Wallachs' Pta.,—20159

REPORT No. 13
OF 1943

F.R.I.

RAPPORT No.
VAN

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

BRANDSTOF-NAVORSINGS-INSTITUUT

VAN SUID-AFRIKA.

SURVEY REPORT NO. 60.

SUBJECT:
ONDERWERP: REPORT ON BOREHOLES PUT DOWN BY G.S.O., ON THE FARMS LELIEFONTEIN 25, KRANSPAN 95, LEEUWENBURG 273, SMITSFIELD 137, DRIEFONTEIN 139, COALBANK 77, LIEFGEKOZEN 183, AND BLOEMKRANZ 185, IN THE EASTERN PORTION OF THE ERMELO DISTRICT OF TRANSVAAL.

DIVISION:
AFDELING: CHEMISTRY

NAME OF OFFICER:
NAAM VAN AMPTENAAR: DR. F.W. QUASS

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

REPORT NO. 13 OF 1943.

SURVEY REPORT NO. 60.

REPORT ON BOREHOLES PUT DOWN BY G.S.O., ON THE FARMS LELIEFONTEIN 25, KRANSPAN 95, LEEUWENBURG 273, SMITSFIELD 137, DRIEFONTEIN 139, COALBANK 77, LIEFGEKOZEN 183, AND BLOEMKRANZ 185, IN THE EASTERN PORTION OF THE ERMELO DISTRICT OF TRANSVAAL.

INTRODUCTION. x

In September, 1939, an intensive survey of the torbanite occurrences in the vicinity of Mooifontein 287, north of Ermelo, was begun by the Geological Survey. A number of boreholes were sunk on behalf of the Mines Department by the Irrigation Department in those areas of the Ermelo District where deposits of torbanite were believed to exist. This report deals with holes put down in the eastern portion of the Ermelo District.

The drilling was carried out by two Sullivan machines, one giving a large core ($3\frac{1}{2}$" diameter) and the other a small core $\frac{3}{4}$" in diameter. The large cores were almost completely recovered and proved suitable for analytical work; the small core machine was used only for piloting purposes in order to obtain the thicknesses and depths of the strata.

In this area 13 boreholes were put down of which only 6 were large core holes. The location of the holes are shown in the accompanying map. All the holes lie close to the Ermelo- Lothair railway line. The large coal cores were sent to the Fuel Research Institute where they were split and examined and analyses were made on a number of coal samples.

THE GENERAL GEOLOGICAL FEATURES OF THE AREA. x

As can be seen from the accompanying map, the geology of the area is of a very simple nature. By far the greatest portion of the area is covered by almost horizontally disposed sandstones and sandy shales of the Middle Ecca series. Outcrops of these rocks are usually seen in spruits and rivers, but over large stretches outcrops are scarce and the soil is generally of a greyish sandy type, which is not very fertile.

The drainage is effected by tributaries of the Vaal river flowing in a southerly direction. The Vaal river itself flows through the area. Many lakes or pans are present in the area.

The dolerite outcrops visible on the surface are shown on the map. (See back of report).

ANALYTICAL METHODS AND THEIR SIGNIFICANCE.

The analytical methods employed by the Fuel Research Institute for Coal Survey work and the significance to be attached to the determinations, are given in the Appendix. (see at back of report).

SECTION A: GENERAL DISCUSSION OF THE BOREHOLE CORES. x

The details of the borehole cores indicating the seams and the strata encountered and the depths below the surface are recorded in Table 1 (see at back of report, page 6).

x See "A Short Report on the Results obtained by Drilling for Torbanite in the Ermelo District", by F.A. Venter, G.S.O. of S.A., 1942.

x The/.....

The following were large core holes: B.H.3 on Kranspan 95, B.H.'s 1 and 2 on Leeuwenburg 273, B.H. 1 on Smitsfield 137, B.H's 1 and 2 on Liefgekozen 183. No coal was found in B.H. 2 on Leeuwenburg 273 (large core).

The strata encountered in the boreholes consist almost entirely of sandstones and shales and shaly sandstones.

In 10 boreholes dolerite was encountered generally located below the coal horizon. The intrusions appear to be in the form of sills and sometimes more than one is present. They vary in thickness from a few feet to over 70 feet.

The coarse grit immediately overlying the Dwyka conglomerate is present in this area. It varies in thickness from 10 to 70 feet.

Dwyka conglomerate was encountered in borehole 5. In the deep borehole on Coalbank 77 the Dwyka is absent and the grit, together with some shaly sandstone, lies directly on Swaziland schist. In two boreholes schist was struck and in two old Granite. The pre-Karroo floor in this area is therefore identical in nature to that to the north of Ermelo.

In two boreholes thin seams of torbanite were intersected. In B.H. 1 on Coalbank 77, 1 inch of torbanite was found 110 feet above seam A. In B.H. 1 on Smitsfield 137, a 2 inch seam of torbanite was found 105 feet below Seam C. No analyses were carried out on these torbanite occurrences.

In Table 1 a correlation of the seams is indicated.

It is necessary to point out at this stage that this nomenclature is based on very scanty information and that for the greater part it is purely conjectural. The succession as indicated by the G.S.O. is also given in Table 1. A number of the boreholes showed the normal succession of coal seams from A to E (top to bottom) generally found in the Ermelo-Breyten Coalfield. A "seam" F is also shown and it is present in the following boreholes from 110 to 130 feet below seam C:

B.H. 1 on Kranspan 95		2" Coal
B.H. 2 " Kranspan 95		1" shaly coal
B.H. 1 " Leeuwenburg 273	1'	7" Coaly shale
B.H. 1 " Smitsfield 137		2" Torbanite
B.H. 1 " Blenkranz 185		6" Coal

This correlation is of interest, since in the adjoining district of Wakkerstroom, a seam F is also encountered which in places has been found to be torbanitic in nature.

Seam E was intersected in 6 boreholes; it is a thin band of coal from 1 - 12 inches thick, and lies from 40 to 60 feet below seam C.

Seams C and D are present in nearly all the boreholes if the F.R.I. nomenclature be adopted. Both seams are very variable in width and nature.

Seams C and D are usually separated by 30 feet of sandstone and shale, except in the boreholes on the farms Driefontein 139, Liefgekozen 183 and Coalbank 77, where the whole section of the coal horizon seems to be abnormal. Here the width of the parting is from 60 to 80 feet.

Seam B is present in 7 boreholes and is also very variable. It is never more than 20 feet away from seam C and on Liefgekozen 183, less than 2 feet of parting separates the two seams. Similar conditions exist in other areas of the Ermelo coalfield, e.g. at Mooifontein 287, where seam B is sometimes found lying immediately above seam C.

Seam A is only present in 6 boreholes; this is largely due to denudation. It lies 30 to 60 feet above seam B. This is

normal/.....

normal for the coalfield.

About 100 feet above seam A in B.H.1 on Leliefontein 25, two thin bands of coal are present. This horizon coincides with the 1" band of torbanite found in B.H.1 on Coalbank 77, and also with the torbanite in the Kranspoort 264 - Driehoek 12 area (north of Ermelo) and the Blaauwkop Oil-shales (Wakkerstroom District).

In 5 of the 6 large holes cores of the coal seams were obtained. The following seams were sampled:-

B.H.3 on Kranspan 95: Seams C and D
B.H.1 on Smitsfield 137: Seams C,D, and E
B.H.1 on Leeuwenburg 273: Seam D
B.H. 1 and 2 on Liefgekozen 183: Seams B and C.

SECTION B: PROXIMATE ANALYSES OF SAMPLES.

The details of the samples taken are given in Table 2 (see back of report, page 18). The core or section of each seam is given a distinctive sample number.

Table 3 (see back of report, page 20) gives the proximate analyses of the samples detailed in Table 2 on an air-dried basis together with:

(a) the percentage float at a S.G. of 1.45;
(b) the percentage ash on the float at S.G. 1.45;
(c) the percentage float at a S.G. of 1.6;
(d) the percentage ash on the float at S.G. 1.6 and
(e) the Woodall Duckham swelling number of the float at S.G. 1.45.

The samples from B.H.1 on Smitsfield 137 (K13,K14, K15) and from B.H.1 on Leeuwenburg 88 (L88) were burnt. This fact has increased the difficulty of determining the correct correlation of the seams. The coal in B.H.1 on Leeuwenburg 88 was burnt by the dolerite between seams C and D; this dolerite has also widened the distance between seams C and D. No dolerite is shown in the record of B.H.1 on Smitsfield 137.

The remaining unaffected samples have analyses typical of the high volatile Ermelo-Breyten Coals.

SECTION C: ULTIMATE ANALYSES OF SAMPLES.

For the purpose of further and more detailed investigation, a series of ultimate analyses have been carried out. In the case of the two boreholes on Liefgekozen 183, composite samples have been made since both the seam sections and the proximate analyses have confirmed the similarity of the coals. The details of the composition and the type of coal represented by these samples, are given in Table 4 (see back of report, page 21) together with the proximate analyses of the composite samples.

In Table 5 (see back of report, page 21) the ultimate analyses of the coal samples are listed. The analyses were carried out on the floats at a S.G. of 1.6 and the results expressed to a dry, ash-free basis, so as to present the composition of the coal substance proper.

Table 6 (see back of report, page 22) shows the sulphur distribution on the whole coal together with the sulphur content of the floats at a S.G. of 1.6.

The carbon contents of the samples are low and the oxygen contents high, especially of the samples L177, L178, and L180. The hydrogen contents of the samples L179 and L180 are exceptionally high. The nitrogen contents are slightly higher and the sulphur contents slightly lower than are normal for Transvaal coals. The analyses on the whole agree closely with those of adit samples taken

from/.....

from the Lake Chrissie area.

The organic sulphur contents of the seams are higher than those of the main Ermelo-Breyten area and in this again are comparable with the coals of the adit samples of the Lake Chrissie area.

SECTION D: CARBONIZATION ASSAYS.

The figures that have been obtained from the low temperature (600°C) Gray-King carbonization assay tests, are given in Table 7 (see back of report, page 22). The analyses were carried out on the floats at a S.G. of 1.6.

There is a decided correlation between the yields of coke, tar and gas, the hydrogen contents and the volatile matter contents of the samples. Samples L179 and L180 which have higher hydrogen and volatile matter contents, yield less coke and more tar and gas than samples L177 and L178 which have lower hydrogen and volatile matter contents.

SECTION E: DETAILED FLOAT AND SINK ANALYSES.

Float and sink analyses, together with their attendant ash and swelling number determinations have been made on the composite samples. The results are tabulated in Table 8 (see back of report, page 23), and are of value for future correlative purposes.

SECTION F: ASH FUSION TEMPERATURES.

Ash fusion temperatures determined on the whole coal samples are listed in Table 9 (see back of report, page 24). Samples L177, L179 and L180 have highly refractory ashes. Sample L178 gives a low value which is similar to that obtained from Seam D in B.H.22 on Kaffirspruit 265, to the north-west of Ermelo.

SECTION G: GENERAL SUMMARY.

A generalised vertical section of the strata encountered in the boreholes is as follows:-

Surface soil, clay,"ouklip", etc.
Sandstone and shale
Seam A ½ - 5 feet Coal
Sandstone 30-60 feet
Seam B 1 - 3 feet Coal
Sandstone and shale 2 - 20 feet
Seam C 3 inches - 5 feet Coal
Sandstone and shale 30 feet (on Coalbank 77, Liefgekozen 183 and Driefontein 139, 60 - 80 feet)
Seam D ½ - 4 feet Coal (or up to 10 feet coaly shale and shale).
Sandstone and shale 10 - 25 feet
Seam E 1 - 12 inches Coal
Sandstone and shale 60 - 80 feet
Seam F 1 - 6 inches Coal or Torbanite (or 1½ feet coaly shale)
Sandstone and shale
Black shale
Grit
Dwyka.

The seams generally have a sandstone roof and floor. The continuity, width and the nature of the seams vary considerably.

Seam A. The seam varies in thickness from ½ to 5 feet. Where it is thick it is usually composed of 2 to 3 portions separated by

thin/.....

thin shale and sandstone partings. No samples of seam A were taken.

Seam B. The seam is from 1 to 3 feet thick and consists at times of two portions separated by a thin sandstone parting. The seam is very variable being described in places as coaly shale and shaly coal, whereas on Liefgekozen 183 where samples were taken from two boreholes the coal was bright-banded. The ash contents of these two samples were 12 and 20 %; the samples indicate a coal very high in volatile matter and hydrogen contents, but non-swelling. The seam here also has a very low sulphur content, the greater part of which is organic sulphur

Seam C. Seam C varied in width from a few inches to 5 feet. It consists generally of bright coal and at times split into two by a thin sandstone parting. Where it was found to be unburnt the ash content varies from 13 to 22 %. It has a very high volatile matter content (32 - 38%) and is non-swelling. The hydrogen content of the seam on Liefgekozen 183 was found to be extremely high (5.98%).

Seam D. The seam consists either as ½ to 4 feet of coal or as 2½ to 10ft. of coaly shale and shale. The samples obtained indicate a bright, clean non-swelling coal (9 - 13 % ash) having a high volatile matter (35%) content. The ash fusion temperature (1200°C) of the seam here is very low compared to those of other seams.

Seam E. This seam is from 1 - 12 inches thick. One sample was obtained from B.H.1 on Smitsfield 137; the seam here consisted of 2" of bright coal but was burnt. The ash content of this burnt sample was 18%.

Seam F. This seam consists usually of 1 - 6 inches of coal. In B.H.1 on Smitsfield 137 it was found as 2" of torbanite. No samples were available for analyses.

None of the seams encountered in the large core holes have a width that could be considered of economic value. The nature of the coal seams encountered in the small core holes could not be ascertained. It is therefore inadvisable to discuss the mining potentialities of the area under consideration.

From a correlative point of view, the information obtained from the borehole records and the analyses of the samples is also insufficient to allow specific conclusions to be drawn. Attention has however, been drawn to certain correlative data throughout the report. Finally it must again be emphasised that the suggested nomenclature of the seams is greatly a matter of conjecture.

F.W. Quass.

F.W. QUASS

ASSISTANT.

27th September, 1943.

TABLE 1.

DETAILS OF BOREHOLE RECORDS.

B.H.1
Farm: Leliefontein 25.
Surface Elevation 5743 feet. (Small core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
1' 0"	1' 0"		Soil	
4' 0"	3' 0"		Ouklip	
54' 6"	50' 6"		Weathered stone	
55' 0"	6"		COAL	Seam X
62' 0"	7' 0"		Banded shaly sandstone	
62' 4"	4"		Coaly shale	
77' 4"	15' 0"		Banded shaly sandstone	
88' 0"	10' 8"		Medium grained sandstone	
95' 4"	7' 4"		Banded shaly sandstone	
98' 2"	2'10"		Sandy shale	
112' 0"	13'10"		Banded shaly sandstone	
128' 0"	16' 0"		Black sandy shale	
142' 8"	14' 8"		Sandstone	
143' 0"	4"		Bright COAL	
144' 6"	1' 6"	Seam	Shaly COAL	Seam A
145' 6"	1' 0"	A	Sandy shale	
146' 1"	7"		Banded shaly sandstone	
146' 6"	5"		COAL	
164' 6"	18' 0"		Sandstone	
165' 4"	10"		Banded shaly sandstone	
248' 6"	83' 2"		Sandstone	
249' 5"	11"		Shaly COAL	
249' 6½"	1½"		Sandstone	Seam D
251' 0½"	1' 6"		COAL	
251' 1½"	1"	Seam	Sandstone	
252' 7½"	1' 6"	C	COAL	
254' 1½"	1' 6"		Banded shaly sandstone	
258' 1½"	4' 0"		Sandstone	
263'11"	5' 9½"		Banded shaly sandstone	
269' 5"	5' 6"		Black sandy shale	
270' 9"	1' 4"		Sandstone	
275'11"	5' 2"		Banded shaly sandstone	
277' 6"	1' 7"		Black sandy shale	
277' 7"	1"		Sandstone	
277' 8"	1"		COAL	Seam E
284' 6"	6'10"		Banded shaly sandstone	
311' 6"	27' 0"		Dolerite	
375' 0"	63' 6"		Banded shaly sandstone	
445' 0"	70' 0"		Sandstone	
500' 0"	55' 0"		Banded shaly sandstone	
520' 0"	20' 0"		Black shale	
546' 0"	26' 0"		Grit	

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. 1.
Farm: Kranspan 95
Surface Elevation 5620 feet (Small core)

Depth from Surface	Section	G.S.O. Correlation	Strate	F.R.I. Correlation
2' 0"	2' 0"		Soil	
3' 0"	1' 0"		Ouklip	
20' 0"	17' 0"		Weathered sandstone	
30' 0"	10' 0"		Banded shaly sandstone	
51' 2"	21' 2"		Sandstone	
55' 6"	4' 4"		Banded shaly sandstone	
56' 6"	1' 0"	)	COAL	)
57' 1"	7"	)	Sandstone	)
58' 4"	1' 3"	) Seam A	COAL	) Seam A
59' 4"	1' 0"	)	Coaly shale	)
60' 7"	1' 3"	)	COAL	)
115' 0"	54' 5"		Sandstone	
116' 6"	1' 6"	)	Shaly COAL	)
118' 0"	1' 6"	) Seam B	COAL	) Seam B
123' 6"	5' 6"		Sandstone	
126' 7"	3' 1"		Banded shaly sandstone	
127' 2"	7"	)	COAL	)
127' 4"	2"	) Seam C	Sandstone	) Seam C
129' 2"	1'10"	)	COAL	)
146' 3"	17' 1"		Banded shaly sandstone	
149' 3"	3' 0"		Sandy shale	
151' 1"	1'10"		Black shale	
159' 9"	8' 8"		Sandstone	
162' 9"	3' 0"	Seam D	COAL	Seam D
168' 6"	5' 9"		Sandstone	
179' 3"	10' 9"		Banded shaly sandstone	
179' 9"	6"		Shaly COAL	Seam E
191' 0"	11' 3"		Sandstone	
193' 0"	2' 0"		Banded shaly sandstone	
201' 8"	8' 8"		Dolerite	
213' 8"	12' 0"		Sandstone	
230' 2"	16' 6"		Banded shaly sandstone	
235' 2"	5' 0"		Sandstone	
238' 4"	3' 2"		Black shale	
243' 4"	5' 0"		Sandstone	
243' 6"	2"		COAL	Seam F
315' 0"	71' 6"		Sandstone	
340' 6"	25' 6"		Banded shaly sandstone	
347' 8"	7' 2"		Black shale	
361' 5"	13' 9"		Banded shaly sandstone	
376' 0"	14' 7"		Black shale	
449' 0"	73' 0"		Grit	
471' 0"	22' 0"		Dwyka	
480' 0"	9' 0"		Granite	

B.H. No.2/...

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. No.2
Farm: Kranspan 95.
Surface Elevation 5548 feet. (Small core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
3'	3'		Soil	
34'	31' 0"		Weathered sandstone	
35'	1' 0"		Banded shaly sandstone	
60' 6"	25' 6"		Sandstone	
62'10"	2' 4"	(Seam A horizon)	Black sandy shale	
138'10"	76' 0"		Sandstone	
140'10"	2' 0"		Sandy shale	
152' 2"	11' 4"		Grey sandstone	
155' 5"	3' 3"		Banded sandstone	
159'11"	4' 6"		Sandy shale	
164' 5"	4' 6"		Banded shaly sandstone	
164'11"	6"	Seam C?	COAL	Seam C
173'11"	9' 0"		Banded shaly sandstone	
182' 5"	8' 6"		Sandstone	
182'11"	6"		Black shaly sandstone	
185' 8"	2' 9"		Sandstone	
187'11"	2' 3"		Black shale	
197'11"	10' 0"		Banded shaly sandstone	
198' 6"	7"		Shaly COAL	Seam D
217' 6"	19' 0"		Banded shaly sandstone	
219' 2"	1' 8"		Baked sandstone	
243' 0"	23'10"		Banded shaly sandstone	
250' 8"	7' 8"		Black sandy shale	
253' 9"	3' 1"		Shaly sandstone	
254' 6"	9"		Black shale	
256' 2"	1' 8"		Shaly sandstone	
257' 2"	1' 0"		Black shale	
261' 2"	4' 0"		Shaly sandstone	
263'11"	2' 9"		Sandstone	
268' 4"	4' 5"		Shaly sandstone	
286' 8"	18' 4"		Sandstone	
287' 4"	8"		Shaly sandstone	
304' 2"	16'10"		Banded shaly sandstone	
304' 3"	1"		Shaly COAL	Seam F
305' 9"	1' 6"		Banded shaly sandstone	
326' 0"	20' 3"		Sandstone	
327'11"	1'11"		Coarse shaly sandstone	
334' 0"	6' 1"		Banded shaly sandstone	
347' 2"	13' 4"		Dolerite	
371' 0"	23'10"		Black banded carbonaceous sandstone	
380' 0"	9' 0"		Black shale	
392' 0"	12' 0"		Black sandy shale	
412' 0"	20' 0"		Black shale	
462' 0"	50' 0"		Grit	
470' 0"	8' 0"		Dwyka	

B.H. 3/.....

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. 3.
Farm: Kranspan 95.
Surface Elevation 5632 feet (Large core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
23' 0"	23' 0"		Soil and ouklip	
33' 0"	10' 0"		Weathered sandstone	
54' 0"	21' 0"		Fine-grained banded sandstone with parts of grit	
56' 0"	2' 0"	(Seam A horizon)	Black carbonaceous shale	
58' 0"	2' 0"		Fine-grained banded sandstone	
62' 0"	4' 0"		Black sandy shale	
183' 0"	121' 0"		Medium to coarse-grained sandstone with big portion of very coarse grit size ¼" to ½"	
185' 8"	2' 8"	Seam C	COAL	Seam C
188' 8"	3' 0"		Medium-grained to fine-grained sandstone	
198' 8"	10' 0"		Fine-grained banded sandstone. Latter part almost shale	
203' 8"	5' 0"		Black carbonaceous shale	
209' 0"	5' 4"		Fine-grained mottled sandstone banded medium-grained	
214' 0"	5' 0"		Sandstone	
215' 9"	1' 9"	Seam D	COAL	Seam D
230' 9"	15' 0"		Medium to fine-grained sandstone	
246' 9"	16' 0"		Very fine-grained white sandstone	
256' 9"	10' 0"		Medium to fine-grained banded sandstone	
260' 9"	4' 0"		Black carbonaceous shale	
280' 9"	20' 0"		Banded fine-grained shaly sandstone	
310' 9"	30' 0"		Very fine-grained white sandstone	
311' 9"	1' 0"		Black carbonaceous shale	
375' 9"	64' 0"		Very coarse sandstone with portions of very coarse-grained grit	

B.H. 1/.....

TABLE 1: DETAILS OF BOREHOLE RECORDS- CONTINUED.

B.H. 1
Farm: Leeuwenburg 273
Surface Elevation 5490 feet (Large core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
2' 0"	2' 0"		Soil	
6' 0"	4' 0"		Ouklip	
15' 0"	9' 0"		Weathered sandstone	
16' 6"	1' 6"		Weathered black shale	
17' 0"	6"	Seam A	Weathered COAL	Seam A
18' 0"	1' 0"		Weathered shale	
30' 6"	12' 6"		Sandstone	
33' 5"	2' 1"		Shaly sandstone	
55' 5"	22' 0"		Sandstone	
56' 2"	9"		Coaly shale	Seam B
74' 4"	18' 2"		Sandstone	
74' 6"	2"	)	Bright COAL	)
74' 8"	2"	) Seam B?	Shaly sandstone	) Seam C
75' 0"	4"	)	Bright COAL	)
77' 5"	2' 5"		Sandy shale	
82' 0"	4' 7"		Banded shaly sandstone	
90' 6"	8' 6"		Shaly sandstone	
95' 4"	4'10"		Sandstone	
134'10"	39' 6"		Dolerite	
135'10"	1' 0"		Grey shale	
139' 5"	3' 7"		Black shale	
141' 9"	2' 4"		Banded shaly sandstone	
149' 6"	7' 9"		Banded shaly sandstone	
150' 8"	1' 2"	Seam C	COAL	Seam D
152' 0"	1' 4"		Sandstone	
161' 0"	9' 0"		Banded shaly sandstone	
167' 0"	6' 0"		Black sandy shale	
167' 3"	3"		COAL	Seam E
169' 3"	2' 0"		Black sandy shale	
177' 1"	7'10"		Sandstone	
185' 1"	8' 0"		Banded shaly sandstone	
187' 7"	2' 6"		Shaly sandstone	
204' 2"	16' 7"		Banded shaly sandstone	
223'11"	19' 9"		Sandstone	
235' 6"	11' 7"		Shaly sandstone	
235' 9"	3"		Black shale	
251' 3"	15' 6"		Grit	
254' 0"	2' 9"		Banded shaly sandstone	
255' 7"	1' 7"		Coaly shale	Seam F
256'10"	1' 3"		Banded shaly sandstone	
294'10"	38' 0"		Sandstone	
311' 0"	16' 2"		Banded shaly sandstone	
331' 6"	20' 6"		Sandstone	
354' 0"	22' 6"		Shaly sandstone	

B.H. No. 2/.....

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. No. 2
Farm: Leeuwenburg 273
Surface Elevation 5326 feet (Large core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
	3"		Soil	
10"	7"		Clay and weathered sand stone	
12' 6"	2' 6"		Shaly sandstone	
40' 0"	27' 6"		Sandstone	
64' 0"	24' 0"		Dolerite	
69' 0"	5' 0"		Sandy shale	
95' 6"	26' 6"		Sandstone	
98' 6"	3' 0"		Black shale	
106' 0"	7' 6"		Shaly sandstone	
114' 0"	8' 0"		Sandstone	
154' 0"	32' 0"		Dolerite	

B.H. 1/.....

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. 1
Farm: Smitsfield 137
Surface Elevation 5491 feet (Large core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
18' 0"	18' 0"		Soil and ouklip	
22' 0"	4' 0"		Weathered sandstone	
60' 9"	38' 9"		White medium to very coarse sandstone with portion of grit	
74' 9"	14' 0"		Slightly banded medium-grained sandstone	
74'10"	1")		COAL	)
75' 1"	3")	Seam C?	Black carbonaceous shale	) Seam C
75' 5"	4")		Black sandy shale	)
76' 8"	1' 3")		COAL	)
92' 2"	15' 6"		Black sandy carbonaceous shale	
97' 2"	5' 0"		Black sandy carbonaceous shale	
103' 2"	6' 0"		Black sandy carbonaceous shale	
104' 5"	1' 3"	Seam D ?	COAL medium-grained banded	Seam D
119' 0"	14' 7"		Sandstone	
122' 6"	3' 6"		Fine-grained white sandstone	
124' 1"	1' 7"		Black sandy shale	
124' 3"	2"		COAL	Seam E
124'10"	7"		Black carbonaceous shale	
130'10"	6' 0"		Fine-grained banded sandstone	
136'10"	6' 0"		Black carbonaceous shale	
138'10"	2' 0"		Banded fine-grained sandstone	
147'10"	9' 0"		slightly banded medium-grained sandstone	
154'10"	7' 0"		Banded medium-grained sandstone with portions of carbonaceous shale	
193'10"	39' 0"		White medium to coarse sandstone	
195' 4"	1' 6"		Black carbonaceous shale	
209' 4"	14' 0"		White medium to coarse sandstone slightly banded	
211' 2"	1'10"		Banded sandstone	
211' 4"	2"		TORBANITE	Seam F
212'10"	1' 6"		Sandstone	
220'10"	8' 0"		Coarse to medium-grained sandstone	
254' 4"	33' 6"		Fine-grained banded sandstone lower portion bands of carbonaceous shale	
272' 4"	18' 0"		Medium to coarse white sandstone	
306' 2"	33'10"		Black fine-grained sandstone with mottled portions	
317' 5"	11' 3"		Sandy carbonaceous shale	
332' 5"	15' 0"		Black carbonaceous shale	
368' 7"	36' 2"		Very coarse grit	
377' 0"	9' 5"		Dolerite	

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. 1.
Farm: Driefontein 139
Surface Elevation 5536 feet (Small core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
3' 0"	3' 0"		Soil	
19' 0"	16' 0"		Weathered sandstone	
26' 3"	7' 3"		Clay	
64' 3"	38' 0"		Grit	
65' 3"	1' 0"		COAL	Seam A
65' 6"	3"		Sandy shale	
67' 2"	1' 8"		Grey shale	
95' 9"	28' 7"		Sandstone	
97' 4"	1' 7"		Sandy shale	
99' 7"	2' 3"		Black shale	
101' 6"	1'11"		Shaly sandstone	
104' 9"	3' 3"		Banded shaly sandstone	
108' 0"	3' 3"		Shaly sandstone	
109' 0"	1' 0"	Seam A	COAL (Lost 1")	Seam B
111' 0"	2' 0"		Banded shaly sandstone	
111' 8"	8"		Sandstone	
126' 0"	14' 4"		Banded shaly sandstone	
126' 3"	3"		COAL	Seam C
127' 7"	1' 4"		Banded shaly sandstone	
129' 7"	2' 0"		Sandstone	
158' 0"	28' 5"		Banded shaly sandstone	
207'10"	49'10"		Coarse sandstone	)
210' 4"	2' 6"	)	Dull COAL (Lost 3")	)
210' 6"	2"	)	Shaly sandstone	)
211' 2"	8"	) Seam B	COAL	) Seam D
211'10"	8"	)	Banded shaly sandstone	)
212' 4"	6"	)	COAL	)
218' 9"	6' 5"		Sandstone	
257' 4"	38' 7"		Banded shaly sandstone	
271' 0"	13' 8"		Sandstone	
335' 0"	64' 0"		Micaceous sandstone	
357' 6"	22' 6"		Dolerite	
361' 3"	3' 9"		Micaceous sandstone	
373'11"	12' 8"		Grey sandstone	
396' 4"	22' 5"		Grit (Lost 10")	
398' 9"	2' 5"		Banded shaly sandstone	
400'10"	2' 1"		Shaly sandstone	
470' 0"	69' 2"		Grit (Lost 21')	
475' 6"	5' 6"		Coarse sandstone	
477' 0"	1' 6"		Mudstone with sandy bands	
545' 0"	68' 0"		Dolerite	

B.H. 1./.....

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. 1.
Farm: Coalbank 77
Surface Elevation 5509 feet (Small core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
	9"		Soil	
2' 0"			Yellow sand	
4' 6"	2' 6"		Ouklip	
6' 6"	2' 0"		Weathered sandstone	
8' 0"	1' 6"		Clay	
13' 0"	5' 0"		Decomposed shaly sandstone	
26' 2"	13' 2"		Banded shaly sandstone	
31' 8"	5' 6"		Sandstone	
32' 1"	5"		Grit	
39' 2"	7' 1"		Banded shaly sandstone	
39'11"	9"		Black shale	
40' 0"	1"		TORBANITE	Seam X
63' 0"	23' 0"		Coarse sandstone with grit bands	
64' 8"	1' 8"		Black shale	
66' 7"	1'11"		Shaly sandstone	
118'10"	53' 3"		Coarse sandstone with grit bands	
133' 0"	13' 2"		Grit	
146' 8"	13' 8"		Sandstone	
149' 0"	2' 4"	Seam A	COAL	Seam A
166' 0"	17' 0"		Banded shaly sandstone	
171' 3"	5' 3"		Banded shale	
171' 8"	5"		Black sandy shale	
179' 4"	7' 8"		Banded shale	
180' 8"	1' 4")		COAL	)
180'10"	2")	Seam B	Banded shaly sandstone	) Seam B
181' 1"	3")		COAL	)
192' 0"	10'11"		Banded shaly sandstone	
192' 8"	8"		Black shale	
200' 5"	7' 9"		Banded shaly sandstone	
201' 7"	1' 2"	Seam C	COAL	Seam C
211' 7"	10' 0"		Banded shaly sandstone	
218' 8"	7' 1"		Sandstone	
225' 8"	7' 0"		Banded shaly sandstone	
232' 2"	6' 6"		Sandstone	
242' 8"	10' 6"		Banded shaly sandstone	
254' 8"	12' 0"		Black sandy shale	
258' 2"	3' 6"		Shaly sandstone	
259' 6"	1' 4"		Black shale	
260' 8"	1' 2"		Shaly sandstone	
263' 0"	2' 4"	Seam D ?	COAL	Seam D
264'11"	1'11"		Banded shaly sandstone	
269' 4"	4' 5"		Shaly sandstone	
269' 6"	2"		COAL	Seam E
306' 5"	36'11"		Micaceous sandstone	
312' 0"	5' 7"		Black sandy shale	
352' 3"	40' 3"		Micaceous sandstone	
352' 9"	6"		Mudstone	
354' 8"	1'11"		Micaceous sandstone	
354' 9"	1"		Mudstone	
378' 6"	23' 9"		Micaceous sandstone	
395' 0"	16' 6"		Baked sandstone	
433' 0"	38' 0"		Dolerite	
442'10"	9'10"		Gritty sandstone	
445' 7"	2' 9"		Dolerite	

460' 0"/.....

TABLE 1: DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. 1.
Farm: Coalbank 77 (Continued)
Surface Elevation 5509 feet (Small core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
460' 0"	14' 5"		Gritty sandstone	
461'10"	1'10"		Spotted Dolerite	
471'10"	10' 0"		Gritty sandstone	
520' 1"	48' 3"		Grit	
524' 7"	4' 6"		Baked sandstone	
526' 5"	1'10"		Dolerite	
527' 1"	8"		Burnt shale	
534' 0"	6'11"		Dolerite	
556' 6"	22' 6"		Grit	
558' 6"	2' 0"		Banded shaly sandstone	
560' 3"	1' 9"		Coarse sandstone	
560' 8"	5"		Sandstone	
564' 9"	4' 1"		Banded shaly sandstone	
607' 0"	42' 3"		Schist	

B.H. 1.
Farm: Liefgekozen 183
Surface Elevation 5425 feet (Large core)

3' 0"	3' 0"		Soil	
14' 0"	11' 0"		Weathered sandstone and clay	
24' 9"	10' 9"		Sandstone	
30' 6"	5' 9"		Banded shaly sandstone	
40' 0"	9' 6"		Shale	
55' 6"	15' 0"		Banded shaly sandstone	
69' 3"	13' 9"		Dolerite	
77' 3"	8' 0"		Sandstone	
81' 2"	3'11"		Black sandy shale	
81'10"	8"	Seam B?	COAL	Seam A
106'10"	25' 0"		Sandstone	
138' 4"	31' 6"		Banded shaly sandstone	
139' 1"	9"		Sandstone	
139' 6"	5")		COAL)	
140' 0"	6")		Shaly sandstone)	Seam B
140' 9"	9")	Seam C	COAL)	
142' 6"	1" 9")		Shaly sandstone	
143' 4"	10")		COAL	Seam C
167' 4"	24' 0"		Fine grained sandstone	
183' 0"	15' 8"		Banded shaly sandstone	
207' 9"	24' 9"		Sandstone	
214' 9"	7' 0"		Black sandy shale	
217' 0"	2' 3"		Coaly shale	Seam D
218'10"	1'10"		Black sandy shale	
237' 4"	18' 6"		Coarse grained sandstone	
240' 1"	11' 9"		Banded shaly sandstone	
280' 7"	40' 6"		Coarse grained sandstone	
296'11"	16' 4"		Banded shaly sandstone	
343' 8"	46' 9"		Grit	
370' 0"	26' 4"		Dwyka	

B.H. No 2/.....

TABLE 1 : DETAILS OF BOREHOLE RECORDS - CONTINUED.

B.H. No. 2
Farm: Liefgekozen 183
Surface Elevation 5510 feet (Large core)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
3' 0"	3' 0"		Soil	
17' 0"	14' 0"		Weathered sandstone	
53' 3"	36' 3"		Banded shaly sandstone	
56' 6"	3' 3"		Mottled sandstone	
57' 9"	1' 3")		COAL	Seam B
59' 4"	1' 7")	Seam C	Banded shaly sandstone	
60' 6"	1' 2")		COAL	Seam C
89' 9"	29' 3"		Fine-grained sandstone	
101' 0"	11' 3"		Banded shaly sandstone	
137' 0"	36' 0"		Medium-grained sandstone	
142' 6"	5' 6"		Banded shaly sandstone	
144' 0"	1' 6"		Banded shaly sandstone	
145' 2"	1' 2"		COALY Shale	)
150' 3"	5' 1"		Black shale	) Seam D
153' 9"	3' 6"		COALY Shale	)
156' 9"	3' 0"		Black sandy shale	
163'11"	7' 2"		Banded shaly sandstone	
201' 9"	37'10"		Coarse-grained sandstone	
211' 9"	10' 0"		Banded shaly sandstone	
260' 3"	48' 6"		Grit	
290' 9"	30' 6"		Dwyka	
295' 0"	4' 3"		Schist	

B.H. 1.
Farm: Bloemkranz 185.
Surface Elevation 5542 feet (Small core)

	6"		Soil	
2' 9"	2' 3"		Yellow soil	
4' 0"	1' 3"		Ouklip	
18' 7"	14' 7"		Weathered S.A. and grit	
24' 6"	5'11"		Banded shaly sandstone	
24'10"	4")		COAL	)
25' 6"	8")		Banded coaly sandstone	)Seam B
26' 6"	1' 0")	Seam C	COAL	)
27' 3"	9")		Black shale	
32' 0"	4' 9")		COAL	Seam C
32' 3"	3"		Shaly sandstone	
42' 3"	10' 0"		Sandstone	
52' 3"	10' 0"		Banded shaly sandstone	
52' 9"	6"		Burnt shale	
56' 2"	3' 5"		Shaly sandstone	
59' 0"	2'10"		Banded shaly sandstone	
61' 5"	2' 5")		COAL	Seam D
83' 4"	21'11")	Seam D	Banded shaly sandstone	
84' 4"	1' 0")		COAL	Seam E
91' 5"	7' 1"		Sandstone	
128' 9"	38' 4"		Banded shaly sandstone	
138' 6"	9' 9"		Sandy shale	
140' 9"	2' 3"		Banded shaly sandstone	
141' 3"	6"		COAL	Seam F
206' 3"	65' 0"		Micaceous sandstone	

206' 9"/.....

B.H. 1.
Farm: Bloemkranz 185 (Continued)

Depth from Surface	Section	G.S.O. Correlation	Strata	F.R.I. Correlation
206' 9"	6"		Mudstone	
217' 6"	10' 9"		Shale sandstone	
230' 6"	13' 0"		Sandy shale	
239' 0"	8' 6"		Black shale	
243' 8"	4' 8"		Shaly sandstone	
296' 8"	53' 0"		Gritty sandstone	
308' 0"	11' 4"		Banded shaly sandstone	
317' 6"	9' 6"		Coarse sandstone	
378' 0"	60' 6"		Grit	
419' 4"	41' 4"		Banded shaly sandstone	
437' 0"	17' 8"		Black shale	
447' 0"	10' 0"		Grit	
449' 0"	2' 0"		Shaly sandstone	
452'10"	3'10"		Grey shale	
543' 0"	90' 2"		Dwyka	
547' 0"	4' 0"		Granite	

B.H. No. 2.
Farm: Bloemkranz 185
Surface Elevation 5386 feet (Small core)

	2' 6"		Soil	
11' 6"	9' 0"		Weathered sandstone	
16' 0"	4' 6"		Coarse sandstone	
25' 0"	9' 0"		Banded coaly sandstone	
29' 6"	4' 6"		Shaly COAL	
30' 0"	6"		Coaly sandstone	
44' 4"	14' 4"		Soft shaly sandstone	
103' 7"	59' 3"		Coarse sandstone	
113' 1"	9' 6"		Banded shaly sandstone	
118'10"	5' 9"		Spotted dolerite	
120' 0"	1' 2"		Mudstone	
122' 8"	2' 2"		Hard grit	
122' 8"	6"		Mudstone	
123' 0"	4"		Hard grit	
124' 2"	1' 2"		Mudstone	
147' 0"	22' 8"		Hard grit	
162' 0"	15' 0"		Fine sandstone	
172' 4"	10' 4"		Spotted dolerite	
174' 7"	2' 3"		Fine sandstone	
254' 0"	79' 5"		Dwyka	
263' 0"	9' 0"		Schist	

TABLE 2.

DESCRIPTION OF SAMPLES.

Sample Number	B.H. No.	Name of Farm	Seam	Depth from Surface Ft. ins.	Width of Section Ins.	Description of Sample
K164	3	Kranspan 95	C	183' 0"		Roof: Medium to coarse grained sandstone with big part of very coarse grit
					32"	Finely-banded bright coal
				185' 8"		Floor: Medium to fine grey sandstone
K165	3	Kranspan 95	D	214' 0"		Roof: Sandstone
					19"	Finely banded coal
					2"	Carbonaceous sandstone and stony coal with bright stringers
				215' 9"		Floor: Sandstone
K13	1	Smitsfield 137	C	75' 5"		Roof: Sandy shale
					15"	Mixed, mainly bright-banded coal. Slight brown stains
				76' 8"		Floor: Sandy shale
K14	1	Smitsfield 137	D	103' 2"		Roof: Carbonaceous shale
D					2½"	Inferior stony coal with a few thin bright streaks
C					3"	Mixed coal
B					5"	Bright coal
A					4½"	Inferior stony coal with a little bright coal
				104' 5"		Floor: Sandstone
K15	1	Smitsfield 137	E	124' 1"		Roof: Black sandy shale
					2"	Bright coal
				124' 3"		Floor: Black carbonaceous shale
L88	1	Leeuwenburg 273	D	149' 6"		Roof: Sandstone
					14"	Mainly finely-banded bright coal
				150' 8"		Floor: Sandstone
K278	1	Liefgekozen 183	B	139' 1"		Roof: Sandstone
					5"	Coal Not Sampled
					6"	Shaly sandstone
B					9"	Bright banded coal
				140' 9"		Floor: Shaly sandstone grading into sandstone

TABLE 2: DESCRIPTION OF SAMPLES - CONTINUED.

Sample Number	B.H. No.	Name of Farm	Seam	Depth from Surface Ft. Ins.	Width of Section Ins.	Description of Sample
K278	1	Liefgekozen 183	C	142' 6"		Roof: Shaly sandstone grading into sandstone
A					10"	Bright-banded coal, duller at bottom
				143' 4"		Floor: Sandstone
K279	2	Liefgekozen 183	B	56' 6"		Roof: Sandstone
B					15"	Finely-banded bright coal - smithy looking
				57' 9"		Floor: Sandstone
K279	2	Liefgekozen 183	C	59' 4"		Roof: Sandstone
A					14"	Finely banded bright coal - smithy looking
				60' 6"		Floor: Fine-grained sandstone

TABLE 3.

PROXIMATE ANALYSES OF SAMPLES.

Sample Number	Width (ins.)	Cal.Val. lbs/lb	% H_2O	% Ash	% V.M.	% F.C.	% F1.45	% Ash F1.45	% F1.6	% Ash F1.6	Sw. No. F1.45	Seam.
K164	32	11.8	3.6	12.6	31.8	52.0	69.8	6.9	85.5	8.8	1F	C
K165	19	12.5	3.7	8.5	34.5	53.3	80.3	5.5	89.8	6.7	1F	D
K13	15	13.2	2.2	12.9	8.9	76.0	68.4	6.1	89.3	9.4	1P	C
K14 D	2½	-	1.5	24.9	10.7	62.9	50.1	6.7	64.3	10.4	1P	D
C	3	13.8	1.6	10.2	11.6	76.6	81.5	6.6	94.7	8.3	1P	
B	5	14.0	1.6	8.5	11.9	78.0	88.0	4.5	92.9	5.4	1P	
A	4½	-	0.7	59.0	11.3	29.0	-	-	-	-	-	
K15	2	12.3	1.7	17.5	13.4	67.4	55.0	6.0	79.3	10.3	1P	E
L88	14	12.8	2.9	12.7	10.4	74.0	71.2	6.7	88.9	8.7	1P	D
L278 B	9	-	2.4	19.8	33.8	44.1	68.1	9.8	84.9	12.6	1F	B
L278 A	10	-	2.2	22.2	34.8	40.5	50.7	9.7	75.0	14.7	1F	C
L279 B	15	12.1	2.5	12.1	36.8	48.6	83.9	6.7	91.8	7.8	1F	B
L278 A	14	11.1	2.3	18.6	37.5	41.6	69.4	8.9	84.3	11.4	1F	C

TABLE 4.

DETAILS OF THE COMPOSITE COAL SAMPLES.

Sample Number	Composition	Seam Number	PROX. ANALYSIS % Ash	% H_2O	% V.M.	FLOAT at S.G. 1.6 % Yield	% Ash	% H_2O
L 177	K164	C	12.7	4.8	30.8	87.6	9.3	4.2
L 178	K165	D	9.9	4.7	32.4	91.1	7.1	4.3
L 179	K278 B - 9 pts K279 B - 15 "	B	14.8	3.3	33.5	86.8	9.6	2.8
L 180	K278 A - 10 pts K279 A - 14 "	C	20.5	3.2	33.8	79.4	13.2	2.5

TABLE 5.

ULTIMATE ANALYSES OF SAMPLES.

(On a dry, ash-free basis)

Sample Number	Seam	% C	% H	% N	% S	% O & Errors
L 177	C	79.1	5.24	2.2	0.6	12.9
L 178	D	78.9	5.23	2.3	0.7	12.8
L 179	B	80.3	5.71	2.2	0.6	11.1
L 180	C	78.3	5.98	2.1	0.8	12.9

TABLE 6.

SULPHUR DISTRIBUTION OF COAL SAMPLES.

Sample Number	Seam	WHOLE COAL Mineral Sulphur	Organic Sulphur	Total Sulphur	Sulphur on Float at 1.6
L 177	C	0.89	0.37	1.26	0.53
L 178	D	0.61	0.49	1.10	0.64
L 179	B	0.15	0.40	0.55	0.55
L 180	C	0.79	0.47	1.26	0.66

TABLE 7.

LOW TEMPERATURE (600°C) CARBONIZATION ASSAY

ON FLOAT AT S.G. 1.6

Sample Number	Seam Number	% Coke	% Tar	% Liquor	% Gas	Gas Dens air = 1	% V.M coke	Nature of Coke
L 177	C	71.0	9.8	10.0	8.7	0.71	3.8	Pulverulent
L 178	D	71.0	11.1	8.5	9.0	0.73	4.2	"
L 179	B	70.4	12.5	7.8	9.2	0.70	5.4	"
L 180	C	66.7	12.3	9.5	10.7	0.72	4.9	"

TABLE 8.

FLOAT AND SINK ANALYSES.

Sample Number	Seam	Float 1.30	Float 1.30-1.35	Float 1.35-1.40	Float 1.40-1.45	Float 1.45-1.50	Float 1.50-1.55	Float 1.55-1.60
L 177	C							
Weight %		0.2	32.8	25.1	13.1	8.8	4.5	3.1
Ash %		-	-	8.6	8.0	23.5	21.2	22.9
Cum. weight %		0.2	33.0	58.1	71.2	80.0	84.5	87.6
Cum. ash %		-	3.7	5.8	6.2	8.1	8.8	9.3
Cum. Sw.No.		-	1 f	-	-	-	-	-
L 178	D							
Weight %		1.1	52.3	19.2	7.4	6.5	3.6	1.0
Ash %		-	-	5.2	11.7	13.8	18.9	25.1
Cum. weight %		1.1	53.4	72.6	80.0	86.5	90.1	91.1
Cum. ash %		-	3.9	5.2	5.8	6.4	6.9	7.1
Cum. Sw.No.		-	1 p	-	-	-	-	-
L 179	B							
Weight %		5.1	37.4	23.4	11.0	5.4	3.4	1.1
Ash %		-	4.8	9.2	16.1		24.4	
Cum. weight %		5.1	42.5	65.9	76.9	82.3	85.7	86.8
Cum. ash %		4.2	4.7	6.3	7.7	8.6	9.1	9.6
Cum. Sw.No.		1 f	-	-	-	-	-	-

TABLE 8. (continued)

Sample Number	Seam	Float 1.30	Float 1.30-1.35	Float 1.35-1.40	Float 1.40-1.45	Float 1.45-1.50	Float 1.50-1.55	Float 1.55-1.60
L 180	C							
Weight %		5.9	26.9	15.3	11.1	9.2	5.7	5.3
Ash %		-	5.3	10.7	18.0	21.5	27.5	31.4
Cum. Weight %		5.9	32.8	48.1	59.2	68.4	74.1	79.4
Cum. Ash %		3.5	5.0	6.8	8.9	10.6	11.9	13.2
Cum. Sw. No.		1F	-	-	-	-	-	-

TABLE 9.

ASH FUSION TEMPERATURES.

Sample Number	Seam	Ash Fusion Temperature.
L177	C	+ 1400°C
L178	D	1200°C
L179	B	+ 1400°C
L180	C	+ 1400°C

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APPENDIX.

ANALYTICAL METHODS AND THEIR SIGNIFICANCE.

1. SAMPLING:

Sampling is carried out according to South African Standard Specification, S.A. No. 13 of 1937, "Standard Methods for the Sampling of Coal in South Africa".

11. PREPARATION OF SAMPLES:

The samples are prepared in the manner specified in "Sampling of Coal in South Africa", S.A. No. 13 of 1937, issued by the South African Standards Institution. The laboratory samples are ground to pass a 60 mesh sieve (square aperture : 0.3 mm) except in the case of specific gravity analysis (float and sink tests) and hydrogenation tests, for which minus 20 mesh (square aperture : 1 mm) material is used.

111. PROXIMATE ANALYSES:

(1) Moisture Content: This is the loss of weight obtained by heating 1 gram of coal at 101 - 105°C for one hour.

(2) Ash Content: This is the residual ash obtained by combusting 1 gram of coal in a muffle furnace. The coal is slowly heated to 800°C and kept at this temperature for one hour.

(3) Volatile Matter Content: This is the loss of weight obtained by heating 1 gram of coal at 920°C for 7 minutes minus the weight of water present in the coal.

(4) Fixed Carbon percentage: This is obtained by subtracting the sum of moisture, ash and volatile matter contents, expressed as percentages, from 100.

1V. CALORIFIC VALUE:

This value, reported in Evaporative Units (lbs/lb), is calculated from the rise in temperature obtained by combusting 1 gram of coal in oxygen at 30 atmospheres pressure in a Berthelot-Mahler-Kroeker bomb calorimeter.

The determination is carried out according to South African Standard Specification, S.A. No. 5 of 1940, "The Determination of the Comparative Calorific Values of Coals in South Africa".

V. PRELIMINARY FLOAT AND SINK ANALYSES:

Twenty gram portions of the coal are separated into different specific gravity fractions in a centrifuge using petrol and carbon tetrachloride mixtures of varying specific gravity. The apparatus and method used is described in the Journal of the Chemical, Metallurgical and Mining Society of South Africa, Vol. 34, No. 8 : "A Specific Gravity Investigation of Coal Samples" by P.E. Hall.

(a) The percentage float at a S.G. of 1.45 is the percentage by weight of the coal which has a S.G. less than 1.45. This float contains the majority of the swelling constituents of the coal when these are present in a sample.

(b)/.....

(b) The percentage of float at a S.G. of 1.6 is the percentage by weight of the coal which has a S.G. less than 1.6. It represents approximately the amount of coal substance present and also gives a rough figure for the performance of an ordinary washer on the coal. This figure subtracted from 100 gives the amount of adventitious mineral matter in a coal sample.

(c) The percentage ash on the float at 1.45 gives some indication of the minimum ash content likely to be obtained by washing at this specific gravity.

(d) The percentage ash on the float at 1.6 represents the amount of mineral matter intimately associated with the coal substance and as such furnishes an approximate figure for the minimum ash content for a normal washed product from the particular sample.

(e) The Swelling Number is the ratio of the final to the initial volume of 1 gram of coal heated strongly under standard conditions and is a measure of tne swelling propensities of the coal.

This test is carried out according to B.S.S. Specification, No. 804 of 1938. "The Crucible Swelling Test for Coal".

1 Denotes a residue of definite coke structure but no swelling. 1 f denotes a residue easily friable and possessed of no coke structure. 1 p denotes a residue in powder form. A value of 3 or more indicates definite coking possibilities.

(f) If the float 1.45 material exhibits swelling propensities, further swellin number determinations are carried out on the S.G. 1.6 fraction. These figures give an indication of the swelling propensity with this S.G. cut.

VI. DETAILED FLOAT AND SINK ANALYSIS:

Float and sink analyses together with their attendant ash and swelling number determinations, are made on composite coal samples.

This work is usually carried out from three different aspects viz:-

(i) the characterisation of types of coal and the subsequent use of this data in correlation.

(ii) the investigation, in a more detailed manner, of the possibilities and results of washing.

(iii) the investigation of the effects of washing on the swelling properties of the coal.

Where the two latter aspects - which are, of course, closely related - command the most attention, floats corresponding to possible washery products are preferred, since from them the yields and charateristics of the cleaned products can be readily obtained. This involves making cuts at various specific gravities and analysing the resulting floats. Such a method is known as "cumulative" float and sink analysis.

On the other/.....

On the other hand, where the characterisation and correlation of coal seams are involved, the separation into a series of fractions of narrow specific gravity range is adopted. In this way, any change in the nature or behaviour of the coal fractions with change in specific gravity is more easily appreciated and more strongly emphasised than would be the case in the cumulative method. This type is known as "fractional" float and sink analysis.

For those properties which are additive e.g. ash content, the cumulative figures can be built up from the fractional and vice versa. This cannot be done in the case of non-additive properties. Nevertheless, swelling numbers - strictly speaking a non-additive property - can be calculated with fair accuracy from fractional to cumulative figures if the number for any fraction is not greater than 8 or less than 1½.

Where desirable, complete float and sink analyses of both types are determined.

When using float and sink analysis figures as guides to possible commercial results, it must always be remembered that the laboratory separations are made on fine coal and depend entirely on specific gravity differences. The products are, therefore, cleaner and more uniform than could ever be obtained from a commercial washer whether operating on run-of-mine or sized coal. The analytical figures represent optimum conditions and due allowance must be made for this when interpreting them into commercial practice.

Experience of many laboratory float and sink analyses carried out on coal actually being commercially washed has suggested a rough interpretation which can be given to the figures. In general, if the coal is not poor in quality the large scale percentage of float will not be less than the figure obtained in the laboratory on fine coal.

The percentage ash on the float obtained from a commercial washer is, however, usually from 2 - 4% higher than the value obtained from a laboratory separation. Furthermore, it has been found that the smaller the size of the coal being washed on a large scale, the more closely does the percentage yield and the percentage of ash in the product approach the fine coal float and sink analysis. That is to say, for example, that the allowance made in estimating the washability of pea coal need not be so great as that for, say round coal.

If the coal is poor (more than 18 - 20% ash) it is advisable to make a liberal allowance, since with this material only washers of the best type operated under strict control function at all satisfactorily.

VII. ULTIMATE ANALYSIS:

The ultimate analysis is generally carried out on the float at a S.G. of 1.6. This procedure is adopted in order to eliminate as far as possible the effects due to the presence of adventitious mineral matter.

Carbon, hydrogen, nitrogen and sulphur contents are all determined by standard methods for coal analysis:- viz:

(a) Carbon/.....

(a) Carbon and Hydrogen: The method used is described in B.S.S. No. 1016 of 1942, "Analysis and Testing of Coal and Coke", page 31.

(b) Nitrogen: The method followed is that described by Beet (Fuel in Science and Practice, volume XI of 1932, page 196; volume XIII of 1934, page 343) and Hall (Journ. Chem. Met. and Min. Soc. of South Africa, volume XXXVI of 1935, No. 2, page 28).

(c) Total Sulphur: This is determined by the Eschka method, described in B.S.S. No. 1016 of 1942, "Analysis and Testing of Coal and Coke", page 43.

The oxygen content is obtained by subtracting the sum of the carbon, hydrogen, nitrogen and sulphur percentages from 100. The value obtained therefore includes all analytical errors.

The results are expressed on a dry-ash-free basis, so as to present the composition of the organic substance itself, unmixed with mineral matter.

VIII. SULPHUR DISTRIBUTION:

The figures showing the distribution of sulphur in a sample are on an "as received" basis i.e. including adventitious mineral matter.

The total sulphur content on the whole coal is determined by the Eschka method and the mineral sulphur content by extraction with dilute nitric acid, according to the method described in B.S.S. No. 1016 of 1942, page 45.

IX. CARBONIZATION ASSAYS:

There are two forms of carbonization assays, viz: the low temperature (600°C) and the high temperature (900°C) and both are carried out in the Gray-King Apparatus.

Low Temperature Gray-King Assay:

This is carried out at a temperature of 600°C on the floats at a S.G. of 1.6 and is used, primarily for correlative purposes either as a means of characterising a new coal or for establishing the variation in a given type of coal. The results can also be used, however, for determining the type and quantity of the products which the coal under test would furnish in a large scale low temperature carbonization retort. The apparatus and method used is that described in the "Methods of Analysis of Coal" issued by the Fuel Research Station, Greenwich (Physical and Chemical Survey of the National Coal Resources, No. 7.)

No direct relationship between the retort and assay yields obtained from South African coals has been deduced but the following interpretation has been found to be applicable overseas. Depending on the type of plant, the large scale tar yield varies from 70 - 80% of that given by the assay. The gas yield is also slightly higher than can be obtained in practice. The yield of coke will be very close to that given by the assay. "Standard" to "very swollen" coke residues indicate coals which will probably produce satisfactory smokeless fuels, while those which are appreciably more

friable/.....

friable than "standard" indicate coals which will not yield suitable large scale coke products.

The assay is carried out on the float at 1.6 S.G. for the same reasons as are outlined in Section 7 (ultimate analysis) and also since that fraction would most nearly represent the ordinary washed product from the seam or section of the seam under consideration.

High Temperature Gray-King Assay:

This test is only made on such seams or sections of seams as appear to be possible sources of coking or gas coals. Usually the float at a S.G. of 1.45 is used as representing the optimum quality of coal which could be commercially produced by the best possible washing.

A temperature of 900°C is employed and a cracking unit kept at a constant temperature of 800°C is installed. The method and apparatus used is that described in "The Assay of Coal for Carbonization Purposes (Part III)" issued by the Fuel Research Station, Greenwich, (Technical Paper No. 24). The calorific value of the gas is determined by combustion of a measured volume in excess air in a Löffler Gas Calorimeter.

The High Temperature Gray-King Carbonization Assay has been designed specifically to simulate large scale gas making conditions both in horizontal and continuous vertical retorts. Here again no direct relationship between the retort and assay yields with South African coals has been deduced and it is necessary to rely entirely on overseas results. The assay conditions are such that the factors of comparison with horizontal retort practice approach unity. It is considered that the factors for coke oven practice should not diverge unduly from unity in spite of a number of variables such as type of plant, type of coal and size of coal. The factors retort/assay for gas yield, gas calorific value and coke yield are very close to unity. The assay yield of tar is low and the factor varies from 1.2 to 1.5 as the coal varies from strongly to weakly-swelling. The coke residues "friable" and "pulverulent" obtained from the assays indicate coals unsuitable for large scale coke production. Coke residues from "standard" to "very swollen" indicate that the coals will probably yield cokes under large scale conditions.

The best gas coals so far tested in South Africa give about 18 - 20% gas, and they yield 65 - 70 therms of gas per long ton of coal. The highest calorific values of the gas so far found vary from 5400 to 5700 Calories per cubic metre at N.T.P.

X. ASH FUSION TEMPERATURES:

A knowledge of the composition and behaviour of the ash from any coal is of importance from both a fundamental and technical aspect. The use of coal in many industrial appliances e.g. producers and forced draught boilers is seriously limited by the behaviour of the ash.

The mineral matter from which the ash is derived occurs in two forms:-

(a) Inherent mineral matter which occurs as an integral part of the coal and is not separable therefrom by ordinary means e.g. picking or washing.

(b) Adventitious/.....

(b) Adventitious mineral matter which may be again sub-divided into:-

(i) more or less isolated pockets and more continuous bands included in the coal seams.

(ii) mineral matter derived from accompanying strata.

Run-of-mine coal would contain all the forms of mineral matter described above; effective picking should remove the greater portion of (b) (ii) and washed coals would contain (a), and (b) (i) to a limited extent only. In order to determine the ash fusion temperatures of ordinary picked but unwashed coal, these tests are carried out on the whole coal samples, including adventitious mineral matter. If a figure for washed coal is required, the determination is made on the floats at 1.6 S.G.

A direct correlation between the laboratory determinations of the ash fusion temperature and behaviour of the ash in practice has not so far been possible. Although the determinations are carried out under conditions designed to resemble as closely as possible those actually obtaining in a furnace, the differences between small and large scale conditions are appreciable. The results indicate, however, the probable behaviour of the ash in practice and the following scheme may be used for interpreting the laboratory determination of the ash fusion temperature.

(a) less than 1250°C - likely to cause clinkering trouble under all furnace conditions.

(b) 1250°C to 1400°C - unlikely to produce clinker under general conditions, although trouble may be experienced with industrial appliances like producers and forced draught boilers.

(c) greater than 1400°C - highly refractory ash which will probably not clinker under any conditions.

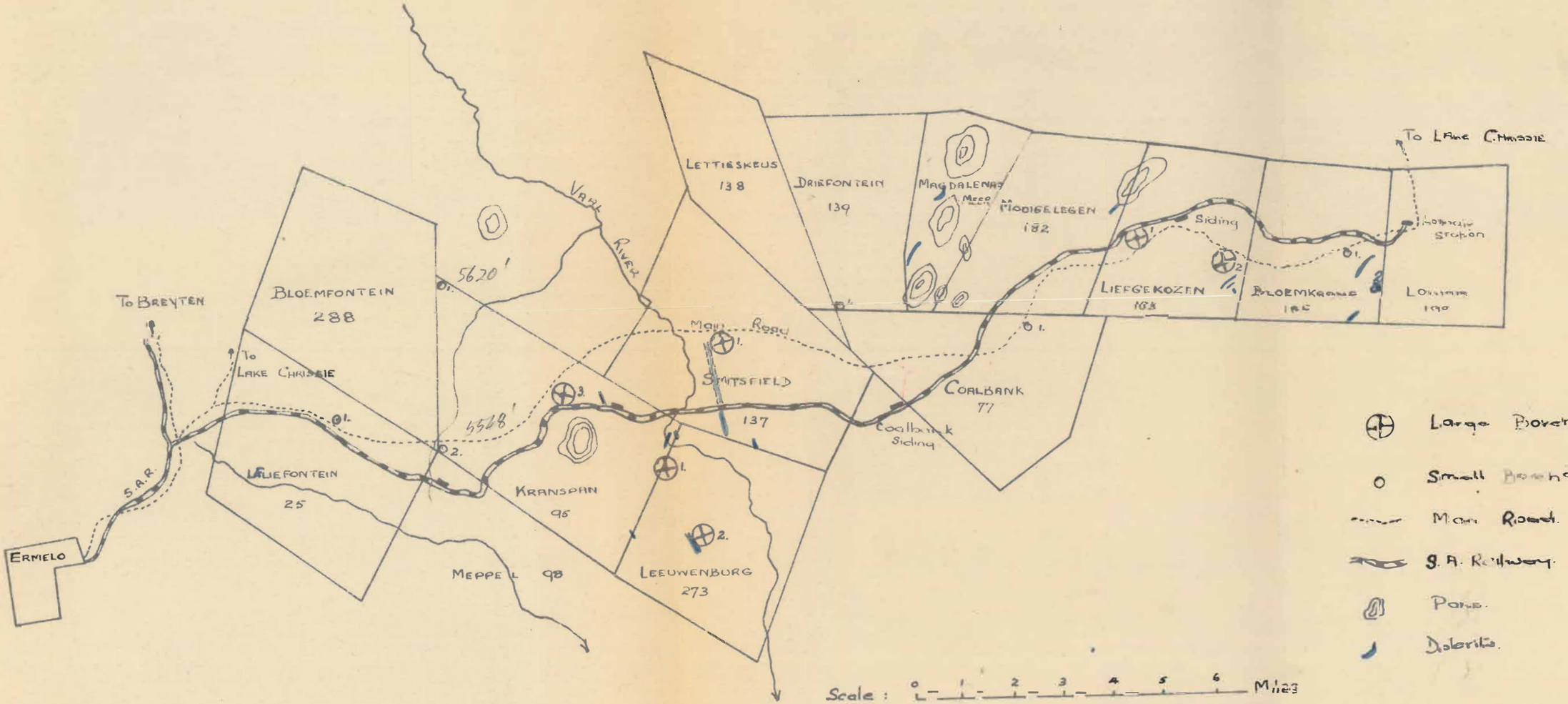
XI. HYDROGENATION:

The work done in this sphere constitutes a comparative hydrogenation survey. Consequently, a discontinuous rotary converter, though it affords no quantitative data as to the behaviour of the coal in a large scale continuous plant, can nevertheless be used. Under rigidly standard conditions, results obtained with this apparatus are qualitatively comparable.

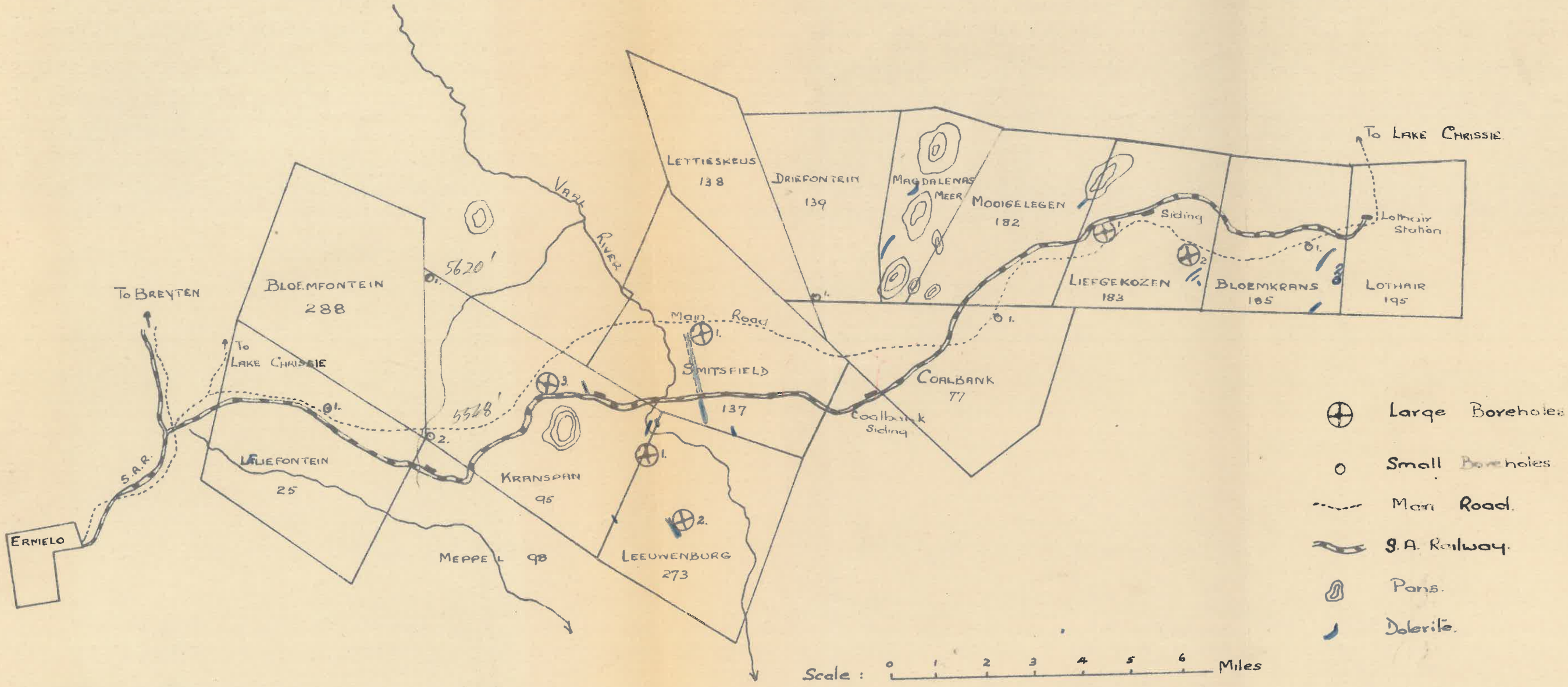
The coals are heated in the form of a paste containing 57% of coal, 38% of oil and 5% of molybdenum sulphide as catalyst. After filling the converter with 440 grams of the paste and hydrogen to a pressure of 100 atmospheres, the converter is heated to 450°C and kept at this temperature for one hour.

The evaluation of the results is based on the percentage of residual organic benzene-insoluble material reckoned on a dry-ash-free basis. Where this figure is low, the coal may be expected to give better large scale results than where it is high. The best coals so far tested in South Africa have yielded 8 - 11% of this insoluble residue. The average is about 31% and the maximum 60%.

PLAN SHOWING POSITIONS OF BOREHOLES SUNK FOR TORBANITE EAST OF ERMELO.



PLAN SHOWING POSITIONS OF BOREHOLES SUNK FOR TORBANITE EAST OF ERMELO.



VLAKLAAGTE 35

PLAN SHEWING:-

(1) NATAL NAVIGATION BOREHOLES - NN 1, etc.
(2) SNEDDON & SINCLAIR BOREHOLES - S 1 etc
(3) SURFACE LEVELS - relative to assumed datum.

Assumed datum 5000 ft. A.S.L.

N.

S 4 5018
S 1 5029
S 3. 5107
S 2 5031
NN 1 5102
S 5 5103
NN 24 5092
S 4 R. 5112
NN 7 5117
S 11 4977
S 9 5136
NN 21 5119
S 6 5052
NN 6 5053
NN 5 5055
NN 1 5026
NN 22 5132
NN 10 5184
S 10 4998
NN 4 4998
NN 23 5102
NN 4 5111
S 8 5063
NN 3 5124
NN 8 5085
NN 15 5043
NN 13 5024
S 12
S 14
NN 16 4968
NN 20 5089
S 13
NN 17 4948
S 15
S 16
NN 19 5090
NN 18 5013

VAALKRANS 24.

NORTHERN AREA

HARTEBESTFONTEIN 79.

GOEDEHOOP 270.

FAULT 70°

Northern Area
Southern Area Boundary Int.

BURNT COAL

APPROX LINE OF 70°

BURNT COAL

OLIFANTS RIVER

SOUTHERN AREA

No 2 SEAM - 1.8m.

WELSTAND 34

KLEINFONTEIN 269.

Scale: 1/30,000