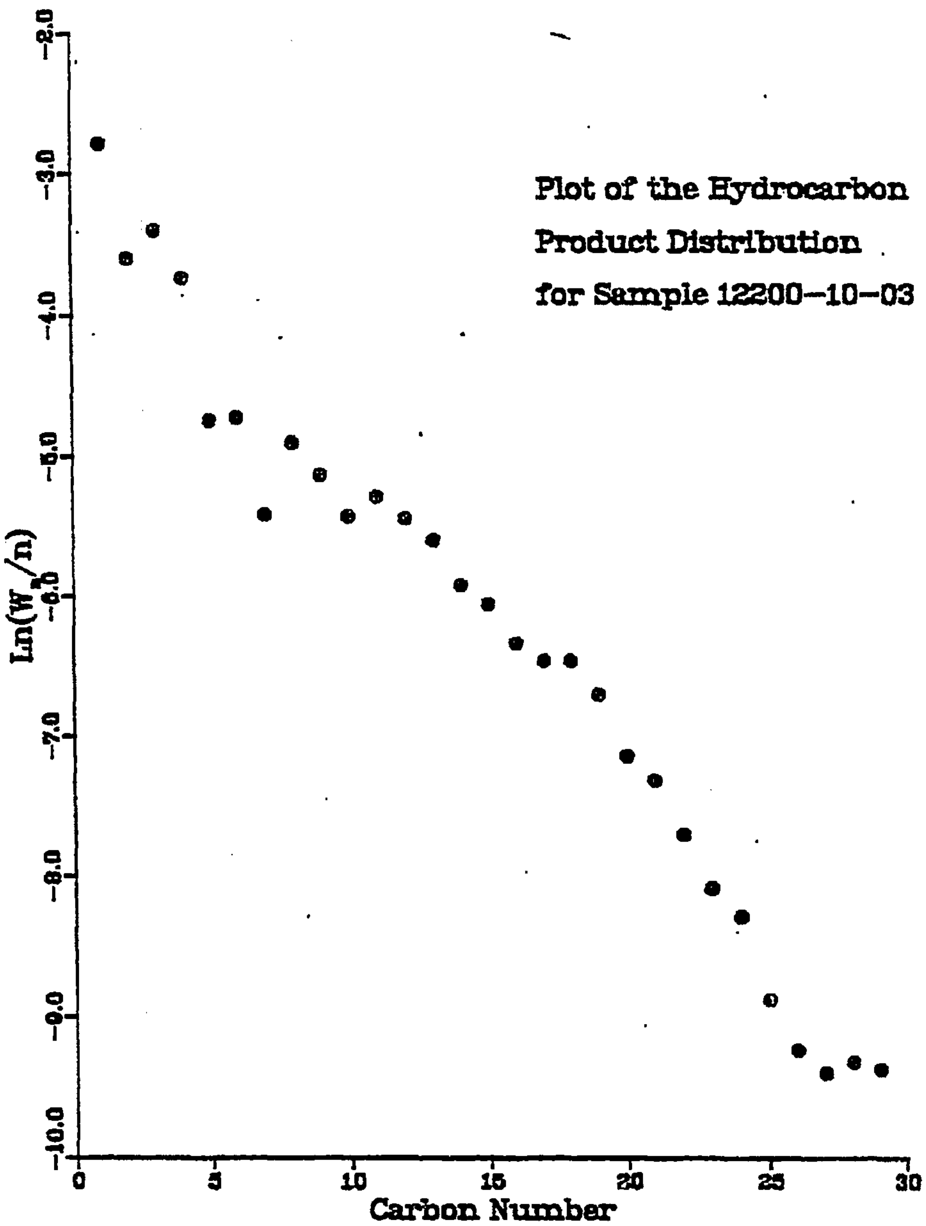

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-10-03
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B215

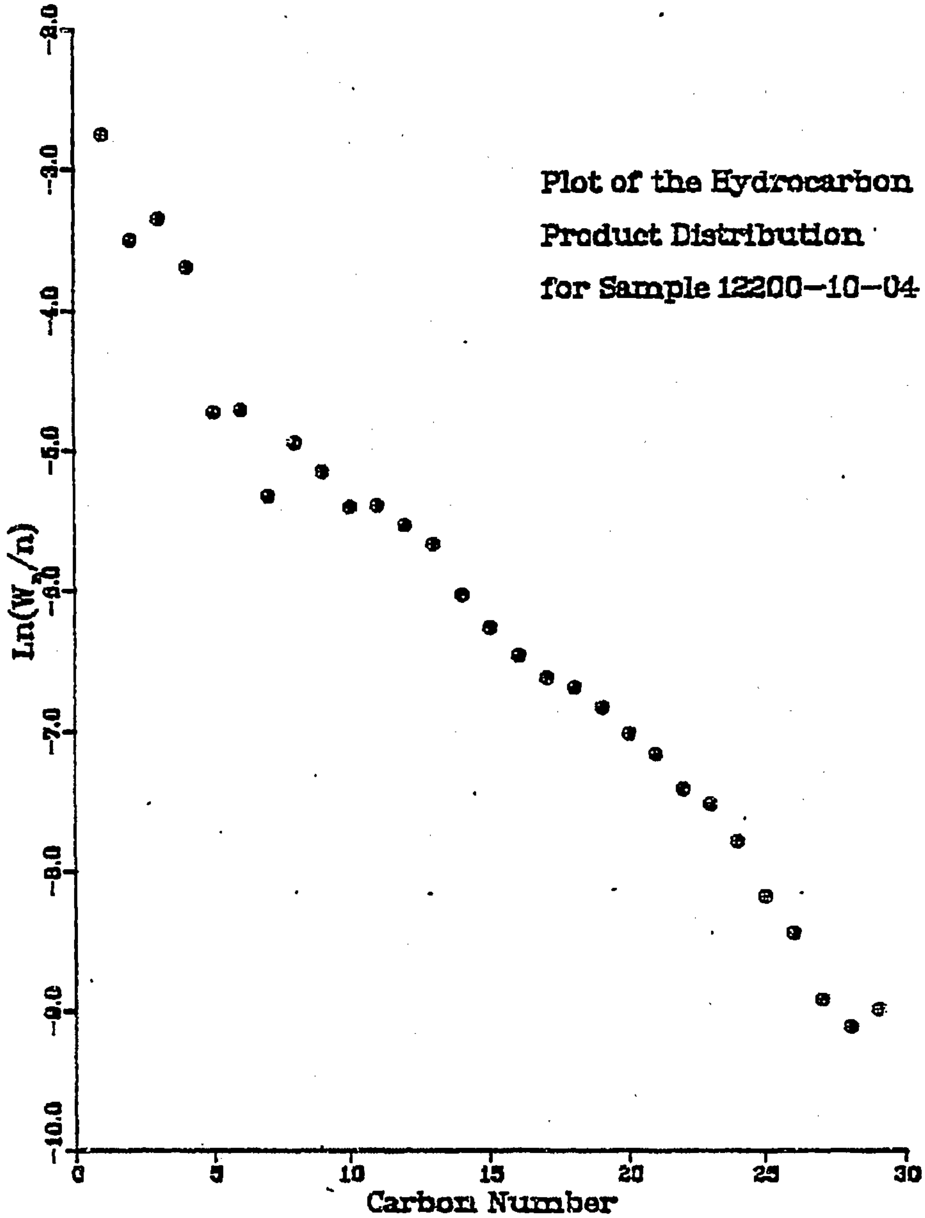

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-10-04
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B216

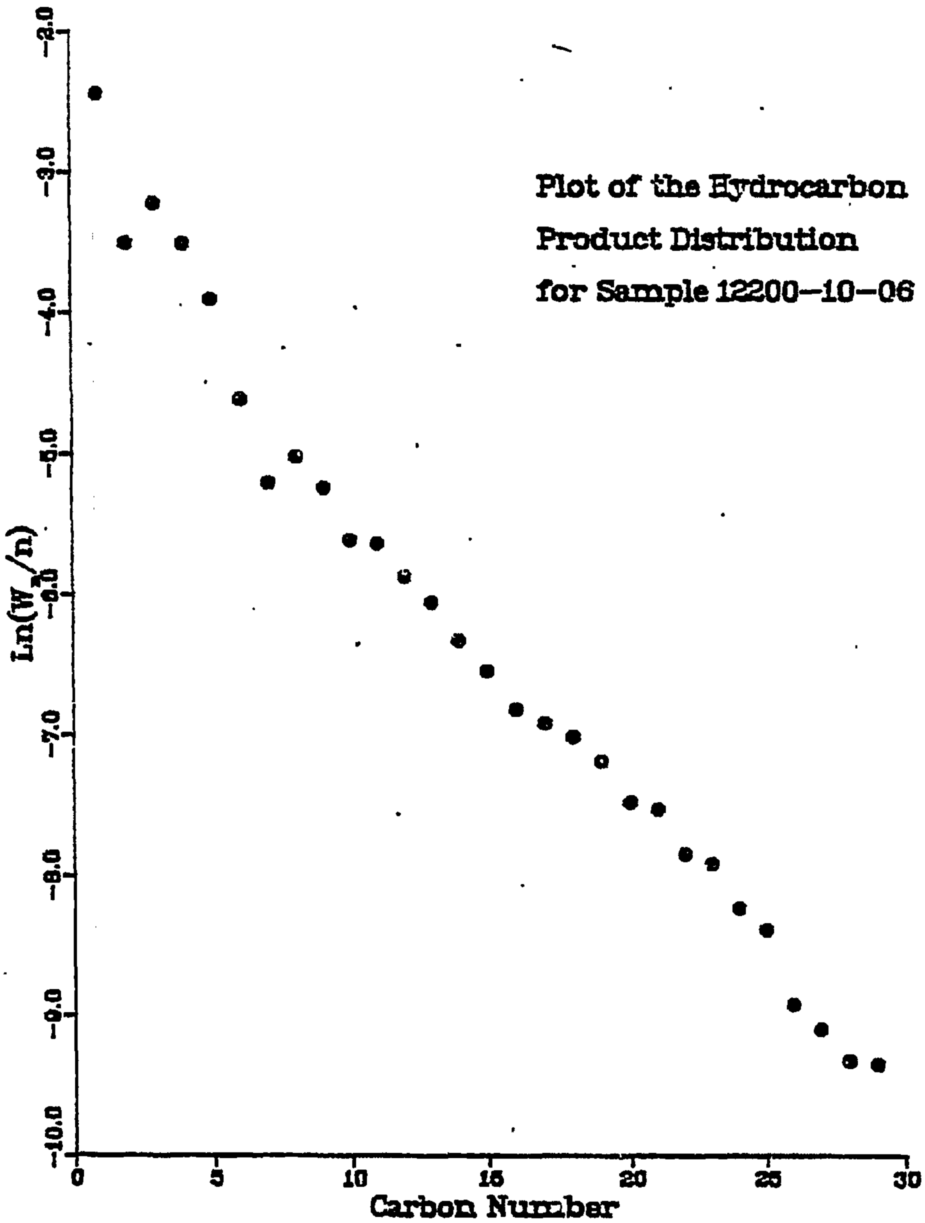

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-10-06
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B217

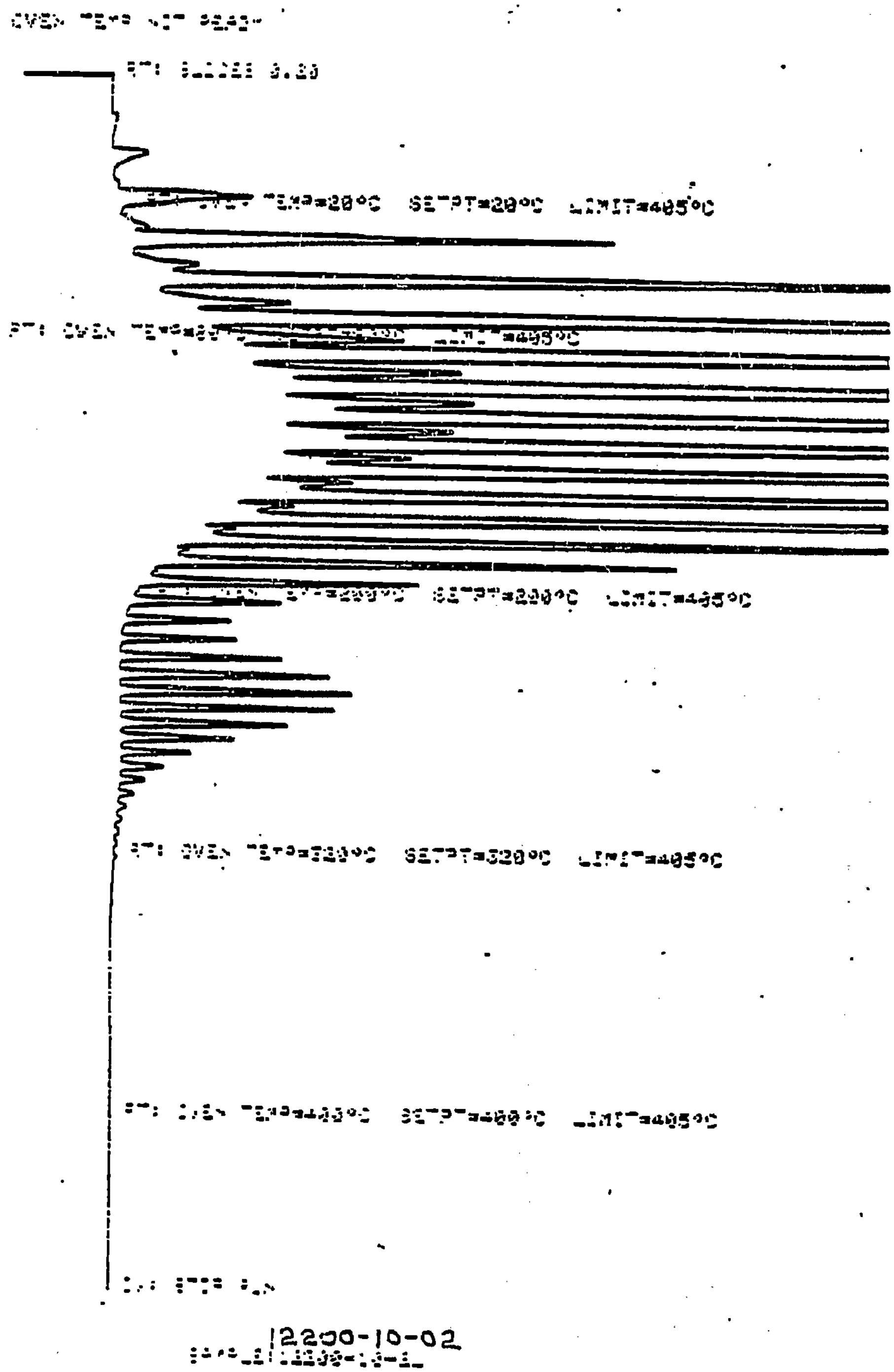
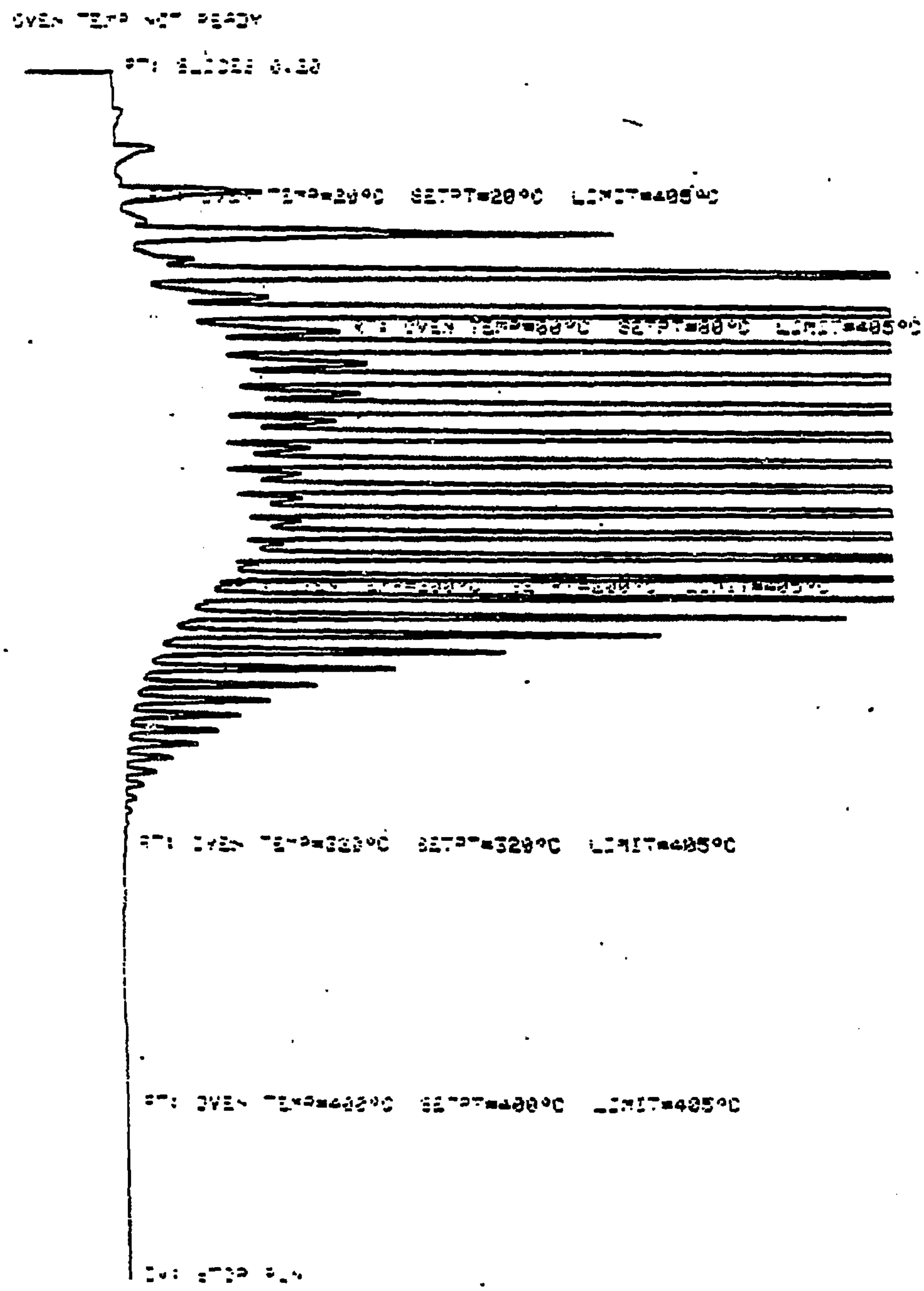
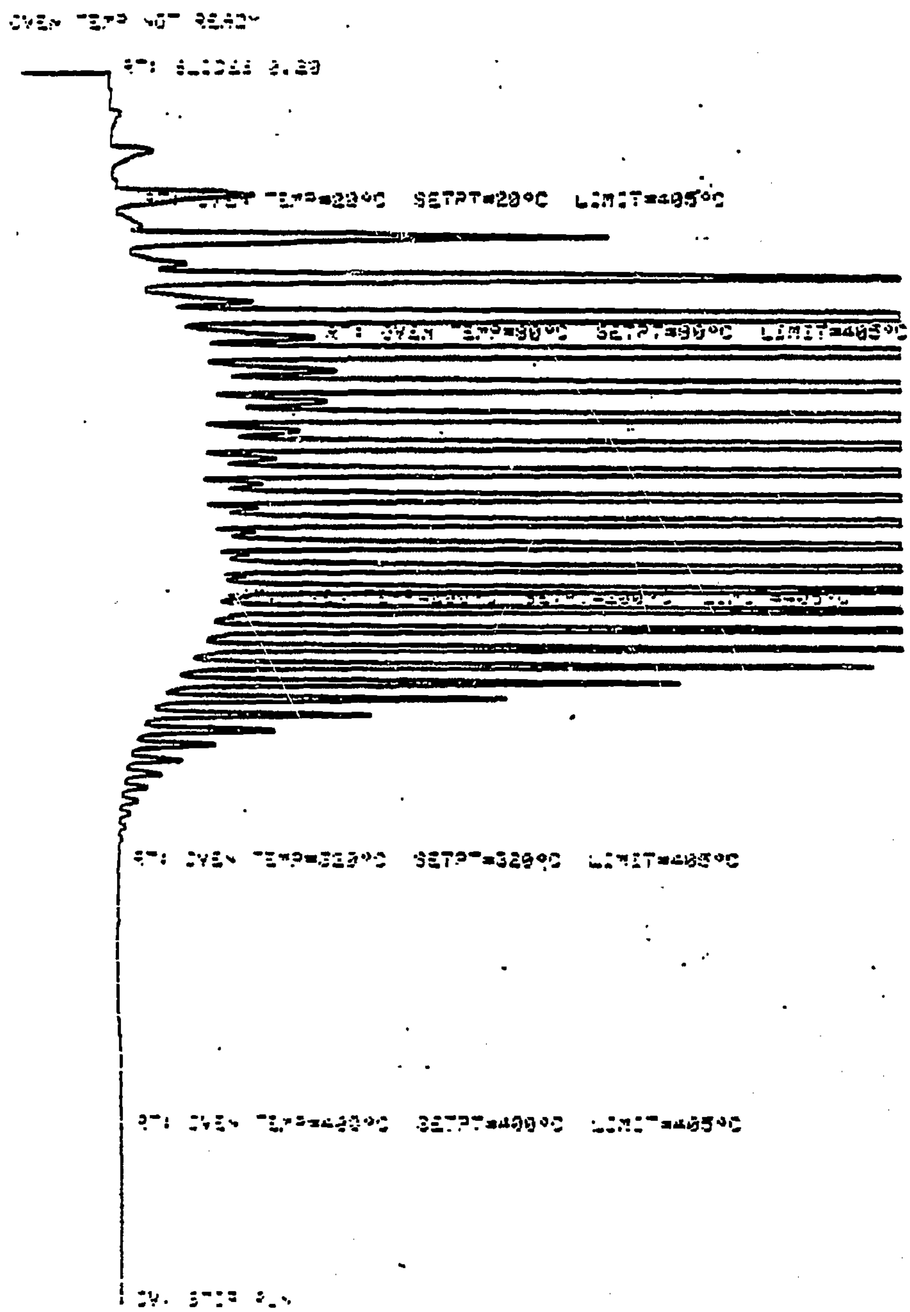


Fig. B218



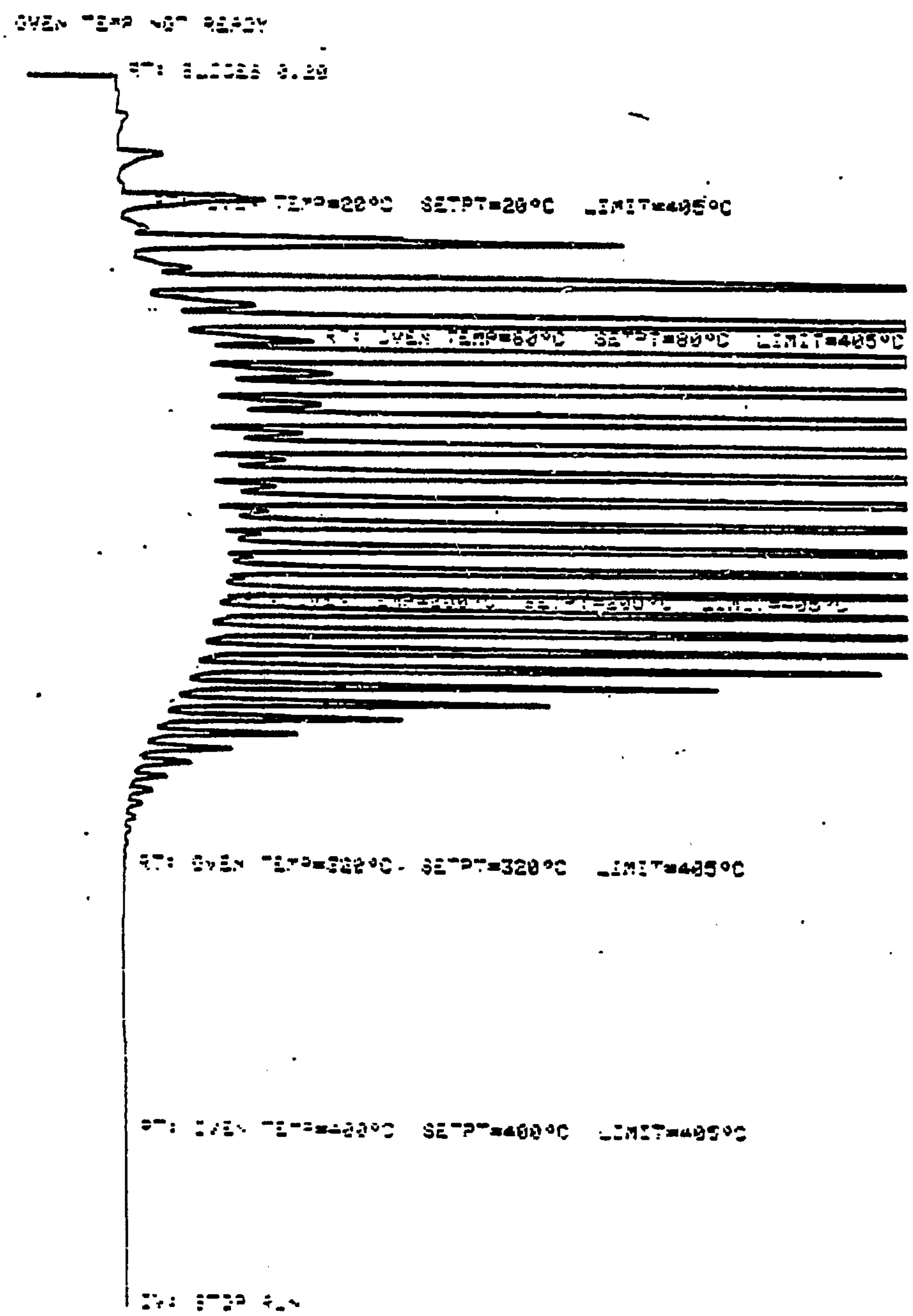
12200-10-03

Fig. B219



12200-10-04

Fig. B220



12200-10-06

Fig. B221

RESULT OF SYNGAS OPERATION

RUN NO. 12200-10
CATALYST FE/K-U103 12251-17 80 CC 37.5 G (WT CHANGE +5.5 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-10-02	200-10-03	200-10-04	200-10-06
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	41.5	66.0	90.7	116.2
PRESSURE,PSIG	300	300	300	299
TEMP. C	250	250	250	250
FEED CC/MIN	400	400	400	400
HOURS FEEDING	22.50	24.50	24.67	25.50
EFFLNT GAS LITER	199.60	207.39	212.31	444.80
GM AQUEOUS LAYER	18.06	20.76	22.73	24.18
GM OIL	2.94	5.33	5.10	6.28
MATERIAL BALANCE				
GM ATOM CARBON %	46.38	45.62	46.16	92.07
GM ATOM HYDROGEN %	48.61	48.40	49.62	86.86
GM ATOM OXYGEN %	51.36	50.05	51.56	94.94
RATIO CHX/(H2O+CO2)	0.5624	0.6226	0.5713	0.8097
RATIO X IN CHX	2.2777	2.2442	2.2486	2.2867
USAGE H2/CO PRODT	2.4032	2.3354	2.4592	1.9727
FEED H2/CO FRM EFFLNT	1.0482	1.0609	1.0748	0.9435
RESIDUAL H2/CO RATIO	0.7919	0.7833	0.7823	0.7607
RATIO CO2/(H2O+CO2)	0.0849	0.0733	0.0686	0.1105
K SHIFT IN EFFLNT	0.0735	0.0620	0.0576	0.0945
SPECIFIC ACTIVITY SA	0.4998	0.5742	0.5562	0.5109
CONVERSION				
ON CO %	15.90	17.89	17.44	15.08
ON H2 %	36.46	39.37	39.91	31.53
ON CO+H2 %	26.43	28.95	29.08	23.07
PRDT SELECTIVITY,WT %				
CH4	7.75	6.20	6.38	8.71
C2 HC'S	7.03	5.51	6.04	6.02
C3H8	3.09	2.47	2.52	2.96
C3H6=	9.36	7.63	8.00	9.02
C4H10	2.92	2.38	2.43	2.87
C4H8=	8.52	7.21	7.53	9.14
C5H12	3.23	2.57	2.68	3.29
C5H10=	1.94	1.78	1.73	6.79
C6H14	3.51	2.55	2.45	3.10
C6H12= & CYCLO'S	3.10	2.76	2.92	2.85
C7+ IN GAS	20.68	16.65	16.54	16.74
LIQ HC'S	28.86	42.28	40.79	28.52
TOTAL	100.00	100.00	100.00	100.00

Table B16

SUB-GROUPING				
C1 -C4	38.68	31.41	32.89	38.72
C5 -420 F	42.42	39.42	38.56	41.18
420-700 F	17.72	26.68	24.39	17.08
700-END PT	1.18	2.49	4.16	3.02
C5+-END PT	61.32	68.59	67.11	61.28
ISO/NORMAL MOLE RATIO				
C4	0.0687	0.0668	0.0712	0.0735
C5	0.0906	0.0954	0.0986	0.0925
C6	0.1225	0.0580	0.1048	0.0579
C4=	0.0000	0.0000	0.0000	0.0000
PARAFFIN/OLEFIN RATIO				
C3	0.3146	0.3088	0.3009	0.3129
C4	0.3310	0.3193	0.3111	0.3034
C5	1.6152	1.4080	1.5028	0.4703
SCHULZ-FLORY DISTRBTN				
ALPHA (EXP(SLOPE))	0.7487	0.8027	0.8214	0.8014
RATIO CH4/(1-A)**2	1.2276	1.5933	1.9999	2.2082
ALPHA FRM CORRELATION	0.8227	0.8233	0.8233	0.8247
ALPHA (EXPTL/CORR)	0.9101	0.9750	0.9977	0.9717
WTCH4 FRM CORRELATION	20.6666	20.5010	20.4822	20.0580
WTCH4 (EXPTL/CORR)	0.3751	0.3026	0.3114	0.4344
LIQ HC COLLECTION				
PHYS. APPEARANCE	CLR OIL	CLR OIL	CLR OIL	CLR OIL
DENSITY	0.7630	0.7663	0.7677	0.7675
N, REFRACTIVE INDEX	1.4285	1.4304	1.4314	1.4314
SIMULT'D DISTILATN				
10 WT % @ DEG F	340	340	340	340
16	350	355	363	362
50	457	486	490	491
84	553	626	669	669
90	595	667	701	707
RANGE(16-84 %)	203	271	306	307
WT % @ 420 F	34.50	31.00	30.00	29.50
WT % @ 700 F	95.90	94.10	89.80	89.40

Table B16, cont

X. Run 18 (12200-11) with Catalyst 18 (Fe/K/UCC-103)

This catalyst is identical, in composition and preparation, to Catalyst 17, Run 12200-10, except that it was calcined at a lower temperature and contained slightly more potassium.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B222-225. A simulated distillation of the C_5^+ product of one sample is plotted in Fig. B226. A carbon number product distribution for one sample is plotted in Fig. B227. A chromatogram from simulated distillation of one sample is reproduced in Fig. B228. Detailed material balances appear in Table B17.

Both the activity and the selectivity of this catalyst were even poorer than with Catalyst 17. The product was lighter, less olefinic, and higher in methane.

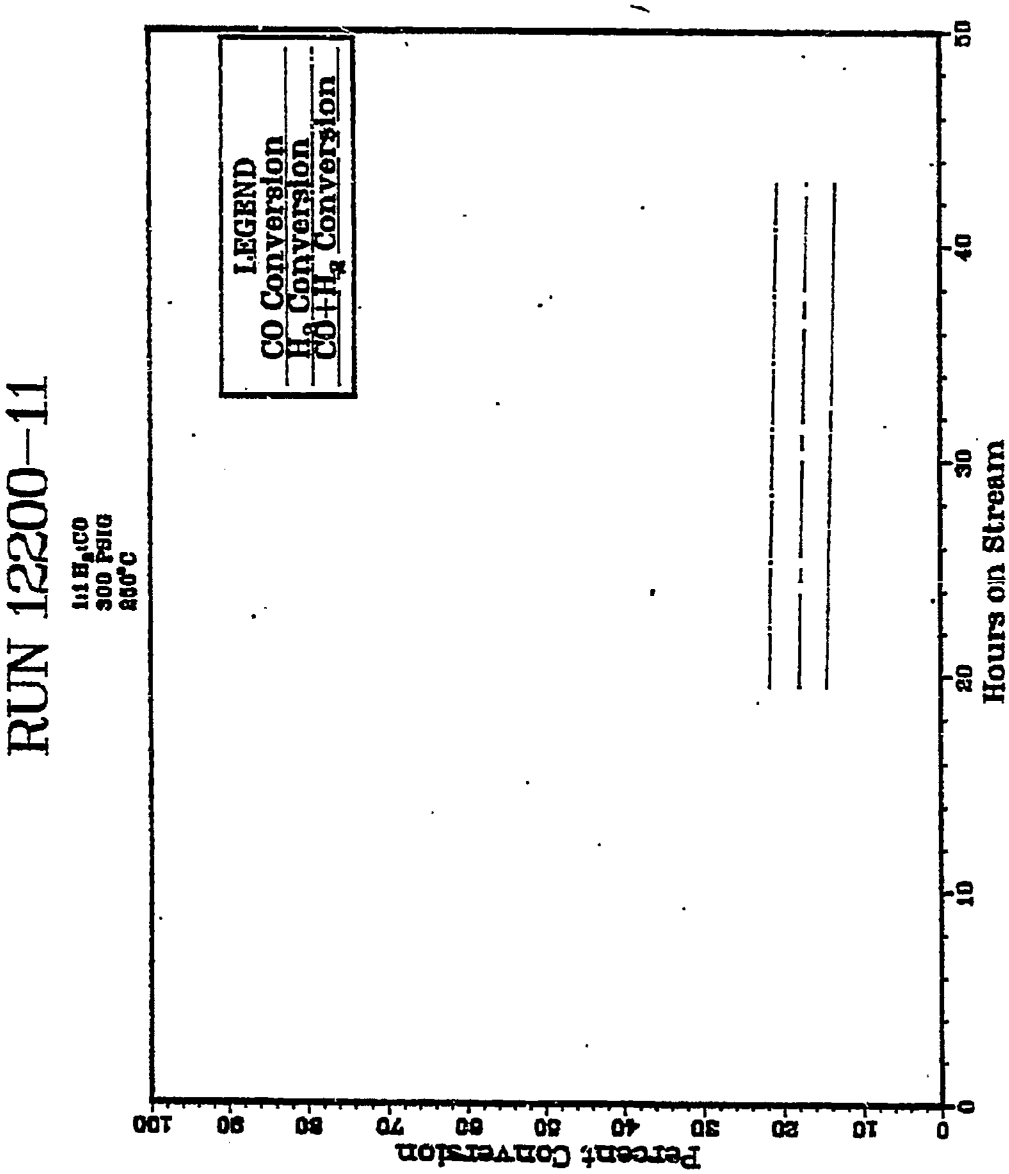

RUN 12200—11
1:1 H2:CO
300 PSIG
250°C
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. B222

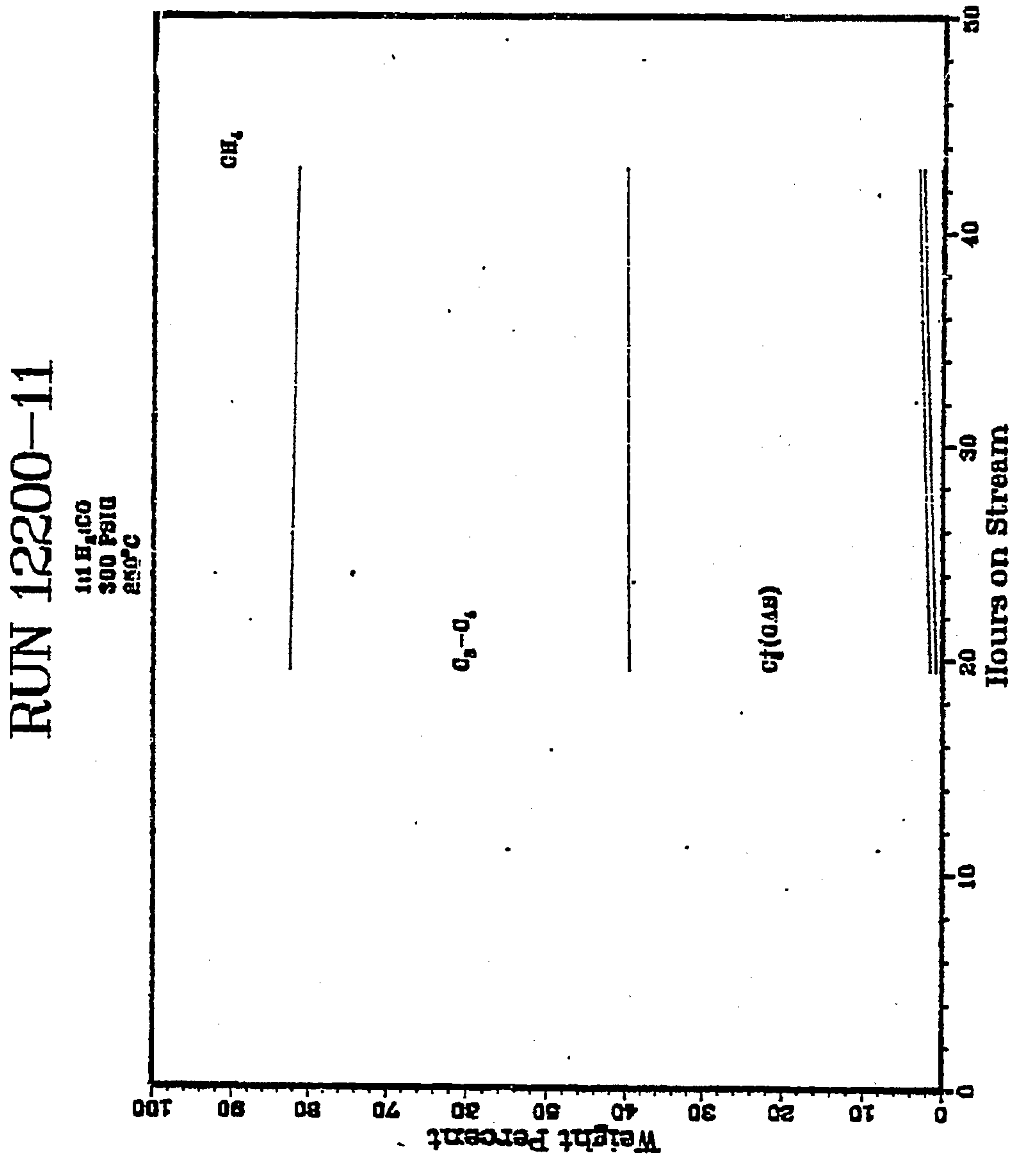

RUN 12200-11
1:1 H_2:CO
300 PSIG
250°C
CH_4
C_2-C_4
Hours on Stream
Weight Percent
0
10
20
30
40
50
60
70
80
90
100

Fig. B223

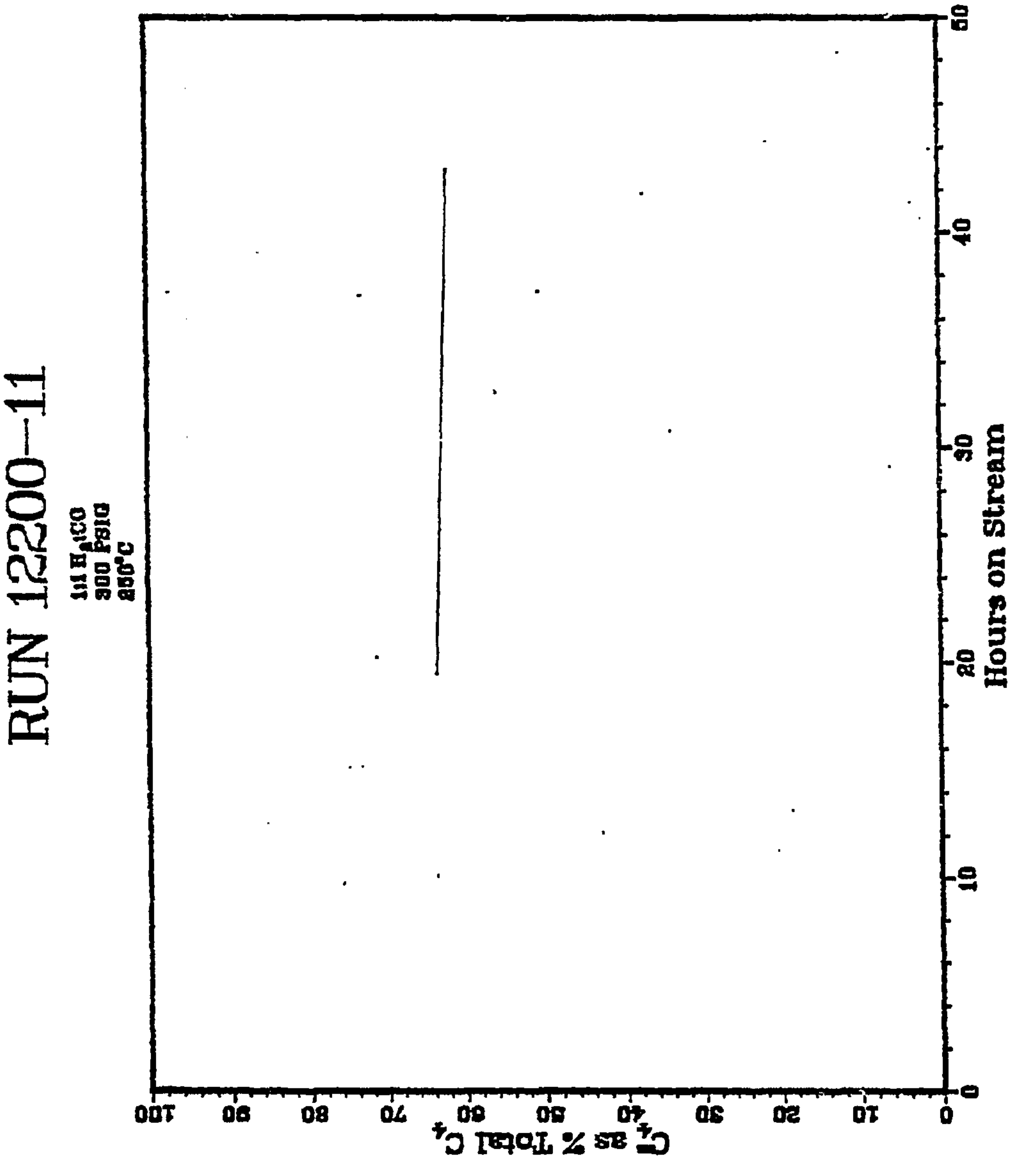

RUN 12200—11
1:1 H2:CO
300 PSIG
350°C
Hours on Stream
0
10
20
30
40
50
C4= as % Total C4
0
10
20
30
40
50
60
70
80
90
100

Fig. B224

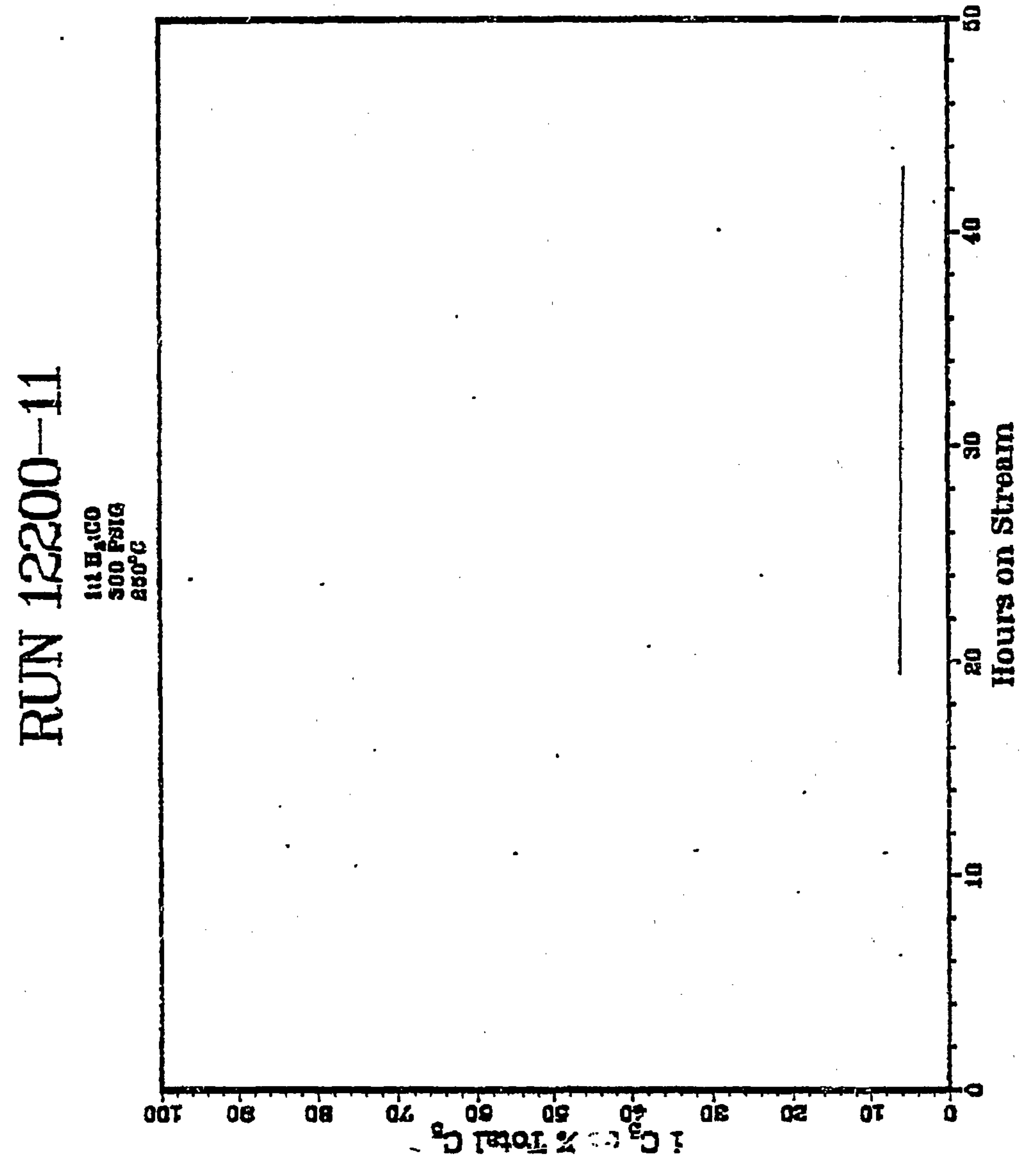
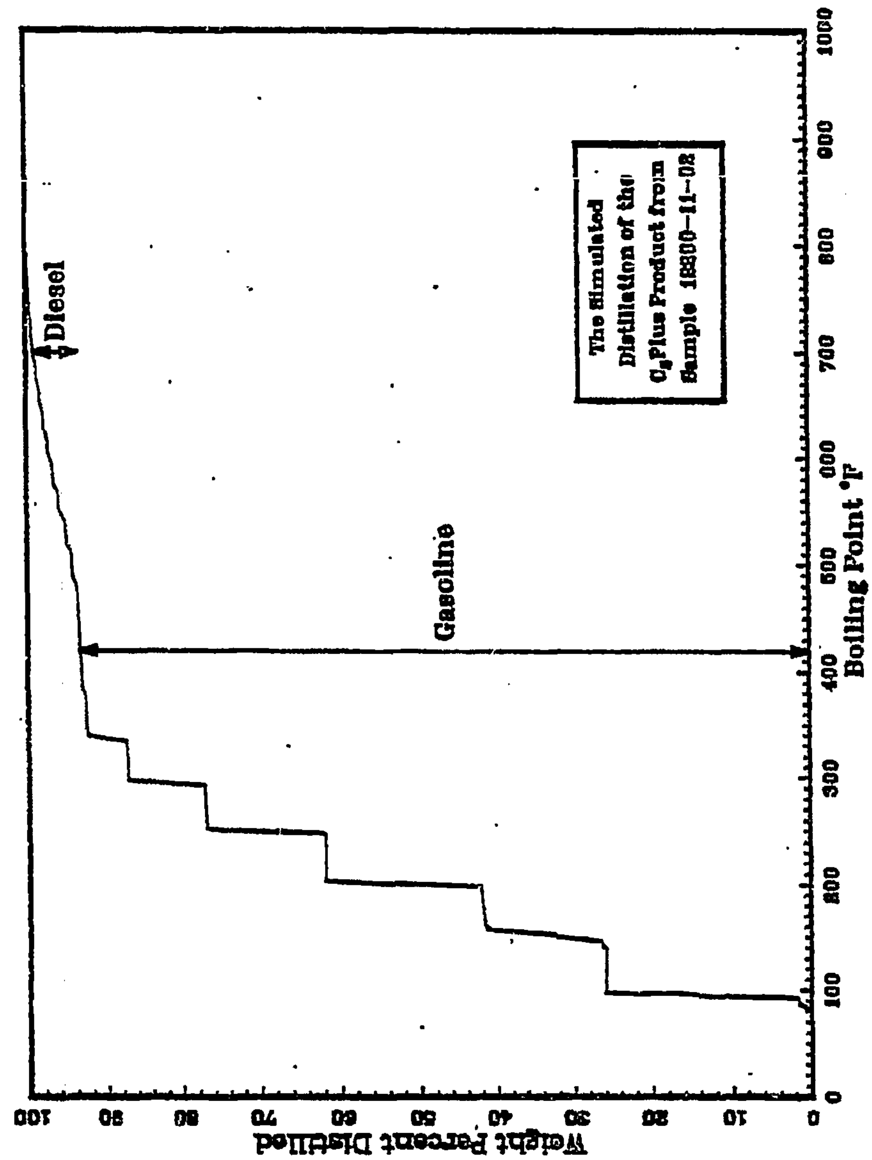


Fig. B225



Diesel
Gasoline
The Simulated
Distillation of the
C_5Plus Product from
Sample 18800-11-02
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. B226

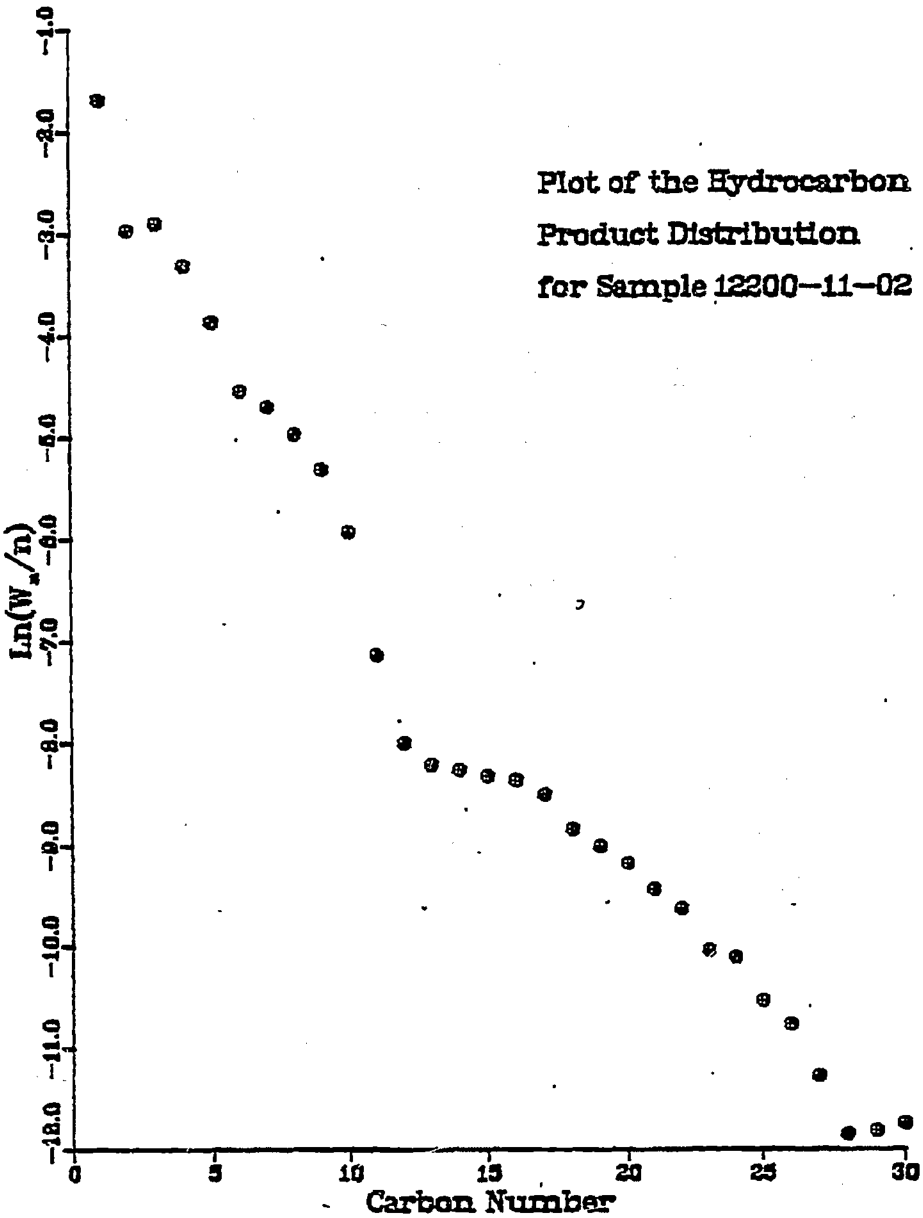
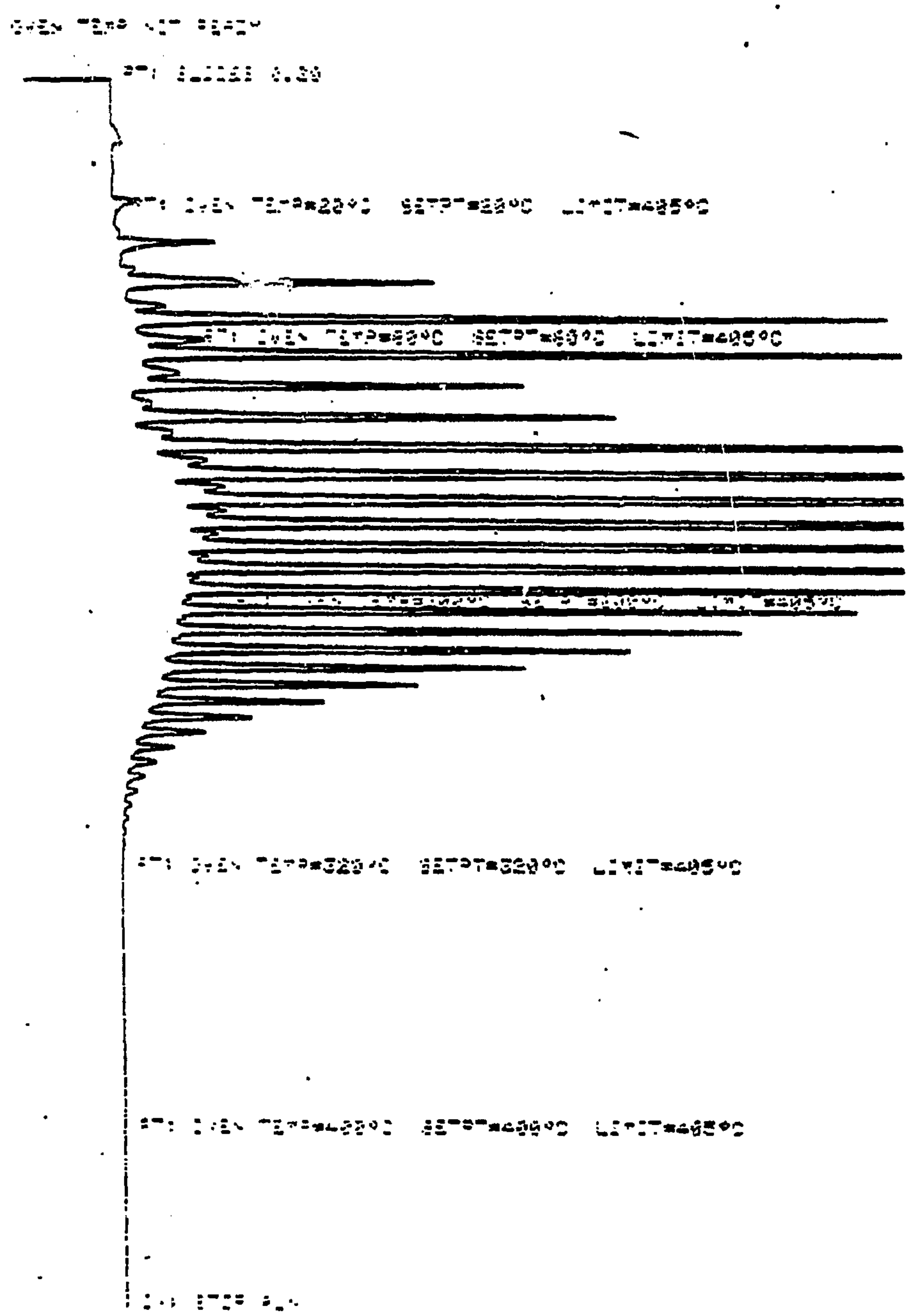

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-11-02
Ln(W_n/n)
Carbon Number
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
-12.0
0
5
10
15
20
25
30

Fig. B227



12200-11-02

Fig. B228

RESULT OF SYNGAS OPERATION

RUN NO. 12200-11
CATALYST FE/K-U103 12251-28 80 CC 34.0 G (WT CHANGE +0.9 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-11-01	200-11-02
FEED H2:CO:AR	50:50:0	50:50:0
HRS ON STREAM	19.5	43.0
PRESSURE,PSIG	300	300
TEMP. C	250	251
FEED CC/MIN	400	400
HOURS FEEDING	19.50	23.50
EFFLNT GAS LITER	371.40	472.10
GM AQUEOUS LAYER	6.35	7.85
GM OIL	0.22	0.51
MATERIAL BALANCE		
GM ATOM CARBON %	93.67	97.43
GM ATOM HYDROGEN %	86.52	91.01
GM ATOM OXYGEN %	94.49	98.58
RATIO CHX/(H2O+CO2)	0.9226	0.8915
RATIO X IN CHX	2.4985	2.5183
USAGE H2/CO PRODT	1.3837	1.4395
FEED H2/CO FRM EFFLNT		0.9341
RESIDUAL H2/CO RATIO	0.8454	0.8558
RATIO CO2/(H2O+CO2)	0.3675	0.3440
K SHIFT IN EFFLNT	0.4912	0.4488
SPECIFIC ACTIVITY SA	0.4229	0.4016
CONVERSION		
ON CO %	14.54	13.41
ON H2 %	21.78	20.66
ON CO+H2 %	18.01	16.91
PRDT SELECTIVITY,WT %		
CH4	17.61	18.55
C2 HC'S	10.24	10.27
C3H8	5.89	5.91
C3H6=	11.47	10.60
C4H10	5.67	5.67
C4H8=	9.56	8.89
C5H12	5.01	4.93
C5H10=	6.34	5.47
C6H14	4.70	3.85
C6H12= & CYCLO'S	2.98	2.49
C7+ IN GAS	18.91	20.18
LIQ HC'S	1.61	3.20
TOTAL	100.00	100.00

Table B17

SUB-GROUPING		
C1 -C4	60.44	59.88
C5 -420 F	38.75	37.46
420-700 F	0.65	2.26
700-END PT	0.16	0.40
C5+-END PT	39.56	40.12
ISO/NORMAL MOLE RATIO		
C4	0.0358	0.0438
C5	0.0656	0.0596
C6	0.1124	0.0494
C4=	0.0000	0.0000
PARAFFIN/OLEFIN RATIO		
C3	0.4901	0.5315
C4	0.5730	0.6153
C5	0.7684	0.8760
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))	0.6041	0.7216
RATIO CH4/(1-A)**2	1.1233	2.3919
ALPHA FRM CORRELATION	0.8195	0.8189
ALPHA (EXPTL/CORR)	0.7371	0.8811
WTCH4 FRM CORRELATION	21.6545	22.0748
WTCH4 (EXPTL/CORR)	0.8131	0.8401
LIQ HC COLLECTION		
PHYS. APPEARANCE	CLR OIL	CLR OIL
DENSITY	N/A	N/A
N, REFRACTIVE INDEX	N/A	N/A
SIMULT'D DISTILATN		
10 WT % @ DEG F		377
16		414
50		565
84		686
90		715
RANGE(16-84 %)		272
WT % @ 420 F		17.00
WT % @ 700 F		87.50

Table B17, cont

XI. Run 19 (12185-09) with Catalyst 19 ($Co/X_9/X_{10}/X_4$/UCC-103)

This run is a second attempt to develop an effective catalyst by incorporating the three additives X_9, X_{10} and X_4 into the cobalt/UCC-103 formulation of Catalyst 11 (Run 12200-06). The first attempt, in Catalyst 16 (Run 12200-09), was unsuccessful.

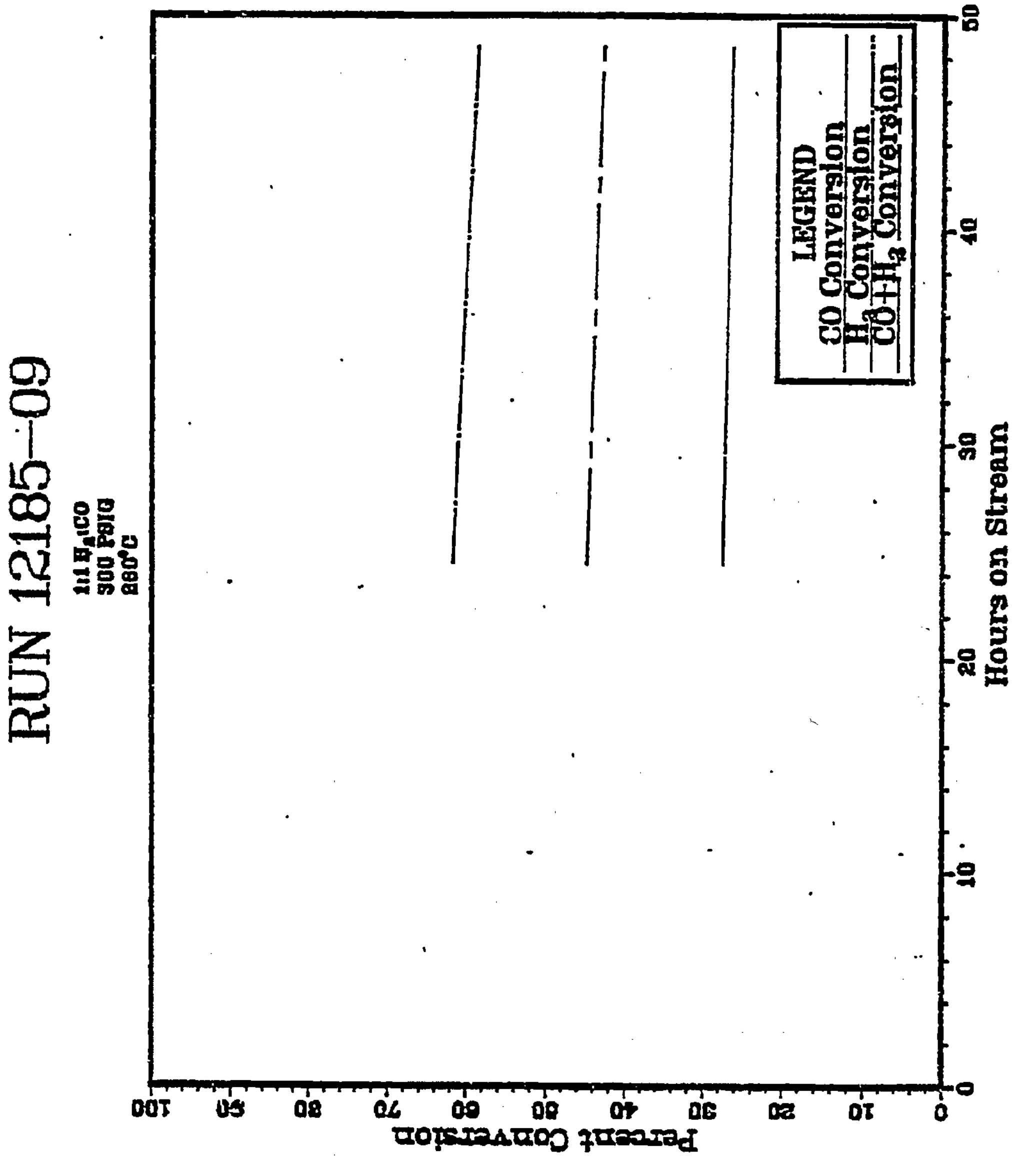
Cobalt oxide was formed in close contact with UCC-103 by the method used in Run 11, then further promoted with X_9, X_{10} and X_4. The resulting powder, after bonding with 15 percent silica, was extruded to 1/8-inch pellets. The final catalyst contained 11.3 percent cobalt, 0.5 percent X_9, 0.7 percent X_{10} and 1.3 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. B229-232. Simulated distillations of the C_5^+ product are plotted in Figs. B233-234. Carbon number product distributions are plotted in Figs. B235-236. Chromatograms from simulated distillations are reproduced in Figs. B237-238. Detailed material balances appear in Table B18.

The initial activity, although higher than with Catalyst 16--syngas conversion about 44.8 percent, specific activity 0.7, as against 28.7 percent and 0.29 respectively--was still unacceptably low.

Due to the nature of the new method of preparation, the X_4

used both in this catalyst and in Catalyst 16 was obtained from a different source than previously. As will be reported in Run 20, subsequent analysis of the catalyst indicated that use of the new source resulted in a poisoning of the catalyst.



RUN 12185-09
Percent Conversion
Hours on Stream
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion

Fig. B229

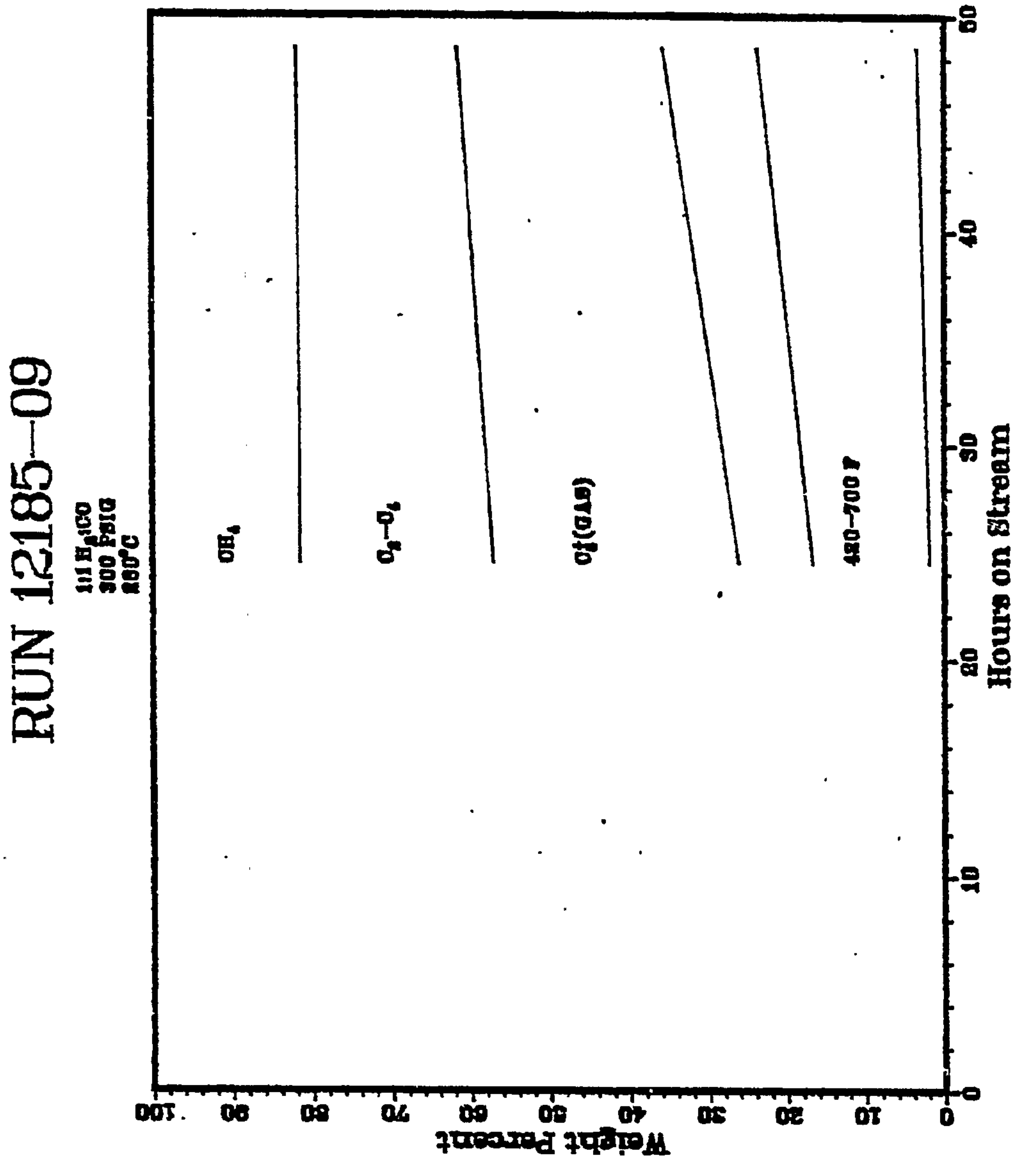
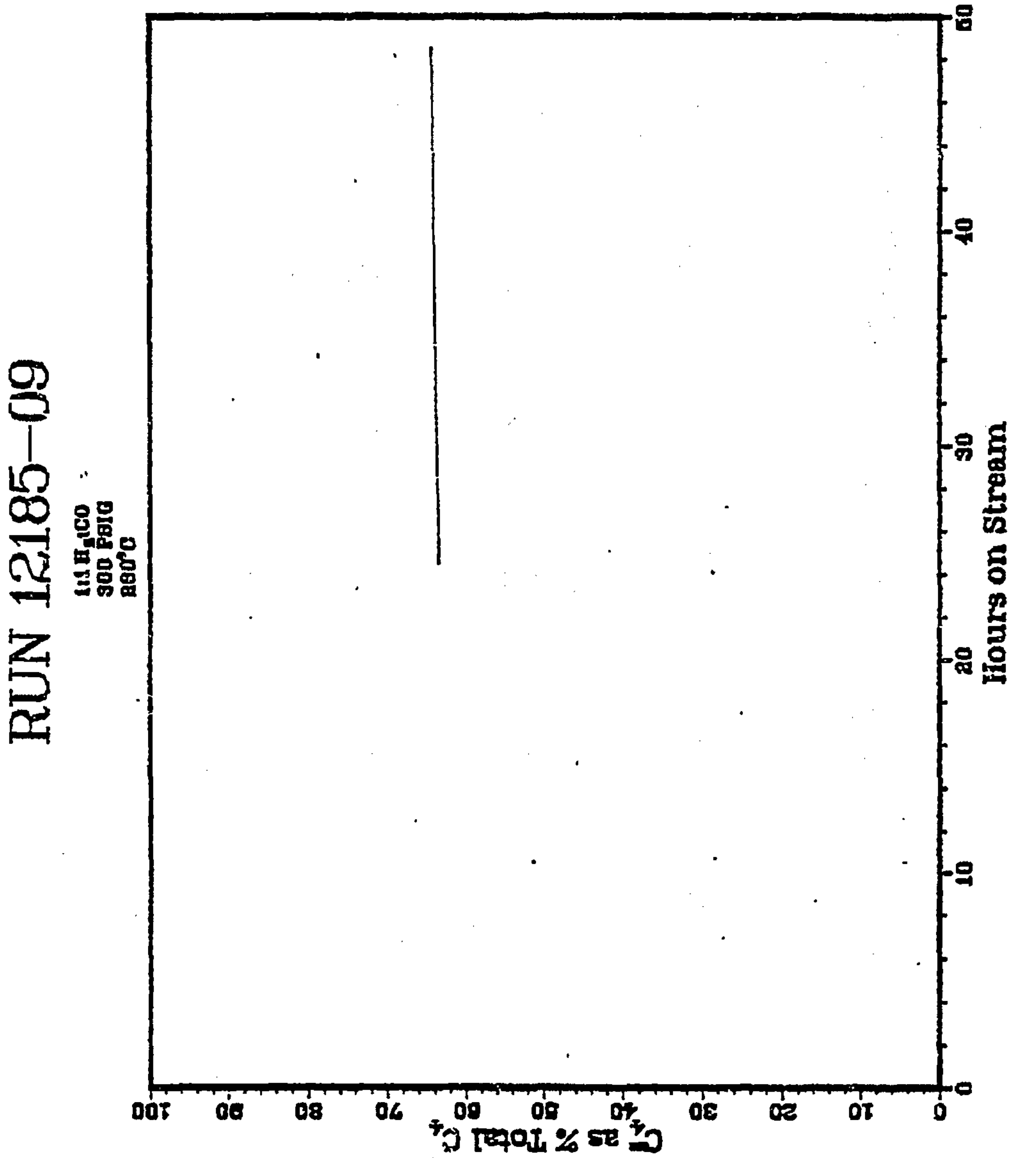

RUN 12185—09
300 PSIG
CH4
Hours on Stream
Weight Percent
0
10
20
30
40
50
60
70
80
90
100

Fig. B230



RUN 12185-09
1:1 H_2:CO
300 PSIG
Hours on Stream
0
10
20
30
40
50
0
10
20
30
40
50
60
70
80
90
100
$C_4^=$ as % Total C_4

Fig. B231

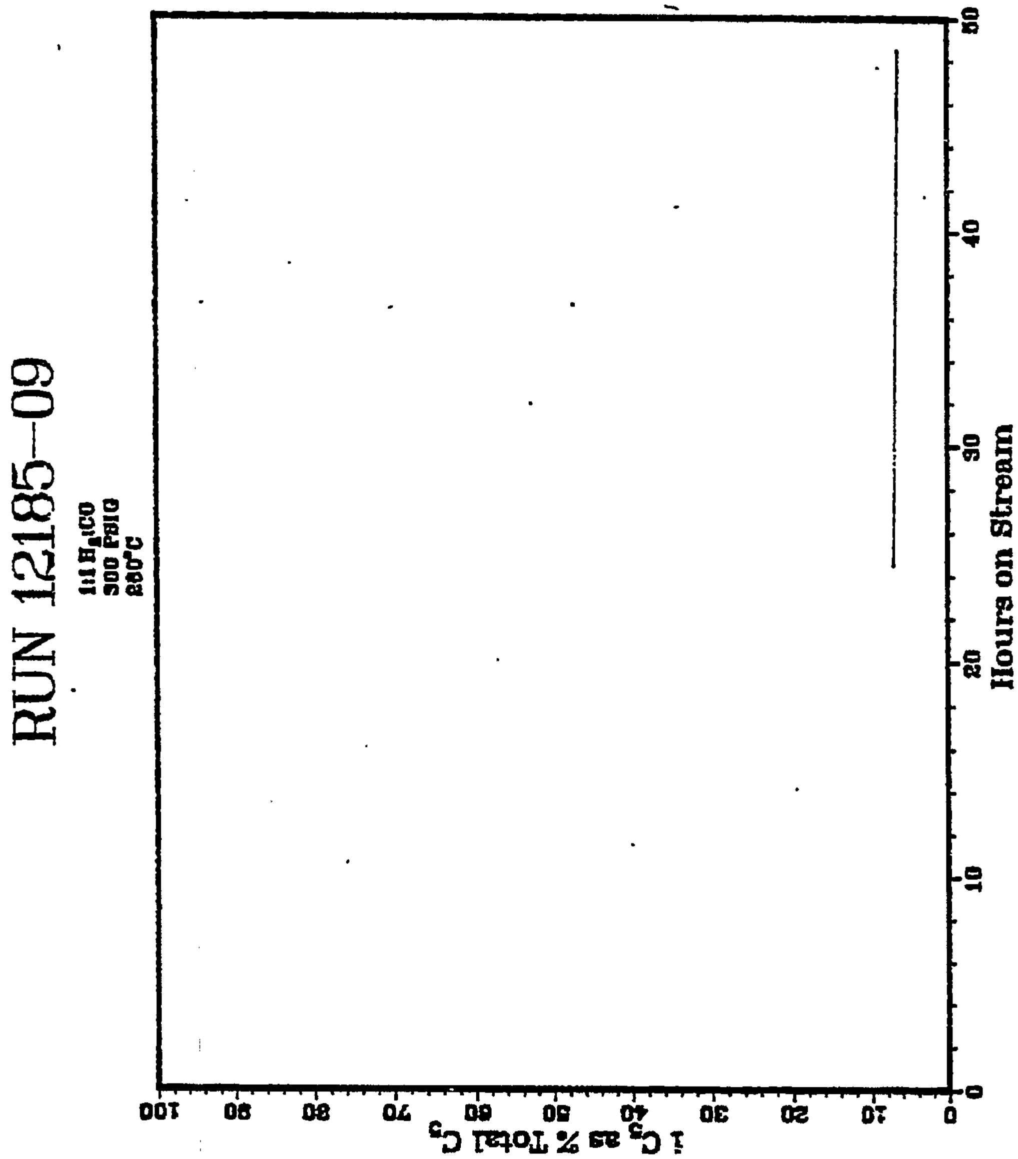
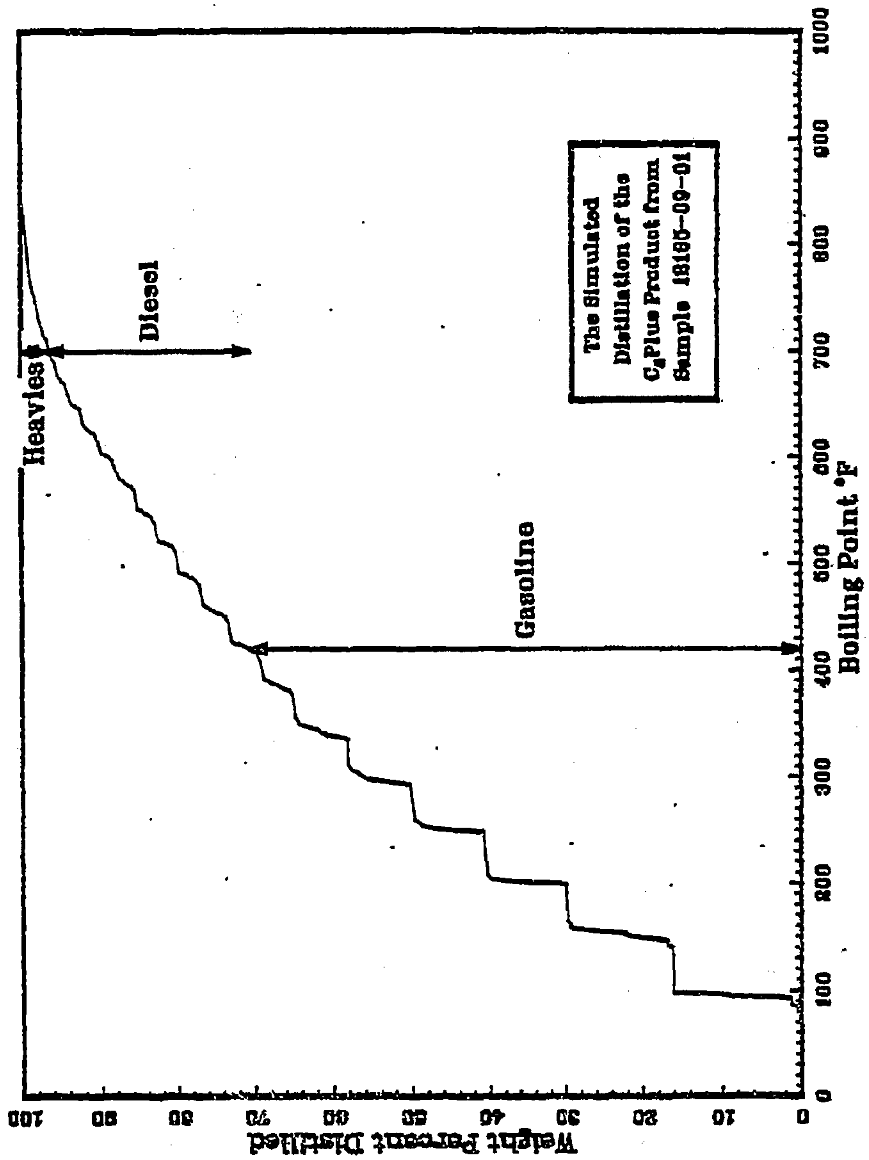
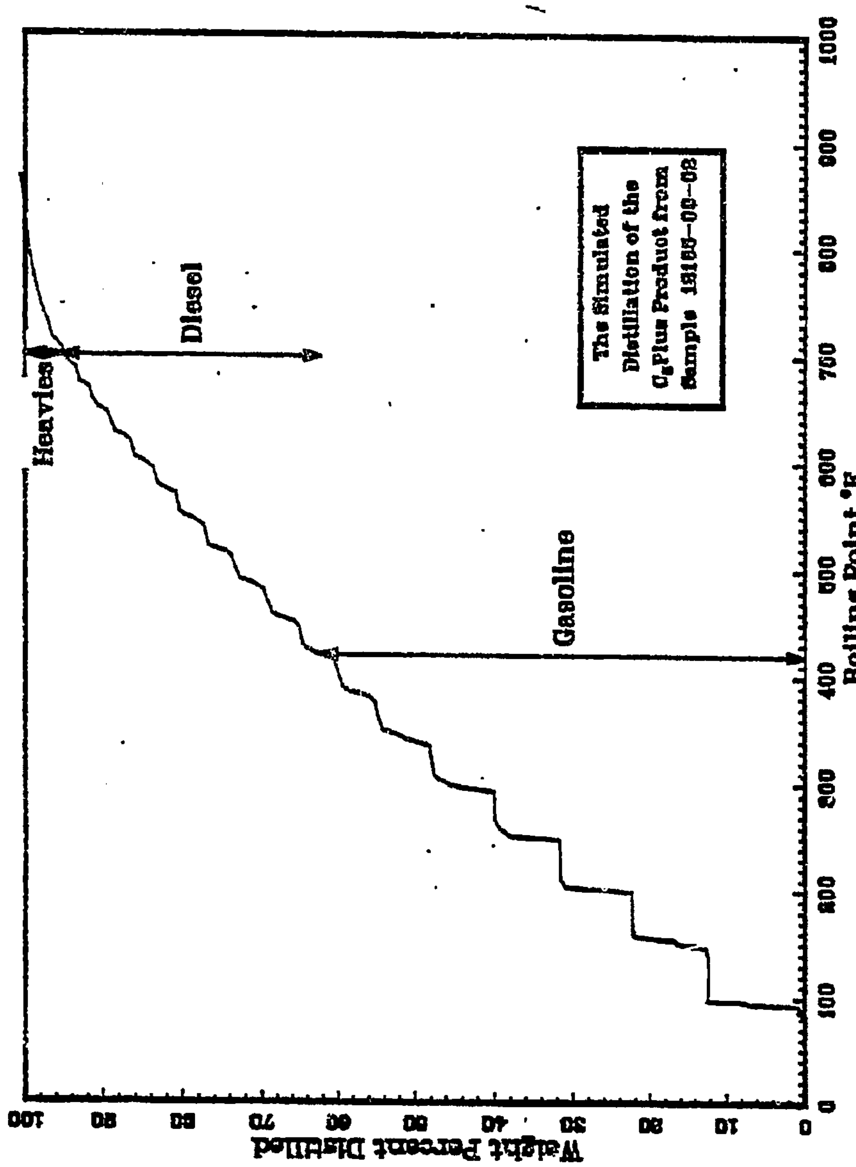

RUN 12185–09
1:1 H2:CO
300 PSIG
280°C
Hours on Stream
i C5 as % Total C5
0
10
20
30
40
50
60
70
80
90
100

Fig. B232



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
Heavies
Diesel
Gasoline
The Simulated
Distillation of the

Fig. B233



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

Fig. B234

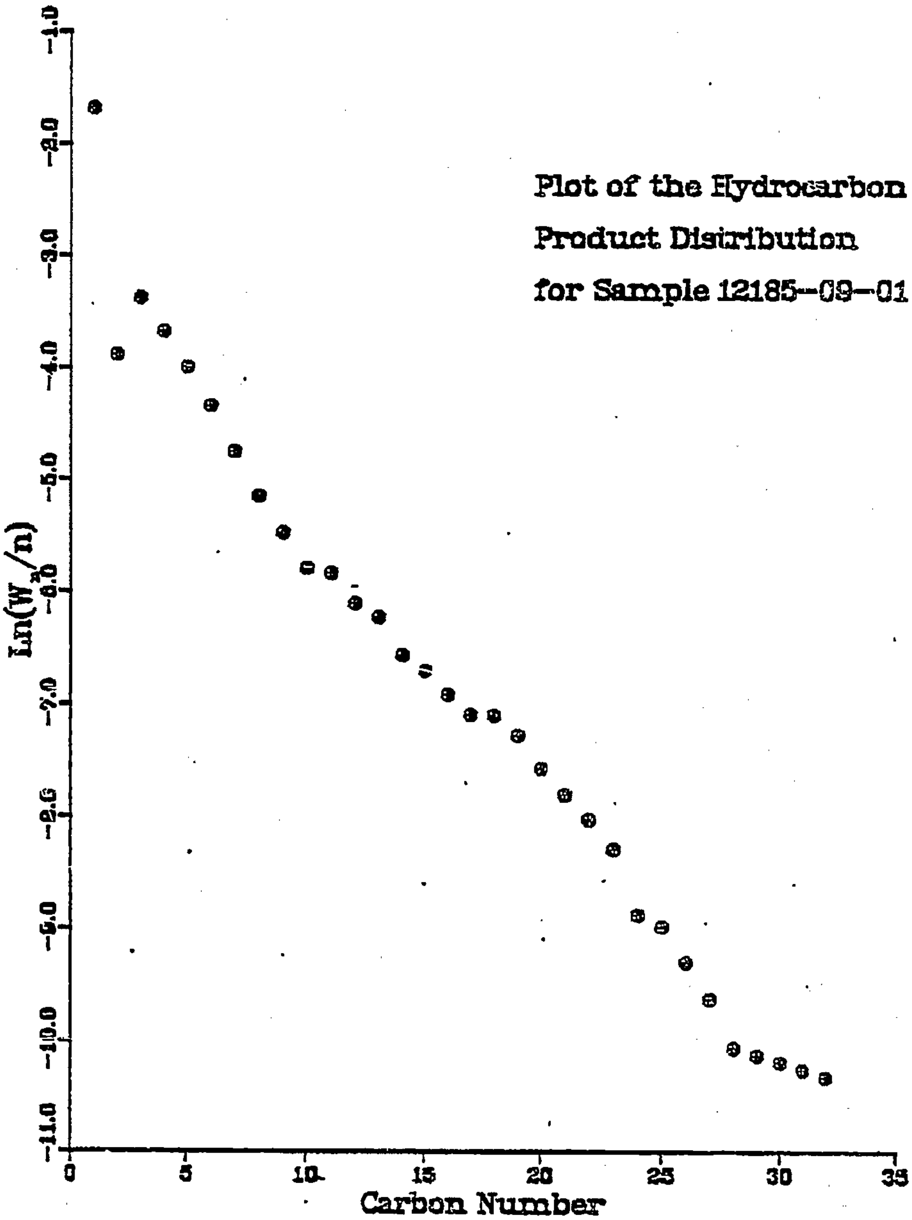

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-09-01
Ln(W$_n$/n)
Carbon Number

Fig. B235

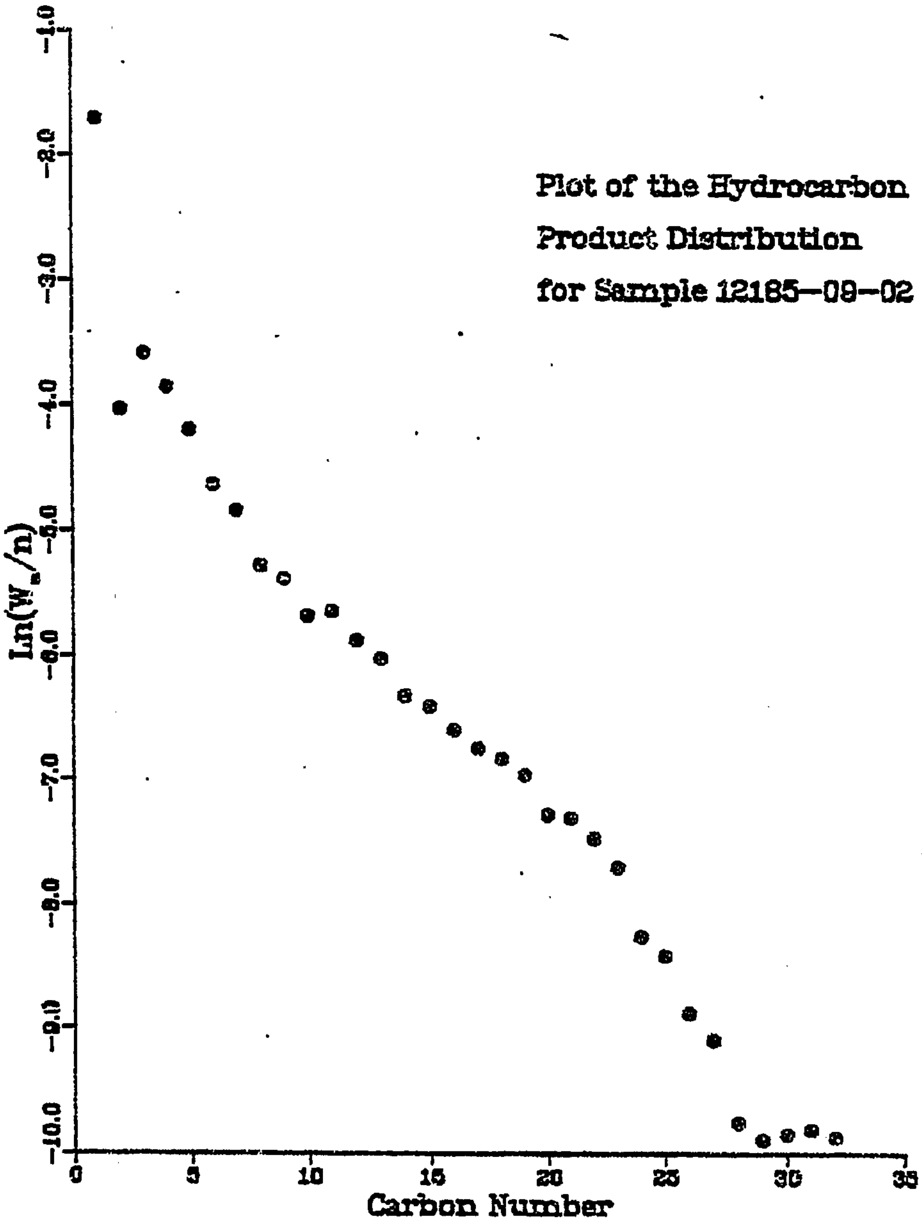
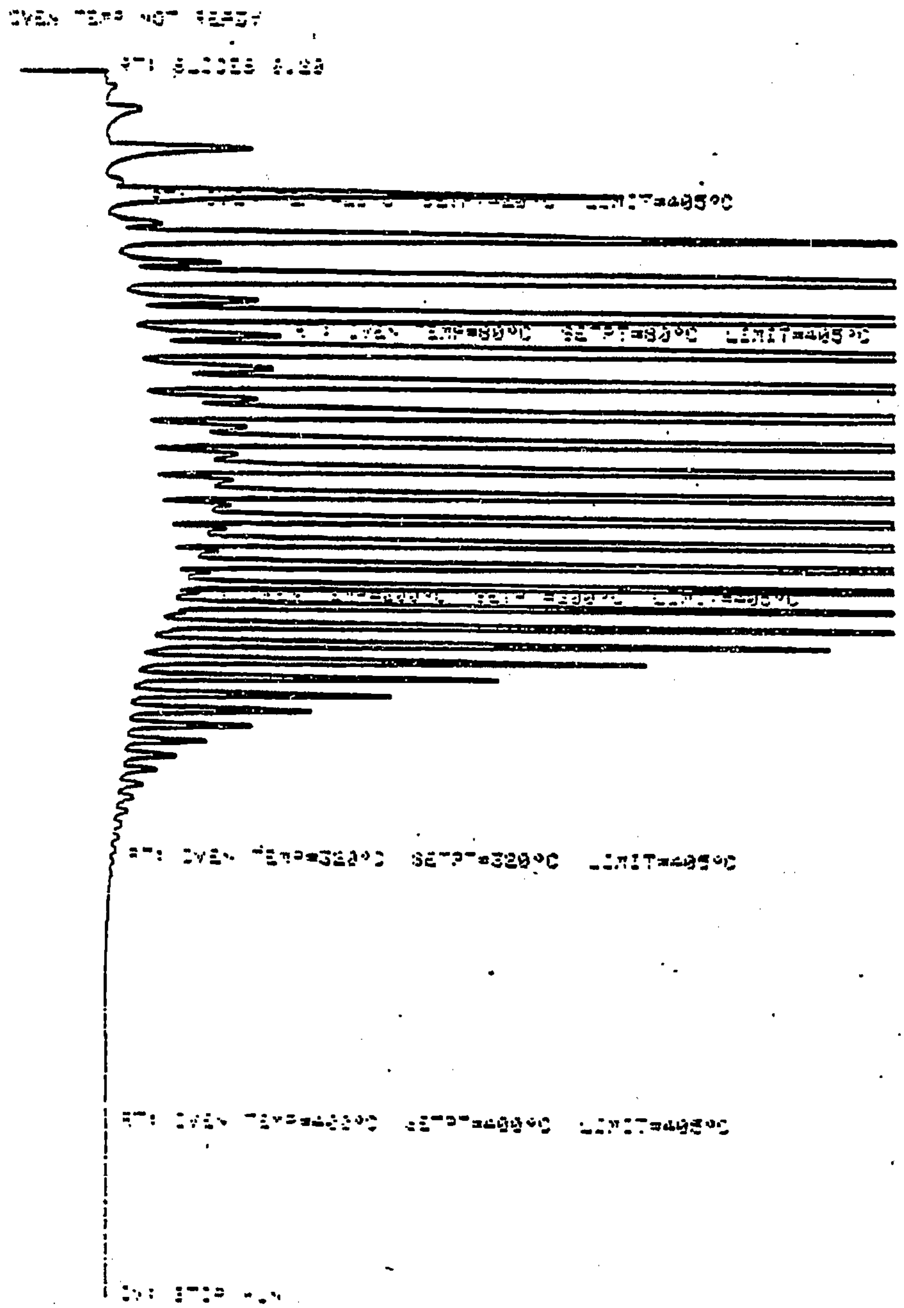

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-09-02
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B236



12185-09-01

Fig. B237

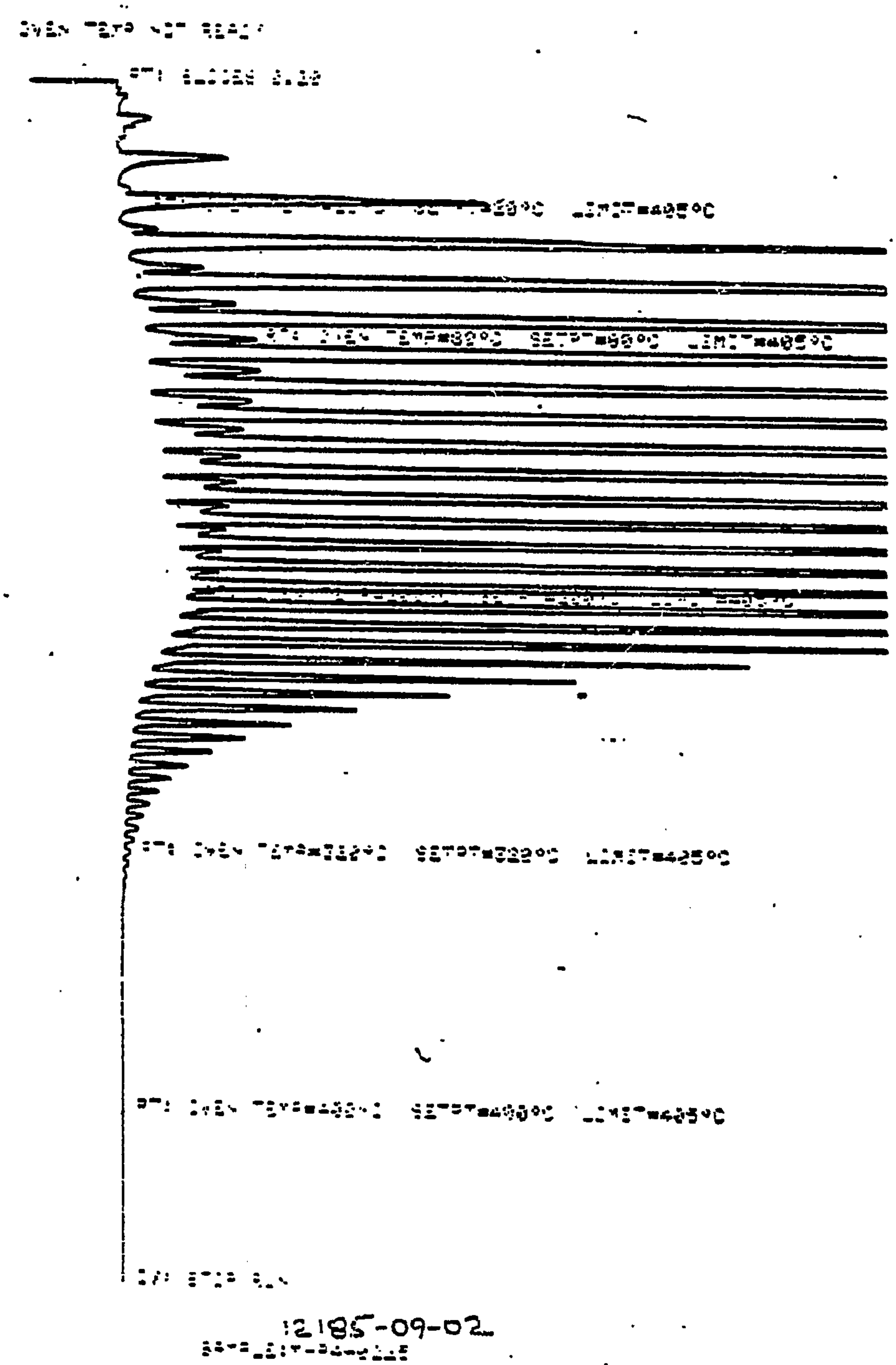


Fig. B238

RESULT OF SYNGAS OPERATION

RUN NO. 12185-09
CATALYST CO/X9/X10/X4-U103 12251-20-14 80 CC 42.4 G (WT CHANGE +2.8 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12185-09-01	185-09-02
FEED H2:CO:AR	50:50: 0	50:50: 0
HRS ON STREAM	24.5	48.5
PRESSURE,PSIG	300	300
TEMP. C	262	264
FEED CC/MIN	400	400
HOURS FEEDING	24.50	24.00
EFFLNT GAS LITER	335.00	349.15
GM AQUEOUS LAYER	58.01	56.96
GM OIL	10.70	14.28
MATERIAL BALANCE		
GM ATOM CARBON %	91.89	94.82
GM ATOM HYDROGEN %	93.39	98.16
GM ATOM OXYGEN %	99.42	102.29
RATIO CHX/(H2O+CO2)	0.7558	0.7568
RATIO X IN CHX	2.4783	2.4592
USAGE H2/CO PRODT	2.2778	2.3019
FEED H2/CO FRM EFFLNT	1.0163	1.0353
RESIDUAL H2/CO RATIO	0.5370	0.5813
RATIO CO2/(H2O+CO2)	0.0656	0.0571
K SHIFT IN EFFLNT	0.0377	0.0352
SPECIFIC ACTIVITY SA	0.7337	0.5577
CONVERSION		
ON CO %	27.53	26.38
ON H2 %	61.71	58.66
ON CO+H2 %	44.76	42.80
PRDT SELECTIVITY,WT %		
CH4	18.53	18.09
C2 HC'S	4.11	3.54
C3H8	3.60	2.80
C3H6=	6.60	5.50
C4H10	3.76	3.08
C4H8=	6.33	5.41
C5H12	4.34	3.34
C5H10=	4.84	4.19
C6H14	4.46	3.24
C6H12= & CYCLO'S	3.31	2.62
C7+ IN GAS	13.95	12.42
LIQ HC'S	26.18	35.75
TOTAL	100.00	100.00

Table B18

SUB-GROUPING		
C1 -C4	42.92	38.43
C5 -420 F	40.32	37.79
420-700 F	14.90	20.31
700-END PT	1.86	3.47
C5+-END PT	57.08	61.57
ISO/NORMAL MOLE RATIO		
C4	0.0367	0.0358
C5	0.0757	0.0692
C6	0.0900	0.0379
C4=	0.0000	0.0000
PARAFFIN/OLEFIN RATIO		
C3	0.5208	0.4852
C4	0.5731	0.5501
C5	0.8718	0.7752
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))	0.7852	0.8107
RATIO CH4/(1-A)**2	4.0144	5.0514
ALPHA FRM CORRELATION	0.8410	0.8370
ALPHA (EXPTL/CORR)	0.9336	0.9686
WTCH4 FRM CORRELATION	17.5659	19.2152
WTCH4 (EXPTL/CORR)	1.0547	0.9417
LIQ HC COLLECTION		
PHYS. APPEARANCE	CLD OIL	OIL WAX
DENSITY	0.7577	0.7730
N, REFRACTIVE INDEX	1.4265	1.4276
SIMULT'D DISTILATN		
10 WT % @ DEG F	301	303
16	341	344
50	480	489
84	647	658
90	678	696
RANGE(16-84 %)	306	314
WT % @ 420 F	36.00	33.50
WT % @ 700 F	92.90	90.30
	36.00	33.50
	92.27	90.36

Table B18, cont

XII. Run 20 (12185-11) with Catalyst 20 ($Co/X_9/X_{10}$/UCC-103)

This run continues the search for additives to stabilize the cobalt/UCC-103 Catalyst 11 of Run 12200-06, whose initial activity was exceptionally high. Formulation was the same as for Catalyst 16 (Run 12200-09) but omitting the additive X_4.

Cobalt oxide was promoted with X_9 and X_{10}, then formed in close contact with UCC-103 by the method used in Run 11. The resulting powder, after bonding with 15 percent silica, was extruded to 1/8-inch pellets. The final catalyst contained 11.9 percent cobalt, 0.5 percent X_9 and 0.7 percent X_{10}.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B239-242. Simulated distillations of the C_5^+ product are plotted in Figs. B243-247. Carbon number product distributions are plotted in Figs. B248-252. Chromatograms from simulated distillations are reproduced in Figs. B253-257. Detailed material balances appear in Table B19.

The performance of this catalyst was similar in many respects to that of Ca alyst 11 (Run 12200-06). Its conversion of syngas was initially 88.8 percent, for a specific activity of about 7.6 (vs. 91.48 percent and 12.5 respectively for Catalyst 11), and deactivated rapidly to 62.0 percent, specific activity 2.3, at 115.5 hours on stream (vs. 68.5 percent, 4.0 and 165.5 hours respectively for Catalyst 11). Evidently the inferior activity of Catalysts 16 and 19, both consisting of Co/X_9/X_{10}/X_4/UCC-103, was due to the additive X_4.

The initial water gas shift activity was also extremely high, with nearly 60 percent of the oxygen converted to CO_2, and decreased to 28 percent at 115.5 hours. These values compare with an initial 69 percent for Catalyst 11, and a final 26 percent at 165.5 hours; the final levels with both catalysts were twice as high as for any previous intimately contacted catalyst.

As to selectivity, the calculated alpha value and the C_5^+ product were substantially lower than with Catalyst 11. Most of the difference in this respect, however, is probably due to the slightly lower activity of this catalyst, resulting in a higher residual H_2:CO ratio in the reactor. In terms of ratio of weight percent methane experimentally observed to weight percent predicted by the mathematical model, this catalyst actually produces less methane than Catalyst 11:

Catalyst 20, Run 12185-11	1.09:1
Catalyst 11, Run 12200-06	1.28:1

The olefinic content of the C_4's varied with time, and leveled off at about 50 percent, as compared with about 60 percent for Catalyst 11.

An unusual feature of this catalyst is a carbon number cutoff, as shown in the Schulz-Flory plots. The effect appears to be real, since it persisted even after good material balances were obtained. This is the most striking difference between this catalyst and Catalyst 11.

This run has been useful for its demonstration that the additive X_4 has probably been responsible for the poor activity of certain previous catalysts. The additives X_9 and X_{10} have somewhat improved product selectivity, reduced the production of methane, and induced a carbon number cutoff. What is needed now is an additive or treatment to improve the catalyst's stability.

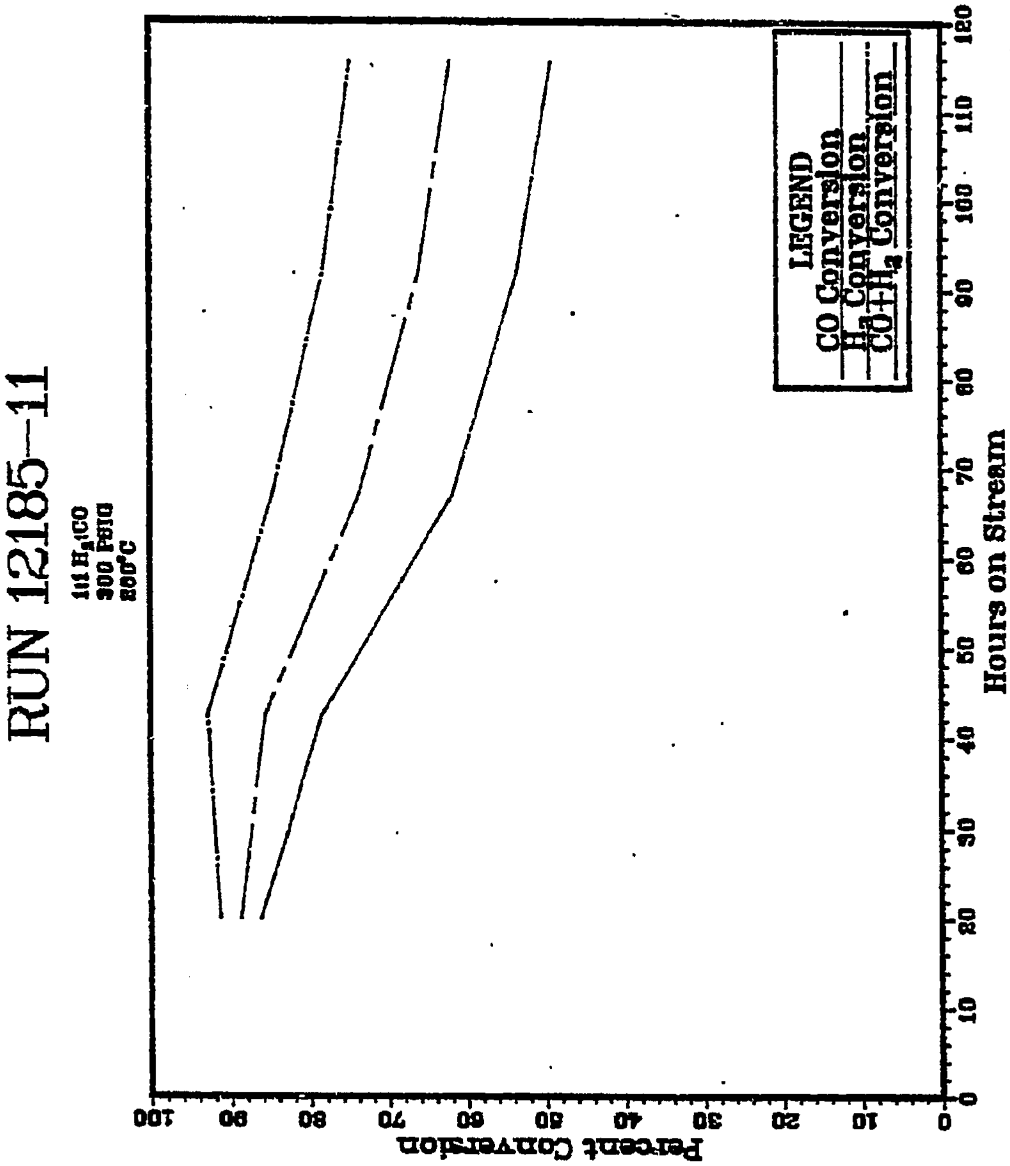

RUN 12185—11
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
110
120

Fig. B239

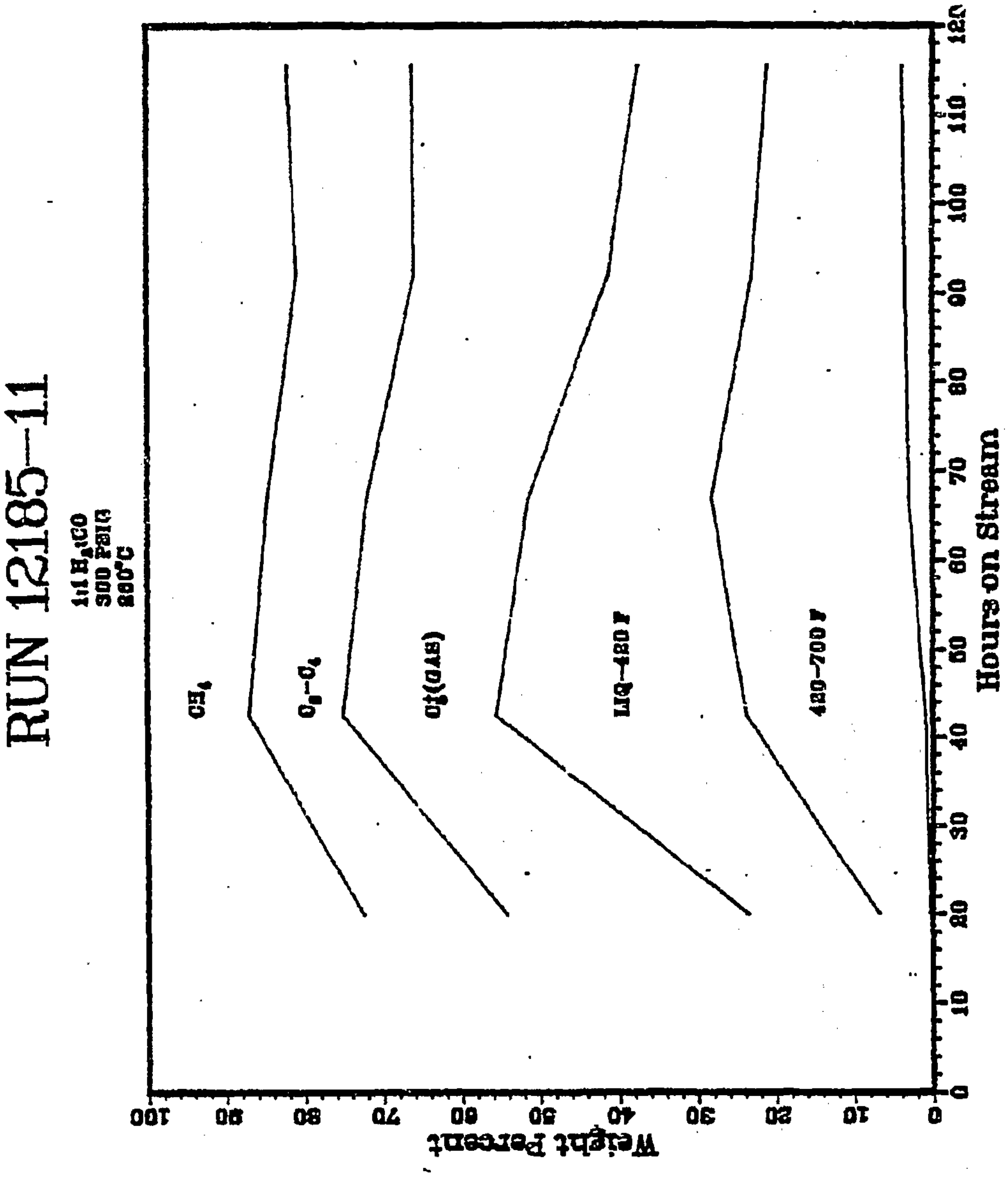

RUN 12185—11
CH4
C2-C4
C5+(GAS)
LIQ-420 F
420-700 F
Weight Percent
Hours on Stream

Fig. B240

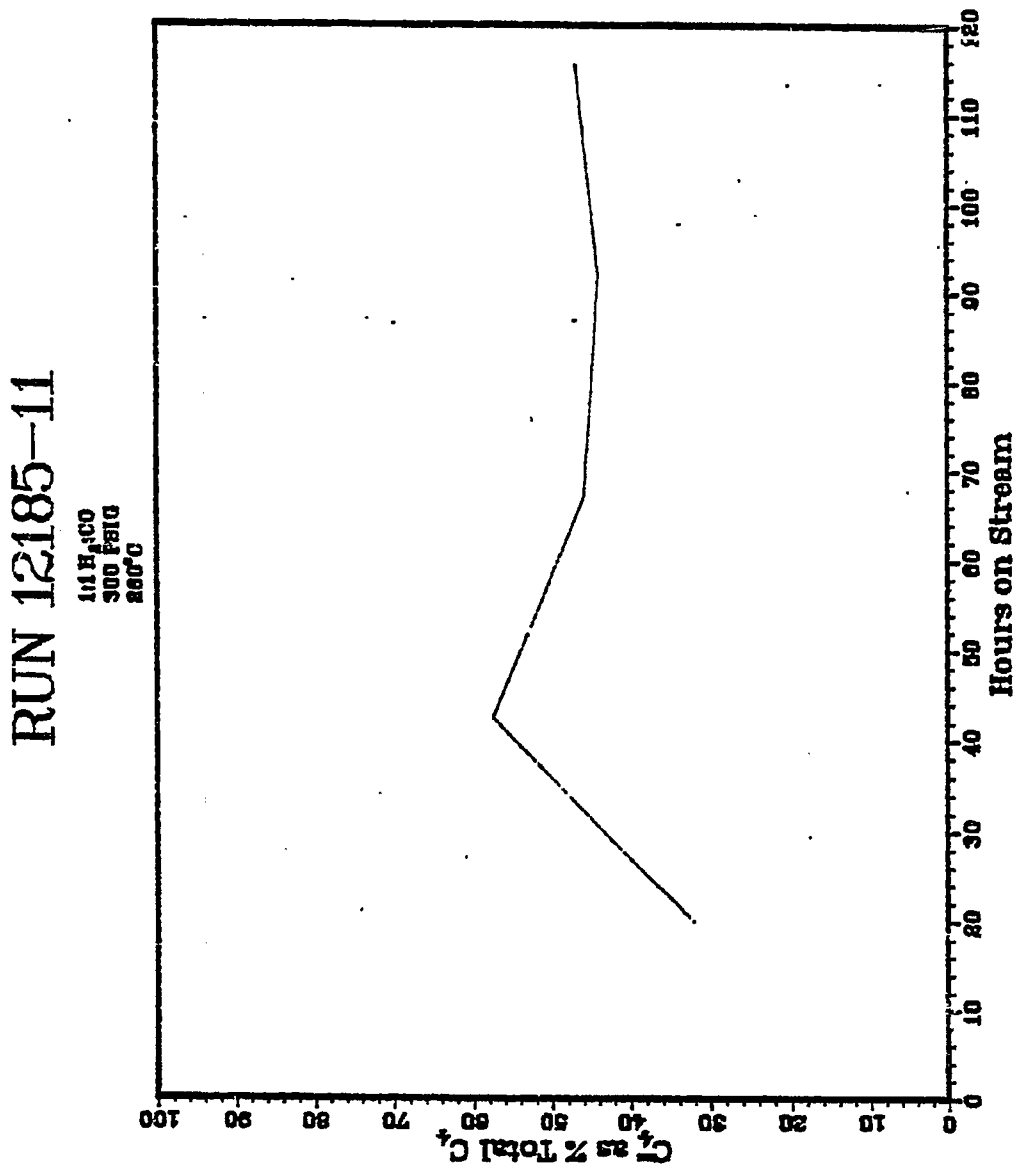


Fig. B241

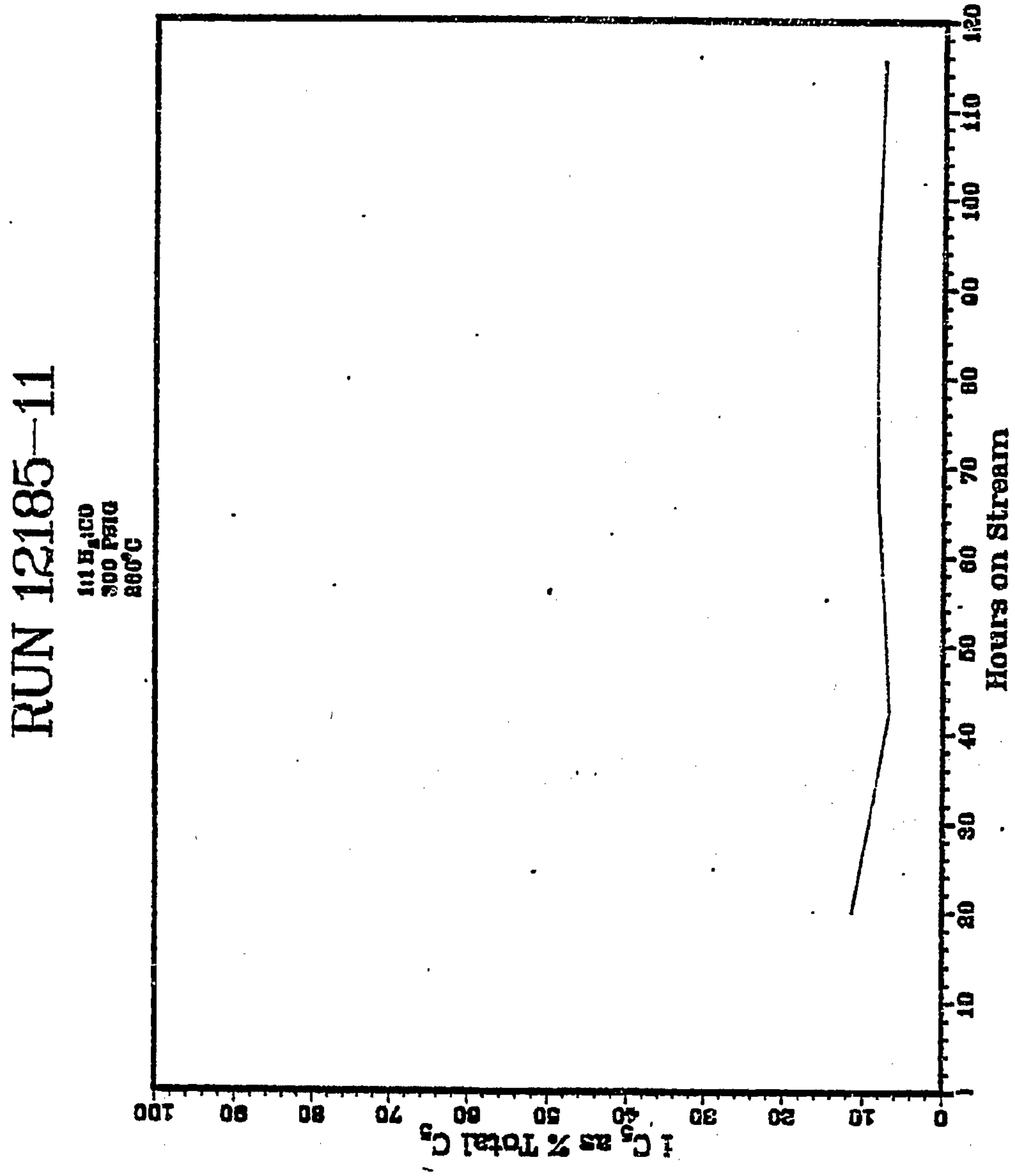

RUN 12185-11
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
110
120
i C5 as % Total C5
0
10
20
30
40
50
60
70
80
90
100

Fig. B242

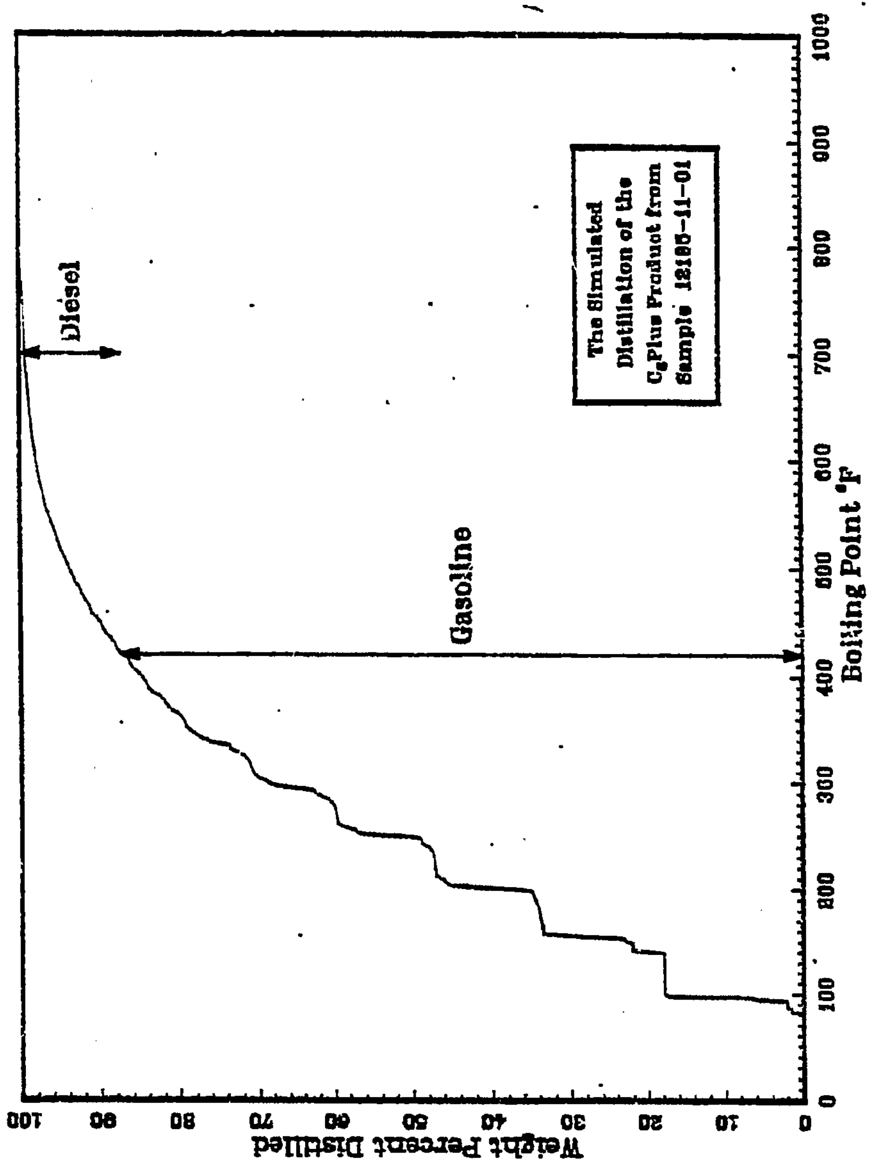

The Simulated Distillation of the C_6Plus Product from Sample 12186-11-01
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0 100 200 300 400 500 600 700 800 900 1000
0 10 20 30 40 50 60 70 80 90 100

Fig. B243

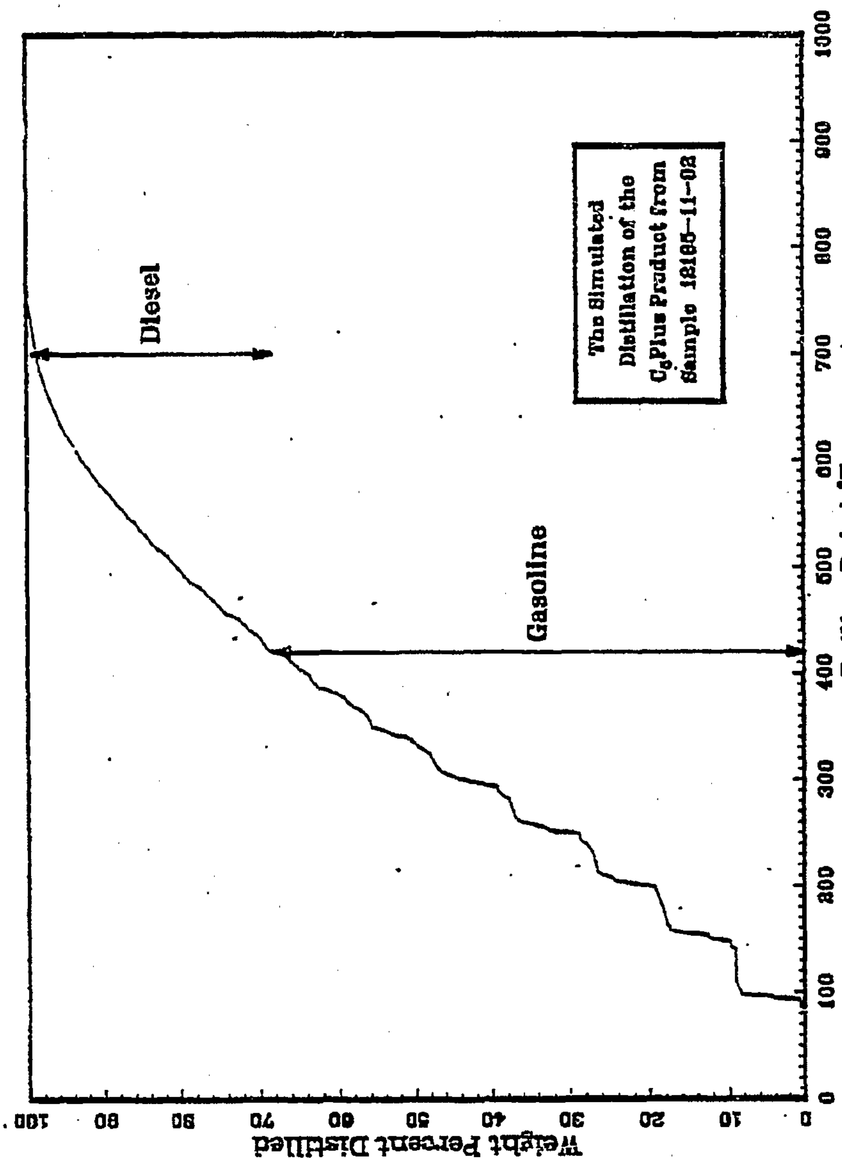


Fig. B244

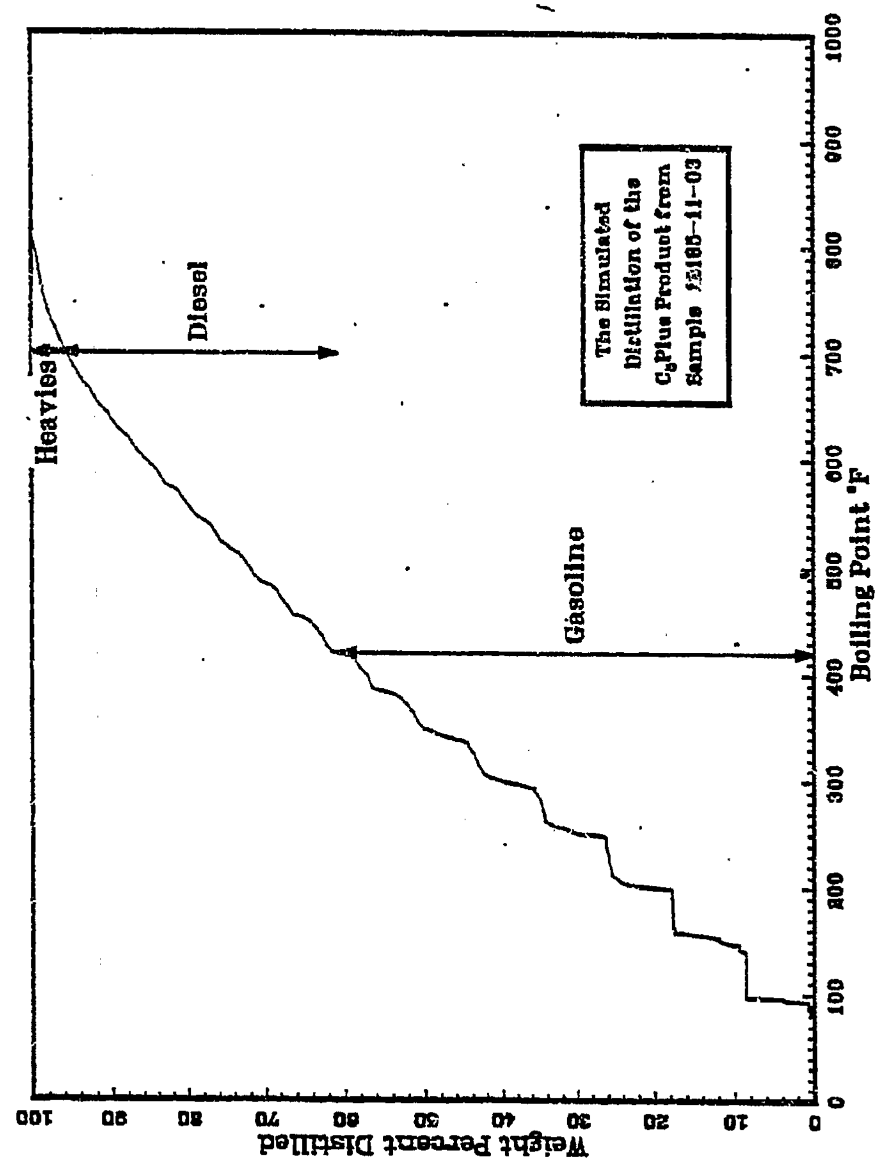
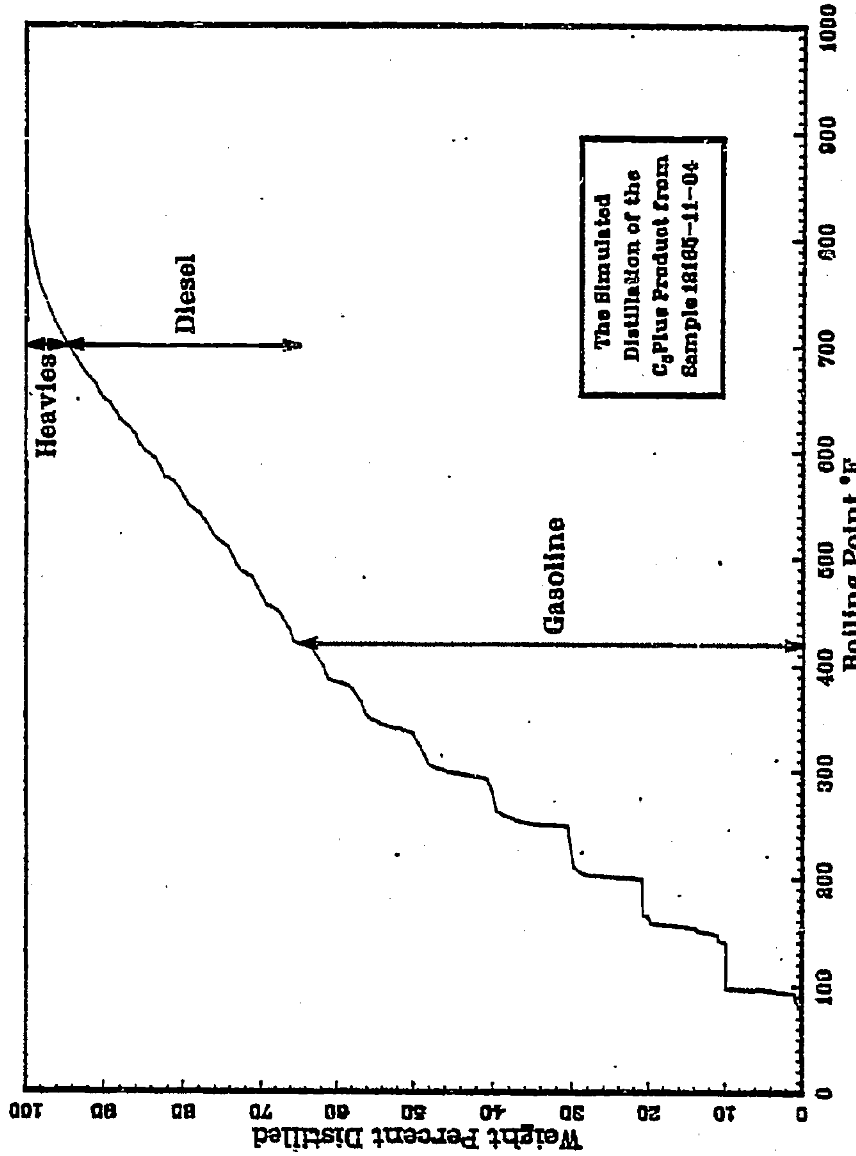

The Simulated
Distillation of the
C_5Plus Product from
Sample 185-11-03
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0 100 200 300 400 500 600 700 800 900 1000
0 10 20 30 40 50 60 70 80 90 100

Fig. B245



Weight Percent Distilled
Boiling Point °F
Heavies
Diesel
Gasoline
The Simulated Distillation of the C_5Plus Product from Sample 18185-11-04

Fig. B246

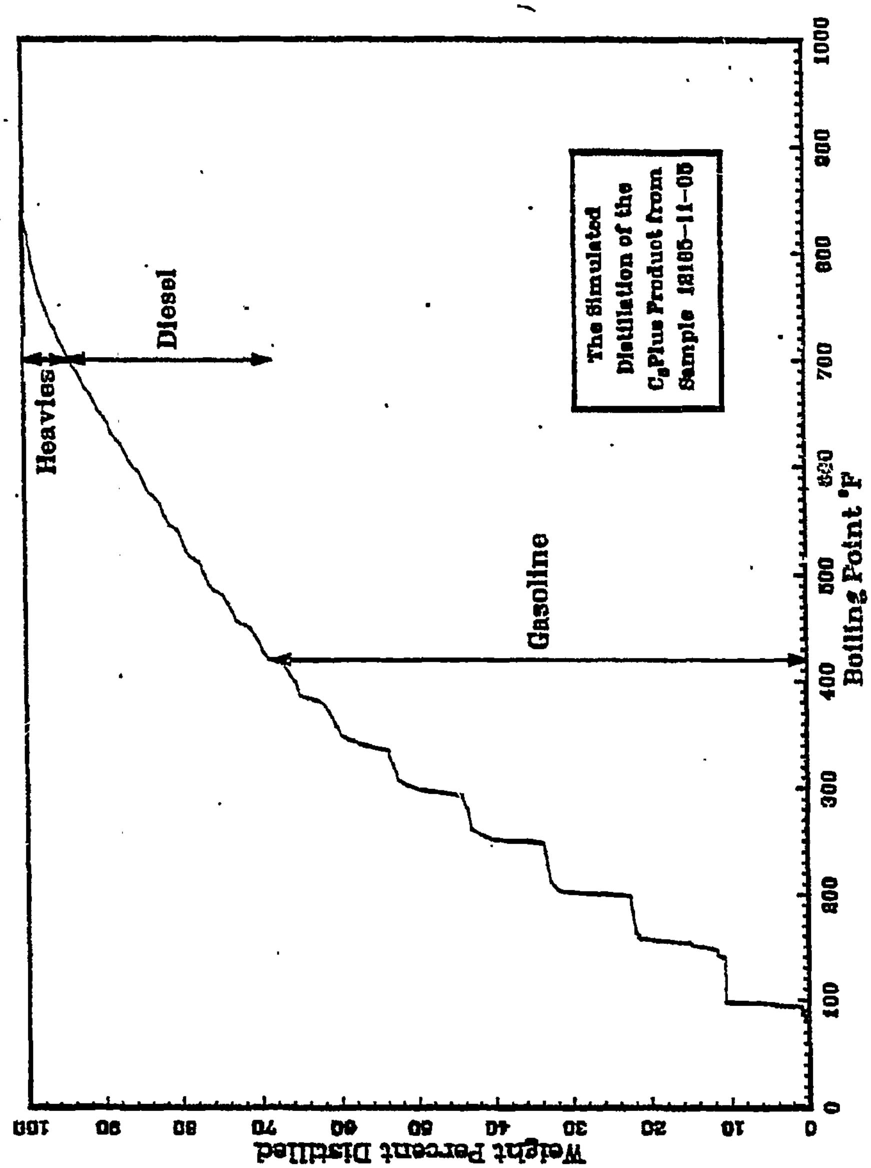
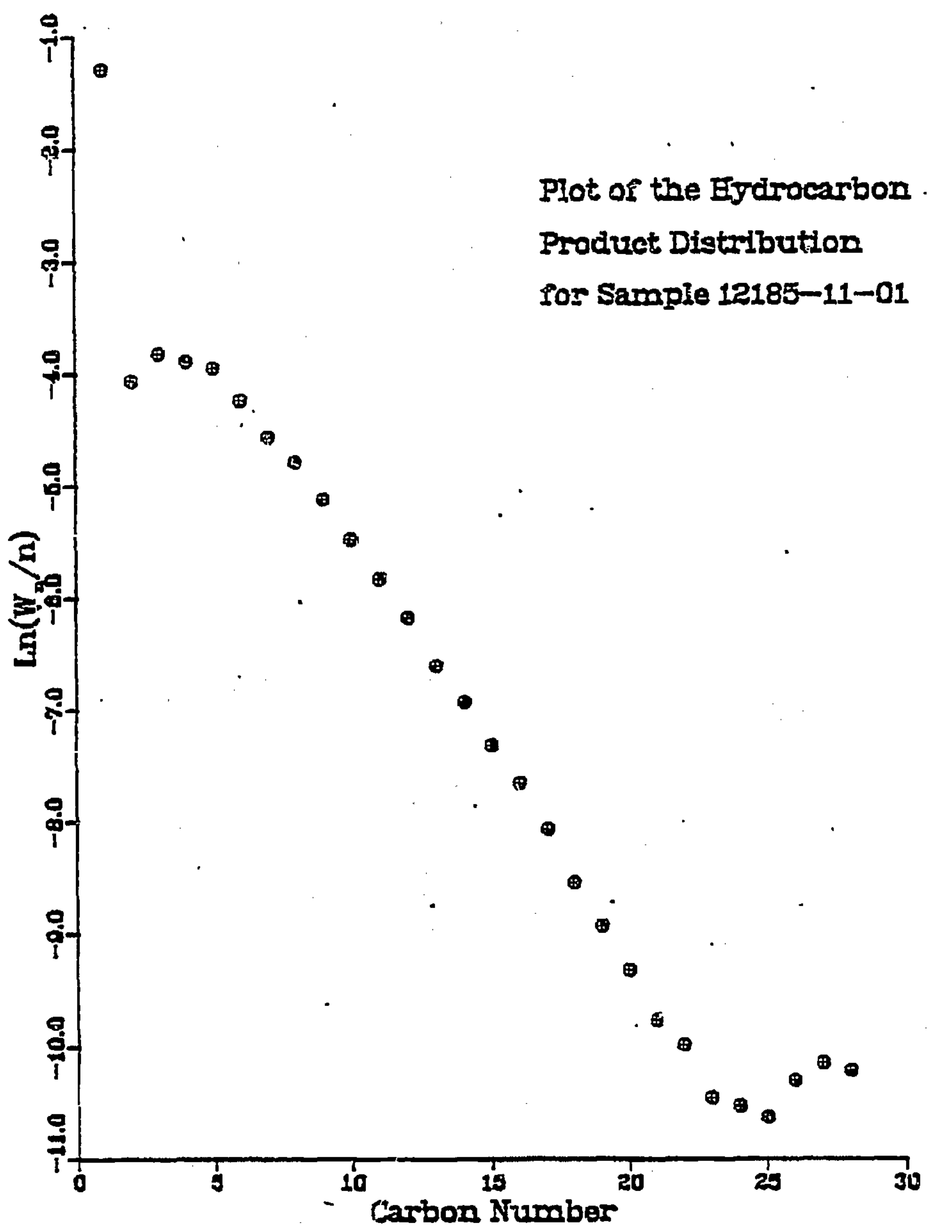
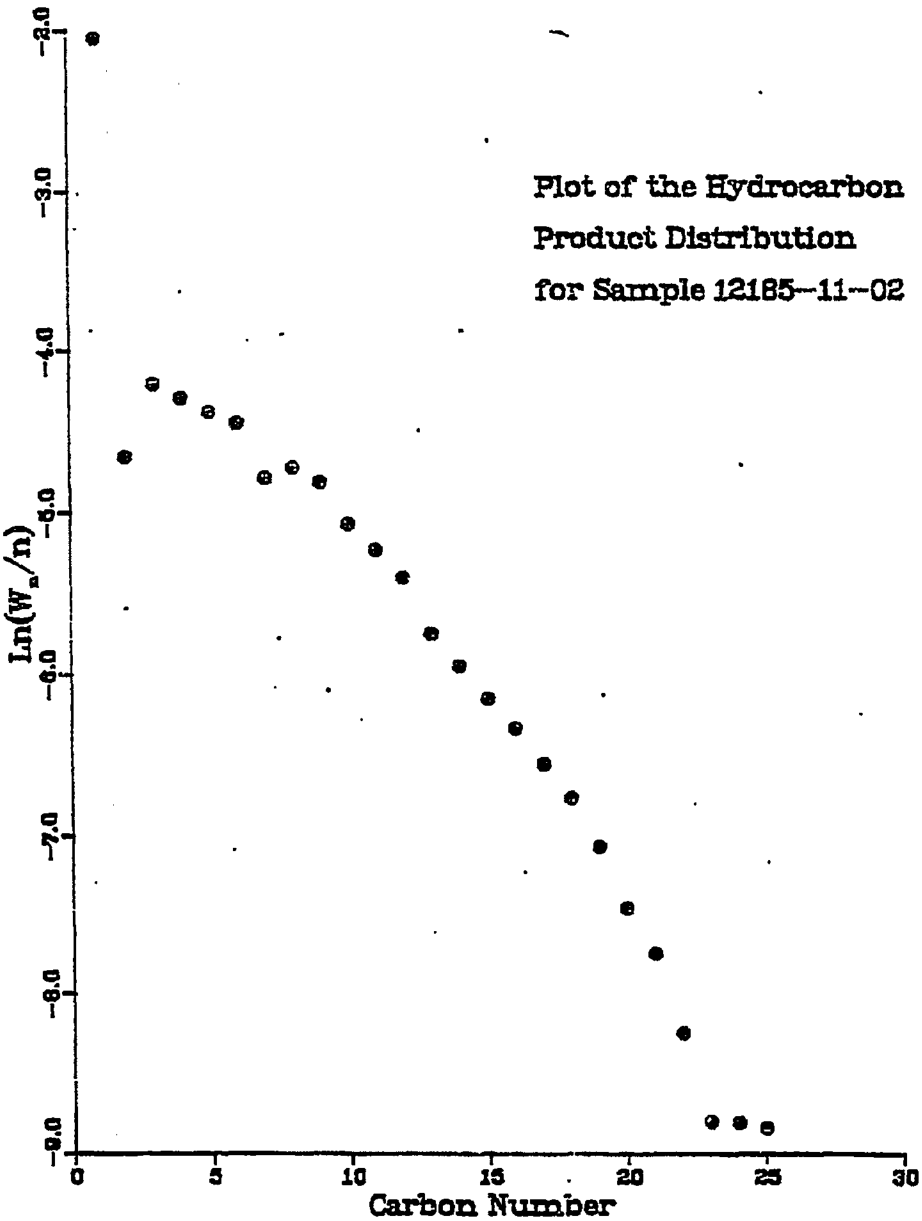
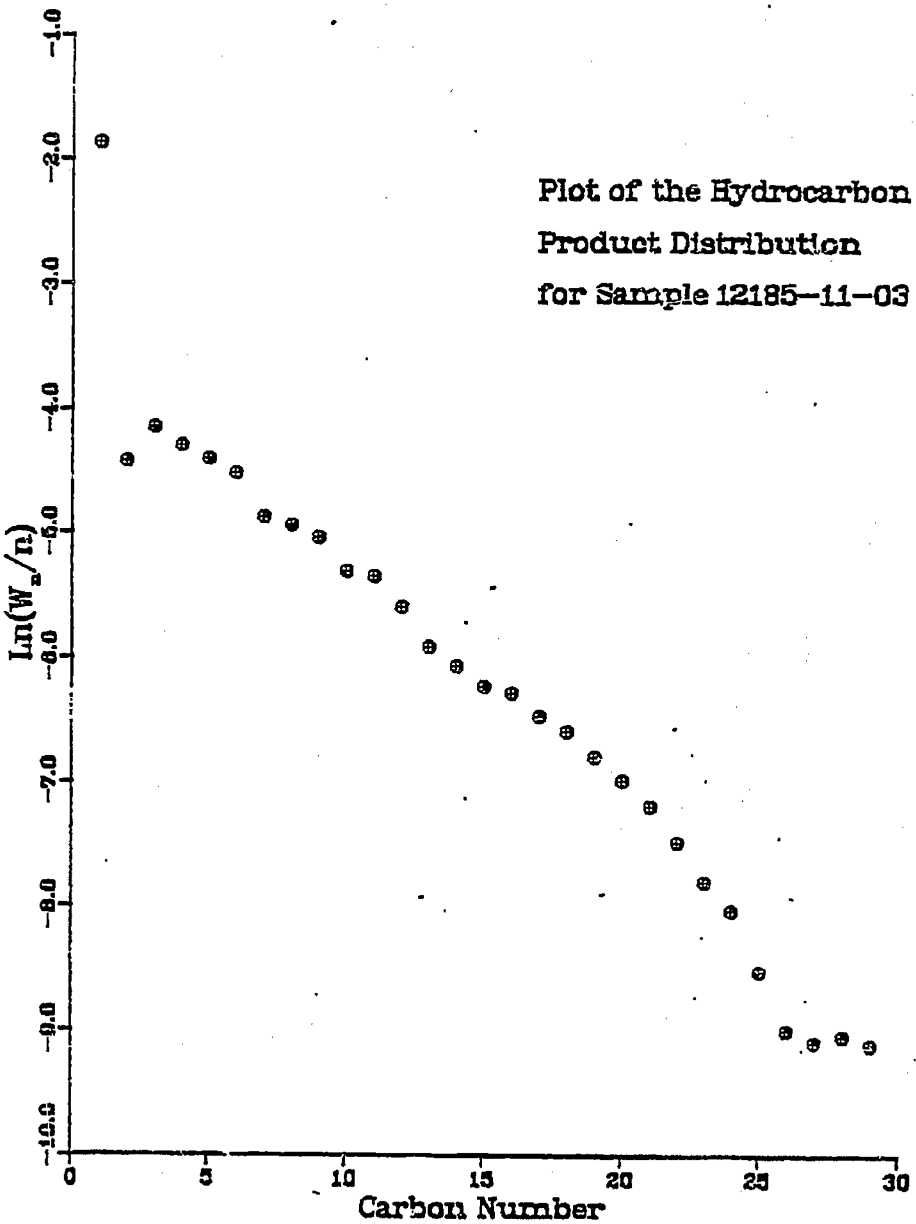

The Simulated
Distillation of the
C5Plus Product from
Sample 18185-11-05
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B247


Plot of the Hydrocarbon
Product Distribution
for Sample 12185-11-01
Ln(W_n/n)
-1.0
-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
Carbon Number
Fig. B248


Plot of the Hydrocarbon
Product Distribution
for Sample 12185--11--02
Ln(Wn/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
Carbon Number
Fig. B249



Plot of the Hydrocarbon
Product Distribution
for Sample 12185–11–03
Ln(W_n/n)
Carbon Number

Fig. B250

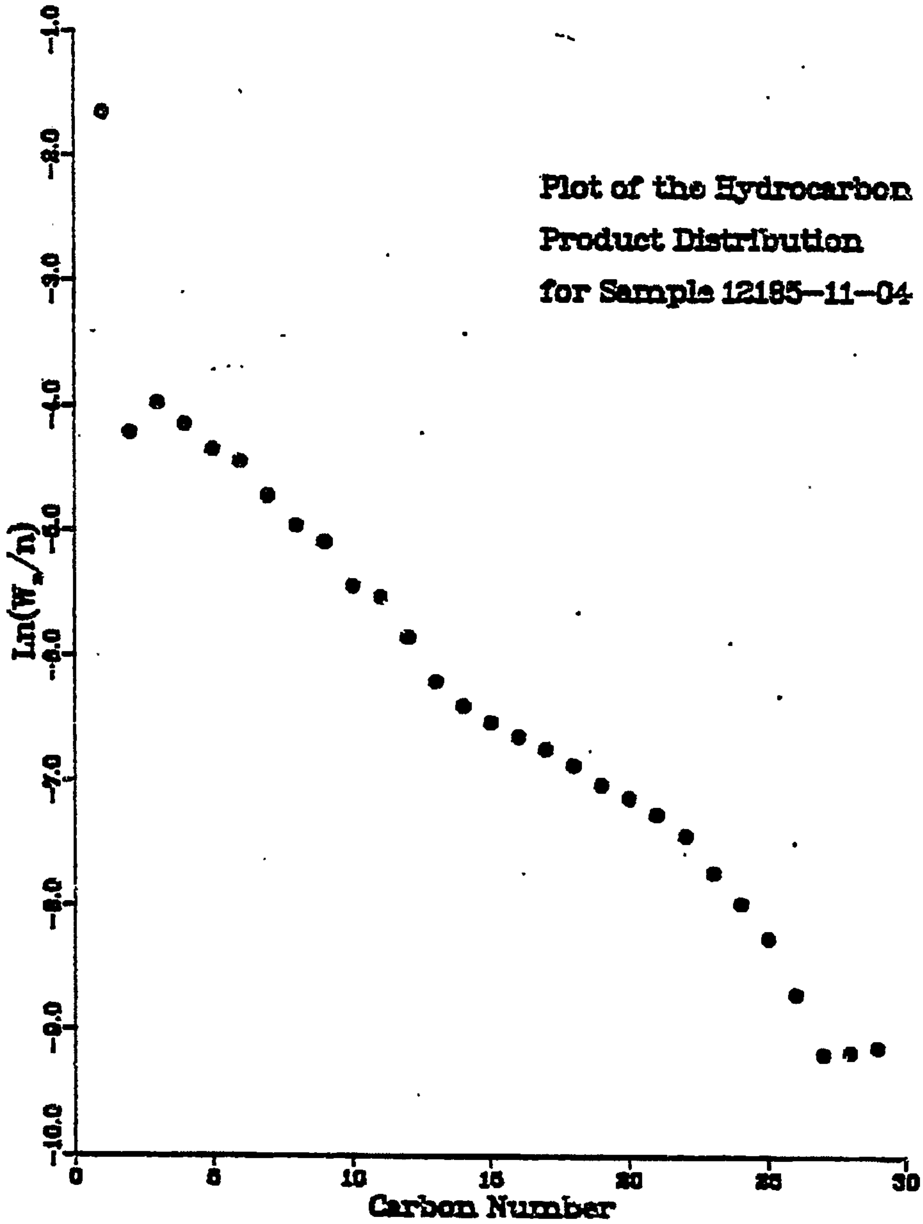
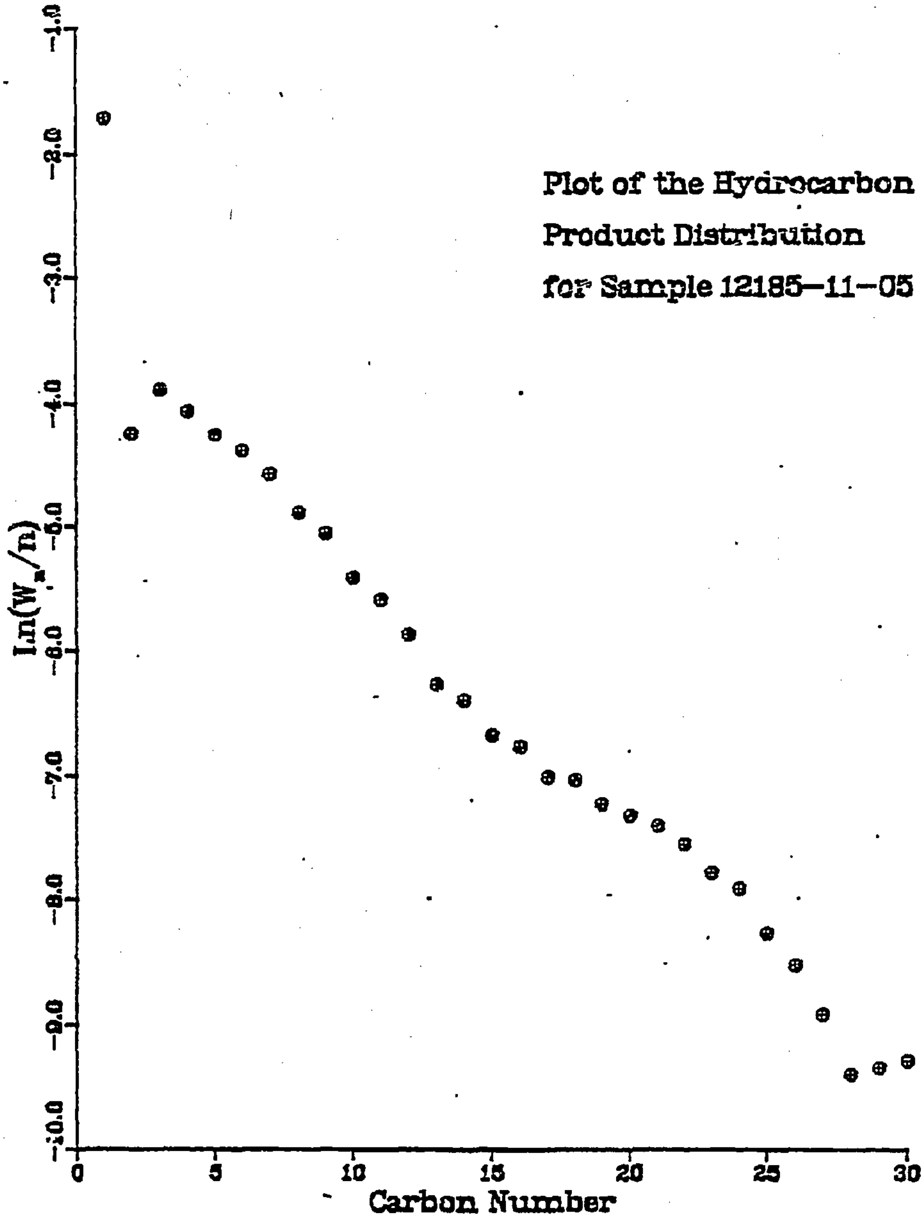

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-11-04
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
Ln(W_n/n)
0
5
10
15
20
25
30
Carbon Number

Fig. B251


Plot of the Hydrocarbon
Product Distribution
for Sample 12185-11-05
Ln(W_n/n)
-1.0
-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
Carbon Number
Fig. B252

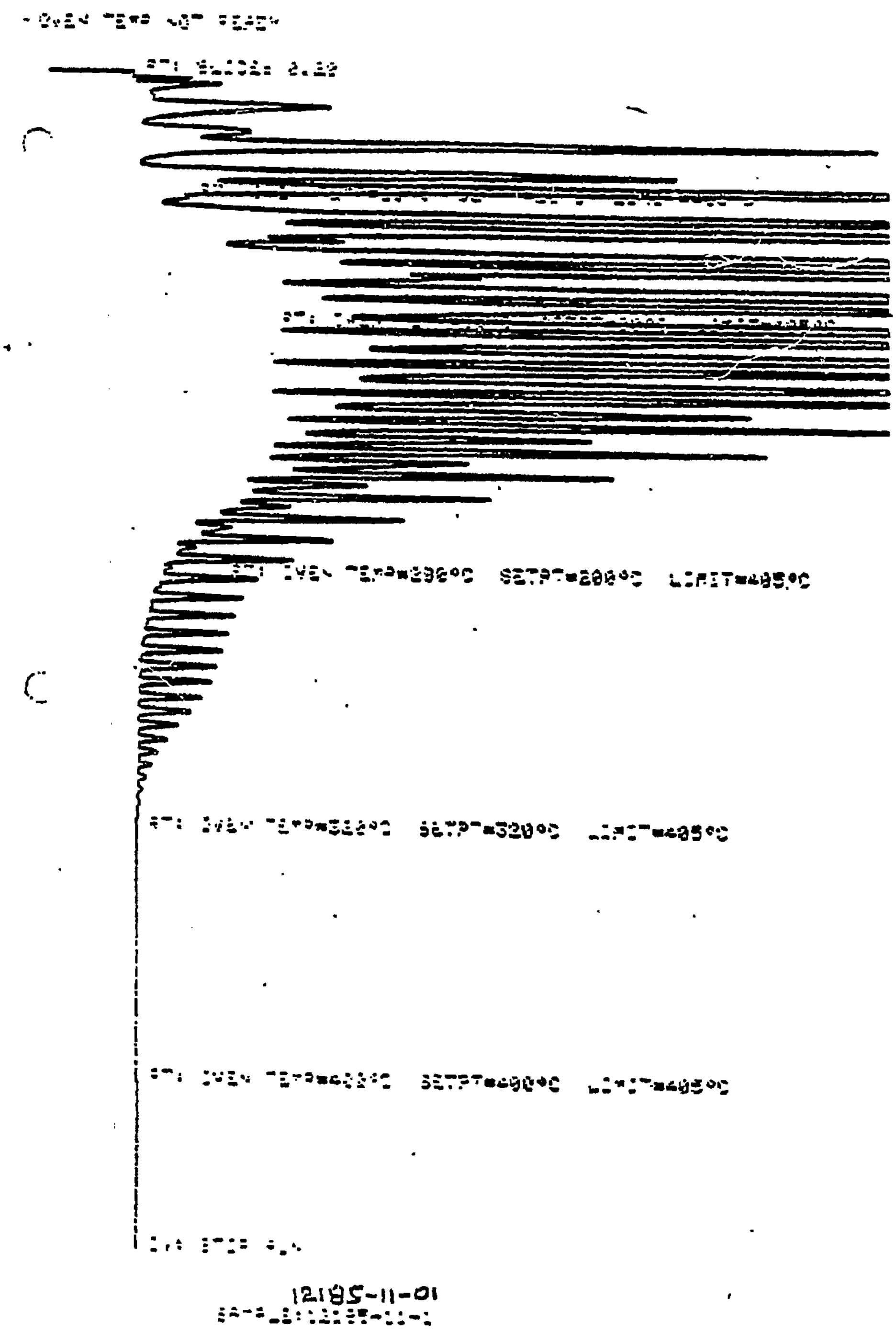
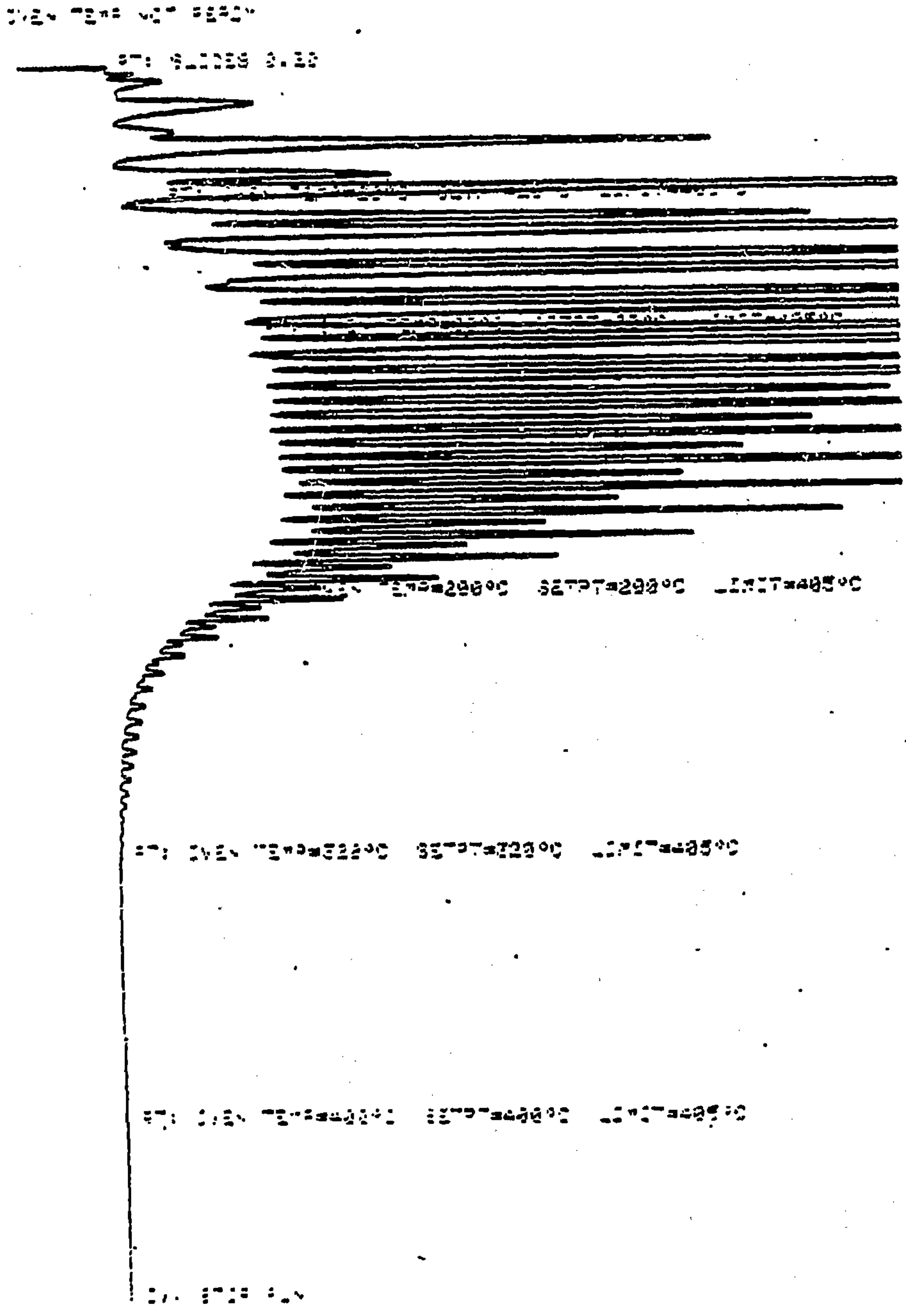


Fig. B253



12185-11-02

Fig. B254

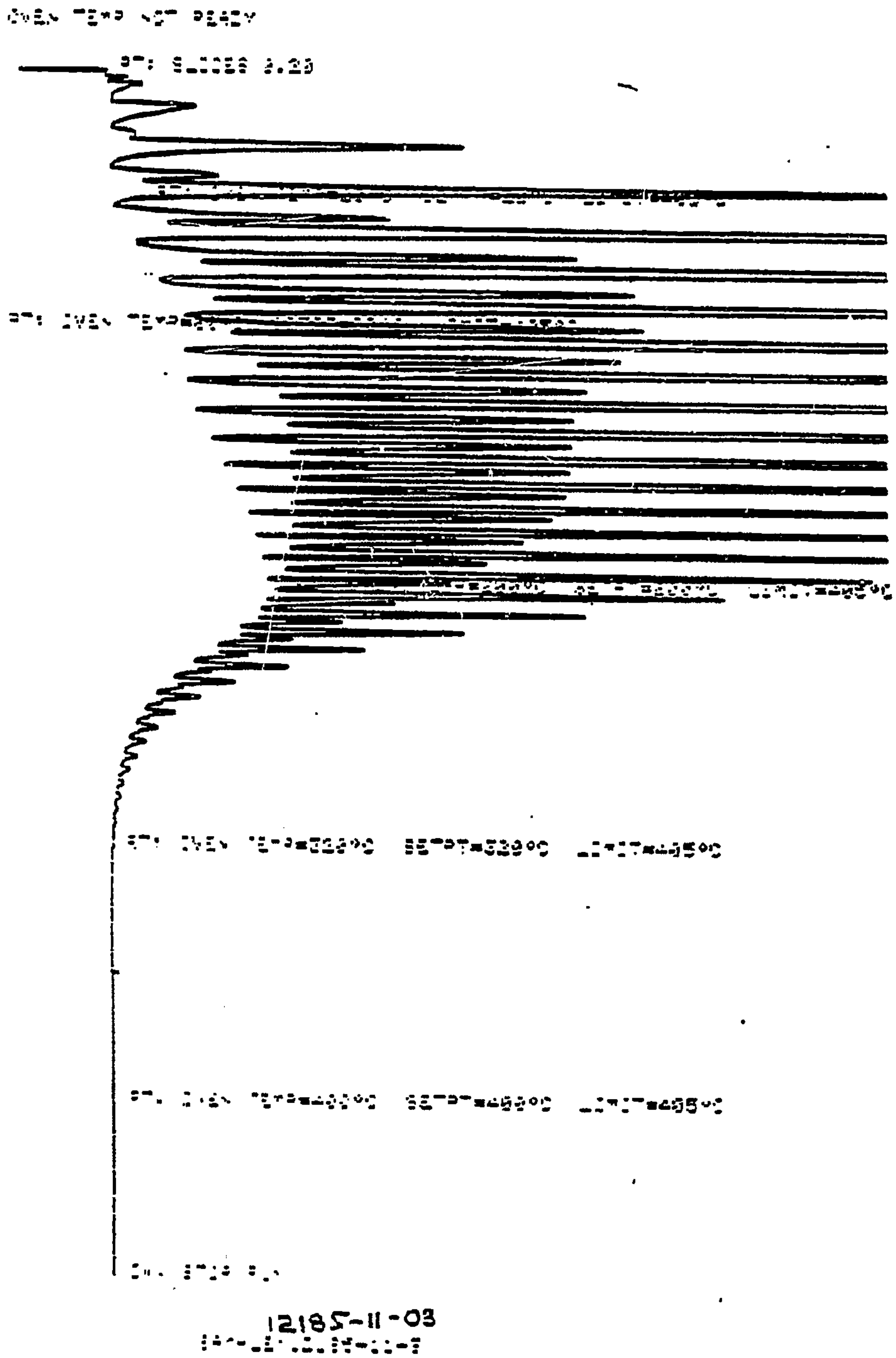
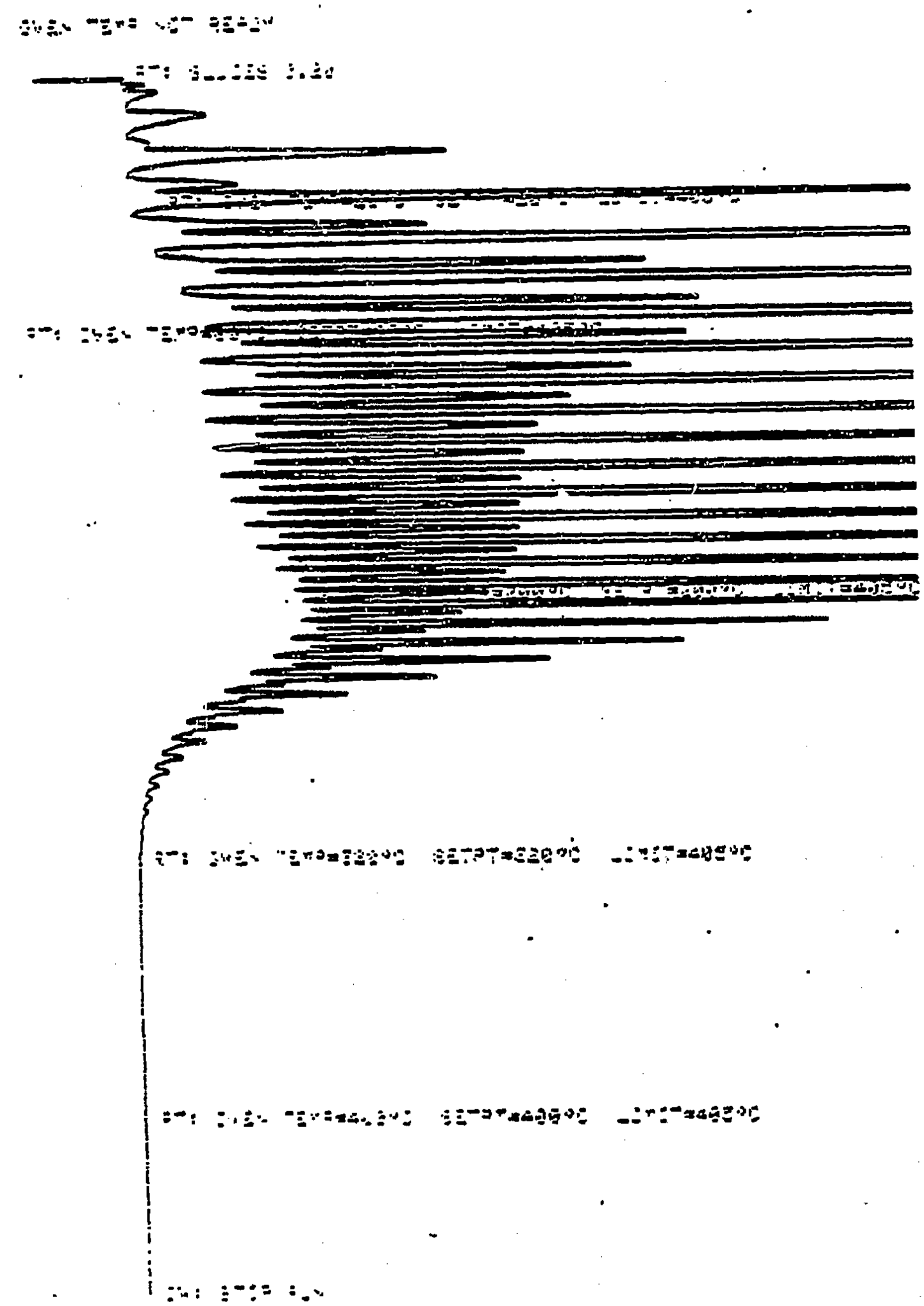


Fig. B255



12185-11-04

Fig. B256

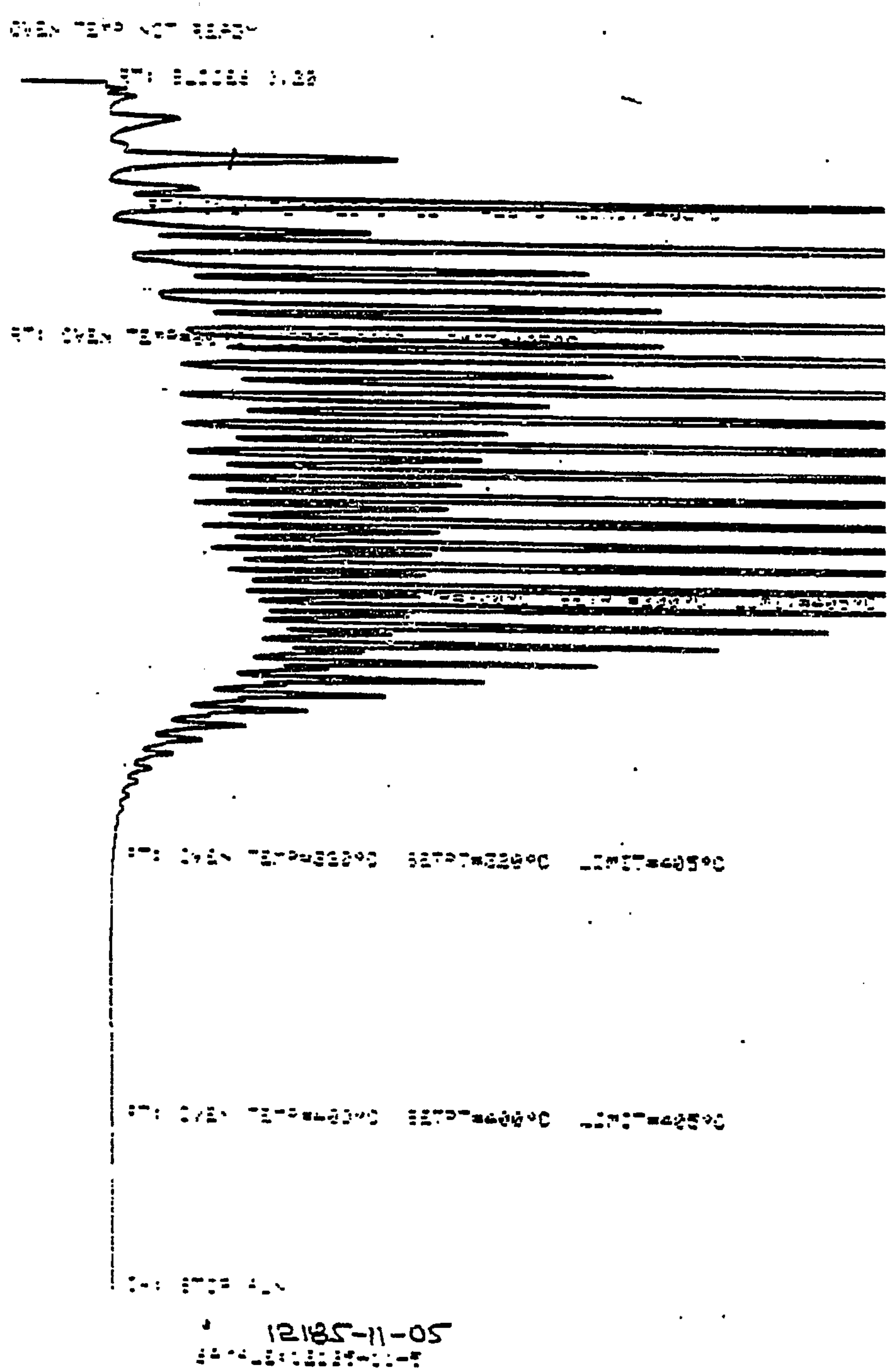


Fig. B257

RESULT OF SYNGAS OPERATION

RUN NO. 12185-11
CATALYST CO/X9/X10-U103 12251-30-23 250 CC 108.2 G (WT CHANGE +49.4 G)
FEED H2:CO OF 50:50 @ 1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	18511.01	18511.02	18511.03	18511.04	18511.05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	20.0	42.5	67.0	92.0	115.5
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	262	262	262	262	261
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	20.00	22.50	24.50	25.00	23.50
EFFLNT GAS LITER	515.75	513.86	649.19	841.80	841.45
GM AQUEOUS LAYER	104.72	167.30	205.10	185.61	171.53
GM OIL	50.79	130.81	113.59	87.82	70.79
MATERIAL BALANCE					
GM ATOM CARBON %	88.43	90.53	85.45	93.81	94.51
GM ATOM HYDROGEN %	90.58	89.47	94.35	96.13	96.01
GM ATOM OXYGEN %	91.13	95.91	89.40	96.98	97.85
RATIO CHX/(H2O+CO2)	0.9454	0.8966	0.9103	0.9222	0.9138
RATIO X IN CHX	2.6870	2.3730	2.4294	2.5030	2.4799
USAGE H2/CO PRODT	1.0862	1.1686	1.5108	1.4999	1.5470
FEED H2/CO FRM EFFLNT	1.0244	0.9883	1.1041	1.0247	1.0159
RESIDUAL H2/CO RATIO	0.6385	0.3283	0.4442	0.4788	0.5031
RATIO CO2/(H2O+CO2)	0.5959	0.4685	0.2909	0.3084	0.2825
K SHIFT IN EFFLNT	0.9417	0.2895	0.1823	0.2135	0.1981
SPECIFIC ACTIVITY SA	7.5897	12.7630	4.0002	2.7086	2.3143
CONVERSION					
ON CO %	86.19	78.55	61.87	53.46	49.13
ON H2 %	91.39	92.87	84.66	78.26	74.81
ON CO+H2 %	88.82	85.67	73.83	66.01	62.07
PRDT SELECTIVITY,WT %					
CH4	27.49	12.91	15.35	19.01	17.87
C2 HC'S	3.43	1.91	2.41	2.96	2.87
C3H8	5.44	2.55	3.25	4.02	4.11
C3H6=	1.15	1.96	1.50	1.63	2.04
C4H10	5.61	2.40	3.01	3.60	3.71
C4H8=	2.57	3.13	2.47	2.73	3.16
C5H12	6.92	3.23	3.70	4.36	4.64
C5H10=	2.52	3.03	2.42	2.10	2.44
C6H14	7.52	3.62	4.04	4.77	5.03
C6H12= & CYCLO'S	0.37	1.84	1.56	1.68	2.00
C7+ IN GAS	13.25	7.87	8.83	11.80	14.50
LIQ HC'S	23.73	55.57	51.45	41.34	37.63
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B19

SUB-GROUPING					
C1 -C4	45.69	24.85	27.99	33.95	33.75
C5 -420 F	47.43	51.26	43.71	42.90	45.17
420-700 F	6.45	22.95	25.21	19.60	17.20
700-END PT	0.43	0.94	3.09	3.56	3.88
C5+-END PT	54.31	75.15	72.01	66.05	66.25
ISO/NORMAL MOLE RATIO					
C4	0.0293	0.0138	0.0239	0.0223	0.0192
C5	0.1278	0.0722	0.0899	0.0912	0.0818
C6	0.3643	0.1537	0.1710	0.1706	0.1516
C4=	0.2294	0.0549	0.1171	0.1124	0.0916
PARAFFIN/OLEFIN RATIO					
C3	4.5172	1.2425	2.0674	2.3475	1.9210
C4	2.1064	0.7404	1.1762	1.2726	1.1357
C5	2.6724	1.0372	1.4853	2.0169	1.8488
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.7305	0.7969	0.8184	0.8185	0.8150
RATIO CH4/(1-A)**2	3.7838	3.1313	4.6531	5.7713	5.2226
ALPHA FRM CORRELATION	0.8325	0.8649	0.8502	0.8466	0.8442
ALPHA (EXPTL/CORR)	0.8774	0.9214	0.9625	0.9668	0.9655
W%CH4 FRM CORRELATION	20.1838	10.1304	14.6990	15.8328	16.3551
W%CH4 (EXPTL/CORR)	1.3620	1.2746	1.0444	1.2009	1.0924
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLD OIL	OIL WAX	OIL WAX	CLR OIL	CLR OIL
DENSITY	0.7310	0.7421	0.7521	0.7531	0.7536
N, REFRACTIVE INDEX	1.4142	1.4192	1.4244	1.4248	1.4254
SIMULT'D DISTILATN					
10 WT % @ DEG F	209	231	257	258	259
16	243	258	298	299	300
50	347	391	450	454	453
84	486	559	625	650	661
90	533	599	666	690	703
RANGE(16-84 %)	243	301	327	351	361
WT % @ 420 F	71.00	57.00	45.00	44.00	44.00
WT % @ 700 F	98.20	98.30	94.00	91.40	89.70

Table B19, cont

XIII. Run 21 (12200-12) with Catalyst 21 ($Co/X_9/X_{10}/X_4$/UCC-103+UCC-112) Run 22 (12185-12) with Catalyst 22 ($Co/X_9/X_{10}/X_4$/UCC-103)

The purpose of these two runs was to test the effects of a number of variations on the successful Catalyst 15 (Run 12185-08). As compared with Catalyst 15, both catalysts contained (a) higher levels of cobalt oxide in close contact with UCC-103, intended to improve the specific activity, and (b) higher proportions of X_4 to cobalt, intended to raise the olefin content of the product. In addition, a new shape selective component, UCC-112, was incorporated in Catalyst 21 to test its effect on product quality.

In Catalyst 21, cobalt oxide was promoted with X_9 and X_{10}, then further promoted with X_4, and formed in close contact with UCC-103, as in Catalyst 15. The resulting powder was mixed with UCC-112 in a weight ratio of 1.125:1, and the mixture, after bonding with 15 percent silica, was extruded as 1/8" pellets. The final catalyst contained 5.84 percent cobalt, 0.26 percent X_9, 0.29 percent X_{10} and 1.34 percent X_4.

Catalyst 22 was formulated in the same way except without UCC-112. The final catalyst contained 11.0 percent cobalt, 0.49 percent X_9, 0.54 percent X_{10} and 2.54 percent X_4.

For Catalyst 21 (Run 12200-12), conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B258-261. Simulated distillations of the C_5^+ product are plotted in Figs. B262-268. Carbon number product distributions are plotted in Figs. B269-275. Chromatograms from simulated distillations are reproduced in Figs. B276-282. Detailed material balances appear in Tables B20-21.

For Catalyst 22 (Run 12185-12), conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B283-286. Simulated distillations of the C_5^+ product are plotted in Figs. B287-290. Carbon number product distributions are plotted in Figs. B291-294. Chromatograms from simulated distillations are reproduced in Figs. B295-298. Detailed material balances appear in Table B22.

The specific activity of Catalyst 15, at 93 hours on stream, was about 2.3. On a percent cobalt basis, the comparable specific activities of Catalysts 21 and 22 should have been 1.6 and 3.0 respectively. Instead, the specific activity of Catalyst 21 at 90.5 hours was 0.71, and that of Catalyst 22 at 93.5 hours was 2.1.

Both runs were too short to provide useful data on stability. Catalyst 21, at the end of its 163.5 hour run, was still deactivating at a rate of one percentage point every 20 hours. Catalyst 22, which lacked UCC-112, appeared to have stabilized after about 69.5 hours on stream at a syngas conversion rate of 58 percent and specific activity of 2.1. A similar initial deactivation was observed for the reference Catalyst 15.

The product selectivities of all three catalysts were fairly similar. Raising the X_4 content in Catalysts 21 and 22, as expected, improved the olefin content of the C_4 fractions: 56 and 55 percent respectively at about 100 hours on stream, versus about 50 percent for Catalyst 15.

Isomerization of the C_5^+'s was nearly the same with both Catalysts 21 and 22. The product of Catalyst 21, however, did contain a small proportion of isomerized C_4 olefins, which was not detected in the product of Catalyst 22. The incorporation of UCC-112 thus had little or no effect on product quality.

These two runs demonstrate that increasing the cobalt content does not in itself necessarily raise a catalyst's specific activity; that raising the X_4 content in this type of formulation can improve olefin production; and that UCC-112, like other second shape-selective components which have been added, contributes little or nothing to product quality.

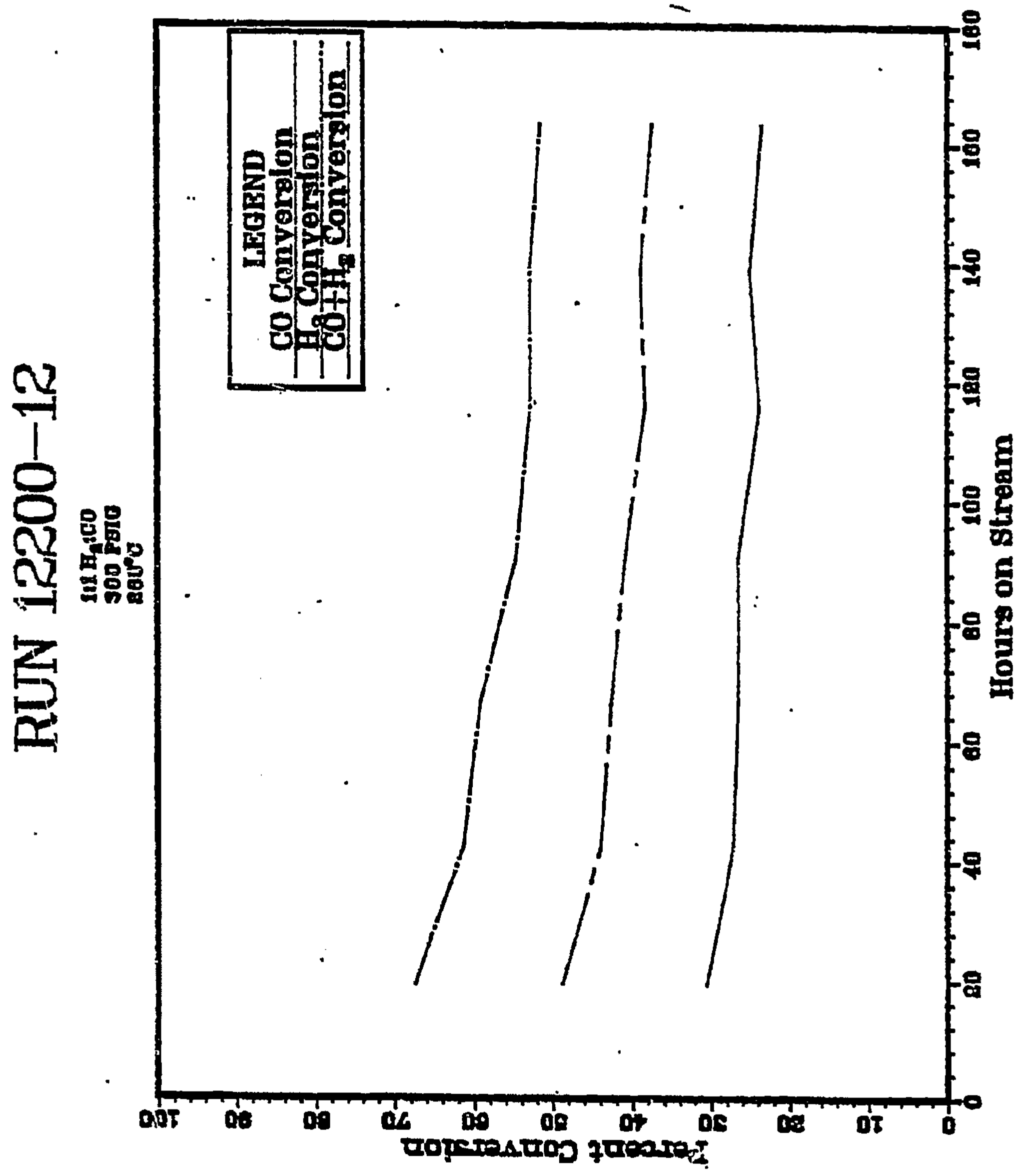

RUN 12200-12
LEGEND
CO Conversion
H_2 Conversion
$CO+H_2$ Conversion
Hours on Stream
Percent Conversion

Fig. B258

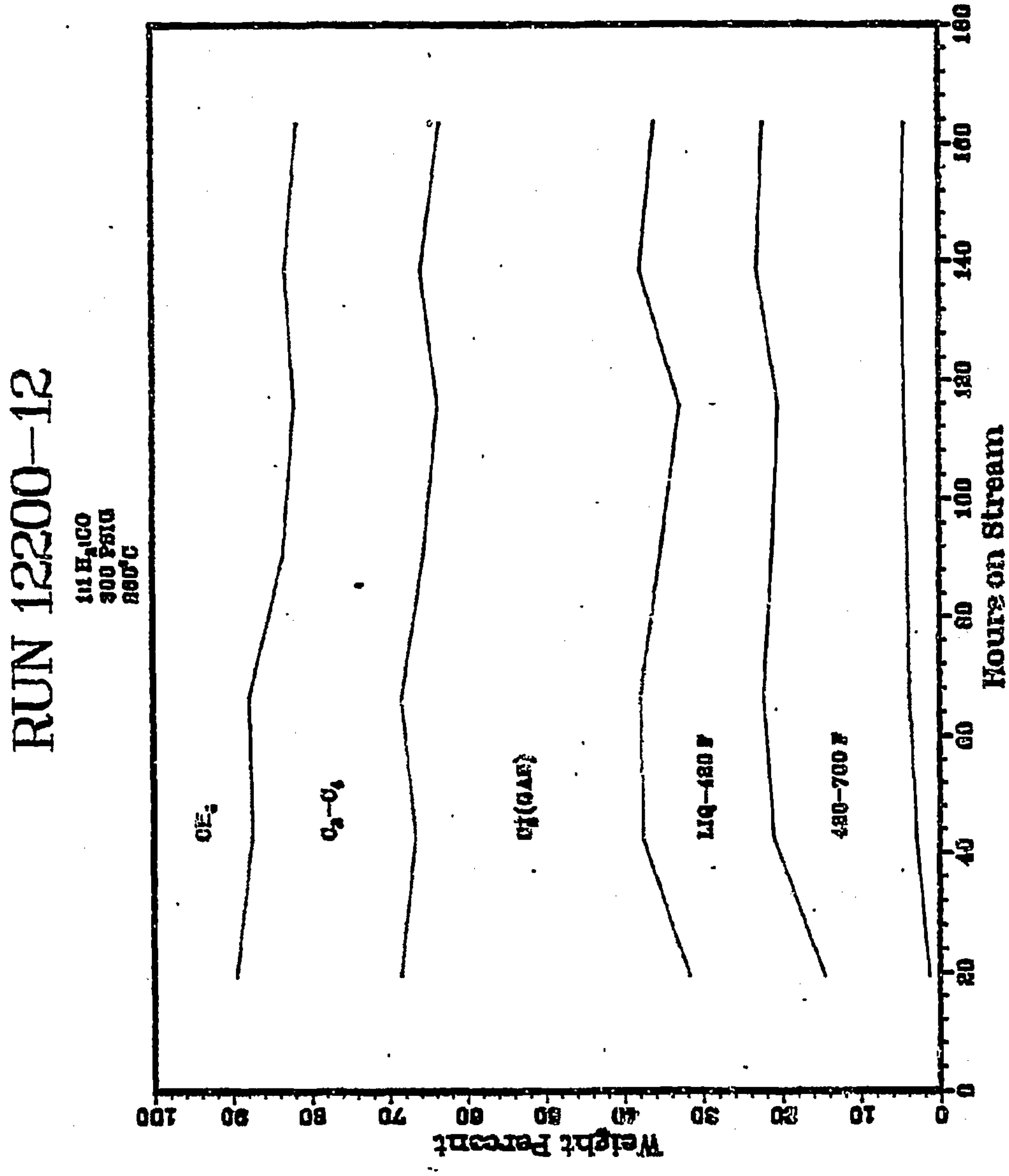
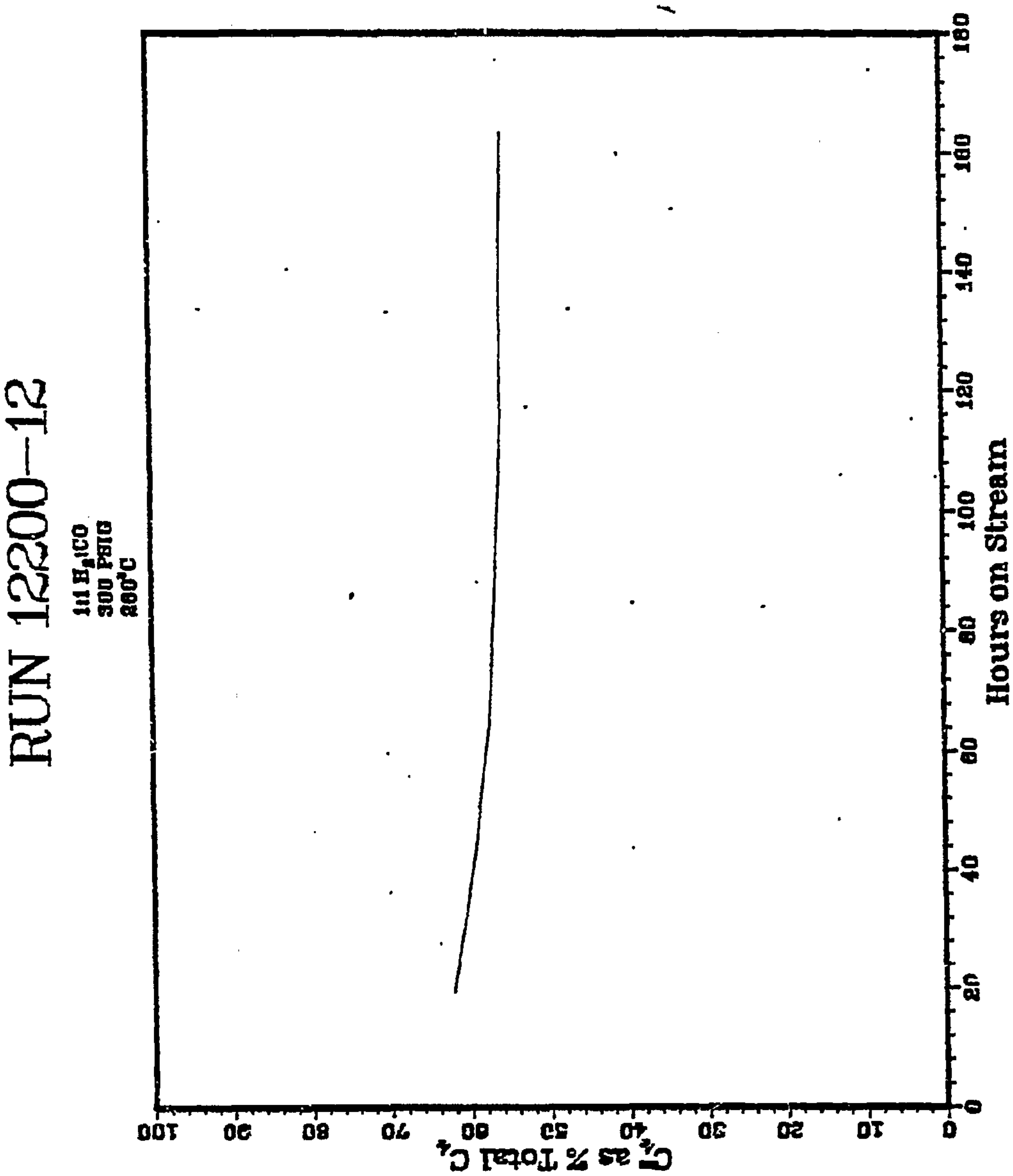

RUN 12200—12
300 PSIG
CH4
C2-C4
LIQ-480 F
480-700 F
Hours on Stream
Weight Percent
0
20
40
60
80
100
120
140
160
180
10
30
50
70
90

Fig. B259



RUN 12200—12
1:1 H2:CO
300 PSIG
260°C
Hours on Stream
C4= as % Total C4

Fig. B260

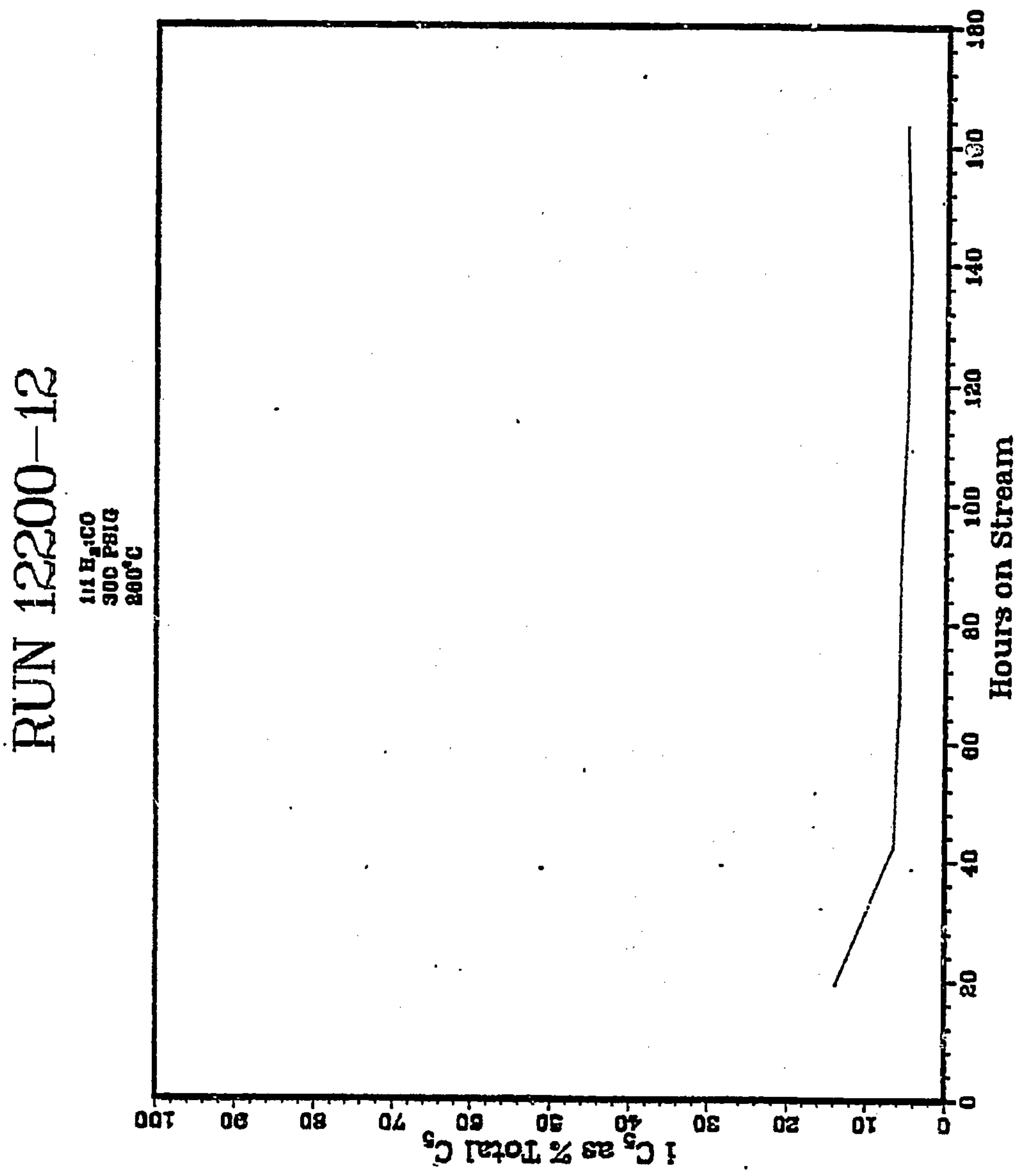

RUN 12200-12
1:1 H_2:CO
300 PSIG
280°C
Hours on Stream
i C_5 as % Total C_5
0
20
40
60
80
100
120
140
160
180
0
10
20
30
40
50
60
70
80
90
100

Fig. B261

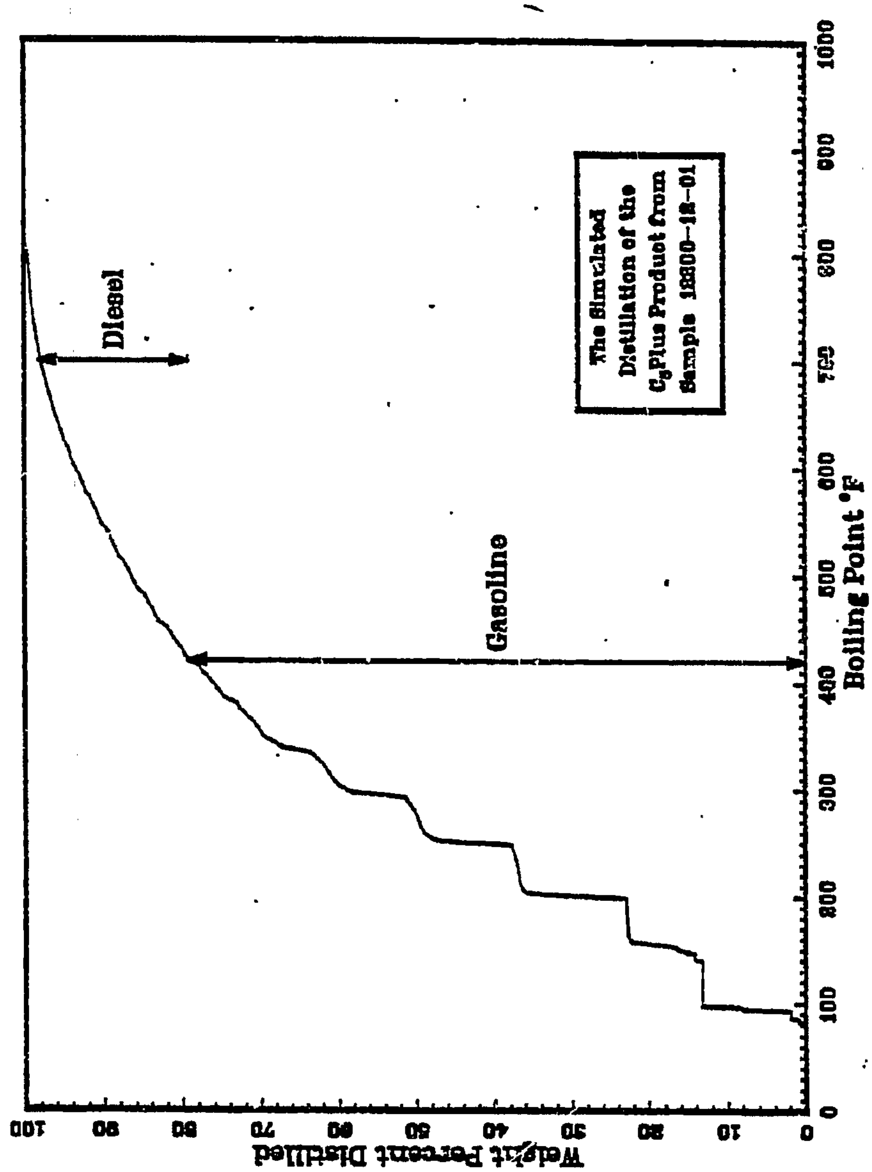
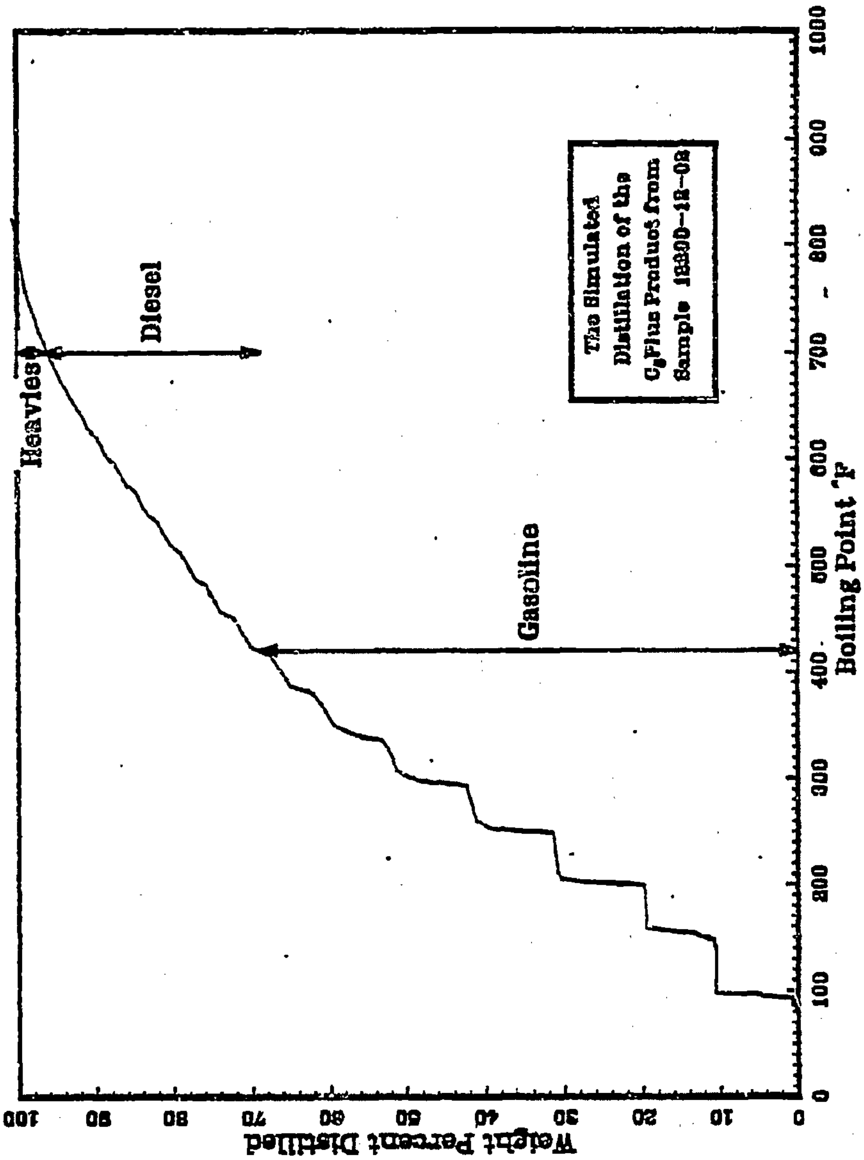

Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
The Simulated
Distillation of the
C_5 Plus Product from

Fig. B262



Diesel
Gasoline
Heavies
Boiling Point °F
Weight Percent Distilled

Fig. B263

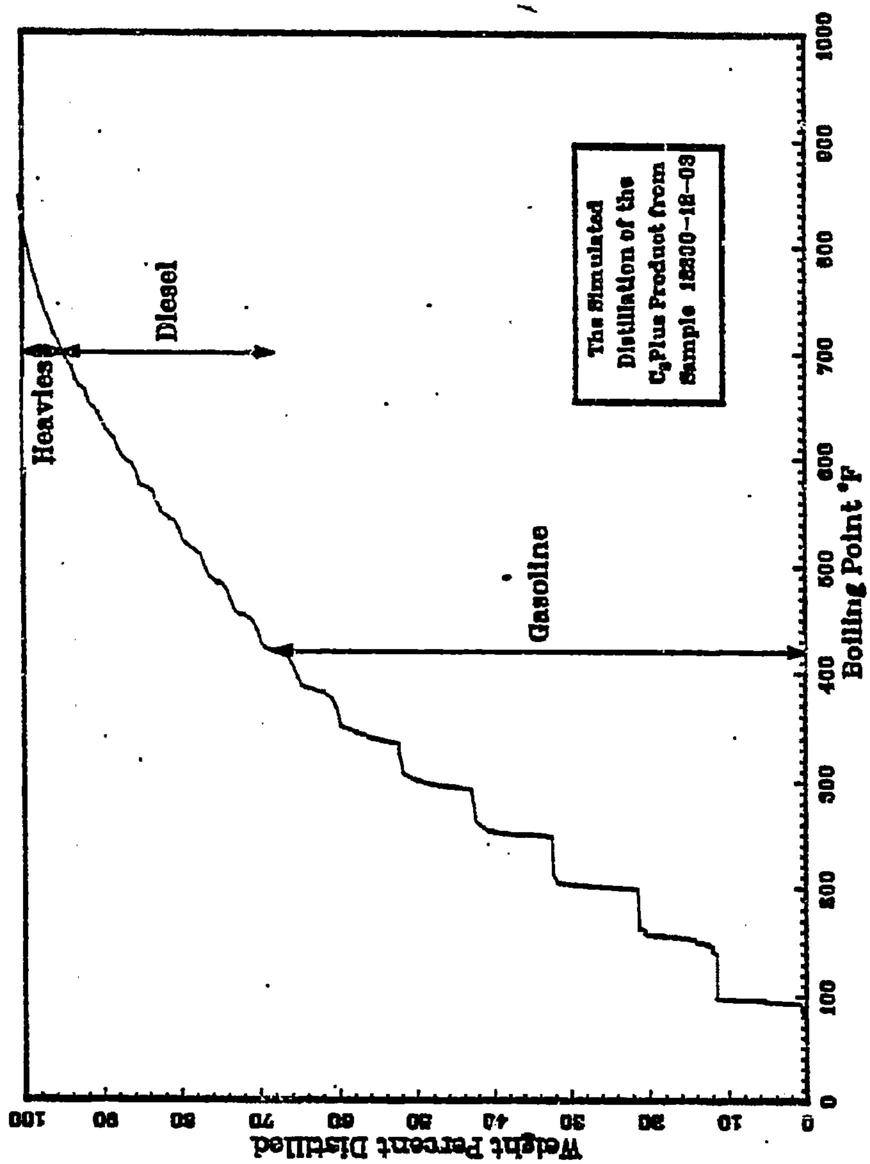

The Simulated
Distillation of the
C_3Plus Product from
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B264

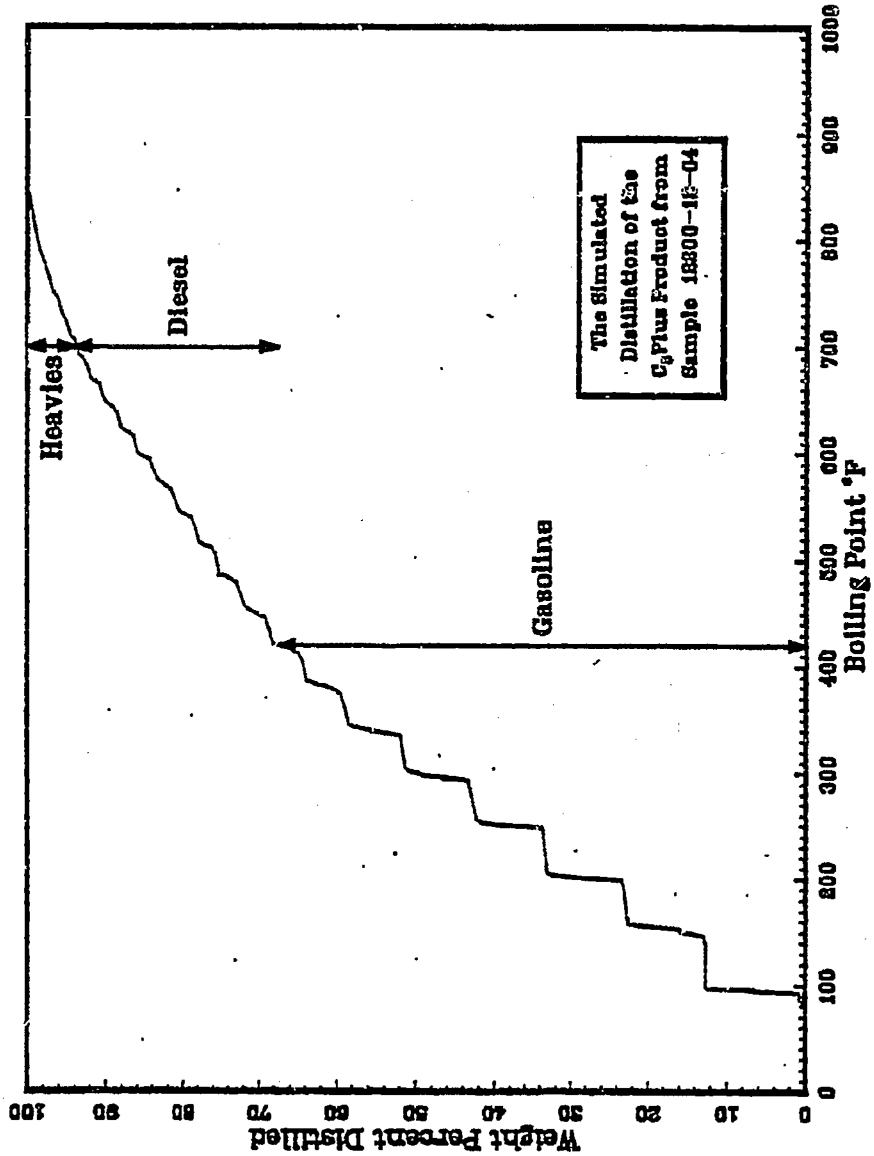
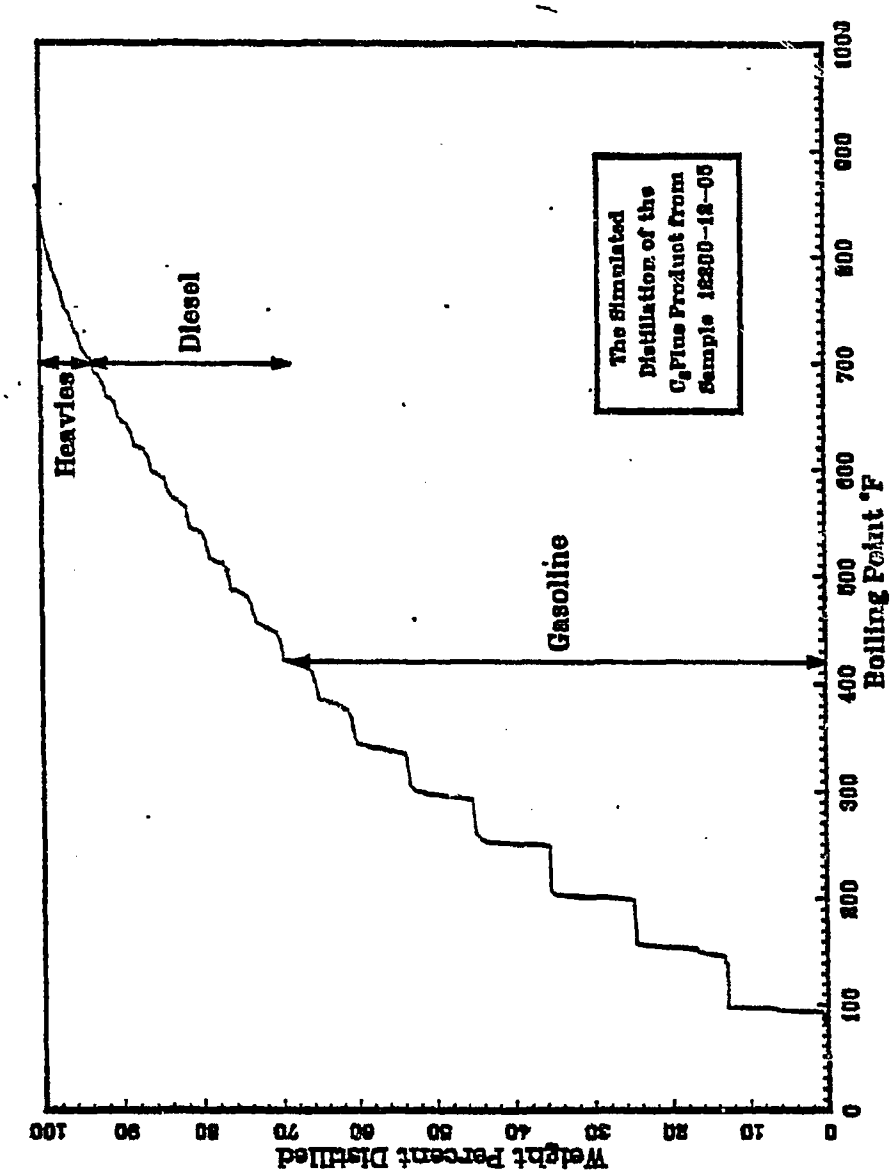

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
C5Plus Product from
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B265



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. B266

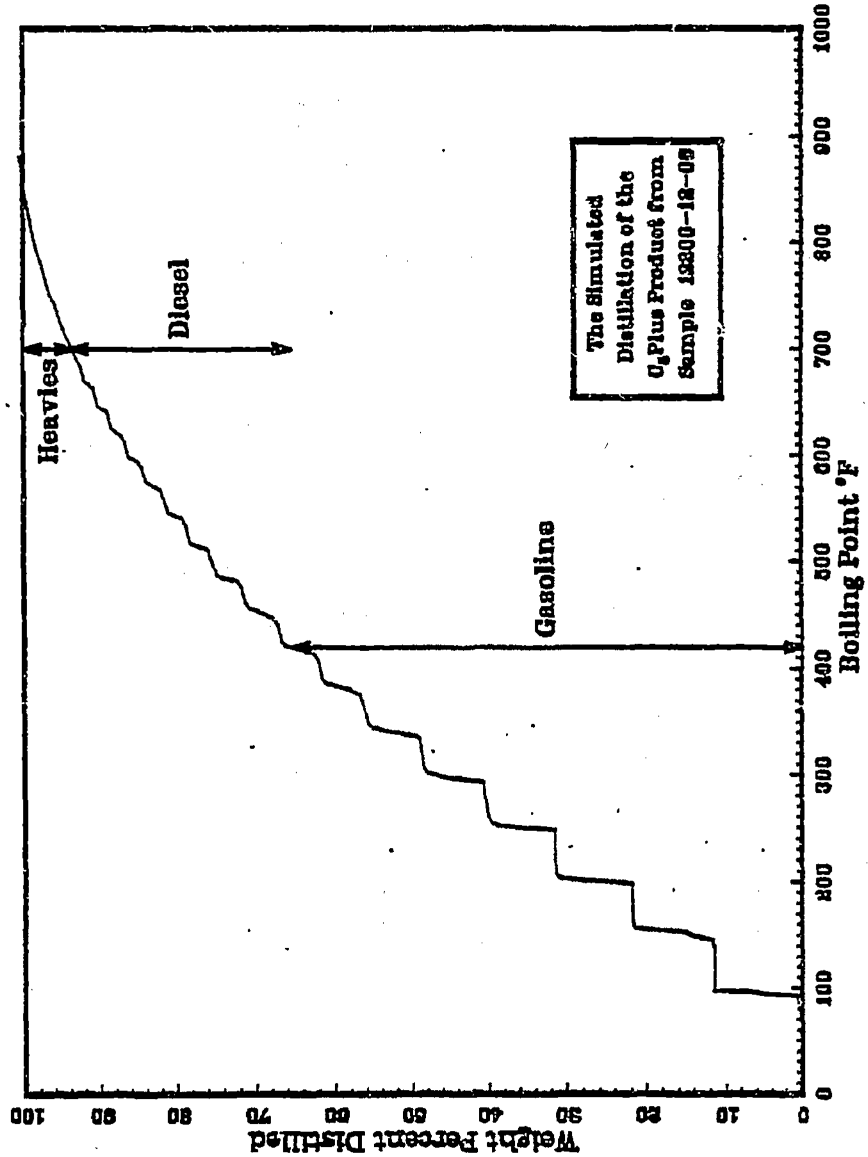

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Plus Product from
Boiling Point °F
Weight Percent Distilled

Fig. B267

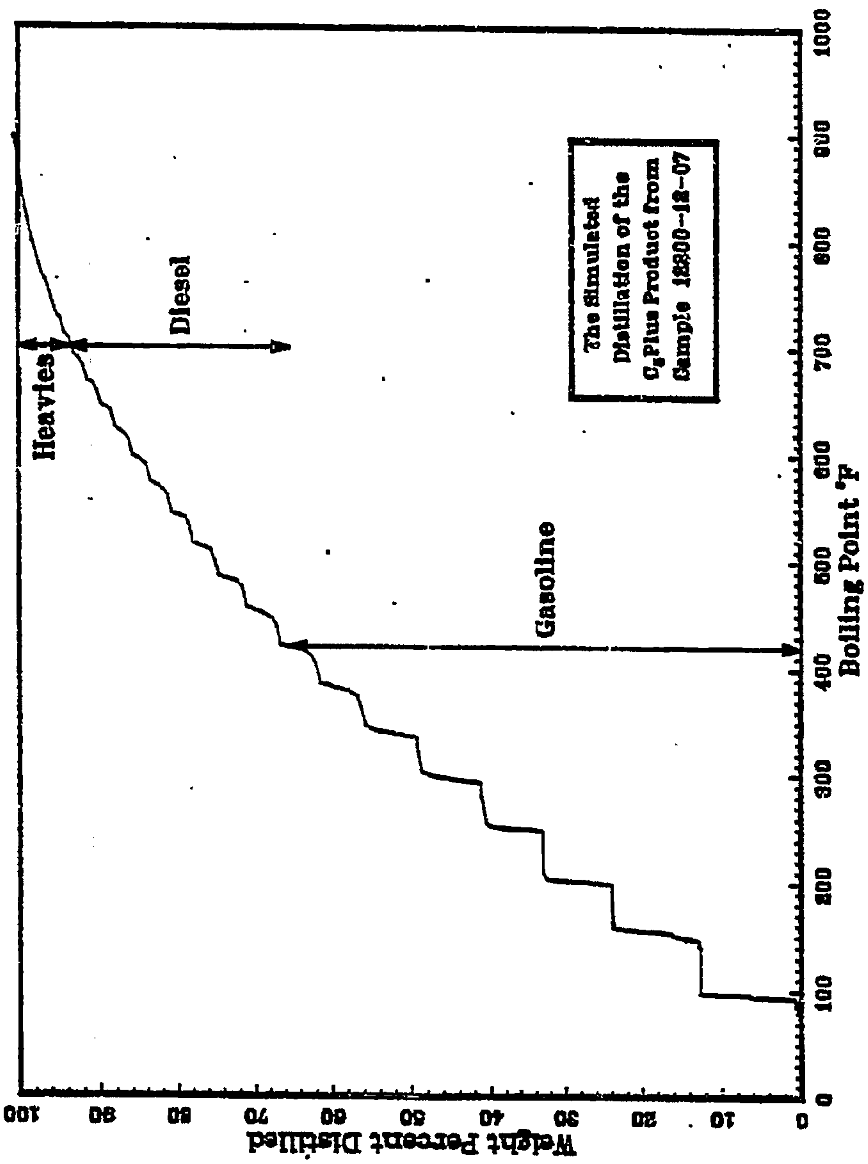

The Simulated
Distillation of the
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B268

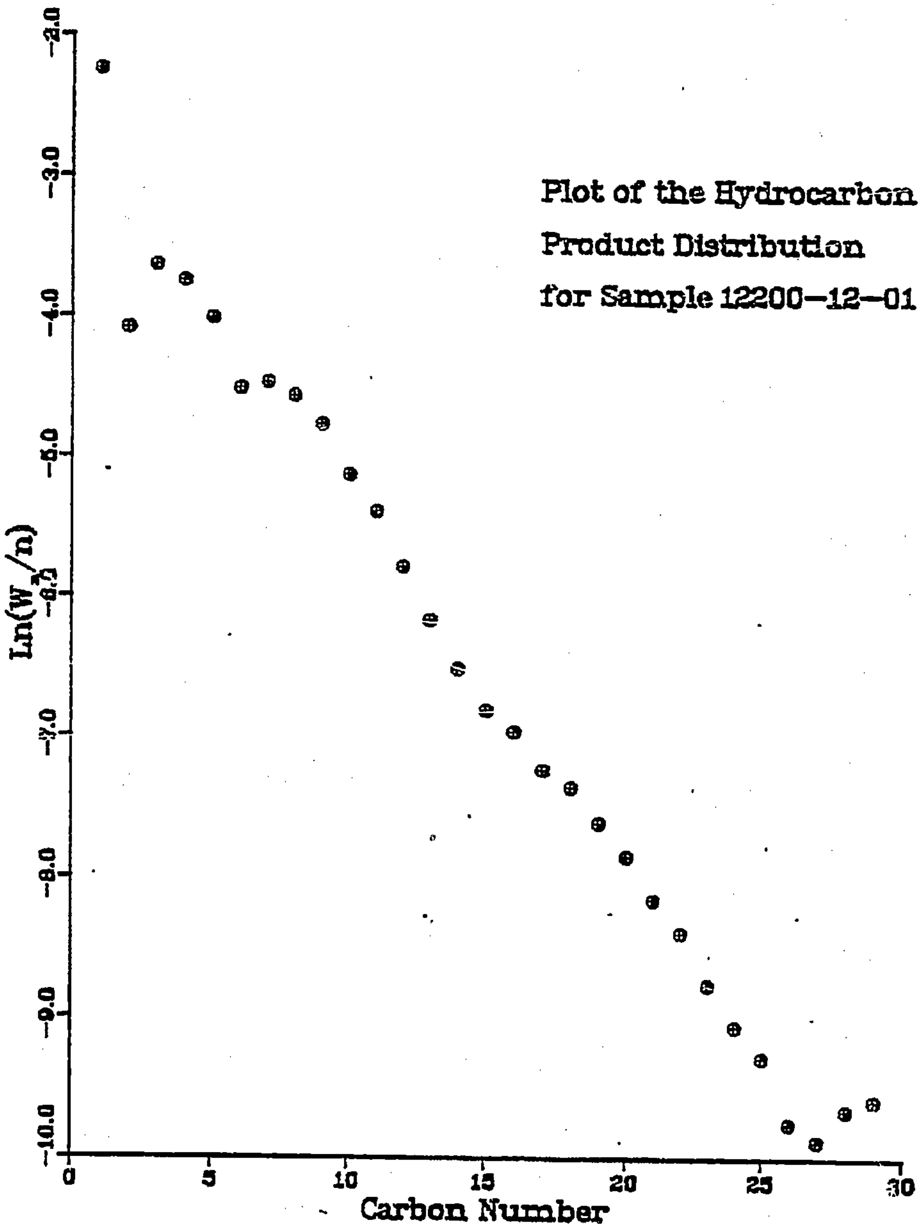
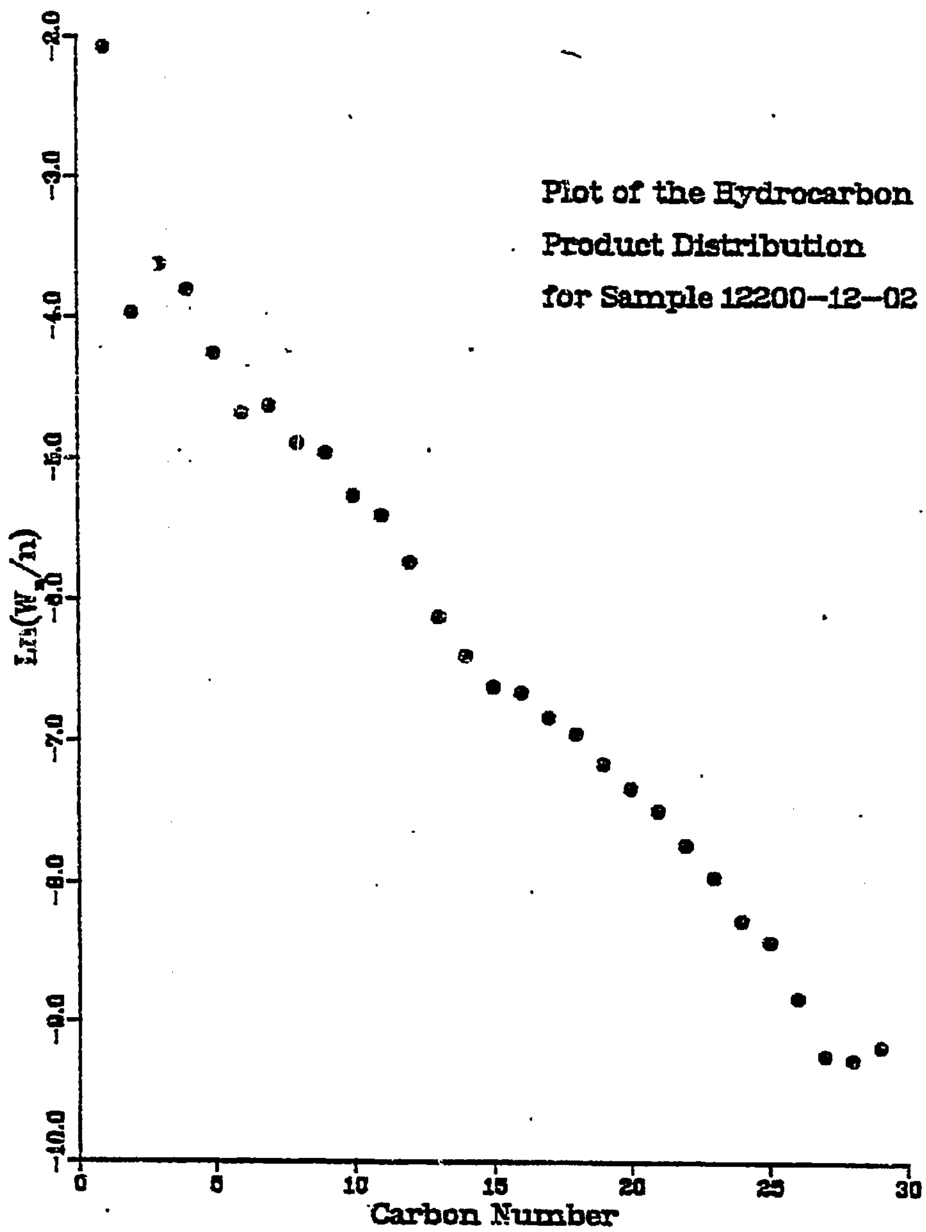
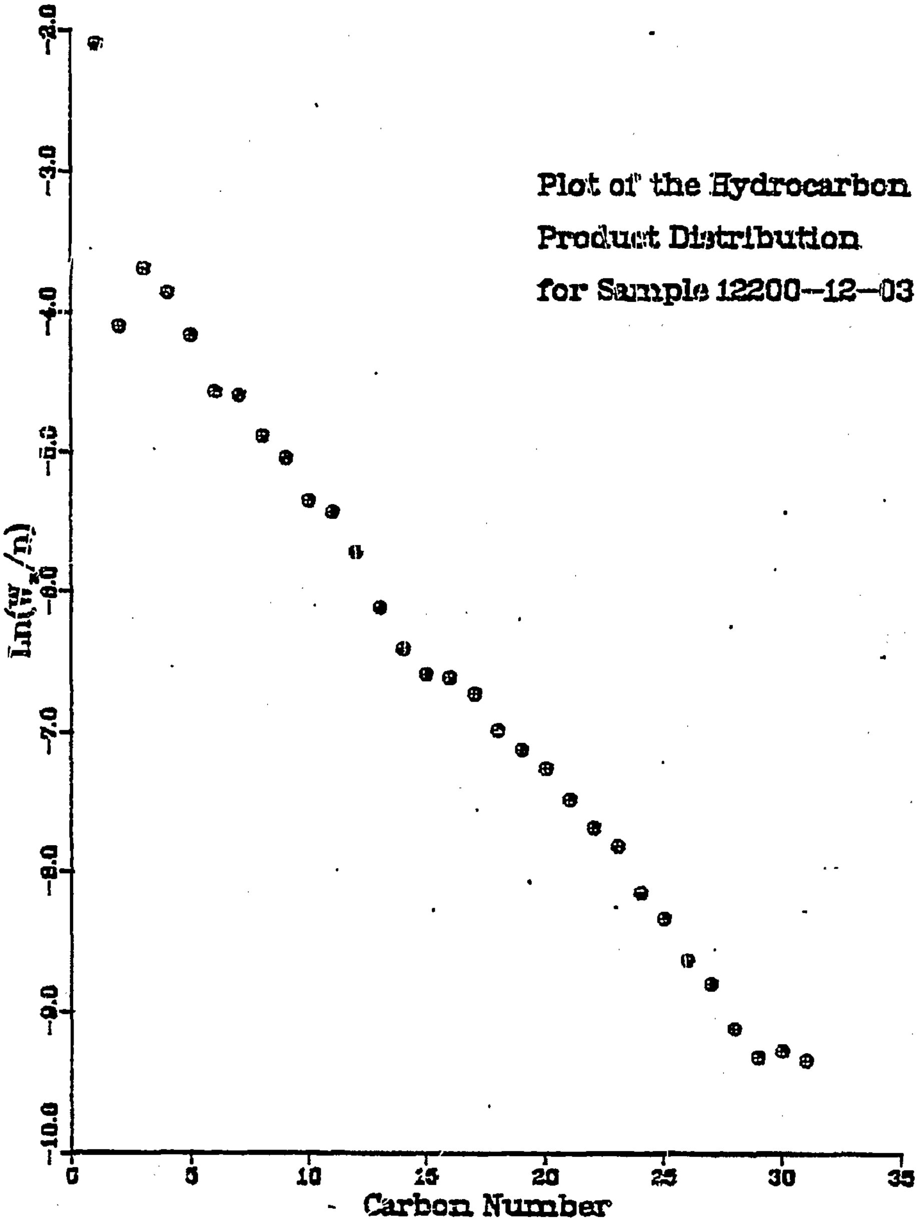

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-12-01
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B269



Plot of the Hydrocarbon
Product Distribution
for Sample 12200-12-02
-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
Carbon Number

Fig. B270


Plot of the Hydrocarbon
Product Distribution
for Sample 12200-12-03
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
Ln(w_x/n)
0
5
10
15
20
25
30
35
Carbon Number
Fig. B271

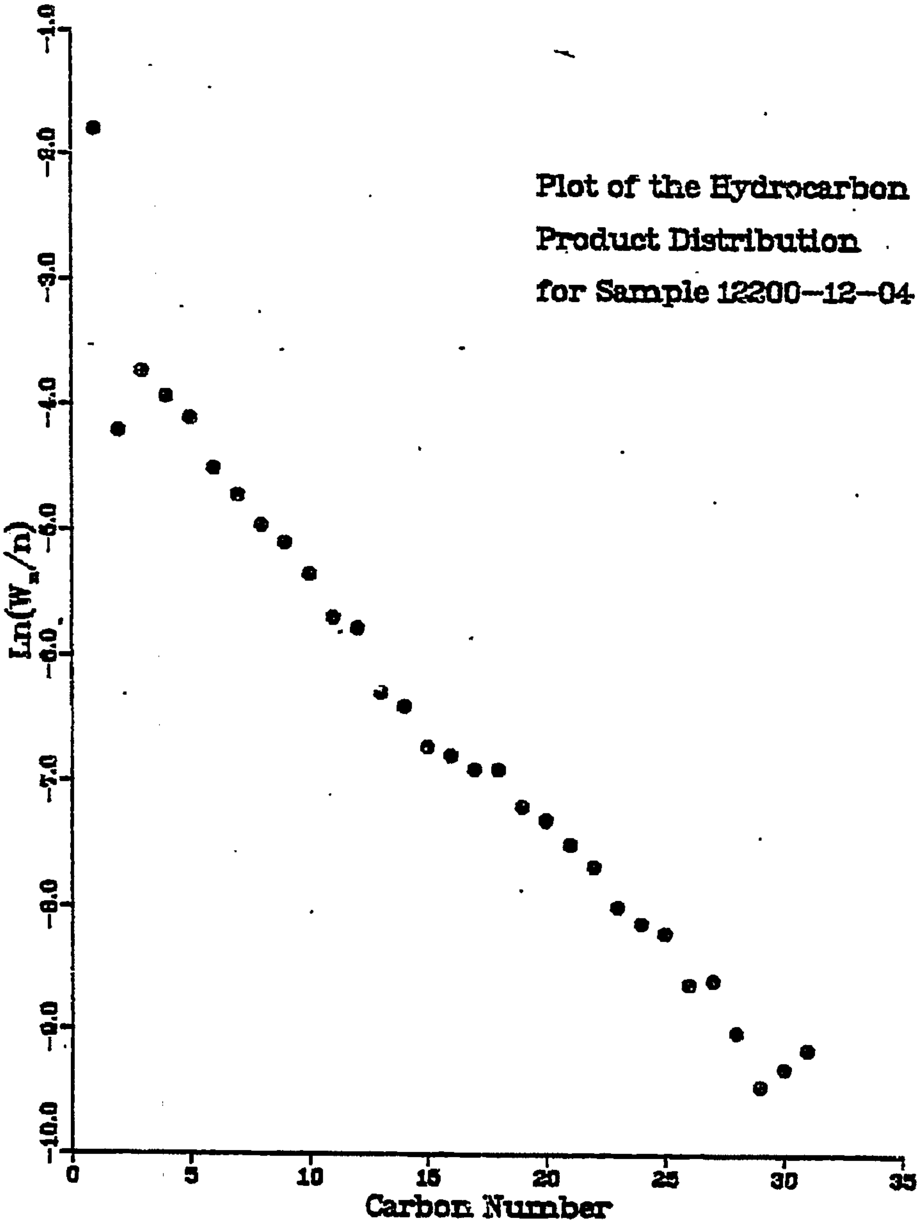

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-12-04
Ln(Wn/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B272

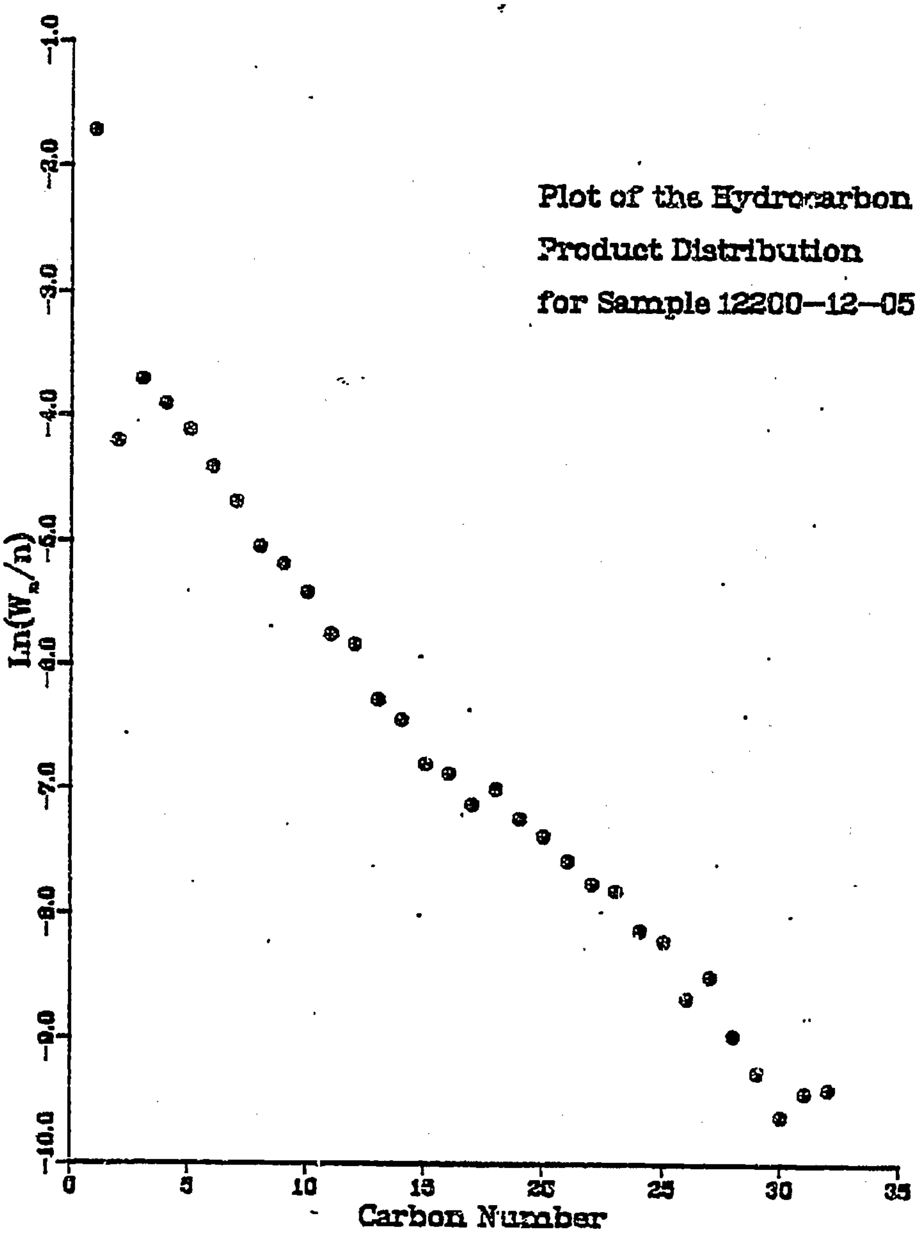

Plot of the Hydrocarbon
Product Distribution
for Sample 12200—12—05
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B273

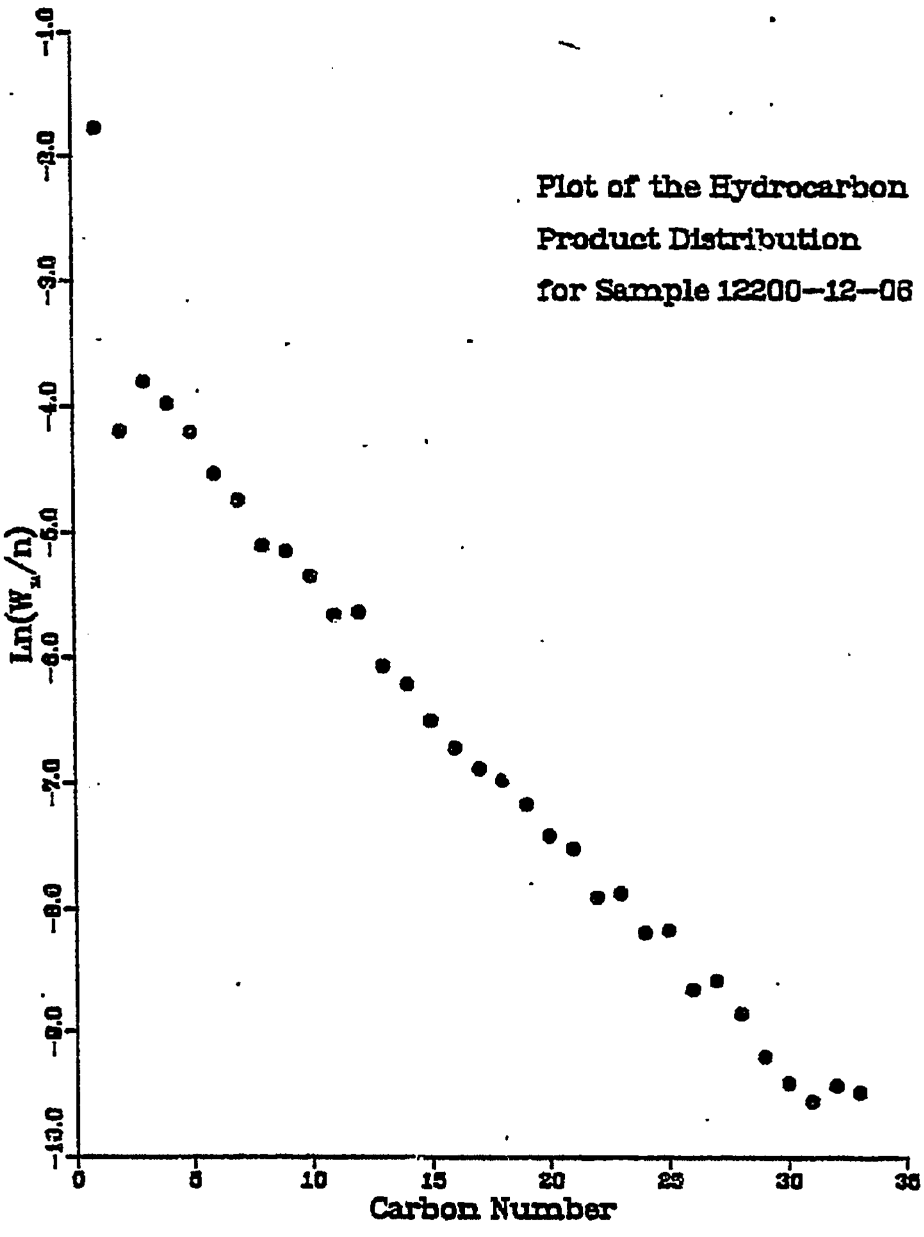

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-12-06
Ln(W_n/n)
Carbon Number
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35

Fig. B274

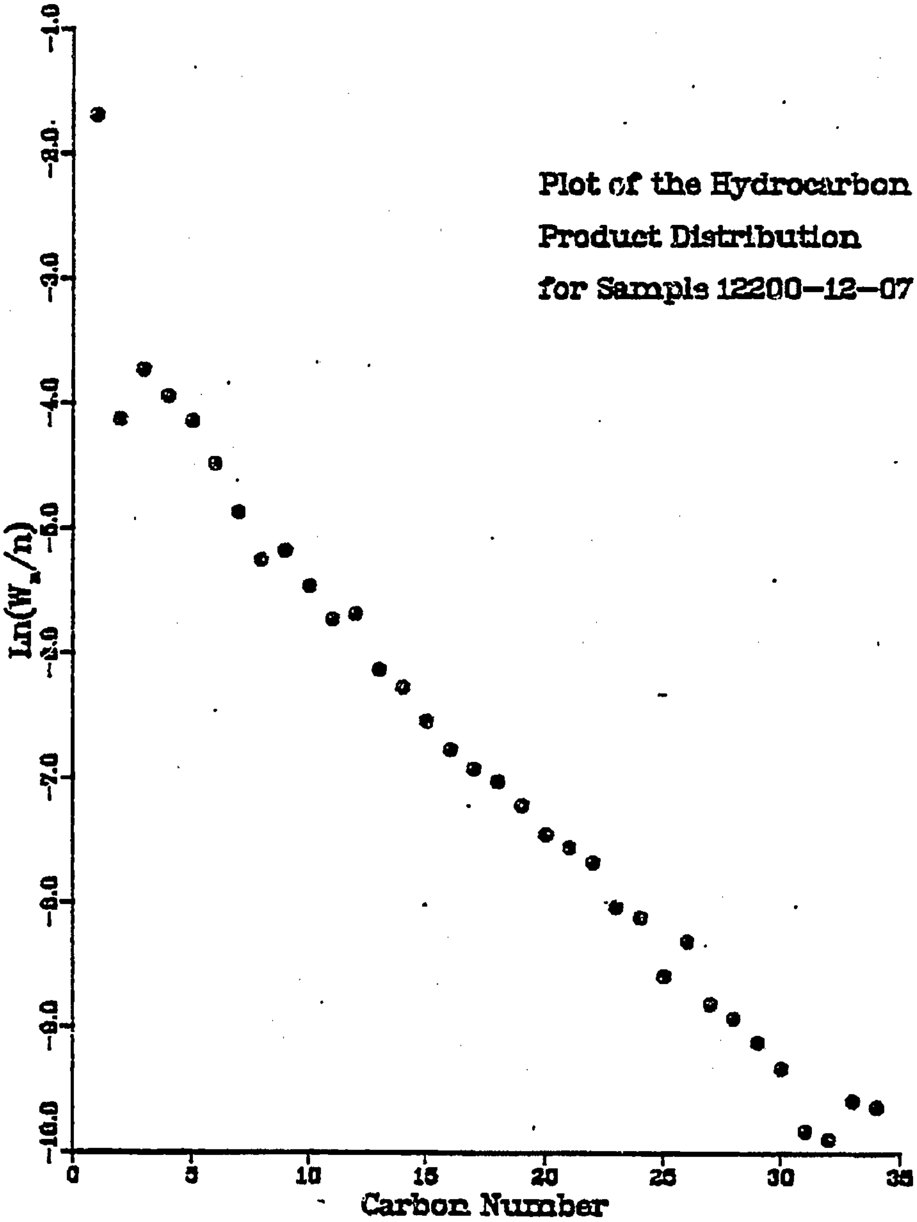
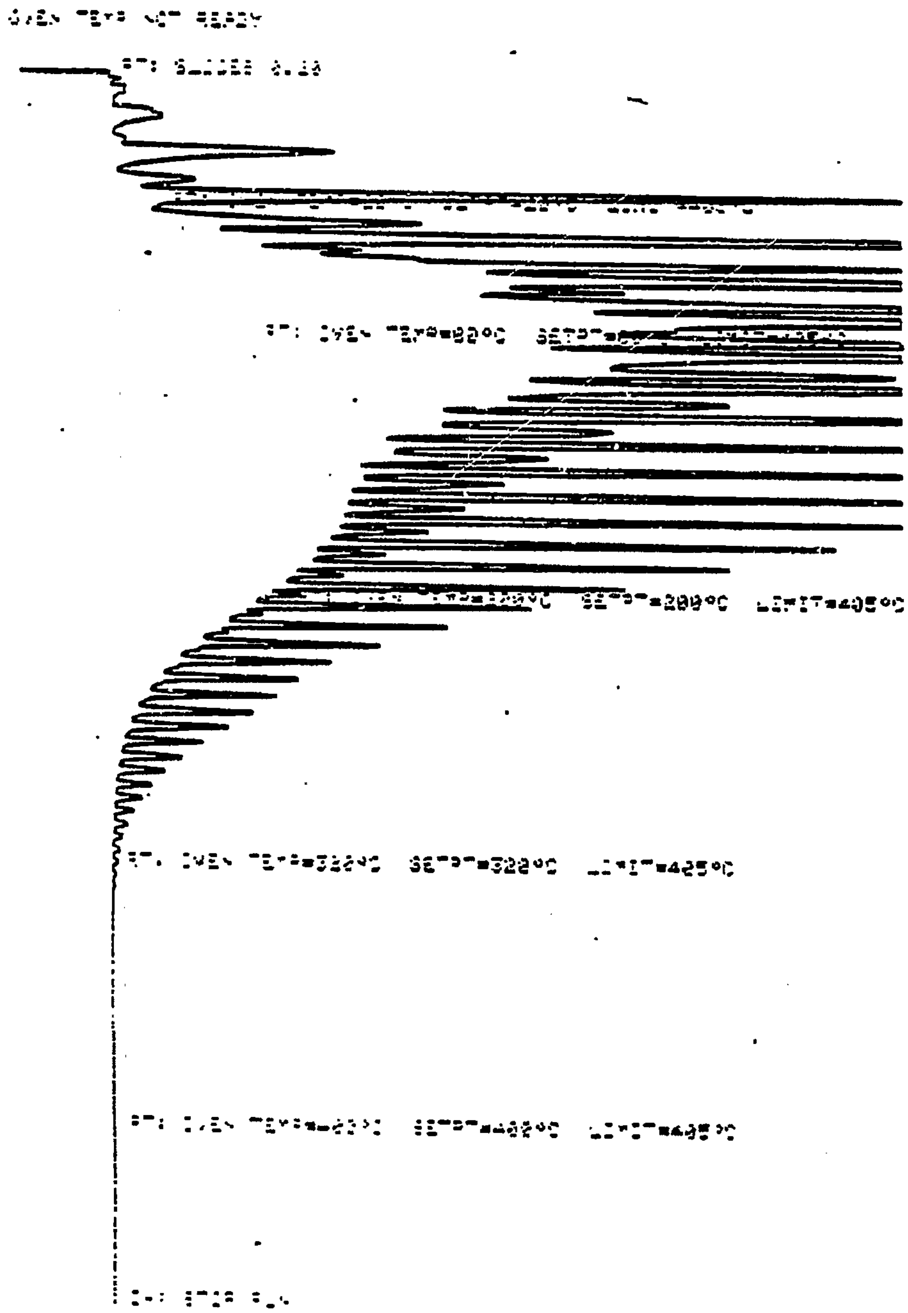
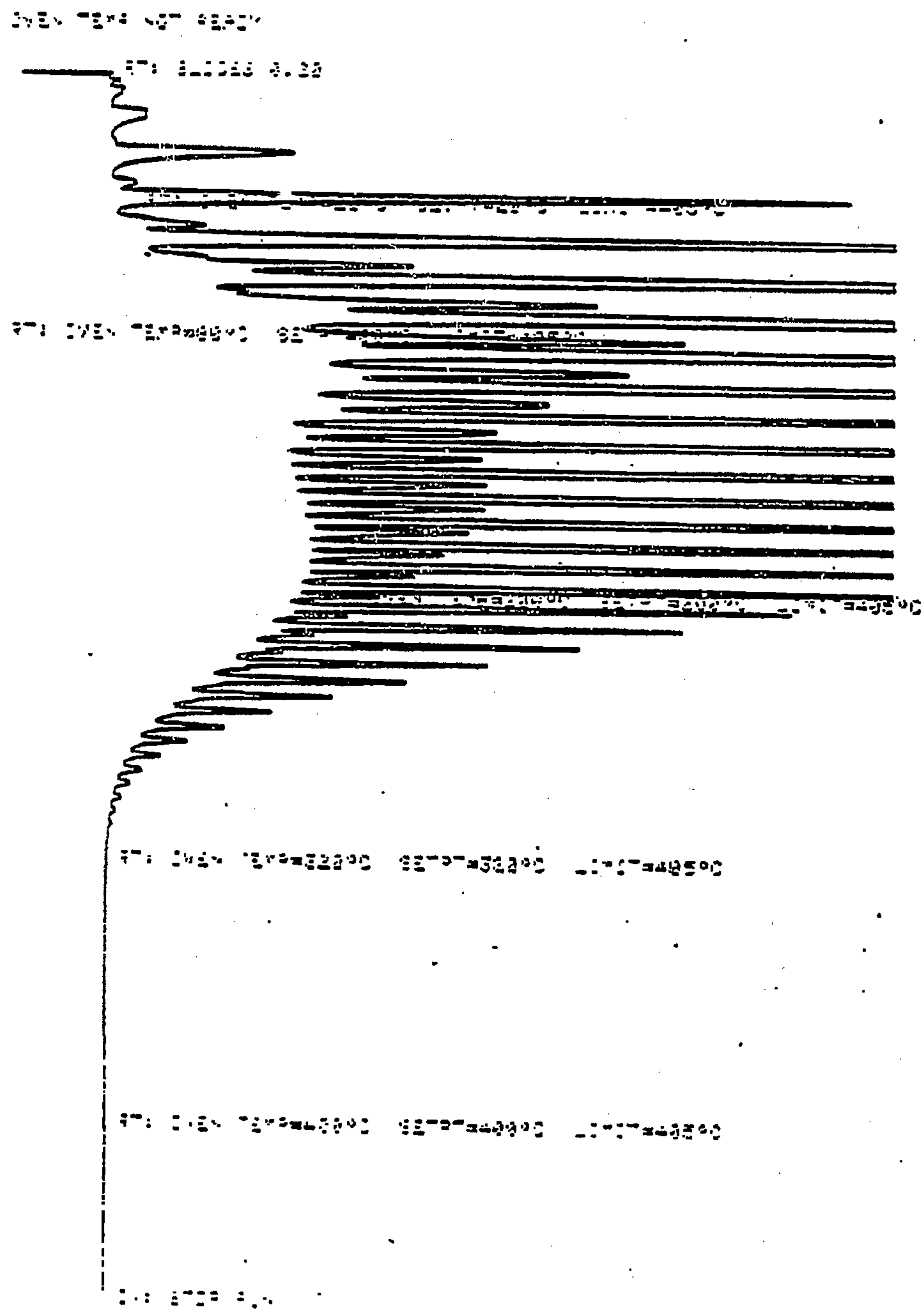

Plot of the Hydrocarbon
Product Distribution
for Sample 12200-12-07
Ln(W_n/n)
Carbon Number

Fig. B275



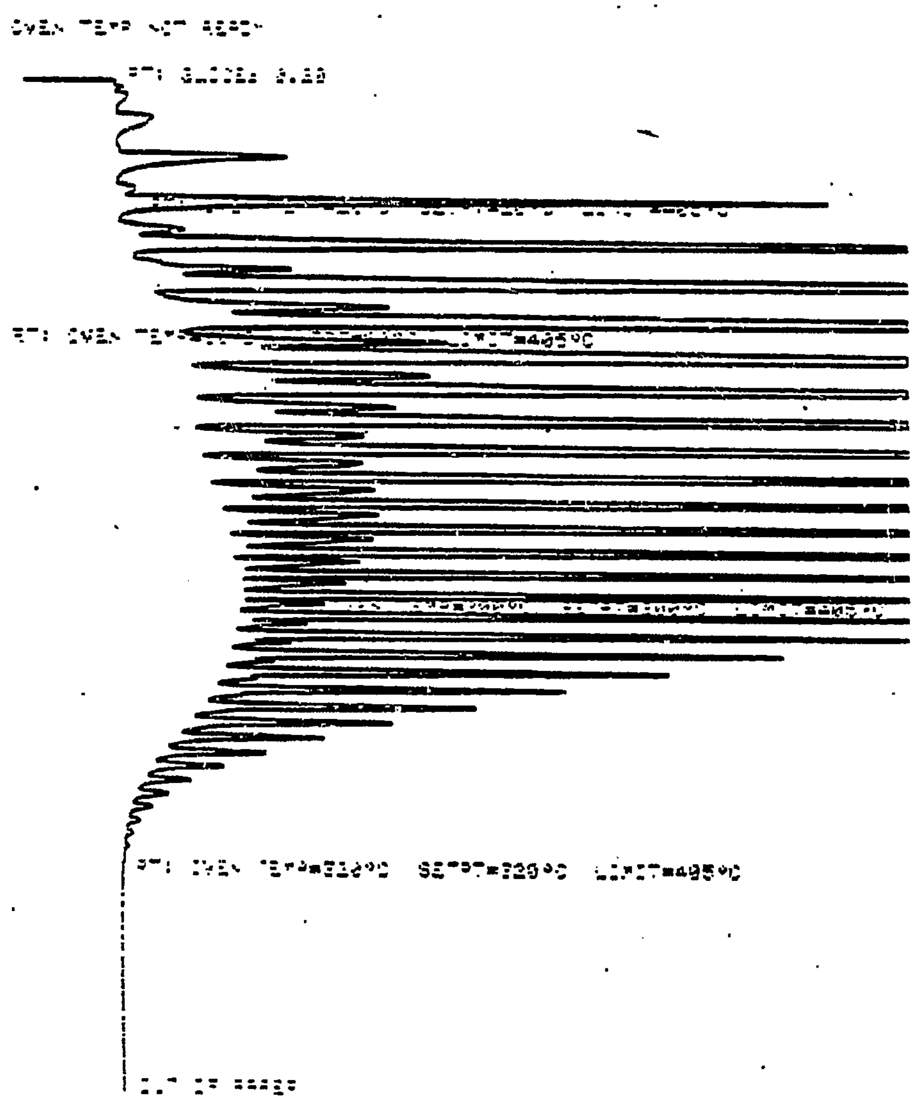
12200-12-01

Fig. B276



12200-12-02

Fig. B277



12200-12-03

Fig. B278

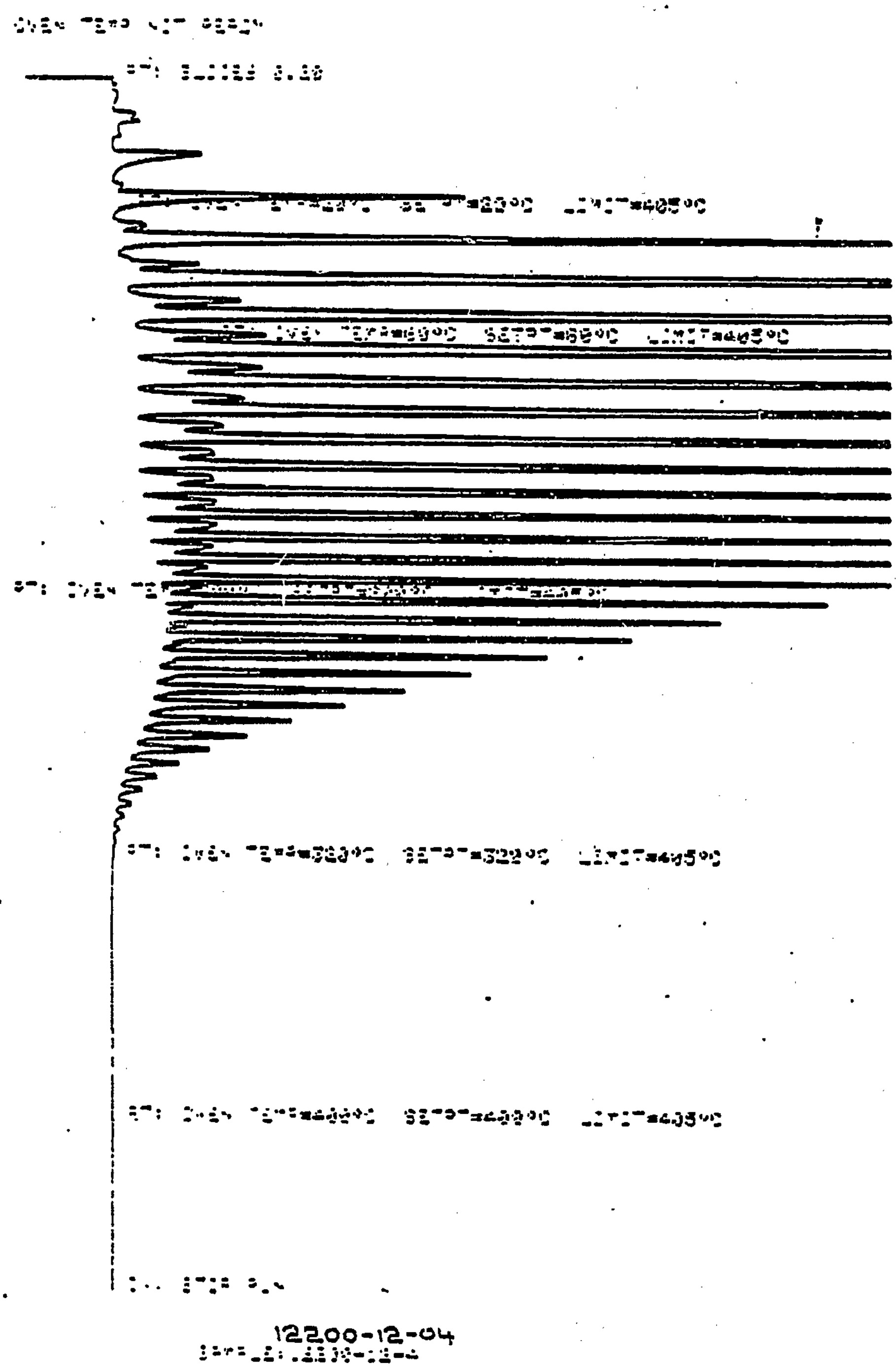


Fig. B279

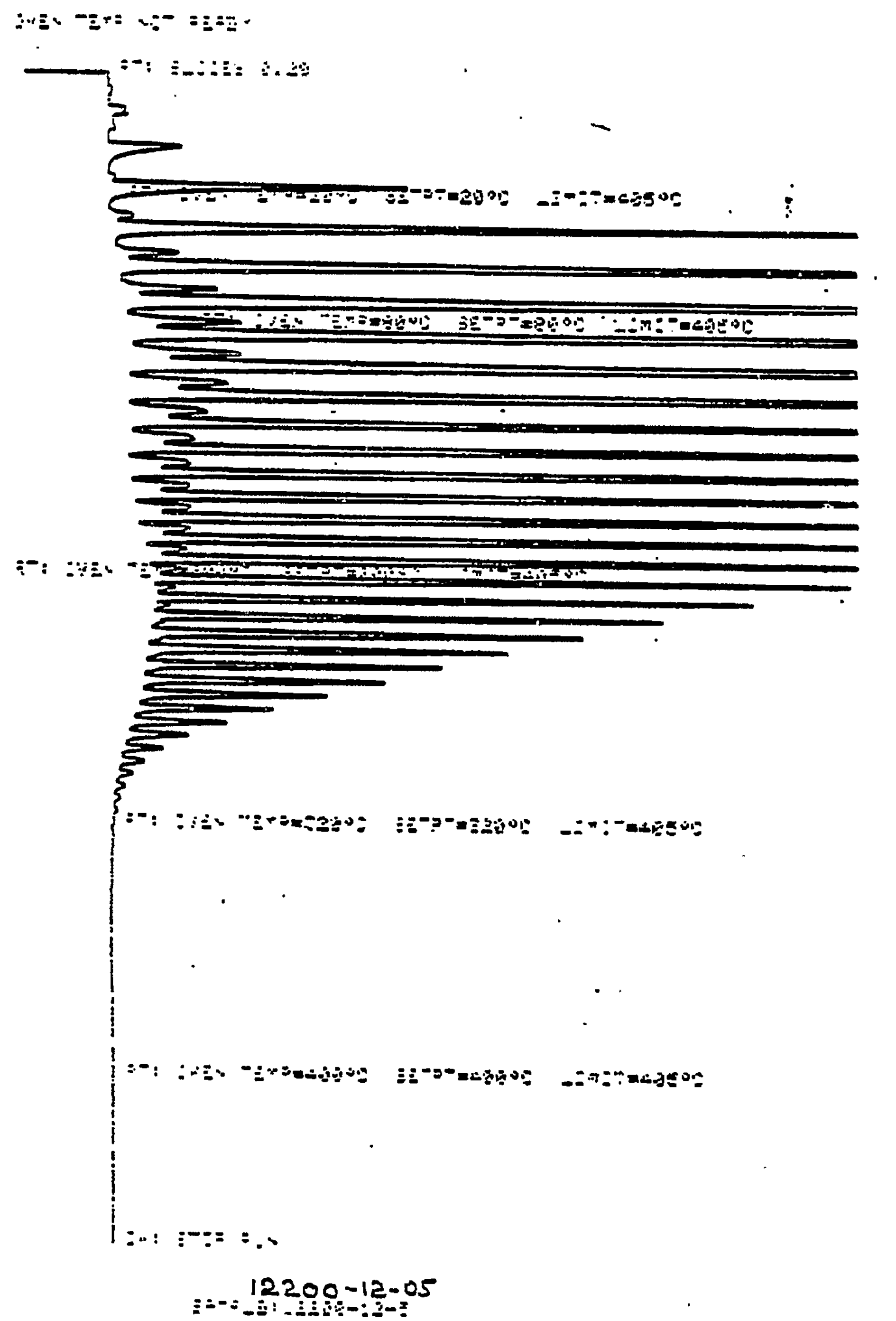
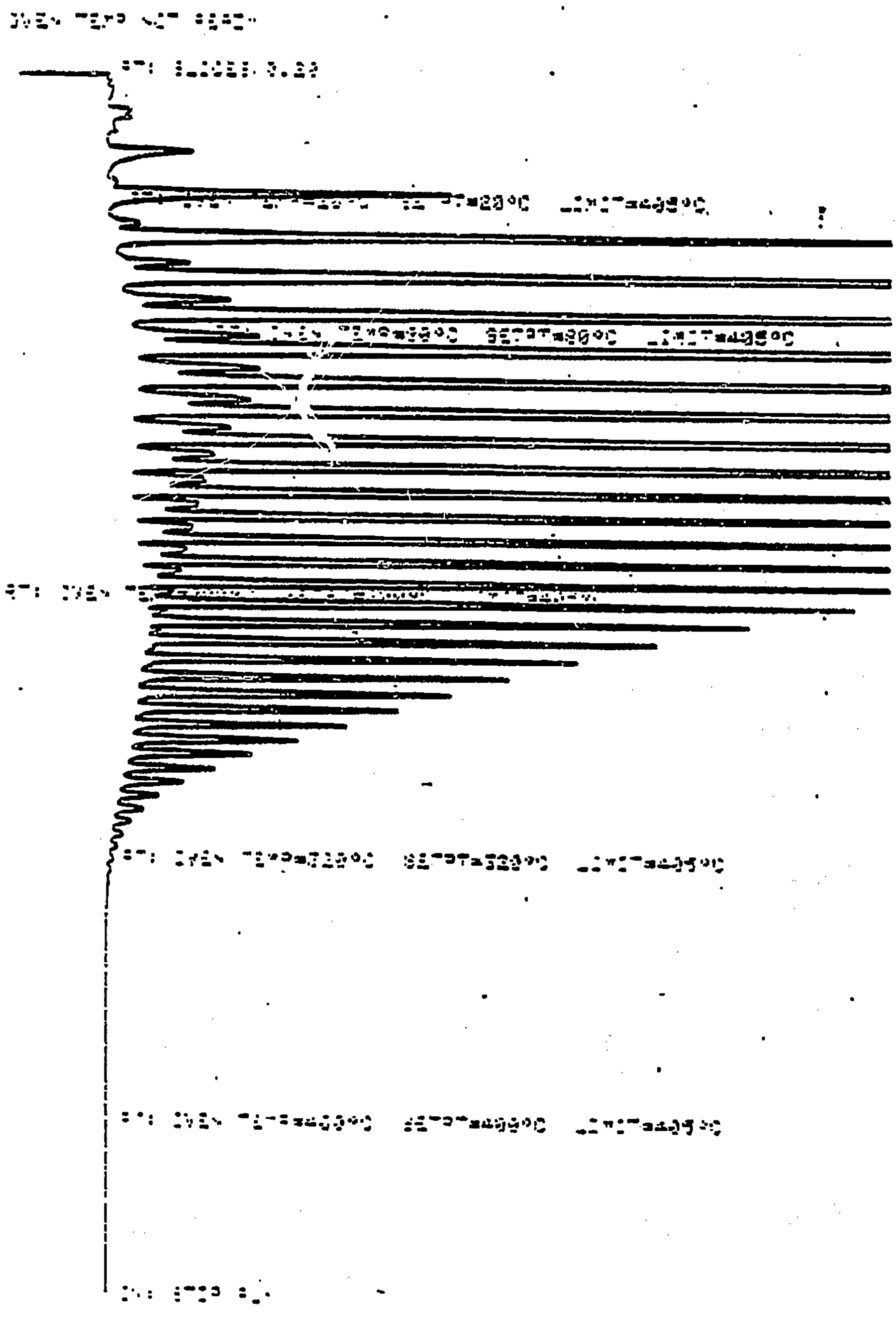


Fig. B280



12200-12-06

Fig. B281

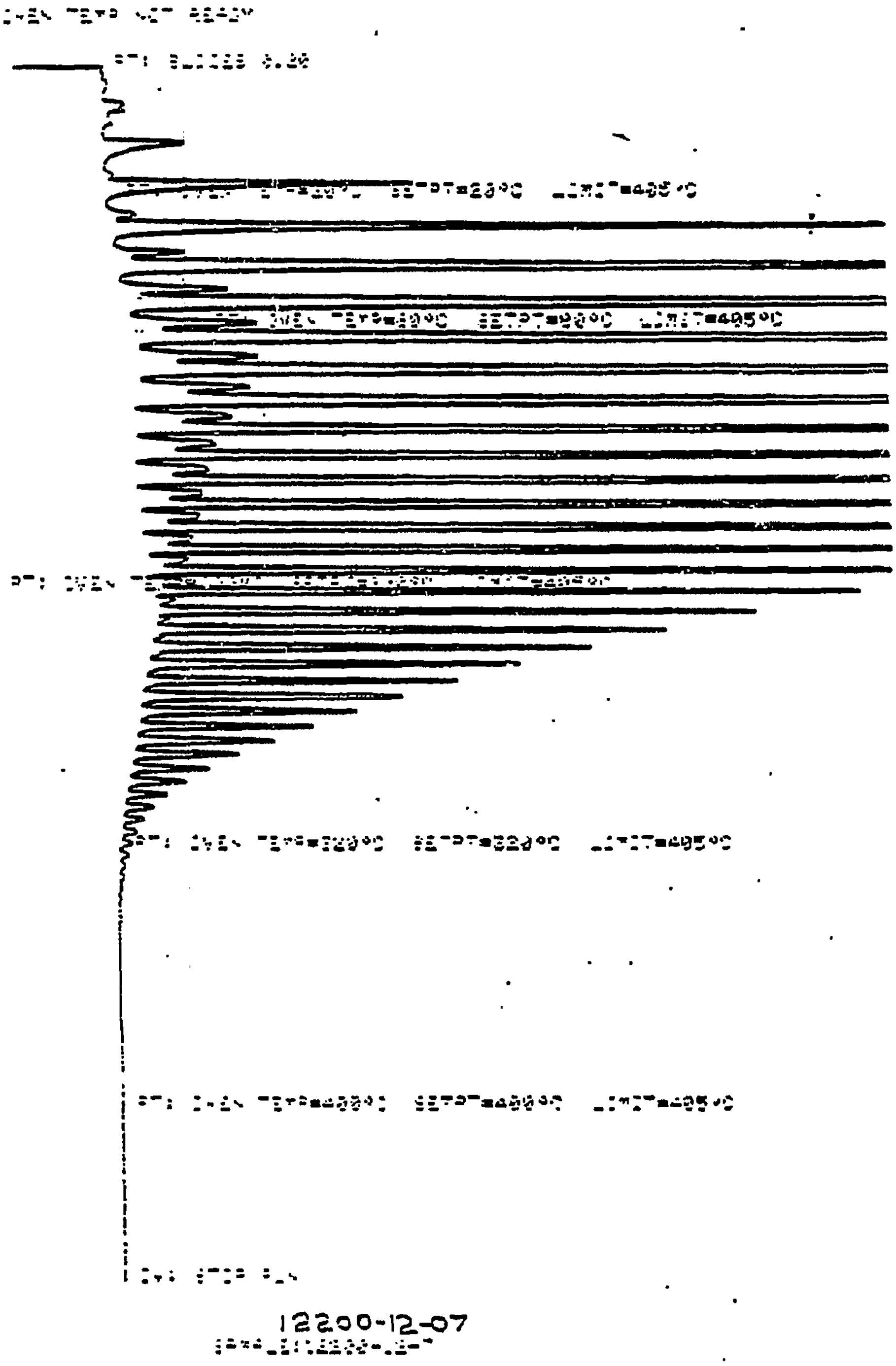


Fig. B282

RESULT OF SYNGAS OPERATION

RUN NO. 12200-12
CATALYST CO/X9/X10/X4-U103+U112 250 CC 107.5G (WT CHANGE +16.7 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-12-01	200-12-02	200-12-03	200-12-04	200-12-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	19.5	42.5	66.5	90.5	115.5
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	262	261	261	261	261
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	19.50	23.00	24.00	24.00	25.00
EFFLNT GAS LITER	783.75	1021.75	1092.40	1143.35	1234.20
GM AQUEOUS LAYER	158.48	168.73	167.95	154.49	152.32
GM OIL	36.61	47.54	49.27	45.48	40.37
MATERIAL BALANCE					
GM ATOM CARBON %	94.55	97.47	97.79	95.54	97.63
GM ATOM HYDROGEN %	91.81	93.95	94.76	99.79	97.08
GM ATOM OXYGEN %	101.62	103.37	102.59	98.64	101.65
RATIO CHX/(H2O+CO2)	0.7889	0.8059	0.8346	0.8847	0.8443
RATIO X IN CHX	2.3417	2.3905	2.3819	2.4488	2.4752
USAGE H2/CO PRODT	2.1452	2.1792	2.1627	2.1511	2.2013
FEED H2/CO FRM EFFLNT	0.9710	0.9639	0.9689	1.0445	0.9943
RESIDUAL H2/CO RATIO	0.4546	0.5108	0.5382	0.6450	0.6163
RATIO CO2/(H2O+CO2)	0.0736	0.0651	0.0598	0.0571	0.0582
K SHIFT IN EFFLNT	0.0361	0.0356	0.0342	0.0391	0.0381
SPECIFIC ACTIVITY SA	1.3416	1.0307	0.9289	0.7067	0.6708
CONVERSION					
ON CO %	30.55	27.16	26.52	26.52	23.85
ON H2 %	67.48	61.40	59.18	54.63	52.80
ON CO+H2 %	48.74	43.97	42.59	40.88	38.28
PRDT SELECTIVITY,WT %					
CH4	10.64	12.62	12.32	16.58	18.04
C2 HC'S	3.37	3.76	3.31	2.98	2.97
C3H8	4.61	4.90	4.45	4.06	4.06
C3H6=	3.31	3.10	3.05	3.06	3.29
C4H10	3.66	3.69	3.65	3.45	3.62
C4H8=	5.81	5.22	4.75	4.35	4.42
C5H12	4.05	4.27	4.44	4.28	4.31
C5H10=	4.99	2.79	3.34	3.95	3.83
C6H14	4.38	4.21	4.81	4.46	4.91
C6H12= & CYCLO'S	1.86	1.09	1.20	2.16	2.35
C7+ IN GAS	21.54	16.74	16.81	15.31	15.34
LIQ HC'S	31.79	37.62	37.84	35.35	32.86
TOTAL	100.00	100.00	100.00	100.00	100.00

Table B20

SUB-GROUPING					
C1 -C4	31.39	33.28	31.54	34.48	36.40
C5 -420 F	54.08	45.65	46.13	44.31	43.23
420-700 F	13.10	18.10	18.54	17.14	15.97
700-END PT	1.43	2.97	3.78	4.07	4.40
C5+-END PT	68.61	66.72	68.46	65.52	63.60
ISO/NORMAL MOLE RATIO					
C4	0.1328	0.0369	0.0302	0.0255	0.0290
C5	0.1587	0.0693	0.0628	0.0605	0.0525
C6	0.1745	0.0313	0.0805	0.0360	0.0333
C4=	0.1510	0.0772	0.0757	0.0722	0.0693
PARAFFIN/OLEFIN RATIO					
C3	1.3313	1.5110	1.3921	1.2650	1.1787
C4	0.6079	0.6820	0.7406	0.7660	0.7896
C5	0.7894	1.4903	1.2907	1.0537	1.0951
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.7703	0.8056	0.8127	0.8159	0.8160
RATIO CH4/(1-A)**2	2.0162	3.3379	3.5139	4.8899	5.3263
ALPHA FRM CORRELATION	0.8491	0.8435	0.8409	0.8321	0.8343
ALPHA (EXPTL/CORR)	0.9072	0.9551	0.9665	0.9805	0.9780
WT%CH4 FRM CORRELATION	15.0493	16.5842	17.3732	20.1096	19.4224
WT%CH4 (EXPTL/CORR)	0.7072	0.7609	0.7093	0.8243	0.9286
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.7578	0.7568	0.7560	0.7569*	0.7486*
N, REFRACTIVE INDEX	1.4268	1.4274	1.4266	1.4206*	1.4216*
SIMULT'D DISTILATN					
10 WT % @ DEG F	260	289	298	298	300
16	296	305	308	336	340
50	406	451	457	479	483
84	585	639	652	668	681
90	634	682	700	711	728
RANGE(16-84 %)	289	334	344	332	341
WT % @ 420 F	54.30	44.00	41.00	40.00	38.00
WT % @ 700 F	95.50	92.10	90.00	88.50	86.60

Table B20, cont

RESULT OF SYNGAS OPERATION

RUN NO. 12200-12
CATALYST CO/X9/X10/X4-U103+U112 12251-14 250 CC 107.5 G(WT CHANGE +16.7
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12200-12-06	200-12-07
FEED H2:CO:AR	50:50: 0	50:50: 0
HRS ON STREAM	138.5	163.5
PRESSURE,PSIG	300	300
TEMP. C	261	262
FEED CC/MIN	1260	1260
HOURS FEEDING	23.00	25.00
EFFLNT GAS LITER	1148.30	1265.25
GM AQUEOUS LAYER	135.90	147.88
GM OIL	45.95	43.98
MATERIAL BALANCE		
GM ATOM CARBON %	99.70	98.88
GM ATOM HYDROGEN %	99.19	98.25
GM ATOM OXYGEN %	101.33	102.40
RATIO CHX/(H2O+CO2)	0.9349	0.8601
RATIO X IN CHX	2.4531	2.4855
USAGE H2/CO PRODT	2.0991	2.1861
FEED H2/CO FRM EFFLNT	0.9949	0.9937
RESIDUAL H2/CO RATIO	0.6264	0.6299
RATIO CO2/(H2O+CO2)	0.0594	0.0592
K SHIFT IN EFFLNT	0.0396	0.0396
SPECIFIC ACTIVITY SA	0.6946	0.6031
CONVERSION		
ON CO %	25.02	23.38
ON H2 %	52.79	51.43
ON CO+H2 %	38.87	37.36
PRDT SELECTIVITY,WT %		
CH4	16.96	18.42
C2 HC'S	3.02	3.24
C3H8	3.66	3.88
C3H6=	3.04	3.32
C4H10	3.39	3.52
C4H8=	4.14	4.23
C5H12	3.96	4.21
C5H10=	3.52	3.75
C6H14	4.40	4.67
C6H12= & CYCLO'S	2.02	2.13
C7+ IN GAS	14.07	12.60
LIQ HC'S	37.81	36.03
TOTAL	100.00	100.00

Table B21

SUB-GROUPING		
C1 -C4	34.22	36.60
C5 -420 F	42.72	41.06
420-700 F	18.45	17.83
700-END PT	4.61	4.50
C5+-END PT	65.78	63.40
ISO/NORMAL MOLE RATIO		
C4	0.0311	0.0250
C5	0.0483	0.0549
C6	0.0341	0.0305
C4=	0.0675	0.0000
PARAFFIN/OLEFIN RATIO		
C3	1.1507	1.1162
C4	0.7900	0.8049
C5	1.0923	1.0916
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))	0.8172	0.8145
RATIO CH4/(1-A)**2	5.0758	5.3514
ALPHA FRM CORRELATION	0.8335	0.8332
ALPHA (EXPTL/CORR)	0.9804	0.9776
W%CH4 FRM CORRELATION	19.6679	19.9785
W%CH4 (EXPTL/CORR)	0.8625	0.9218
LIQ HC COLLECTION		
PHYS. APPEARANCE	OIL WAX	OIL WAX
DENSITY (* 40 C)	0.7479*	0.7489*
N, REFRACTIVE INDEX	1.4210*	1.4217*
SIMULT'D DISTILATN		
10 WT % @ DEG F	300	300
16	340	340
50	476	481
84	667	669
90	719	727
RANGE(16-84 %)	327	329
WT % @ 420 F	39.00	38.00
WT % @ 700 F	87.80	87.50

Table B21, cont

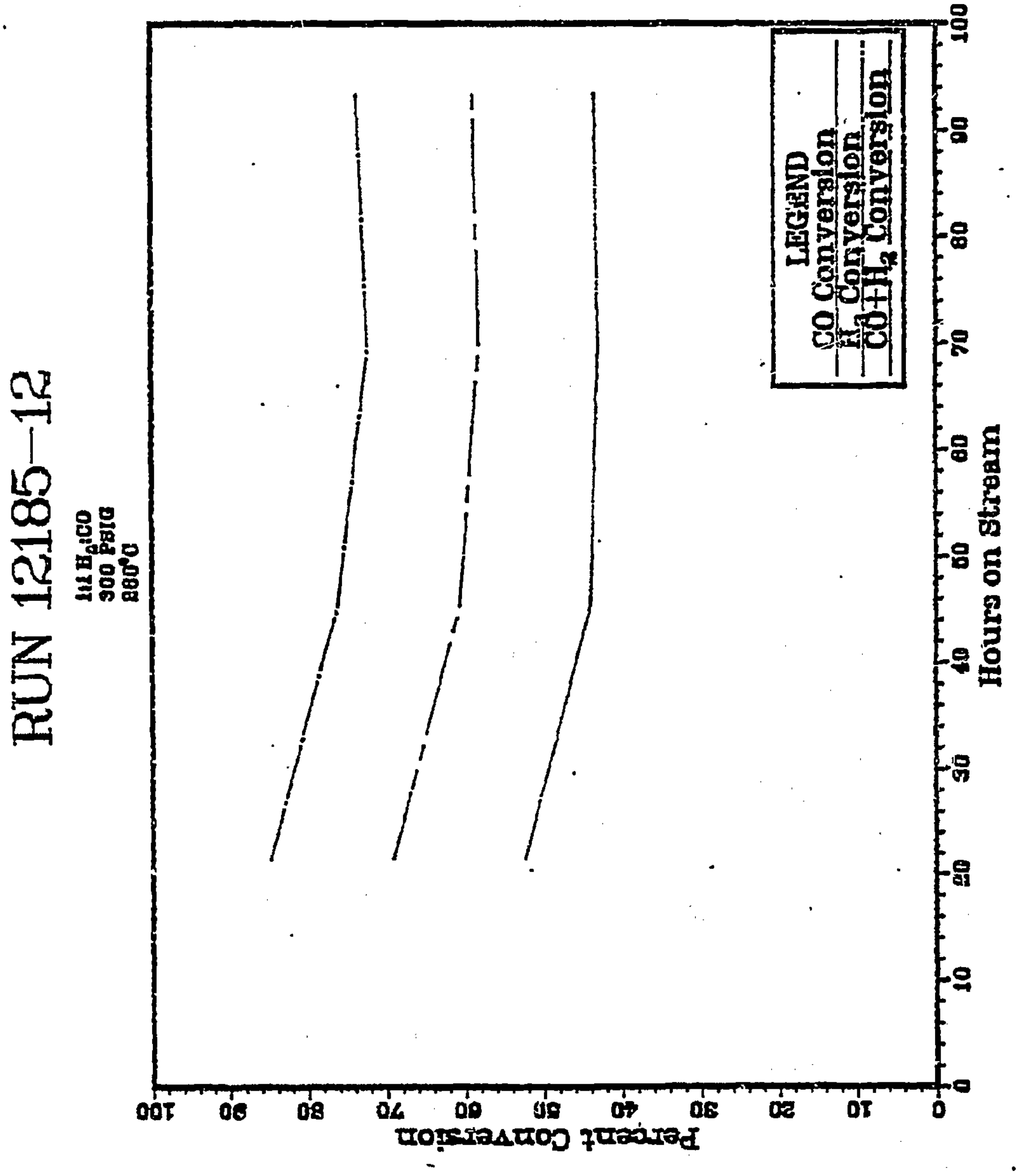

RUN 12185-12
300 PSIG
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion
Hours on Stream
Percent Conversion

Fig. B283

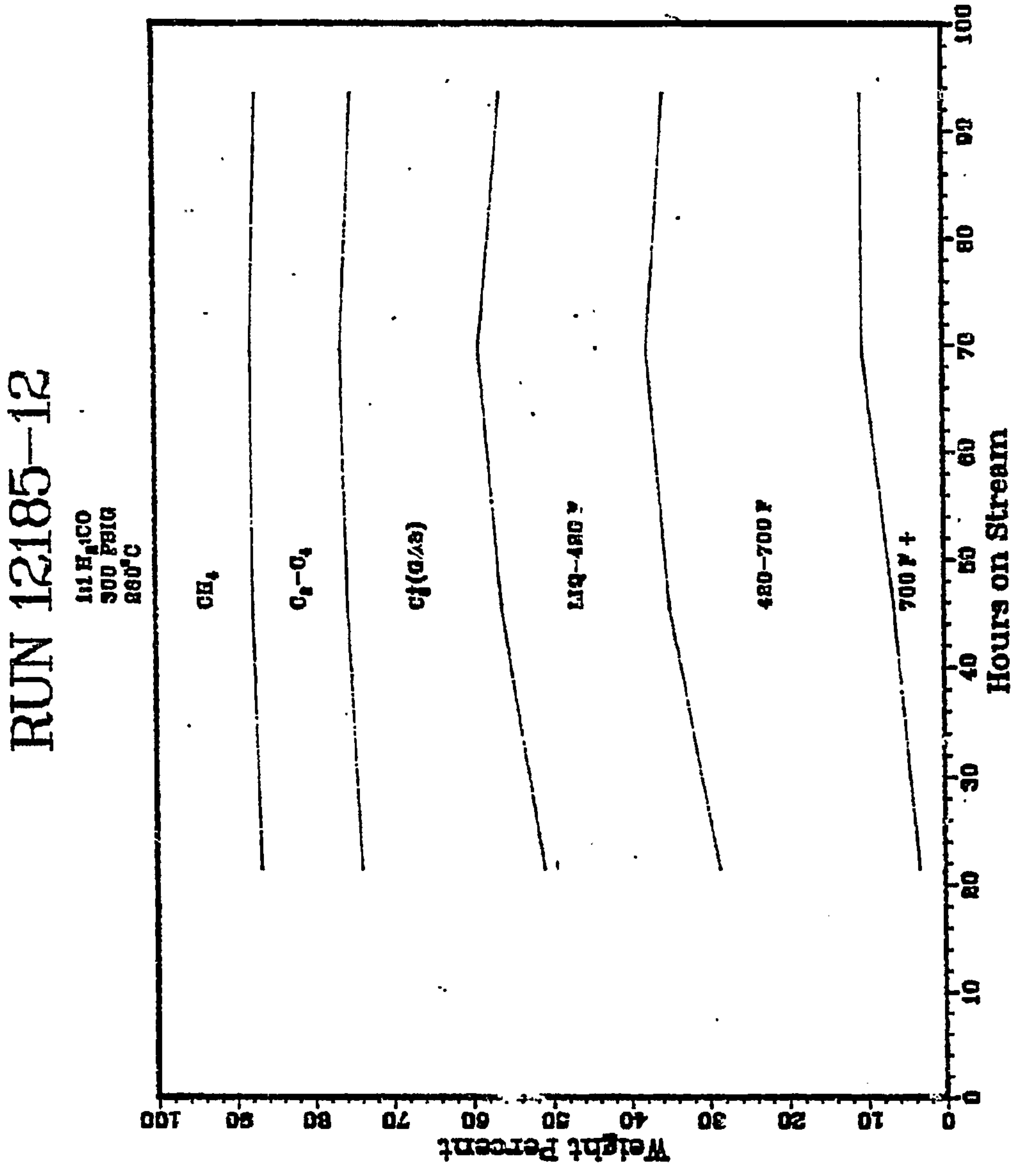

RUN 12185-12
CH4
C2-C4
LIQ-480 F
480-700 F
700 F +
Hours on Stream
Weight Percent

Fig. B284

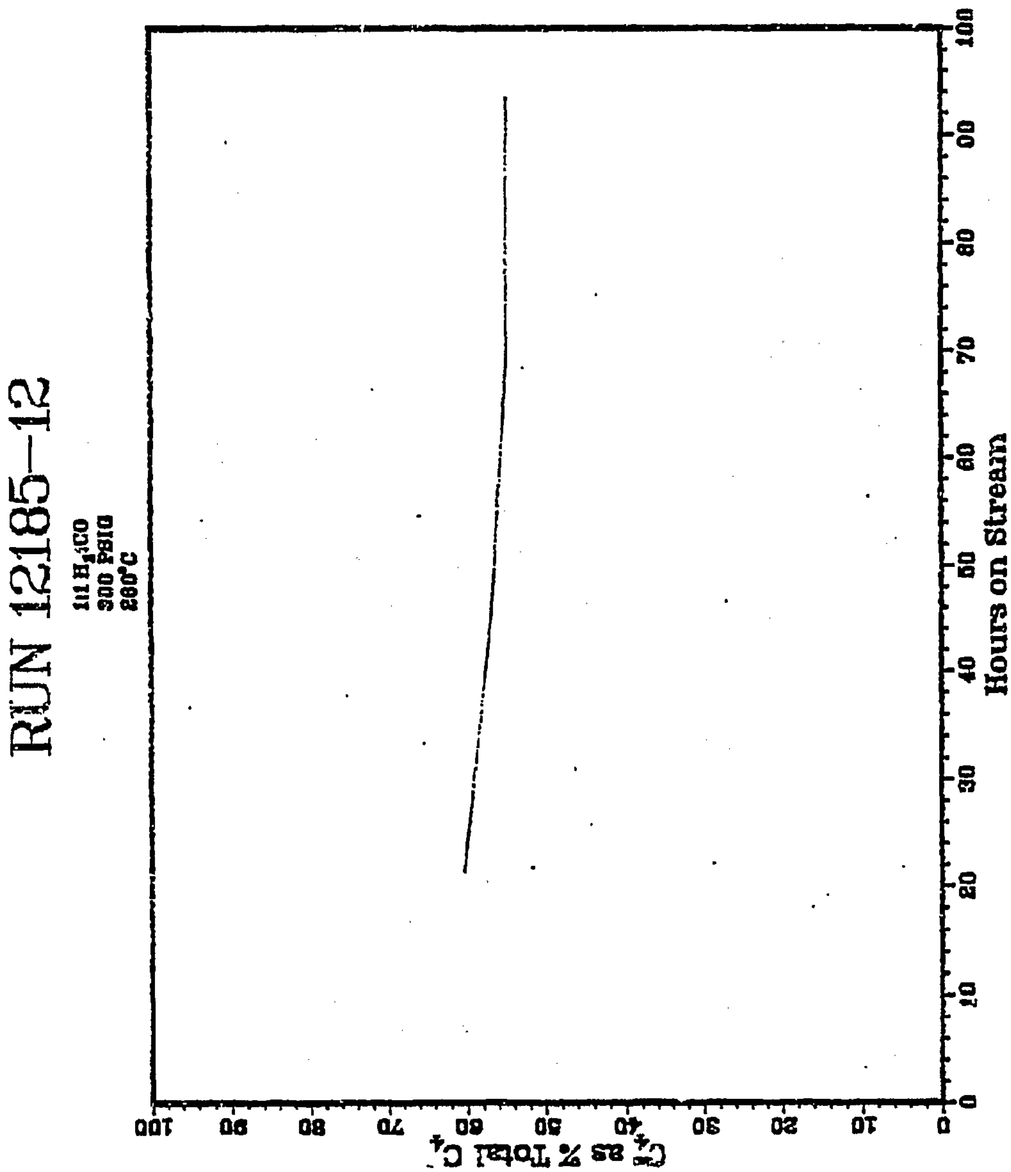

RUN 12185—12
1:1 H2:CO
300 PSIG
280°C
Hours on Stream
C4= as % Total C4
0
10
20
30
40
50
60
70
80
90
100

Fig. B285

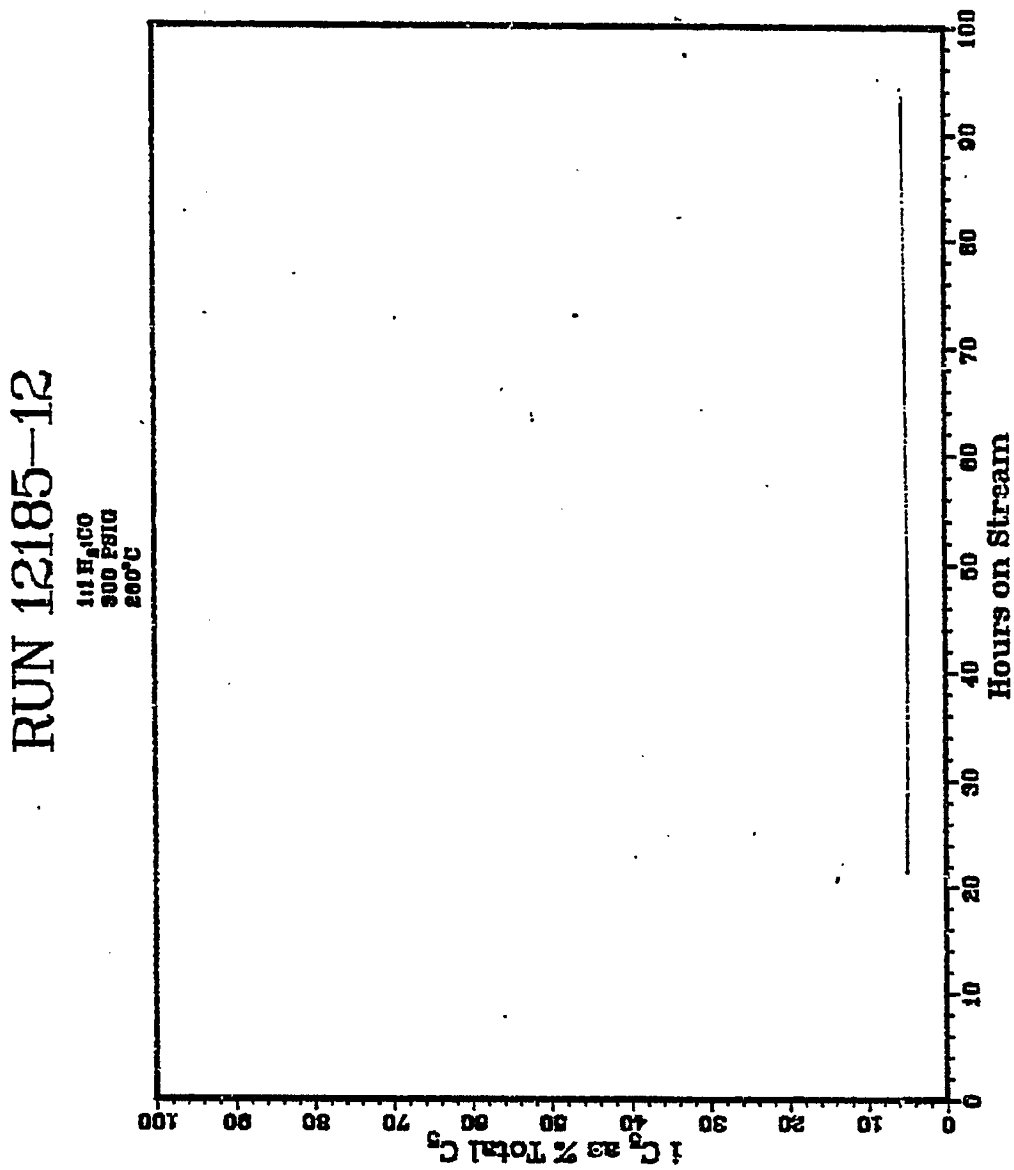
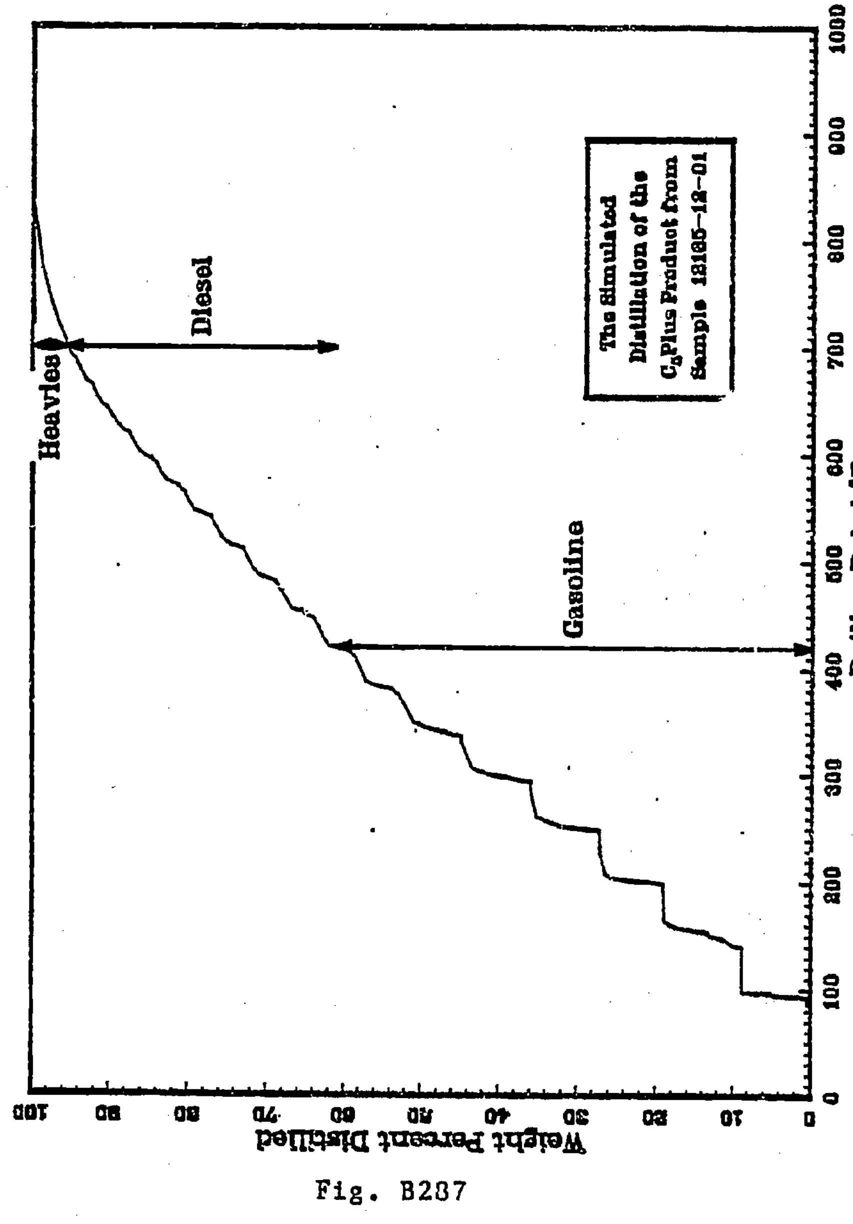

RUN 12185—12
1:1 H_2:CO
300 PSIG
200°C
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
i C_5 as % Total C_5

Fig. B286



Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled

Fig. B287

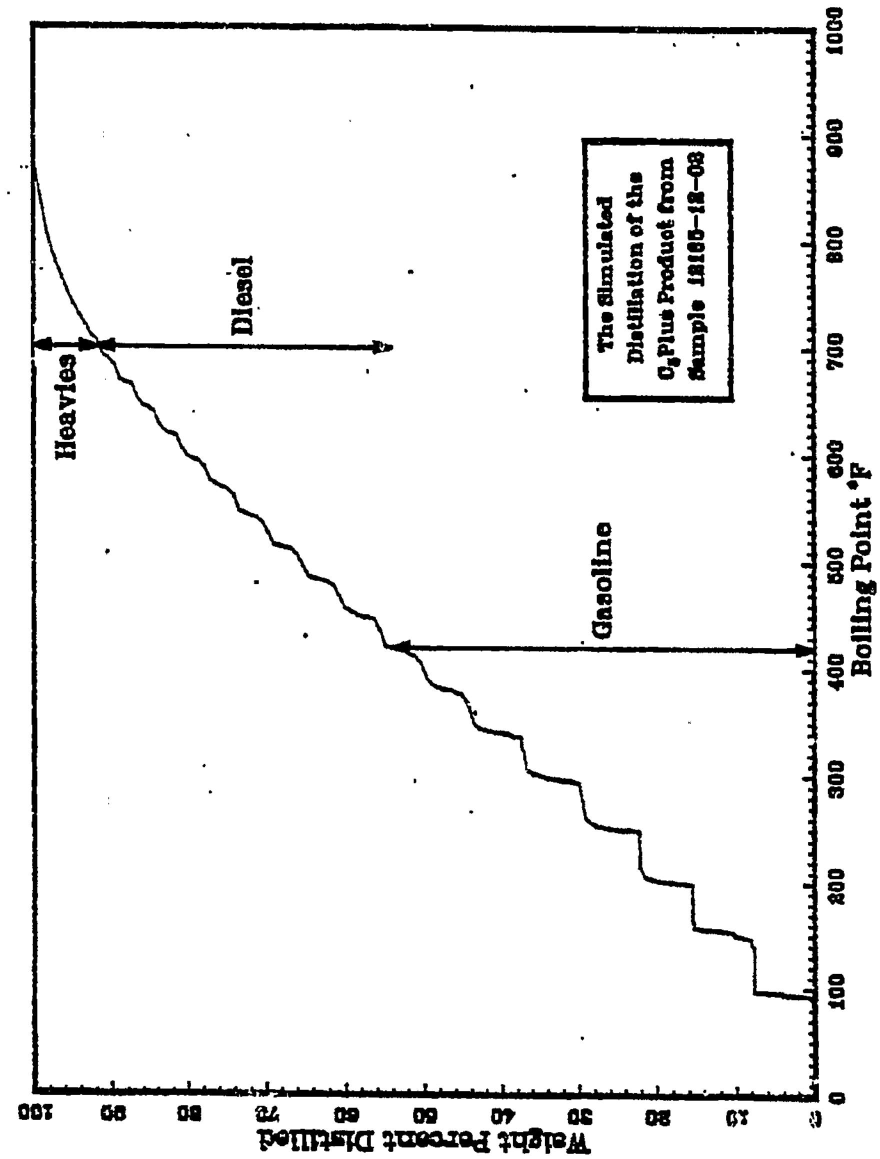

The Simulated
Distillation of the
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B288

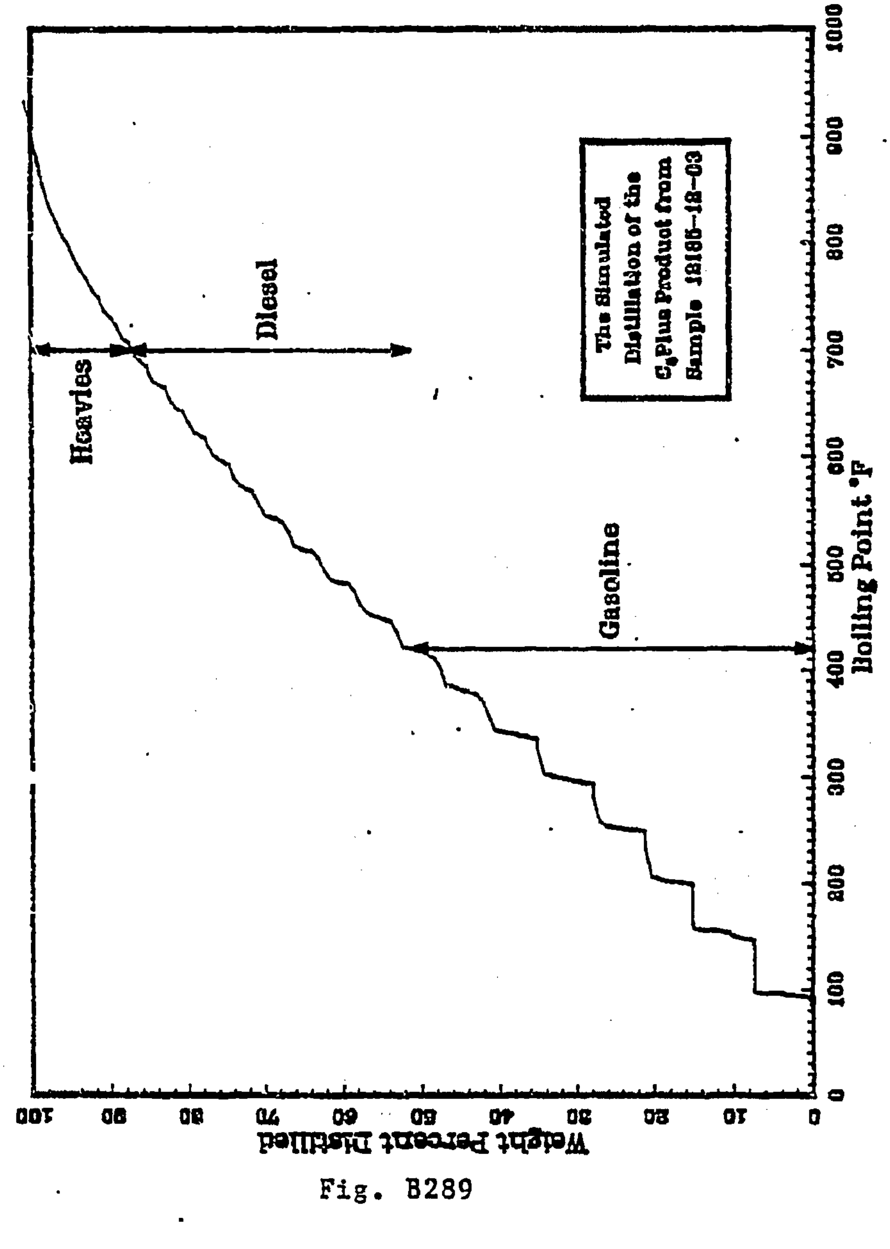

The Simulated
Distillation of the
C_6 Plus Product from
Sample 12186-12-03
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B289

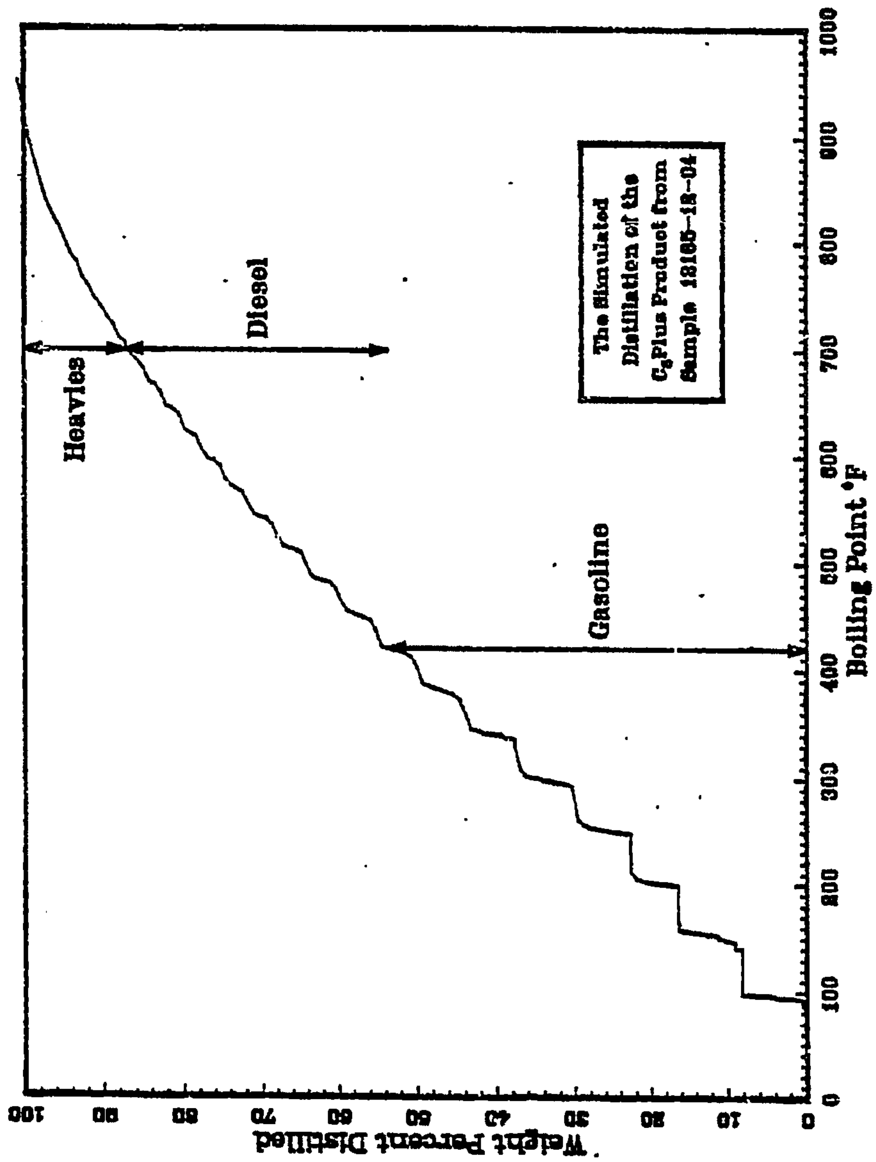

Heavies
Diesel
Gasoline
The Simulated
Distillation of the
Boiling Point °F
Weight Percent Distilled

Fig. B290

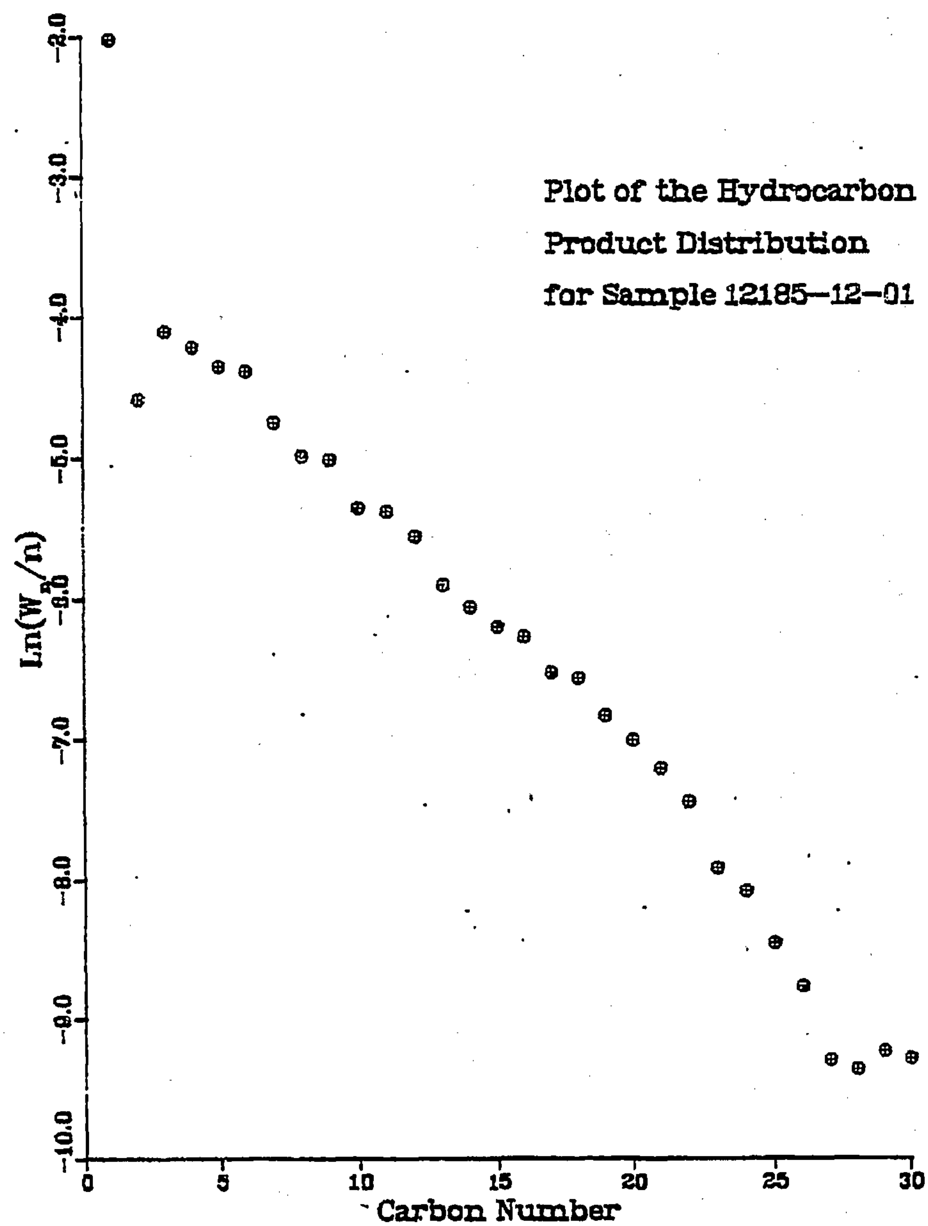

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-12-01
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B291

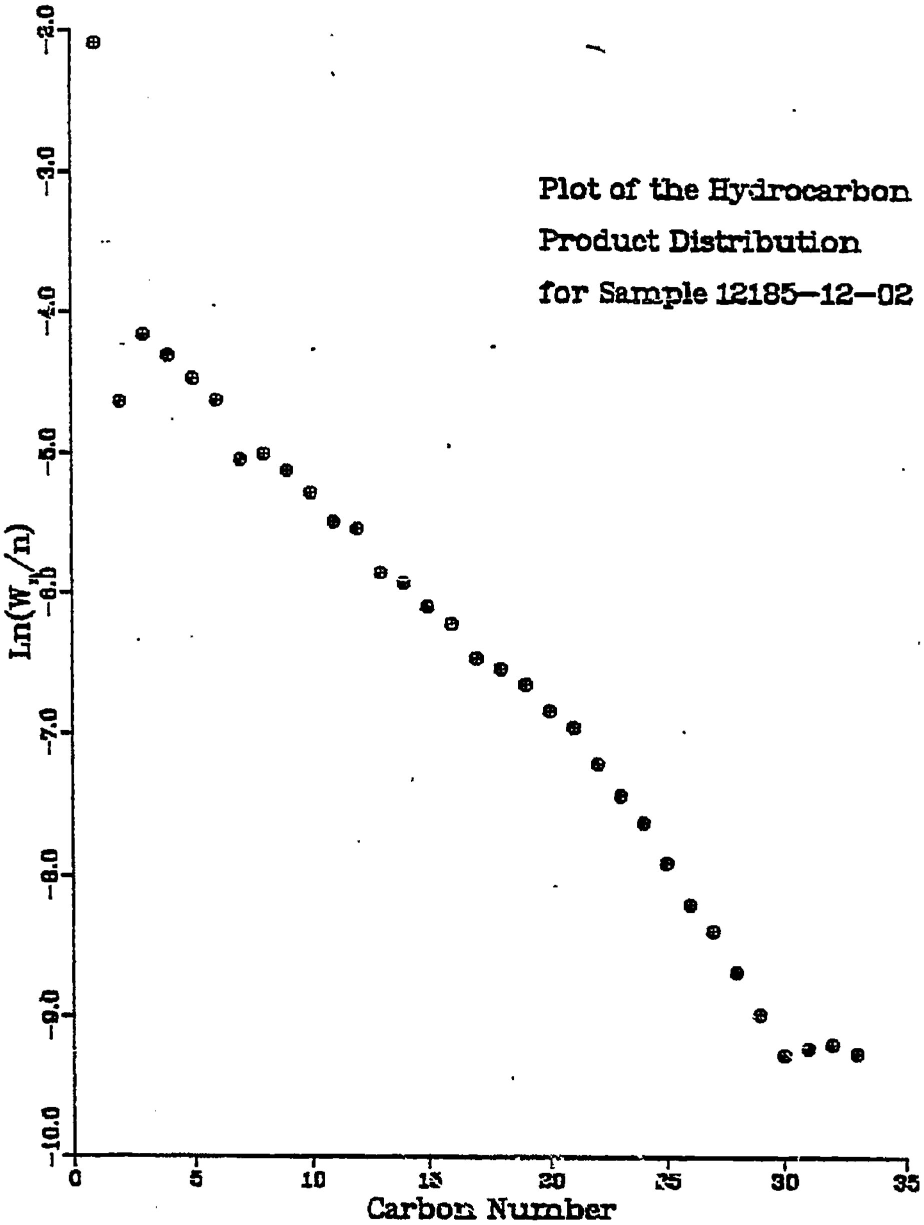

Plot of the Hydrocarbon
Product Distribution
for Sample 12185—12—02
Ln(W_n/n)
Carbon Number

Fig. B292