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FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

BRANDSTOF-NAVORSINGS-INSTITUUT

VAN SUID-AFRIKA.

SURVEY REPORT NO. 57

SUBJECT :
ONDERWERP: REPORT ON SAMPLES OBTAINED FROM BOREHOLES PUT DOWN BY THE ANGLO-TRANSVAAL COLLIERIES, LTD., ON THE FARM GROOTPAN 67 IN THE WITBANK DISTRICT OF TRANSVAAL.

DIVISION :
AFDELING: CHEMISTRY

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

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REPORT ON SAMPLES OBTAINED FROM BOREHOLES PUT DOWN BY THE ANGLO-TRANSVAAL COLLIERIES, LTD., ON THE FARM GROOTPAN 67 IN THE WITBANK DISTRICT OF TRANSVAAL.

INTRODUCTION.

A series of six boreholes were put down during 1941 by the Anglo-Transvaal Collieries Ltd., on the farm Grootpan 67 in the Witbank District of Transvaal. The location of the boreholes is shown in the accompanying sketch map (see back of report.) Borehole Nos. MW 5/41 and MW 6/41 which were reamed and deepened, were originally numbered 3/1929 and G7 respectively. It has not been possible to obtain the old records of these holes.

The farm Grootpan 67 lies approximately 12 miles south-west of Witbank. The Johannesburg-Witbank railway line crosses the farm. The Minnaar-Witbank Colliery and Minnaar Station are situated very close to the prospected area. 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 6/8).

The strata encountered consist almost entirely of sandstones, shales and carbonaceous shales. Dwyka was encountered only in borehole MW 1/41 at a distance of 12 feet below the No. 1 Seam. The other holes were stopped just after the No. 1 Seam had been intersected.

The boreholes show the normal succession of coal seams from 1 to 5 (bottom to top) found in the Witbank coalfield. A generalised vertical section of the strata intersected is given below:-

	Soil, clay, decomposed sandstone, etc.	
	Sandstone and shale	
5 - 12'	Coal and Shaly coal	No. 5 Seam
40 - 50'	Sandstone and shale	
2'	Coal and carbonaceous shale	No. 4 A Seam
2 - 4'	Sandstone and shale	
10 - 15'	Shaly coal and carbonaceous shale	Upper 4 Seam
2 - 4'	Sandstone and shale	(24' Grit in Borehole MW 2/41)
9 - 12'	Coal and shaly coal (2½' Coal in Borehole MW 2/41)	Lower No. 4 Seam
	Sandstone (grit)	
½ - 2'	Bright coal	No. 3 Seam
5 - 15'	Sandstone and shale	
15 - 30'	Black shale	
7 - 10'	Shaly coal	No. 2 Seam
70 - 80'	Sandstone and shale	
4 - 9'	Coal	No. 1 Seam
	Sandstone and shale	
	Dwyka	

Seam 5 has deteriorated to shaly coal in this area. Samples were only taken of the coal core from Borehole MW 1/41.

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It is difficult to correlate the components and the partings of the whole No. 4 seam; the total width is usually about 30 feet consisting mainly of coal and shale and mixtures of the two. In Borehole MW 2/41, the section is however exceptional. Here the Upper and Lower No. 4 seams are separated by 24 feet of grit. The component seams were only sampled in boreholes MW 1/41, 2/41 and 3/41. Seam 3 was readily recognised in the boreholes. It consists of $\frac{1}{2}$ to 2 feet of bright coal and is separated from the Lower No. 4 seam by 5 - 12 feet of grit.

The coal of seam 2 was found to be of inferior quality. It was not sampled in borehole MW 5/41 and had been already extracted in the deepened borehole MW 6/41. The No. 1 seam was intersected in all of the six boreholes. The drilling programme was carried out primarily to ascertain the extent and nature of this seam.

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: PROXIMATE ANALYSES.

The cores from all the boreholes were sampled and analysed by officers of the Fuel Research Institute. The details of the samples taken are given in Table 2 (see at back of report, page 9/12). The core of each seam in each borehole is given a distinctive sample number and each subdivision of such a core, a distinctive letter starting from the bottom of the seam with the letter "A".

Table 3 (see at back of report, page 13/16) gives the proximate analyses on an air-dried basis of the samples detailed in Table 2 together with:
(a) the percentage float at a S.G. of 1.45,
(b) the percentage ash on the float at 1.45,
(c)the Woodall Duckham swelling number on the float 1.45,
(d) the percentage float at a S.G. of 1.6,
(e) the percentage of ash on the float at 1.6 and
(f) the Woodall Duckham swelling number on the float 1.6.

From the individual analytical data given in Table 3, certain average proximate analyses of the various sections of the Lower No. 4 and No. 1 seams have been drawn up and are tabulated in Table 4 (see back of report, page 17). The average analyses are intended to be representative of the maximum mining width of coal, and inferior bands which are capable of removal by picking during production, have been excluded from both the widths and the analyses.

SECTION B: ULTIMATE ANALYSES.

For the purpose of further and more detailed investigation, composite samples of the No. 1 and 3 seams were made up. These were made by mixing - in proportion to the amount of coal they represent - samples of the same seam from the different boreholes. The composition and the proximate analyses of the composite seam samples are given in Table 5 (see at back of report, page 18).

The samples of the No. 1 seam found in boreholes MW 1/41 and MW 5/41 have not been included in the composite sample. The seam in borehole MW 5/41 was considered to be too poor to be included, and insufficient material of the samples of the No. 1 seam in borehole MW 1/41 remained for mixing purposes.

The samples of No. 3 seam from boreholes MW 1/41, MW 2/41

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and MW 4/41 were mixed. The holes lie in the middle of the area under consideration.

No samples have been made from the No. 2, Upper No. 4, No. 4A and No. 5 seams. Where samples were taken of these seams, they have proved to be of inferior quality and it was therefore decided to be unnecessary to investigate the nature of the seams more fully. A composite sample of the Lower No. 4 seam was also not prepared, since it is only in boreholes MW 1/41 and MW 3/41 that the bottom portion of the seam is wide enough to be considered of economic importance. It is unfortunate that the records of the original holes 3/1929 and G7 (boreholes MW 5/41 and MW 6/41) do not exist, since these would have indicated the nature of the Lower No. 4 seam in the southern portion of the prospected area.

In Table 6 (see at back of report, page 18) the ultimate analyses of the composite samples listed in Table 5, are given. The analyses have been carried out in all cases 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. The results are expressed on a dry, ash-free basis, so as to present the composition of the coal substance proper, unmixed with mineral matter. The process of floating the coal also materially reduces the error involved in calculating actual analyses to a dry, ash-free basis.

Table 7 (see at back of report, page 18) shows the sulphur distribution in the composite samples. The analyses have been carried out on the whole coal including adventitious mineral matter. The sulphur content of the floats at 1.6 are also included in the table.

The hydrogen content of the No. 1 seam is higher than is normally the case for this seam. The ultimate analysis of the No. 3 seam agrees closely with analyses of the same seam in other parts of the district. The greater portion of the sulphur content of the No. 1 seam is present as pyrites. Much of this can be readily removed by washing.

SECTION C: CARBONISATION ASSAYS.

Low temperature carbonisation assays (600°C) were carried out on both the composite samples. The assay is carried out on the float at 1.6 S.G. for the same reasons as are outlined in Section B, and also since that fraction would most nearly represent the ordinary washed product obtainable from the seams. The figures obtained are given in Table 8 (see back of report, page 19).

A high temperature Gray-King assay (900°C) was carried out on the composite No. 3 seam sample. The details of the test are also listed in Table 8 (see back of report, page 19). Owing to the narrow width of the No. 3 seam, the results obtained are of value from a correlative rather than an economic aspect.

The yields of tar and gas from the No. 1 seam in the low temperature carbonisation assay are higher than normal for this seam in other parts of the Witbank Coalfield. The No. 3 seam with its high volatile matter and hydrogen contents yields more tar and gas than the No. 1 seam. The figures obtained for the high temperature carbonisation assay of the No. 3 seam, when compared to the low temperature result, show that the yield of gas is higher and that the yields of coke and tar are lower. The results are normal for the No. 3 seam.

SECTION D: DETAILED FLOAT AND SINK ANALYSES.

Float and sink analyses together with their attendant ash and swelling number determinations, were made on the composite seam samples. The results are given in Table 9 (see at back of report page 19). In determining the washability of the coals, the figures tabulated in Table 9 must be considered together with the results of the float and sink tests given in Table 3.

SECTION E: ASH FUSION TEMPERATURES.

Ash fusion temperatures have been carried out on the whole coal, including adventitious mineral matter, of the composite samples. These are shewn in Table 10 (see at back of report page 20).

SECTION F: GENERAL SUMMARY.

THE NO. 1 SEAM:

This seam was encountered in all the holes. It varies in width from 4 to 9 feet and consists of mainly dull, medium quality coal, except in the most westerly borehole (MW 5/41), where the coal is inferior and the seam is split by a wide parting ($2\frac{1}{2}$ feet) of shaly sandstone. The seam in the southern portion of the prospected area is generally thinner (4 to 6 feet in boreholes MW 1/41, MW 5/41 and MW 6/41) than in the northern section (boreholes MW 2/41, MW 3/41 and MW 4/41). The volatile matter content of the seam is higher in holes MW 5/41 and MW 6/41 (38 to 41% on a dry, ash-free basis) than in boreholes MW 1/41 to MW 4/41 (33 to 34% on a dry, ash-free basis).

The seam has the average proximate analysis:

% Ash	12 - 16%
% H_2O	2%
% Volatile Matter	27 - 31%
Calorific Value lbs/lb	12.1 - 12.7
Ash fusion temperature	1300°C

If the coal were cleaned in a good type of washer operating at a S.G. of 1.5, 75% of cleaned product, having an ash content of 10 - 12% and carrying a calorific value of 12.7 - 13.0 lbs/lb, could be obtained. The sulphur content of the coal is low. Owing to the lack of swelling properties the coal would be of value only as a general purpose fuel for domestic and industrial use, where a medium ash and a low sulphur content are suitable.

THE NO. 2 SEAM:

The seam is present over the whole area and is situated 70 to 80 feet above the No. 1 seam. It varies in width from 7 to 10 feet and consists mainly of shaly coal. The seam is so poor that it is not of economic importance.

THE NO. 3 SEAM:

Though the ash content of the seam is variable over this area (10 to 25%) the characteristic properties which make it so useful for correlative purposes in the Witbank Coalfield are persistent. The coal is high in hydrogen content and yields fairly high percentages of tar and gas on carbonisation. The organic sulphur content of the seam is high. The seam accurs 30 to 35 feet above the No. 2 seam over the whole area, and consists of $\frac{1}{2}$ to 2 feet of bright coal having medium swelling properties and a high volatile matter content (39 to 41% on a dry, ash-free basis).

THE NO. 4 SEAM:

Though the No. 4 seam is present over the whole area, only the lower section of it (designated as the Lower No. 4 Seam) over portions of the prospected area, could be considered of possible aconomic value. It is separated from the No. 3 seam by 5 to 12 feet of grit and the bottom 4 to 6 feet consists of medium to poor quality coal of general dull appearance, having the following proximate analysis:

% Ash	16 - 19
% H_2O	2 - 3
% Volatile Matter	22 - 24
Calorific Value lbs/lb	11.2 - 11.7

If the possible extraction of this seam is contemplated it is suggested that further drilling should be done, in order to ascertain the width and quality of the seam, especially in the vicinity of boreholes MW 2/41, MW 5/41 and MW 6/41.

THE NO. 5 SEAM:

The No. 5 seam in the prospected portion of Grootpan 67 is of no commercial value. It was found to consist of 5 to 12 feet of coal and shaly coal, and it occurs 40 to 50 feet above the uppermost component of the No. 4 seam. It was intersected and sampled only in borehole MW 1/41, and was found to be very poor in quality.

Date: August, 1943.

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F.W. QUASS.

ASSISTANT

TABLE 1.

BOREHOLE RECORDS.

Borehole Number	Collar Elevation (feet a.m.s.l.)	Thickness Ft. ins.	Description of Strata	Total Depth Ft. ins.
M.W.1/41	5213.5	32' 6"	Soil and decomposed sandstone	32' 6"
		1' 3"	Decomposed sandstone	33' 9"
		14'10"	Fine-grained sandstone with shale bands and partings	48' 7"
		1' 8"	Medium-grained sandstone	50' 3"
		4' 4"	Shaly sandstone	54' 7"
		1' 5"	Fine-grained sandstone	56' 0"
		1' 4"	No core (shaly sandstone ?)	57' 4"
		0'11"	Shaly sandstone	58' 3"
		3' 3"	Fine-grained sandstone	61' 6"
		0' 5"	Sandy shale	61'11"
		25' 1"	Bedded fine and medium grained sandstone - Sericitic	87' 0"
		5' 6"	Micaceous sandstone	92' 6"
		13'11"	Sandstone with shaly partings	106' 5"
		4' 7"	Fine-grained sandstone	111' 0"
		18' 0"	Fine-grained sandstone with shale partings	129' 0"
		5' 0"	Shale and sandstone	134' 0"
		3' 0"	Felspathic sandstone	137' 0"
		1' 3"	Carbonaceous shale	138' 3"
		5' 6"	COAL NO.5 SEAM	143' 9"
		0'10"	Carbonaceous shale, streaks of coal	144' 7"
		2' 5"	Dark brown clayey shale - conchoidal fracture	147' 0"
		1' 2"	Shaly sandstone	148' 2"
		1' 4"	Shale	149' 6"
		4' 2"	Fine-grained sandstone with shale partings	153' 8"
		10'11"	Black shale	164' 7"
		1' 5"	Gritty sandstone	166' 0"
		3' 7"	Fine-grained sandstone with shale partings	169' 7"
		4' 5"	Coarse sandstone	174' 0"
		5' 9"	Fine-grained sandstone with shale	179' 9"
		1' 2"	Carbonaceous shale	180'11"
		0' 5"	COAL NO. 4 A SEAM	181' 4"
		2' 3"	Black Micaceous shale	183' 7"
		2' 4"	COAL UPPER NO.4 SEAM	185'11"
		1' 3"	Black shale	187' 2"
		24'10"	COAL LOWER NO. 4 SEAM	212' 0"
		0' 6"	Black shale	212' 6"
		4' 4"	Fine-grained sandstone	216'10"
		2' 6"	Coarse-grained sandstone	219' 4"
		0' 7"	Bright banded coal.NO.3 SEAM.	219'11"
		1' 3"	Black shale with coal streaks	221' 2"
		10' 4"	Fine-grained sandstone with shale partings and bands - pyritic cluster	231' 6"
		4' 6"	Shale with sandstone	236' 0"
		19' 0"	Black shale	255' 0"
		8' 5"	COAL NO. 2 SEAM	263' 5"
		3' 7"	Carbonaceous shale - with coal streaks	267' 0"
		6' 8"	Brown clayey shale	273' 8"

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TABLE 1 (BOREHOLE RECORDS:CONTINUED).

Borehole Number	Collar Elevation (feet a.m.s.l)	Thickness Ft. ins.	Description of Strata	Total Depth Ft. ins.
M.W.1/41	5213.5	21'10"	Massive grits	295' 6"
		6' 6"	Medium grained sandstone	302' 0"
		7' 0"	Gritty sandstone	309' 0"
		1' 9"	Shaly sandstone	310' 9"
		4' 7"	Black shale	315' 4"
		6' 1"	Grits	321' 5"
		4' 1"	Medium-grained sandstone	325' 6"
		3' 6"	Grits	329' 0"
		1' 1"	Black shale	330' 1"
		2' 3"	Sandstone with shale bands	332' 4"
		4' 3"	COAL NO.1 SEAM. Badly broken	336' 7"
		0' 7"	Shale	337' 2"
		1' 1"	Sandstone with shale	338' 3"
		8'11"	Shale with gritty sandstone lenses	347' 2"
		8' 2"	Dwyka	355' 4"
M.W.2/41	5267.9	25' 0"	Surface soil	25' 0"
		25' 0"	Sandstone	50' 0"
		4'10"	Sandstone shale bands	54'10"
		29' 7"	Sandstone	84' 5"
		22' 9"	Sandstone shale bands	107' 2"
		65' 4"	Sandstone	172' 6"
		7' 5"	Sandstone shale bands	179'11"
		7' 5"	Grit and shale	187' 4"
		5' 3"	COAL NO. 5 SEAM	192' 7"
		9' 6"	Sandstone shale bands	202' 1"
		11' 0"	Shale	213' 1"
		13' 0"	Grit	226' 1"
		2' 3"	Shale. Coal bands	228' 4"
		17' 6"	COAL UPPER NO.4 & 4A SEAMS	245'10"
		24' 0"	Grit	269'10"
		2' 6"	COAL LOWER NO. 4 SEAM	272' 4"
		7' 9"	Grit	280' 1"
		6"	COAL NO. 3 SEAM	280' 7"
		12' 0"	Sandstone shale bands	292' 7"
		16' 8"	Shale	309' 3"
		7' 4"	COAL NO. 2 SEAM	316' 7"
		3' 0"	Shaly coal and shale	319' 7"
		6' 0"	Brown shale	325' 7"
		4' 9"	Sandstone	330' 4"
		26' 3"	Grit	356' 7"
		6' 3"	Banded sandstone	362'10"
		6' 3"	Grit	369' 1"
		5' 0"	Sandstone	374' 1"
		17' 8"	Grit	391' 9"
		6' 9"	COAL NO. 1 SEAM	397' 4"
		6' 6"	Sandstone and grit	405' 0"
M.W. 3/41	5283.8	25' 6"	Surface soil and clay	25' 6"
		6' 3"	Sandstone	31' 9"
		9' 0"	Quartzitic sandstone	40' 9"
		53' 3"	Sandstone	94' 0"
		4"	COAL	94' 4"
		29' 4"	Sandstone	123' 8"
		31' 6"	Sandstone shale bands	155' 2"
		64' 6"	Sandstone	219' 8"
		14' 3"	Sandstone shale bands	233'11"
		11' 6"	NO.5 SEAM. SHALE WITH COAL BANDS	245' 5"
		4' 3"	Black shale	249' 8"
		5' 6"	Burnt Sandstone	255' 2"
		13' 3"	Black shale	268' 5"
		22' 7"	Grit	291' 0"

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TABLE 1 (BOREHOLE RECORDS: CONTINUED)

Borehole Number	Collar Elevation (Feet a.m.s.l.)	Thickness ft. ins.	Description of Strata	Total Depth ft. ins
M.W.3/41 (Cont.)	5283.8	2' 0"	COAL NO. 4 A SEAM	293' 0"
		3' 7"	Sandstone shale bands	296' 7"
		24' 1"	COAL UPPER & LOWER NO.4 SEAMS	320' 8"
		12' 1"	Grit	322' 9"
		1' 2"	COAL NO. 3 SEAM	333'11"
		5' 6"	Sandstone shale bands	339' 5"
		22' 7"	Black shale	362' 0"
		7' 9"	COAL NO. 2 SEAM	369' 9"
		9' 0"	Brown shale	378' 9"
		30' 0"	Grit	408' 9"
		4' 3"	Shale	413' 0"
		32'10"	Grit	445'10"
		8'11"	COAL NO.1 SEAM	454' 9"
		5' 3"	Shaly sandstone	460' 0"
M.W.4/41	5223.5	36' 0"	Surface soil and ouklip	36' 0"
		65' 0"	Sandstone	101' 0"
		31' 0"	Sandstone shale bands	132' 0"
		83" 9"	Sandstone	215' 9"
		10' 3"	COAL NO. 5 SEAM	226' 0"
		19' 8"	Shale	245' 8"
		17' 6"	Grit	263' 2"
		3"	COAL	263' 5"
		3' 3"	Shale	266' 8"
		2' 3"	COAL NO.4A SEAM	268'11"
		2' 4"	Shale	271' 3"
		24' 6"	COAL UPPER & LOWER NO.4 SEAMS	295' 9"
		8' 6"	Grit	304' 3"
		1' 9"	COAL NO.3 SEAM	306' 0"
		4' 6"	Sandstone shale bands	310' 6"
		29' 0"	Shale	339' 6"
		10' 3"	COAL NO. 2 SEAM	349' 9"
		10' 1"	Brown shale	359'10"
		64' 8"	Grit shale bands	424' 6"
		7' 0"	COAL NO. 1 SEAM	431' 6"
		6' 6"	Sandstone shale bands gritty	438' 0"
M.W.5/41 (Originally 3/1929)	5239.2	188' 4"	Reamed old hole	188' 4"
		7' 5"	Sandstone	195' 9"
		6"	COAL NO. 3 SEAM	196' 3"
		10' 3"	Sandstone shale band	206' 6"
		24' 9"	Black shale	231' 3"
		9' 0"	COAL NO. 2 SEAM	240' 3"
		4' 6"	Brown shale	244' 9"
		29' 0"	Grit	273' 9"
		13' 4"	Sandstone	287' 1"
		8' 6"	Grit	295' 7"
		8' 7"	Sandstone shale bands	304' 2"
		8' 8"	Grit	312'10"
		4' 2"	COAL)	317' 0"
		2' 7"	Shale) NO.1 SEAM	319' 7"
		1' 0"	COAL)	320' 7"
		6' 5"	Sandstone shale band	327' 0"
M.W.6/41 (Originally G7)	5197.0	31' 7"	Coarse Sandstone	299' 6"
		16' 2"	Black shale	315' 8"
		6' 1"	COAL NO. 1 SEAM	321' 9"
		2' 3"	Shale	324' 0"
		4'10"	Coarse sandstone	328'10"
			Old borehole cleaned out to 267'11"	

TABLE 2.

DESCRIPTION OF SAMPLES TAKEN.

Sample Number	B.H. No.	Seam	Width of Section (ins.)	Description of Sample
K70	MW 1/41	5		138' 3" Roof: Carbonaceous shale
			10	Black shale with coal streaks Not Sampled
			3	Very dirty coal Not Sampled
C			7	Bright-banded coal
			2	Shale Not Sampled
B			5	Non-banded coal, dull
			4	Shale with coal streaks Not Sampled
A			9	Inferior mixed pyritic coal
			4½	Sandy shale Not Sampled
			1	Very bright coal Not Sampled
			3½	Sandy shale Not Sampled
			4½	Carbonaceous shale, little coal Not Sampled
			6½	Shaly sandstone Not Sampled
			2	Bright, very pyritic coal Not Sampled
			2½	Carbonaceous shale Not Sampled
			1½	Very bright coal Not Sampled
				143' 9" Floor: Carbonaceous shale with streaks of coal.
K69	MW 1/41	4A		180'11" Roof: Carbonaceous shale
C			5	Bright coal
				181' 4" Floor: Black micaceous shale
K123	MW 2/41	4A		228' 4" Roof: Shale and coal bands
			2	Shale Not Sampled
E			19	Bright coal, 4" dull 4" from bottom
				230' 1" Floor: Carbonaceous shale
K196	MW 3/41	4A		291' 0" Roof: Grit
			4	Very bright coal (vitrain)
			10	Dull coal with a few thin bright streaks and a few granular bands
			5	Bright-banded coal (very pyritic)
			3½	Finely-banded bright coal
			1½	Carbonaceous shale with bright coal streaks - Not Sampled
				293' 0" Floor: Sandstone and shale bands
K69	MW 1/41	Upper 4		183' 7" Roof: Black micaceous shale
			14	Carbonaceous shale, little bright coal at bottom - Not Sampled
B			6	Dull, non-banded coal
A			6	Bright-banded coal
			1	Shale - Not Sampled
			1	Bright coal - Not Sampled
			15	Black shale - Not Sampled
			59	Coaly shale - Not Sampled
K68 J			26	Dull granular coal, pyritic, some bright streaks
			22	Shaly coal - Not Sampled
			33	Shaly, pyritic coal - Not Sampled
				198'10" Floor: Coaly shale

TABLE 2 (DESCRIPTION OF SAMPLES TAKEN).

Sample Number	Borehole Number	Seam	Width of Section (ins.)	Description of Sample
K123	MW 2/41	Upper 4		232' 1" Roof: Carbonaceous shale
D			36	Inferior Coal
			3	Carbonaceous shale - Not Sampled
C			42	Inferior coal
B			42	Shaly coal
A			38	Mixed, mainly dull inferior coal
			4	Shale - Not Sampled
				245'10" Floor: Grit
K195	MW 3/41	Upper 4		296' 7" Roof: Sandstone and shale bands
			54	Carbonaceous shale - Not Sampled
			22	Shaly coal with bright bands - Not Sampled
			44	Inferior shaly coal and Carb. shale - Not Sampled
E			32	Shaly coal with bright streaks
				309' 3" Floor: Shaly sandstone
K68	MW 1/41	Lower 4		200' 0" Roof: Coaly shale
H			33	Dull, inferior granular coal
			1½	Carbonaceous shale - Not Sampled
G			14	Granular coal
			3	Shaly coal - Not Sampled
F			6	Granular coal
			5	Dull, very pyritic coal - Not Sampled
E			14	Dull inferior coal 9" at top, mainly bright coal 5" at bottom
			17	Shaly coal with 3" shale at top Not Sampled
D			24	Inferior coal, burnt appearance, pyritic
C			10	Dull coal with a few bright bands
			1½	Pyritic carbonaceous sandstone - Not Sampled
B			8	Dull coal with a few bright bands
A			7	Mainly mixed coal, top 1½" dull, pyritic
				212' 0" Floor: Black shale
K122	MW 2/41	Lower 4		269'10" Roof: Grit
			5½	Dull coal with few thin bright bands
			18½	Dull coal (few bright bands)
			2½	Very bright banded coal
			1	Shale - Not Sampled
			2½	Very bright banded coal
				272' 4" Floor: Grit
K195	MW 3/41	Lower 4		311'11" Roof: Shaly sandstone
D			32	Mixed inferior coal
			4½	Carbonaceous sandstone - Not Sampled
			6	Coaly shale - Not Sampled
C			13	Dull, non-banded coal
B			19	Dull pyritic coal with a few bright bands
A			29	Mixed mainly dull coal
			2	Shale - Not Sampled
				320' 8" Floor: Grit
K67	MW 1/41	3		219' 4" Roof: Coarse-grained sandstone
			7	Mixed, mainly bright coal
				219'11" Floor: Black shale with coal streak

TABLE 2 (DESCRIPTION OF SAMPLES TAKEN: CONTINUED)

Sample Number	Borehole Number	Seam	Width of Section (ins.)	Description of Samples
K191	MW 2/41	3		280' 1" Roof: Grit
			6	Very bright highly laminated coal; gaslike appearance
				280' 7" Floor: Grit
K194	MW 3/41	3		332' 9" Roof: Grit
			3½	Broad-banded bright coal
			3	Shaly coal with bright streaks
			½	Carbonaceous shale - Not Sampled
			6	Very bright coal
			½	Carbonaceous shale - Not Sampled
				333'11" Floor: Sandstone and shale bands
K283	MW 4/41	3		304' 3" Roof: Grit
			4	Sandstone - Not Sampled
			1	Coal - Not Sampled
			2	Carb. shale - Not Sampled
			14	Very bright-banded coal
				306' 0" Floor: Sandstone and shale bands
K66	MW 1/41	2		255' 0" Roof: Black shale
K			23	Dull granular coal
H			13	Dull granular coal
			½	Carbonaceous shale - Not Sampled
G			7	Mixed dull and bright coal
			2	Mixed shale and coal - Not Sampled
F			10	(8½" non-banded coal, bright lustre (1½" carbonaceous shale - Excluded
E			17	Inferior, mainly dull coal
D			6	Mixed heavy coal
C			11	Non-banded coal with a bright lustre
B			9	Very dirty coal with a few thin bright streaks; gypsum and sandstone
A			3	Dull heavy coal
				263' 5" Floor: Carb. shale with bright streaks and gypsum
K121	MW 2/41	2		309' 3" Roof: Shale
			78	Dull heavy shaly coal
			10	Carb. shale with bright streaks - Not Sampled
				316' 7" Floor: Shaly coal and shale
K193	MW 3/41	2		362' 0" Roof: Black shale
			93	Inferior, mainly dull heavy coal
				369' 9" Floor: Brown shale
K284	MW 4/41	2		339' 6" Roof: Shale
			43	Inferior, mainly dull heavy coal
			4	Carbonaceous sandstone - Excluded
			36	Inferior, mainly dull heavy coal
			40	Shaly coal - Not Sampled
				349' 9" Floor: Brown shale

TABLE 2 (DESCRIPTION OF SAMPLES TAKEN: CONTINUED)

Sample Number	Borehole Number	Seam	Width of Section (ins.)	Description of Samples
K65	MW 1/41	1		332' 4" Roof: Sandstone with shale bands
D			14	Mainly dull coal
C			10	Alternating dull and bright coal bands, mainly dull
B			15	Dull coal, pyritic, with few bright bands
A			12	Dull coal with a few bright bands (broken core).
				336' 7" Floor: Shale
K120	MW 2/41	1		391' 9" Roof: Grit
			2	Carbonaceous shale - Not Sampled
G			7½	Dull coal
F			7½	Mainly dull coal, with 1" shale (broken core)
E			21½	Mainly dull coal
D			8½	Mainly dull coal, dull at top (broken core)
C			10½	Dull, non-banded, pyritic coal
B			8	Gaslike coal
A			5	Dull, non-banded coal (broken core)
			10½	Carbonaceous shale - Not Sampled
				398' 6" Floor: Shale
K192	MW 3/41	1		445'10" Roof: Grit
C			36	Dull, non-banded coal
B			31	Dull coal, with a few thin bright streaks
A			33	Mixed coal; bright in very fine bands; Carbonaceous sandstone band 20" from bottom
				454' 9" Floor: Sandstone
				Note: 7" Core missing
K280	MW 4/41	1		424' 6" Roof: Grit and shale bands
E			23	Mixed, mainly dull coal
D			19	Dull non-banded coal
C			15	Dull pyritic coal
			1	Shale - Not Sampled
B			22	Mixed coal
A			3½	Shaly coal with thin bright streaks
				431'6" Floor: Sandstone and shale bands
K281	MW 5/41	1		312'10" Roof: Grit
C			31	Mainly dull coal
			1	Shaly sandstone - Not Sampled
B			18	Mixed coal, bright in very fine bands
			31	Shaly sandstone - Not Sampled
A			12	Finely-banded bright coal
				320' 7" Floor: Shale
K282	MW 6/41	1		315' 8" Roof: Coarse Sandstone
			55	Mainly non-banded coal with a little bright in fine bands
				321' 9" Floor: Shale
				Note: Only 55" recovered

TABLE 3.

PROXIMATE ANALYSES OF SAMPLES.

Sample Number	Borehole Number	Seam	Width 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	Sw. No. Fl. 1.45	Sw. No. Fl. 1.6
K70 C	MW 1/41	5	7	-	2.5	22.2	30.0	45.3	-	-	-	-	-	-
B			5	-	2.6	25.7	20.2	51.5	-	-	-	-	-	-
A			9	-	2.4	26.7	26.2	44.7	-	-	-	-	-	-
K69 C	MW 1/41	4A	5	-	2.1	17.2	36.9	43.8	70.2	8.4	73.7	6.1	2½	2½
K123 E	MW 2/41	4A	19	-	1.8	23.1	29.3	45.8	-	-	-	-	-	-
K196	MW 3/41	4A	22½	-	1.9	22.8	29.7	45.6	53.1	7.7	72.5	11.5	1	-
K69 B	MW 1/41	Upper 4	6	-	2.3	30.5	20.9	46.3	-	-	-	-	-	-
A			6	-	2.4	11.8	35.1	50.7	85.0	7.2	90.0	8.4	2½	2
K68 J	MW 1/41		26	-	2.5	27.8	24.0	45.7	-	-	-	-	-	-
K123 D	MW 2/41	Upper 4	36	-	2.3	38.2	16.9	42.6	-	-	-	-	-	-
C			42	-	2.1	32.3	21.7	43.9	-	-	-	-	-	-
B			42	-	2.0	34.3	20.8	42.9	-	-	-	-	-	-
A			38	-	1.8	29.9	23.8	44.5	-	-	-	-	-	-
K195 E	MW 3/41	Upper 4	32	-	2.2	30.5	24.4	42.9	-	-	-	-	-	-

TABLE 3 (PROXIMATE ANALYSES OF SAMPLES: CONTINUED).

Sample Number		Borehole Number	Seam	Width 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	Sw. No. Fl 1.45	Sw. No. Fl 1.6
K68	H	MW 1/41	Lower 4	33	-	2.8	27.7	20.2	49.3	-	-	-	-	-	-
	G			14	-	2.6	23.1	22.0	52.3	-	-	-	-	-	-
	F			6	-	2.8	25.7	17.4	54.1	-	-	-	-	-	-
	E			14	11.3	2.7	16.6	23.4	57.3	42.5	6.8	78.1	11.4	1F	-
	D			24	11.2	2.8	16.0	22.6	58.8	45.5	7.2	80.8	11.4	1F	-
	C			10	12.3	2.9	11.4	22.9	62.8	-	-	-	-	-	-
	B			8	11.3	2.6	18.6	21.0	57.8	-	-	-	-	-	-
	A			7	11.7	2.5	16.4	28.5	52.6	64.3	7.1	80.4	9.5	1F	-
K122		MW 2/41	Lower 4	29	11.7	2.3	16.6	24.4	56.7	51.1	7.2	80.9	11.3	1F	-
K195	D	MW 3/41	Lower 4	32	-	2.6	24.4	21.5	51.5	-	-	-	-	-	-
	C			13	10.3	3.0	22.8	18.6	55.6	13.1	7.7	58.8	15.3	1F	-
	B			19	11.1	2.9	18.6	20.8	57.7	32.2	7.5	75.2	11.9	1F	-
	A			29	11.6	2.7	16.9	23.6	56.8	45.5	6.9	79.5	10.9	1F	-
K67		MW 1/41	3	7	12.4	2.4	12.0	33.2	52.4	81.5	7.5	90.2	8.8	2	1½
K191		MW 2/41	3	6	12.8	2.5	10.2	34.8	52.5	88.4	7.3	94.6	8.7	2	1½
K194		MW 3/41	3	12½	-	2.1	24.5	29.7	43.7	-	-	-	-	-	-
K283		MW 4/41	3	14	11.8	1.6	16.9	32.3	49.2	68.7	7.6	81.4	10.2	1½	1F
K66	K	MW 1/41	2	23	-	2.6	24.7	18.5	54.2	-	-	-	-	-	-
	H			13	-	2.6	29.8	18.3	49.3	-	-	-	-	-	-
	G			7	-	2.6	29.3	17.4	50.7	-	-	-	-	-	-
	F			8½	-	2.6	24.3	19.7	53.4	-	-	-	-	-	-
	E			17	-	2.3	31.5	21.5	44.7	-	-	-	-	-	-
	D			6	-	2.4	32.8	18.7	46.1	-	-	-	-	-	-
	C			11	-	2.3	33.3	20.2	44.2	-	-	-	-	-	-
	B			9	-	2.1	42.3	20.1	35.5	-	-	-	-	-	-
	A			3	-	2.1	43.3	19.3	35.3	-	-	-	-	-	-

TABLE 3 (PROXIMATE ANALYSES OF SAMPLES: CONTINUED).

Sample Number	Borehole Number	Seam	Width 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	Sw. No. Fl.1.45	Sw. No. Fl 1.6
K121	MW 2/41	2	78	-	2.2	29.2	19.3	49.3	-	-	-	-	-	-
K193	MW 3/41	2	93	-	2.5	29.8	19.1	48.6	-	-	-	-	-	-
K284	MW 4/41	2	79	-	1.5	28.5	20.2	49.8	-	-	-	-	-	-
K65 D	MW 1/41	1	14	12.6	1.9	12.5	27.7	57.9	77.6	8.2	91.9	9.4	1F	-
C			10	12.9	2.0	11.0	30.3	56.7	81.6	7.5	94.8	9.2	1F	-
B			15	12.7	2.0	12.9	29.5	55.6	73.0	8.1	92.0	10.4	1F	-
A			12	12.7	1.9	12.4	30.5	55.2	79.0	9.4	95.1	10.9	1F	-
K120 G	MW 2/41	1	7½	-	1.7	25.0	22.6	50.7	-	-	-	-	-	-
F			7½	-	1.8	28.8	23.3	46.1	-	-	-	-	-	-
E			21½	11.6	1.9	18.2	25.5	54.4	49.1	7.0	76.1	11.0	1F	-
D			8½	12.8	1.9	11.9	29.2	57.0	77.8	5.9	88.3	7.6	1F	-
C			10½	12.3	1.9	14.5	28.0	55.6	71.1	7.6	87.8	9.5	1F	-
B			8	12.6	1.9	12.2	28.6	57.3	75.3	8.5	92.8	10.5	1F	-
A			5	12.5	1.8	13.0	27.6	57.6	70.4	9.0	93.5	11.1	1F	-
K192 C	MW 3/41	1	36	12.6	2.1	12.4	28.1	57.4	73.2	6.3	87.5	8.3	1F	-
B			31	12.0	2.1	15.5	26.9	55.5	64.1	6.8	82.7	9.8	1F	-
A			33	12.6	2.0	13.1	30.8	54.1	78.2	6.8	86.7	8.0	1F	-
K280 E	MW 4/41	1	23	12.5	1.8	13.5	28.1	56.6	75.6	7.0	87.0	8.7	1F	-
D			19	11.6	1.8	16.8	23.0	58.4	53.9	8.3	82.7	11.4	1F	-
C			15	11.2	1.4	20.0	23.5	55.1	47.7	8.2	77.6	12.4	1F	-
B			22	12.9	1.5	11.8	34.5	52.2	85.1	7.2	92.4	8.1	1	1
A			3½	-	1.6	40.7	26.5	31.2	-	-	-	-	-	-

TABLE 3 (PROXIMATE ANALYSES OF SAMPLES: CONTINUED).

Sample Number	Borehole Number	Seam	Width 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	Sw. No. Fl 1.45	Sw. No. Fl 1.6
K281 C	MW 5/41	1	31	-	1.6	22.4	30.7	45.3	54.5	9.8	76.5	13.9	1F	-
B			18	-	1.5	20.3	32.5	45.7	60.7	10.5	83.4	14.8	1F	-
A			12	12.9	1.4	13.2	36.6	48.8	86.7	9.4	93.5	10.8	1F	-
K282	MW 6/41	1	73	12.2	2.3	15.8	31.4	50.5	74.3	9.0	88.1	11.2	1F	-

TABLE 4.

AVERAGE PROXIMATE ANALYSIS OF SEAM SECTIONS.

Sample Number and Sections Included	Borehole Number	Total Width ins.	Width of Exclusions 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
Lower No. 4 Seam:												
K68 A,B,C,D,	MW 1/41	49	1½	11.5	2.7	15.5	23.3	58.6	-	-	-	-
K122	MW 2/41	29	1	11.7	2.3	16.6	24.4	56.7	51.1	7.2	80.9	11.3
K195 A,B,C,	MW 3/41	61	0	11.2	2.8	18.7	21.7	56.8	34.5	7.1	73.7	12.0
No. 1 Seam:												
K65 A,B,C,D,	MW 1/41	51	0	12.7	1.9	12.3	29.4	56.4	77.4	8.3	93.3	10.0
K120 A,B,C,D,E,	MW 2/41	53½	0	12.2	1.9	15.1	27.2	55.8	63.9	7.4	84.5	10.1
K192 A,B,C,	MW 3/41	100	0	12.4	2.1	13.6	28.6	55.7	72.0	6.6	85.7	8.6
K280 B,C,D,E,	MW 4/41	79	1	12.1	1.6	15.1	27.8	55.5	68.6	7.5	85.7	9.8
K281 B,C,	MW 5/41	49	1	-	1.6	21.6	31.4	45.4	56.8	10.1	79.1	14.2
K282	MW 6/41	73	0	12.2	2.3	15.8	31.4	50.5	74.3	9.0	88.1	11.2

TABLE 5.

COMPOSITION AND PROXIMATE ANALYSIS OF COMPOSITE SEAM SAMPLES

Sample Number	Composition	Seam	PROXIMATE ANALYSIS: Whole Coal % H_2O	% Ash	% V.M.	Float at S.G. 1.6: % Yield	% H_2O	% Ash
L228	K120 A - 5 parts	1	2.3	13.9	28.5	87.0	2.4	9.8
	B - 8 "							
	C - 10½ "							
	D - 8½ "							
	E - 21½ "							
	K192 A - 33 "							
	B - 31 "							
	C - 36 "							
	K280 B - 22 "							
	C - 15 "							
	D - 19 "							
	E - 23 "							
	K282 - 55 "							
L229	K67 - 7 parts	3	2.6	14.5	32.5	85.8	2.9	9.1
	K191 - 6 "							
	K283 - 14 "							

TABLE 6.

ULTIMATE ANALYSIS OF SAMPLES.

(On a dry, ash-free basis).

Sample Number	Seam	% C.	% H.	% N.	% S.	% O + Errors
L228	1	83.2	5.23	1.7	0.6	9.3
L229	3	80.1	5.32	2.1	1.0	11.4

TABLE 7.

SULPHUR DISTRIBUTION.

Sample Number	Seam	WHOLE COAL: Mineral Sulphur %	Organic Sulphur %	Total Sulphur %	FLOAT AT SG 1.6: Total Sulphur %
L228	1	1.22	0.31	1.53	0.51
L229	3	0.98	0.64	1.62	0.89

TABLE 8.

CARBONISATION ASSAY RESULTS.

Sample Number	Seam	Type of Assay	Material Used	% Coke	% Tar	% Liquor	% Gas	R.D. of Gas	Nature of Coke	% Vol. in Coke	% S. in Coke
L228	1	Low. temp.	Float 1.6	74.6	10.9	7.2	7.5	0.68	Friable	6.2	-
L229	3	do	do	70.3	11.9	8.3	8.7	0.67	do	5.8	-
L229	3	High temp.	Float 1.45	67.7	5.1	9.65	17.7	0.46	do	-	0.57

TABLE 9.

DETAILED FLOAT AND SINK ANALYSES.

Sample Number	Seam	Details	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
L228	1	Fractional Weight %	8.4	16.6	19.5	22.5	10.3	5.4	4.3
		Fractional Ash %	2.8	5.1	7.3	9.5	17.4	21.8	
		Fractional Sw. No.	3	1	-	-	-	-	-
		Cumulative Weight %	8.4	25.0	44.5	67.0	77.3	82.7	87.0
		Cumulative Ash %	2.8	4.3	5.6	6.9	8.3	9.1	9.8
		Cumulative Sw. No.	3	1½	1	1	1	1F	-
L229	3	Fractional Weight %	15.7	33.9	13.8	11.3	4.9	3.8	2.4
		Fractional Ash %	2.1	4.9	10.9	16.7		21.9	
		Fractional Sw. No.	2½	1F	-	-	-	-	-
		Cumulative Weight %	15.7	49.6	63.4	74.7	79.6	83.4	85.8
		Cumulative Ash %	2.1	4.0	5.5	7.2	7.6	8.4	9.1
		Cumulative Sw. No.	2½	1	1F	-	-	-	-

TABLE 10.

ASH FUSION TEMPERATURES OF COMPOSITE SAMPLES

Sample Number	Seam	Ash Fusion Temperature
L228	1	1300°C
L229	3	+ 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. Except in the case of specific gravity analysis (float and sink tests) and hydrogenation tests the laboratory samples are ground to pass a 60 mesh sieve (square aperture : 0.3 mm). For the two above-mentioned tests minus 20 mesh (square aperture : 1 mm) material is used.

111. PROXIMATE ANALYSES.

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

(2) Ash Content: The residual ash obtained on combustion of 1 gram of coal. The coal is slowly heated to 800 800°C and kept at this temperature for one hour.

(3) Volatile Matter Content: The loss of weight of 1 gram of coal heated at 920° for 7 minutes minus the weight of water present in the coal.

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

1V. CALORIFIC VALUE.

This value, reported in Evaporative Units (lbs/lb), is calculated from the rise in temperature obtained from the combustion of 1 gram of coal under 30 atmospheres pressure of oxygen 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. (1 lb/lb unit = 970 BThu's/lb.)

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. ~~XXX~~/1V, 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 coking constituents 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 an optimum figure for the performance of an ordinary washer on the coal. This figure subtracted from 100 gives the amount of adventitious matt r in a coal sample. This cut at 1.6, together with that at 1.45, gives a rough idea of the distribution of the mineral matter in a 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.

(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 a figure for the minimum ash content for a normal washed product from the particular sample.

(e) The Woodall Duckham 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 coking 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. 1f 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 coking possibilities, further swelling number determinations are carried out on the S.G. 1.6 fraction. These figures give an indication of the coking propensity with this S.G. cut.

V1. 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:-

(a) the charaterisation of types of coal and the subsequent use of this data in correlation.

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

(c) the investigation of the effects on the coking properties of the changes brought about in the nature of the coal by washing.

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 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, Woodall Duckham 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.

It is therefore attempted with composite samples to obtain where desirable, complete float and sink analyses of both types.

When using float and sink analysis figures as guides to possible commercial results, it must always be remembered that the laboratory separations are <u>made on fine coal</u> 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. <u>The analytical figures represent optimum conditions and due allowance must be made for this when interpreting them into commercial practice.</u>

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. <u>ULTIMATE ANALYSIS</u>.

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 of coal analysis:- viz:

(a) Carbon and Hydrogen: The method ised 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 X1 of 1932, page 196; volume X111 of 1934 page 343) and Hall (Journ. Chem. Met. and Min. Soc. of South Africa, volume XXXV1 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, "Analyses and Testing of Coal and Coke", page 43.

(The oxygen content is obtained by difference and therefore includes all analytical arrors.)

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

V111. SULPHUR DISTRIBUTION.

Sulphur distribution figures are usually carried out on the whole samples including adventitious mineral matter.

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

1X. 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 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 mineral matter which may be again sub-divided into

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

(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.

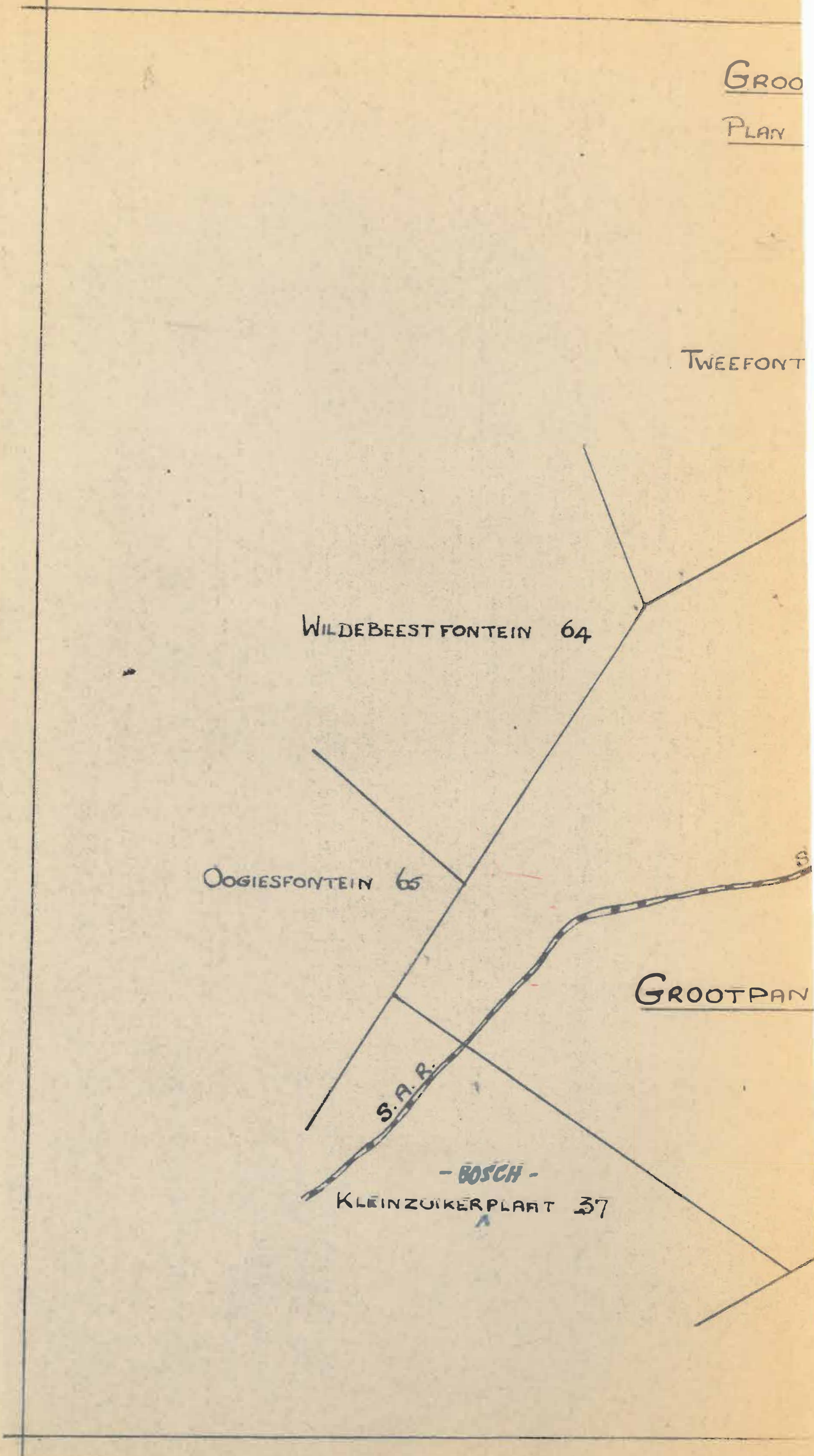
(c) greater than 1400°C - highly refractory ash which will probably not clinker under any conditions.

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 molybenum 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.

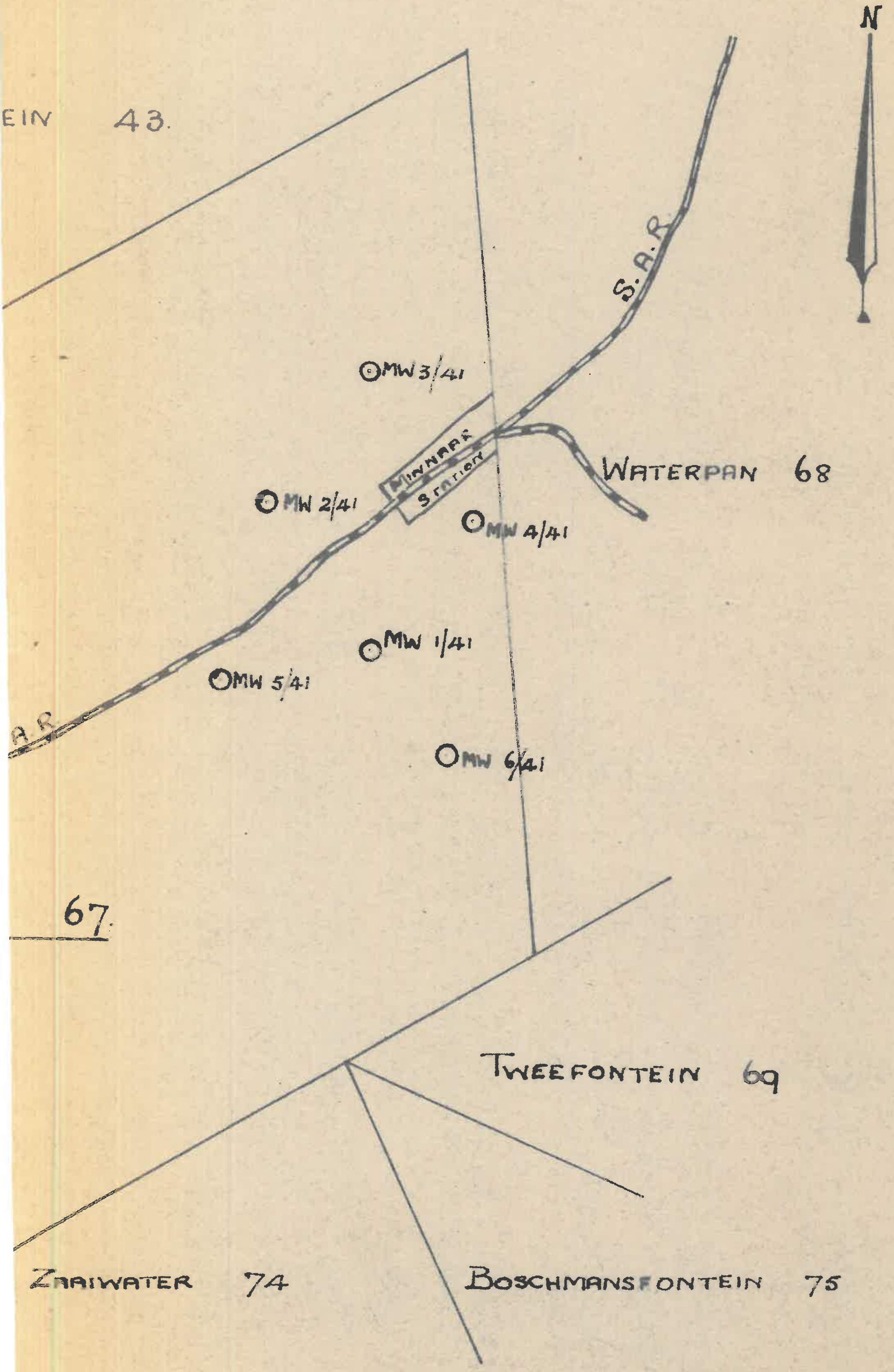
The evaluation of the results is based on the percentage of residual organic benzene-insoluble material reckoned on a dry-ash-free basis. Where this figure is low, the coal may be expected to give better large scale results than where it is high. The best coals so far tested in South Africa have yielded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


GROO
PLAN
TWEEFONT
WILDEBEESTFONTEIN 64
OOGIESFONTEIN 65
GROOTPAN
S.A.R.
-BOSCH-
KLEINZUIKERPLAAT 37

TPAN 67 – WITBANK DISTRICT.

SHOWING POSITION OF BOREHOLES ~

MW 1/41 → MW 6/41.



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