

L-176

19 OKT 1977  
**REGISTRERT  
OLJEDIREKTORATET**

BA 77-48-1

**FORTROLIG**  
i h.t. Beskyttelsesinstruksen,  
jfr. offentlighetslovens  
§ ..... nr. ....

725.3

012728 20. OKT 77

OLJEDIREKTORATET

OFFENTLIG  
UNNTATT OFF. 3

SIGN.

CONOCO/STATOIL/NORSK HYDRO/HUDBAY

NORWAY NORTH SEA WELL

24/9-2

FINAL GEOLOGICAL REPORT

GEOLOGIST: T. SULLIVAN  
ENGINEER: C.R. HANSON

## CONTENTS

	<u>Page</u>
<b>A. <u>GEOLOGICAL REPORT</u></b>	
I. Essential well data	1
Well location plat	
II. Well Summary	
IIIi) Objectives and results	2
IIIii) Well history	2
III. Stratigraphy	
IIIii) Table of Lithostratigraphic units	3
IIIiii) Table of Paleontological Divisions	4
IIIiiii) Stratigraphic summary	5-6
IV. Formation Evaluation	
IVi) Hydrocarbon indications	7
IVii) Log interpretation	7-8
<b>B. <u>ENGINEERING REPORT</u></b>	<u>Page</u>
Statistical Summary	2
Well Summary	3
Daily Activity Summary	5
Rig Time Analysis	7
Depth Versus Days Plot	8
Casing, Cementing and Abandonment	9
Schematic	
Anchor Pattern	10
Bit Record	11
Mud Record	12
Pore Pressure Prediction	32

ENCLOSURES - Composite log.

NORTH SEA NORWAY

24/9-2

I. Essential Well Data

Location: 59° 16' 12.43"N  
01° 55' 12.26"E

Classification: Wildcat

Objective: To test Danian and lower Paleocene Sands

Drilling Period:  
Spudded: 13 June 1977  
Completed: 22 July 1977

D.F. Elevation: 25.3 M (AMSL)

Water Depth: 117.7 M (MSL)

Rig: Borgny Dolphin

Total Depth: 2743.2 M

Pay Zones Encountered: None

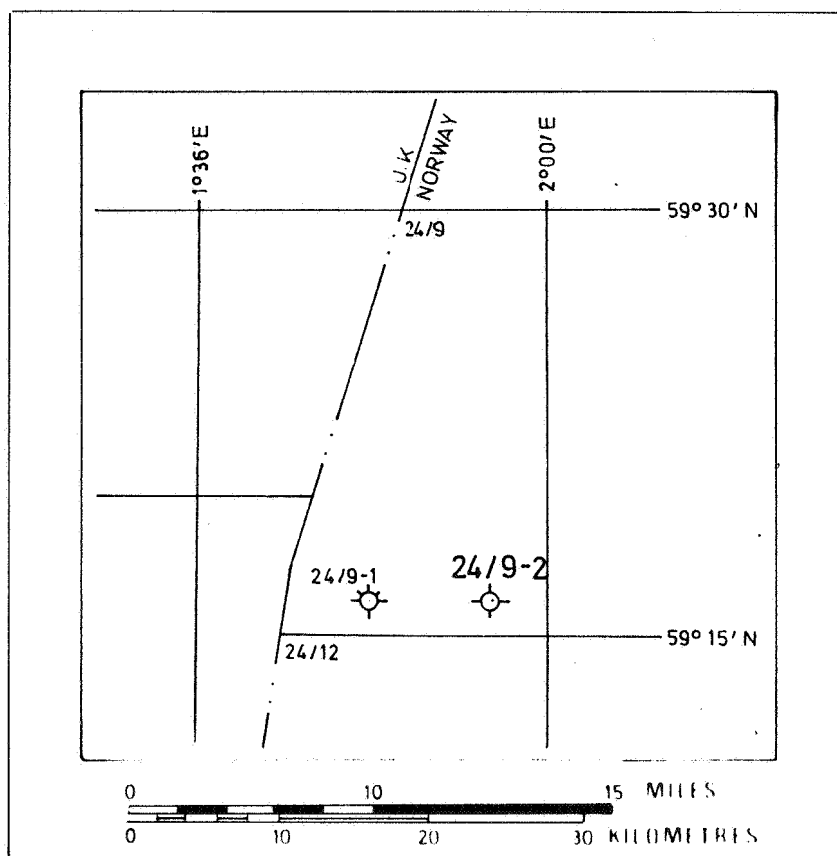
Completion Status: P & A as a dry hole

(All depths in this report  
are in metres D.F. unless  
otherwise stated.)

# WELL LOCATION PLAT

CONOCO/STATOIL/NORSK HYDRO/HUDBAY

24/9-2



LATITUDE	: 59°16'12.43" N
LONGITUDE	: 01°55'12.26" E
DF MEAN SEA LEVEL	: 25.3 M
WATER DEPTH	: 117.7 M
TOTAL DEPTH	: 2743.2 M

II. Well Summary

IIIi) Objectives and Results:

The 24/9-2 exploratory well was drilled by Conoco as operator for the Conoco/Statoil/Norsk Hydro/Hudbay group. The well was located to test the Danian and Lower Paleocene sands. Dip closure at this level was enhanced by a seismic anomaly of a "build-up" shape within the Middle-Upper Paleocene Heimdal sands.

The well penetrated a gross interval of 439 M of Paleocene sands. No sands were found in the Danian, which was of a marl and limestone lithology.

All sands were waterbearing except for a minor isolated oil bearing sand within the Upper Paleocene.

The well was plugged and abandoned as a dry hole after reaching a total depth of 2743.2 M in the Maastrichtian.

IIIii) Well History:

The well was spudded on the 13th June 1977 and reached T.D. on the 17th July 1977. Cutting samples were collected at 6 metre intervals from below 30" casing to 1500 M. Below this depth samples were taken every 3 metres to T.D. Sampling and mudlogging were performed by NEC Gas. Paleoservices did the paleontological analysis of the whole well, while Robertson Research performed geochemical analyses on samples caught every 30 metres below 1950 metres. Petrophysical logs were run prior to running the 13-3/8" casing and at TD.

Details of Schlumberger logs, lithological and drilling data together with sidewall core descriptions are recorded on the Composite well log.

III. Stratigraphy

IIIi) Table of Lithostratigraphic Units:

<u>INTERVAL IN METRES</u>	<u>GROUP</u>	<u>FORMATION</u>	<u>AGE(as determined by Paleoservices)</u>
? - 2004	Hordaland	---	Lower to Upper Eocene
2004 - 2608	Rogaland	Balder	Lower Eocene
		2004-2075	
		Sele	Upper Paleocene to L. Eocene
		2075-2169	
		Heimdal	Middle to U. Paleocene
		2169-2502.5	
2608 - 2743.2(T.D.)	Shetland	Lista	Middle Paleocene
		2502.5-2534	
		Maureen	Lower to Middle Paleocene
		2534-2608	
2608 - 2743.2(T.D.)	Shetland	Ekofisk	U. Cretaceous to L. Paleocene
		2608-2667	
		Tor	U. Cretaceous
		2667-2743.2(T.D.)	

The lithostratigraphic units in this report and on the composite log are those defined by the Norwegian, Danish and U.K. committees for nomenclature.

IIIIii) Table of Paleontological Divisions:

<u>SYSTEM</u>	<u>SUB-SYSTEM</u>	<u>STAGE</u>	<u>INTERVAL</u>
Eocene			FSR(1302)-2145
	Upper to Middle Eocene		FSR(1302)-1569
	Lower Eocene		1569-2145
Paleocene			2145-2661
	Upper Paleocene		2145-c.2500
	Middle Paleocene		c.2500-2604
	Lower Paleocene	Danian	2604-2661
Cretaceous			2661-2743.2(T.D.)
	Upper Cretaceous	Maastrichtian	2661-2743.2(T.D.)

IIIIii) Stratigraphic Summary:

Hordaland group ? - 2004 M (Lower to Upper Eocene)

The lithology is very sandy down to 915 M (possibly Nordland Group) with abundant shells and shell fragments, forams and occasional coral. Below this depth grey, silty claystone becomes predominant with interbeds of fine to coarse sand. Limestone stringers increase in abundance with depth.

Rogaland group 2004 - 2608 M (Paleocene to L. Eocene)

Balder Formation 2004 - 2075 M (Lower Eocene)

The top of this formation is marked by an increase in the sonic velocity. Lithology is principally brown and grey-blue claystone with traces of tuffaceous material, and occasional limestone.

Sele Formation 2075 - 2169 M (Upper Paleocene to L. Eocene)

An increase in the gamma ray log and decrease in sonic velocity marks the top of this formation. Claystone is again the dominant lithology, being mostly grey or grey-brown. Tuffaceous material is present in the upper part of the formation. Below the tuffaceous section is the only sandstone in this well with oil shows. This sandstone is only three meters thick and grades downwards into silt and claystone.

Heimdal Formation 2169 - 2502.5 (Middle to U. Paleocene)

Massive sands and sandstones are the principal lithology. Grain size ranges from fine to coarse and is occasionally pebbly. There are many thin beds of sandstone with a calcareous matrix that results in zero porosity. Mica and pyrite are relatively common with rare glauconite. Porosity in the very friable sands averages 26%.

Grey claystone interbeds are thin and infrequent.

Lista Formation 2502.5 - 2534 M (Middle Paleocene)

This is a thin claystone formation with rare cemented sandstone. The claystone is light to medium grey, occasionally greenish or brownish, non-calcareous, micaceous and pyritic. It is easily identified on logs, being isolated between sandstone formations.



Maureen Formation      2534 - 2608 M (Lower to Middle Paleocene)

Sand and sandstone is interbedded with clay, marl and occasional limestone. The sand is very fine to coarse grained and poorly sorted. The sandstone is white and cemented with a calcareous matrix. Soft-firm grey calcareous clay grades into marl. The limestone is white, chalky and argillaceous.

Shetland group      2608 - 2743.2 M (U.Cretaceous to L.Paleocene)

Ekofisk Formation      2608 - 2667 M (U.Cretaceous to L.Paleocene)

The top of this formation is marked by the consistent appearance of marl, clay and limestone and the absence of sandstone. The marl is off-white to light grey, soft and sticky, and grades into firm, white chalky limestone. Occasionally pink and red-brown marl is observed with interbeds of light grey, green and brown claystone.

Tor Formation (Upper Cretaceous)

This formation top is picked on log character by an increase in sonic velocity that is caused by an increase in limestone content. The limestone is white to off-white, soft to firm, and chalky and grades to calcilutite. Interbedded marl is predominantly light grey with common pyrites. There is a trace of sandstone near TD that is off-white, fine to medium grained with calcareous cement.

IV. Formation Evaluation

IVi) Hydrocarbon indications:

Hydrocarbons in commercial quantities were not encountered in this well.

While drilling the gas detector showed two slight increases, one within the Upper Paleocene and one within the Lower Paleocene Sand. Fluorescence was observed in the samples from the Upper Paleocene Sand. Log analysis proved a 3 meter hydrocarbon bearing sand in the Upper Paleocene between 2101.5 and 2104.5 metres (DF), and sidewall cores proved the presence of oil in this interval.

The Lower Paleocene and Danian - the principal objectives in this well - are water bearing.

IVii) Log interpretation:

Interval logged in metres (below DF)

<u>Log type</u>	<u>Run 1</u>	<u>Run 2</u>	<u>Run 3</u>
ISF/SONIC/SP/GR	1028.3-503.8 GR to 143		
ISF/SONIC/SP/GR		1556.6-1009	
BHC SONIC/GR			2746-1527
FDC/CAL	2745.5-1527		
CNL	2745.5-2050		
DLL/GR/SP	2746.4-1527		
HDT	2746.0-1527		
CST	1 RUN	SHOT 30	RECOVERED 28 EMPTY 2
VELOCITY SURVEY		18 CHECK SHOT LEVELS	

Log analysis indicates good quality reservoir sand in the Paleocene, but hydrocarbons are indicated only in one thin sand within the Upper Paleocene.

2101.5 - 2104.5 M Upper Paleocene

This is a thin sand isolated within claystone.

Average porosity = 20% (from neutron-density)

Porosity range = 15% to 27%

Average Sw = 60%

Sw range = 50% to 70%

Rw was calculated from SP and from a porosity/resistivity crossplot to be 0.05 ohm. metre at formation temperature.

2169 - 2608 M Upper to Lower Paleocene

Gross interval = 439 M

Net porous sand(>10% porosity) = 313 M

Net gross = 0.71

Average porosity = 26% (from neutron-density)

Porosity range = 10% to 32%

All sands are water bearing.

Lithologies that have not been included as net sand are calcareous sandstones and claystones.

CONOCO NORWAY INC.

FINAL ENGINEERING WELL REPORT

24/9-2

C.R. HANSON  
AUGUST 1977

TABLE OF CONTENTS

	PAGE
Statistical Summary	2
Well Summary	3
Daily Activity Summary	5
Rig Time Analysis	7
Depth Versus Days Plot	8
Casing, Cementing and Abandonment Schematic	9
Anchor Pattern	10
Bit Record	11
Mud Record	12
Pore Pressure Prediction	32

	FIGURE
Dc.	1
Sonic Travel Time	2
Resistivity	3
Neutron Density	4
Hole Diameter	5
Normalized Drilling Rate	6
Mud Logger's Plot.	7

## STATISTICAL SUMMARY

Well Name: 24/9-2

Classification: Exploration

Partners: Conoco Norway Inc.  
Statoil  
Norsk Hydro A/S  
Hudbay Oil International Ltd.

Location: 59° 16' 12.432 N  
01° 55' 12.264 E

Casing Program: 30" at 678'  
20" at 1652'  
13 3/8" at 5009'

Rig: Borgny Dolphin

Water Depth: 386 ft.

RKB to W.L.: 84 ft.

RKB to M.L.: 470 ft.

Date Rig Accepted: 06:55 hours 11 June, 1977

Date of Spud: 02:00 hours 13 June, 1977

Date of Release: 20:30 hours 22 July, 1977

Total Rig Days: 40.6 days

Total Depth: 9000 ft.

Status of Well: Plugged and Abandoned.

## WELL SUMMARY

Well 24/9-2 was drilled by the Aker H-3 Borgny Dolphin in June - July of 1977. Numerous problems were encountered in drilling the hole.

While running the 30" the bottom two joints fell off. The probable cause was not installing the locking blocks on the Vetco ATD connections. Divers recovered the two joints but 27 hours were lost.

During the underreaming of the 17½" hole to 26" two and one-half arms and all three cones were lost off the underreamer. Fourteen hours were required to reunderream the hole.

After setting the 20" a test could not be obtained on the BOP stack. Divers found that the AX gasket had fallen out. Five hours were lost because of this problem.

When preparing to run the 13 3/8" casing the wearbushing could not be pulled. Attempts to jar it out failed. The stack had to be pulled and a diver burned a slot nearly the entire length of the bushing before it could be pulled free. A total of 111.5 hours were lost because of the wearbushing.

The pulling of the wearbushing from 20" housings has been a problem on many holes. Cameron has had at least four designs to solve this problem. The wearbushing on this job was of the latest design in that it had an O ring near the top to prevent sand from getting behind the bushing. Below the O ring area the bushing is slightly cut down to reduce the friction while running and pulling. However, the reduced area is a potential holding area for sand and barites.

After setting 13 3/8" casing no additional mechanical problems were encountered but tight hole was a problem. At least 61 hours were lost due to tight hole conditions in spite of running what should have been more than adequate mud properties.

A total of 236 hours or 9.8 days were lost on 24/9-2 because of mechanical and hole problems. The hole was plugged and abandoned July 22, 1977 as a dry hole.



DAY / DATE	DEPTH FT/ PROGRESS	DAILY ACTIVITY SUMMARY
1/June 11, 77	0/0	In transit at 06:55 hours from Stavanger to location
2/ 12	0/0	Anchoring up.
3/ 13	681/681	Drilled 36" hole to 681'. Lost bottom 2 joints of 30" while running.
4/ 14	681/0	Recovered 30" with help of divers.
5/ 15	681/0	Ran and cemented 30" at 678'.
6/ 16	1707/1026	Drilled to 1707'.
7/ 17	1707/0	Underreamed 17½ hole to 26". Lost 2 arms of underreamer in hole.
8/ 18	1707/0	Reunderreamed to 1707'.
9/ 19	1707/0	Ran and cemented 20" casing at 1652'. WOW to run BOP stack.
10/ 20	1707/0	Ran stack. Stack wouldn't test. Jumped divers and found "AX" ring had fallen out.
11/ 21	2585/878	Drilled to 2585'.
12/ 22	3428/843	Drilled to 3428'.
13/ 23	4730/1302	Drilled to 4730'.
14/ 24	5098/368	Drilled to 5098'.
15/ 25	5098/0	Logging, couldn't get below 3370, made wiper trip.
16/26	5098/0	Completed logging. Couldn't pull wear-bushing.
17/27	5098/0	Jarring on wear bushing.
18/28	5098/0	Fired string shot in wear bushing, couldn't pull same. Laid cement plug and pulled stack.
19/29	5098/0	Jarring on wear bushing. Broke wear-bushing under threads. Diving to split wear bushing with torch.
20/30	5098/0	Finished cutting wear bushing and pulled same.

DAY / RATE	DEPTH FT/ PROGRESS	DAILY ACTIVITY SUMMARY
21/July 1 77	5098/0	Ran stack. Drilling plug and Reaming hole to 4631'.
22/ 2	5098/0	Reamed to 5090".
23/ 3	5098/0	Set 13 3/8" casing as at 5009'.
24/ 4	5151/53	Cemented 13 3/8" casing. Tested formation which leaked off at 14.00 PPG. Drilled to 5151'.
25/ 5	6389/1238	Drilled to 6389'.
26/ 6	6855/466	Drilled to 6855'.
27/ 7	7373/518	Drilled to 7373'.
28/ 8	7490/117	Drilled to 7490'.
29/ 9	7895/405	Drilled to 7895'.
30/ 10	8184/289	Drilled to 8184'.
31/ 11	8223/39	Drilled to 8223'.
32/ 12	8320/97	Drilled to 8320'.
33/ 13	8518/198	Drilled to 8518'.
34/ 14	8604/86	Drilled to 8604'.
35/ 15	8700/96	Drilled to 8700'.
36/ 16	8882/182	Drilled to 8882'.
37/ 17	9000/118	Drilled to 9000'.
38/ 18	9000/0	Logging.
39/ 19		Finished logging. Set 300 sack class G plug from 6700' - 7074'. Set 400 sack class G plug from 4785' - 5180'.
40/ 20		Set 150 sack class G plug 4757'-4962'. Set 150 sack class G plug 1525'-1730'. Set 150 sack class G plug 545' -750'.
41/ 21		Pulled riser and stack. Cut 13 3/8", 20" and 30" casing at 489'. Pulled wellhead and casing.
42/22		Attempted to run side scan sonar under rig. - Sonar didn't work. Divers took video of sea bed under rig. Rig released to Mobil Oil at 20:30 hours July 22, 1977.

## RIG TIME ANALYSIS

	Hours	%
Under tow	17	1.73
Positioning Rig	12.5	1.28
Running/Picking up anchor	21	2.16
Rigging up/down	2	.21
Running/Pulling Stack or Riser	54.5	5.60
Surveying	20	2.05
Drilling	258	26.50
PU/LD Drill String	24	2.47
Under-reaming	24	2.47
Re-drilling	52	5.34
Tripping	119	12.22
Circulating	46.5	4.78
Testing Equipment	22	2.26
Running Casing/Wellhead	48	4.93
Cementing/WOC	24.5	2.52
Diving	45.5	4.67
Running Wireline FP, String Shot Casing Cutter, FIT, etc.	20.5	2.11
Logging	55.5	5.70
Repairing Rig Equipment	2	.21
Fishing	93.5	9.60
Waiting on Weather	11.5	1.18
	973.5	100.00

### TIME LOST DUE TO

Weather	11.5	1.18
Rig Repair	5.0	.51
Fishing	152.5	15.67
Tight Hole	67	6.88
	236	24.24

ABANDONMENT  
SCHEMATIC

CASING AND CEMENTING  
SCHEMATIC

Cut 30", 20" and 13 3/8"  
at 489'-19" below  
mudline

RKB 470'

150 Sack "G" 545'-750'

30" 678'-1" wall with Vetco ATD  
Cemented with 904 Sacks G neat

150 Sack "G" 1525'-  
1730'

20 1652'-6 JTS. 94 lb/ft  
J-55 Butt., 24 JTS. 94 lb/ft  
X-52 Vetco "L". Cemented with  
1979 Sacks "G" with 8% GEL +  
500 Sacks "G" with 2% Cacl.

150 Sacks "G"  
4757'-4962'  
400 Sacks "G" 4785'-5180'

13 3/8" 5009'-113 JTS. 68  
lbs/ft K-55 Butt. Cemented  
with 2600 Sacks "G" with 8%  
GEL and 0.5% CFR-2. Tailed in  
with 500 Sacks "G" with 1%  
CFR-2 and 0.1% HR-7.

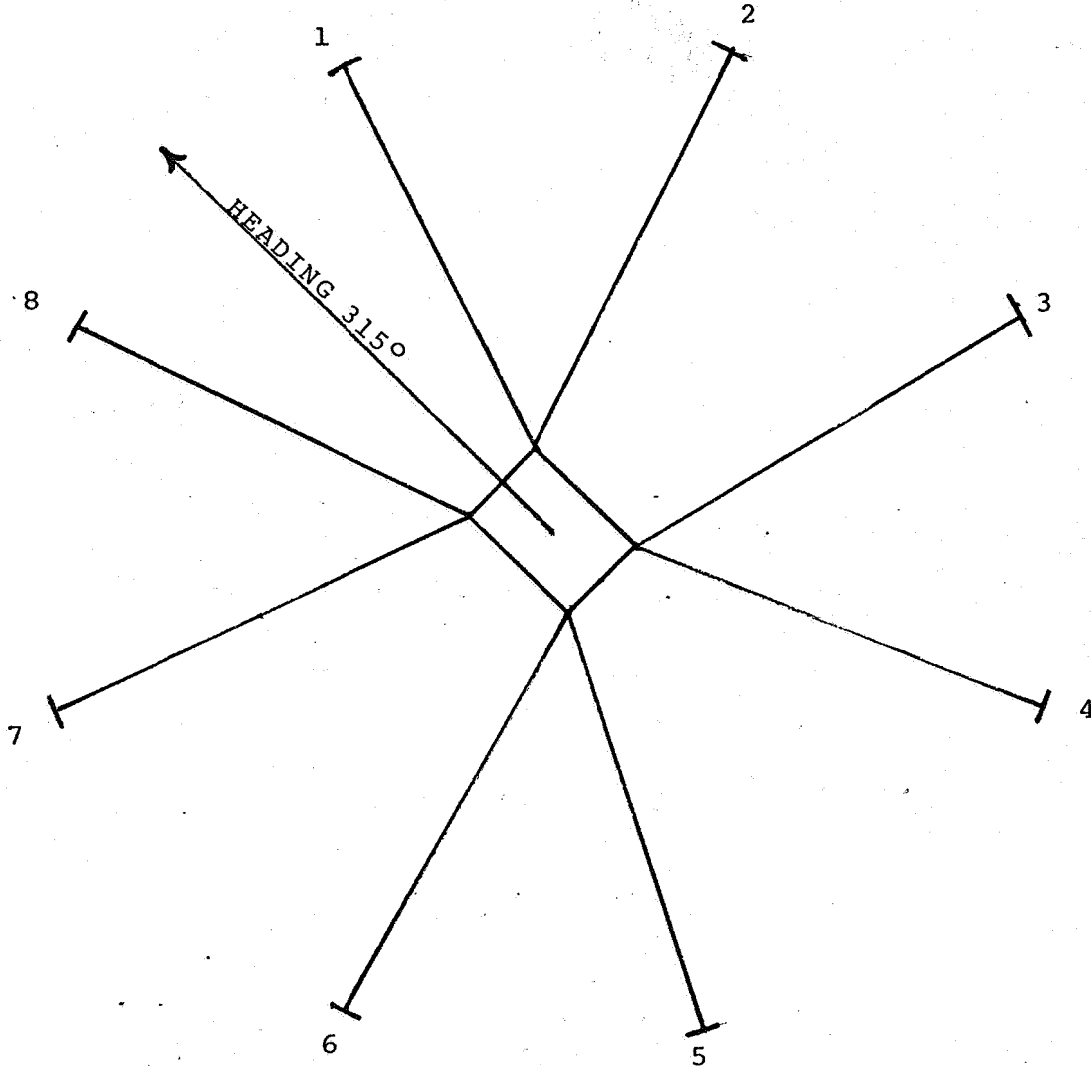
300 Sacks "G" 6700'-7074'

Butt. is on bottom of string

TD 9000'

"BORGNY DOLPHIN"

FINAL MOORING INFORMATION LOCATION 24/9-2

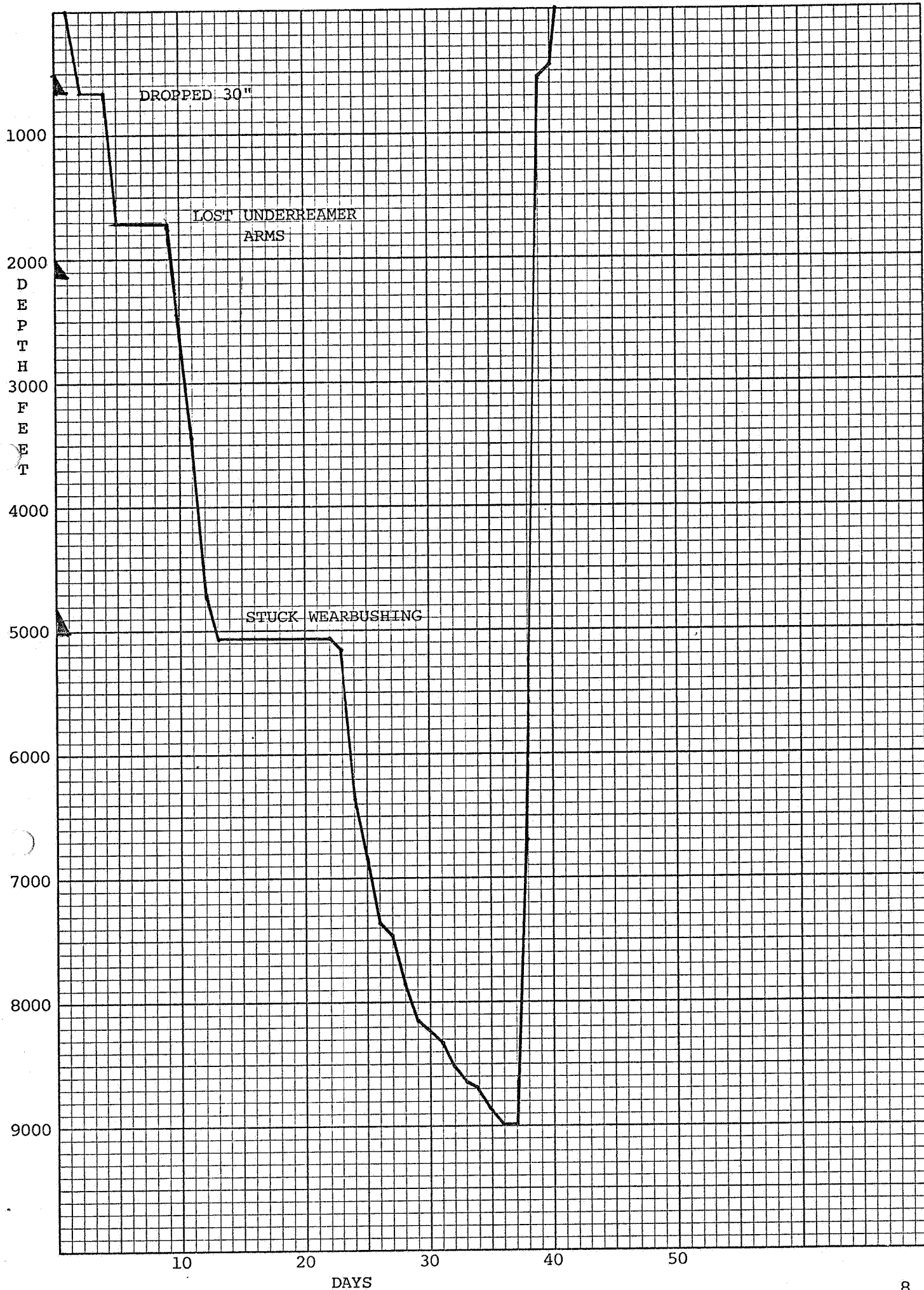


NO	MAX STATIC TENSION	MAX DYNAMIC TENSION	FINAL STATIC TENSION	FINAL CHAIN OUT	BEARING	DIST TO BUOY
1	260 000	400 000	200 000	3590	336	1120 MTS
2	280 000	400 000	205 000	3700	022	1140 "
3	265 000	400 000	205 000	3530	065	1060 "
4	255 000	400 000	200 000	3620	110	1130 "
5	260 000	400 000	200 000	3355	163	1090 "
6	250 000	400 000	185 000	3550	205	1130 "
7	260 000	400 000	175 000	3550	250	1070 "
8	260 000	400 000	180 000	3545	194	1060 "

FINAL POSITION BY SAT.FIX. N59°16'12.43" E01°55'12.26"

46 MTS. in 072° FROM INTENDED LOC.

ARNE ROVDE





## PRESSURE DETECTION

Two pressure detection methods based on drilling rate were used when drilling 24/9-2. The  $D_c$  plot Figure 1 does not indicate abnormal pressure. A second method, normalized drilling rate produces a plot Figure 6 which is badly scattered but the general indication is that the formation pore pressure increases from 5500' to the bottom of the massive shale section which ends near 7000'. Maximum indicated pressure is less than 10 PPG.

Two of the logs, Resistivity Figure 3 and Sonic Figure 2 have only very slight if any indications of pressure. The only log method which indicates abnormal pressure is the Neutron Density Figure 4. It is questionable if interpreting Figure 4 as abnormal pressure is correct because the lower density shales are among the sands and not above 6900 feet in the massive shale section where one would expect to find pressure.

The only real indicator of abnormal pressure on this hole was the amount of shale coming over the shaker. At 6000 feet while drilling with 10.3 PPG mud large amounts of cuttings were on the shaker. The mud weight was increased to 10.8 PPG by 6200 feet and the amount of cuttings returned to normal. Figure 5 is a plot of hole diameter and mud weight. Note that when the mud weight was begun to be increased at 5500 feet the hole diameter began to decrease. In general the hole diameter decreases as the mud weight increases between 5500' and 6250'.

In conclusion, hole conditions suggest that the massive shale and claystone section from about 4375 feet to 6900 feet is not normally pressured. This conclusion is only weakly supported by logs. It is suspected this section could be drilled by mud weights as low as 10 PPG but tight hole and washout would probably be a problem.



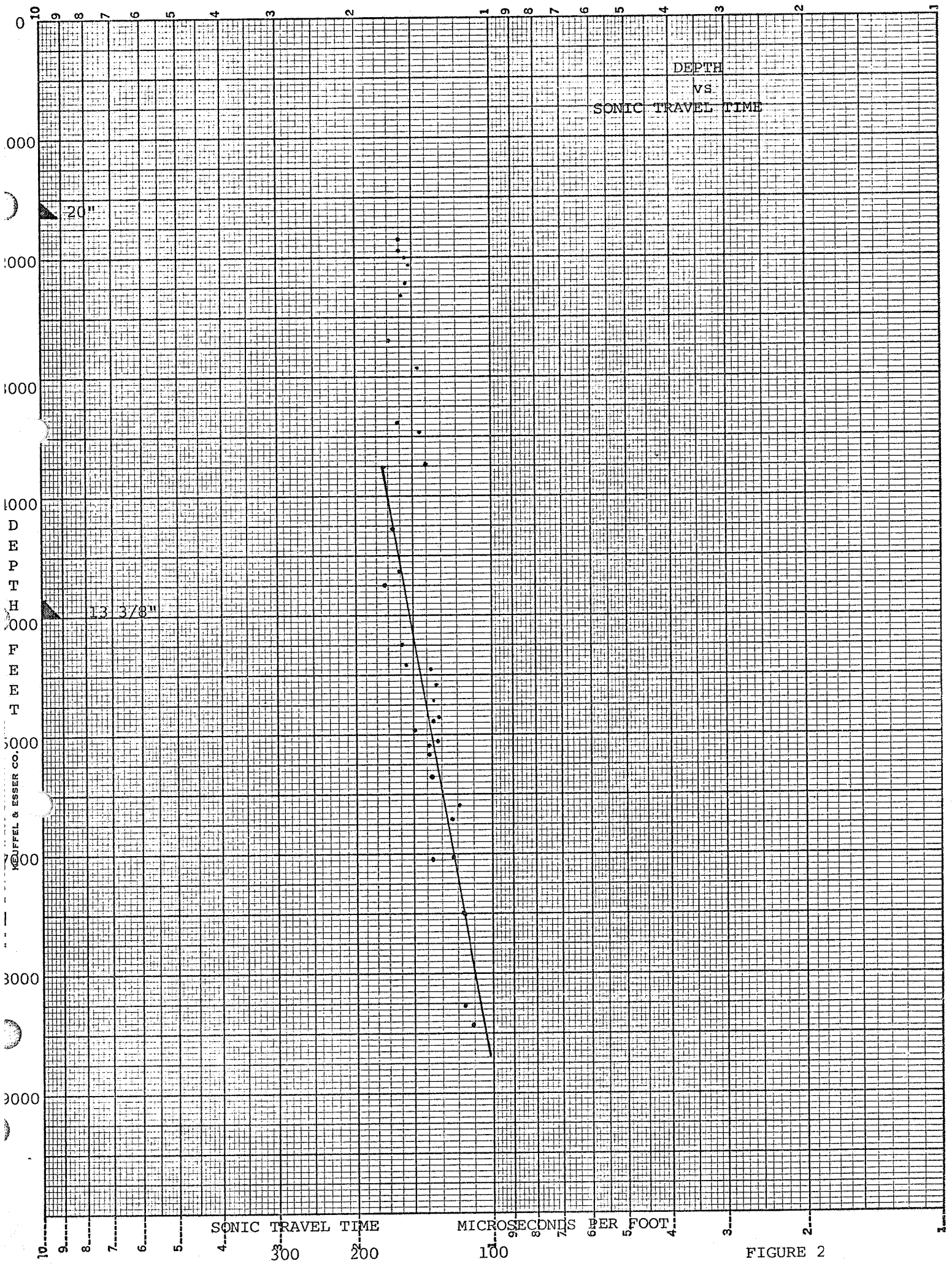


FIGURE 2

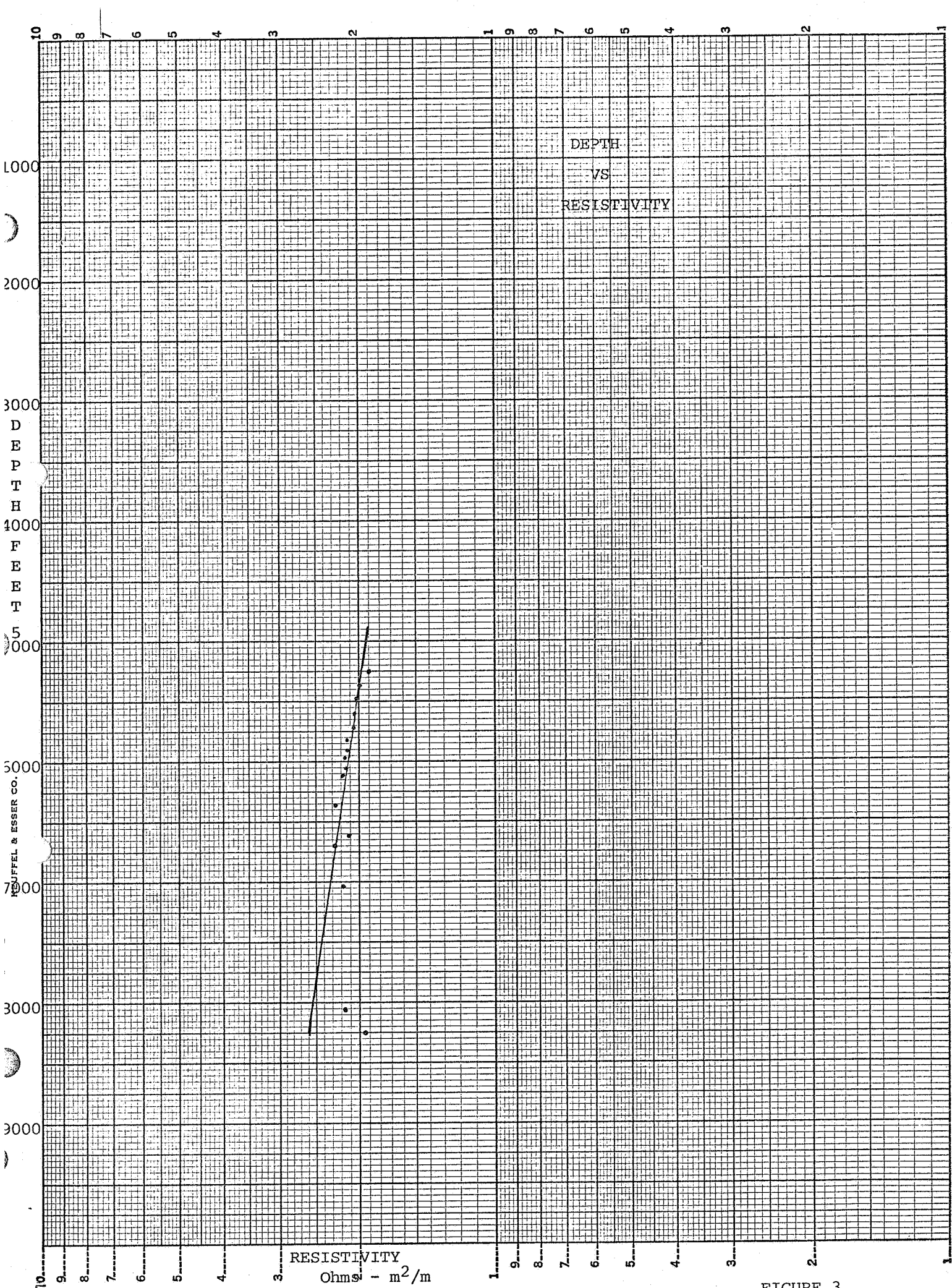
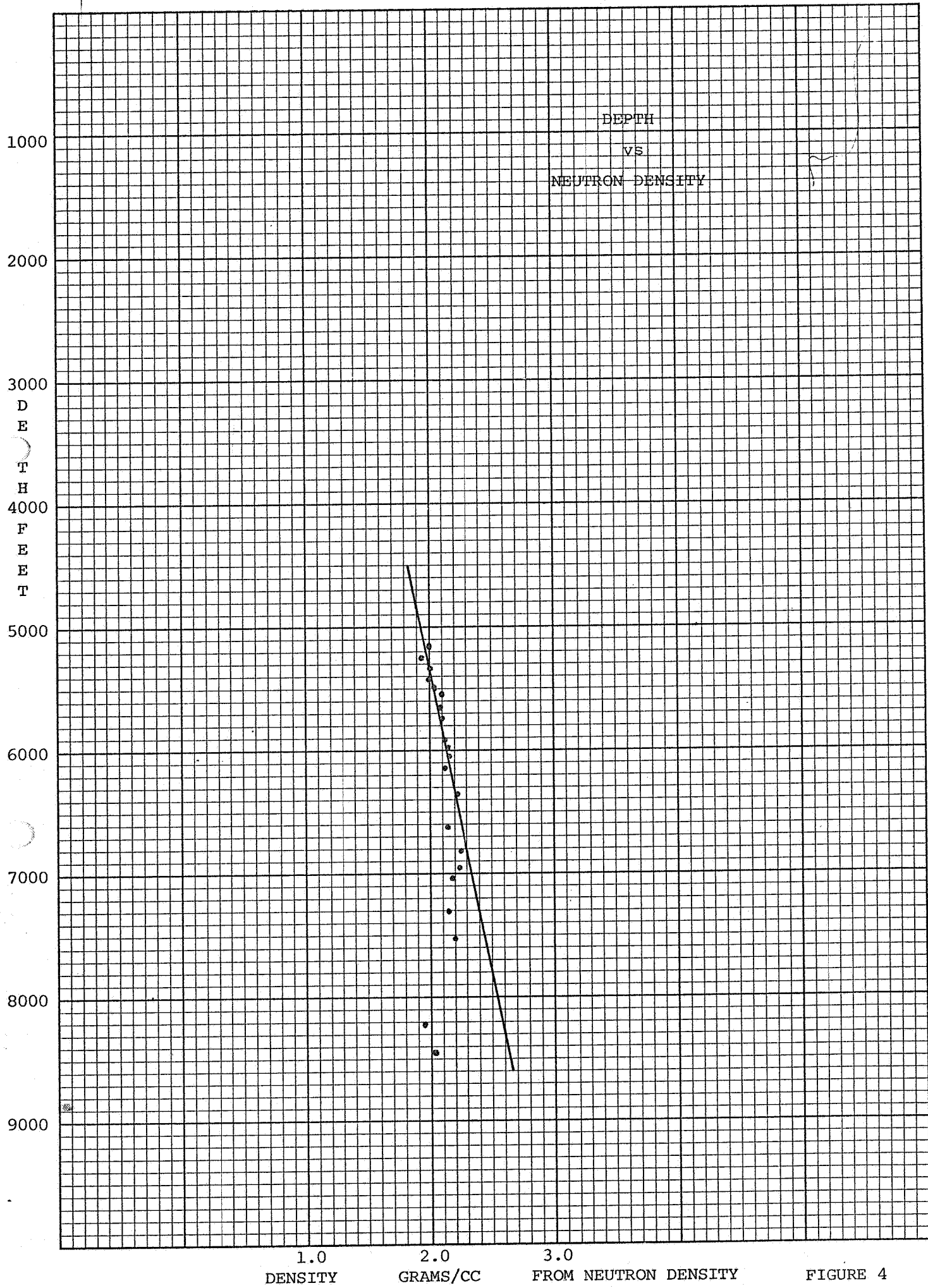


FIGURE 3



1.0      2.0      3.0  
DENSITY      GRAMS/CC      FROM NEUTRON DENSITY

FIGURE 4

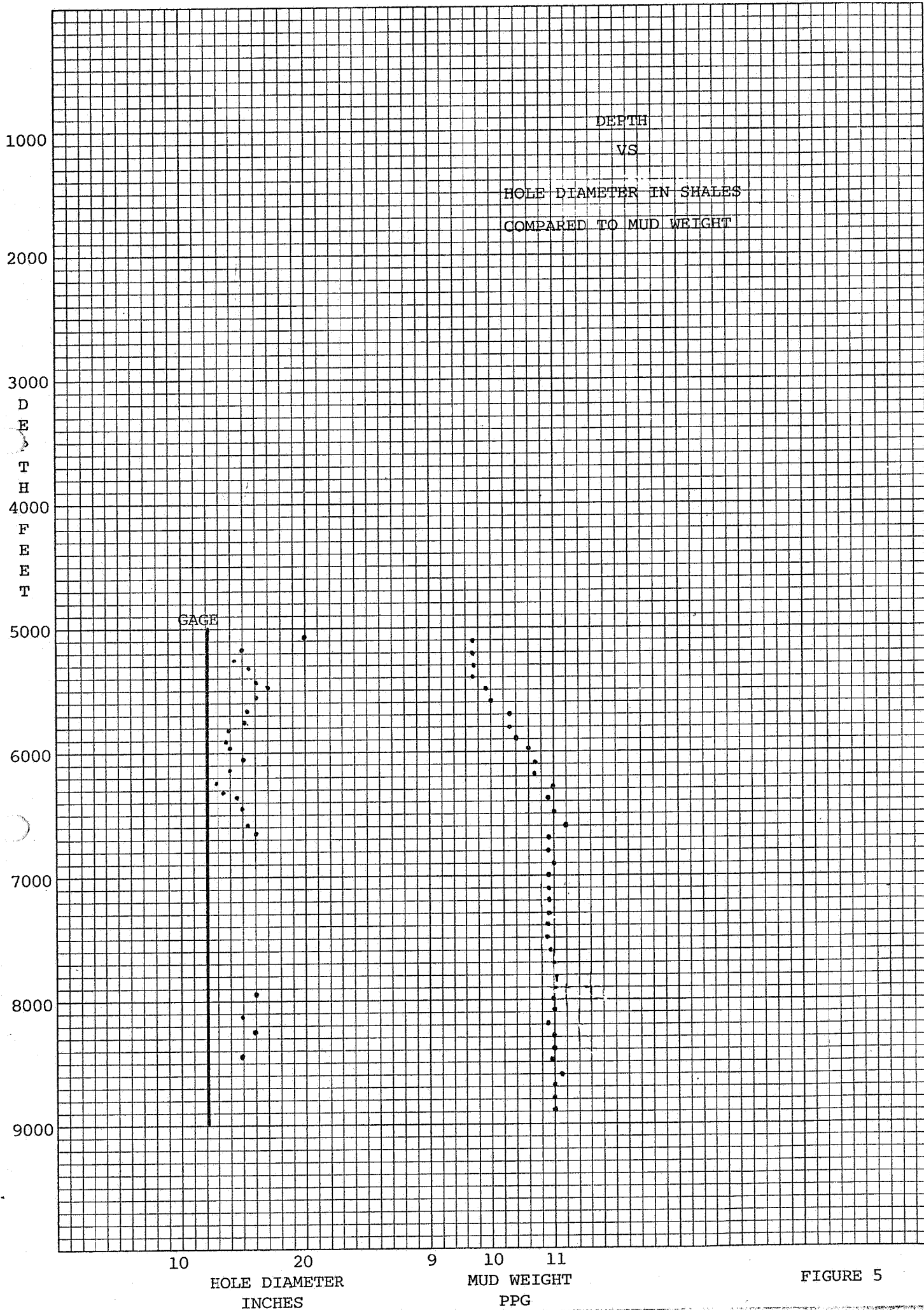


FIGURE 5

H. W. NEUPPEL & SONS CO. MADE IN U.S.A.

