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REPORT No. 11

OF 1945

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BRANDSTOF-NAVORSINGS-INSTITUUT

VAN SUID-AFRIKA.

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

SURVEY REPORT NO. 74.

ONDERWERP:
SUBJECT: REPORT ON BOREHOLES PUT DOWN BY THE CONSOLIDATED MARSFIELD COLLIERY (ANGLO-TRANSVAAL COLLIERIES, LTD.) ON THE FARMS VOGELFONTEIN 4 AND WATERVAL 18 IN THE ERMELO DISTRICT OF THE TRANSVAAL.

AFDELING:
DIVISION: CHEMISTRY

NAAM VAN AMPTENAAR:
NAME OF OFFICER: C. C. VAN DER MERWE.

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

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REPORT ON BOREHOLES PUT DOWN BY THE CONSOLIDATED MARSFIELD COLLIERY (ANGLO TRANSVAAL COLLIERIES, LTD) ON THE FARMS VOGELFONTEIN 4 AND WATERVAL 18 IN THE ERMELO DISTRICT OF THE TRANSVAAL.

INTRODUCTION.

The farms Vogelfontein 4 and Waterval 18 lie in the Ermelo-Breyten Coalfield and from 4 to 5 miles south west of Breyten. The Breyten-Ermelo railway cuts through the most easterly corner of Waterval, while the Breyten-Bethal railway runs across the farm Vogelfontein following roughly the watershed of the Vaal River to the south and the Komati River to the north.

The workings of the Consolidated Marsfield Colliery are situated in the north-western half of the farm Vogelfontein. Waterval adjoins the south-eastern boundary of Vogelfontein.

During the year 1941 two boreholes were sunk towards the north of the workings (Boreholes No. 1/41 and 2/41) and one towards the south (Borehole No. 3/41). The drilling towards the south was resumed during 1943. This latter programme comprises four boreholes (C.M.C. No.1/43, 2/43, 3/43 and 4/43) on the farm Vogelfontein and six boreholes (C.M.C. Nos. 5 to 10/43) on Waterval.

The positions of the boreholes and a rough indication of the workings of the Marsfield Colliery are shown on the accompanying map (see back of report).

This report deals with the characteristics of the coal as revealed by both these drilling programmes, although boreholes Nos. 1/41, 2/41 and 3/41 were excluded from the composite samples that were made up.

SECTION A: BOREHOLE RECORDS. (Table 1, page 8)

The collar elevations of the boreholes in the vicinity of the Bethal-Breyten railway vary from 5800 to 6000 feet a.m.s.l. Here the coal seams are covered by a stratum consisting mainly of sandstone, from 200 - 300 feet thick. On top of this sandstone 90 feet of dolerite is present in borehole 3/43.

Towards the south the surface dips at a fairly steep angle, having an elevation of 5646 feet at borehole 6/43. The coal seams, however, rise slightly (50 to 80 feet) towards the south east. The result is that the highest seam (Bloukop oil shale horizon) is absent in boreholes 7/43, 6/43 and 9/43, and in borehole 6/43 seam A has been denuded.

The coal-bearing formation consists mainly of sandstone with impersistent bands of shale of varying width.

A thin band of coal (6" - 7" thick) is present in boreholes 4/43 and 1/43, from 50 to 60 feet above the oil-shale horizon. It was not sampled.

At an elevation of approximately 5700 feet a.m.s.l. one or more thin bands of coal were intersected. These bands have been called the Top Seam and correspond with the bands of Bloukop oil shale found on farms further south

One band of bright coal was fairly well developed and was sampled when found. This band tends to decrease in width towards the south east and in boreholes 6/43 and 9/43 it has been denuded.

Seam A/....

Seam A was intersected at an average distance of 100 feet below the top seam. The parting consists mainly of sandstone. The seam varies in width from 3½ to 8½ feet with a general tendency to thin out from north to south.

At an average distance of 40 feet below seam A a wide band of coal was intersected. The parting between these seams is persistently described as "coarse sandstone with grit" by the officials of the Anglo-Transvaal Collieries.

This band of coal is split up by shaly sandstone varying in width from 3" to 24 feet. The top half is designated Seam B and the bottom half Seam C.

Seam B consists of from 3 - 4 feet of dull coal where the coal is unaffected by dolerite. A thin band of laminated shale constitutes the roof of this seam in most of the boreholes.

Seam C varies in width from 4 to 7 feet and the whole seam is composed of mineable coal.

All the boreholes were stopped in sandstone after passing through the latter seam.

Dolerite destroyed all the coal seams in boreholes 1/41 and 2/41 towards the north of Marsfield Colliery. Dolerite was also found below the top seam in boreholes 1/43 and in 3/43 and 4/43 towards the south.

Indications of the effect of a dolerite sill, underlying the main coal seams are found in boreholes 3/41, 1/43, 4/43, 5/43, 6/43, 7/43, 8/43 and 9/43. In these boreholes either the swelling properties have been affected or the lower coal seams have been destroyed. Dolerite is actually present in boreholes 6/43, 7/43 and 9/43.

CORRELATION OF COAL SEAMS.

In the borehole sections that were drawn up by the officials of the Anglo-Transvaal Collieries, the top coal seam was designated Seam A. In this report this seam is regarded to correspond with the Bloukop oil shale horizon which is normally found at a distance of from 70 to 120 feet above Seam A.

The lower seams were designated Seam B, Upper Seam C and Lower Seam C respectively, from the top downwards by the Anglo-Transvaal Collieries. In this report these seams are regarded as Seams A, B and C, respectively. The nomenclature adopted in this report corresponds closely with that accepted by the Geological Survey Office for the seams on the farms towards the south. A typical section of the strata on the farms Driehoek 12, Kafferspruit 265 and the southern corner of Waterval 18 is given for comparative purpose.

Width in feet.	Anglo-Transvaal Colliery nomenclature.	Strata and nomenclature adopted in this report.
-		Soil, clay decomposed sandstone and shale.
-		Sandstone and shale.
60 - 80		Sandstone.
¼ - 1	Seam A	Torbanite or coal
60 - 80		Sandstone
30 - 50		Sandstone and shale
4 - 6	Seam B	Coal, Seam A
40 - 50		Grit
2 - 4	Upper Seam C	Coal, Seam B.
1 - 5		Sandstone and shale.
3 - 6½	Lower Seam C	Coal, Seam C.
30 - 60		Sandstone and shale.
½ - 3		Coal, Seam D
65		Sandstone and shale
4		Coal, Seam E
-		Sandstone and shale.

SECTION B.

The analytical methods employed in the coal survey work and the significance to be attached to the determinations are given in the appendix (see end of report).

SECTION C: PROXIMATE ANALYSES.

The coal cores were sampled by officers of the Anglo-Transvaal Collieries and portions of the crushed samples were sent to the Fuel Research Institute.

Table 2 (see back of report page 21) gives the details of the samples. The core or section of each seam in each borehole is given a distinctive sample number and each sub-division of such a core or section a distinctive letter starting from the bottom with the letter A.

Table 3. (see back of report, page 28) gives the proximate analyses on an air dried basis of the samples detailed in Table 2, together with

(a) the percentage float at a specific gravity of 1.45
(b) the percentage ash on the float at 1.45 S.G.
(c) the swelling number on the float at 1.45 S.G.
(d) the percentage float at a S.G. of 1.6
(e) the percentage ash on the float at S.G. of 1.6
(f) the swelling number on the float at 1.6 S.G.

From the individual analytical data given in Table 3, certain average proximate analyses of various sections of the seams have been drawn up and are tabulated in Table 4, (See back of report, page 32) together with analyses of single samples which may represent a mining width or which can be used for correlative purposes. Inferior bands, which could be removed by picking during production, have been excluded from both the widths and the analyses.

SECTION D: ULTIMATE ANALYSES.

For the purpose of further and more detailed investigation, composite samples, based on the characteristics of the coals revealed by the proximate analyses in section C, were made up. These were made by mixing - in proportion to the amount of coal they represent - samples of the same type of coal from different boreholes, provided that the proximate analyses have confirmed their general similarity. A series of samples were thus obtained representing the various types of coal found in each seam. The composition and the type of coal represented by these samples is given in Table 5, (See back of report, page 33).

One composite sample of the top seam has been made.

Seam A is represented by three composite samples one of the top half of the seam and one of the bottom half of the seam. The third composite sample represents the section from the top which has swelling properties.

Samples from Seam C which show marked indications of burning by dolerite (as well as boreholes 1/41, 2/41 and 3/41) have been excluded from the composite samples. Three composite samples were taken from Seam C, representing the whole coal at the top and bottom sections and the band that shows swelling properties, respectively.

In Table 6 (See back of report, page 34) are given the proximate analyses of the samples listed in Table 5, together with analyses of the floats at S.G. of 1.6 of each sample.

In/....

In Table 7 (See back of report, page 35) are given the ultimate analyses of the samples listed in Table 5. The analyses have been carried out in all cases on the floats at a S.G. of 1.6 and the results are expressed on a dry, ash free basis so as to present the composition of the coal substance itself.

Table 8 (see back of report, page 35.) shows the sulphur distribution in the composite samples. These analyses have been carried out on the whole coal including the adventitious mineral matter. The total sulphur contents of the floats at 1.6 S.G. are also included in this table for comparative purposes. A comparison of the total sulphur content on the whole coal and on the float at 1.6 gives an indication of whether the sulphur content of the coal could be improved by washing.

SECTION E: CARBONISATION ASSAYS.

Low temperature carbonisation assays have been made on the floats at 1.6 S.G. of the samples listed in Table 5. The results are given in Table 9 (see back of report, page 36.).

Table 10 gives the results of high temperature carbonisation assays carried out on those samples, listed in Table 5, which appear to be possible sources of gas or coking coals. The assays have been done on the floats at 1.45 S.G.

SECTION F: FLOAT AND SINK ANALYSES.

Float and sink analyses together with their attendant ash and swelling number determinations have been done on the samples listed in Table 5. The results are given in Table 11 (see back of report, page 37.).

SECTION G: ASH FUSION TEMPERATURES.

Ash fusion temperatures have been determined on the ash from the whole coal and from the floats at 1.6 S.G. of the samples given in Table 5. They are given in Table 12 (see back of report, page 39)

SECTION H: SUMMARY.

(a) General.

The general description of the coal seams and the proximate analyses indicate that the types of coal vary from high-volatile slightly swelling coal in the top seam and in Seam C to high ash mainly dull coal in Seam B. Mixed coal is also present in Seam C.

The swelling properties are of importance from the coke-production point of view. The proximate analyses, however, indicate that these properties have been destroyed by the effect of dolerite in the central portion of the prospected area. A separate composite sample was made of those samples which showed definite swelling properties.

The detailed analytical results are normal and, as is usual, the higher yields of tar and gas are associated with the high hydrogen-content bright coals. The ratios of % tar/% H and % H/% gas are, however, lower for these coals than is the case with the same type of coals found in other coalfields (e.g. Witbank Coalfield).

The types of coke found, on carbonisation, were unexpected. The preliminary analyses indicated a slightly developed coke-forming tendency in some of the samples, but the carbonisation assays yielded a powdery coke in all cases. The results indicate that weathering of the fine coal has a deleterious effect on its swelling properties.

The/...

The swelling properties are, however, not sufficiently developed to make the coal suitable for the carbonisation industries.

The nitrogen contents are very constant and high, which is normal for all South African coals.

The mineral sulphur contents of the whole coal vary considerably from 0.41 to 1.60% while the organic sulphur contents are much more constant (0.3 to 0.6%). It is of importance to note that the mineral sulphur contents are decreased by approximately 50% on washing the fine coal at a S.G. of 1.6

The ash fusion temperatures vary between 1200°C and +1400° with the highest and lowest values associated with the lowest and highest sulphur contents respectively. The ash fusion temperatures are generally improved by washing the fine coal at a S.G. of 1.6

(b) Nature of the Coal.

TOP SEAM.

This seam is of no economic importance in this area. No indications of oil shale were found associated with this seam.

The general characteristics of this coal are, however, of considerable value from a correlative point of view. The coal is mainly bright with an ash content of approximately 17%, and a volatile matter content of 28%. The coal contains a very light fraction which shows slight swelling properties.

The other analyses show the coal to be normal excepting the oxygen content which is 1% higher than the maximum value obtained for the other seams (12.6 and 11.6% respectively). It is also of interest to note that the mineral sulphur content, which is usually high for a bright coal, is exceptionally low for the coal from this seam (0.19%).

SEAM A.

Seam A is composed of two bands of coal, a top band with an average width of 2 feet, and a bottom band of 2½ feet, separated by a band of high ash dull coal or carbonaceous shale. The width of the parting varies from 1 to 3 feet.

The top band consists of mixed coal with the following average proximate analyses:

Ash %	18.4
Moisture %	2.8
Volatile matter %	27.9
Fixed carbon %	50.9
Calorific value lbs/lb.	11.7

The bottom band of coal is duller in appearance and gave the following results:

Ash %	17.4
Moisture %	2.9
Volatile matter %	24.5
Fixed carbon %	55.2
Calorific value lbs/lb.	11.5

At the present time these two bands of coal can not be considered as of economic value either separately or together. The parting obviously decreases the value of the seam as a whole.

The coal could, however, be cleaned by a washing process. This would require a good type of washer and the following results could be obtained:

Float/. . .

Float at specific gravity of 1.55:

Yield	80%
Ash %	14%
Calorific value	12.0 - 12.4 lbs/lb.

SEAM B.

Seam B, in the prospected area, consists of inferior coal. The coal has a dull appearance and contains from 27 to 40% ash.

No detailed analyses have been done on the sample from this seam since the coal is of no economic value.

This seam maintains a fairly constant width over the whole area (40 - 45") except in borehole 3/41 where it is represented by only 4 " of bright coal. A thin band of low quality torbanite is also present at the bottom of the seam in boreholes 1/43 and 3/43.

SEAM C.

Seam C is the main seam of the Ermelo-Breyten coal area, and on the farms Waterval and Vogelfontein it constitutes the only economically mineable seam found.

Many indications of dolerite were found and towards the north of the Marsfield Colliery (boreholes 1/41 and 2/41), in the central portion of the area towards the south (boreholes 1/43, 5/43, 6/43 and 7/43) and towards the south-east (borehole 9/43) the coal has been destroyed.

Over the rest of the two farms Seam C varies in width from 4 to 6 feet with an average of 5 feet.

Torbanite was found at the top of the seam in boreholes 1/43 and 2/43. The analyses of a few samples of a thin band of "dull" coal at the top of the seam indicate the presence of cannel-like coal or oil-shale. The samples described as torbanite, that were taken proved to be of low quality.

The rest of the seam is composed of mainly bright coal with thin partings of carbonaceous shale which is present only in borehole 3/41, towards the north of the workings of the Marsfield Colliery.

An average width of 5 feet of coal with the following analyses could be mined:

Ash %	15
Moisture %	3
Volatile matter %	31
Fixed carbon %	51
Calorific value lbs/lb.	12.0

These results correspond closely with those obtained for the coal that has been marketed by the Marsfield Collieries in the past few years, which is represented by the following analyses:

Ash %	14.9
Moisture %	2.3
Volatile matter %	31.3
Fixed carbon %	51.5
Calorific value lbs/lb.	12.2
Ash fusion temperature °C	1300 - 1400

The coal is of a very useful second grade quality, and to improve the quality to a first grade standard would require, owing to the type of coal, that the ash content be decreased to 10 - 11%. This could readily be achieved in a washer separating at a S.G. of 1.50, with a discard of 20%. A washing process would also improve the ash fusion temperatures of the raw coals which are low, and the sulphur contents which are rather on the high side.

Where/....

Where unaffected by dolerite, the lighter fractions of the coal had a swelling number of 2. Carbonisation tests gave a powdery coke which indicated that the swelling properties are not sufficiently developed to make the coal suitable as a raw material for the carbonisation industry, and also that these properties are readily destroyed by oxidation when exposed to the air.

Generally, the coal from this seam corresponds to the characteristics of the type of coal found between Ermelo and Breyten.

The boreholes proved the mining value of Seam C. The coal from these boreholes, as is the case with the present product from the Marsfield Colliery, would be suitable as a high volatile-content fuel, for general steam raising and domestic purposes. It would be advantageous to the consumer if the large amount of volatiles was properly utilized in the combustion appliance employed.

The presence of dolerite in a large number of boreholes makes it difficult to arrive even at tentative estimates of the in situ amount of coal and the extent of the extractable seam. It would be advisable to carry out an intensive borehole survey of this area before developing extensively towards the south east or sinking a new shaft in the area under consideration.

C. C. VAN DER MERWE

Assistant

November 1945.

TABLE 1.

BOREHOLE RECORDS

Depth Ft.	Ins.	Width Ft.	Ins.	Description of Strata
Borehole CMC 1/41, Vogelfontein 4. Collar Elevation 5903 feet a m s.l				
22	3	22	3	Sandy soil
35	0	12	9	Pot clay
39	6	4	6	Black shale
40	8	1	2	Dolerite
43	0	2	4	Sandstone
43	8	0	8	Shale
47	8	4	0	Shaly sandstone
48	10	1	2	Sandstone
70	5	21	7	Shaly sandstone
72	0	1	7	Sandstone
72	11	0	11	Dolerite - soft texture
76	5	3	6	Shale
77	0	0	7	Sandstone
85	0	8	0	Sandy shale
89	9	4	9	Shale
144	4	54	7	Sandstone - coarse grain with bands of fine grain.
150	0	5	8	Shaly sandstone
151	1	1	1	Sandstone
159	0	7	11	Shaly sandstone
167	7	8	7	Sandy shale
174	6	6	11	Sandstone - medium grain
175	1	0	7	Carbonaceous shale
176	8	1	7	Sandstone
176	10	0	2	Shale
183	0	6	2	Shaly sandstone
205	8	22	8	Sandstone
219	0	13	4	Laminated shale - sandy
257	10	38	10	Sandstone
				(Coal 7")
258	8	0	10	(Shaly sandstone 2½") TOP SEAM
				(Coarse granular coal ½")
259	10	1	2	Shaly sandstone
264	11	5	1	Sandstone
265	4	0	5	Shale with coal streaks
280	3	14	11	Sandstone with shaly streaks
290	2	9	11	Laminated sandy shale
295	0	4	10	Fine grain sandstone
300	0	5	0	Laminated sandy shale
300	4	0	4	Shale
302	0	1	8	Interbanded shale and sandstone
306	0	4	0	Sandstone
306	4	0	4	Micaceous sandstone
313	8	7	4	Sandstone
314	5	0	9	Micaceous sandstone
314	11	0	6	Sandstone
315	4	0	5	Shale
325	4	10	0	Shaly sandstone
332	0	6	8	Laminated shaly sandstone
337	0	5	0	Laminated sandy shale
340	2	3	2	Shale
340	10	0	8	Coarse grain sandstone
343	10	3	0	Shale
350	0	6	2	Laminated shaly sandstone

357/...

TABLE 1, continued.

Depth Ft.	Depth Ins.	Width Ft	Width Ins.	Description of Strata
Borehole CMC 1/41 (contd.)				
357	10	7	10	Sandstone
358	5	0	7	COAL, shaly
359	4	0	11	Dolerite
364	2	4	10	Shaly burnt coal (placed in core box). SEAM A.
367	5	3	3	Fine laminated shale
384	4	16	11	Coarse grain sandstone
384	6	0	2	Burnt shale
385	0	0	6	Shaly sandstone - burnt
385	11	0	11	Carbonaceous shale
386	5	0	6	Dolerite
387	2	0	9	Shale
388	10	1	8	Dolerite and carbonaceous shale
397	10	9	0	Dolerite - dyke with burnt coal contacts.
400	0	2	2	Dolerite with burnt coal contacts
401	9	1	9	Burnt coal
405	5	3	8	Laminated micaceous sandstone
406	5	1	0	Laminated sandy shale
408	0	1	7	Shaly sandstone
408	3	0	3	Dolerite
413	0	4	9	Shaly sandstone
422	5	9	5	Sandstone - medium grain
424	6	2	1	Shaly sandstone
428	2	3	8	Sandy shales
434	0	5	10	Micaceous shales
437	8	3	8	Black sandy shales
438	6	0	10	Dolerite
440	10	2	4	Black sandy shales
452	4	11	6	Sandstone - medium grain
487	11	35	7	Dolerite (greenish colour)
490	0	2	1	Sandy shale
498	8	8	8	Black sandy shale
520	4	21	8	Black sandy shale
529	9	9	5	Carbonaceous shale
530	4	0	7	Carbonaceous shale
536	1	5	9	Sandstone
540	6	4	5	Sandy shale
543	3	2	9	Black shale
554	3	11	0	Sandstone
561	0	6	9	Shaly sandstone
562	9	1	9	Sandstone
563	0	0	3	Shaly sandstone
564	0	1	0	Sandstone
565	2	1	2	Shaly sandstone
584	5	19	3	Sandstone
595	9	1	4	Shaly sandstone
599	0	3	3	.....Core lost

Borehole CMC 2/41 /...

TABLE 1, continued.

Depth Ft.	Depth Ins.	Width Ft.	Width Ins.	Description of Strata
Borehole CMC 2/41, Vogelfontein 4. Collar Elevation 5°33 ft. a.m.s.l.				
1	0	1	0	Soil and subsoil
15	7	14	7	Decomposed sandstone
32	0	16	5	Soft quartzitic sandstone
39	2	7	2	Banded shale
42	6	3	4	Dolerite - sill.
52	0	9	6	Banded shale
56	10	4	10	Banded sandstone
70	11	14	1	Black micaceous sandstone
72	5	1	6	Banded sandstone
78	10	6	5	Dark micaceous sandy shale
89	10	11	0	Banded shale
91	6	1	8	Sandstone
98	10	9	4	Banded shale
100	9	1	11	Sandstone
107	0	6	3	Banded sandstone
109	0	2	0	Dolerite
125	9	16	9	Banded sandstone
127	10	2	1	Sandstone
128	7	0	9	Banded shale
129	4	0	9	Metamorphosed dolerite
144	8	15	4	Banded shale
147	5	2	9	Sandy shale
150	6	3	1	Sandstone
152	11	2	5	Carbonaceous micaceous shale
153	7	0	8	Micaceous sandstone
205	3	51	8	Sandstone
218	7	13	4	Banded sandstone
230	5	11	10	Sandstone
233	8	3	3	Micaceous sandstone
241	2	7	6	Banded sandstone
257	4	16	2	Sandstone
270	0	12	8	Carbonaceous shale
274	0	4	0	Banded shale
300	6	26	6	Sandstone
303	0	2	6	Sandstone with coal streaks
303	1	0	1	Coal
303	3	0	2	Sandstone
304	2	0	11	COAL - TOP SEAM
307	10	3	8	Micaceous shale
315	4	7	6	Sandstone
315	6	0	2	Carbonaceous shale
315	9	0	3	Sandstone
315	10	0	1	Carbonaceous shale
324	0	8	2	Banded shaly sandstone
336	10	12	10	Banded shaly sandstone
336	11	0	1	COAL
338	8	1	9	Carbonaceous shale
370	8	32	0	Banded shaly sandstone
371	2	0	6	Micaceous shale
372	2	1	0	Dolerite - sill.
378	0	5	10	Banded sandstone
387	6	9	6	Banded shale
389	7	2	1	Dolerite - dyke.
402	6	12	11	Hard carbonaceous shale
411	0	8	6	Shaly banded sandstone
422	0	11	0	Dolerite - dyke.
423	9	1	9	Burnt coal

425/....

Table 1, continued.

Depth Ft.	Depth Ins.	Width Ft.	Width Ins.	Description of Strata
Borehole CMC 2/41 (contd.)				
425	9	2	0	Black burnt shale
433	10	8	1	Sandstone
435	2	1	4	Sandy burnt shale
458	6	3	4	Dolerite
461	6	3	0	Shaly coal
465	1	3	7	Burnt shale
468	3	3	2	Burnt coal
477	8	9	5	Black muddy shale
478	9	1	1	Burnt coal
484	6	5	9	Shaly sandstone
495	0	10	6	Sandstone
495	4	0	4	Dolerite
499	0	3	8	Sandstone
499	5	0	5	Dolerite
502	0	2	7	Sandstone
527	1	25	1	Shaly sandstone
528	0	0	11	Core left in the borehole.
Borehole CMC 3/41, Vogelfontein 4. Collar Elevation 5923 ft.a.m.s.l.				
25	6	25	6	Soil and subsoil
28	2	2	8	Mudstone
36	0	7	10	Decomposed banded sandstone
50	0	14	0	Banded sandstone
55	4	5	4	Sandstone
66	0	10	8	Banded shale
101	0	35	0	Sandstone
101	9	0	9	Banded sandstone
127	6	25	9	Sandstone
136	2	8	8	Banded sandstone
201	6	65	4	Sandstone
214	0	12	6	Banded shale
237	6	23	6	Sandstone
239	1	1	7	COAL. TOP SEAM.
239	2	0	1	Carbonaceous shale
242	5	3	3	Sandy shale
250	0	7	7	Sandstone
250	1	0	1	COAL
250	2	0	1	Sandstone
250	7	0	5	COAL
269	4	18	9	Banded sandstone
269	6	0	2	Carbonaceous shale
269	7	0	1	COAL
270	0	0	5	Carbonaceous shale
317	1	47	1	Banded sandstone
321	8	4	7	Banded shale
329	8	8	0	Sandstone
330	11	1	3	Carbonaceous shale
337	6	6	7	Banded sandstone
341	3	3	9	Sandstone
348	0	6	9	COAL. SEAM A.
395	5	47	5	Micaceous sandstone
399	4	3	11	Dull coal and torbanite
400	4	1	0	Carbonaceous shale with coal streaks.
400	8	0	4	Sandstone
401	3	0	7	COAL
401	6	0	3	Carbonaceous sandstone
406	11	5	5	COAL. SEAMS B AND C.
407	2	0	3	Carbonaceous micaceous sandstone
415	0	7	10	Laminated micaceous sandstone

TABLE 1, continued.

DEPTH Ft.	DEPTH Ins.	WIDTH Ft.	WIDTH Ins.	Description of Strata
Borehole CMC 1/43, Vogelfontein 4. Collar Elevation 5924 ft. a.m.s.l.				
0-30	9	30	9	Surface measures
35	9	5	0	Decomposed micaceous sandstone
40	10	5	1	Banded shale
41	5		7	Coarse sandstone
			1	Shale
49	8	8	2	Medium sandstone
50	3		7	Fine micaceous sandstone
50	6		3	Grit
58	9	8	3	Banded shale - micaceous.
60	10	2	1	Sandy shale
62	0	1	2	Fine sandstone
88	10	26	10	Sandstone
89	0		2	Carbonaceous shale
90	0	1	0	Coarse grit
98	5	8	5	Sandstone
121	3	22	10	Sandstone with paper thin bands of micaceous shale
123	4	2	1	Sandstone
138	3	14	11	Sandstone with micaceous shale bands.
150	9	12	6	Sandstone
168	1	17	4	Laminated sandstone shale
170	5	2	4	Coarse sandstone
171	0		7	COAL
187	5	16	5	Sandstone with occasional bands of micaceous shale.
191	6	4	1	Laminated sandstone
203	6	12	0	Sandstone
205	6	2	0	Sandy shale
215	0	9	6	Fine sandstone micaceous
215	9		9	Sandstone fine micaceous
229	4	13	7	Banded sandstone
229	9		5	Laminated sandy black shale
230	11	1	2	COAL. TOP SEAM.
233	8	2	9	Sandy shale
238	10	5	2	Sandstone medium, occasional ¼" bands of carbonaceous shale.
240	1½	1	3½	Black shale
240	4		2½	Gritty sandstone
240	8		4	Shale
240	8½		½	COAL BAND.
241	10	1	1½	Sandstone
250	0	8	2	Laminated sandstone micaceous
253	4½	3	4½	Banded shale, micaceous.
264	9½	11	5	Dolerite
308	7½	43	10	Banded sandstone - micaceous
313	8½	5	1	Laminated shale, sandstone (coarse sandstone)
318	9	5	0½	Sandstone
323	2	4	5	Sandy shale
330	3½	7	1½	Fine grained micaceous sandstone
336	10½	6	7	COAL, SEAM A.
368	2	31	3½	Sandstone with grits and ¼" pebbles.
368	3		1	COAL
375	4	7	1	Laminated sandstone
375	8½		4½	Sandstone shaly
376	4½		8	Gritty sandstone
377	8	1	3½	Laminated shale
377	11		3	Shale
381	8	3	9	COAL, SEAM B.

383/...

TABLE 1, continued.

Depth Ft.	Depth Ins.	Width Ft.	Width ins.	Description of Strata
Borehole CMC 1/43 (contd.)				
383	4½	1	9½	Laminated sandstone
384	4		11½	Torbanite
389	1	4	9	COAL, SEAM C.
392	3½	3	2½	Shaly sandstone
Borehole CMC 2/43, Vogelfontein 4, Collar Elevation 5874 ft.a.m.s.l.				
16	1	16	1	Surface soil and clay
19	1	3		Decomposed sandstone
24	4	5	3	Medium sandstone
40	2	15	10	Sandstone
66		25	10	Sandstone with occasional laminations of micaceous shale
71	10	5	10	Fine sandstone
84	4	12	6	Laminated sandstone
131	6½	47	2½	Sandstone
155	2	23	7½	Laminated sandstone
164	7	9	5	Medium sandstone
172	0	7	5	Laminated shale
179	3	7	3	Micaceous shaly sandstone
179	11		8	Banded shale
181	1½	1	2½	COAL. TOP SEAM
183	7	2	5½	Sandy shale - micaceous.
183	11		4	Shale with coal streaks
198	8	14	9	Laminated sandstone shale
207	1	8	5	Laminated sandstone
207	5½		4½	Dolerite
224	11	17	5½	Laminated sandstone shale
227	11	3		Sandstone
250	10	22	11	Laminated micaceous sandstone
273	9	22	11	Micaceous laminated sandstone
279	2	5	5	Sandstone
280	2	1	0	Banded shale
280	4	2		Banded sandstone
288	11½	8	7½	COAL. SEAM A.
289	3		3½	Sandstone
322	6½	33	3½	Sandstone with grits
322	10½		4	COAL
325	10½	3	0	Grey sandy shale
328	9½	2	11	Sandy micaceous shale
332	8	3	10½	COAL. SEAM B
333	2		6	Shaly sandstone
334	6½	1	4	Sandstone with paper thin laminations.
336	1½	1	7	Micaceous shaly sandstone
338	1½	2	3	Coarse gritty sandstone
338	9		4½	Coarse carbonaceous micaceous grit.
346	1½	7	4½	COAL. SEAM C.
349	10	3	8½	Banded micaceous sandstone

TABLE 1, continued.

Depth Ft.	Depth Ins	Width Ft.	Width Ins.	Description of Strata
Borehole CMC 3/43, Vogelfontein 4. Collar Elevation 5983 ft. a.m.s.l.				
10	0	10	0	Surface soil
101	0	91	0	Dolerite
112	10	11	10	Medium sandstone with shale bands
120	4	7	6	Coarse sandstone
121	11	1	7	Grits
131	6	9	7	Micaceous shale
133	10	2	4	Fine sandstone
137	5	3	7	Calcareous sandstone
191	11	54	6	Fine sandstone
203	11	12	0	Laminated sandstone
275	3	71	4	Medium sandstone
288	6	13	3	Banded sandstone
296	6	8	0	Medium sandstone
311	1	14	7	Laminated sandstone
312	6	1	5	COAL. TOP SEAM
312	10		4	Very fine sandstone
313	6		8	Black shale
322	5	8	11	Sandstone with thin shale bands
322	10		5	Shale with 1" band of coal.
323	1		3	Fine sandstone
323	2		1	Shale
351	7	28	5	Laminated banded shale
380	5	28	10	Laminated banded sandstone
395	1	14	8	Banded shale
399	0	3	11	Fine sandstone
406	6	7	6	Banded grey shale
409	6	3	0	Micaceous laminated fine sandstone
414	5	4	11	Sandstone
415	0		7	Shale
421	3	6	3	COAL. SEAM A.
451	4	30	1	Medium sandstone
452	0		8	Shale
458	3	6	3	Laminated shale
459	1		10	Sandy shale
459	5		4	Shale
463	4	3	11	COAL. SEAM B.
464	9	1	5	Shale Torbanite
465	6		9	COAL
465	9		3	Sandstone
471	4	5	7	COAL. SEAM C.
471	10		6	Shale
478	6	6	8	Medium sandstone
Borehole CMC 4/43, Vogelfontein 4. Collar Elevation 5927 ft. a.m.s.l.				
0-40	0	40	0	Surface soil
41	6	1	6	Laminated sandstone
43	10	2	4	Laminated shale
48	5	4	7	Sandstone, fine
48	7		2	Coarse grit
59	5	10	10	Laminated shale
112	9	53	4	Sandstone
123	9	11	0	Laminated sandstone
130	0	6	3	Laminated shale
171	0	41	0	Sandstone, medium

171'6" /....

TABLE 1, continued.

Depth Ft.	Depth ins.	Width Ft.	Width ins.	Description of Strata
Borehole CMC 4/43 (contd.)				
171	6		6	COAL
173	6	2	0	Dolerite (Felspathic)
183	6	10	0	Sandstone
200	2	16	8	Laminated sandstone
202	11	2	9	Sandstone
220	0	17	1	Laminated sandstone
221	9	1	9	COAL. TOP SEAM
225	4	3	7	Laminated sandstone
227	0	1	8	Laminated shale
227	1		1	Shale
227	2		1	COAL
227	3		1	Shale
249	9	22	6	Laminated sandstone
250	2		5	Black shale
250	6		4	COAL
252	0	1	6	Dolerite (Felspathic)
274	7	22	7	Sandstone
279	6	4	11	Laminated sandstone
309	10	30	4	Laminated sandstone
315	0	5	2	Sandstone, medium
315	5		5	Shaly coal
315	8		3	Shale
315	10		2	COAL
324	11	9	1	Laminated sandstone
332	3	7	4	COAL. SEAM A .
333	1		10	Sandy shale
335	6	2	5	Sandstone with occasional paper thin bands of shale.
360	11	25	5	Coarse sandstone with grits and pebbles $\frac{1}{2}$" at 357' to 360' 11".
361	4		5	Banded shale
361	11		7	Shaly coal
366	3	4	4	Laminated sandstone
369	10	3	7	COAL. SEAM B.
370	2		4	Shale
372	0	1	10	Sandstone
372	5		5	Black shale
372	$6\frac{1}{2}$		$1\frac{1}{2}$	Sandstone
372	10		$3\frac{1}{2}$	COAL
373	0		2	Shaly sandstone
373	5		5	COAL
373	$5\frac{1}{2}$		$\frac{1}{4}$	Sandstone
373	7		$1\frac{1}{2}$	COAL
373	8		1	Sandstone
378	5	4	9	COAL. SEAM C.
378	8		3	Sandy shale
379	3		7	Shaly sandstone
379	6		3	Stump left in hole

Table 1, continued.

Depth Ft.	Depth Ins.	Width Ft.	Width ins.	Description of Strata
Borehole CMC 5/43, Waterval 18.				Collar Elevation 5764 ft. a.m.s.l.
0 - 23	7	23	7	Subsoil
23	10		3	Decomposed sandstone
- 30	7	6	9	Laminated sandstone
- 33	7	3	0	Laminated shale
- 57	1	23	6	Laminated sandstone
- 57	3		2	Laminated shale
- 57	8		5	COAL. TOP SEAM.
57	9		1	Black shale
59	0	1	3	Sandy micaceous shale
64	0	5	0	Sandstone with thin laminations.
70	8	6	8	Sandstone
70	9		1	Shale
70	10		1	Sandstone
70	11		1	Shale
71	9		10	Indurated sandstone, micaceous
71	10		1	COAL
75	11	4	1	Sandstone
85	3	9	4	Laminated sandstone
93	0	7	9	Laminated shale
93	2		2	Torbanite
93	3		1	Sandstone
93	8		5	Shale with thin coal bands.
102	2	8	6	Laminated sandstone
110	3	8	1	Laminated shale
111	6	1	3	Indurated sandstone
116	5	4	11	Laminated sandstone
118	3	1	10	Laminated shale
120	9	2	6	Indurated sandstone
122	9	2	0	Laminated shale
123	9	1	0	Sandstone
137	3	13	6	Laminated shale
139	4	2	1	Sandstone
141	11	2	7	Laminated sandstone
142	5		6	COAL
142'5"-142'8½"			3½	Sandstone
142	10		1½	COAL
143	0		2	Shale
143	11		11	Laminated shale
155	3	11	4	Sandstone
156	1		10	Laminated shale
156	1½		½	COAL
156	4		2½	Sandstone with coal streaks
163	4	7	0	COAL. SEAM A.
164	7	1	3	Shale
165	0		5	Sandstone
165	3		3	Shale
167	6	2	3	Sandstone
167	10		4	Shale
169	5	1	7	Sandstone
169	10		5	Laminated sandstone
171	9	1	11	Medium sandstone
177	3	5	6	Coarse sandstone
191	7	14	4	Coarse sandstone with grits and pebbles.
193	1	1	6	Burnt coarse sandstone
193	3		2	Burnt coal

195'8" /....

TABLE 1, continued.

Depth Ft.	Depth ins.	Width Ft.	Width ins.	Description of Strata
Borehole CMC 5/43 (contd.)				
195	8	2	5	Shale
199	8	4	0	Sandstone
201	2	1	6	Laminated shale
202	3	1	1	Burnt shaly coal. SEAM B.
203	6	1	3	Fine sandstone , indurated.
203	7		1	Shale
204	1		6	Laminated sandstone
204	3		2	Burnt coal
204	7½		4½	Sandstone
204	9		1½	Burnt coal
204	10		1	Sandstone
206	5	1	7	Burnt coal SEAM C.
210	8	4	3	Black shale
217	8	7	0	Sandstone
218	0		4	Stump left in hole
Borehole CMC 6/43, Waterval 18.				**Collar Elevation 5646 ft. a.m.s.l.**
0 - 26	1	26	1	Subsoil
32	4	6	3	Coarse sandstone and grit
35	4	3	0	Burnt laminated sandstone, micaceous
35	11		7	Black shale
36	0		1	Sandstone
36	7		7	Shaly sandstone
38	6	1	11	Burnt coal. SEAM B
41	0	2	6	Black shale
45	0	4	0	Dolerite
46	11	1	11	Coarse sandstone with pebbles
47	4		5	Burnt coal. SEAM C.
47	7		3	Sandstone
49	6	1	11	Burnt coal. SEAM C.
50	10	1	4	Sandy shale
53	6	2	8	Laminated shale, not burnt
81	6	28	0	Fine sandstone
84	4	2	10	Laminated shale
89	2	4	10	Fine sandstone
95	6	6	4	Laminated shale
103	0	7	6	Sandstone

B.H. CMC 7/43 /. . .

TABLE 1, continued.

Depth Ft.	Depth Ins.	Width Ft.	Width ins.	Description of Strata
Borehole CMC 7/43, Waterval 18.				Collar Elevation 5751 ft. a.m.s.l.
0-17	6	17	6	Subsoil.
19	8	2	2	Decomposed sandstone
30	4	10	8	Laminated shale
31	10	1	6	Sandstone
32	7		9	Black shale
33	0		5	Sandstone with shale bands
41	6	8	6	Coarse sandstone
47	0	5	6	Laminated sandstone
50	5	3	5	Sandstone
56	8	6	3	Laminated sandstone
61	2	4	6	Laminated shale
65	0	3	10	Laminated sandstone, burnt
65	10		10	Sandy shale - burnt.
72	9	6	11	Laminated sandstone - micaceous. burnt.
73	6		9	Sandstone - burnt.
80	4	6	10	Sandy shale - burnt
86	3	5	11	Laminated shale - burnt
87	2		11	Indurated sandstone
87	7		5	Dolerite
88	5		10	Indurated sandstone
89	11	1	6	Laminated shale - burnt
90	8		9	Shale - burnt
92	3	1	7	Laminated shale - burnt
93	0		9	Black shale - burnt
94	1	1	1	Sandstone - burnt
97	5	3	4	Laminated shale, micaceous burnt.
99	1	1	8	Laminated shale
142	11	44	10	Coarse sandstone with grits -unburnt
143	3		4	Black shale - burnt
143	4		1	Sandstone - burnt
144	0		8	Black shale - burnt
144	7		7	Sandstone - burnt
145	1		6	Burnt coal. SEAM B.
146	11		10	Sandstone - burnt
151	10	4	11	Dolerite
152	5		7	Indurated sandstone
154	2	1	9	Coal, burnt. SEAM C.
156	11	2	9	Fine sandstone, contorted, burnt.
165	11	9	0	Indurated shale
176	0	10	1	Indurated talcose shale, calcitic.
179	4	3	4	Sandstone
183	8	4	4	Laminated sandstone - contorted.
184	5		9	Indurated sandstone.
188	11	4	6	Dolerite
190	11	2	0	Laminated shale - burnt
192	5	1	6	Black shale - burnt
195	9	3	4	Coarse sandstone - burnt
199	9	4	0	Laminated shale
200	4		7	Black shale - burnt
201	0		8	Coarse sandstone - burnt
202	0	1	0	Black shale - carbonaceous, burnt.
231	0	29	0	Coarse sandstone - burnt.

TABLE 1, continued.

Depth Ft.	ins.	Width Ft.	ins.	Description of Strata
Borehole CMC 8/43, Waterval 18.				**Collar Elevation 5918 ft. a.m.s.l.**
0 - 20	3	20	3	Surface soil and clay
66	5	46	2	Sandstone (medium grain)
85	1	18	8	Laminated sandstone
138	8	53	7	Sandstone
140	6	1	10	Calcareous sandstone
158	5	17	11	Laminated shale
167	5	9	0	Sandstone
178	3	10	10	Laminated sandstone
179	11	1	8	Sandy grey shale
192	7	12	8	Sandstone
193	6		11	Black shale with coal streaks TOP SEAM
195	6	2	0	Very fine micaceous sandstone.
195	9		3	Shaly coal
197	11	2	2	Sandstone
211	6	13	7	Laminated shale
211	9		3	Coal
219	3	7	6	Laminated sandstone
221	8	2	5	Laminated shale
232	3	10	7	Laminated sandstone
255	7	23	4	Laminated shale
265	7	10	0	Laminated sandstone
266	0		5	Shale with coal bands
266	4		4	Sandy black shale
278	6	12	2	Laminated sandstone
283	9	5	3	COAL. SEAM A.
325	4	41	7	Sandstone with grits and pebbles.
326	6	1	2	Laminated shale
326	10		4	Shale
330	4	3	6	COAL. SEAM B.
330	6		2	Sandy shale
331	4		10	Sandstone
331	8		4	Shale with coal streaks
331	9		1	COAL
332	6		9	Sandy shale
332	8		2	Gritty sandstone
333	1		5	COAL
333	11		10	Black shale with coal streaks
334	0		1	COAL
334	3		3	Sandstone
339	8	5	5	COAL. SEAM C.
341	0	1	4	Sandy shale.
Borehole CMC 9/43, Waterval 18.				**Collar Elevation 5752 ft. a.m.s.l.**
22	0	22	0	Surface measures
24	6	2	6	Decomposed sandstone
37	4	12	10	Laminated sandstone
54	7	17	3	Laminated shale
55	3		8	Very fine sandstone
57	2	1	11	Laminated shale
67	1	9	11	Laminated fine sandstone
69	5	2	4	COAL. SEAM A.
70	5	1	0	Laminated shale, sandy
71	7	1	2	COAL. SEAM A.
72	3		8	Shale

TABLE 1, continued.

Depth Ft.	Depth Ins.	Width Ft.	Width ins.	Description of Strata
Borehole CMC 9/43 (contd.)				
114	1	41	10	Very coarse gritty sandstone with pebbles.
115	7	1	6	Fine sandstone
118	11	3	4	COAL. SEAM B.
120	7	1	8	Medium sandstone
126	2	5	7	Laminated sandstone
132	8	6	6	Fine sandstone
133	8	1	0	Very gritty sandstone
137	0	3	4	COAL. SEAM C. (inclined to be burnt
137	6		6	Laminated shale
140	6	3	0	Fine sandstone
144	4	3	10	Fine sandstone
148	1	3	9	Burnt sandstone
149	0		11	Dolerite, 6" stump in hole.
Borehole CMC 10/43, Waterval 18.				Collar Elevation 5768 ft. a.m.s.l.
0 - 22	2	22	2	Surface measures (not recovered)
25	2	3	0	Decomposed laminated sandstone
26	4	1	2	Decomposed sandstone
28	4	2	0	Black sandy shale
29	0		8	Fine sandstone
29	7		7	COAL. TOP SEAM.
31	1	1	6	Fine sandstone
40	8	9	7	Laminated shale
41	0		4	COAL
47	8	6	8	Very fine sandstone with occasional paper thin bands of shale.
49	0	1	4	Laminated shale
61	1	12	1	Fine sandstone
67	4	6	3	Laminated shale
80	0	12	8	Laminated sandstone
89	4	9	4	Laminated shale (gritty sandstone bands)
99	2	9	10	Fine sandstone
101	0	1	10	Sandstone with paper thin laminations of shale.
102	9	1	9	Black shale
111	11	9	2	Sandstone with occasional very thin laminations.
114	1	2	2	Sandstone (medium)
117	6	3	5	COAL. SEAM A.
118	7	1	1	Shale with occasional streaks of coal
120	0	1	5	Coarse sandstone
120	1		1	Black shale
146	7	26	6	Coarse sandstone with grits and pebbles.
146	9		2	Shaly coal.
148	7	1	10	Shale
154	1	5	6	Fine sandstone
154	9		8	Laminated shale
158	1	3	4	COAL. SEAM B
160	0	1	11	Sandstone
160	5		5	Shale
161	10	1	5	Laminated sandstone
162	10	1	0	Sandstone
163	5		7	COAL
163	7		2	Sandstone
168	5	4	10	COAL SEAM C.
168	8		3	Black shale
171	4	2	8	Laminated sandstone.

TABLE 2.

DESCRIPTION OF SAMPLES

F.R.I.Sample Number	Borehole Number and Farm	Width Ins.	Description of Section
TOP SEAM			
M 59	C.M.C. 1/41 Vogelfontein 4	7	257' 10" ROOF: Sandstone Mixed coal. 258' 5" FLOOR: Shaly sandstone.
M 54	C.M.C. 2/41 Vogelfontein 4	11	303' 3" ROOF: Sandstone Bright coal. 304' 2" FLOOR: Micaceous shale.
M 55	C.M.C. 3/41 Vogelfontein 4		237' 6" ROOF: Sandstone
C		11	Bright coal
		1	Shale. Not sampled.
B		3	Bright coal
		1	Shale. Not sampled.
A		3	Shaly coal. 239' 1" FLOOR: Carbonaceous shale.
M 157	C.M.C. 2/43 Vogelfontein 4	14½	179' 11" ROOF: Banded shale Mainly bright banded coal with occasional shale bands. 181' 1½" FLOOR: Sandy shale (micaceous).
M 262	C.M.C. 3/43 Vogelfontein 4	17	311' 11" ROOF: Laminated sandstone. Mixed bright and dull coal shaly bands. 312' 6" FLOOR: Fine sandstone.
M 289	C.M.C. 4/43 Vogelfontein 4		220' ROOF: Laminated sandstone.
		19	Mainly bright coal.
		2	Shale. Not sampled. 221' 9" FLOOR: Laminated sandstone.
M 304	C.M.C. 5/43 Waterval 18	5	57' 3" ROOF: Laminated shale. Mainly bright coal. 57' 8" FLOOR: Black shale.

SEAM ./....

TABLE 2, continued.

F.R.I.Sample Number		Borehole Number and Farm	Width Ins.	Description of Section
SEAM A.				
M 53		C.M.C. 1/41 Vogelfontein 4		359' 4" ROOF: Dolerite
			8	Sandstone and carbonaceous shale. Not sampled.
			50	Burnt coal.
				364' 2" FLOOR; Fine laminated shale.
M 56		C.M.C. 3/41		341' 3" ROOF: Sandstone.
	D	Vogelfontein 4	110	Dull shaly coal.
			6	Shale. Not sampled.
	C		8	Bright coal.
			3	Shale. Not sampled.
	B		37	Dull shaly coal.
	A		17	(Broken core)
				348' 0". FLOOR: Micaceous sandstone.
M 154		C.M.C. 1/43 Vogelfontein 4		330' 3½" ROOF: Micaceous sandstone.
	D		14	Dull inferior coal (Dreyer's description).
	C		7"	Bright calcitic coal. (Dreyer's description).
	B		41	Dull shaly coal. (Dreyer&s description)
	A		17	Alternating dull and bright banded coal. (Dreyer's description).
				336' 10½" FLOOR: Sandstone.
M 158		C.M.C. 2/43 Vogelfontein 4		280' 4" ROOF: Banded sandstone.
	H		(6	Mainly bright coal with dull bands.
			(3	Shale. Not sampled.
			(6	Mainly bright coal with dull bands.
	G		15	Mainly bright coal with occasional dull bands (calcitic and pyritic).
			10	Inferior shaly coal (core broken). Not sampled.
	F		9	Dull shaly coal.
	E		17	Dull granular coal.
	D		16	Bright and dull granular coal
	C		10	Mixed mainly bright coal.
	B		6	Mainly bright coal(pyritic) with mud bands (core broken).
	A		5½	Finely banded mainly dull coal (Broken core).
				288' 11½" FLOOR: Sandstone.

TABLE 2, continued.

F.R.I.Sample Number	Borehole Number and Farm.	Width Ins.	Description of Section
Seam A (contd.)			
M 263	C.M.C. 3/43		415' 0" ROOF: Shale.
C	Vogelfontein 4	28	Mixed mainly dull coal with some bright bands at the bottom.
		6½	Carbonaceous shale. Not sampled
B		16½	Dull granular coal.
A		24	Mainly dull coa.
			421' 3" FLOOR: Coarse sandstone
M 290	C.M.C. 4/43 Vogelfontein 4		324' 11" ROOF: Laminated sandstone.
		2½	Sandstone. Not sampled.
C		21½	Bright and dull banded coal.
		4	Shale.
B		21	Dull shaly coal.
A		38	Mainly bright coal, some dull bands.
		1	Shale. Not sampled.
			332' 3" FLOOR: Sandy shale. NOTE: Core badly broken.
M 305	C.M.C. 5/43 Waterval 18		156' 4" ROOF: Sandstone with coal streaks.
		2	Sandstone. Not sampled.
D		15	Mainly bright coal. Calcitic.
C		27	Dull shaly coal.
B		25	Alternating dull and bright banded coal.
A		14	Mainly bright coal.
		1	Sandy shale. Not sampled.
			163' 4" FLOOR: Shale.
M 366	C.M.C. 8/43 Waterval 18		278' 6" ROOF : Laminated sandstone.
		2	Sandy shale. Not sampled.
C		20	Mainly dull coal with bright bands, calcitic.
		1	Shale. Not sampled.
B		19	Dull shaly coal.
A		21	Mixed bright and dull coal, core badly broken.
			383' 9" FLOOR: Sandstone with grits and pebbles.

TABLE 2, continued.

F.R.I. Sample Number		Borehole Number and Farm	Width Ins.	Description of Section
Seam A (contd.)				67' 1" ROOF: Sandstone
M 387	B	C.M.C. 9/43	28	Mixed mainly dull coal
		Waterval 18	12	Shale. Not sampled.
	A		14	Mixed mainly dull coal
				71' 7" FLOOR: Shale.
M 389		C.M.C. 10/43		114' 1" ROOF: Sandstone.
	C	Waterval 18	13	Mixed bright and dull coal, probably some burning.
			2	Shale excluded.
	B		15	Dull inferior shaly coal
			6	Shale excluded.
	A		5	Dull coal with some bright bands.
				117' 6" FLOOR: Shale with occasional streaks of coal.
SEAM B:				
M 57 F		C.M.C. 3/41		401' 6" ROOF: Carbonaceous sandstone.
		Vogelfontein 4	4	Bright coal.
				401' 10" FLOOR: Sandstone.
M 155		C.M.C. 1/43		377' 11" ROOF: Shale.
		Vogelfontein 4	45	Dull inferior shaly coal with very occasional paper thin bright streaks near bottom (Dreyer's description).
				381' 8" FLOOR; Laminated sandstone.
M 159		C.M.C. 2/43		328' 9½" ROOF: Sandy micaceous shale.
		Vogelfontein 4	6½	Carbonaceous shale, Not sampled.
	B		17	Dull inferior heavy coal with very few bright bands.
	A		23	Mainly dull coal (heavy)
				332' 8" FLOOR: Shaly sandstone
M 264		C.M.C. 3/43		459' 5" ROOF: Shale.
	E	Vogelfontein 4		(20" Dull coal.
				(2" Carbonaceous shale. Not
			45	(sampled.
				(21" Dull coal.
				(4" Bright coal.
	D		8	Torbanite
			3½	Carbonaceous shale. Not sampled.
			8	Shaly coal. Not sampled.
				464' 11½" FLOOR: Sandstone.

TABLE 2, continued.

F.R.I.Sample Number	Borehole Number and Farm	Width Ins.	Description of Section
(Seam B contd.)			
M 291	C.M.C. 4/43 Vogelfontein 4		366' 3" ROOF: Laminated sandstone.
		43	Dull shaly coal
			369' 10" FLOOR: Shale
M 364	C.M.C. 6/43 Waterval 18		36' 7" ROOF: Shaly sandstone.
		23	Burnt coal
			38' 6" FLOOR: Black shale.
M 367	C.M.C. 8/43 Waterval 18		326'10" ROOF: Shale.
		42	Dull shaly coal.
			330' 4" FLOOR: Sandy shale.
M 388 B	C.M.C. 9/43 Waterval 18		115' 7" ROOF: Sandstone.
		40	Inferior shaly coal, core very badly broken.
			118' 11" FLOOR: Sandstone
M 390 E	C.M.C. 10/43 Waterval 18		154' 9" ROOF: Laminated shale.
		40	Dull shaly coal.
			158' 1" FLOOR: Sandstone
SEAM C.			
M 57	C.M.C. 3/41		402' 1" ROOF: Sandstone
E	Vogelfontein 4	16½	Bright coal
		1½	Shale. Not sampled.
D		17	Bright coal
C		6	Dull calcitic coal
B		20	Dull coal with bright streaks
		1½	Shale. Not sampled.
A		2½	Bright coal
			406' 11" FLOOR: Carbonaceous micaceous sandstone.
			NOTE: 3" of section lost.
M 156	C.M.C. 1/43		384' 4" ROOF: Torbanitic shale
G	Vogelfontein 4	8	Dull inferior coal
		3	Sandstone. Not sampled.
F		5	Very bright banded coal.
E		1½	Dull coal
D		12½	Mixed mainly dull coal
C		9½	Mixed mainly bright coal
B		9	Mixed mainly bright coal - (core broken)
A		9	Mainly bright coal with dull bands
		½	Shale. Not sampled.
			389' 2" FLOOR: Shaly sandstone

M 160/....

TABLE 2, continued.

F.R.I.Sample Number		Borehole Number and Farm	Width Ins.	Description of Section
(Seam C, contd.)				
M 160		C.M.C. 2/43 Vogelfontein 4		338' 9" ROOF: Carbonaceous micaceous grits.
			4	Sandy torbanite. Not sampled.
	G		7	Dull inferior coal
			3	Carbonaceous sandstone. Not sampled.
	F		13½	Mainly bright splinty coal - pyritic.
	E		12	Bright coal with dull band 2" from bottom - pyritic and calcitic.
	D		12	Mainly bright splinty coal with occasional thin dull bands.
	C		12	Mainly bright with very thin dull bands - pyritic and calcitic.
	B		12	Alternating dull and bright banded coal.
	A		(13	Mainly bright coal (core broken)
			(1	Shale. Not sampled.
				346' 1½" FLOOR: Micaceous banded sandstone.
M 264		C.M.C. 3/43		465' 6½" ROOF: Sandstone
	C	Vogelfontein 4	18	Bright coal with ? stringers of pyrites near top.
	B		24	Mixed coal
	A		22	Mixed mainly bright coal, duller towards bottom.
				471' 4" FLOOR: Shale.
M 292		C.M.C. 4/43		373' 0" ROOF: Sandstone.
		Vogelfontein 4	8	Dull coal with 2" sandstone excluded, position not known. Not sampled.
	D		18	Mainly bright coal with dull bands.
	C		16	Alternating bright and dull banded coal. Calcitic and pyritic.
	B		5	Dull coal
	A		18	Mainly bright coal
				378' 5" FLOOR: Sandy shale.
M 365		C.M.C. 6/43 Waterval 18		46' 11" ROOF: Coarse sandstone with pebbles.
			5	Burnt coal. Not sampled.
			3	Sandstone
			23	Burnt coal
				49' 6" FLOOR: Sandy shale.

TABLE 2, continued.

F.R.I. Sample Number		Borehole Number and Farm	Width Ins.	Description of Section
(Seam C, contd.)				
M 368		C.M.C. 8/43		334' 3" ROOF: Sandstone.
	C	Waterval 18	10	Bright coal, calcitic.
	B		25	Mainly bright coal with dull bands.
	A		30	Mainly bright coal with few dull bands.
				339' 8" FLOOR: Sandy shale.
M 388		C.M.C. 9/43		133' 8" ROOF: Sandstone
	A	Waterval 18	40	Burnt coal, mixed bright and dull. Core badly broken.
				137' 0" FLOOR: Laminated shale.
M 390		C.M.C. 10/43		162' 10" ROOF: Sandstone
	D	Waterval 18	8	Dull shaly coal with bright bands.
			3	Sandstone
	C		11	Mainly bright coal with dull bands - Calcitic.
	B		20	Very bright coal
	A		25	Mixed bright and dull coal.
				168' 5" FLOOR: Black shale.

TABLE 3. /....

TABLE 3.

PROXIMATE ANALYSES.

F.R.I.Sample Number		Width Ins	CAL.VAL. Lbs/lb.	% H_2O	% ASH	% VOL. MATTER	% FIXED CARBON	% Fl 1.45	% ASH Fl.1.45	% Fl. 1.6	% ASH Fl.1.6	SW.NO. Fl.1.45	SW.NO. Fl.1.6
TOP SEAM:													
M 59		7	-	2.6	29.0	15.5	61.0	-	-	-	-	-	-
M 54		11	12.3	2.9	13.7	31.2	52.2	72.0	7.5	88.2	10.0	1 f	1 p
M 55	C	11	12.5	3.0	11.7	29.0	56.3	76.5	7.6	92.0	9.4	1 f	1 p
	B	3	11.6	3.1	17.4	28.6	50.9	64.0	8.2	79.0	11.0	1 f	1 p
	A	3	-	2.5	42.5	21.9	33.1	-	-	-	-	-	-
M 157		14½	-	2.3	20.4	29.0	48.3	59.4	7.5	72.1	10.0	1 f	-
M 262		17	11.8	3.0	16.6	30.2	50.2	67.1	6.5	84.1	11.0	1 f	-
M 289		19	11.9	3.5	15.7	27.5	53.3	65.0	7.9	84.4	10.4	1 f	-
M 304		5	12.0	3.8	15.4	27.3	53.5	63.1	7.6	82.5	9.9	1 p	1 p
SEAM A:													
M 53		50	-	2.2	33.0	5.4	59.4	-	-	-	-	-	-
M 56	D	10	11.5	2.9	18.3	26.3	52.5	52.5	7.5	81.5	11.1	1 f	1 p
	C	8	12.4	2.7	12.1	35.8	49.4	82.8	7.4	90.5	8.8	3	2
	B	37	11.2	3.0	18.0	23.4	55.6	42.0	7.7	77.2	12.0	1 p	1 p
	A	17	No sample.										
M 154	D	14	-	1.6	40.0	12.8	45.6	-	-	-	-	-	-
	C	7	12.7	1.2	16.7	20.7	62.6	-	-	-	-	-	-
	B	41	-	2.0	32.2	14.6	51.2	-	-	-	-	-	-
	A	17	11.8	1.5	19.8	25.5	53.2	-	-	-	-	-	-

Table 3, continued.

F.R.I.Sample Number		Width Ins.	CAL.VAL lbs/lb	% H_2O	% ASH	% VOL. Matter	% FIXED CARBON	% Fl 1.45	% ASH Fl.1.45	% Fl. 1.6	% ASH Fl.1.6	SW.NO. Fl.1.45	SW.NO. Fl.1.6
(Seam A, contd.)													
M 158	H	12	-	2.7	20.0	24.7	52.4	36.2	7.7	80.1	13.9	1	1 p
	G	15	11.5	2.4	19.1	31.2	47.3	60.9	7.5	75.3	10.4	3½	2
	F	9	-	2.4	48.6	14.2	34.8	-	-	-	-	-	-
	E	17	-	3.1	26.3	18.6	52.0	-	-	-	-	-	-
	D	16	11.5	2.8	17.7	22.4	57.1	41.9	7.7	81.3	13.3	1 p	-
	C	10	12.1	2.6	14.1	29.6	53.7	76.5	9.5	91.3	11.9	1 f	-
	B	6	-	1.7	25.1	33.3	39.9	-	-	-	-	-	-
	A	5½	-	2.3	20.0	27.5	50.2	44.9	10.3	85.8	16.4	1 f	-
SEAM B:													
M 263	C	28	11.4	3.4	19.5	24.1	53.0	42.3	8.5	80.8	13.9	1 f	-
	B	16½	-	2.7	27.0	19.4	50.9	16.8	8.5	55.0	14.8	1 f	-
	A	24	12.0	2.8	15.0	26.3	55.9	63.2	7.0	87.7	10.2	1 f	-
M 290	C	21½	11.7	2.8	17.0	27.5	52.7	56.3	7.0	79.9	10.0	1 f	-
	B	21	-	2.8	41.7	15.4	40.1	-	-	-	-	-	-
	A	38	11.6	3.1	16.5	25.4	55.0	47.3	7.5	79.7	11.0	1 f	-
M 305	D	15	11.4	3.0	19.8	30.0	47.2	64.4	8.3	76.7	10.3	1 f	1 f
	C	27	-	2.3	50.2	14.2	33.3	-	-	-	-	-	-
	B	25	11.2	3.5	18.1	21.0	57.4	31.1	7.6	77.5	12.8	1 p	1 p
	A	14	11.8	2.9	16.7	24.6	55.8	59.0	7.8	84.2	10.6	1 p	1 p
M 366	C	20	11.2	3.1	20.3	26.0	50.6	37.3	7.5	73.7	12.3	1 f	-
	B	19	11.2	3.1	18.6	22.2	56.1	32.8	6.7	75.1	11.5	1 f	-
	A	21	11.4	3.8	18.9	24.7	52.6	39.7	7.8	78.6	12.9	1 f	-
M 387	B	28	11.9	2.9	16.6	32.2	48.6	69.6	7.4	83.3	10.0	1½	1 f
	A	14	11.4	3.0	18.4	28.1	50.5	45.6	7.5	79.9	13.1	1 f	-
M 389	C	13	-	2.3	24.5	6.8	66.4	-	-	-	-	-	-
	B	15	-	2.5	21.7	6.2	69.6	-	-	-	-	-	-
	A	5	-	2.0	45.5	7.7	44.8	-	-	-	-	-	-

Table 3, continued.

F.R.I.Sample Number		Width Ins	CAL.VAL lbs/lb.	% H_2O	% ASH	% VOL. MATTER	% FIXED CARBON	% Fl. 1.45	% ASH Fl.1.45	% Fl. 1.6	% ASH Fl.1.6	SW.NO Fl.1.45	SW.NO. Fl.1.6
(Seam B, contd.)													
M 57	F	4	9.1	2.2	32.6	24.4	40.8	-	-	--	-	-	-
M 155		45	-	1.5	38.3	17.1	43.1	-	-	-	-	-	-
M 159	B	17	-	2.7	37.1	17.2	43.0	-	-	-	-	-	-
	A	23	-	2.6	32.1	18.1	47.2	9.0	8.4	34.0	15.8	1 p	-
M 264	E	45	-	3.1	31.0	18.2	47.7	-	-	-	-	-	-
	D	8	-	1.9	50.5	22.1	25.5	-	-	-	-	-	-
M 291		43	-	3.2	32.8	17.4	63.6	-	-	-	-	-	-
M 364		23	-	2.3	29.2	7.0	61.5	-	-	-	-	-	-
M 367		42	-	2.8	36.9	17.6	42.7	-	-	-	-	-	-
M 388	B	40	-	2.5	26.6	23.7	47.2	-	-	-	-	-	-
M 390	E	40	-	2.9	27.5	19.4	50.2	-	-	-	-	-	-
SEAM C:													
M 57	E	16½	12.9	2.7	10.3	35.2	51.8	85.0	5.3	88.3	6.2	1	1 f
	D	17	12.1	2.8	13.6	30.2	53.4	72.2	7.6	88.8	10.2	1 f	1 f
	C	6	12.4	2.6	13.6	32.3	51.5	75.1	8.5	92.2	11.1	1 f	1 f
	B	20	11.8	2.9	15.6	29.0	52.5	67.6	8.4	85.9	11.1	1 f	1 f
	A	2½	12.5	2.9	12.0	34.0	51.1	82.4	6.8	89.3	7.6	1	1 f
M 156	G	8	-	1.0	36.4	20.0	42.6	-	-	-	-	-	-
	F	5	14.3	0.8	8.0	27.9	63.3	90.7	5.7	93.9	6.2	1 f	-
	E	1½	-	1.2	23.6	21.2	54.0	-	-	-	-	-	-
	D	12½	12.2	2.0	20.6	20.6	56.8	54.6	8.3	73.7	12.7	1 f	1 p
	C	9½	12.9	0.8	17.1	20.6	61.5	63.9	9.6	88.8	13.9	1 p	1 p
	B	9	13.0	0.9	15.8	18.9	64.4	68.7	9.0	88.9	12.4	1 p	1 p
	A	9	12.7	1.0	16.7	18.8	63.5	63.5	9.8	88.1	13.1	1 p	1 p

Table 3, continued.

F.R.I.Sample Number		WIDTH Ins.	CAL.VAL. lbs/lb	% H_2O	% ASH	% VOL. MATTER	% FIXED CARBON	% Fl 1.45	% ASH Fl.1.45	% Fl. .6	% ASH Fl.1.6	SW.NO Fl.1.45	SW.NO. Fl.1.6
(Seam C, contd.)													
M 160	G	7	-	2.0	35.3	24.1	38.6	-	-	-	-	-	-
	F	13½	12.9	2.7	10.7	35.4	51.2	81.1	6.8	93.6	9.0	2½	2
	E	12	12.5	2.6	13.2	34.3	49.9	76.0	7.2	87.4	9.4	4	3½
	D	12	11.5	2.5	18.6	29.0	49.9	59.7	7.9	81.7	13.1	1½	1
	C	12	12.4	2.5	12.7	32.2	52.6	78.0	8.7	94.1	11.1	1½	1
	B	12	11.4	2.6	18.7	28.7	50.0	60.5	7.2	76.8	10.5	1	1 f
	A	12	11.9	2.6	15.5	31.9	50.6	69.9	8.0	87.7	11.2	1½	1
M 264	C	18	12.6	3.1	12.4	32.6	51.9	74.3	5.9	89.3	8.7	2	1
	B	24	11.8	3.0	16.9	29.8	50.3	62.1	7.2	81.3	10.4	1½	1 f
	A	22	12.2	3.2	14.5	30.3	52.0	70.0	7.5	88.4	10.7	1½	1 f
M 292	D	18	12.5	3.1	12.3	33.7	50.9	79.1	7.2	88.9	8.2	1	1
	C	16	12.1	3.0	14.5	30.2	52.3	69.1	8.2	87.4	10.1	1 f	-
	B	5	11.4	3.3	17.9	24.7	54.1	46.6	7.2	78.8	10.9	1 f	-
	A	18	11.2	3.2	19.0	28.5	49.3	60.2	7.8	76.1	10.2	1 f	-
M 365		23	12.3	2.8	17.2	8.6	71.4	40.9	7.7	85.3	12.3	1 p	-
M 368	C	10	12.1	2.6	13.2	35.8	48.4	77.7	6.0	84.7	7.0	-	-
	B	25	12.0	2.8	15.2	30.9	51.1	68.5	7.5	83.9	9.8	1 f	-
	A	30	11.6	2.8	17.1	30.1	50.0	62.4	8.2	83.2	10.8	1 f	-
M 388.	A	40	11.4	2.4	20.6	25.3	51.7	55.9	9.0	78.6	12.4	1	1 p
M 390	D	8	-	2.6	26.4	25.8	45.2	-	-	-	-	-	-
	C	11	-	2.7	21.8	29.6	45.9	51.1	7.4	77.4	13.8	1	1 f
	B	20	12.1	2.8	14.8	29.1	53.3	65.1	7.6	84.8	10.3	1½	1 f
	A	25	11.6	2.9	17.0	28.9	51.2	55.1	7.6	81.0	11.0	2	1 f

TABLE 4.

AVERAGE PROXIMATE ANALYSES OF SEAM SECTIONS.

Sample Number Sections Incl.	B.H. No.	Width Ins	Width excl. Ins.	Cal.Val. lbs/lb	% H_2O	% Ash	% V.M.	% F.C.	% Fl 1.45	% Ash Fl.1.45	% Fl. 1.6	% Ash Fl.1.6
SEAM A (BOTTOM)												
M56 B	3/41	37	-	11.2	3.0	18.0	23.4	55.6	42.0	7.7	77.2	12.0
M290 A	4/43	38	-	11.6	3.1	16.5	25.4	55.0	47.3	7.5	79.7	11.0
M263 A	3/43	24	-	12.0	2.8	15.0	26.3	55.9	63.2	7.0	87.7	10.2
M158 C & D	2/43	26	-	11.7	2.7	16.3	25.2	55.8	55.2	8.6	85.1	12.3
M305 A & B	5/43	39	-	11.4	3.3	17.6	22.3	56.8	41.4	7.7	79.9	12.0
M366 A & B	8/43	40	-	11.3	3.5	18.8	23.5	54.2	36.4	7.3	76.9	12.3
M387 A	9/43	14	-	11.4	3.0	18.4	28.1	50.5	45.6	7.5	79.9	13.1
SEAM A (TOP)												
M290 C	4/43	21½	-	11.7	2.8	17.0	27.5	52.7	56.3	7.0	79.9	10.0
M263 C	3/43	28	-	11.4	3.4	19.5	24.1	53.0	42.3	8.5	80.8	13.9
M158 G & H	2/43	27	3	-	2.5	19.5	28.3	49.7	49.9	7.6	77.4	11.8
M305 D	5/43	15	-	11.4	3.0	19.8	30.0	47.2	64.4	8.3	76.7	10.3
M366 C	8/43	20	-	11.2	3.1	20.3	26.0	50.6	37.3	7.5	73.7	12.3
M387 B	9/43	28	-	11.9	2.9	16.6	32.2	48.6	69.6	7.4	83.3	10.0
SEAM C.												
M57 B,C,D & E	3/41	59½	1½	12.3	2.8	13.4	31.4	52.5	74.5	7.2	88.0	9.5
M156 A,B,C & D	1/43	40	-	12.7	1.2	17.8	19.8	61.1	62.0	9.1	83.9	13.0
M160 A,B,C,D,E&F	2/43	73½	1	12.1	2.6	14.8	32.0	50.8	71.1	7.6	87.0	10.6
M264 A,B & C	3/43	64	-	12.2	3.1	14.8	30.8	51.3	68.2	6.9	86.0	10.0
M292 A,B,C & D	4/43	57	-	11.9	3.1	15.5	30.3	51.1	67.5	7.7	83.6	9.6
M368 A,B & C	8/43	65	-	11.8	2.8	15.8	31.3	50.2	67.1	7.5	83.7	9.8
M390 A & B	10/43	45	-	11.8	2.9	16.0	29.0	52.1	59.5	7.6	82.7	10.7

TABLE 5. /...

TABLE 5.

COMPOSITION OF ULTIMATE ANALYSES SAMPLES.

Sample Number	Composition		Type of Coal
TOP SEAM.			
N 438	M289 - 19 pts. M262 - 17 " M157 - 14½ " M304 - 5 "		Composite of whole seam in boreholes 4/43, 3/43, 2/43 and 5/43.
SEAM A			
N 440	M290C - 21½ Pts. M263C - 28 " M158G - 15 " H - 12 "	M305D - 15 pts. M366C - 20 " M387B - 28 "	High ash, mixed coal at top of seam in boreholes 2/43, 3/43, 4/43, 5/43, 8/43 and 9/43.
N 441	M158G - 15 pts H - 12 " M387B - 28 "		High ash, mixed coal at top of seam with swelling properties in boreholes 2/43 and 9/43.
N 439	M290A - 38 pts. M263A - 24 " M158C - 10 " D - 16 " M305A - 14 " B - 25 "	M366A - 21 pts B - 19 " M387A - 14 "	High ash, mixed coal at bottom of seam in boreholes 2/43, 3/43, 4/43, 5/43, 8/43 and 9/43.
SEAM C.			
N444	M292D - 18 pts. M264C - 18 " M160E - 12 " F - 13½ " M368C - 10 "		Medium to low ash, slightly swelling bright coal above bottom coal in boreholes 2/43, 3/43, 4/43 and 8/43.
N 443	M264A - 22 pts. B - 24 " M160A - 12 " B - 12 " C - 12 " D - 12 "	M390A - 25 pts. B - 20 "	Medium to high ash, swelling coal at bottom of seam in boreholes 2/43, 3/43 and 10/43.
N 442	M292A - 18 pts. B - 5 " C - 16 " D - 18 " M368A - 30 " B - 25 "		Medium to high ash, non-swelling coal at bottom of seam in boreholes 4/43 and 8/43.

TABLE 6. /....

TABLE 6.

PROXIMATE ANALYSES OF COMPOSITE SAMPLES.

Sample Number	WHOLE COAL				FLOAT AT S.G. 1.6				% Float 1.6
	Cal.Val. lbs/lb	% H_2O	% ASH	% V.M.	Cal.Val. lbs/lb	% H_2O	% ASH	% V.M.	
N 438	11.7	3.1	17.3	27.9	12.8	3.2	10.0	30.3	81.2
N 440	11.4	2.8	18.4	27.9	12.7	3.0	10.8	31.5	77.3
N 441	-	2.8	19.6	25.7	12.4	3.1	12.6	26.3	75.0
N 439	11.5	2.9	17.4	24.5	12.4	3.2	11.3	25.6	81.3
N 444	-	2.6	12.0	37.3	13.1	2.8	8.1	36.4	87.5
N 443	11.8	2.7	15.9	29.9	12.7	2.0	10.5	32.4	80.1
N 442	11.8	2.6	15.6	30.3	12.8	3.0	10.0	32.5	84.1

TABLE 7./....

TABLE 7.

ULTIMATE ANALYSES OF COMPOSITE SAMPLES.
(On dry ash free basis - Float S.G.1.6)

Sample Number	% Carbon	% Hydrogen	% Nitrogen	% Sulphur	% Oxygen + Errors
N 438	79.5	5.2	2.1	0.6	12.6
N 440	80.5	5.2	2.1	1.5	10.7
N 441	81.7	4.9	2.0	1.3	10.1
N 439	81.1	4.7	2.0	0.6	11.6
N 444	80.5	5.3	2.0	1.1	11.1
N 443	80.6	5.2	2.1	1.3	10.8
N 442	80.7	5.2	2.0	1.2	10.9

TABLE 8

SULPHUR DISTRIBUTION OF COMPOSITE SAMPLES.

Sample Number	ON WHOLE COAL			% Sulphur on Fl. 1.6
	% Mineral Sulphur	% Organic Sulphur	% Total Sulphur	
N 438	0.19	0.39	0.58	0.55
N 440	1.15	0.49	1.64	1.32
N 441	1.33	0.29	1.62	1.12
N 439	0.41	0.31	0.72	0.52
N 444	1.21	0.47	1.68	1.00
N 443	1.47	0.58	2.05	1.16
N 442	1.60	0.41	2.01	1.04

TABLE 9./....

TABLE 9.

LOW TEMPERATURE CARBONISATION ASSAYS ON FLOAT AT S.G.1.6

Sample Number	% Coke	% Tar	% Liquor	% Gas	R.D.of Gas	Nature of Coke	V.M. in Coke %
N 438	74.3	9.5	7.6	8.7	0.68	Pulverulent	7.3
N 440	73.8	10.4	7.1	9.0	0.69	Pulverulent	7.5
N 441	-	-	-	-	-	-	-
N 439	77.9	6.9	7.3	7.9	0.68	Pulverulent	8.0
N 444	71.2	11.8	7.3	10.8	0.70	Pulverulent	6.4
N 443	73.1	10.7	7.2	9.1	0.70	Pulverulent	5.2
N 442	72.8	9.5	8.5	9.3	0.69	Pulverulent	8.3

TABLE 10.

HIGH TEMPERATURE CARBONISATION ASSAYS ON FLOAT AT S.G. 1.45

Sample Number	% Coke	% Tar	% Liquor	% Gas	R.D.of Gas	Nature of Coke	% Sulphur in Coke
N 443	68.9	3.5	10.5	16.8	0.48	Pulverulent	0.83

TABLE 11./....

TABLE 11.

DETAILED FLOAT AND SINK ANALYSES OF COMPOSITE SAMPLES.

Sample Number	DETAILS	Float at 1.30	Float at 1.30-1.35	Float at 1.35-1.4	Float at 1.40-1.45	Float at 1.45-1.50	Float at 1.50-1.55	Float at 1.55-1.60
N 438	Fractional wt. %	8.5	22.7	19.9	11.6	10.7	3.4	4.4
	Fractional ash %	4.2		9.4	12.3	15.0	26.4	
	Cumulative wt. %	8.5	31.2	51.1	62.7	73.4	76.8	81.2
	Cumulative ash %	-	4.2	6.2	7.3	8.4	9.3	10.1
	Cumulative Sw. No.	$1\frac{1}{2}$	1 F	-	-	-	-	-
N 440	Fractional wt. %	4.5	22.8	15.3	10.9	10.6	8.3	4.9
	Fractional ash %	5.3		8.8	12.8	13.2	21.7	23.5
	Cumulative wt. %	4.5	27.3	42.6	53.5	64.1	72.4	77.3
	Cumulative ash %	-	5.3	6.5	7.8	8.7	10.2	11.2
	Cumulative Sw. No.	-	$1\frac{1}{2}$	1	1 F	-	-	-
N 441	Fractional wt. %	-	-	-	-	-	-	-
	Fractional ash %	-	-	-	-	-	-	-
	Cumulative wt. %	-	-	-	-	-	-	75.0
	Cumulative ash %	-	-	-	-	-	-	12.6
	Cumulative Sw. No.	-	-	-	-	-	-	-
N 439	Fractional wt. %	1.6	11.8	17.7	14.4	19.4	10.6	5.8
	Fractional ash %	4.3		7.2	11.3	12.4	20.7	
	Cumulative wt. %	1.6	13.4	31.1	45.5	64.9	75.5	81.3
	Cumulative ash %	-	4.3	6.0	7.7	9.1	10.8	11.4
	Cumulative Sw. No.	-	1	1 F	-	-	-	-

N 444/....

TABLE 11, continued.

Sample Number	D E T A I L S	Float at 1.30	Float at 1.30-1.35	Float at 1.35-1.4	Float at 1.40-1.35	Float at 1.45-1.50	Float at 1.50-1.55	Float at 1.55-1.60
N 444	Fractional wt. %	19.7	33.3	13.2	-	-	-	-
	Fractional ash %	2.7	4.9	9.1	-	-	-	-
	Cumulative wt. %	19.7	53.0	66.2	-	-	86.7	87.5
	Cumulative ash %	2.7	4.1	5.1	6.5	-	7.4	7.9
	Cumulative Sw. No.	1½	1 F	-	-	-	-	-
N 443	Fractional wt. %	5.6	25.5	21.1	13.2	6.6	4.5	3.6
	Fractional ash %	4.7		8.7	13.6	16.7	24.7	
	Fractional Sw. No.	1½	1 F	-	-	-	-	-
	Cumulative wt. %	5.6	31.1	52.2	65.4	72.0	76.5	80.1
	Cumulative ash %	-	4.7	6.4	7.8	8.8	9.9	10.3
	Cumulative Sw. No.	1½	1	1	1 F	-	-	-
N 442	Fractional wt. %	6.7	28.9	20.3	9.0	11.6	4.6	3.0
	Fractional ash %	4.8		9.4	15.0		19.5	33.4
	Cumulative wt. %	6.7	35.6	55.9	64.9	76.5	81.1	84.1
	Cumulative ash %	-	4.8	6.4	7.9	8.7	9.4	10.2
	Cumulative Sw. No.	1½	1 F	-	-	-	-	-

TABLE 12. /....

TABLE 12.

ASH FUSION TEMPERATURES

°C

Sample Number	WHOLE COAL	FLOAT AT S.G. 1.6
N 438	+ 1400	+ 1400
N 440	1300	1300
N 441	1200	1300
N 439	1300	1400
N 444	1300	1400
N 443	1300	1400
N 442	1200	1300

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APPENDIX.

ANALYTICAL METHODS AND THEIR SIGNIFICANCE.

I. 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," issued by the South African Standards Institution.

II. PREPARATION OF SAMPLES:

The samples are prepared in the manner specified in Standard Methods for the "Sampling of Coal in South Africa", S.A. No. 13 of 1937. 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.

III. PROXIMATE ANALYSIS:

(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.

IV. 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/.....

(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) 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 ordianry 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 the 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 swelling 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. 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 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/.....

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.

VII. 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 of the floats at 1.6 S.G. is usually given in the same table as the sulphur distribution on the whole coal. This is done for comparative purposes since it indicates the change in sulphur content that would be brought about by washing the raw coal at a specific gravity of 1.6.

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

VIII. 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 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/.....

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.

IX. DETAILED FLOAT AND SINK ANALYSIS:

Float and sink analyses together with their attendant ash and swelling number determinations, are made on composite coal samples ground to -20 mesh.

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

(i) the characterization 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 characteristics of the cleaned products can be readily obtained. This involves making cuts at various specific gravities

and/.....

and analysing the resulting floats. Such a method is known as "cumulative" float and sink analysis.

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.

Comparative figures obtained from many float and sink analyses carried out on both -20 mesh and commercial coal sizes have demonstrated the value of the laboratory scale tests and have suggested a reliable interpretation which can be given to the figures.

(1) The shape of the graph of percentage yield vs. Specific Gravity obtained from fine coal is similar to that obtained from the commercial sizes of the same coal. This means that the washability of the coal can be satisfactorily determined from the -20 mesh size float and sink analysis.

(2) The large scale percentage of float is always 5 - 10% more than the figure obtained in the laboratory on fine coal at the same Specific Gravity.

(3) The percentage ash on the float obtained at any Specific Gravity from large coal is usually from 2 - 4% higher than the value obtained from a laboratory separation.

(4) It has also been found that the smaller the size of the coal to be 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 analyses. 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 liberal allowances, since with this material only

washers/.....

washers of the best type operated under strict control function at all satisfactorily.

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 mineral matter which may be again subdivided 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 - 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.

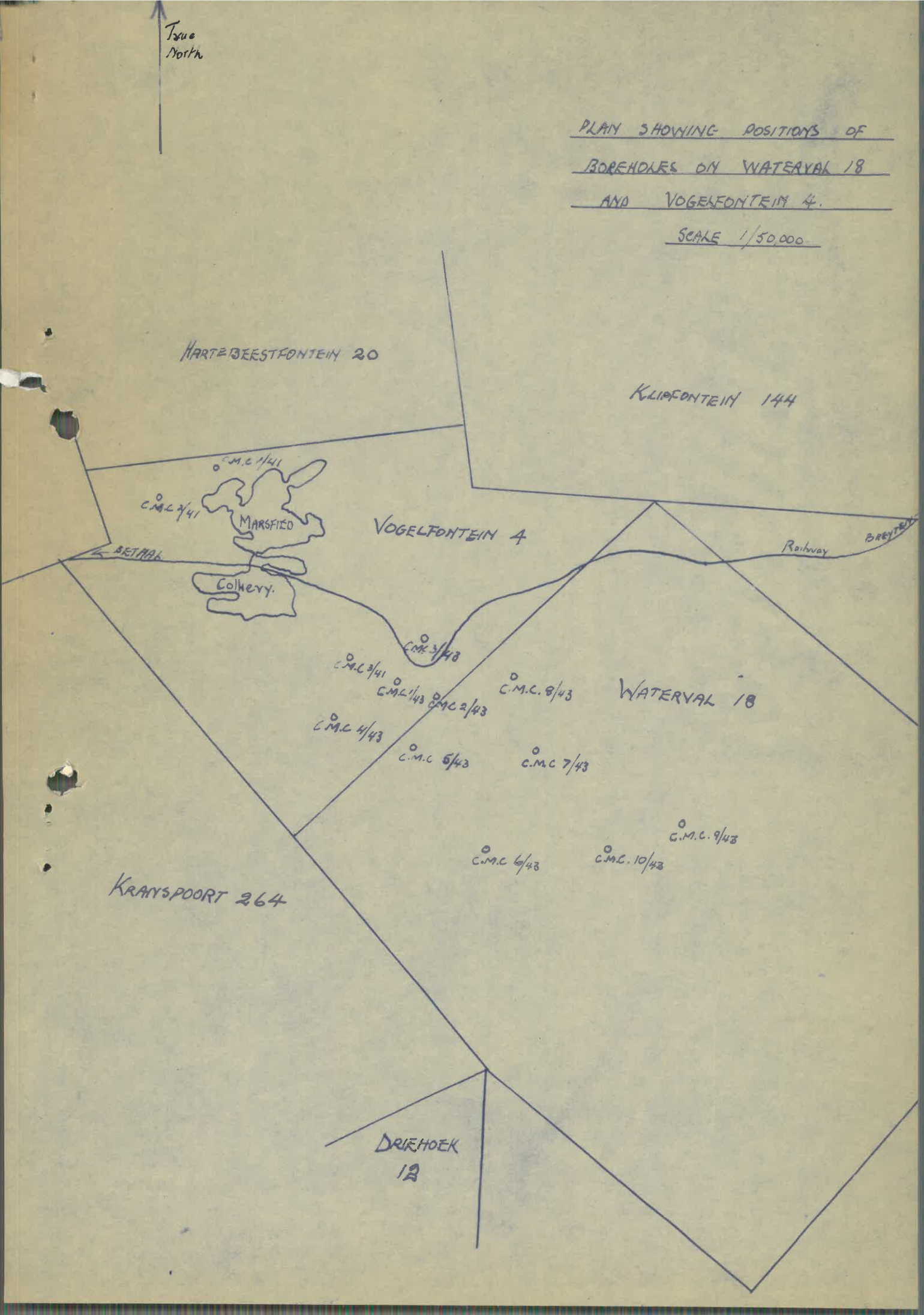
XI. Hydrogenation/.....

XI. HYDROGENATION:

The work done in this sphere constitutes a comparative hydrogenation survey. Consequently, a discontinuous rotary converter, though it affords no quantitive 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 treated 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, after which it is allowed to cool down and the products of hydrogenation examined.

In evaluating the results obtained from rotary converters, it has been found that the best guide to the probable behaviour of the coal is the percentage of organic benzene - insoluble material remaining after treatment 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%.


True North
PLAN SHOWING POSITIONS OF BOREHOLES ON WATERVAL 18 AND VOGELFONTEIN 4.
SCALE 1/50,000
HARTEBEESTFONTEIN 20
KLIPFONTEIN 144
C.M.C 1/41
C.M.C 2/41
MARSFIELD
VOGELFONTEIN 4
BETHAL
Railway
BREYTEN
Colliery.
C.M.C 3/43
C.M.C 3/41
C.M.C 1/43
C.M.C 2/43
C.M.C. 8/43
WATERVAL 18
C.M.C 4/43
C.M.C 5/43
C.M.C 7/43
C.M.C. 9/43
C.M.C 6/43
C.M.C. 10/43
KRANSPOORT 264
DRIEHOEK 12