Table A17

RESULT OF SYNGAS OPERATION

RUN NO. 11723-18
CATALYST Co/Th/K/X4-U103+U101 11864-39 80 CC 40.63G(51.1 @END +10.5G)
FEED H2:CO:ARGON OF 50:50:0 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	11723-18-01	723-18-03	723-18-05	723-18-07	723-18-09
FEED H2:CO:AR	52:47: 0	52:47: 0	52:47: 0	52:47: 0	52:47: 0
HRS ON STREAM	17.5	42.0	65.5	89.4	113.2
PRESSURE,PSIG	306	302	301	302	307
TEMP. C	269	272	272	271	264
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	17.50	24.42	23.67	23.92	24.00
EFFLNT GAS LITER	98.35	212.17	203.30	211.53	236.60
GM AQUEOUS LAYER	51.52	77.55	75.64	76.20	74.18
GM OIL	26.97	41.25	40.48	38.06	36.05
MATERIAL BALANCE					
GM ATOM CARBON %	71.91	100.70	98.55	97.36	93.81
GM ATOM HYDROGEN %	77.68	97.46	96.57	95.00	95.60
GM ATOM OXYGEN %	81.13	106.07	102.60	103.20	100.07
RATIO CHX/(H2O+CO2)	0.8000	0.8990	0.9199	0.8828	0.8598
RATIO X IN CHX	2.3344	2.3928	2.3805	2.3990	2.3615
USAGE H2/CO PRODT	1.6710	1.5541	1.6375	1.6846	1.8616
FEED H2/CO FRM EFFLNT	1.1939	1.0697	1.0831	1.0784	1.1263
RESIDUAL H2/CO RATIO	0.2853	0.2970	0.2984	0.3065	0.4513
RATIO CO2/(H2O+CO2)	0.2235	0.2656	0.2231	0.2130	0.1449
K SHIFT IN EFFLNT	0.0821	0.1074	0.0857	0.0829	0.0765
SPECIFIC ACTIVITY SA	4.9498	3.5517	3.1950	2.8685	1.7908
CONVERSION					
ON CO %	65.57	61.47	58.60	56.01	47.87
ON H2 %	91.77	89.30	88.60	87.50	79.11
ON CO+H2 %	79.83	75.86	74.20	72.35	64.42
PRDT SELECTIVITY,WT %					
CH4	11.53	15.08	14.46	15.52	13.38
C2 HC'S	1.54	1.94	1.83	1.96	1.69
C3H8	1.96	2.22	2.16	2.06	1.95
C3H6=	2.25	2.23	2.69	2.23	1.88
C4H10	1.70	1.81	1.75	1.68	1.61
C4H8=	3.06	3.67	3.67	3.57	2.89
C5H12	1.79	1.79	1.64	1.63	1.64
C5H10=	2.87	4.58	4.26	3.84	3.18
C6H14	2.35	2.23	1.92	1.99	1.95
C6H12= & CYCLO'S	2.02	2.65	2.49	2.70	2.30
C7+ IN GAS	6.86	9.54	8.69	9.32	9.64
LIQ HC'S	62.06	52.26	54.44	53.50	57.90
TOTAL	100.00	100.00	100.00	100.00	100.00

Table A17 (continued)

SUB-GROUPING					
C1 -C4	22.05	26.96	26.57	27.03	23.39
C5 -420 F	48.32	45.70	45.94	45.86	43.84
420-700 F	26.95	24.57	23.95	22.83	27.14
700-END PT	2.69	2.77	3.54	4.28	5.63
C5+-END PT	77.95	73.04	73.43	72.97	76.61
ISO/NORMAL MOLE RATIO					
C4	0.1362	0.0686	0.0555	0.0532	0.0427
C5	0.1140	0.0836	0.0857	0.0685	0.0517
C6	0.7228	0.3370	0.2696	0.2346	0.1680
C4=	0.0607	0.3746	0.0647	0.0540	0.0461
PARAFFIN/OLEFIN RATIO					
C3	0.8316	0.9532	0.7648	0.8836	0.9911
C4	0.5377	0.4749	0.4592	0.4550	0.5375
C5	0.6067	0.3805	0.3743	0.4135	0.5023
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8023	0.8097	0.8167	0.8205	0.8332
RATIO CH4/(1-A)**2	2.9494	4.1646	4.3040	4.8192	4.8064
ALPHA FRM CORRELATION	0.8714	0.8693	0.8691	0.8678	0.8493
ALPHA (EXPTL/CORR)	0.9207	0.9314	0.9397	0.9456	0.9810
W%CH4 FRM CORRELATION	9.5681	10.8304	10.8997	11.1974	15.3879
W%CH4 (EXPTL/CORR)	1.2050	1.3928	1.3270	1.3861	0.8695
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLDY OIL	CLR OIL	CLDY&SLD	CLDY&SLD	CLDY&SLD
DENSITY	0.755	0.752	0.756	0.756	0.760
N, REFRACTIVE INDEX	1.4260	1.4270	1.4273	1.4275	1.4290
SIMULT'D DISTILATN					
10 WT % @ DEG F	251	251	251	252	284
16	284	291	289	291	306
50	414	432	422	422	450
84	581	611	614	615	639
90	627	655	664	675	697
RANGE(16-84 %)	297	320	325	324	333
WT % @ 420 F	52.25	47.67	49.50	49.33	43.40
WT % @ 700 F	95.67	94.69	93.50	92.00	90.27

NEW FORMAT JAN 25,85

Table A18

RESULT OF SYNGAS OPERATION

RUN NO. 11723-18
CATALYST Co/Th/K/X4-U103+U101 11864-39 80 CC 40.63G(51.1 BEND +10.5G)
FEED H2:CO:ARGON OF 50:50:0 @ 400 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	11723-18-11	723-18-13	723-18-15	723-18-17	723-18-19
FEED H2:CO:AR	52:47: 0	52:47: 0	52:47: 0	52:47: 0	52:47: 0
HRS ON STREAM	137.4	161.4	185.4	210.4	232.9
PRESSURE,PSIG	301	300	307	303	301
TEMP. C	261	261	261	262	260
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	24.00	24.00	24.00	25.00	22.50
EFFLNT GAS LITER	291.05	315.30	321.35	337.65	309.00
GM AQUEOUS LAYER	60.37	55.01	53.81	54.45	48.75
GM OIL	29.69	25.21	23.44	23.80	19.87
MATERIAL BALANCE					
GM ATOM CARBON %	96.59	99.56	99.28	99.68	98.87
GM ATOM HYDROGEN %	96.85	96.46	96.15	96.82	96.09
GM ATOM OXYGEN %	99.56	101.77	102.23	100.93	101.54
RATIO CHX/(H2O+CO2)	0.9197	0.9359	0.9136	0.9619	0.9182
RATIO X IN CHX	2.4153	2.4540	2.4676	2.4732	2.4927
USAGE H2/CO PRODT	1.8593	1.8383	1.8374	1.8340	1.8848
FEED H2/CO FRM EFFLNT	1.1082	1.0708	1.0705	1.0735	1.0742
RESIDUAL H2/CO RATIO	0.5956	0.6070	0.6224	0.6311	0.6375
RATIO CO2/(H2O+CO2)	0.1401	0.1508	0.1581	0.1501	0.1434
K SHIFT IN EFFLNT	0.0971	0.1078	0.1169	0.1115	0.1068
SPECIFIC ACTIVITY SA	1.1259	0.9978	0.9106	0.8578	0.8848
CONVERSION					
ON CO %	40.56	37.67	36.88	36.78	35.01
ON H2 %	68.05	64.67	63.30	62.84	61.43
ON CO+H2 %	55.01	51.63	50.54	50.27	48.69
PRDT SELECTIVITY,WT %					
CH4	15.87	17.95	18.61	18.82	19.85
C2 HC'S	2.09	2.14	2.45	2.76	2.45
C3H8	2.41	2.78	2.90	3.23	3.11
C3H6=	1.86	2.21	2.10	2.32	2.24
C4H10	1.96	2.31	2.34	2.45	2.54
C4H8=	2.94	3.45	3.17	3.04	3.21
C5H12	2.33	2.70	2.73	2.95	2.98
C5H10=	2.97	3.21	2.90	2.84	2.85
C6H14	2.31	2.55	2.96	3.08	3.10
C6H12= & CYCLO'S	2.02	2.27	2.55	2.39	2.50
C7+ IN GAS	9.55	10.57	11.28	12.01	11.87
LIQ HC'S	53.70	47.86	46.01	44.12	43.30
TOTAL	100.00	100.00	100.00	100.00	100.00

Table A18 (continued)

SUB-GROUPING					
C1 -C4	27.12	30.85	31.57	32.62	33.40
C5 -420 F	41.30	40.68	41.17	41.50	41.20
420-700 F	25.96	22.73	21.66	20.48	20.03
700-END PT	5.61	5.74	5.60	5.40	5.38
C5+-END PT	72.88	69.15	68.43	67.38	66.60
ISO/NORMAL MOLE RATIO					
C4	0.0430	0.0323	0.0349	0.0597	0.0369
C5	0.0795	0.0780	0.0796	0.0799	0.0804
C6	0.1436	0.1686	0.3026	0.3626	0.3098
C4=	0.0512	0.0587	0.0530	0.0585	0.0595
PARAFFIN/OLEFIN RATIO					
C3	1.2377	1.2028	1.3192	1.3279	1.3262
C4	0.6458	0.6450	0.7121	0.7779	0.7619
C5	0.7615	0.8173	0.9155	1.0083	1.0170
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8336	0.8304	0.8280	0.8250	0.8243
RATIO CH4/(1-A)**2	5.7274	6.2420	6.2903	6.1476	6.4288
ALPHA FRM CORRELATION	0.8360	0.8351	0.8338	0.8331	0.8327
ALPHA (EXPTL/CORR)	0.9971	0.9944	0.9930	0.9903	0.9899
W%CH4 FRM CORRELATION	18.9063	19.1914	19.5720	20.0060	19.7063
W%CH4 (EXPTL/CORR)	0.8393	0.9355	0.9506	0.9409	1.0074
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLDY/SLD	CLDY/SLD	CLDY/SLD	CLDY/SLD	CLDY/SLD
DENSITY	0.759	0.762	0.761	0.758	0.759
N, REFRACTIVE INDEX	1.4289	1.4290	1.4284	1.4286	1.4283
SIMULT'D DISTILATN					
10 WT % @ DEG F	292	294	295	294	294
16	316	323	324	323	322
50	464	470	466	459	457
84	652	666	666	665	666
90	705	719	722	723	725
RANGE(16-84 %)	336	343	342	342	344
WT % @ 420 F	41.20	40.50	40.75	41.33	41.33
WT % @ 700 F	89.55	88.00	87.82	87.75	87.58

NEW FORMAT JAN 25,85

VIII. Run 7 (11885-02) with Catalyst 7 (Co/Th/X_4/X_8/UCC-103+UCC-101

This catalyst is similar to Catalyst 4, with the same components but in different concentrations. It contained about 7 percent cobalt, 15 percent as much thorium as cobalt, 15 percent as much X_4 as cobalt, and 2 percent as much X_8 as cobalt. The X_4 was obtained from the same source as for Catalyst 4. The major differences from Catalyst 4 are the higher concentrations of X_4 and X_8.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. A145-148. Simulated distillations of the C_5^+ product are plotted in Figs. A149-152. Carbon number product distributions are plotted in Figs. A153-179. Chromatograms from simulated distillations are reproduced in Figs. A180-183. Detailed material balances appear in Tables A19-24.

The catalyst was maintained on stream for a very long run of one month, under fairly constant operating conditions, and performed steadily during most of that time.

The initial specific activity was 1.89, only about 70 percent as high as for Catalyst 3 which contained the same level of cobalt. At 200 hours on stream it was down to 1.09, and at 660 hours to 0.83. The deactivation rate was the lowest of any test-

ed this quarter, although not as low as for the catalyst of Run 11677-11. Between 200 and 600 hours on stream the conversion decreased at a rate of one percentage point every 200 hours. Most of the loss was again in conversion of H_2, at one percentage point every 160 hours. Although Catalyst 3 was more active initially, the specific activity at the end of its run, 166 hours, was 1.89; at 181.5 hours the specific activity of this catalyst was 1.97. If this catalyst had deactivated at this same rate, a loss of one percentage point every 200 hours, its loss of conversion, in six months under constant process conditions, would have been 22 percent.

The low material balances prior to Sample 51 are due to a leak in the feed system through the magna-drive system, and therefore do not affect the calculated conversion or selectivity.

During the period of steady conversion the selectivity held steady as well. Production of methane increased at a rate of one percentage point every 200 hours, again due to loss of conversion, and throughout the run remained 80 percent as much as predicted by the model.

The selectivity for C_5^+ was a little less stable. The output was good initially, at about 74 percent of the total product, but decreased by one percentage point every 93 hours. Most of the loss, as usual, was in diesel fuel, which decreased by one percentage point every 150 hours, although in this case both the gasoline and the heavies contributed as well. The motor fuels decreased by one percentage point every 120 hours, with a resul-

tant increase in the percentage of gasoline with time on stream. The product was a little less olefinic than usual, but no more isomerized. Apart from the usual excess of methane, the hydrocarbons followed the Schulz-Flory distribution.

The combination of X_4 and X_8 was much more effective at the levels in this catalyst than it was at lower levels of both in Catalyst 3, or at a lower level of X_8 alone in Catalyst 5. It was not, however, as effective as X_4 alone in the catalyst of Run 11677-11.

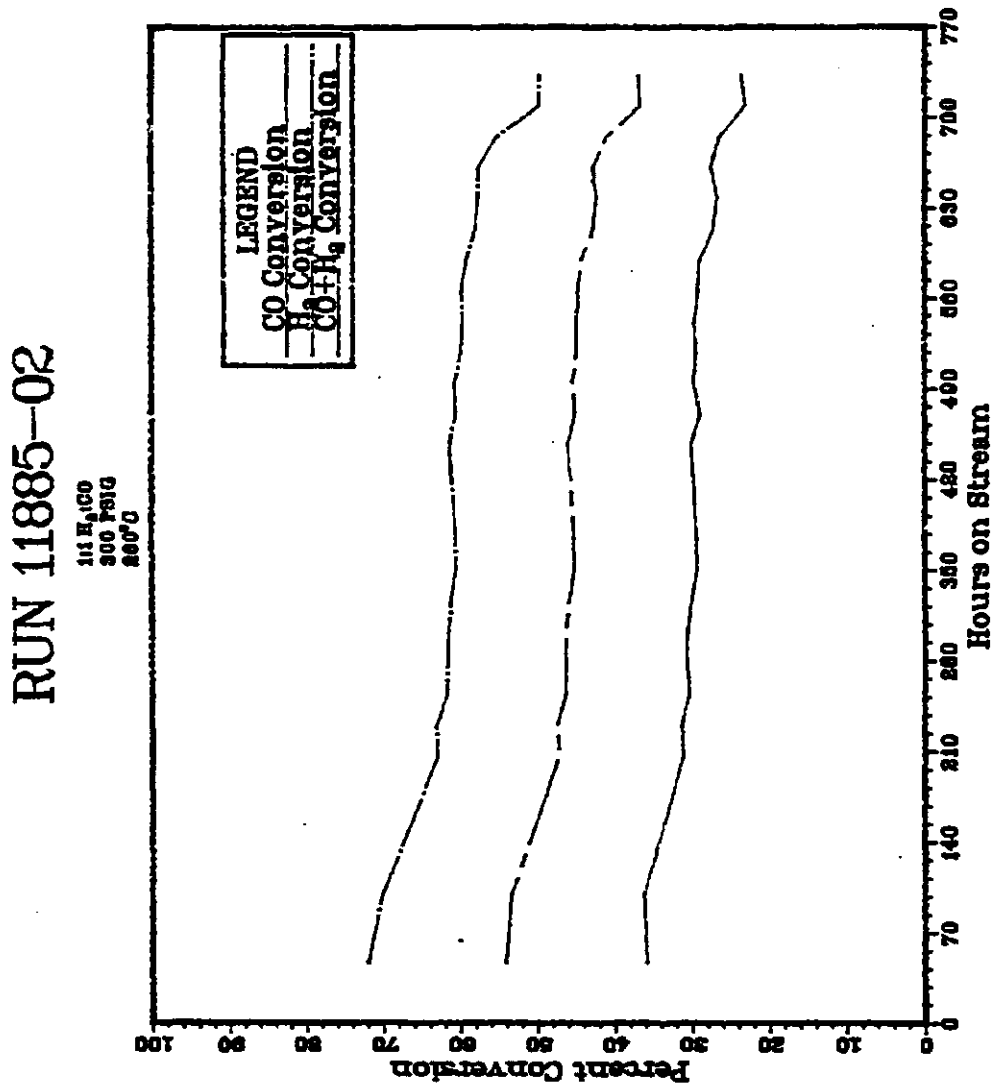
RUN 11885-02
1:1 H2:CO
300 PSIG
280°C
LEGEND
CO Conversion
H2 Conversion
CO+H2 Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
70
140
210
280
350
420
490
560
630
700
770

Fig. A145

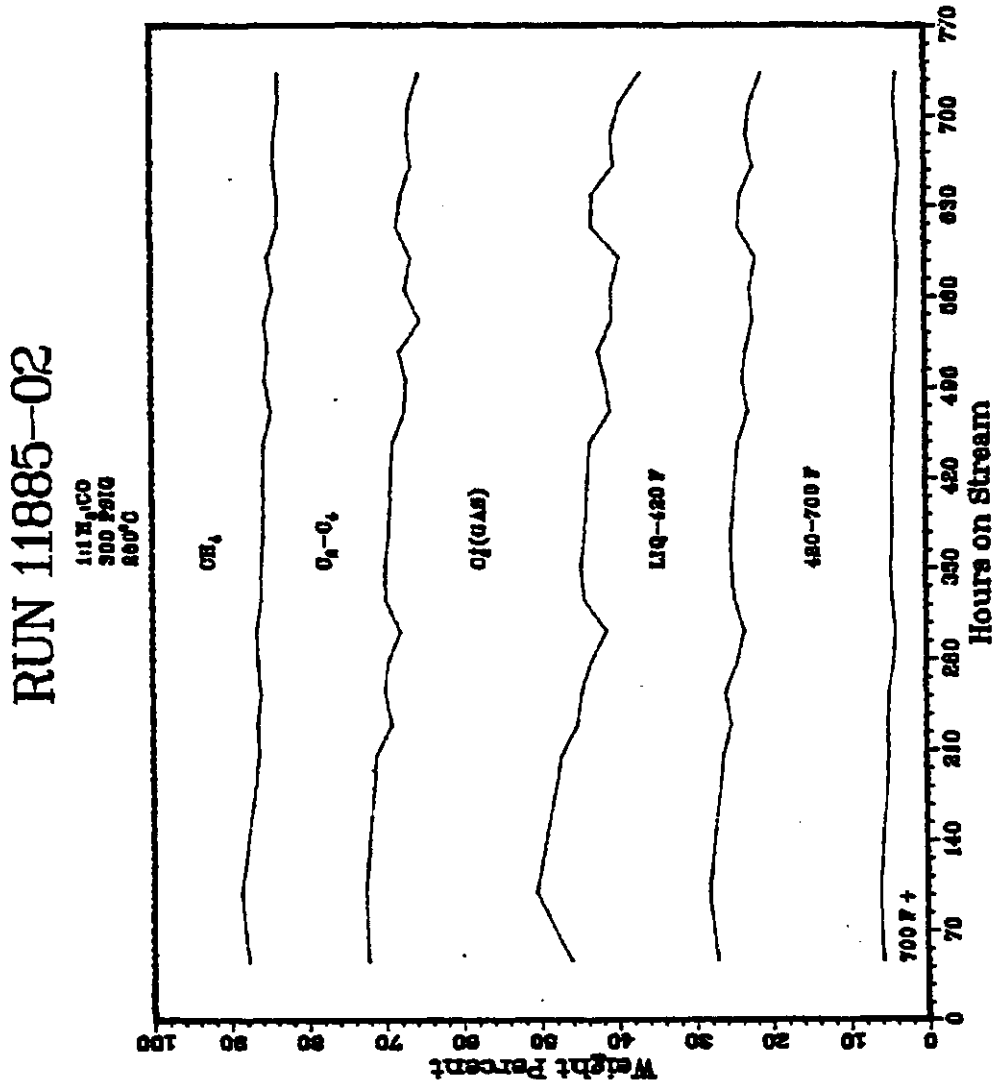
RUN 11885-02
1:1 H2/CO
300 PSIG
260°C
CH4
C2-C4
C5((GAS)
110-420 F
420-700 F
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
70
140
210
280
350
420
490
560
630
700
770

Fig. A146

RUN 11885-02

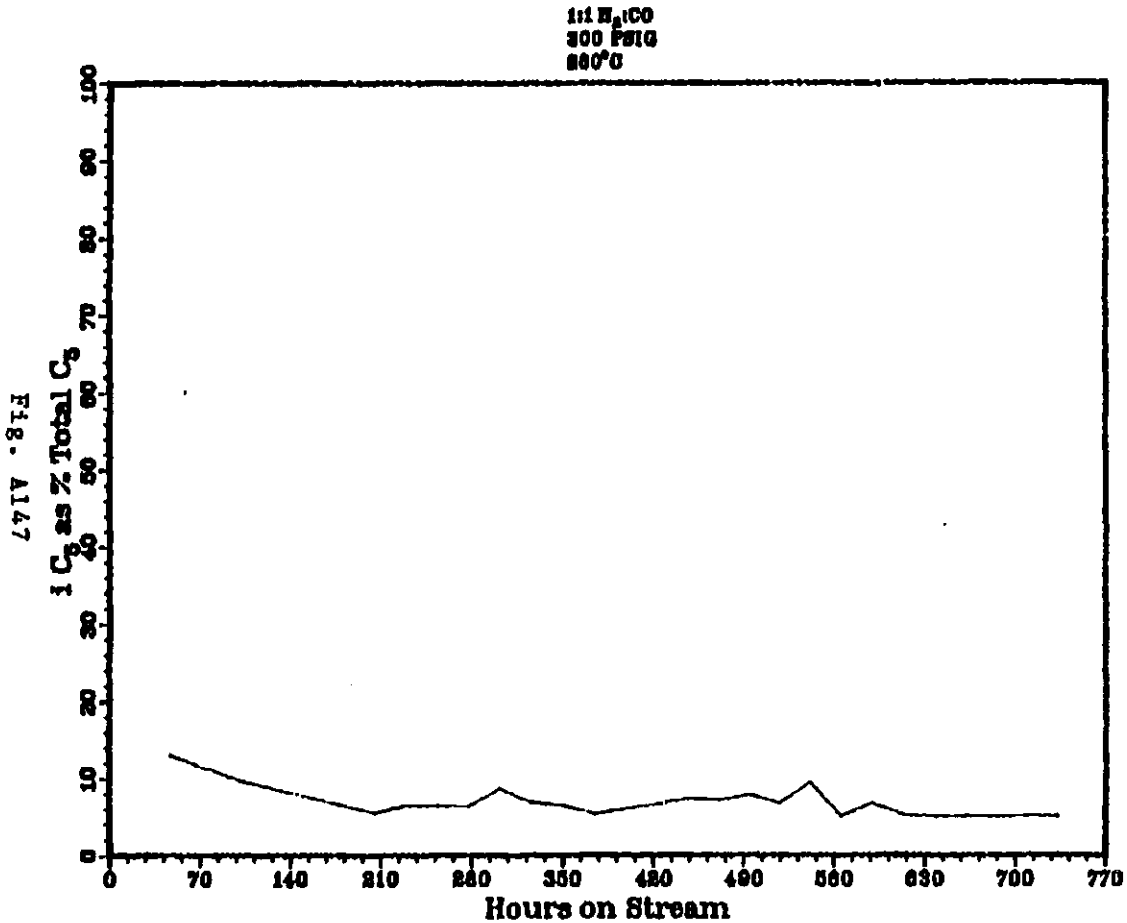

Fig. A147

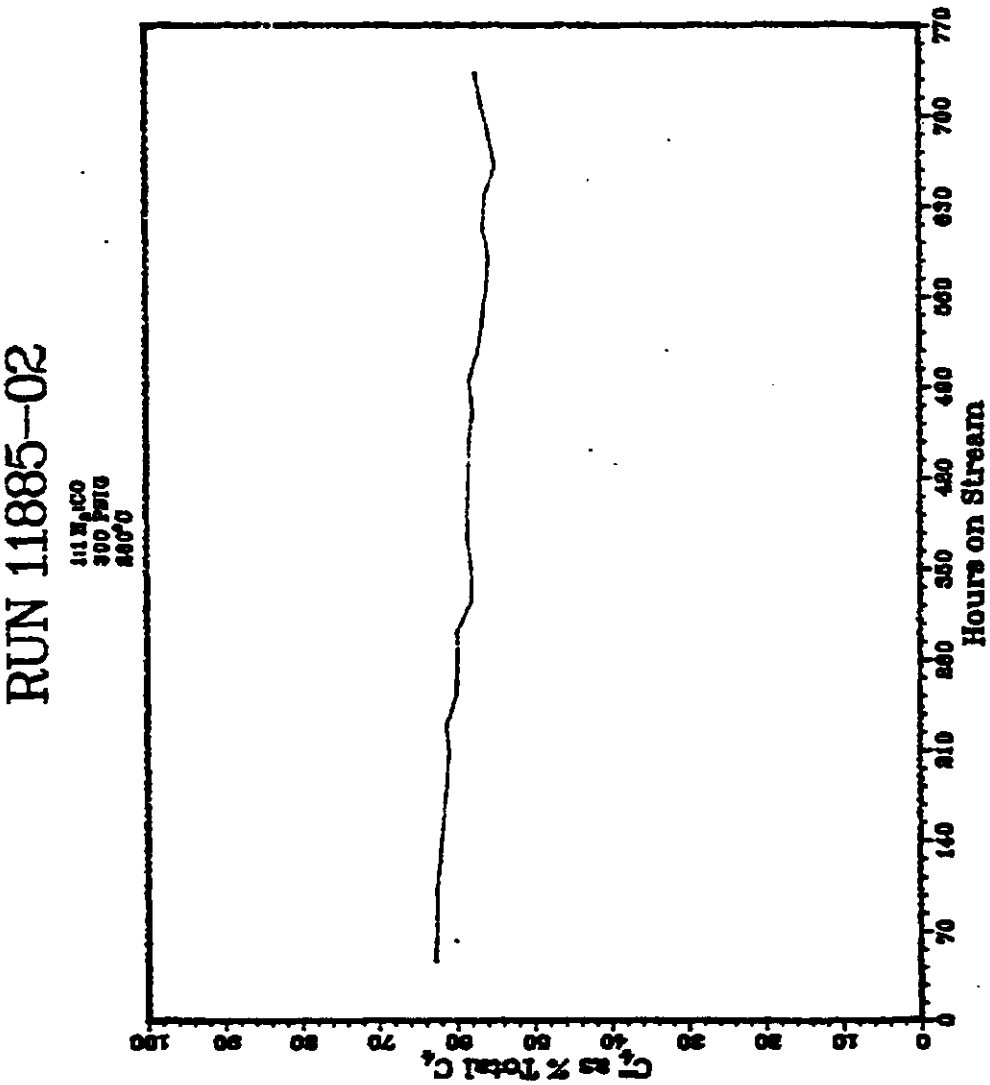
RUN 11885-02
Hours on Stream
0
40
80
120
160
200
240
280
320
360
400
440
480
520
560
600
640
680
720
760
800

Fig. A148

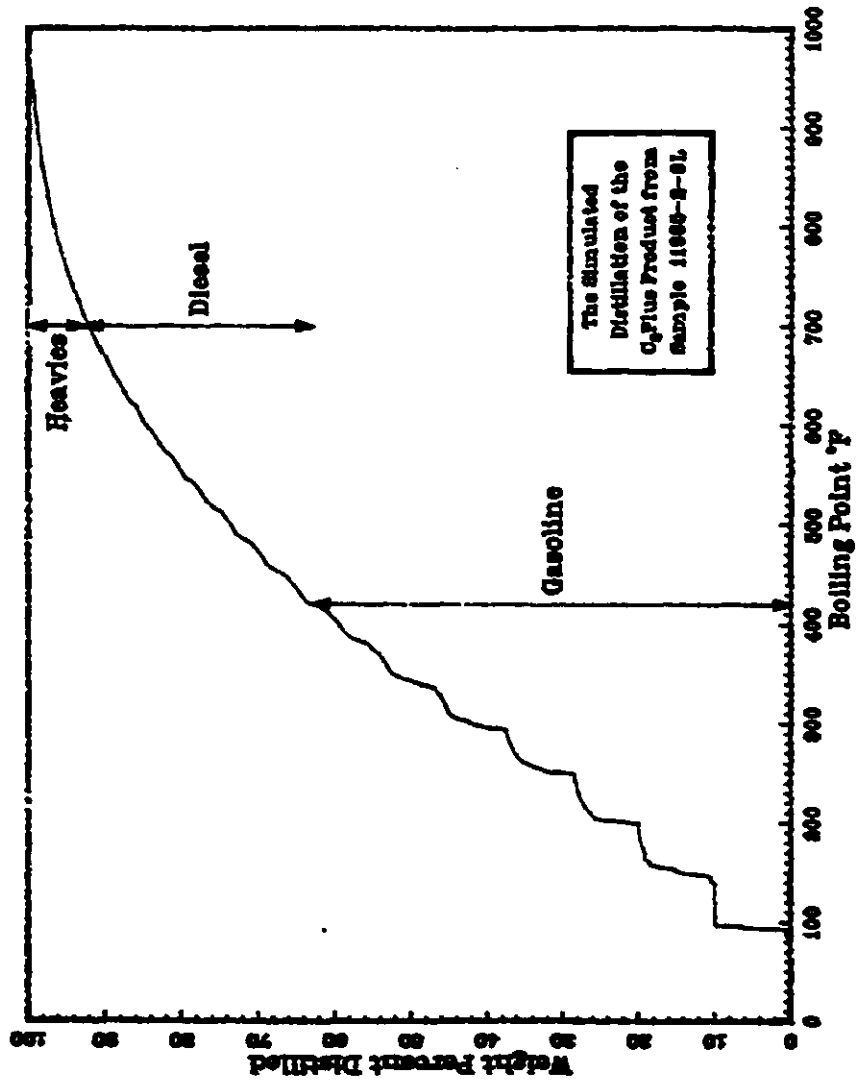
Heavies
Diesel
Gasoline
The Simulated Distillation of the C5Plus Product from Sample 11680-8-81
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
10
20
40
60
70
80
90
100

Fig. A149

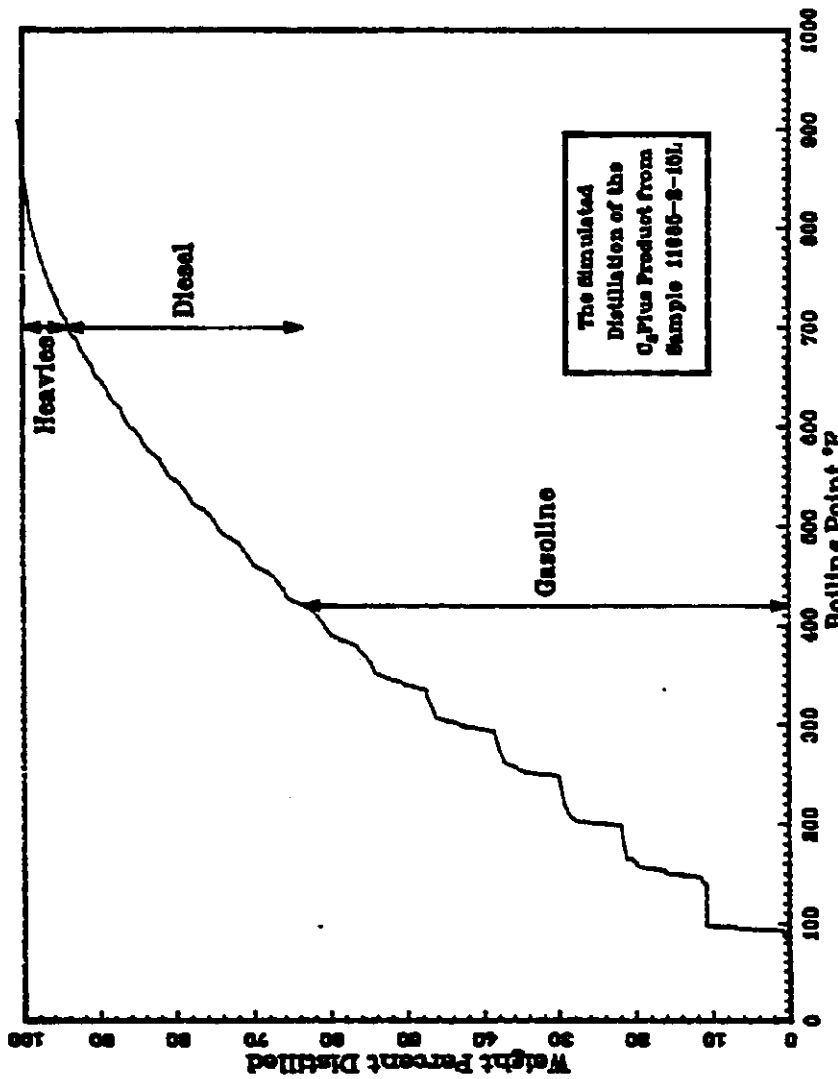
Heavies
Diesel
Gasoline
The Simulated Distillation of the C5 Plus Product from Sample 11885-8-101
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. A150

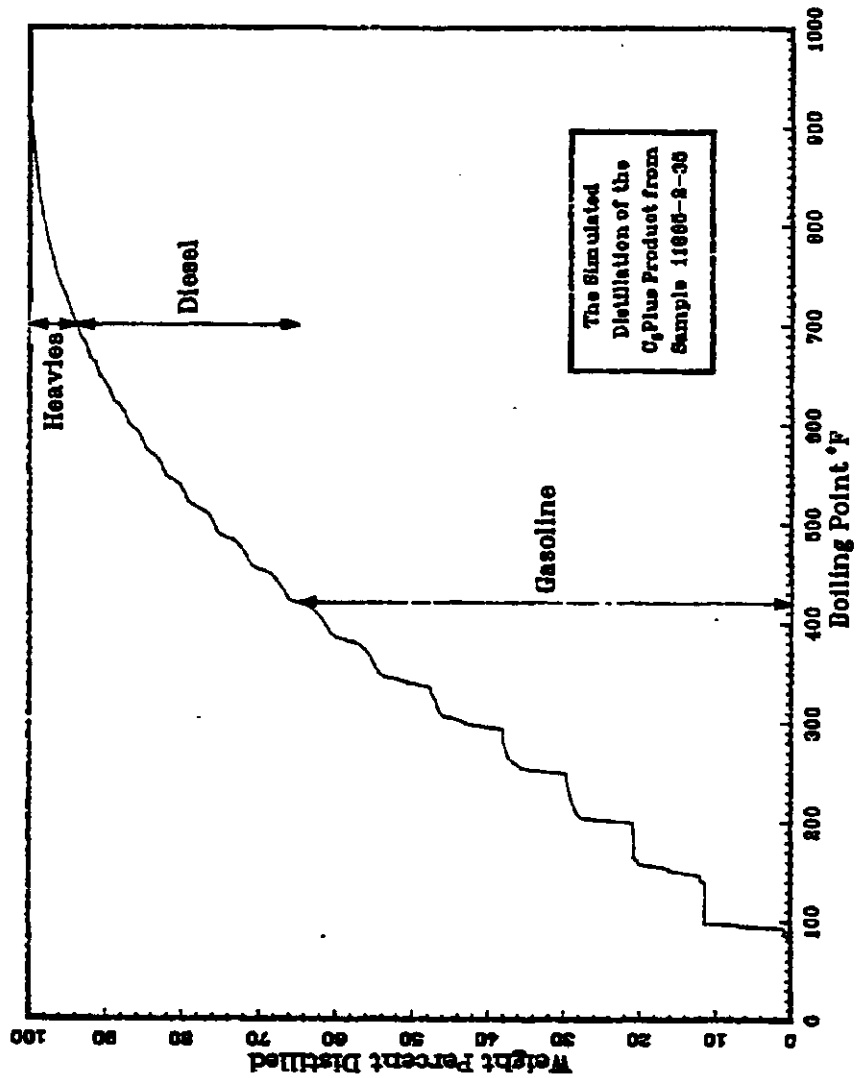
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point °F
0
100
200
300
400
500
600
700
800
900
1000
Gasoline
Diesel
Heavies
The Simulated Distillation of the C5 Plus Product from Sample 11865-8-35

Fig. A151

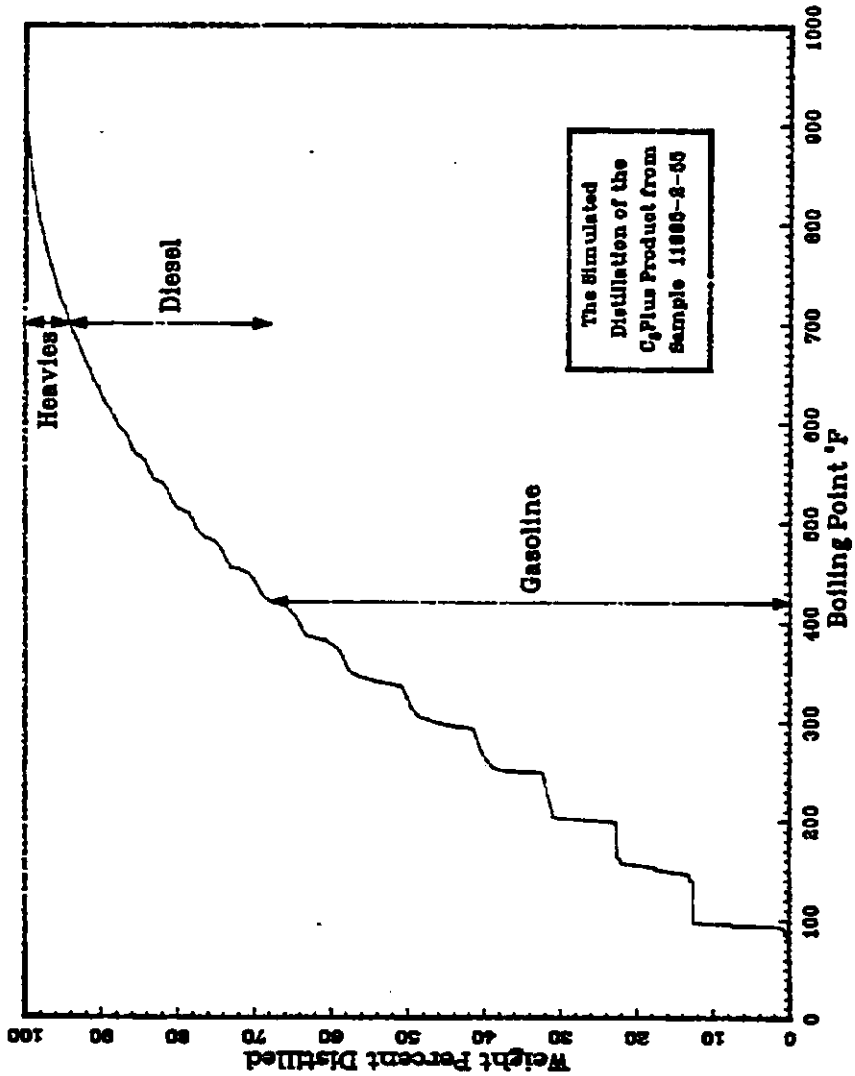
The Simulated Distillation of the C5Plus Product from Sample 11888-2-55
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point 'F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. A152

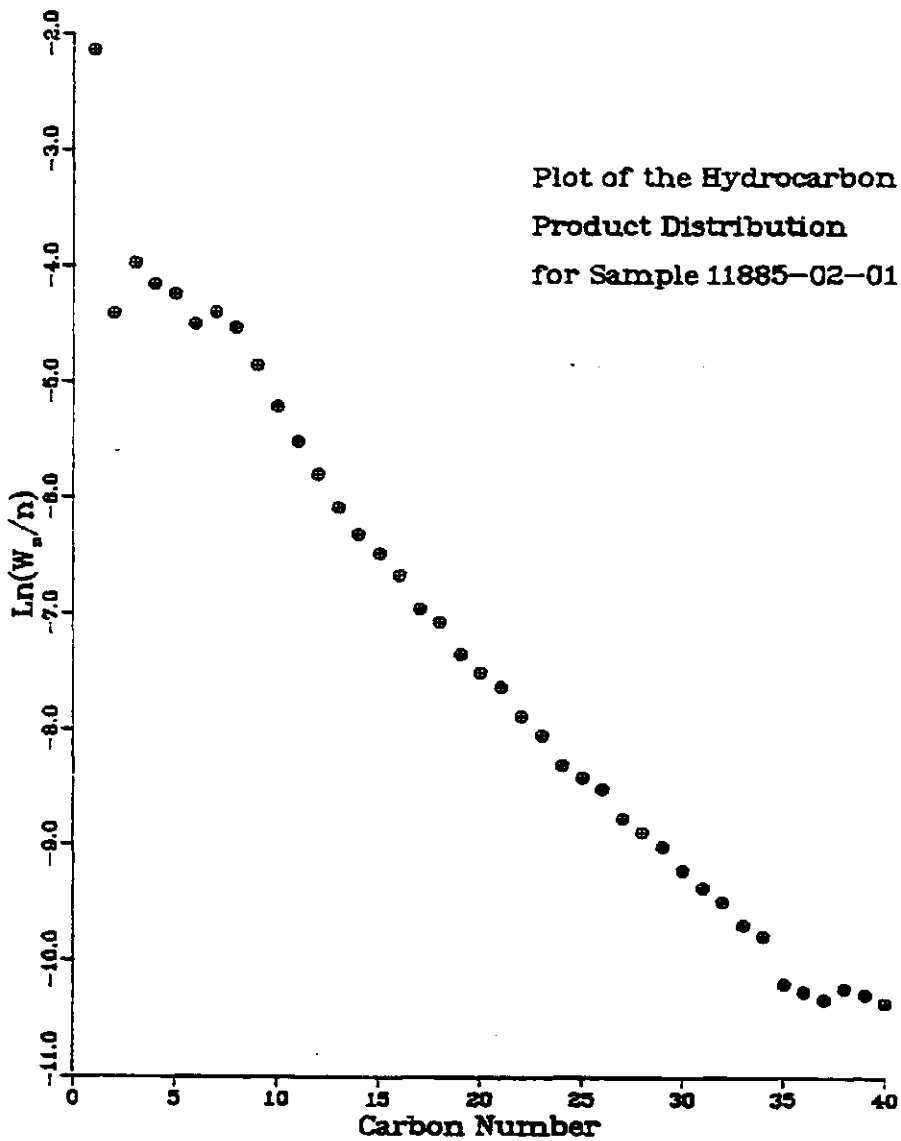
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-01
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A153

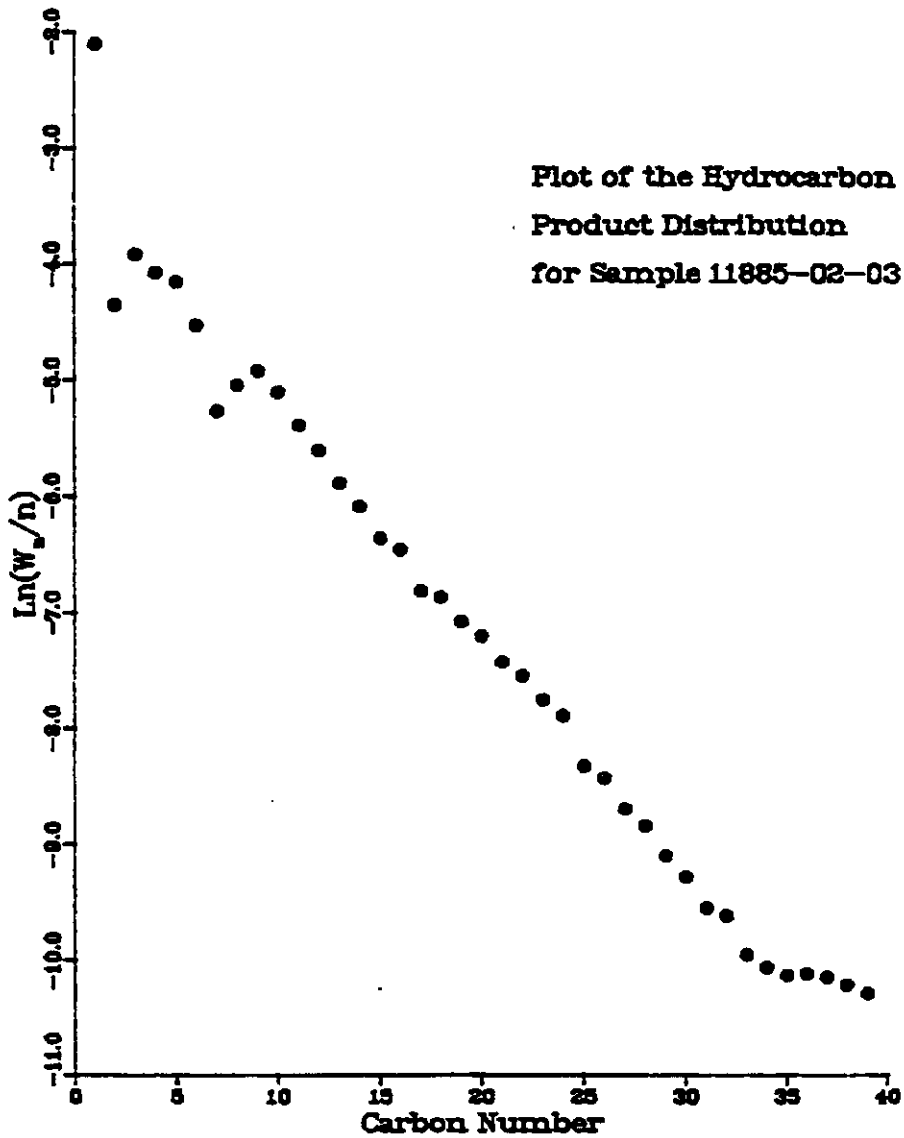
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-03
Ln(Wn/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A154

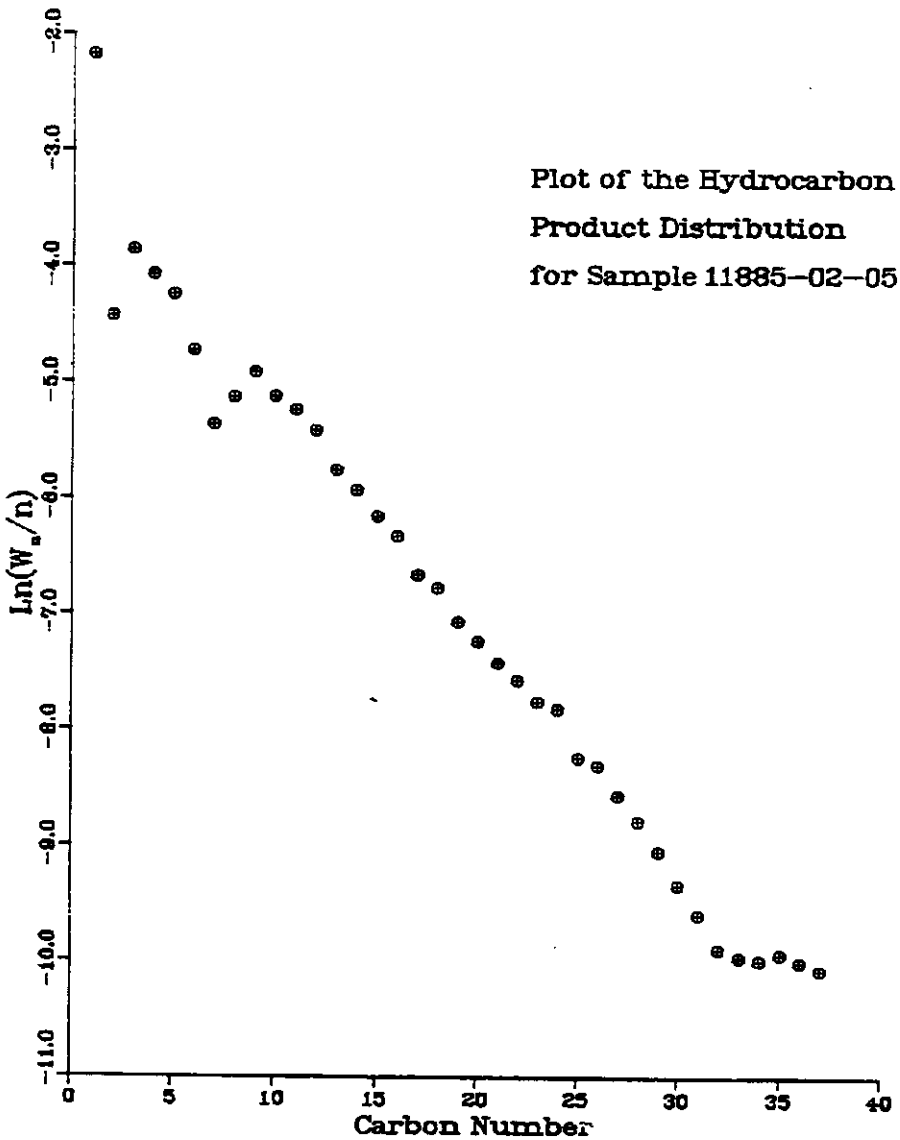
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-05
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A155

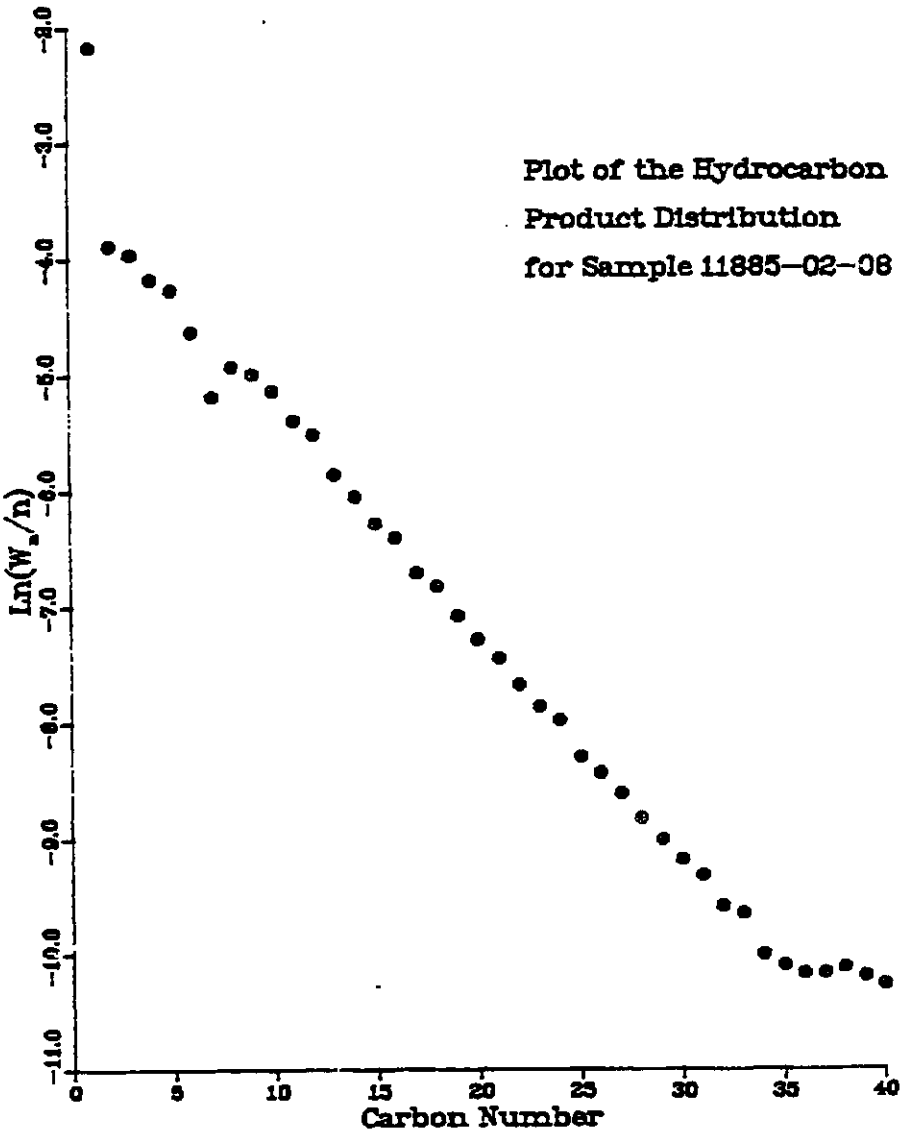
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-08
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A156

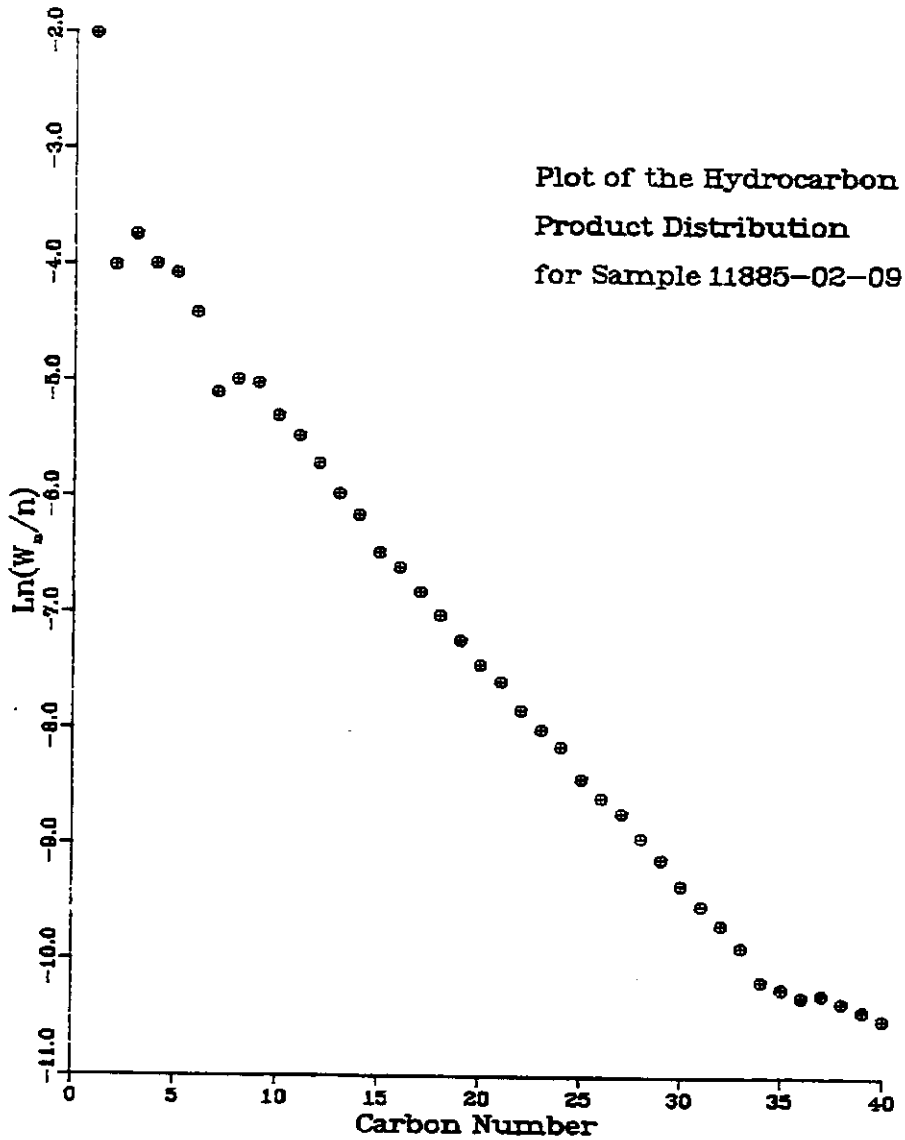
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-09
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A157

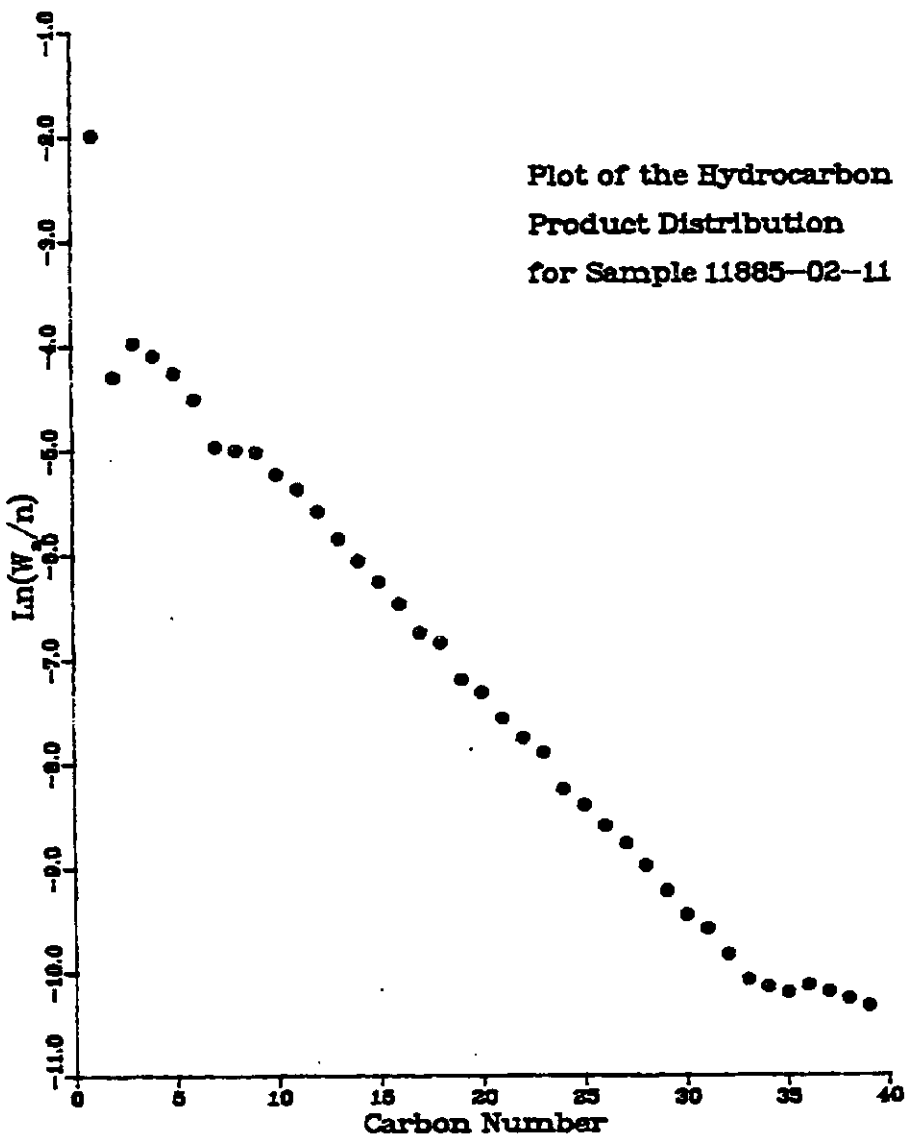
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-11
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A158

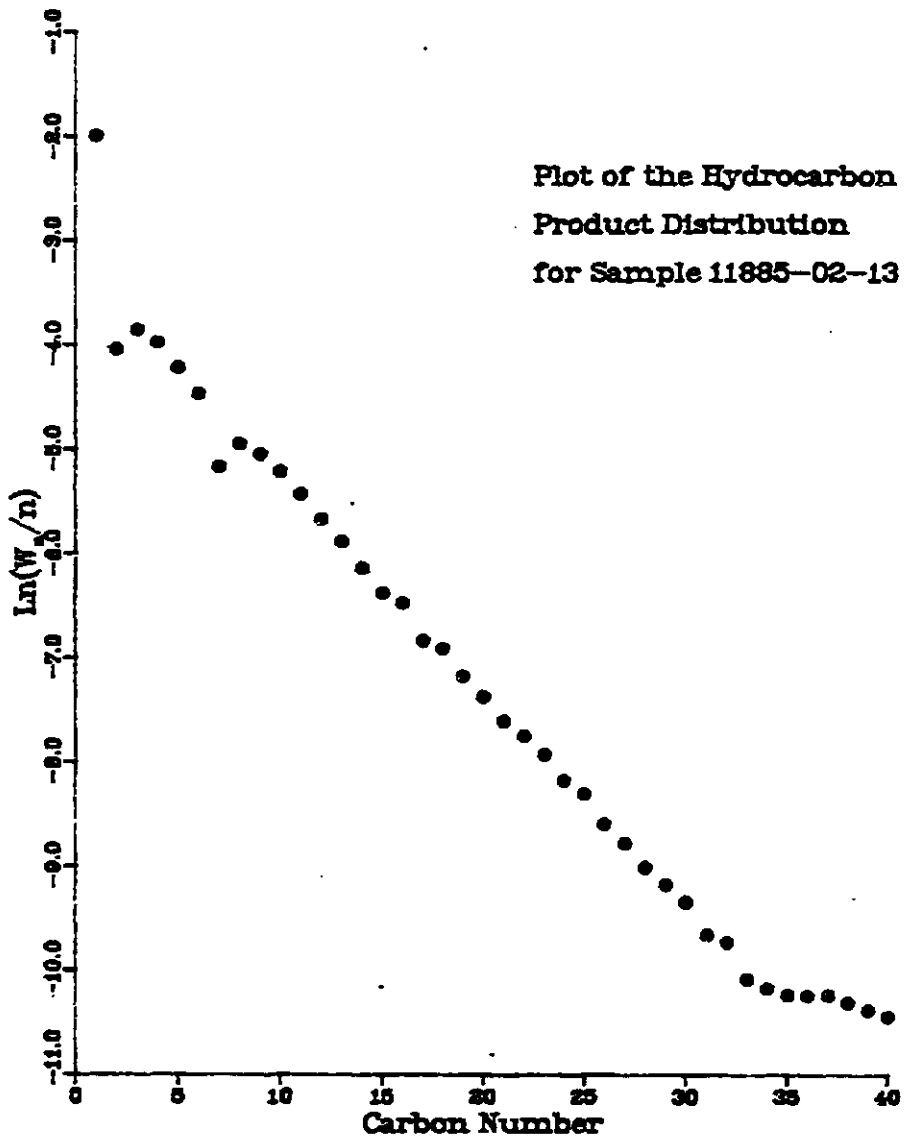
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-13
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A159

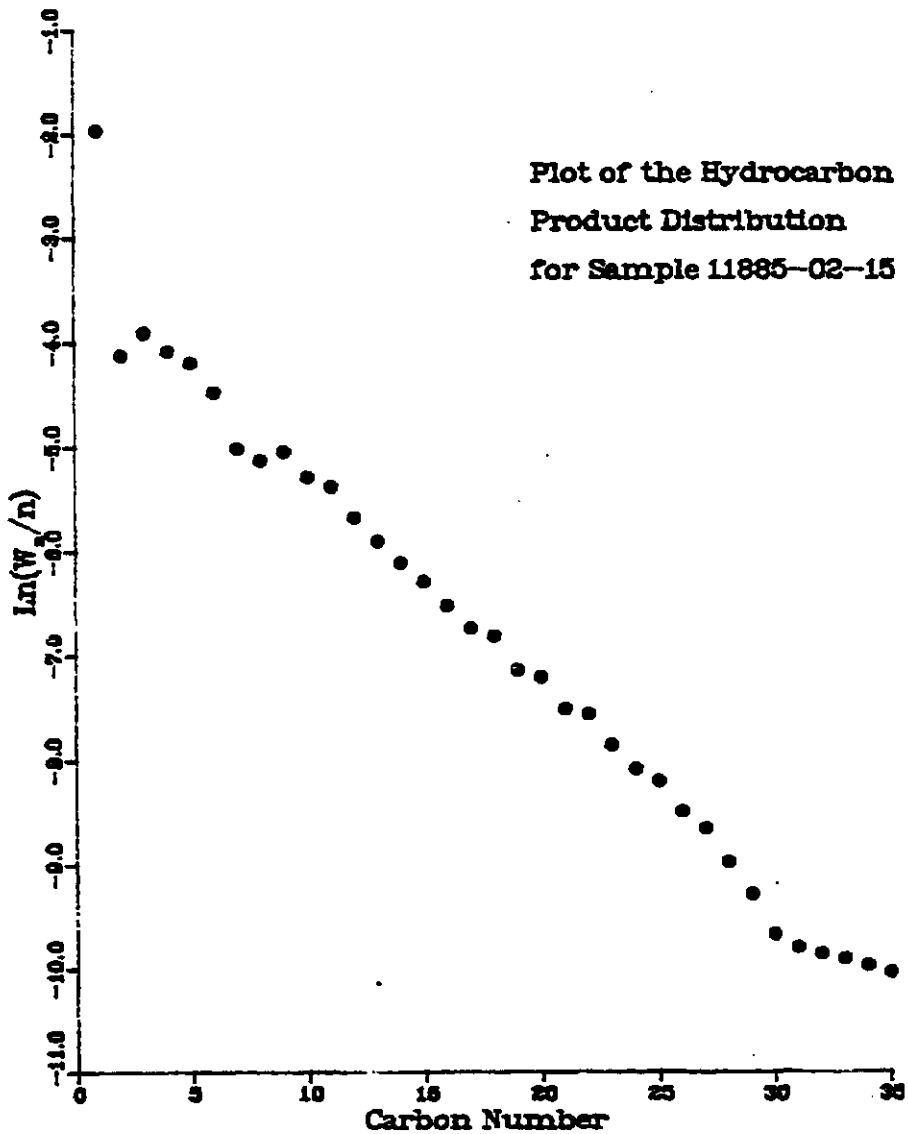
Plot of the Hydrocarbon
Product Distribution
for Sample 11885--02--15
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. A160

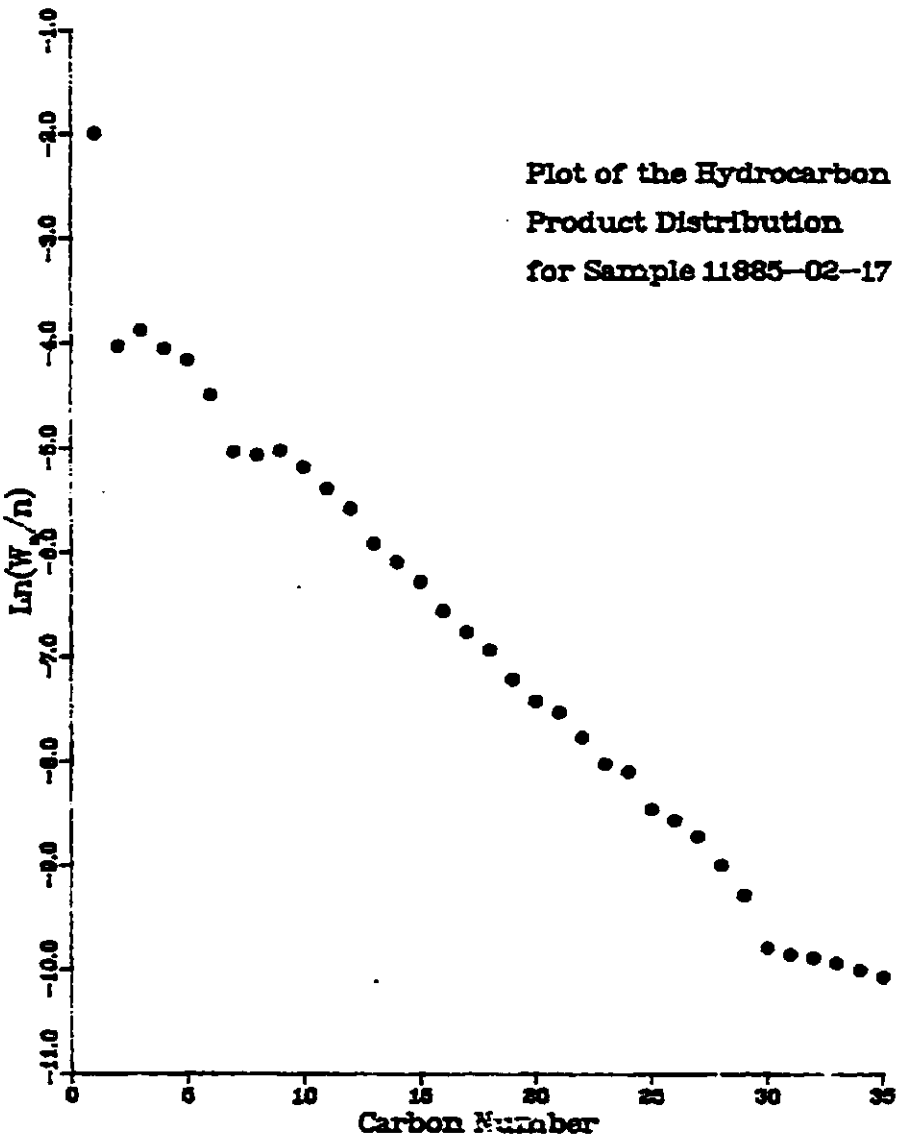
Plot of the Hydrocarbon
Product Distribution
for Sample 11885-02-17
Ln(W_n/n)
-1.0
-4.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. A161

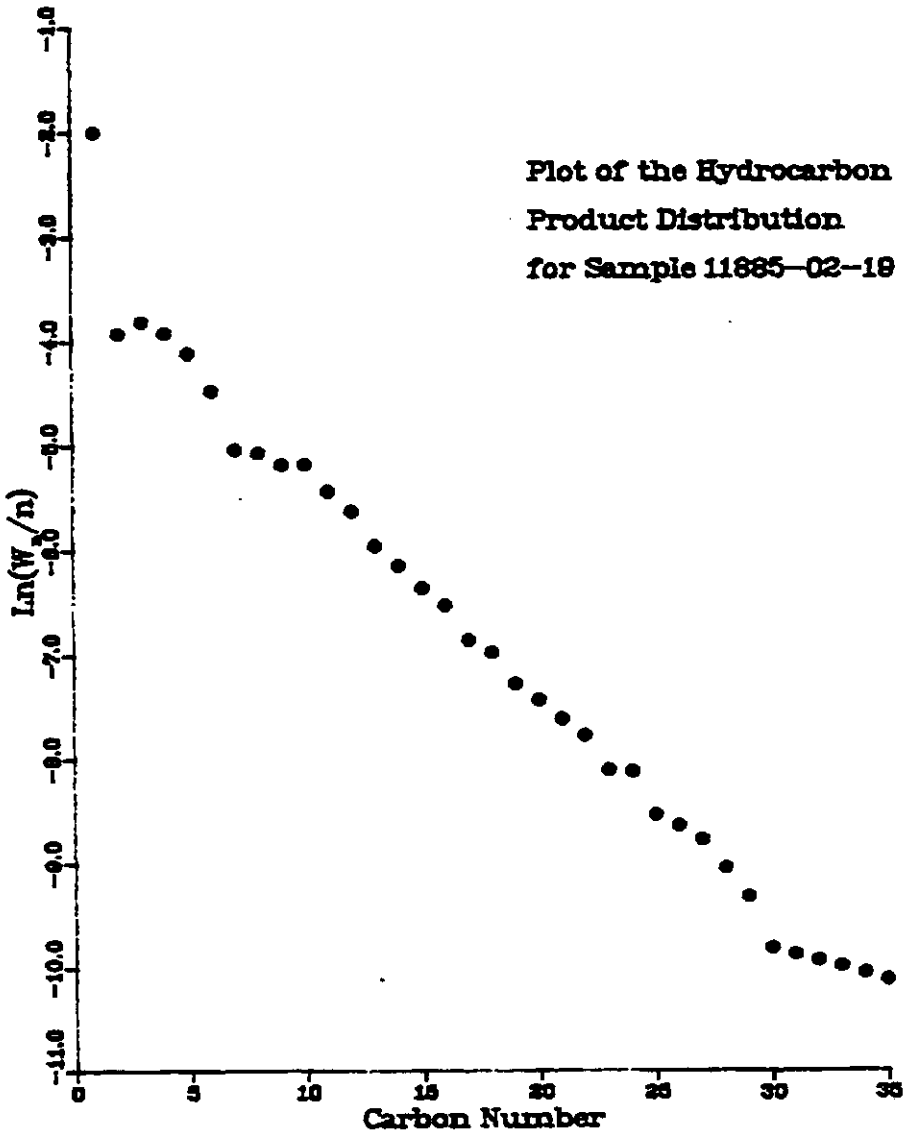
Plot of the Hydrocarbon
Product Distribution
for Sample 11685-02-19
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. A162