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Preliminary Report on the Use of Electric Logging in connection with Coal Exploration in the Cessnock-Muswellbrook Area

by

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COMMENTS TO PRELIMINARY REPORT ON THE USE OF ELECTRIC LOGGING IN CONNECTION WITH COAL EXPLORATION IN THE CESSNOCK-MUSWELLBROOK DISTRICT.

The equipment used for electric logging described in the report consists only of a single point resistivity and a self potential log. An attempt is being made to use this procedure

1) for correlation over big distances,

2) for determining the thickness and quality of co~~f~~al interbedded with shales.

There are natural limitations to these tasks. Coal and shale can normally be recognised and defined as such if they show their normal characteristic features:-

Coal: high resistivity, moderate S.P. value.
Shale: low resistivity, low S.P. value.

Sand, sandstone, limestone, however, depend for their electric character upon porosity of the formation and the conductivity of the water contained therein. Sand and limestone show a high resistivity if dry or filled with fresh water, a low resistivity if filled with saline water.

Where porous zones do not contain groundwater of different resistivity to the bore hole fluid, the single point electrode method alone might not give sufficient information. The use of short normal and long normal resistivity curves is advisable if the two curves mentioned in the report are not sufficiently characteristic.

The single point electrode method uses only one electrode moving in the borehole and measures all variations of resistivity in the strata near the moving electode. Resistivity changes are sharply defined and the method is well suited for correlation but it has one disadvantage. The results are affected by the resistivity of the water or drilling mud in the bore hole. The general level of the resistivity values is changed for instance by the resistivity of water flowing into the borehole from a porous bed. Such effects must be recognised when correlating bore holes electrically. That can be done best by using the long normal electrode arrangement (same current, two potential electrodes with constant spacing).

Coal seams show usually a high resistivity and moderate S.P. values, characteristic for a relatively thick seam are the results of B.M.R.7. But if the seam is interbedded with shale or sand and consists of several thin layers of coal or if the coal is fractured or weathered the electric log has a jagged appearance as in B.M.R.8. If the seam is broken and is accompanied by water of low resistivity, the electric log can even show an inverted curve but such occasions are rather rare (B.M.R.2.).

With coal seams interbedded with shale the electric log can be used to assess the quality of the zone and to see whether the coal improves or not from one borehole to the other.

If certain electric marker beds exist boreholes can be correlated even over larger distances. But recognition of such marker beds needs close study and is often only possible after several boreholes have been logged and studied. But if that is not the case boreholes can be correlated only if geologic features from one borehole to the next remain more or less constant (distance between coal seams, thickness of shale beds, succession of shales and sands). But the electric correlation of B.M.R.1. and B.M.R.8. over a distance of 6 miles can easily bring erroneous conclusions as the petrological character of the two drill holes is rather different.

The distances over which boreholes can be correlated electrically varies in different fields and depend upon how quickly the formations alter.

....
J. Horvath.

20th. May, 1958.

PRELIMINARY REPORT ON THE USE OF ELECTRIC LOGGING IN CONNECTION WITH COAL EXPLORATION IN THE CESSNOCK - MUSWELLBROOK DISTRICT.

PRELIMINARY REPORT ON THE USE OF ELECTRIC LOGGING IN CONNECTION WITH COAL EXPLORATION IN THE CESSNOCK - MUSWELLBROOK DISTRICT.

1. Introduction:

As a result of a suggestion that electric logging might be employed successfully in coal exploration, a Geophysicist from Melbourne visited Field Headquarters, Muswellbrook and ran electric logs in holes which are being drilled in this district. The equipment consisted of a Widco Logger with one movable electrode capable of measuring Resistivity to a depth of 500 feet. An adaption has been made to this equipment to enable Self Potential to be measured.

The details of work done are listed in Table 1 and the results of the logging as compared with the usual method of core-logging are summarized briefly hereunder.

2. The Curves Compared with Stratigraphic and Descriptive Logs:

(a) Coal Seams:

In general, coal bands were prominently shown by high resistivity peaks with intervening shale bands of low resistivity showing sharp contrast. (The term "bands" is used in distinction to seams, the latter referring to strata consisting of coal bands with intervening thin bands of siltstone, shale, etc.). The self-potential curves exhibited similar effects on most occasions but were not as pronounced. It was noted that coal bands in two seams showed very low resistivity and shale bands in these cases were of higher resistivity. (see Electric Log of B.M.R. 2(S) Blakefield). However, the SP curves of these two seams showed pronounced peaks of opposite sign to those of other seams. These effects are probably due to the presence within the seams of water containing various salts. The descriptive log reveals that both seams contain a relatively high percentage of mineral matter such as calcite. One of these seams was sampled for analysis and the following note concerning bands from this seam was made by the analyst: "These cokes contain up to 35% acid soluble material, mainly calcite, and apparently represent localised conditions." While some of this mineral may be endogenetic, the greater portion may be considered as exogenetic in view of the conclusion drawn above. Coal from such bands has a high ash content and in view of the presence of $CaCO_3$ could not be considered as high grade coal.

The geophysical report will probably outline the method whereby the thickness of bands within a coal seam may be determined. This would be extremely useful in such cases where loss of core makes it difficult to determine the position and thickness of the individual bands within the seam. While there are examples of this illustrated in more than one of the holes logged, the most outstanding is the one described hereunder. From the descriptive log of B.M.R.8(T) Pond's Creek it may be seen that the topmost coal seam was estimated to be 3'2" thick and that there was very poor recovery in the underlying claystone. The electric log of this hole revealed a series of three pronounced peaks of high resistivity from approximately 47' to 58' suggesting that the coal seam was greater than 3'2" thick as above. This idea was confirmed by the core obtained from 8(T)R Pond's Creek which showed a thickness of 11 feet for the top seam.

(b) <u>Other than Coal Seams</u>:

The resistivity curves of certain bands of strata other than coal seams are mentioned because of their apparent similarity to those of bands of coal. Reference to the logs reveals that while conglomerates and coarse grained greywackes show some relatively very high resistivity peaks, medium to fine grained greywackes and occasionally lutites also show high resistivities in some zones.

Since only one movable electrode is employed, the resistivity measured is that in the immediate vicinity of the hole i.e. the Apparent Resistivity. Therefore, where porous zones do not contain percolating ground water, it is the water used in the drilling fluid which will exert most effect on the resistivity curves. From the results of the logging, it may be assumed that most water used in this area is practically non-electrolytic.

While shales, siltstones and other lutites generally show relatively low resistivity, there are some zoneswhich give high resistivity peaks. This is accounted for by the presence of sandy bands and lenses, of fissures, etc., which bring about greater porosity. It is just the other way round

Bands of tough compact clay-ironstone and other sideritic sediments appear to show smaller high resistivity peaks, but they are not prominent due to the fact that such bands are not very thick.

(c) Igneous Intrusions:

The only intrusion logged was that in 4(S) Saddler's Creek. Unfortunately, this band was in part weathered and a true impression of the effect of igneous rock could not be ascertained. In addition, intrusive rock encountered in this area is generally altered slightly by deuteric action. However, zones logged descriptively as unweathered seem to show a high resistivity comparable with that of coal bands of the non-weathered seams. Pending microscope examination, Dr. Rutledge of Sydney University tentatively classed this type of igneous rock as dolerite with teschenitic affinities. Except when altered by such processes as weathering, deuteric action, etc., this rock may be regarded as compact and of high resistivity.

3. Accuracy of Descriptive Logs:

Bursill, in his discussion on Geological Descriptions of Coal[1], concludes: "The evidence is not conclusive but it seems that most of the geological descriptions in common use are almost without value, at least in the case of Barrett's Seam, and can be discounted without loss and should be replaced, if at all, by quantitative descriptions which will serve either to correlate the seam or ply geologically or give some prescience of the proximate analysis." Such a statement is not without justification particularly in the case of logs where estimations of thicknesses have been made due to low recoveries. The example given on page 2 (B.M.R. 8(T) Pond's Creek) is typical,

1. "Northern Prospect Report", Records 76/1952.

although low recoveries are not confined to coal seams.

Descriptive logs could be made considerably more accurate with the additional information which would be available from electric logs, and the risk of incorrect correlations being made would be lessened.

4. Possibilities of Use in Correlation:

Correlation in this area has often been difficult due to a number of causes such as splitting, thickening and thinning of seams, igneous intrusion, folding, etc. As a result, it is quite often necessary to drill until the Mulbring Stage marine beds have been penetrated. However, in some small areas, coal seams tend to remain constant in composition and of uniform stratification and it is in such areas that correlation by electric logging should be most effective. Unfortunately, although such small areas were being drilled, coal seams which would have been of use had not been penetrated at the time of logging in most cases. Correlation of B.M.R. 1(S) State Reserve, Ravensworth with B.M.R. 8(T) Pond's Creek was attempted, but the conclusions arrived at have been proven erroneous as a result of later drilling. These two holes are approximately six miles apart. The Geophysicist, after correlating the electric log of B.M.R. 8(T) Pond's Creek with that of B.M.R. 75(T) Parnell's Creek, (600 yards away), was able to predict that the top of the coal seam would be at approximately 110 feet in 75(T). Later drilling proved the top of the coal in this hole to be at 103'5½".

5. Summary and Conclusions:

(a) Coal seams show distinctive patterns in the electric log curves and to some extent these may be employed for correlation and for determination of loss when core recoveries are poor.

(b) Zones of relatively high porosity may be revealed by abnormal resistivity and occasionally self-potential values. The determination of such zones could prove useful in (i) defining a bed which contains water and possibly the degree of salinity of such water, (ii) indicating the depth at which drilling fluid is being lost to the formation.

(c) The resistivity curve obtained from an igneous intrusion (where unaltered) could be confused with that of unweathered coal.

Due to the causes mentioned earlier, it is impossible to predict the depth at which any one coal seam will be encountered. In view of this fact and since all seams must be cored to obtain samples for analysis, it may be stated that coring will continue with or without the use of electric log equipment. The extent to which such equipment could be used has been summarized and, while tests conducted have been insufficient to determine the degree of usefulness, there are indications that, compared with the small amount of time needed for operation, electric logging would prove to be a profitable supplement to coring.

TABLE I

DETAILS OF WORK DONE.

Date	Holes Logged	Drilling Company	Type of Drill	Fluid in Hole	Depth to which Hole Logged
23-2-53	B.M.R.7(S) Blakefield	B.M.R.	Failing 1500/316	Muddy water (Visc.=30 secs.)	133 feet
23-2-53	B.M.R.2(S) Blakefield	Pacific Boring Coy.	Bucyrus 22W	Water with some mud from hole	500 "
24-2-53	B.M.R.3(S) Saddler's Ck.	Pacific Boring Coy.	Failing 750 S/N290	Water as above	130 "
24-2-53	B.M.R.4(S) Saddler's Ck.	Pacific Boring Coy.	Failing 750 S/N291	Clean water	145 "
24-2-53	B.M.R.5(S) Saddler's Ck.	Houben & Kent	Mindrill A2000	Water with some mud from hole	139½ "
25-2-53	B.M.R.8(T) Pond's Ck.	Drilling Corp. Aust. Pty. Ltd.	Mindrill E1000:5	Water as above	132 "
25-2-53	B.M.R.75(T) Parnell's Ck.	Drilling Corp. Aust. Pty. Ltd.	Mindrill E1000:4	Water as above	96 "
26-2-53	B.M.R.1(S) State Reserve Ravensworth	B.M.R.	Failing 1500/293	Mud	246 "

__Time Taken:__ For most holes the time varied between 50 minutes and 1 hour, 15 minutes except in the case of B.M.R.4(S) Saddler's Creek where water had to be run into the hole. The time for this hole was 1½ hours.

B.M.R. 2 (S) Blakefield.

Geological Description of Strata	Core Recovered		Estimated Thickness		Estimated Depth	
	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.
Clay, reddish-brown, sdy.						
Greywacke, br., m.grd., fri.	-	-	3	-	3	-
" " ".-c.grd., fri.	-	-	7	-	10	-
Shale, brownish-gy.	15	6	16	-	26	-
" dk.gy., w.sdy.bds.	5	-	12	6	38	6
Greywacke, l.gy., f.-m.grd.	22	2	22	6	61	-
" " " f.grd., v.dk.gy.sh.& slst.bds.	15	10	15	10	76	10
Shale, dk.gy.	24	7	25	-	101	10
COAL, mostly dull w. thick bright bds.	-	5	-	5	102	3
Shale, br.	1	-	1	-	103	3
COAL, as above, w.R. shaly bds.	-	1½	-	1½	103	4½
Shale, gy.-bk.	2	9	2	10	106	2½
COAL, as above	-	3	-	3	106	5½
Shale, gy.	1	1½	1	2	107	7½
COAL, mostly bright	-	2	-	2	107	9½
Shale, bk.-dk.gy., w.bright COAL bds.	-	11	-	11	108	8½
COAL, bright	2	5½	2	6	111	2½
Shale, bk.	-	1½	-	1½	111	4
COAL, mostly bright	-	1	-	1	111	5
Shale, gy.-bk., silty & sdy. in lighter bds.	-	10	-	10	112	3
Shale, dk.gy., w.some bright COAL bds. in the top 2' & sdy. bds. near bottom	20	11	20	11	133	2
COAL, mostly bright w.calcitic cleat & some dull shaly bds.	17	3	17	4	150	6
Shale, l.gy., shaly	4	1	4	1	154	7
COAL, generally dull	1	-	1	-	155	7
Shale, gy.-dk.gy., silty in parts	-	9	-	9	156	4
Greywacke, gy.-l.gy., m.grd., shaly in parts	35	7	35	9	192	1
Shale, gy.w.silty & sdy.bds., approx. 5° dip	5	11	5	11	198	-
COAL, bright	32	6	32	8	230	8
Shale, gy.-bk.	-	4	-	4	231	-
Siltstone, gy. w.vertical joints w.calcite	-	6	-	6	231	6
Shale, dk.gy., silty becoming bk.& carb.	7	3	7	3	238	9
Siltstone, bk.w.shaly bds.& fine CO_3" lam.	9	6	9	6	248	3
" as above, w.t.COAL bds.	30	3	30	3	286	6
Shale & Shale-COAL, cindered & indurated in part. Some slight coking. Highly pyritiferous & v.abundant calcite	4	-	4	-	290	6
	4	6	4	6	2945	-

B.M.R. 2 (S) Blakefield (Contd.)

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
					295	-
Siltstone, dk.gy. massive, v.hd.,w.plant remains	13	2	13	2	308	2
Greywacke, l.gy.,v.f.grd.,w.m.grd.bds.in lower 6"	18	-	19	4	327	6
" " " m.-f.grd.w.t.carb.lam.,generally hd.	52	4	54	5	381	11
Shale, gy.-bk.,hd.,poorly fissile	3	5	3	5	385	4
COAL, generally bright, v. abundant calcite	2	-	2	-	387	4
Shale, bk.	-	3	-	3	387	7
COAL, as above, w.several shaly bds.	4	3½	4	3½	391	10½
Shale, gy.-wh.,silty	1	3	1	3	393	1½
COAL, as above	-	10½	-	10½	394	-
Claystone, y.-gy.	-	3	-	3	394	3
Shale, bk.	9	5	9	5	403	8
Siltstone to f.grd,dk.gy.Greywacke	7	9	7	9	411	5
Greywacke, l.gy.,v.c.grd.,calcareous	14	11	15	4	426	9
Shale, dk.gy.,silty	~~10~~ 9	6	~~10~~ 9	6	436	3
Conglomerate, gy.,f.grd.	-	1	-	1	436	4
COAL, mostly dull w.bright bds.	2	5	2	5	438	9
Shale, br.	-	2	-	2	438	11
COAL, dull	-	8	-	8	439	7
Shale, dk.gy.	3	10	5	5	445	-
COAL, hd.,bright, broken	1	-	1	-	446	-
Siltstone, l.gy.,v.hd.,w.carb.bds.	26	9	27	-	473	-
Shale, bk.,carb.,v.hd.	-	10	-	10	473	10
COAL, br.,hd.	-	3	-	3	474	1
Shale, as above	-	11	-	11	475	-
Siltstone, as above	6	3	6	3	481	3
Shale, as above	-	4	-	4	481	7
COAL, hd.,generally dull & shaly w.br.bds.	1	9	1	9	483	4
Shale, as above	1	6	1	6	484	10
Siltstone, dk.gy.,hd.,mass.,w.t.wh.sdy.bds.& lenses, mic. in part	16	9	18	2	503	-

B.E.R. 7 (S) Blakefield.

G Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins
Surface Clays, reddish-brown	-	-	3	-	3	-
Shale, l.gy., soft, w.dark bds.	11	4	29	1	32	1
" Dk.gy., w.wh.?tuff.bds.	55	-	55	-	87	1
COAL, mostly dull, w.R.thick bright bds.	5	6	7	3	94	4
Claystone, br. to l.gy., soft	-	3	-	3	94	7
COAL, generally dull, fragmentary & broken	2	3	3	-	97	7
Claystone, wh., sdy. in part	-	5	-	7	98	2
COAL, dull fragmentary	-	4	-	10	99	-
Shale, gy. w. bk. bds.	1	1	1	2	100	2
Claystone, bk. dense	-	4	-	5	100	7
Claystone, wh.	1	3	1	6	102	1
Sandstone, wh. f. to m. grd. ?tuff.	4	-	4	3	106	4
COAL, mostly dull w.R. br. shaly bds.	4	10	6	-	112	4
Siltstone, gy. shaly	1	4	1	4	113	8
Greywacke, wh., c. grd.	-	7	-	7	114	3
Shale, gy. silty w. t. bd. clay-ironstone	2	10	3	-	117	3
" br. ?tuff.	-	5	-	5	117	8
" bk. carb. w. t. COAL bds.	-	3	-	3	117	11
Interbdd. s. gy. shale & COAL	-	3	-	3	118	2
COAL, dull & bright, shaly	-	3	-	3	118	5
Shale, bk. carb. w. t. COAL bds.	-	2	-	2	118	7
COAL, dull & bright bdd. w. some t. shale bds.	-	5½	-	5½	119	-½
Shale, dk. gy.-bk. carb. w. numerous t. bds. COAL	1	6	1	6	120	6½
COAL, dull & bright Bdd. powdered over bottom 8½"	1	3½	1	3½	121	10
Shale, dk. gy.-gy., w. t. bds. COAL, slickensided	2	6	2	6	124	4
Claystone, gy. silty in part, fractured	2	8	2	8	127	-
Sandstone, l. gy. v. s. shaly, tuff.	-	10½	-	10½	127	10½
Shale, bk. carb. w. t. COAL bds. & wh. calcite veins along cleavage planes	-	2	-	2	128	-½
" br. ?tuff.	-	2	-	2	128	2½
" bk. carb. to shaly dull COAL w. some bright lam.	-	5½	-	5½	128	8
COAL, dull & bright Bdd., w. vertical calcite veins	-	2	-	2	128	10
Shale to dullCOAL as above	-	7½	-	7½	129	5½
COAL, dull & bright bdd., w. dip of about 20^{0}	-	1½	-	1½	129	7
Shale to dull Coal as above	-	1½	~~1~~-	1½	129	8½
COAL, dull & bright bdd. w. dip as above	1	8	1	8	131	4½
Shale, dk. br. silty	-	1	-	1	131	5½
COAL, bdd., shattered in part	1	3½	1	3½	132	9

D.E.R. 7 (C) Blakefield (Contd.)

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
					132	9
Shale, br.,?tuff.	-	1½	-	1½	132	10½
COAL, dull & bright bdd.,shattered at top	1	2½	1	3½	134	2
Shale, br.,sdy.,?tuff.	-	2½	-	2½	134	4½
COAL, bdd.as above	-	2	-	2	134	6½
Shale, dk.br. & bk.tough, to gy., w.t.bds. COAL	-	9½	-	9½	135	4
Siltstone, gy.w.t.f.grd.Gw. bds.	4	-	4	-	139	4
Greywacke, l.gy.,f.grd.	2	1½	2	1½	141	5½
Siltstone, gy.	-	8½	-	9½	142	3
COAL, dull & bright	-	-½	-	-½	142	3½
shale, gy.	-	4½	-	4½	142	8
COAL, mostly bright	-	3½	-	3½	142	11½
Shale, dk.br.to bk.tough & gy.w.t.bds.COAL	-	3½	-	3½	143	3
Siltstone, gy.	1	-	1	-	144	3
Greywacke, l.gy.,f.grd.w.t.bd.clay-ironstone	3	3	4	1	148	4

B.M.R. 4 (S) Saddler's Creek.

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
Clay surface br.	-	-	15	-	15	-
Shale, br.to gy.,w.clay-ironstone bds.	23	9	32	-	47	-
Greywacke, l.br.-gy.,f.to v.c.grd.,fractd. in parts & w.s.finely conglomeratic bds.	22	-	23	-	70	-
Conglomerate, br.-gy. to gy.,f.-m.grd.fri.in bds.	12	-	15	-	85	-
Siltstone, br.-gy.w.red-br.sideritic bds.	7	-	8	-	93	-
Clay-Ironstone, pinkish-br., broken	3	6	6	9	99	9
Sandstone, br.,m.grd.,sideritic	-	3	-	3	100	-
Teschenite(?), m.grd.gy.	7	-	7	-	107	-
Reddish-br.& y. weathering products of the immediately preceding rock, fragments of the original rock are discernible. Vertical crevices are developed near the top.	7	-	7	-	114	-
Teschenite(?) as above	29	1	29	7	143	7
Clay-Ironstone, br.	-	5	-	5	144	-
COAL, dull,cindered	-	5	-	5	144	5
Shale, bk.-gy.	-	7	-	7	145	-
COAL, dull, indurated	-	5	-	5	145	5
Clay-Ironstone, reddish-bk.	-	1	-	1	145	6
Greywacke, l.gy., f.grd.	1	4	1	4	146	10
Siltstone, gy. w.darker shaly bds.	22	6	26	5	173	3

[illegible] 1 ([illegible]) State Reserve, Ravensworth.

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins
Greywacke, f.grd. w. thin bd. ironstone, weathered	4	7	16	7	16	7
Shale, Gy.-dk.gy.carb.w.th.bds.smut; sdy. and silty in part to siltstone at bottom	11	2	13	7	30	2
COAL, bright	-	4	-	4	30	6
Shale, gy.	-	3	-	3	30	9
Siltstone to f.grd. Gw. in part w. th. iron-stone bd.	18	10	18	10	49	7
Shale, dk.gy.	-	1	-	1	49	8
COAL dull & bright bdd.	1	9	1	9	51	5
Shale, bk.carb.sdy.mic.	-	1½	-	1½	51	6½
COAL, dull& bright bdd. w.t.shaly bd.near top	2	4½	2	4½	53	11
Shale,dk.gy.	-	3½	-	3½	54	2½
Greywacke,l.gy.,f.grd.	2	1½	2	1½	56	4
Siltstone,gy.w.t.sh.bd.at top & occasional t.sdy.bd.	7	6	7	11½	64	3½
COAL, dull & bright bdd.	-	1½	-	3	64	6½
Greywacke,l.gy.,f.-m.grd.	1	7½	1	7½	66	2
" gy.,v.f.grd.to Siltstone, slickensided	2	10½	2	10½	69	-½
CoAL, bright w.t.sh.bd.at top	-	6	-	6	69	6½
Shale,dk.gy.carb.w.t.bds.Coal	-	3½	-	3½	69	10
Siltstone to f.grd. Greywacke, dk.gy.carb.	2	2	2	4	72	2
" dk.gy.	1	6	1	6	73	8
Shale,dk.gy.carb.	-	2	-	2	73	10
COAL,dull & bright bdd.,mostly bright powdery	2	-½	2	-½	75	10½
Intermixed COAL & dk.gy.shale	-	4½	-	4½	76	3
COAL, as above	-	3½	-	3½	76	6½
Interbdd.v.f.-m.grd. Greywacke and gy. Siltstone w. t.bds.clay-ironstone near top	45	10	46	6½	123	1
Greywacke,m.-c.grd.w.some pebbles	5	1	5	1	128	2
Conglomerate,m.grd. fri. in part w.c.grd. Gw. matrix	14	5	15	-	143	2
Greywacke,gy.,f.grd.	1	1	1	1	144	3
" l.gy.,m.-c.&v.c.grd.w.occasional pebble bds.	8	2	8	2	152	5
" gy.,v.f.grd.w.t.bd.clay-ironstone	3	8	3	8	156	1
" l.gy.,f.-m.grd.	6	7	9	6	165	7
COAL,dull & bright bdd.	-	4	-	9	166	4
Shale,br.,sdy.w.t.COAL & Marcasite bds	-	2½	-	2½	166	6½
COAL, mostly bright	-	5	-	5	166	11½
Shale,bk. carb.	-	1	-	1	167	-½
COAL, as above	-	1	-	1	167	1½
Shale,bk.carb.silty	1	1	1	1	168	2½
COAL,bdd.mostly bright	-	11	-	11	169	1½

B.M.R. 1 (S) State Reserve, Ravensworth (Contd.)

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
					169	1½
Shale, bk., carb.	-	2½	-	2½	169	4
COAL, bdd., mostly bright	-	7½	-	7½	169	11½
Siltstone, br.	-	1½	-	1½	170	1
COAL, as above	-	1	-	1	170	2
Siltstone, dk.br.-br.	-	2½	-	2½	170	4½
COAL, as above	2	7	2	11	173	3½
Shale, bk.carb., w.t. vertical veins	-	5½	-	9½	174	1
Siltstone gy.w.bd.f.grd. Greywacke	4	6	4	6	178	7
Shale, dk.gy.carb.& gy.silty w.t.bds.COAL	1	6	1	6	180	1
Siltstone to v.f.grd.Greywacke in part w.t.sh.bds.	11	1	11	1	191	2
Clay-ironstone, br.	-	3	-	3	191	5
Interbdd.gy.Siltstone & f.grd.Greywacke	10	-	10	-½	201	5½
Clay-ironstone, br.silty	-	6	-	6	201	11½
Greywacke, l.gy., f.grd.	19	6	19	6	221	5½
" gy., v.f.grd. to Siltstone	7	5½	8	-½	229	6
COAL, dull w.bright bds., shaly	1	-	1	-	230	6
COAL, mostly bright, powdery intermixed w.sh.over bobtom 5"	4	1	5	1	235	7
Shale, gy.	2	-	2	-	237	7
Siltstone to v.f.grd.Greywacke, gy.	6	6	6	6	244	1
Interbdd.f.grd.Greywacke and gy. Siltstone	11	8	14	6½	258	7½

B.M.R. 8 (T) Pond's Creek.

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
Clay, br.	-	4½	2	-	2	-
Greywacke, m.grd.,wd.to c.grd.,w.t.ironstone bd.	19	6½	33	-	35	-
Iron-stone, red	-	4½	-	4½	35	4½
Greywacke, f.-m.grd.w.some t.clst.bds.	3	3½	6	7½	42	-
" M)-c.grd.	4	-	4	-	46	-
" f.-m.grd.,COALY traces	-	1½	-	7	46	7
COAL, dull w. bright bds. broken	-	3½	-	5	47	-
COAL, dull & bright w. siltstone bds.,shattered	1	6	1	9	48	9
COAL, dull w.t.bright bds.	-	7	-	7	49	4
COAL, dull to bright, shattered	-	3½	-	5	49	9
Claystone, gy.,soft	1	-	13	9	63	6
Greywacke, f.grd.w.clst.bd.	1	6	3	6	67	-
" f.-m.grd.,steep bedded	2	7	4	-	71	-
Clay-Ironstone	-	4	-	8	71	8
Greywacke, f.grd.	-	2	1	4	73	-
" m.grd. w.t.clst.bds.,soft	1	4	5	-	78	-
" m. & c.grd	16	7	32	-	110	-
" f.grd.	2	-	2	7	112	7
Siltstone, gy.	-	10	-	10	113	5
Claystone, dk.gy.	1	4	1	7	115	-
COAL, bright broken	-	1½	-	5	115	5
COAL, dull	-	1	-	2	115	7
Siltstone, gy.	1	-	1	-	116	7
Greywacke, f.grd.	1	10	1	10	118	5
Siltstone, gy.	1	4	2	9	121	2
COAL, dull	-	3	-	10	122	-
COAL, (core barrel jammed)	-	-	1	6	123	6
COAL, dull & bright bdd.	1	7½	4	-	127	6
COAL, dull, fragmentary	-	5	2	6	130	-
Siltstone, gy.	-	5	2	6	132	6
Greywacke, c.grd.	4	2	5	-	137	6
" m.-v.f.grd.	2	10	2	10	140	4
Siltstone, gy.	-	9	-	9	141	1
Clay-Ironstone	-	5	-	5	141	6
Greywacke, v.f.grd.	-	7½	1	-	142	6
Shale, Carb.	-	4	-	4	142	10
Greywacke, f.-m. grd.	4	8	5	8	148	6

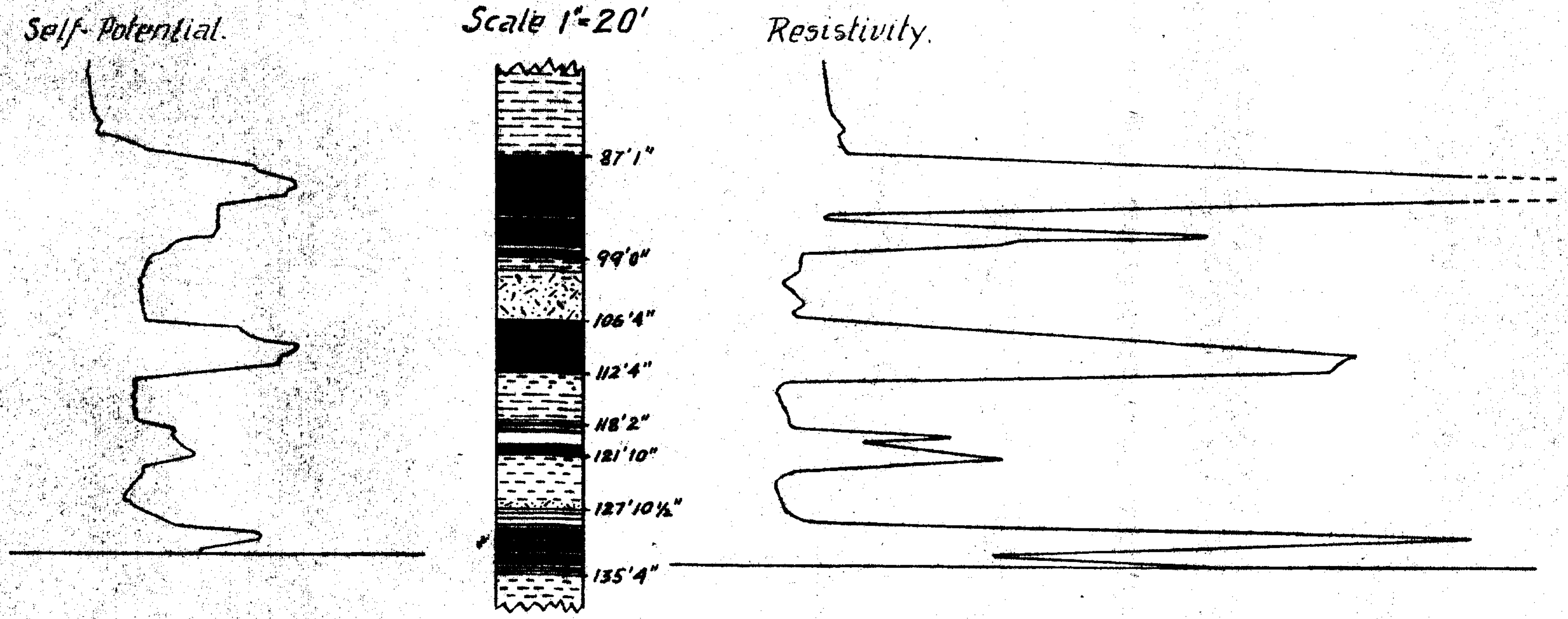
B.M.R. 8 (T) R Pond's Creek.

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
Sandy Clay	-	-	3	-	3	-
Greywacke, f.grd.w.clst.bds.	1	5½	4	-	7	-
" " "	1	1	3	-	10	-
" " " sideritic	-	10	1	-	11	-
" f.grd.-v.f.grd.w.clst.bds.,soft	3	8	4	-	15	-
" f.grd.sideritic	1	4½	1	6	16	6
" m.grd.	3	3	3	6	20	-
" f.grd.sideritic	-	5	-	6	20	6
" m.-c.grd.	7	7	14	6	35	-
Ironstone, red	-	3	-	4	35	4
Claystone, gy.	-	5	1	2	36	6
Greywacke, f.& m.grd. w.slst.bds.	9	6½	10	6	47	-
COAL, dull w.bright bds.,broken	-	5	1	-	48	-
Siltstone, gy.,slickensided	-	7	-	7	48	7
COAL, bright w. dull bds.,broken and shattered	1	11	1	11	50	6
Siltstone, gy.,sdy.	-	4	-	4½	50	10½
COAL, dull w. 1" Slst. bd. broken in parts	3	1	4	7½	55	6
COAL, dull & bright Bdd. fragmentary	-	6½	1	6	57	-
Greywacke, m.grd.	-	2	-	3	57	3
COAL, dull & bright Bds.	-	2	-	9	58	-
Clay-Ironstone	-	6	-	6	58	6
COAL, dull	-	1	-	1	58	7
Greywacke, f.grd.	-	1	-	1	58	8
COAL, bright, broken	-	1	-	1	58	9
Greywacke, m.grd.	1	-	1	-	59	9
COAL, dull w. bright bds.	-	6	-	7	60	4
Greywacke, m.grd.	-	5	-	5	60	9
COAL, bright, broken	-	2½	-	3½	61	-½
Greywacke, m.grd.w.Coal lenticles	1	-	1	1	62	1½
COAL, bright w.dull bds. shattered	-	9	-	9½	62	11
Claystone, gy.,soft	2	-	6	7	69	6
Greywacke, f.-m.grd.w.t.sideritic bds.	6	7	21	-	90	6
" m.grd.w.t.slst.bd.	3	5	16	-	106	6
" v.f.grd.w.slst.bds.	2	6	3	-	109	6
Siltstone, gy.,shattered w.ironstone pebbles	-	3	1	-	110	6
Claystone, gy.,Siltstone, gy., & COAL, fragmentary	-	9	3	-	113	6
Greywacke, v.f.-f.grd.,broken	2	10	3	8	117	2
Siderite	-	3	-	6	117	8
Siltstone, dk.gy.w.s.clst.bds.	-	8	1	7	119	3

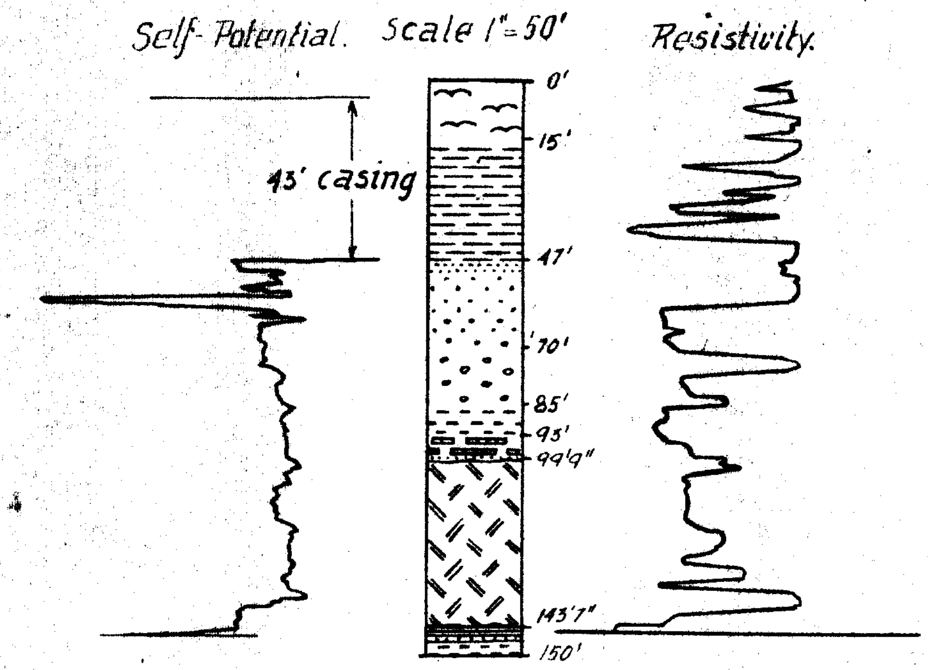
B.M.R. 8 (T) R Pond's Creek (Contd.)

Geological Description of Strata	Core Recovered Ft.	Core Recovered Ins.	Estimated Thickness Ft.	Estimated Thickness Ins.	Estimated Depth Ft.	Estimated Depth Ins.
					119	3
COAL, dull, shattered at base	-	9	1	3	120	6
COAL,	-	-	3	-	123	6
COAL, dull, fragmentary	-	2	-	6	124	-
Siltstone, carb.	-	1	-	2	124	2
COAL, dull, fragmentary intermixed with	-	2	-	6	124	8
Siltstone, gy., "	-	4	-	10	125	6
" " w.s. COALY bed	-	5	-	10	126	4
Greywacke, f.-m. grd.	1	2	2	2	128	6
" m.-c. grd.	4	10	8	-	136	6

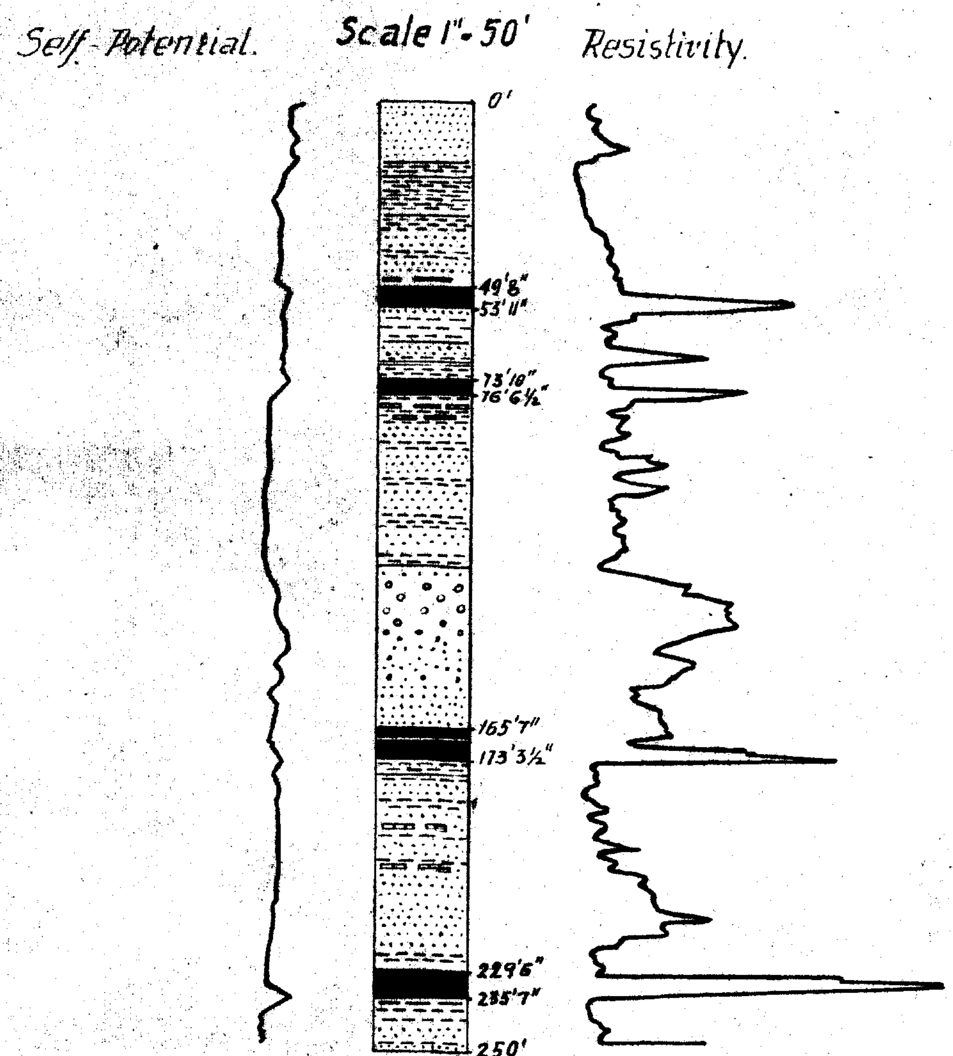
B.M.R. 7(s) BLAKEFIELD.



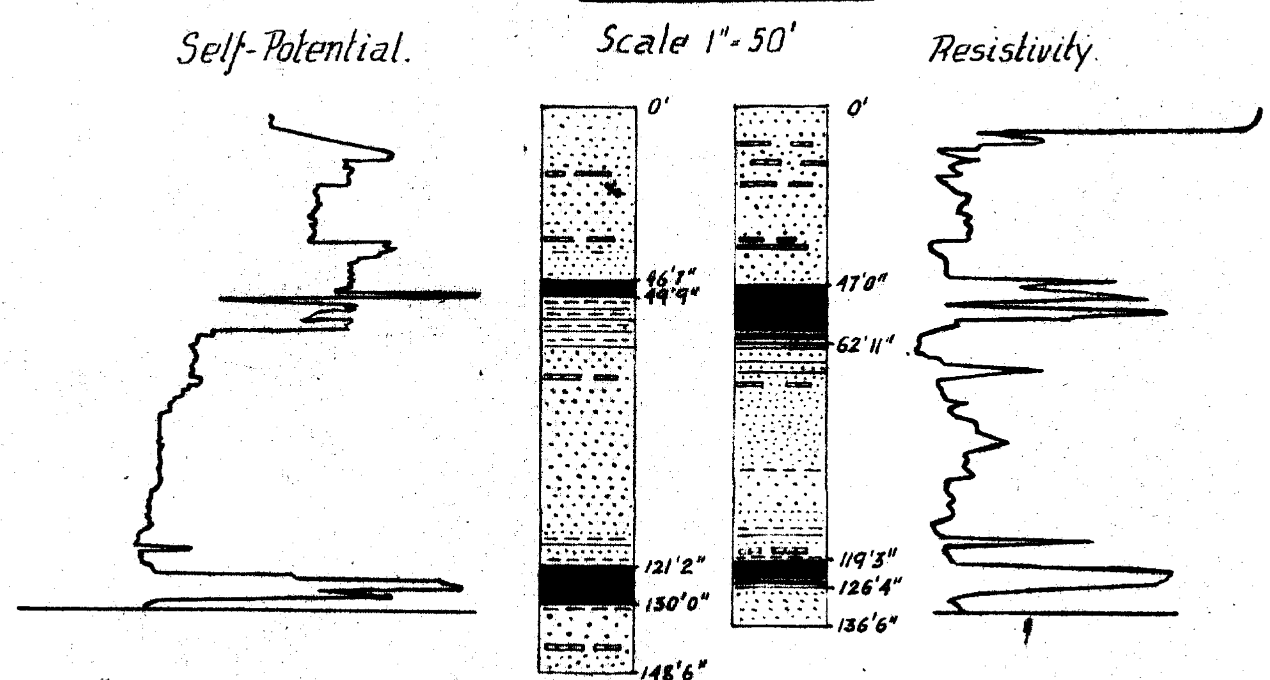
B.M.R. 4(s) SADDLER'S CREEK.



B.M.R. 1(s) STATE RESERVE RAVENSWORTH.



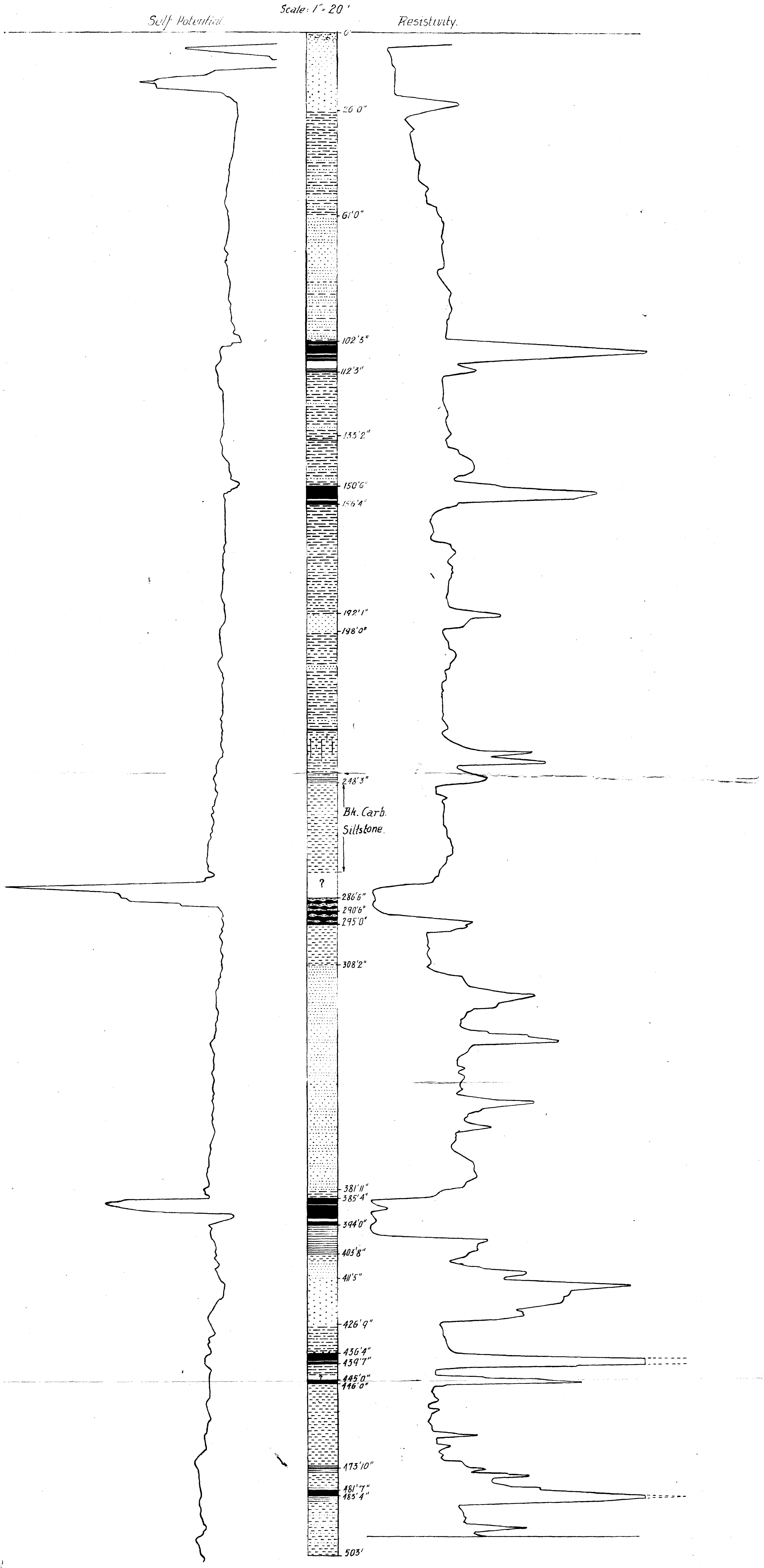
B.M.R. 8 (T) B.M.R. 8 (T) R. POND'S CREEK.



NOTE. These logs are diagrammatic as no scales were available at the time of drafting.

B.M.R. 2 (s) Blakefield

Scale: 1" = 20'



NOTE: These logs are diagrammatic as no scales were available at the time of drafting.