DRILL HOLE LOG

McCULLOCH DRILL HOLE #145

LOCATION: NE1/4, SE1/4, SEC. 33, T. 12 S., R. 9 E. Carbon County, Utah, Bear Canyon

LATITUDE:	512,091.708
DEPARTURE:	2,166,444.844
COLLAR ELEVATION:	7,104.31
TOTAL DEPTH:	1,215.0'
INCLINATION:	90

DRILLED BY: G. Greener, Longyear Company

LOGGED BY: K. L. Ball, American Electric Power Service Corporation

DATE STARTED: 3/29/77

DATE FINISHED: 4/13/77

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	Start HQ			
QAL	Valley fill, silty sand with sandstone boulders, yellowish gray (5 Y 7/2) to very light gray (N8), fine grained	20	0	50
Sandstone	Very light gray (N8) and medium gray (N5) mottled, fine grain, jointed 60 limonite staining on joint surfaces	18.9	50.0	68.4
Siltstone	Medium gray (N5), carbonaceous, clayey and broken in places	38.6	68.4	107.6
Sandstone	Very light gray (N8) and medium gray (N5) mottled, fine grain, carbonaceous in places, fractured in places, medium gray (N5) siltstone lamina to thin interbeds in places	96.2	107.6	205.4
Siltstone	Medium gray (N5) and light gray (N7) mottled to medium dark gray (N4) and medium light gray (N6) mottled, carbonaceous, clayey in places, very light gray (N8) sandstone lamina to thick interbeds throughout, fine grained	98.8	205.4	304.3
Sandstone	Very light gray (N8) medium gray (N5) and medium dark gray (N4) mottled, fine grain, carbonaceous in places, medium gray (N5) siltstone lamina to thin interbeds throughout, Top of coal 509.6 coal 2.1; Top of coal 520.5 coal 0.5'	225.9	304.3	530.4
Siltstone	Medium gray (N4) and very light gray (N8), carbonaceous in places, shalely in places, very light gray (N8) sandstone lamina to thin interbeds in places	20.5	530.4	551.1
Coal	4.4 Bright banded, vitrain and durain, resinous, shale streaks in places - 4.4	4.4	551.1	555.5
Siltstone	Medium gray (N5), medium dark gray (N4) and very light gray (N8) mottled, carbonaceous to bony in places, shalely in places, very light (N8) sandstone lamina to thick interbeds throughout, Top of coal	50.9	555.5	607.1

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	568.2 coal 0.8', Top of coal 596.5 coal 0.5', Top of coal 603.9 coal 1.1			
Sandstone	Very light gray (N8) with medium gray (N5) mottling in places, fine grain, silty in places, carbonaceous partings in places	19.3	607.1	626.2
Coal	0.2 Bony shale 4.1 Bright banded, vitrain and durain, resinous shale streaks in places 4.3 Coal	4.3	626.2	630.5
Sandstone	Very light gray (N8), fine grain, carbonaceous partings	6.2	630.5	636.7
Shale	Medium dark gray (N4), carbonaceous, bony in places, Top of coal 645.2 coal 0.7'	19.6	636.7	656.2
Sandstone	Very light gray (N8) and medium gray (N5) mottled, fine grain, carbonaceous in places, medium gray (N5) siltstone lamina to thick interbeds throughout, Top of coal 562.1 coal 0.9'	15.4	656.2	671.2
Shale	Medium dark gray (N4), carbonaceous to bony	1.3	671.2	672.5
Coal	Bright banded, vitrain and durain, resinous, shale streaks in places 4.2 Coal	4.2	672.5	676.7
Sandstone	Very light gray (N8), fine grain, carbonaceous partings in places	6.4	676.7	683.1
Siltstone	Medium gray (N5) with very light gray (N8) mottling in places, carbonaceous in places, sandy in places	18.4	683.1	701.5
Sandstone	Very light gray (N8) with medium light gray (N6) mottling in places, fine grain, carbonaceous partings in places, silty in places, Top of coal 722.7 coal 0.6	23.6	701.5	726.1

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
Siltstone	Medium gray (N5) and medium dark gray (N4) mottled, carbonaceous bony in places, shalely in places, Top of coal 732.0 coal and bone 1.1', Top of coal 735.9 coal 0.4', Top of coal 739.2 coal and bone 1.6'	15.3	726.1	741.6
Coal	4.5 Bright banded, vitrain and durain, resinous, shale streaks in places 4.5	4.5	741.6	746.1
Sandstone	Very light gray (N8) and medium gray (N5) mottled, fine grain, carbonaceous in places, shalely in places, Top of coal 761.0 coal 0.8', Top of coal 780.8 coal 1.9', Top of coal 783.4 coal 0.8'	45.1	746.1	791.5
Shale	Medium dark gray (N4), carbonaceous, bony in places, resinous 0.3 Bony shale, resinous 4.7 Coal 4.4 Bright banded, vitrain and durain, resinous, shale streaks in places, bony in places	4.7	791.5	796.2
Sandstone	Very light gray (N8), medium gray (N5) and medium dark gray (N4) mottled, fine grain, carbonaceous in places, shalely in places, Top of coal 817.1 coal 1.2', Top of coal 824.8 coal 824.8 coal 1.1'	30.1	800.9	830.8
Siltstone	Medium gray (N5, light gray (N7) and medium dark gray (N4) mottled, carbonaceous, sandy in places, Top of coal 843.6 coal 1.5	18.8	830.8	848.6
Coal	3.5 Bright banded, vitrain and durain, resinous 3.5 Coal	3.5	848.6	852.1
Sandstone	Very light gray (n8) and medium gray (N5), fine grain, carbonaceous in places medium gray (N5) siltstone lamina in places, Top of coal 862.8 coal 60.4', Top of coal 866.5 coal and bone 1.7' Top of coal 882.5 coal 0.5', Top of coal 893.0 coal 0.8', Top of coal 899.4 coal 0.9 clayey and slickensided 900.0	125.4	852.1	977.4
Coal	2.3 Bright banded, vitrain and durain, shale streaks throughout	2.3	977.4	979.7

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
Sandstone	Very light gray (N8) and medium gray (N5) banding, mottled in places, fine grain to medium grain carbonaceous partings in places, crossbedded, fossiliferous in places Top of coal, 1136.9 coal 2.4'	165.2	979.7	1144.9
Coal	3.1 Bright banded, vitrain and durain, shale streaks throughout bony in places	3.1	1144.9	1148.0
Siltstone	Medium dark gray (N4), light gray (N7) and medium gray (N5) mottled, carbonaceous, sandy in places, shalely and fossiliferous 1162.6 - 1165.0, Top of coal 1181.5 coal 0.8'	37.0	1148.0	1185.0
Coal	7.6 Bright banded , vitrain and durain, resinous, silt streaks in places - 7.6	7.6	1185.0	1192.6
Sandstone	Very light gray (N8) and medium dark gray (n4) banded, medium grain, crossbedded	22.2	1192.6	1215.0

Bottom of hole 4/13/77
T.D. 1215.0'
Stemmed with 30 bags of cement
Plug at top

McCULLOCH DRILL HOLE #106-77

LOCATION: SW1/4, SE1/4, SEC. 35, T. 12 S., R. 10 E. Carbon County, Utah,
Mathis Canyon

LATITUDE:	511,587.434
DEPARTURE:	2,207,671.382
COLLAR ELEVATION:	8,154.91
TOTAL DEPTH:	2,365.5'
INCLINATION:	90

DRILLED BY: R. Dennis, Longyear Company

LOGGED BY: D. Stephens, American Electric Power Service Corporation

DATE STARTED: 7/13/77

DATE FINISHED: 8/24/77

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	HQ Core 0-1133 NQ 1133-2348 A Core 2348-2365.5			
	Rock Bit		0	30
Siltstone	Light gray (N7) to medium gray (N5), highly benonetic, breaks up on exposure to air	18	30	48
Siltstone	Very light gray (N8) to light gray (N7), very sandy	26	48	74
Sandstone	Pinkish gray (5 YR 8/1) to very light gray (N8), medium-coarse grained	13.9	74	87.9
Siltstone	Very light gray (N8) to light gray (N7), some clayey zones which disintegrate upon exposure	37.9	87.9	125.8
Sandstone	Very light gray (N8) to light gray (N7), medium-coarse grained	12.1	125.8	137.9
Siltstone	Very light gray (N8) to light gray (N7), slightly sandy to very sandy in places with some sandstone interbeds (Medium-coarse grained), occasional clayey zone which falls apart on exposure to atmosphere	164.7	137.9	302.6
Sandstone	Light gray (N7) to medium light gray (N6), fine-medium grained	25.8	302.6	328.4
Siltstone	Very light gray (N8) to light gray (N7) with zones of grayish red (10 R 4/2) to light olive gray (5Y 5/2), slightly sandy in places, benonetic zones which fall apart upon exposure, some medium-coarse grained, sandstone interbeds	123	328.4	415.4
Sandstone	Very light gray (N8) to light gray (N7), medium-coarse grained	77.7	451.4	529.1
Siltstone	Medium light gray (N60 to medium dark gray (N4), highly benonetic falls apart upon exposure to air, weathered, some hard siltstone interbeds, very sandy	550.1	529.1	646

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LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
Sandstone	Light gray (N7) to medium gray (N5) with some medium dark gray (N4) banding, medium-coarse grained	135.1	646	778.8
Siltstone	Medium light gray (N6) to medium dark gray (N4), highly benonetic, falls apart upon exposure	32.1	778.8	810.9
Sandstone	Very light gray (N8) to medium light gray (N6), fine-very fine-medium grained, some siltstone interbeds	54.1	810.9	865.0
Siltstone	Medium light gray (N6) to medium dark gray (N4), benonetic zones which fall apart on exposure	38.5	865	903.5
Sandstone	Very light gray (N8) to medium light gray (N6), medium-coarse grained	42.7	903.5	946.2
Siltstone	Light gray (N7) to medium gray (N5), slightly sandy in places	15.8	946.2	962
Sandstone	White (N9) to very light gray (N8), medium-coarse grained	55	962	1017
Siltstone	Light gray (N7) to medium gray (N5), slightly sandy	10	1017	1027
Siltstone	White (N9) to very light gray (N8), medium-coarse grained	73	1027	1100
Siltstone	Light gray (N7) to medium gray (N5), slightly sandy in places	33	1100	1133
Sandstone	White (N9) to very light gray (N8), medium - fine grained	21.9	1133	1154.9
Siltstone	Medium light gray (N6) to medium gray (N5), with medium dark gray (N4) mottling slightly sandy to very in places, with coal: Top of coal 1176 coal 0.6	37.4	1154.9	1194.0
Sandstone	Very light gray (N8) to light gray (N7) with some medium gray (N5) mottling, silty to very silty in places	40	1194	1234

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
Siltstone	Medium light gray (N6) to medium dark gray (N4), slightly sandy in places	30	1234	1264
Sandstone	White (N9) to light gray (N7) with medium light gray (N6) to to medium gray (N5) mottling in places, slightly silty to very silty in places with some siltstone interbeds, fine-medium grained	310.6	1264	1577
Siltstone	Light gray (N7) to medium gray (N5), slightly sandy to very sandy in places	152.2	1577	1723.8
Sandstone	White (N9) to very light gray (N8) with light gray (N7) mottling, fine-very fine grained, very silty in places	36.2	1723.8	1759.6
Siltstone	Light gray (N7) to medium gray (N5), slightly sandy in places	17.9	1759.6	1777.4
Sandstone	White (N9) to very light gray (N8), fine-very fine grained	17.8	1777.4	1801.8
Siltstone	Light gray (N7) to medium gray (N5) with some medium dark gray (N4) mottling, slightly sandy to very sandy in places with some sandstone interbeds, with coal as follows: Top of coal 1840 coal 0.3., Top of coal 1856.9 coal 0.35, Top of coal 1864 shale/ coal stringer 1.0	82.7	1801.8	1882.3
Siltstone	Dark gray (N3) to gray black (N2), with coal stringers	0.15	1882.3	1882.45
Coal	Bright, hard, with resin 4.8	4.8	1882.3	1887.25
Siltstone	Medium dark gray (N4) with 1/10" sandstone interbeds, very light gray (N8)	17.5	1887.25	1904
Sandstone	Very light gray (N8) to light gray (N7), fine-very fine grained, silty in places with some siltstone interbeds medium dark gray (N4), with coal seams as follows: Top of coal 1933.7 coal 0.2,	153.7	1904	2056.3

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	Top of coal 1935.55 coal 1.7, Top of coal 1944 coal 0.5, Top of coal 1951.1 coal 0.35, Top of coal 1961.2 coal 0.1, Top of coal 1977.5 coal 0.3, Top of coal 1990.4 coal 1.0, Top of coal 2010.3 coal 2.4, Top of coal 2020.5 coal 0.8, Top of coal 2037.7 coal 0.2, Top of coal 2041.0 coal 0.04			
Siltstone	Medium gray (N5) to medium dark gray (N4) slightly sandy with coal as follows: Top of coal 2058.8 coal 1.4	12.45	2056.3	2068.75
Coal	0.1 Bone 7.5 Coal, bright, hard, with resin 7.6	7.6	2068.75	2076.35
Siltstone	Medium light gray (N6) to medium gray (N5), slightly sandy in places with coal seams as follows: Top of coal 2090.7 coal 0.1, Top of coal 2091.55 coal 0.33 Top of coal 2095.1 coal 1.1, Top of coal 2105.7 coal 0.3, Top of coal 2116 coal 2.2, Top of coal 2132.3 coal 0.5, Top of coal 2139.7 coal 0.4	68	2076.35	2144
Sandstone	White (N9) to very light gray (N8) with some medium light gray (N6) mottling, fine-very fine grained	30.3	2144	2174.3
Siltstone	Medium dark gray (N4) to dark gray (N3) with coal as follows: Top of coal 2174.7 coal 0.45	1.5	2174.3	2175.8
Coal	2.8 Coal, bright, hard, with resin 0.13 Shale/coal stringers 10.5 Seam 7.57 Coal, bright hard, with resin	10.5	2175.8	2186.3
Siltstone	Light gray (N7) to medium light gray (N6), with medium gray (N5) mottling, sandy with coal as follows: Top of coal 2191 coal 0.4	5.1	2186.3	2191.4
Sandstone	Light gray (N7) to medium gray (N5) with some medium dark gray (N4) banding + x-bedding, medium coarse grained	76.9	2191.4	2267.3

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
Siltstone	Light gray (N7) to medium light gray (96), slightly sandy in places with coal as follows: Top of coal 2273 coal 2.2	17.2	2267.3	2284
Sandstone	White (N9) to very light gray (N8) with medium light gray (N6) mottling	19.5	2284	2303.5
Siltstone	Medium light gray (N6) to medium gray (N5) with some medium dark gray (N4) mottling in places, slightly sandy in places with coal seams as follows: Top of coal 2303.5 coal 0.25	5.0	2303.5	2308.5
Coal	4.3 Coal, bright, hard, with resin	4.3	2308.5	2312.8
Siltstone	Medium light gray (N6) to medium gray (N5) with some medium dark gray (N4) mottling in places, slightly sandy in places	13.2	2312.8	2326
Sandstone	White (N9) to very light gray (N8) with some medium dark gray (N4) siltstone interbeds	13.3	2326	2339.3
Coal	7.4 Coal, bright, hard, with resin 1.3 Coal, bright, hard (Used in gas test) 2.3 Coal, bright, hard with resin 17.74 Seam 2.9 Siltstone 3.7 Coal, bright, hard with resin 0.14 Coal with sandstone stringers	17.74	2339.3	2357.04
Sandstone	Medium light gray (N6) to medium gray (N5), fine-medium grained	8.45	2357.04	2365.5

Finished hole on 8/24/77
Stemmed hole to top.

DRILL HOLE LOG
McCULLOCH DRILL HOLE #191-78

LOCATION: SE1/4, NE1/4, Sec. 12, T. 13 S., R. 10 E., Deadman Canyon
Carbon County, Utah

LATITUDE:	503,594.472
DEPARTURE:	2,214,512.653
COLLAR ELEVATION:	7,282.91
TOTAL DEPTH:	887'
INCLINATION:	90

DRILLED BY: Jack Withers, Longyear Company

LOGGED BY: Don A. Stephens and Mark Bunnell/
American Electric Power Service Corporation

DATE STARTED: 5/29/78

DATE FINISHED: 6/8/78

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	HQ 0 - 279.9 NQ 279.9 - 867			
	Rock Bit		0	17
Sandstone	Yellowish gray (5 YR 8/1) to very light gray (N8) fine-medium grained with siltstone cross bedding in places	18.2	17	35.2
Siltstone	Light gray (N7) to medium dark gray (N4) slightly sandy to very sandy in places including some carbonaceous material with shale interbeds as follows: 1.7 @ 40.1 with sandstone interbeds as follows 1.1 @ 44.3, 1.5 @ 56, .8 @ 62.8	31.8	35.2	67.0
Sandstone	White (N9) to very light gray (N8) fine-medium grained with siltstone cross bedding in places with siltstone interbeds as follows: .4 @ 69.9, 1.5 @ 76.4	23.6	67.0	90.6
Siltstone	Medium light gray (N6) to brownish gray (5 YR 4/1) sandy in places with coal seams as follows: Top of coal 90.9 coal 0.52, Top of coal 96.5 coal/very silty 0.13, Top of coal 97.0 coal 1.0 siltstone/coal stringers 0.2 Top of coal 100.2 coal/ siltstone stringer 0.2, Top of coal 103.7 coal 1.0	14.1	90.6	104.7
Sandstone	Very light gray (N8) to white (N9) fine to medium grained with siltstone cross bedding in places with siltstone interbeds as follows: 1.6 @ 129.1	58.7	104.7	163.4
Siltstone	Light gray (N7) to brownish gray (5 YR 4/1) slightly sandy to very sandy in places with siltstone/coal stringers as follows: .6 @ 179.5	20.1	163.4	183.5
Coal	0.85 Coal, bright, hard 0.10 Siltstone/coal stringers 4.65 Coal, bright hard, with resin 5.84 Seam	5.84	183.5	189.34

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LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	0.09 Siltstone/coal stringers 0.15 Coal, bright, hard			
Sandstone	Light gray (N7) to very light gray (N8) fine to medium grained, carbonaceous with siltstone cross bedding in places, with siltstone/coal stringers interbeds as follows: 2.2 @ 189.34 with siltstone interbeds as follows: .5 @ 191.5	12.76	189.34	202.1
Siltstone	Medium gray (N5) to light gray (N7) to dark gray (N3) slightly sandy to very sandy in places, with sandstone interbeds as follows: 4.1 @ 228.1, with coal seams as follows: Top of coal 213.95 213.95 coal/slightly silty 1.6 coal/siltstone stringers .8, Top of coal 216.5 coal .6 coal/siltstone stringers .5, with siltstone/coal stringers interbedding as follows: 1.7 @ 205.8, .4 @ 217.6, .9 @ 220.9, 1.3 @ 226.4	32.6	202.1	234.7
Sandstone	Very light gray (N8) mottled, siltstone cross bedding in places carbonaceous in places, with coal seams as follows: Top of coal 243.3 coal 1.8 coal/siltstone stringers .4 with siltstone/coal stringers as follows: 1.2 @ 245.8	26.5	234.7	261.2
Siltstone	Dark gray (N3) to light gray (N7) sandy to very sandy in places, carbonaceous with siltstone/coal stringers as follows: .2 @ 262.2, 1 @ 265.3, .3 @ 276.7, .3 @ 297.9, .6 @ 315.4, .5 @ 317.5, .3 @ 320.5, 1.9 327.7, with coal seams as follows: Top of coal 261.2 coal/ siltstone stringers 1.1, Top of coal 276.4 coal/siltstone stringers .3, Top of coal 297.15 coal.65, Top of coal 318.05 coal 2.2 coal/siltstone Stringers .3 with sandstone interbeds as follows: 3.9 @ 311.6	70.3	261.2	331.5
Sandstone	Very light gray (N8) fine to medium grained, mottled with siltstone cross bedding, with fossiliferous siltstone interbeds as follows: .4 @ 363.6 with coal seams as follows: Top of coal 364.0 coal/siltstone stringers .2 coal .65 coal/siltstone stringers .2, Top of coal 365.75 coal/siltstone stringers.25, Top of coal 382.15	52.65	331.5	384.15

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	coal 2.0 with siltstone/coal stringer interbeds as follows: .7 @ 365.1, .4 @ 365.95, .25 @ 381.9 with siltstone interbeds as follows: .9 @ 366.3			
Siltstone	Medium gray (N5) to medium dark gray (N4) slightly sandy in places with fossils as follows: 2.7 @ 390.8, 9.9 @ 399.9 with sandstone interbeds as follows: 4.8 @ 394.5 with coal seams as follows: Top of coal 409.3 coal .13, Top of coal 409.6 coal/siltstone stringers .75, with siltstone/coal stringers .2 @ 410.4	34.65	384.15	418.8
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with siltstone cross bedding in places	79.1	418.8	497.9
Siltstone	Light gray (N7) to medium gray (N5) very sandy in places with sandstone lamina, carbonaceous	18.25	497.9	516.15
Coal	2.8 Coal, bright, hard, resinous	2.8	516.15	518.95
Siltstone	Medium gray (N5) to light gray (N7) slightly to very sandy with sandstone lamina, carboniferous	26.0	518.95	545.0
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained, carboniferous with siltstone cross bedding	13.75	545.0	558.75
Coal	0.2 Coal, bright, hard, resinous 0.22 Coal/siltstone stringers 3.77 Seam 3.3 Coal, bright, hard, resinous 0.02 Siltstone 0.03 Coal, bright, hard resinous	3.77	558.75	562.52
Siltstone	Medium dark gray (N4) slightly sandy	3.05	562.52	565.57
Coal	2.4 Coal, bright, hard, resinous 1.35 Coal, taken for gas test 9.85 Seam	9.85	565.57	575.42

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LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	6.1 Coal, bright, hard, resinous			
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with some siltstone cross bedding with some carboniferous partings with siltstone interbeds as follows: .4 @ 575.42, 1.6 @ 592.8	19.01	575.42	594.43
Coal	2.42 Coal, hard, black, resinous 2.46 Seam .04 Coal/siltstone stringers	2.46	594.43	596.89
Sandstone	Very light gray (N8) fine to medium grained with some siltstone cross bedding slightly carbonaceous in places with carbonaceous partings, some pyrite with siltstone interbeds as follows: 2.9 @ 596.89 with fractures as follows: 4.8 @ 659.7	68.51	596.89	665.4
Siltstone	Light gray (N7) to medium light gray (N6) very sandy to slightly sandy, slightly carbonaceous with sandstone interbeds as follows: 1.1 @ 673.4	20.9	665.4	686.3
Sandstone	Very light gray (N8) to light gray (N7) very fine to medium grained with siltstone cross bedding, carbonaceous in places, with siltstone interbeds as follows: .6 @ 710.9	46.3	686.3	732.6
Siltstone	Light gray (N7) to medium gray (N5) slightly sandy to very sandy in places with sandstone lamina	64.6	732.6	797.2
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with siltstone cross bedding in places, slightly carboniferous with siltstone interbeds as follows: .6 @ 842.9, 2.8 @ 850.6, .7 @ 859.9 2 with fractures as follows: .6 @ 862.7, 1.4 @ 871.3, 1.5 @ 874.1, 1.4 @ 875.7	89.8	797.2	887.0

HOLE FINISHED 6/8/78

cc6.chapter6/5

Total Depth: 887 feet

DRILL HOLE LOG
McCULLOCH DRILL HOLE #MC - 196 - 78

LOCATION: SW1/4, SE1/4, Sec. 13, T. 12 S., R. T E., Top Robinson Gulch, Carbon County, Utah

LATITUDE:	510,594.188
DEPARTURE:	2,154,191.905
COLLAR ELEVATION:	8,648.73
TOTAL DEPTH:	2200'
INCLINATION:	90

DRILLED BY: Gary Greener, Longyear Company

LOGGED BY: Mark Bunnell American Electric Power Service Corporation

DATE STARTED: 7/19/78

DATE FINISHED: 8/7/78

cc6.chapter6/5

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	Rotary: Starner Company Started: 7/19/78 Depth: 1195 ft.			
	Core: Longyear Company Started: 7/19/78 HQ 1195 - 1330 NQ 1330 - 2200			
	Rotary		0	1195
Siltstone	Medium gray (N5) to dark gray (N3) to bright gray (5 YR 4/1) slightly to very sandy and mottled in places carbonaceous, with sandstone interbeds as follows: 1.0 @ 1199.0, .6 @ 1208.1, .5 @ 1234.4, 3.2 @ 1239.2, 1.6 @ 1253.4, 5.5 @ 1263.7, 1.4 @ 1268.8, 1.2 @ 1275.6, .9 @ 1204.6, .9 @ 1318.9, 4.6 @ 1322.2, .3 @ 1332.6, 9.8 @ 1341.1, 1.9 @ 1358.1, 1.5 @ 1361.9, 1.1@ 1364.5, with carbonaceous shale interbeds as follows: 1.7 @ 1264.2, .6 @ 1330.8, with coal seams as follows: Top of coal 1264.4, siltstone/coal stringers - .13, with fractures as follows: .9 @ 1321.3, 2.2 @ 1323.1, 2.4 @ 1342.6	179.6	1195'	1374.4
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained, some carbonaceous partings	15.7	1374.4	1390.1
Siltstone	Light olive gray (5 Y 6/1) to dark gray (N3) to medium gray (N5) slightly to very sandy in places, mottled, carbonaceous, with sandstone interbeds as follows: 2.0 @ 1393.9, .3 @ 1398.4, .4 @ 1400.6, 1.2 @ 1410.8, 4.9 @ 1421.9, .7 @ 1434.5, 1.5 @ 1439.6, 14 @ 1440.8, 3.0 @ 1441.6, 3.8 @ 1449.7, .8 @ 1454.0, 1.9 @ 1455.9, 1.8 @ 1465.5-, .7 @ 1469.2, .8 @ 1476.6 1.2 @ 1477.9, 1.2 @ 1480.1, .9 @ 1487.3, .8 @ 1488.5, 1.3 @ 1492.9, 2.1 @ 1495.3, .5 @ 1497.9, .5 @ 1500.6, 5.8 @ 1510.8,/0 22.2 @ 1517.4, 1.8 @ 1529.3, 1.3 @ 1533.4, .9 @ 1536.8, 1.4 @ 1540.0, 1.1 @ 1548.3, 3.0 @ 1551.7, 2.5 @ 1570.6, .3 @ 1573.7, 1.6 @ 1576.3, 1.0 @ 1578.1, 19 @ 1585.2, .6 @ 1586.5, 1.4 @ 1589.7, 2.0 @	207.3	1390.1	1597.35

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	1592.5, with coal seams as follows: Top of coal 1585.5 coal - .10, Top of coal 1586.8 coal/siltstone stringers - .14, Top of coal 1594.58 siltstone/coal stringers - .18 coal - .43 coal/siltstone stringers - .07 coal - .6 coal/siltstone stringers - .13, with limestone interbeds as follows: .6 @ 1390.1			
Coal	1.65 - Coal, bright, hard resinous 1.75 Seam .10 - Siltstone/coal stringers	1.75	1597.35	1599.1
Siltstone	Medium gray (N5) to dark gray (N3) slightly to very sandy and mottled in places, carbonaceous, with sandstone interbeds as follows: .3 @ 1601.4, .4 @ 1602.1, .6 @ 1603.4, .5 @ 1619.3, 1.1 @ 1620.6, .5 @ 1625.4	27.8	1599.1	1626.4
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with siltstone x-bedding in places, carbonaceous, with siltstone interbeds as follows: .3 @ 1626.5, .2 @ 1627.8, 1.6 @ 1629.9, 5.5 @ 1633.4, 1.2 @ 1633.4, 1.2 @ 1643.6, 1.1 @ 1647.0, .2 @ 1650.0, with coal seams as follows: Top of coal 1646.4 coal - .45 siltstone/coal stringers - .15	25.3	1626.4	1651.6
Siltstone	Medium gray (N5) to dark gray (N3) slightly sandy in places, carbonaceous	4.6	1651.6	1656.2
Coal	2.75 Coal 0 bright, hard resinous 2.87 Seam .12 Coal/siltstone stringers	2.87	1656.2	1659.07
Siltstone	Medium gray (N5) to dark gray (N3) slightly to very sandy in places, carbonaceous, with sandstone interbeds as follows: 3.8 @ 1660.8, .9 @ 1665.8, 1.3 @ 1667.3, .2 @ 1668.8, .3 @ 1669.3, .3 @ 1689.8, .7 @ 1690.3, .4 @ 1691.6, 1.4 @ 1696.5, with coal seams as follows: Top of coal 1694.93 siltstone/coal stringers - .1	46.5	1659.07	1705.2

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
Sandstone	Very light gray (N8) fine to medium grained, with siltstone lamina	1.62	1705.2	1706.82
Coal	.14 Coal/siltstone stringers .40 Coal - bright, hard resinous 4.54 Seam .48 Siltstone .21 Siltstone/coal stringers 3.10 Coal - bright, hard, resinous .11 Coal/siltstone stringers	4.54	1706.82	1711.36
Sandstone	Light gray (N7) fine to medium grained, fractured	2.7	1711.36	1714.4
Siltstone	Medium gray (N5) to dark gray (N3) slightly to very sandy and mottled in places, carbonaceous, with sandstone interbeds as follows: .3 @ 1722.8, 1.9 @ 1724.6, 6.4 @ 1730.4, .7 @ 1740.9, .9 @ 1742.4, .7 @ 1744.1, .9 @ 1748.6, .3 @ 1750.1, .8 @ 1754.9, 8.0 @ 1756.6, .4 @ 1770.9, with coal seams as follows: Top of coal 1726.5 coal - .2, Top of coal 1728.1 @ siltstone/ coal .22, Top of coal 1736.9 coal - .65 siltstone/coal - .11	54.0	1714.4	1768.05
Coal	.3 Coal/siltstone stringers 2.27 Seam 2.14 Coal - bright, hard resinous	2.27	1768.05	1770.32
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with siltstone x-bedding and mottling in places, carbonaceous, with siltstone interbeds as follows: 1.6 @ 1771.2, .5 @ 1775.9, 4.9 @ 1783.2, 1.4 @ 1794.9, with coal seams as follows: Top of coal 1796.6 siltstone/coal stringers - .28, coal - .73	28.9	1770.32	1799.3
Siltstone	Medium gray (N5) to dark gray (N3) slightly to very sandy and mottled in places, carbonaceous, with sandstone interbeds as follows: 1.7 @ 1805.9, .7 @ 1809.5, 5.0 @ 1814.7, 1.0 @ 1830.5, .4 @ 1836.9, 1.2 @ 1841.1., .7 @ 1847.7, 1.0 @ 1850.0,	109.4	1799.3	1908.6

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	1.5 @ 1853.3, .6 @ 1855.4, 2.3 @ 1860.4, 1.4 @ 1864.4, .2 @ 1866.7, .3 @ 1876.0, 3.6 @ 1880.8, 3.9 @ 1885.2, 1.3 @ 1892.7, .5 @ 1895.6, .9 @ 1897.6, .7 @1899.3, .2 @ 1900.3, .7 @ 1903.8, 2.2 @ 1906.3, with coal seams as follows: Top of coal 1800.52 coal - .55, Top of coal 1863.1 coal - .18, Top of coal 1874.95 coal - .45, Top of coal 1878.66 coal/siltstone stringers - .52, Top of coal 1890.75 coal - .45			
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with siltstone lamina, carbonaceous, with siltstone interbeds as follows: .6 @ 1916.0, with fractures as follows .5 @ 1912.1	8.0	1908.6	1916.6
Coal	.08 Coal/siltstone stringers 12.36 Coal - bright, hard, resinous 14.55 Seam .07 Siltstone/coal stringers 2.04 Coal - bright, hard, resinous	14.55	1916.6	1931.15
Siltstone	Medium gray (N5) to medium dark gray (N4) slightly sandy in places, with sandstone lamina	7.7	1931.15	1938.5
Sandstone	Very light gray (N8) to white (N9) fine to medium grained, with some siltstone lamina, carbonaceous, with siltstone interbeds as follows: .7 @ 1939.4, 0 1.8 @ 1948.6, 1.9 @ 1952.6, 7.4 @ 1955.1, 1.4 @ 1964.3, .5 @ 1968.3, 1.1 @ 1970.3	32.5	1938.5	1971.44
Coal	5.71 Coal - bright, hard, resinous .11 Coal/siltstone stringers 6.02 Seam .17 Coal - bright, hard, resinous .03 Coal/siltstone stringers	6.02	1971.44	1977.46
Sandstone	Very light gray (N8) to light gray (N6) fine to medium grained, massive, with siltstone x-bedding beginning	82.4	1977.46	2059.5

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	
	at 2023 feet, with siltstone interbeds as follows: .9 @ 1977.46, .7 @ 2031.8, .2 @ 2040.4, .7 @ 2040.4, 1.4 @ 2051.6, .5 @ 2055.1, with fractures as follows: .8 @ 1982.9, .4 @ 2015.8, .6 @ 2028.4, .4 @ 2033.1			
Siltstone	Dark gray (N3) to bright gray (5 YR 4/1) to medium gray (N5) slightly to very sandy and mottled in places, carbonaeous, with sandstone interbeds as follows: .3 @ 2066.3, 10.3 @ 2070.4, .5 @ 2096.0, 1.0 @ 2102.9, 2.2 @ 2105.8, with coal seams as follows: Top of coal 2101.6 coal - .04, Top of coal 2109.95 siltstone/coal stringers - .05 coal/siltstone stringers - .16 siltstone coal stringers - .55	68.4	2059.5	2127.57
Coal	.09 Coal/siltstone stringers 1.10 Seam 1.01 Coal - bright, hard resinous	1.10	2127.57	2128.67
Siltstone	Bright gray (5 YR 4/1) to dark gray (N3) slightly to very sandy with sandstone lamina, carbonaceous, fossiliferous, with fossils as follows: .55 @ 2131.15	3.06	2128.67	2131.73
Coal	.10 Coal/siltstone stringers .09 Siltstone 2.61 Coal - bright, hard, resinous 4.07 Seam .94 Coal/siltstone stringers .26 Coal - bright, hard, resinous .10 Siltstone .79 Coal - bright, hard resinous .08 Coal/siltstone stringers	4.07	2131.73	2135.80
Sandstone	Very light gray (N8) to light gray (N7) fine to medium grained with siltstone x-bedding in places, fossiliferous, carbonaceous in places, with siltstone interbeds as follows: .2 @ 2135.8, .1 @ 2139.3, .3 @ 2140.6, .7 @ 2140.8, .2 @ 2142.1, 1.85 @ 2142.7, 1.4 @ 2145.2, .5 @ 2155.7,	30.5	2135.8	2166.35

LITHOLOGY	DESCRIPTION	THICKNESS RECOVERED	FROM	TO
	.2 @ 2158.2, 3.2 @ 2162.2, with fossils as follows: .3 @ 2141.55, 1.45 @ 2143.1, with coal seams as follows: Top of coal 2144.55 coal/siltstone stringers - .08 coal - .48 siltstone/coal stringers - .03			
Siltstone	Medium gray (N5) to bright gray (5 YR 4/1) carbonaceous, with some coal stringers	1.2	2166.2	2167.55
Coal	3.22 Coal - bright, hard, resinous .22 Siltstone 1.37 Coal - bright, hard, resinous .18 Siltstone/coal stringers 8.42 Seam 1.75 Coal - bright, hard, resinous vertical fracturing some calcite .08 Siltstone/coal stringers 1.44 Coal - Bright, hard, resinous, some calcite .16 Coal/slightly silty	8.42	2167.55	2175.97
Sandstone	White (N9) to light gray (N7) fine to medium grained massive, with fractures as follows: .4 @ 2179.3	24.2	2157.97	2200

Hole finished 8/1/78
T.D.: 2200

Drill Hole Log
McCulloch Hole No. 6-73

Location: NE1/4NW1/4, Sec. 35, T. 12 S., R. 9 E., Carbon County, Utah
Bear Canyon

Collar Elevation:
Total Depth: 865.0'
Inclination: 90

	Core
Date Started	7/13/73
Date Stopped	7/31/73

Footage From	Footage To	Feet	Rec'y	Remarks
	58.2	58.2		0.0 Broken ss. overburden
58.2	64.6	6.3	6.3'	2.0' Fine gr. ss. 1.2' Carb. shale 3.1' Fine gr. ss.
64.6	75.0	10.4	10.4'	1.8' Dark gray fine gr. carb. ss. 2.2' Light gray Med. gr. ss. 2.5' Fine gr. dark gray siltstone 0.4' Carb. siltstone 3.5' Fine gr. ss., some carb. partings
75.0	85.0	10.0	10.0'	3.0' Fine gr. ss. 1.0' Carb. siltstone to shale 0.8 Med. gr. white ss. 1.9' Black carb. shale 0.4 Bony coal 0.9 Fine gr. white ss. 2.0' Carb. shale, some coal partings
85.0	95.0	10.0	10.0'	1.0' Dark gray siltstone 3.1' Light to dark gray siltstone 0.5 Light gray fine gr. ss. 1.5' Dark gray shalely siltstone 1.4' Carb. shale with coal partings 2.5' Fine gr. gray to white ss.
95.0	105.0	10.0	9.0'	0.0 No apparent loss of core 2.9' Dark gray siltstone and fine gr. ss., minor partings 0.7 Soft carb. shale 0.5 Dirty coal, shalely partings 4.9' Med. gr. ss., siltstone in lower 0.5'

Footage From	Footage To	Feet	Rec'y	Description
105.0	114.2	9.2	10.2'	0.0 Run contains shortage from previous run 2.4' Dense dark gray siltstone, minor carb. inclusions 1.7' Fine to med. gr. white ss. 0.7' Carb. shale, coal partings 3.6' Med. gr. light gray ss., irreg. carb. inclusions 0.5 Bone with coal partings 1.3' Dirty med. gr. gray ss.
14.2	124.6	10.4	10.4'	0.7' Fine gr. gray ss. 2.4' Black carb. shale with minor coal partings 5.0' Med. gr. gray ss. with irreg. carb. and coal inclusions 2.3' Med. to coarse gr. light gray ss.
124.6	134.9	10.3	10.0'	5.7' Med. to coarse gr. ss., minor carb. partings in lower 2' 2.5' Carb. shale with irreg. shite ss. 1.0' Black carb. shale, some coal inclusions 0.8 Dark gray shale
134.9	145.0	10.1	10.4'	3.2' Med. gr. ss., minor shale partings in lower 1' 0.5 Bony coal 2.7' Gray ss., some shalely partings 1.0' Carb. shale, some coal partings 1.4' Dirty med. gr. ss. 1.6' Black carb. shale, some siltstone
145.0	155.0	10.0	9.5'	1.4' Carb. shale and siltstone 2.0' Dirty med. gr. ss., some shale partings 0.9 Coal, minor bony inclusions 4.3' Fine gr. ss. to siltstone, minor carb. inclusions 0.4 Carb. shale 0.5 Med. gr. gray ss.
155.0	158.1	3.1	3.5'	0.5' Carb. shale, some dirty ss. 0.6' Dirty bony coal, some shale 2.4' Med. gr. gray ss., minor coal partings

Footage From	Footage To	Feet	Rec'y	Description
158.1	168.4	10.3	10.0'	1.3' Med. gr. gray ss. 0.3 Carb. shale, coal inclusions 0.9 Bony coal 2.0' Carb. shale, sandy toward bottom 0.6 Dirty med. gr. ss. 0.5 Carb. shale 4.4' Med. gr. dark gray ss., coarse gr. near bottom
168.4	175.0	6.6	7.0'	7.0' Med. to coarse gray ss., irreg. twisted dark banding
175.0	185.0	10.0	10.0'	3.9' Med. to coarse gr. gray ss., irreg. dark banding 1.4' Coal, minor bone 3.6' Dark gray siltstone, minor shale 0.1' Carb. shale, with coal inclusions 1.0' Dark gray siltstone
185.0	195.0	10.0	10.0'	3.4' Fine gr. dark gray ss. 1.4' Carb. shale with minor coal inclusions 5.2' Light to dark gray fine gr. ss to siltstone
195.0	205.0	10.0	9.8'	4.8' Dark and light gray ss., minor siltstone 0.8' Soft carb. shale 0.8' Coal 1.7' Dark gray carb. siltstone 1.7' Dark to light gray fine gr. ss. siltstone
205.0	215.0	10.0	10.1'	2.2' Dark and light gray fine gr. ss. and siltstone 1.2' Carb. shale, minor bone and coal partings 1.6' Dirty coal, shale and bone partings 0.4 Carb. shale, minor coal partings 2.0' Dense carb. siltstone 1.2' Light gray med. gr. ss. 1.5' Dark and light gray ss. and siltstone
215.0	225.0	10.0	10.0'	1.2' Dense black carb. siltstone 1.2' Coal, minor bone 0.7 Bone, minor coal 1.8' Fine gr. gray ss. to siltstone 1.4' Black carb. shale to siltstone

Footage From	Footage To	Feet	Rec'y	Description
				3.7' Light gray med. gr. ss., minor carb. partings
225.0	235.0	10.0	9.7'	9.7' Med. gr. gray to white ss. minor irreg. carb. banding
235.0	245.0	10.0	10.2'	3.4' Med. gr. gray ss. 0.1' Coal 1.09' Carb. shale 3.6' Light to dark gray med. gr. ss. .9 Dense carb. shale 1.2' Med. gr. gray ss.
245.0	255.0	10.0	10.2'	0.5' Sandy shale 9.7' Med. to coarse gr. gray ss., minor carb. inclusions
255.0	265.0	10.0	9.5'	9.5' Med. to coarse gr. gray ss., minor carb. partings
265.0	270.0	5.0	4.8'	0.4' Coal 0.9' Bony shale 0.8' Carb. shale 2.7' Med. gr. ss.
270.0	280.4	10.4	10.4'	1.4' Med. gr. gray ss. 1.1' Carb. shale 1.0' Fine gr. ss. 1.6' Carb. siltstone, some shale partings 2.2' Dark gray siltstone 0.4 Bony siltstone 1.0' Bony coal 1.7' Med. gr. white ss.
280.4	285.0	4.6	5.0'	0.0 Med. gr. dark and light gray ss., minor shalely partings
285.0	287.0	2.0	2.2'	0.8' Broken shalely siltstone 1.4' Siltstone, some fine gr. ss.
287.0	295.0	8.0	8.2'	0.8' Black shale, blocky 4.8' Med. gr. ss., fine gr. in lower 2' 0.7' Fine gr. gray ss., minor carb. partings 1.3' Coal, some irreg. bone 0.6 Fine gr. ss., minor carb. partings

Footage From	Footage To	Feet	Rec'y	Description
295.0	305.0	10.0	10.0'	3.2' Thin bedded ss., some shaley partings 6.8' Fine grained ss.
305.0	315.0	10.0	9.8'	2.2' Fine grained gray ss. 0.3' Bony coal 0.2' Shale 3.4' Fine to med. gr. gray ss., minor carb. paritngs 0.2' Bone 2.0' Carb. shale 1.5' Siltstone, some carb. partings
315.0	325.0	10.0	10.0'	1.0' Carb. shale, minor coaly partings 9.0' Med. to coarse gr. light gray ss.
325.0	335.0	10.0	10.2'	0.0 Light and dark gray mottled ss., blocky
335.0	345.0	10.0	10.1'	0.0 Light and dark gray mottled ss., minor partings
345.0	355.0	10.0	10.2'	3.1' Light and dark gray ss., blocky 0.2' Coal 0.2' Shalely coal 2.0' Coal 0.1' Bony shale 3.8' Light gray med. gr. ss. 0.8' Dark gray siltstone
355.0	365.0	10.0	10.0'	0.4' Dark gray siltstone 5.4' Light and dark gray ss., minor carb. partings 0.4' Bony coal 3.0' Med. gr. gray ss., irreg. carb. banding 0.5' Coal, minor bone 0.3' Fine gr. ss.
365.0	375.0	10.0	10.5'	7.4' Fine to med. gr. gray ss., minor partings 0.2' Bone 2.9' Clean coal Box 35)) 'E' 5.6'
375.0	385.0	10.0	9.9'	2.7' Clean coal Box 36) 0.1' Bone 7.1' Med. to fine gr. gray ss., blocky

cc6.chapter6/6

Footage From	Footage To	Feet	Rec'y	Description
385.0	395.0	10.0	10.1'	5.3' Med. to coarse gr. gray ss., blocky 0.1' Bony coal 1.9' Fine gr. ss. 1.3' Carb. shale, some coal partings, some sandy 1.5' Med. gr. ss.
395.0	405.0	10.0	9.9'	0.0 Fine to med. gr. light and dark gray ss., blocky
405.0	415.0	10.0	10.3'	1.0' Carb. shale, minor coal and bone 4.6' Thin banded blocky siltstone 0.5' Blocky carb. shale 0.5' Bony coal 3.7' Clean coal Box 39)) 'D' 7.9'
415.0	425.0	10.0	9.5'	4.2' Clean coal Box 40) 0.2' Bony coal 5.1' Fine to med. gr. gray ss., blocky
425.0	435.0	10.0	10.2'	10.2' Med. gr. gray ss., lower 2' more silty
435.0	445.0	10.0	10.3'	5.0' Med. gr. gray ss. 0.8' Med. gr. gray ss., secreting yellow oil 1.1' Coal 0.3 Dirty ss. 3.1' Fine to med. gr. gray ss.
445.0	455.0	10.0	9.8'	6.3' Fine gr. dark gray ss., minor carb. banding 2.4' Coal 0.1 Coal 1.0' Silty ss.
455.0	465.0	10.0	10.3'	10.3' Fine to med. gr. ss., few carb. partings in lower 2'
465.0	475.0	10.0	10.3'	1.6' Dark gray siltstone 0.5' Bony coal 0.3' Bony 2.3' Dark sandy shale 0.6' Coal 0.3' Shale 4.7' Fine to med. gr. ss.

Footage From	Footage To	Feet	Rec'y	Description
475.0	485.0	10.0	9.7'	5.4' Med. gr. ss. 2.5' Siltstone with some carb. partings 1.8' Med. gr. white ss.
485.0	495.0	10.0	10.6'	4.0' Med. gr. ss. with shalely partings in lower 2' 0.1' Bone 1.4' Coal 0.9' Gray med. gr. ss. 0.4' Bone 1.7' Coal 0.6' Bony shale 1.5' Coal
495.0	505.0	10.0	10.0'	0.5' Coal 0.2' Bone 2.1' Coal 0.1' Bony shale 3.4' Med. gr. ss. 0.1' Carb. shale 1.1' Coal 2.5' Fine gr. banded ss.
505.0	515.0	10.0	10.2'	5.3' Dense fine gr. ss. to siltstone 2.8' Light gray med. gr. ss. 1.8' Bony shale, minor coal 0.3' Coal
515.0	525.0	0.0	9.9'	0.5' Coal 0.1' Bone 1.0' Gray med. gr. ss. 1.1' Carb. shale, with coal partings 1.0' Bony shale, minor coal 6.2' Med. gr. gray and white ss.
525.0	535.0	10.0	10.5'	3.6' White to gray med. gr. ss. 2.0' Dark, fine banded siltstone 4.9' Dark gray siltstone with bands of light gray ss.
535.0	545.0	10.0	9.8'	4.8' Med. to coarse gr. ss., minor carb. banding 5.0' Coarse white ss., some carb. partings parallel to core
545.0	555.0	10.0	10.5'	0.4' Dark gray ss. 1.5' Shalely carb. siltstone

Footage Foot	To	Feet	Rec'y	Description
				1.2' Carb. shale, some coal and bone
				7.3' Light and dark gray mottled ss.
555.0	565.0	10.0	10.0'	6.1' Light gray med. gr. ss., some mottled in first 1'
				1.0' Dark gray sandy siltstone
				0.1 Bony shale
				1.5' Coal Bench 1
				0.8 Bone and bony coal-Bench 2
				0.5 Coal)
				)
565.0	575.0	10.0	10.0'	10.0' Clean coal) Bench 3
				)
575.0	585.0	10.0	10.0'	2.2' Clean Coal)
				0.5' Carb. siltstone
				1.6' Dark gray ss., some carb. trash
				5.7' Light and dark gray mottled and banded ss.
585.0	595.0	10.0	10.0'	1.5' Med. gr. light gray ss.
				0.3' Bony coal
				0.3' Bony ss.
				7.9' Clean coarse gr. white ss.
595.0	605.0	10.0	10.0'	10.0' Coarse gr. light gray ss., minor carb. banding
605.0	615.0	10.0	10.2'	1.3' Coarse gr. ss.
				3.4' Med. gr. ss. with some siltstone banding
				6.5' Med. gr. ss., some dark banding
615.0	625.0	10.0	9.8'	1.3' Dark gray med. gr. ss.
				3.1' Dense dark siltstone
				0.2' Coal and shale, mixed
				5.2' Clean coal)
				) 'A'
625.0	634.0	9.0	9.0	0.7' Coal, minor bone in bottom 0.2')
				0.3' Carb. shale
				1.2' Dense dark siltstone, minor shalely partings
				2.0' Dense dark fine gr. ss. to siltstone
				4.8' Med. to coarse gr. light gray ss., minor banding
634.0	635.0	1.0	1.3'	1.3' Med. to coarse gr. light gray ss., minor banding

Footage From	Footage To	Feet	Rec'y		Description
635.0	645.0	10.0	9.9′	3.0′	Med. gr. ss., irreg. dark banding
				6.9′	Clean coarse gr. Aberdeen ss.
645.0	665.0	10.0	10.0′	10.0′	Clean coarse gr. Aberdeen ss.
655.0	665.0	10.0	10.0′	10.0′	Clean coarse gr. ss., minor carb. banding
665.0	675.0	10.0	10.2′	10.2′	Coarse gr. ss., minor carb. partings
675.0	685.0	10.0	9.8′	9.8′	Coarse to med. gr. ss., minor dark banding
685.0	695.0	10.0	10.1′	10.1′	Med. to coarse gr. ss., some gray mottling
695.0	705.0	10.0	10.0′	10.0′	Coarse gr. gray ss.
705.0	715.0	10.0	10.1′	10.1′	Coarse gr. gray ss., some mottling
715.0	725.0	10.0	9.4′	9.4′	Med. and coarse gr. mottled gray ss., some carb. trash
725.0	735.0	10.0	10.1′	4.0′	Med. gr. ss., some carb. trash
				6.1′	Coarse gr. gray ss.
735.0	745.0	10.0	10.1′	10.1′	Coarse gr. gray ss.
745.0	755.0	10.0	10.1′	10.1′	Coarse to med. gr. ss., some shalely partings
755.0	765.0	10.0	10.0′	10.0′	Med. to coarse gr. ss., minor shalely partings
765.0	775.0	10.0	10.2′	10.2′	Clear coarse gr. gray ss.
775.0	785.0	10.0	10.1′	10.1′	Coarse gr. gray ss.
785.0	795.0	10.0	10.0′	10.0′	Coarse gr. gray ss., 1/2" bone at 790.4′
795.0	805.0	10.0	10.0′	2.9′	Coarse gr. gray ss.
				2.5′	Coal, 1/2" ss. at +1.7′
				4.6′	Dirty brownish gray med. gr. ss.
805.0	815.0	10.0	10.0′	0.7′	Dirty brownish gray med. gr. ss.
				0.5′	Med. gr. gray ss.

Footage From	Footage To	From	Rec'y		Description
				1.6'	Mixed ss. and carb. shale
				7.2'	Coarse gr. light gray ss.
815.0	825.0	10.0	10.0'	1.3'	Coarse gr. light gray ss.
				4.3'	Mottled dark gray ss.
				4.4'	Med. to fine gr. light and dark gray ss., minor banding
825.0	835.0	10.0	10.1'	2.0'	Med. gr. ss., fine banding in lower 1'
				6.8'	Dark gray to black fine gr. ss. and siltstone, consid. shell fragments
				0.1'	Bony ss.
				1.2'	Med. gr. gray ss.
835.0	845.0	10.0	9.7'	4.7'	Med. to coarse gr. ss.
				0.5'	bony shale
				1.0'	Fine gr. dirty ss.
				1.5'	Med. gr. banded ss.
				0.2'	Bony ss.
				1.7'	Dark gray med. gr. ss.
845.0	855.0	10.0	10.0'	1.0'	Dense black siltstone
				0.3'	Bone and bony shale
				6.0'	Clean coal (Sub-3)
				0.2'	Bony ss.
				2.5'	Clean coarse gr. ss. (Star Point)
855.0	865.0	10.0	10.0'	10.0'	Clean coarse gr. ss. (Star Point)

Drill Hole Log
McCulloch Hole No. 48

Location: NE1/4NE1/4, Sec. 27, T. 12 S., R. 9 E., Carbon County, Utah
Price Canyon

Collar Elevation: 6370'
Total Depth: 1625'
Inclination: 90

Date Started 3/10/75
Date Stopped 3/31/75

Footage From	Footage To	Feet	Rec'y	Remarks
0	30	30.0		0.0 Plugged and cased
30	35	5.0	5.0	5.0 Gray to dark gr. siltst
35	45	10.0	9.8	3.1 Gray and white banded, fine gr. ss. and siltst. interbedded 6.7 White, fine gr. ss., carb. parts, uniform
45	55	10.0	9.7	9.7 White, fine gr. ss., uniform
55	65	10.0	10.3	10.3 White, fine gr. ss., carb. parts uniform
65	75	10.0	10.2	4.1 White, fine gr. ss. 4.9 Gray to dark gr. siltst. to very fine gr. ss., carb. 1.2 Light gr. to white, very fine gr. ss.
75	85	10.0	9.7	4.8 Gray to light gr. siltst. to very fine gr. ss. 4.9 White, fine gr. ss., x bedded, uniform
85	95	10.0	10.1	5.8 White, fine gr. ss. 2.9 Gray to dark gr. siltst. to very fine gr. ss. 1.4 White, fine gr. ss.
95	105	10.0	10.1	7.2 White, fine to med. gr. ss. 2.9 White to light gr. fine gr. ss.

cc6.chapter6/6

DRILL HOLE LOG

Area: Price Canyon

Hole No. MC48

Page _____

Location: NE¼NE¼ Sec 27

N. T12S

E. R9E

Collar Elev. 6370'

Total Depth 1625'

Inclination 90°

Bearing _____

	Plug	Date
Date Start		3-10-75
Date Stop		3-31-75

Sample Number

Description

0.3 Coal

0.3 Coal

D SEAM 18.6 Coal

3.3 Coal

1.1 Coal

0.4 Coal

1.6 Coal

3.1 Shale

3.1 Coal

A SEAM 22.0 Coal

Sub Seam 2 3.5 Coal

2.5 Coal

Sub Seam 3 1.0 Coal

1000 1100 1200 1300 1400 1500 1600 1628

T.D.

% Rec'y

Footage

Rec'y 177.6 234.6

Feet

To

From

Footage From	Footage To	Feet	Rec'y		Description
105	115	10.0		4.1	Light gr., fine gr. ss.
				6.0	White, and gr. mottled, fine gr. ss.
115	125	10.0	10.0	10.0	White, fine gr. ss. uniform
125	355	230.0	230.0	230.0	White, fine to med. gr. ss., some gr. mottling x bedding, generally uniform, some carb. partings - Castle Gate SS
355	365	10.0	10.1	10.1	White, med. gr. ss., x bedded with thin coal bands, and carb. parts
365	375	10.0	10.1	10.1	White, med. gr. ss., x bedded, carb. parts
375	385	10.0	10.0	10.0	White med. gr. ss., x bedded carb. parts
385	425	40.0	39.8	39.8	White, fine to med. gr. ss., x bedded some carb. parts some light gr. sandy zones
425	465	40.0	40.0	40.0	Gray to light gr. and white mottled, fine to very fine gr. ss.
465	475	10.0	10.0	7.0	White, fine gr. ss. some gr. mottling
				1.2	Light gr., fine gr. ss.
				1.8	White, fine gr. ss.
475	485	10.0	10.0	2.5	Light gr., fine gr. ss., carb. trash
				3.3	White, fine to med. gr. ss., x bedded
				4.2	Light gr. fine to very fine gr. ss.
485	495	10.0	10.0	8.6	Light gr. to white, fine to very fine gr. ss.
				1.4	Light gr. to gr. siltst. to very fine gr. ss.

Footage From	Footage To	Feet	Rec'y	Description
495	515	20.0	19.9	2.5 Light gr. to gr. siltst. to very fine gr. ss. 16.3 White, fine to med. gr. ss., x bedded uniform 1.1 Gray and white mottled fine to very fine gr. ss.
515	525	10.0	9.8	9.8 Gray and white mottled fine to very fine gr. ss. 3.1 Gray to dark gr. siltst., carb. 5.8 Light gr. to gr. siltst. to very fine gr. ss.
525	535	10.0	9.8	8.5 White, fine gr. ss., uniform, x bedded 1.3 Gray siltst., carb.
535	545	10.0	10.3	0.4 Gray siltst. 8.7 White, fine gr. ss., uniform, carb. parts 1.2 Gray to light gr. siltst.
545	555	10.0	10.1	3.3 Gray to light gr. siltst. 1.6 White, fine gr. ss. 5.2 Gray to light gr. siltst. to very fine gr. ss.
555	565	10.0	9.9	0.9 White, fine gr. ss. 2.3 Gray siltst. 6.7 Gray to light gr. siltst. to very fine gr. ss.
565	585	20.0	19.7	2.7 Light gr. to white, fine to very fine gr. ss. 2.8 Gray siltst. 2.0 White, fine to med. gr. ss. 12.2 Light gr. to gr. siltst.
585	595	10.0	9.9	2.3 Gray to dark gr. siltst. 1.2 White, and gr. mottled, fine gr. ss. 6.5 Gray siltst.
595	605	10.0	10.0	1.0 Gray to light gr., very fine gr. ss. 9.0 Gray and white mottled, fine gr. ss.

Footage From	Footage To	Feet	Rec'y	Description
605	615	10.0	10.0	10.0 White to gr. and white mottled, fine gr. ss.
615	625	10.0	10.1	9.2 White fine to med. gr. ss., x bedded uniform 0.9 Dark gr. siltst., carb.
625	635	10.0	9.8	0.6 Dark gr. siltst., carb. 3.4 Gray to light gr. siltst. 5.8 White to gray & white mottled, fine gr. ss.
635	645	10.0	10.1	4.4 Gray, fine to very fine gr. ss., carb. parts 5.7 White, fine gr. ss., uniform
645	655	10.0	10.0	6.5 White, fine gr. ss., x bedded, uniform 3.5 Gray to light gr. siltst., carb.
655	665	10.0	9.9	9.9 Gray siltst. to light gr. very fine gr. ss
665	675	10.0	9.9	2.0 Gray to dark gr. siltst., carb. 3.1 Light gr. to white, fine to very fine gr. ss. 4.8 Light gr. to gr. siltst.
675	685	10.0	10.1	2.5 Gray siltst. 3.7 White, fine gr. ss., dark thin bedding 2.4 Gray to dark gr. siltst., carb. 1.5 Light gr. siltst. to very fine gr. ss.
685	695	10.0	9.3	1.1 Dark gr. siltst. 1.8 Light gr. siltst., to very fine gr. ss. 5.0 White & gr. mottled, fine gr. ss.
CHECKED				1.5 Gray to dark gr. siltst., carb.
695	705	10.0	10.8	2.6 Gray siltst. 1.0 Light gr. to white, fine gr. ss. 7.2 Gray to dark gr. siltst., carb.
705	715	10.0	10.1	0.2 Gray siltst. 9.1 White fine to med. gr. ss.,

Footage From	To	Feet	Rec'y	Description
				x bedded
				0.8 Light gr. siltst.
715	725	10.0	9.5	2.3 Light gr. siltst.
				2.9 White & gray mottled fine gr. ss.
				2.5 Light gr. siltst.
				1.8 Light gr. to white, fine gr. ss.
725	735	10.0	9.8	4.7 White, to light gr. fine gr. ss. some carb. trash
				0.4 Dark gr. to black siltst., highly carb., bony
				4.6 Light gr. to gr. siltst.
735	745	10.0	10.0	2.8 White, fine gr. ss.
				2.6 Gray siltst.
				4.6 White fine gr. ss.
745	755	10.0	10.0	10.0 White, fine gr.ss., some carb. parts
755	765		9.5	5.3 White, fine gr. ss., uniform
				3.1 Gray to light gr. siltst.
				0.8 White to light gr. fine to very fine gr. ss.
				0.3 Gray siltst.
765	775	10.0	9.9	1.4 White, fine gr. ss.
				1.8 Gray to dark gr. siltst.
				1.7 Gray and white, mottled, fine gr. ss.
				2.9 Gray to light gr. siltst.
				2.1 White, fine gr. ss.
775	785	10.0	10.0	7.2 White, fine to med. gr. ss., x bedded
				2.3 Gray siltst.
				0.5 White, fine gr. ss.
785	795	10.0	10.0	6.9 White, fine gr. ss., some dark thin bands
				1.2 Gray fine gr. ss.
				1.6 White, fine gr. ss.
				0.3 Gray siltst.
795	805	10.0	9.9	2.5 Gray siltst.
				0.8 Gray and white mottled, fine gr. ss.
				4.0 Gray to light gr. siltst. to very fine gr. ss.

Footage From	Footage To	Feet	Rec'y	Description
				2.6 White, fine gr. ss., uniform
805	815	10.0	9.5	3.7 White, fine to med. gr. ss., uniform 2.3 White to light gr. fine gr. ss. 3.5 Gray siltst.
815	825	10.0	10.3	7.6 Gray to dark gr. siltst., carb. 2.7 Gray to white and gr. mottled, fine gr. ss., carb. trash
825	835	10.0	10.3	1.7 Gray to white and gr. mottled, fine gr. ss., carb. trash 5.9 Gray siltst. to very fine gr. ss. 1.4 White, fine to vey fine gr. ss. 1.3 Gray and white, mottled, siltst. to very fine gr. ss.
835	845	10.0	9.0	0.1 Gray silst. 0.5 Dirty coal, bony 2.5 Gray to light gr. siltst. to very fine gr. ss. 0.8 Coal 0.2 Dirty coal, bony 4.9 Gray to light gr. siltst.
CHECKED				
845	855	10.0	10.3	10.3 Gray siltst., uniform
855	865	10.0	10.3	3.1 Gray siltst. 1.3 Light gr. fine to very fine gr. ss. 2.3 Light gr. siltst. 0.7 White & gr. mottled, fine gr. ss. 2.9 Gray to light gr. siltst.
865	875	10.0	10.3	0.9 Gray siltst. 2.7 Light gr. to white, fine to very fine gr. ss. 1.7 Gray siltst. 5.0 White, fine gr. ss.
875	885	10.0	9.6	8.4 White, fine gr. ss., uniform 1.2 Gray siltst.
885	895	10.0	9.9	6.7 Light gr. to white, siltst. to very fine gr. ss. 1.6 Light gr. to fine gr. ss. 1.6 Light gr. to white, siltst.

Footage From	Footage To	Feet	Rec'y	Description
895	905	10.0	9.3	3.9 Light gr. to gr. siltst. to very fine gr. ss. 1.0 White fine gr. ss. 2.8 Light gr. to white, fine to very fine gr. ss. 1.6 Gray siltst.
905	915	10.0	10.1	1.3 Gray siltst. 3.7 Light gr. to white, fine gr. ss. 0.5 Dark gr. to black siltst., highly carb., bony 0.8 Dirty coal, bony 3.8 Gray to dark gr. siltst., carb.
915	925	10.0	8.9	6.4 Gray to white & gr. mottled, fine gr. ss. 2.5 Gray siltst.
925	935	10.0	11.2	1.4 Gray to light gr. siltst. 5.2 Light gr. to white, fine to very fine gr. ss. 2.4 White, fine gr. ss. 1.8 Light gr. to gr. siltst. 0.4 Light gr. to white, fine gr. ss.
935	945	10.0	9.8	1.8 White, fine gr. ss. 1.6 Gray siltst. 1.2 Light gr. to white, fine gr. ss. 5.2 Gray siltst., pressure slips
945	955	10.0	10.1	3.9 White, fine gr. ss., uniform 0.3 Gray siltst. 0.4 Dark gr. to black siltst., carb. 0.6 Coal 1.2 Dark gr. to black siltst., carb. 3.7 Light gr. to white, fine gr. ss
955	965	10.0	10.0	7.0 Light gr. to light gr. & white mottled, fine gr. ss. 0.3 Dirty coal, bony 2.7 Light gr. to white, fine gr. ss.
965	975	10.0	9.9	4.1 White, fine gr. ss. 0.5 Dirty coal, bony 1.5 Light gr. to white, fine gr. ss. 0.9 Gray siltst. 2.4 Gray and white mottled, fine gr. ss. 0.5 Light gr. to gr. siltst.

Footage From	Footage To	Feet	Rec'y	Description
975	985	10.0	10.1	8.7 Light gr. to gr. siltst. 1.4 White and gr. mottled, fine gr. ss.
985	995	10.0	9.7	6.9 Light gr. to white, fine to very fine gr. ss 2.6 Gray siltst. 9.2 Coal 0.9 Coal
995	1005	10.0	9.7	0.7 Coal 2.3 Light gr. siltst. to very fine gr. ss. 1.2 Gray siltst. 0.7 Dirty Coal 0.2 Dark gr. siltst., highly carb. 4.6 White, fine gr. ss., uniform
1005	1015	10.0	10.0	4.4 White, fine gr. ss. 0.5 Coal 3.3 Light gr. to white, very fine gr. ss. 1.1 Light gr. siltst. 0.7 White, fine gr. ss.
1015	1025	10.0	10.1	0.8 White, fine gr. ss. 3.4 Gray siltst. 3.9 White, fine to very fine gr. ss. 1.0 Gray siltst.
1025	1035	10.0	9.8	1.7 Gray to light gr. siltst. 1.1 White, fine gr. ss. 1.2 Gray siltst., with vertical veinlets of coal 1.5 Light gr. siltst. 4.3 White, fine gr. ss., uniform
1035	1045	10.0	10.1	10.1 White, fine gr. ss., some gr. mottling
1045	1055	10.0	10.1	7.0 White, fine gr. ss., uniform 0.1 Dark gr. siltst. 0.9 Coal 2.1 White, fine gr. ss.
1055	1065	10.0	10.0	10.0 Light gr. to white, fine to very fine gr. ss.
1065	1075	10.0	9.9	7.8 Light gr. siltst. 2.1 Light gr. and white mottled, fine gr. ss

Footage From	To	Feet	Rec'y	Description
1075	1085	10.0	10.1	5.9 Light gr. & white mottled fine gr. ss. 4.2 Gray to light gr. siltst.
1085	1095	10.0	10.0	10.0 Gray to light gr. siltst.
1095	1105	10.0	10.43	1.1 Gray to light gr. siltst. 1.0 Light gr. to white, fine gr. ss. 0.2 Gray siltst. 0.5 Coal 0.4 Gray siltst. 0.4 Coal 0.9 Gray to dark gr. siltst. 5.8 White, fine gr. ss., uniform
1105	1115	10.0	9.8	0.7 Gray siltst. 3.9 White, fine gr. ss. 5.2 Gray siltst.
1115	1125	10.0	9.9	1.5 Gray siltst. 0.6 Dirty coal 2.0 Gray siltst. 5.8 White, fine gr. ss.
1125	1135	10.0	10.7	3.8 Gray siltst. 1.3 White, fine gr. ss. 1.2 Gray siltst. 4.4 White and gr. mottled, fine gr. ss.
1135	1145	10.0	10.1	8.7 White and gr. mottled, fine gr. ss. 1.4 Gray siltst.
1145	1155	10.0	9.9	0.9 Gray siltst. 0.2 White, fine gr. ss. 0.5 Dark gr. siltst., highly carb. 6.3 Gray to light gr. siltst. 0.7 Gray to dark gr. siltst., highly carb. 1.3 Gray to light gr. siltst.
1155	1165	10.0	10.0	2.1 Gray to light gr. siltst. 3.0 Light gr. to white, fine to very fine gr. ss. 2.6 Gray to light gr. siltst. 2.3 Gray & white mottled, fine gr. sss.
1165	1175	10.0	9.68	8.5 Gray & white & mottled, fine gr. ss. 1.3 -1173.5

Footage From	To	Feet	Rec'y	Description
1175	1185	10.0	9.9	9.9 Coal, some broken 18.6 D Seam Sample
1185	1195	10.0	10.0	7.4 Coal 1192.1 2.6 Light gr. fine to very fine gr. ss.
1195	1205	10.0	9.9	1.0 Light gr. fine to very fine gr. ss. 0.6 Dark gr. to black siltst. 3.3 Coal 1196.6 0.2 Sandy coal 4.2 Gray and white, mottled, fine gr. ss. 0.6 Gray silt.
1205	1215	10.0	10.0	3.3 Gray siltst. 0.8 Coal 0.7 Dark gr. to black siltst., highly carb. 1.0 Gray siltst. 2.4 Light gr. siltst. to very fine gr. ss. 1.8 Gray and white, mottled, fine gr. ss.
1215	1225	10.0	10.0	10.0 Gray and white mottled to white, fine fine gr. ss., uniform, x bedded
1225	1235	10.0	9.9	1.6 White, fine gr. ss. 2.4 Gray siltst. 1.4 Gray and white mottled, very fine gr. ss. 0.2 Dark gr. siltst. carb. 3.1 Coal -1230.6 0.3 Gray to dark gr. siltst., carb. 0.9 White, fine to very fine gr. ss.
1235	1245	10.0	10.1	2.7 Gray to dark gr. siltst. 2.1 Gray to light gr. fine to very fine gr. ss. 3.2 Gray & white mottled, fine gr. ss. 1.4 Coal -1243 0.7 Gray to dark gr. siltst., carb.
1245	1255	10.0		2.1 Gray to light gr. siltst. 6.1 White, fine gr. ss., uniform 0.8 Dark gr. to black siltst., carb. 1.1 Light gr. fine to very fine gr. ss.
1255	1265	10.0	9.7	4.4 Light gr. to ss. siltst. 1.1 Dark gr. to black siltst., highly carb.

Footage From	Footage To	Feet	Rec'y	Description
				0.4 Coal
				0.6 Dark gr. to black siltst., highly carb.
				1.1 Gray siltst.
				1.2 Light gr. to white, fine gr. ss.
				0.9 Gray siltst.
1265	1275	10.0	10.0	2.0 Gray to light gr. siltst.
				0.8 Coal
				4.8 Gray to light gr. siltst.
				2.0 Light gr. to white, very fine gr. ss. to siltst.
				0.4 Gray siltst.
1275	1285	10.0	10.3	3.4 Gray to light gr. siltst., carb.
				2.9 Light gr. to white, very fine gr. ss. to siltst.
				4.0 Gray siltst.
1285	1295	10.0	9.5	6.2 Gray siltst. some thin white banding
				0.5 Light gr. to white, fine gr. ss.
				0.9 Dark gr. siltst., carb.
				0.2 Dirty coal, bony
				1.7 Light gr. to gr. siltst.
1295	1305			1.4 Light gr. to white, very fine gr. ss.
				3.7 Gray to light gr. siltst.
				1.7 White to light gr. fine gr. ss.
				1.1 Light gr. siltst.
				0.4 Coal
				0.4 Dark gr. to black siltst., highly carb.
				1.3 Light gr. to white, fine to very fine gr. ss.
1305	1315	10.0	10.0	0.8 White, fine gr. ss.
				1.6 Coal -1305.8
				0.7 Gray to dark gr. siltst.
				0.8 Light gr. to white, fine to very fine gr. ss.
				0.9 Gray to dark gr. siltst., carb.
				3.1 Coal 1309.8
				2.1 Gray siltst.
1315	1325	10.0	10.1	10.1 Gray to dark siltst., some thin carb. zones

Footage From	To	Feet	Rec'y	Description
1325	1335	10.0	10.0	5.7 Gray to dark gr. siltst. 1.4 White fine to very fine gr. ss. 2.9 Gray siltst.
1335	1345	10.0	10.0	8.4 Gray siltst., uniform 1.6 Light gr. to white, fine to very fine gr. ss.
1345	1355	10.0	9.9	2.8 White, and gr. mottled, fine gr. ss. 0.1 Dirty coal, bony 1347.9 7.0 Coal, clean
1355	1365	10.0	10.0	10.0 Coal, clean 22.0' Sample
1365	1375	10.0	10.0	9.2 Dirty coal, bony 4.8 Coal, clean 1369.9 0.1 Dirty coal, bony 0.8 Gray to dark gr., fine to very fine gr. ss. 1.7 White, and gr. mottled, fine gr. ss. 2.4 Gray to dark gr. siltst. to very fine gr. ss. carb. partings
1375	1415	40.0	39.7	0.5 Gray to dark gr. siltst. to very fine gr. ss. 0.1 Coal Top Aberdeen SS 36.4 White fine to med. gr. ss., uniform x bedded, abundant dark minerals 2.7 White with thin gr. bands, fine gr. ss.
1415	1425	10.0	10.1	10.1 White to light gr. & white mottled, fine gr. ss.
1425	1435	10.0	10.0	6.4 White to light gr. & white mottled fine to very fine gr. ss. 3.6 White, fine gr. ss., uniform
1435	1455	20.0	20.0	19.4 White, fine gr. ss., uniform 0.6 Gray and white mottled, fine gr. ss.
1455	1465	10.0	9.8	2.4 Gray and white, mottled, fine gray ss. 2.0 White, fine gr. ss. 1.8 Light gr. to gr. and white mottled, fine gr. ss. 1.8 White fine gr. ss. 1.8 Light gr., fine gr. ss.

Footage From	To	Feet	Rec'y	Description
1465	1485	20.0	19.2	0.8 Light gr. fine gr. ss. 2.1 Gray and white mottled, fine to med. gr. ss. 15.6 White, fine to med. gr. ss., uniform 0.4 Gray siltst. 0.3 White, fine gr. ss.
1485	1495	10.0	10.3	2.4 White, fine gr. ss., x bedded 5.3 Gray to gr. and wh. mottled, fine gr. ss. 3.6 White, fine gr. ss., uniform
1495	1505	10.0	6.2	6.2 White, fine gr. ss., uniform Mislatch lost core
1505	1515	10.0	7.0	0.5 White, fine gr. ss. 5.1 Gray siltst. 1.4 White, fine gr. ss., uniform Mislatch lost core
1515	1525	10.0	9.3	3.2 Light gr. to white, fine to very fine gr. ss. 1.6 Gray siltst. 4.5 Light gr. and white mottled, fine to very fine gr. ss.
1525	1555	30.0	30.0	3.1 Gray and white mottled, fine gr. ss. 26.9 White, fine to med. gr. ss., uniform, x bedded, abundant dark minerals
1555	1565	10.0	10.90	5.3 White to light gr., fine gr. ss., uniform 0.1 Coal 0.1 Dirty coal, bony 1560.5 Sub Seam 1 3.5 Coal, clean 0.4 Dark gr. to black siltst., highly carb. 0.6 White, fine gr. ss.
1565	1575	10.0	10.2	2.8 White fine gr. ss., some thin gr. banding 4.3 White, fine gr. ss., uniform 3.1 Gray siltst., fossils frag., shells, pelcypods
1575	1585	10.0	9.7	1.8 Gray to dark gr. siltst., fossils 0.9 White, fine gr. ss., with thin coal veinlets 3.1 Dark gr. siltst., highly carb.

Footage From	To	Feet	Rec'y	Description
				0.4 Light gr. fine gr. ss.
				1.4 Dark gr. siltst., carb.
				0.6 Light gr. to white, very fine gr. ss.
				0.2 Dirty coal, bony -1583.4
				1.3 Coal
				2.5 - Sub 2 Seam
1585	1595	10.0	10.3	1.2 Coal
				1.0 Gray to dark gr. siltst., carb.
				8.1 White, fine to med. gr. ss., uniform x bedded, carb. partings
1595	1605	10.0	9.9	8.2 White, fine to med. gr. ss., x bedded uniform
				0.6 Dirty coal, bony
				0.7 Dark gr. to black siltst., highly carb.
				0.4 Coal -1604.5
				1.0 Coal Sub 3 Seam
1605	1615	10.0	10.2	0.6 Coal
				0.2 Dirty coal, bony
				2.1 Gray to dark gr. siltst., carb.
				7.3 White, fine to med. gr. ss., uniform x bedded, abundant dark minerals - Star Point SS
1615	1625	10.0	10.0	10.0 White, fine to med. gr. ss., x bedded abundant dark minerals

TD: 1625
March 28, 1975
Unusual amounts of gas in Star Point

APPENDIX 6-B

EXCERPTS FROM THE "SUBSIDENCE ENGINEERS HANDBOOK", NATIONAL COAL BOARD, 1975.

Subsidence Engineers' Handbook

6Bi

NCB

National Coal Board
Mining Department 1975

Foreword

In this revised issue of the Subsidence Engineers' Handbook (which replaces the 1966 edition), some sections have been rewritten with up-to-date information, and new sections have been included to cover the design of mine layouts to minimise subsidence.

It is intended as a reference book for those engineers and surveyors who are concerned with subsidence engineering and who are acquiring a specialist knowledge in the subject. Very little general explanatory material has been included – this can be found in other publications – and therefore the handbook is not suitable for background reading by non-specialist engineers or surveyors.

Like the first issue, this revised edition attempts to satisfy the need for a method of predicting subsidence and its associated phenomena of slope, strain and surface damage at any given site with accuracy and speed. To this end it presents, in concise form, relevant information from various published papers, and shows how subsidence problems may be fully resolved. It does not replace the literature on the subject which must be studied for fuller knowledge to be gained.

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Section 1: Symbols, Terms and Definitions

Many of the terms in the following list are used only in research and not in everyday subsidence engineering work, but they are included because they are all closely associated with factors in everyday use.

Some strata control terms are also included to cover the liaison between the two disciplines.

Figs. 1 and 2 illustrate some of the symbols which are listed.

Other symbols, i.e. those used in the interpretation of mine plans and geological plans, will be found in the Board's Code of Surveying Practice.

Symbols	Terms	Definitions
	Abutment	The region adjoining an excavation which is normally subjected to increased stress as a consequence of the redistribution of load. This may be at the front of, or at the sides or rear of, a working face.
	Abutment pressure	The load per unit area on an abutment.
β	Angle of break	The angle of inclination of the line connecting the edge of the workings and the point of maximum lengthening.
α	Angle of dip	The apparent dip of the seam.
γ	Angle of draw (limit angle)	The angle of inclination from the horizontal of the line connecting the edge of the workings and the edge of the subsidence area.
ζ	Angle of draw (limit angle)	The angle of inclination from the vertical of the line connecting the edge of the workings and the edge of the subsidence area.
	Arch core	The relaxed strata within a pressure arch.
	Block	An area of coal worked between predetermined boundaries.
	Convergence	Movement of roof and floor towards each other after removal of mineral. The rate of convergence is measured as either: (1) the convergence for a given advance of the face; or (2) the convergence in a given time.

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Symbols	Terms	Definitions
	Convergence (initial)	The amount of convergence of the roof and floor in the face directly after working and prior to stowing.
	Cover (see also *depth*)	The strata lying between the surface and the seam.
	Cover load	The dead load of the cover.
	Critical Area	That area the working of which causes the complete subsidence of one point on the surface.
	Sub-critical area:	An area of working smaller than the critical area. (When a sub-critical area is being worked, the point on the surface under examination does not undergo complete subsidence.)
	Super-critical area:	An area of working greater than a critical area. (An area on the surface undergoes complete subsidence.)
R	Critical area (radius of)	
ρ	Curvature (radius of)	The radius of curvature of any part of a subsidence profile.
h	Depth	The vertical distance between the floor of the seam being extracted and any arbitrary datum – usually the surface.
v	Displacement	The horizontal displacement of a point caused by any working.
V	Displacement (maximum)	The maximum horizontal movement of a point caused by working a sub-critical area.
V_{max}	Displacement (maximum possible)	The maximum horizontal movement of a point caused by working a critical area.
$v_x v_y$	Displacement in the direction of co-ordinate axes.	The partial displacement in the direction of the axes of a co-ordinate system, on which the calculations are based.

Symbols	Terms	Definitions
v_r	Displacement (spatial)	The rectilinear connection of the initial and final positions of a point moving in space. (It is determined by direction, inclination and distance.)
d	Distance	Any horizontal distance.
	Face	1. Strictly, any surface exposed by excavation for development or for the getting of mineral; 2. More generally, the supported area in the vicinity of the place at which mineral is worked.
	Face length	The distance between rib-sides or goaf-sides of a coal face.
	Face width	The distance between the line of coal face and the waste edge.
	Panel	The area of coal extracted by a longwall face.
L	Panel length	The dimension of a panel measured in the direction of the line of face advance.
w	Panel width	The transverse distance across a panel, usually equal to the face length.
	Pillar	A block of coal or mass of ore left unworked.
p	Pillar width	The shortest dimension of a rectangular pillar.
	Pressure arch	A zone of increased stress surrounding the relaxed strata which is created when any excavation is made, resulting in the redistribution of the normal strata pressures on to the abutments.
	Profile (longitudinal)	A curve depicting subsidence on a section drawn parallel to the direction of advance of an underground excavation.

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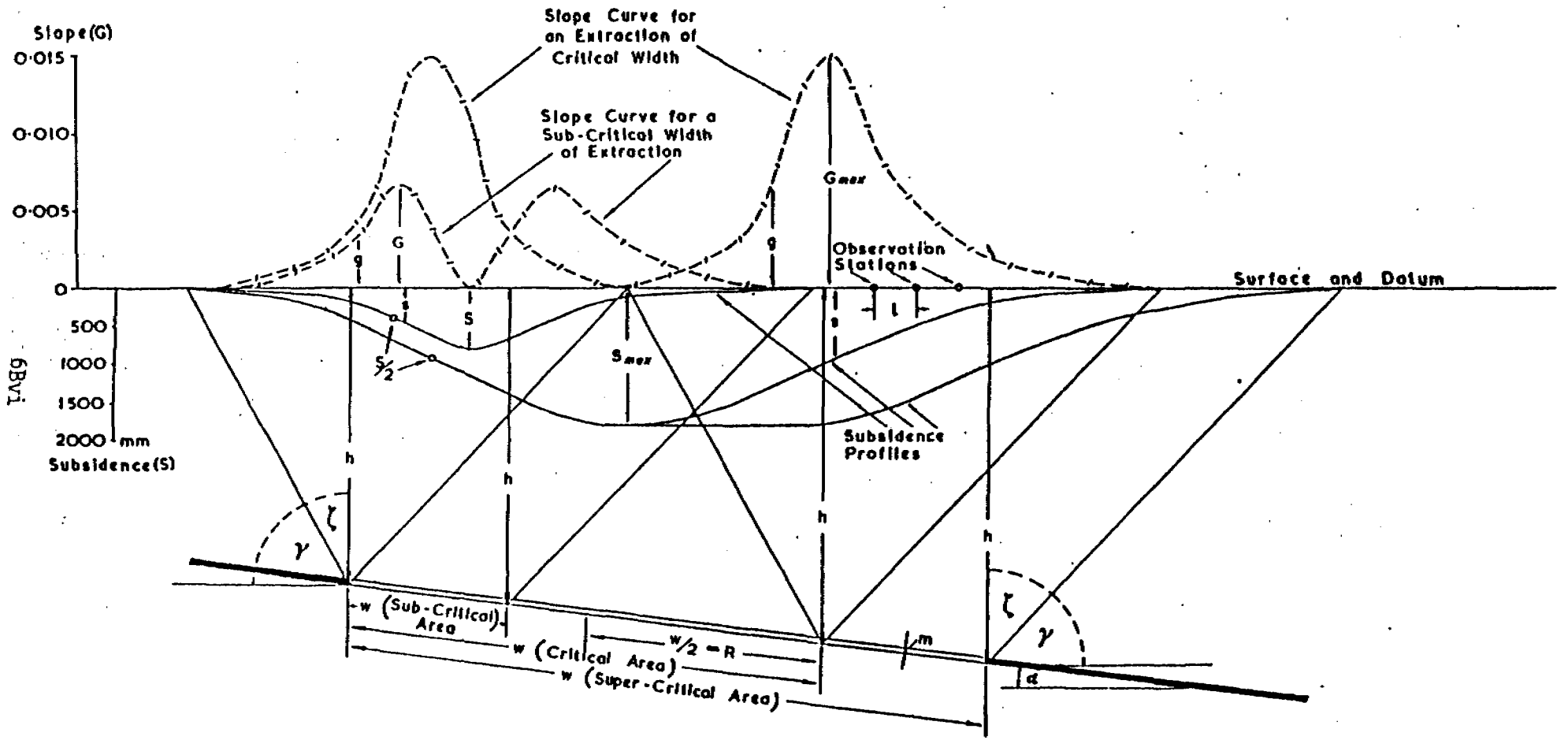

Fig. 1 Typical section through workings, illustrating standard symbols for subsidence and slope.

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Symbols	Terms	Definitions
	Profile (transverse)	A curve depicting subsidence on a section drawn at right-angles to the direction of advance of an underground extraction.
g	Slope	The slope of any part of a subsidence trough. NOTE: All forms of slope are calculated as the difference in subsidence between two points close together divided by their distance apart, and expressed in parts per thousand.
G	Slope (maximum)	The maximum slope in a subsidence trough caused by working a sub-critical area.
G_{max}	Slope (maximum possible)	The maximum slope in a subsidence trough caused by working a critical area.
l	Station interval	The horizontal distance between two observation stations.
$\pm e$	Strain	Change in length per unit of length $e = \frac{\Delta l}{l}$ (Direction to be specified)
$\pm E$	Strain (maximum)	The maximum strain (lengthening or shortening) in a trough.
$\pm E_{max}$	Strain (maximum possible)	The maximum possible strain (lengthening or shortening) in a trough.
s	Subsidence	The vertical movement anywhere within a subsidence trough.
S	Subsidence (maximum)	The maximum vertical movement caused by working a sub-critical area.
S_{max}	Subsidence (maximum possible)	The maximum possible vertical movement of a point on the surface caused by working a critical area. (This corresponds, in general, to the seam thickness multiplied by the subsidence factor.)

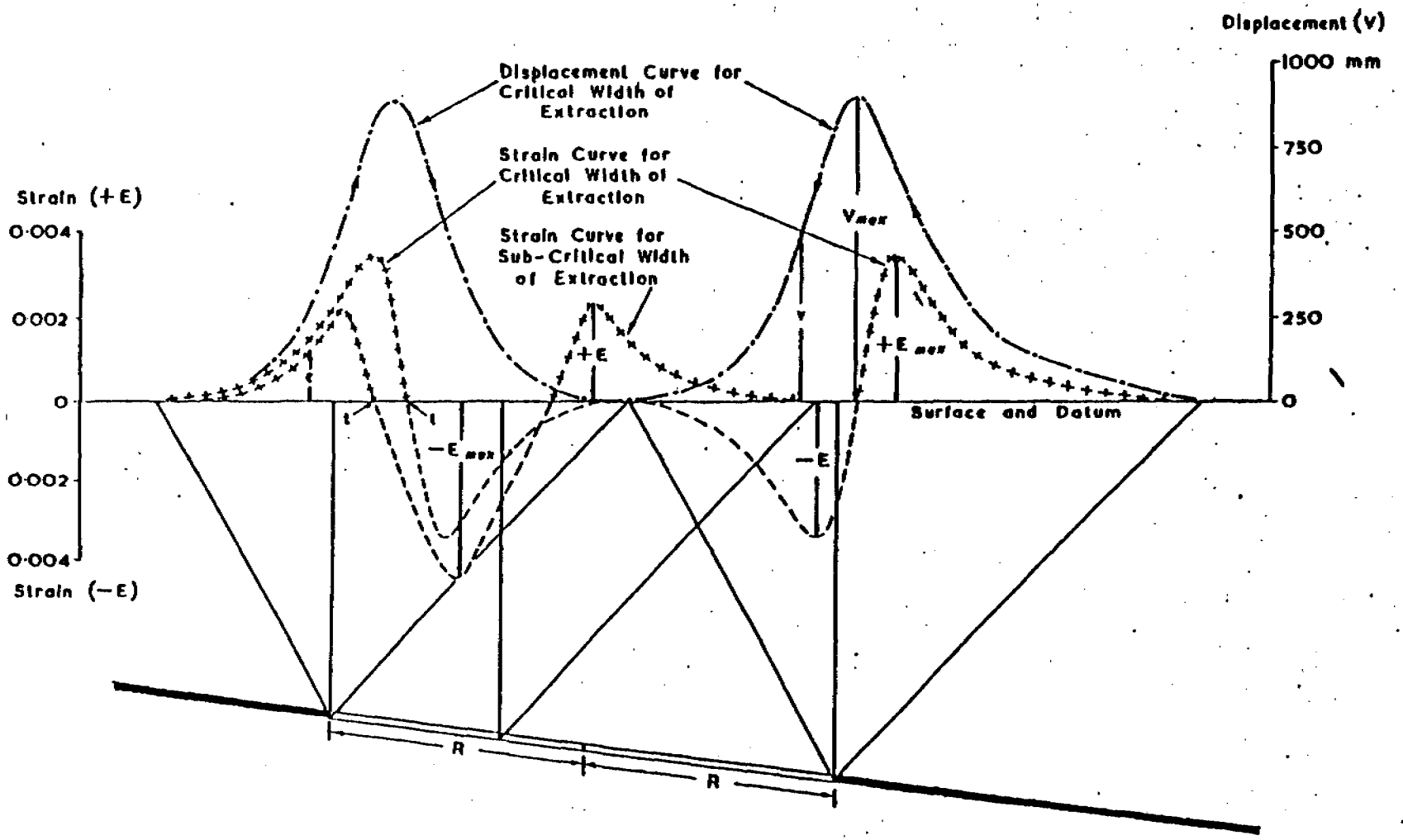

Fig. 2 Typical section through workings, illustrating standard symbols for strain and displacement.

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Symbols	Terms	Definitions
$\frac{S}{2}$	Subsidence (half)	The point where subsidence has half the amplitude of that of the maximum in the profile. (This coincides with the transition point 't'.)
a	Subsidence factor	The ratio of complete subsidence to seam thickness, i.e. S_{max}/m.
	Subsidence development	The manner in which surface subsidence starts increases and finishes in relation to the position of the advancing face of an underground excavation.
	Subsidence development curve	A line on a graph depicting the changing subsidence of a surface point in relation to the position of the face of an excavation passing through the critical area of that point.
m	Thickness (of seam) extracted	
	Time-Subsidence curve	The values of subsidence of a given point on the surface plotted against time as a base.
t	Transition point	The point of transition between concave and convex curvature of a subsidence profile.
	Trough (subsidence)	The surface depression caused by subsidence.

Signs for Plans and Sections of Ground Movements

Name	Shown	Colour
Subsidence curve	———	Black
Displacement curve	· — · ← · — ·	Black
Lengthening curve	+ + + + + + + +	Black with red verge
Shortening curve	- - - - - - - - - - - -	Black with blue verge
Slope curve	– –/– –/– –/– –/– –	Black
Curvature curve	– –U– –U– –U– –U– –	Black
Lines of equal subsidence	——— 200 ———	Black
Displacement directions and values	10 v =	Black
Lengthening zone		Red verge
Shortening zone		Blue verge

6Bx

Section 2: Prediction of Maximum Subsidence

The maximum subsidence S in any subsidence profile is related to the width w and depth of the extraction h, to both of which it is directly proportional. In cases where longwall workings are caved or strip packed it may be predicted by reference to Fig. 3 which has been compiled from numerous field observations. (Solid stowing has a moderating effect on the amount of subsidence in proportion to its efficiency; the most efficient solid stowing in Great Britain has been pneumatic stowing which can reduce the subsidence by 50%).

It is important to realise that the curves were developed from actual cases in which certain limiting conditions existed, and thus they can be used for prediction only in similar limiting conditions. These are:

(1) where the working panels extend for a distance of about 0.7 times the depth in front of and beyond the surface point where subsidence is to be predicted; i.e. the total length of the panel (L) must be about 1.4h;
(2) where the working panels have no centre gates or other zones of special packing apart from those at the main and tail gates; and
(3) where the sides of a panel are not parallel (owing to faulting, etc.) the average panel width must be developed.

Prediction of subsidence by the above method should be correct to ± 10% in the great majority of cases.

When a panel does not travel sufficiently far to cause maximum subsidence – i.e. where the extraction length is less than about 1.4h – the subsidence predicted by the above method must be reduced according to the proportion of maximum subsidence which the limited face advance permits.

This reduction is best calculated by considering the distance travelled by the face as a fraction of the depth and applying the appropriate partial subsidence curve as shown in Fig. 4 for a range of depths.

The distance travelled, as a fraction of the depth, is read off the horizontal scale in Fig. 4 and the subsidence already predicted is multiplied by the factor now read off on the vertical scale.

Example Calculation

Assume that a caved face travels a distance of only 150m in a seam 300m deep, the panel being 180m wide and the seam 1.5m thick. What is the maximum subsidence?

From Fig. 3, when w = 180m and h = 300m, then S/m = 0.61 ∴ S = 0.61 × 1.5 = 0.915m.

This is the maximum subsidence for an extraction length L = 1.4h (i.e. 420m).

The correction for the limited face advance is:

$$\frac{\text{advance}}{h} = \frac{150}{300} = 0.5$$

Referring to Fig. 4, this value of 0.5 on the bottom scale gives an s/S value which is 0.51.

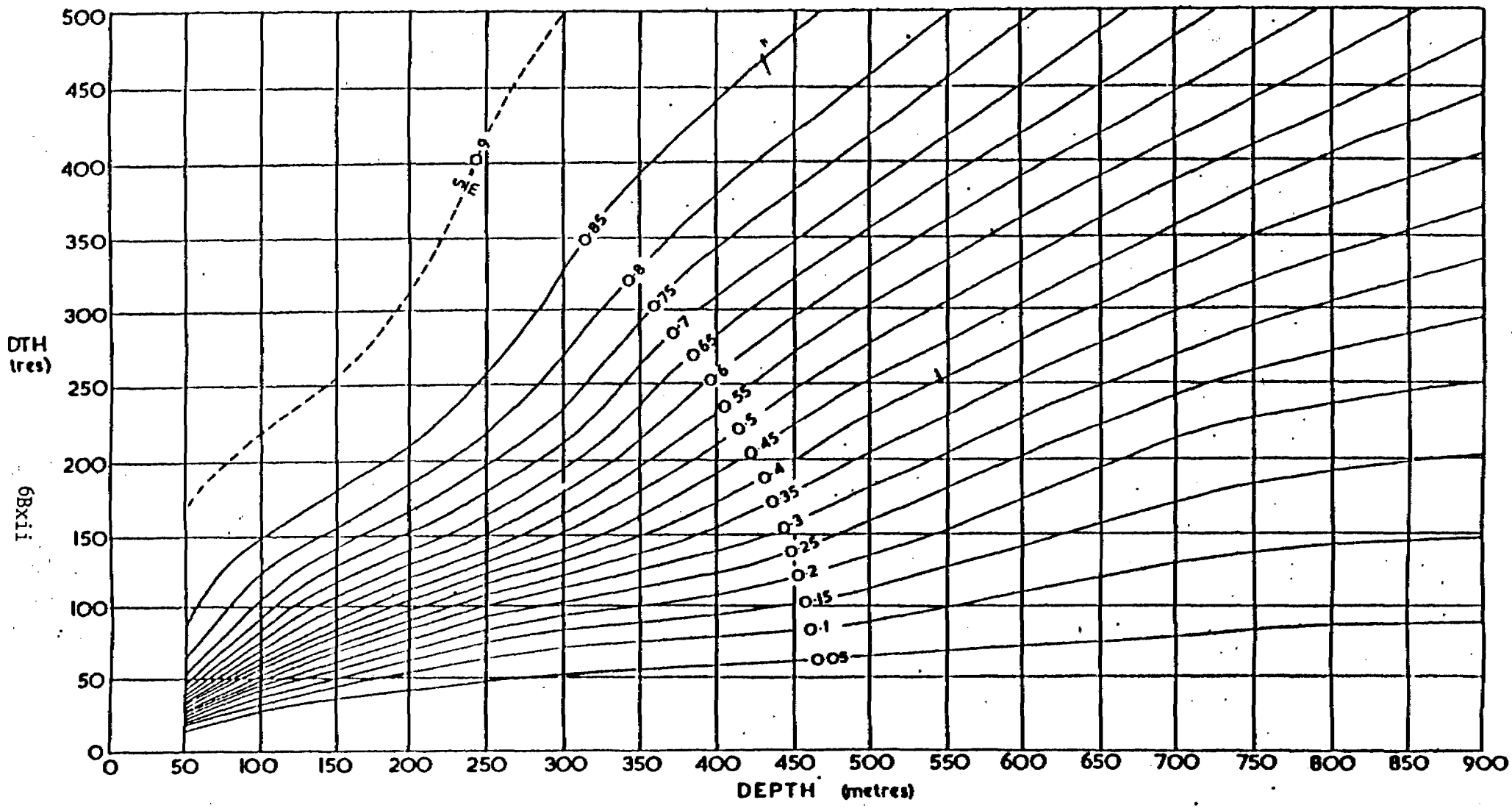

Fig. 3 Relationship of subsidence to width and depth.

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Therefore, the reduced S for the limited face advance = 0.[illegible]m × 0.51 = 0.467m.

This is the maximum subsidence (S) over the centre of the rectangle of goaf.

In some panels the sides may not be parallel; as for example when one end of the face is following a fault. It is necessary in such a case to take an average width depending upon the amount of variation and upon the degree of accuracy required. If necessary the panel may be split up into several lengths, each with a different width and having an effect proportioned according to the standard development curve.

Maximum Possible Subsidence

In cases where no firm plan exists for the working of a particular seam or seams it may be necessary for the surveyor or subsidence engineer to estimate the worst possible effects at the surface for the purpose of advising on the amount of surface damage or on precautions to reduce damage.

The seam might be worked with such dimensions in the layout that the maximum possible subsidence (S_{max}) occurs so that $S_{max} = m \times a$, where a is the Subsidence Factor.

It used to be believed that the subsidence factor depended upon the degree of maximum convergence in the workings which in turn affected the amount of maximum possible subsidence. For example, with deep workings a factor of 0.9 (i.e. S/m = 0.9) was accepted whilst with shallow workings the factor could be as low as 0.75.

Experience has shown however that if the extracted panel is wide enough, an S/m value as high as 0.9 can be produced even by shallow workings; Fig. 3 indicates this. If we take a depth of 50 metres it is clear that for a panel width of 70 metres (i.e. a notional critical area) S/m = 0.8. If a width of 170 metres is taken, the value of S/m reaches 0.9, but a width of more than three times the depth is needed to cause S_{max}. If it is unlikely that such wide panels would be extracted then a lower subsidence factor must be assumed and using the probable widths of extraction the factor can be estimated from Fig. 3.

N.B. When considering workings of any w/h value in a virgin area the prediction from Fig. 3 (which was derived from cases of multi-seam working) should be reduced by a multiplying factor of 0.9.

6Bxiii

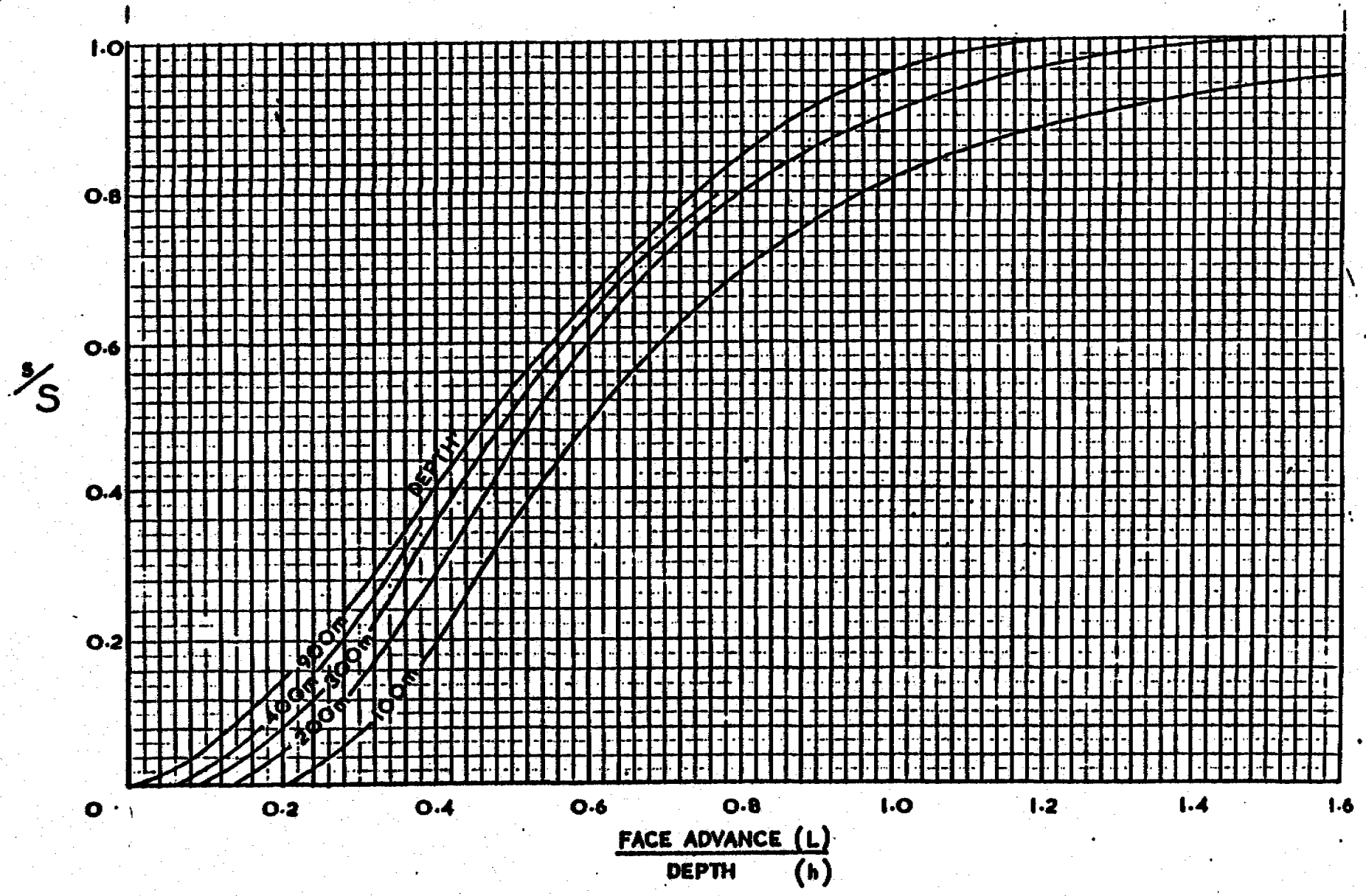

Fig. 4 Correction graph for limited face advance based on Figure 3 (accuracy ±4%).
(For cases outside the limits of this graph use the face advance as the width in Fig. 3, read off the percentage subsidence at the appropriate depth and multiply the resulting subsidence factor by 100/90.)