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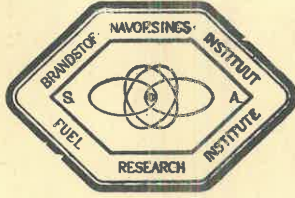
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REPORT No. 8

RAPPORT No.

OF 1949

VAN



WU.1/A/311

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

BRANDSTOF-NAVORSINGS-INSTITUUT

VAN SUID-AFRIKA.

SURVEY REPORT NO. 97

SUBJECT :
ONDERWERP: THE PHYSICAL AND CHEMICAL SURVEY OF THE NO. 4 SEAM

AT ALPHA COLLIERY, DISTRICT WITBANK, TRANSVAAL.

DIVISION :
AFDELING: SURVEY.

NAME OF OFFICER :
NAAM VAN AMPTENAAR: H. BERRY.

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

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THE PHYSICAL AND CHEMICAL SURVEY OF THE NO. 4 SEAM AT
ALPHA COLLIERY, DISTRICT WITBANK, TRANSVAAL

The No. 4 seam at this colliery, judging from the diagrammatic representations at the end of the report, appears to maintain a uniform structure and a fairly consistent thickness throughout the mine. For descriptive purposes it may conveniently be divided into three distinct horizons comprising respectively, an upper section of dull coal, 2 to 3 ft. in thickness, and a lower section of better quality dull coal, approximately 5 ft. in thickness, which invariably contains a 10 to 12 in. band of bright coal adjacent to the floor. A shale roof and sandstone floor are generally associated with the seam.

SAMPLING:

A detailed underground sampling programme was carried out at the colliery by officers of the Institute on January 13th. 1949. In all, 10 suitably distributed faces were prepared and sampled, the seam at each face being subdivided into at least 5 or 6 subsections for analysis purposes according to the different types of coal present.

An underground sketch plan indicating the various sampling positions is given at the end of the report together with diagrammatic representations of the seam showing the subdivisions made for sampling purposes at each point.

In addition to underground samples, three complete series of commercial grade samples were also taken during the period 13/1/49 to 3/2/49. Although the latter strictly do not form part of the survey programme, the analytical results have been included

in the.../

in the report to provide a comparison and to indicate to what extent mining operations affect the quality of the seam during extraction.

The present report is intended to replace the preliminary draft report of the 25th. February, 1949, which was issued as a tentative indication of quality and which was incomplete so far as analytical results were concerned.

ANALYTICAL:

In general, proximate analyses, calorific value determinations and B.S.I. Crucible Swelling Tests were carried out on all samples. These figures were presented in the earlier draft report but mention should be made of the fact that, in the calculated analyses of selected portions of the seam, viz., subsections A + B or subsections A to E, use has been made of a specific gravity correction in the present report in order to obtain a more correct figure. In one or two instances this has led to slight differences between the present figures and those already reported.

Although mainly of academic importance, in order to gain fuller information concerning the type of coal, its chemical characteristics and classification, etc., more detailed analyses of specific portions of the seam were also undertaken. These tests comprised ultimate analyses, (i.e. determinations of elementary carbon), determinations of sulphur contents, ash fusion tests, and were carried out on composite samples of the top and middle dull portions of the seam in which the subsections from each sampling site were represented in proportion to width sampled.

In order to such analysis, each composite sample was floated in water to remove extraneous dirt - the volatile matter, hydrogen, nitrogen, etc., were then determined by standard methods.

Since..../

Since the seam did not evince any marked coking qualities no coking tests beyond the routine B.S.I. Crucible Swelling Tests were considered necessary.

Tables of analytical results, incorporating fractional screen analyses of the commercial products, follow.

Figures for ash fusion point, total sulphur, ash content and calorific value of composite samples of cobbles, nuts, peas and duff, prepared by combining equal quantities of individual grades, are also included.

DESCRIPTIONS OF UNDERGROUND FACE SAMPLES AT ALPHA COLLIERY.

Sample Position.	F.R.I. Sample Number.	Width (ins.)	Description of Subsection.
1	S.20 E	3)6	Dull coal.
	D	3)8	Bright, pyritic coal.
	C	22	Very dull coal. Inferior. Mainly dull coal, brighter towards base.
	B	40	Dull coal; occasional bright streaks.
	A	13	Bright, pyritic coal. <u>Note:</u> Pyritic nodules distributed throughout section.
2	S.21 E	4)7	Dull coal.
	D	3)13	Bright, pyritic coal. Dull coal with 2 1/2 in. bright coal at base. Pyritic.
	C	12	Very dull coal. Inferior.
	B	44	Dull coal; occasional bright streaks. Pyritic.
	A	5)3)11	Bright coal. Pyritic. Dull coal; occasional bright streaks. Pyritic.
		3)	Bright coal. Pyritic.
3	S.22 -	13	Dull, shaly coal, bright at top. <u>Not sampled.</u>
	F	4)7	Dull coal.) Inferior.
	E	3)9	Bright coal.)
	D	10	Dull, inferior coal. Dull, inferior coal streaked with bright coal in middle.
	C	26	Dull, brittle coal; occasional bright streaks.
	B	27	Dull, blocky coal; occasional bright streaks.
	A	5)	Bright coal.
		4)12	Dull coal.
	3)	Bright coal.	

4.....S.23E /

Sample Position.	F.R.I. Sample Number	Width (ins.)	Description of Subsection.
4	S.23 E	6) 9	Dull coal.
		3) 9	Bright, pyritic coal.
	D	8) 14	Dull inferior coal.
	C	6) 13	Mixed coal.
	B	42	Dull, inferior coal.
	A	7) 12	Dull coal; occasional bright streaks. Very bright coal.
5	S.24 E	5) 12	Mixed coal.
	D	6) 14	Dull, inferior coal.
	C	5) 12	Mixed, mainly bright coal.
	B	12	Dull, inferior coal.
		46	Dull coal streaked with bright coal.
	A	5) 10	Bright coal.
6	S.25 E	3) 10	Dull coal.
		2) 10	Bright coal.
	D	6	Dull inferior coal, streaked with bright coal.
	C	2	Shaly coal. <u>Not sampled.</u>
	B	29	Mainly dull coal.
	A	25) 10	Dull coal, occasional bright streaks. Very bright coal.
7	S.26 F	4) 7	Dull coal.
	E	3) 9	Bright coal. Very pyritic.
	D	15	Dull, inferior coal.
	C	31	Dull, shaly coal; occasional bright streaks, pyritic.
	B	17	Dull coal with 2" in. bright coal at base.
	A	5) 12	Dull coal; occasional bright streaks. Very bright coal.
8	S.27 G	7) 12	Mixed coal.
	F	5) 7	Dull coal.
	E	12) 7	Bright, pyritic coal.
	D	9	Dull, inferior coal.
	C	7	Dull, very pyritic coal; occasional bright streaks.
	B	11	Dull, inferior coal.
9	S.28 F	22) 27	Dull, pyritic coal; occasional bright streaks.
	C	27	Dull coal; occasional bright streaks.
	B	5) 27	Dull coal; occasional bright streaks. Very bright coal.
	A	3) 11	Mixed coal.
		3) 11	Bright, pyritic coal.
		5) 7	Dull coal.
9	S.28 F	2) 7	Bright, pyritic coal.
	E	2) 7	Dull, inferior coal.
	D	9	Dull, inferior coal.
	C	15	Mainly dull, inferior coal; 1 in. shale layer at base.
	B	22) 27	Dull coal; occasional bright coal streaks and pyritic nodules.
	A	5) 11	Very bright coal. Mixed coal.
	2) 11	Very bright coal.	

10...S.29 E.../

Sample Position.	P.R.I. Sample Number.	Width (ins.)	Description of Subsection.
10	S.29 E	4) 7	Dull coal
	D	3) 7	Bright coal.
	C	10	Dull, inferior coal.
	B	19	Dull inferior coal; 5 in. of mixed coal at top.
	A	47	Mainly dull coal; occasional bright streaks.
		6	Bright coal.

ANALYSES OF UNDERGROUND FACE SAMPLES.

Sub. Section	Width ins.	Prox. H ₂ O %	Analysis (% on air-dried coal)			Cal.Val. lbs/lb.	Crucible Swelling Index
			Ash %	Vol.Matter. %	Fix.Carbon %		
S.20 E	6	3.9	23.9	26.0	46.2	10.1	P
D	8	-	29.6	-	-	-	-
C	22	3.6	25.6	25.2	45.6	9.9	P
B	40	3.9	17.0	24.4	54.7	11.4	P
A	13	3.7	13.2	30.5	52.6	12.3	lag
A + B calc'd.	53	3.9	16.1	25.9	54.1	11.6	-
A to E calc'd.	89	-	20.4	-	-	-	-
S.21 E	7	3.7	20.1	25.3	50.9	10.6	P
D	13	3.7	25.8	22.6	47.9	9.7	P
C	12	-	36.0	-	-	-	-
B	44	3.9	17.4	24.7	54.0	11.2	P
A	11	3.7	11.3	32.3	52.7	12.4	lag
A + B calc'd.	55	3.9	16.2	26.1	53.8	11.4	-
A to E calc'd.	87	-	21.1	-	-	-	-
S.22 F	7	-	28.1	-	-	-	-
E	9	-	31.9	-	-	-	-
D	10	-	33.3	-	-	-	-
C	26	3.2	21.1	21.9	53.8	10.7	P
B	27	3.4	17.6	24.5	54.5	11.4	P
A	12	3.5	13.4	30.8	52.3	12.2	lag
A to C calc'd.	65	3.3	18.3	24.5	53.9	11.3	-
A to F calc'd.	91	-	22.3	-	-	-	-

ANALYSES OF UNDERGROUND FACE SAMPLES (continued)

Sub. Section.	Width ins.	Prox. Analysis (% on air-dried coal)				Cal.Val. lbs/lb.	Crucible Swelling Index	
		H ₂ O %	Ash %	Vol.Matter. %	Fix.Carbon %			
S.23	E	9	3.5	25.8	24.4	46.3	9.7	P
	D	14	3.3	29.4	21.8	45.5	9.1	P
	C	13	-	33.9	-	-	-	-
	B	42	3.8	17.2	23.3	55.7	11.3	P
	A	12	3.5	16.9	28.4	51.2	11.5	1Ag
A + B calc'd.	54	3.7	17.1	24.4	54.8	11.3	-	
A to E calc'd.	90	-	22.6	-	-	-	-	
S.24	E	6 ¹ / ₂	-	33.3	-	-	-	-
	D	5 ¹ / ₂	3.6	22.2	25.5	48.7	10.3	P
	C	12	-	34.5	-	-	-	-
	B	46	3.9	16.7	24.4	55.0	11.3	P
	A	10	3.8	10.8	32.0	53.4	12.6	1Ag
A + B calc'd.	56	3.9	15.7	25.7	54.7	11.5	-	
A to E calc'd.	80	-	20.9	-	-	-	-	
S.25	E	6	-	31.2	-	-	-	-
	D	29	3.8	26.3	20.9	49.0	9.6	P
	C	25	3.8	23.9	21.6	50.7	10.2	P
	B	25	3.8	19.1	23.1	54.0	11.1	P
	A	10	4.2	9.2	30.9	55.7	12.8	1Ag
A to C calc'd.	60	3.9	19.7	23.6	52.8	11.0	-	
A to E calc'd.	95	-	22.6	-	-	-	-	
S.26	F	7	4.3	22.5	22.8	50.4	10.3	P
	E	9	4.1	27.1	18.2	50.6	9.4	P
	D	15	-	31.7	-	-	-	-
	C	31	3.9	19.3	23.1	53.7	10.9	P
	B	17	4.0	15.2	24.7	56.1	11.7	P
	A	12	3.9	10.9	30.6	54.6	12.6	1Ag
A to C calc'd.	60	3.9	16.6	25.0	54.5	11.4	-	
A to F calc'd.	91	-	20.9	-	-	-	-	

ANALYSES OF COMPOSITE SAMPLES S.115 AND S.116.

S.115 - Comprises subsections A, the bright bottom portions of the seam at each sampling point combined in proportion to the width sampled.

S.116 - Comprises subsections B at sampling points 1,2,4, 5 and 10 together with subsections B + C at points 3,6,7,8 and 9 also combined in proportion to widths sampled.

WASHING TESTS (Minus 16 B.S.mesh coal)

Cumulative floats at	Yield per cent		Ash Content per cent		Crucible Swelling Index	
	S.115	S.116	S.115	S.116	S.115	S.116
Sp. Gr. 1.30	0.4	N11	-	-	-	-
Sp. Gr. 1.40	61.6	15.9	5.2	6.1	1½ Ag.	1 Ag.
Sp. Gr. 1.50	88.3	61.9	8.8	9.5	1½ Ag.	P
Sp. Gr. 1.58	93.9	81.8	10.4	12.3	P	P

PROXIMATE ANALYSIS, SULPHUR AND CALORIFIC VALUE.
(Per cent on air-dried coal)

	S.115		S.116	
	Original Coal	Float Coal at S.G.1.58	Original Coal	Float Coal at S.G.1.58
Moisture	3.9	2.9	4.0	3.7
Ash	12.0	10.4	17.8	12.3
Vol.Matter.(less H ₂ O.)	30.7	30.8	23.3	24.0
Fixed Carbon	53.4	55.9	54.9	60.0
Total Sulphur	2.10	0.71	1.50	0.45
Calorific Value lbs/lb.	12.4	12.7	11.2	12.3

Fusion Point of Ash...

FUSION POINT OF ASH.

	S.115		S.116	
	Original Coal.	Floated Coal at S.G.1.58	Original Coal.	Floated Coal at S.G.1.58
Initial Deformation Temp. °C.	1245	1260	1235	1235
Softening Temp. °C.	1250	1285	1245	1245
Fluid Temperature °C.	1260	1295	1250	1250

ULTIMATE ANALYSIS.

(Per cent on coal floated at S.G.1.58)

	S.115	S.116
<u>Air-dried Coal:</u>		
Moisture	3.4	3.7
Ash	10.4	12.2
Carbon	69.9	69.3
Hydrogen	4.4	4.0
Nitrogen	1.7	1.7
Total Sulphur	0.7	0.5
Difference (oxygen and errors)	9.5	8.6
<u>Calculated to dry, ash-free coal:</u>		
Carbon	81.1	82.4
Hydrogen	5.1	4.8
Nitrogen	2.0	2.0
Total Sulphur	0.8	0.6
Difference (oxygen and errors).	11.0	10.2

Proximate Analyses.... /

PROXIMATE ANALYSES, CALORIFIC VALUES AND SCREENING TESTS
ON COMMERCIAL GRADES.

Samples taken 13/1/1949.*

Air-dried Coal (%)	Cob- bles.	Nuts.	Peas.	Duff.	Size (sq. mesh) in.	Nuts.	Peas.	Duff
H ₂ O.	3.9	3.8	3.6	3.9	+ 1 1/4	26.7	-	-
Ash.	20.2	22.8	23.7	22.9	1 1/4 - 3/4	47.8	-	-
Vol. Matter (less H ₂ O)	23.7	22.7	22.5	23.1	3/4 - 1/2	17.4	10.4	-
Fix. Carbon	52.2	50.7	50.2	50.1	1/2 - 3/8	3.2	31.4	-
					3/8 - 3/16	2.2	41.8	17.4
					3/16 - 1/16	0.9	8.9	30.9
					- 1/16	1.8	7.5	51.7
Cal. Val. lbs/lb.	10.7	10.4	10.2	10.1	Total :	100.0		

Samples taken 27/1/1949.*

H ₂ O.	4.4	4.1	3.6	3.6	+ 1 1/4	26.5	-	-
Ash.	19.6	22.7	22.4	22.4	1 1/4 - 3/4	56.3	1.2	-
Vol. Matter (less H ₂ O)	23.8	22.9	22.7	23.6	3/4 - 1/2	12.3	47.8	-
Fix. Carbon	52.2	50.3	51.3	50.4	1/2 - 3/8	2.0	33.7	0.6
					3/8 - 3/16	1.4	13.7	18.1
					3/16 - 1/16	0.5	2.4	27.0
					- 1/16	1.0	1.2	54.3
Cal. Val. lbs/lb.	10.7	10.4	10.5	10.3	Total :	100.0		

Samples taken 3/2/1949.*

H ₂ O.	3.4	3.3	3.3	3.4	+ 1 1/4	29.5	-	0.2
Ash.	19.6	24.0	24.7	23.4	1 1/4 - 3/4	54.4	1.1	0.5
Vol. Matter (less H ₂ O)	24.0	22.8	22.6	22.2	3/4 - 1/2	10.7	26.0	0.3
Fix. Carbon	53.0	49.9	49.4	51.0	1/2 - 3/8	2.0	48.9	2.2
					3/8 - 3/16	1.6	18.8	35.2
					3/16 - 1/16	0.7	2.6	33.4
					- 1/16	1.1	2.6	28.2
Cal. Val. lbs/lb.	10.9	10.3	10.1	10.3	Total :	100.0		

ANALYSIS OF COMPOSITE COMMERCIAL SAMPLES PREPARED BY
COMBINING EQUAL AMOUNTS OF INDIVIDUAL GRADES.

	Cobbles	Nuts	Peas	Duff
Ash. (calculated) per cent.	19.8	23.2	23.6	22.9
Total Sulphur per cent	1.09	0.76	0.95	0.81
Cal. Val. (calculated) lbs/lb.	10.8	10.4	10.3	10.2
Fusion Point of Ash °C	1300	1350	1350	1320

* Sampled according to S.A. Standard Specification S.A.No.13 of 1937 "Standard Methods for the Sampling of Coal in South Africa."

CONCLUSIONS:

As stated at the beginning of the report, the seam maintains a very constant structure throughout the mine and, to a large extent, this uniformity is also reflected in the analytical results.

The inferior dull coal, roughly 3 ft. in height, comprising the top part of the seam, is consistently poor in quality and invariably attains a mean ash content approaching 30% or over, whereas the middle and lower dull coal, which not infrequently contains bright coal, rarely exceeds 20 per cent; in fact, a normal figure for this section would vary between 15 and 18 per cent ash content. When this lower figure is exceeded it is entirely due to an increase in the mineral matter content of the top layers of this part of the seam.

The bright coal layer at the base provides the cleanest part of the seam; it may be as low as 9.2 per cent in ash content and as high as 12.8 lbs. per lb. in calorific value. Although moderately high in volatile matter it is, however, almost devoid of coking propensities. Unfortunately this high quality is not maintained throughout the mine and the ash content may increase to almost 17 per cent with a consequent decrease in calorific value to 11.5 lbs. per lb. A significant part of this high ash may result from an increase in the pyrites content of the bright coal which is invariably higher in sulphur content than the dull coal.

The usual height of the seam from roof to floor is from 7 to 8 feet and normally this is completely extracted during mining. If the output is not processed in any way then the average analysis of the run-of-mine coal, calculated from the subsections, should be of the order - ash content 21.3 per cent and calorific value 10.5 lbs. per lb. Corroboration of these

figures..../

figures is provided by the actual analysis figures of the commercial samples which vary according to grade from 19.8 to 23.6 per cent ash content and from 10.2 to 10.8 lbs/lb. calorific value, indicating the poor quality of the No. 4 seam in this locality.

Selective mining of the superior parts of the seam, viz., the bottom bright together with the middle dull coal, would yield a much improved product and it should be possible to market a run-of-mine coal approximating to 16.6 per cent ash and 11.4 lbs/lb calorific value from which rounds and cobbles grades approximating 15 to 16 per cent ash content could probably be separated by screening. Such a course of procedure would entail a reduction in mining height from an average of 7 ft. 6 in. to 4 ft. 10 in., a discard of nearly 36 per cent but, in any case much of this inferior roof coal must be picked out in any efficient system of handpicking and, being of high density (specific gravity of 1.63 or more), would most certainly be discarded or returned to middlings if washing were contemplated.

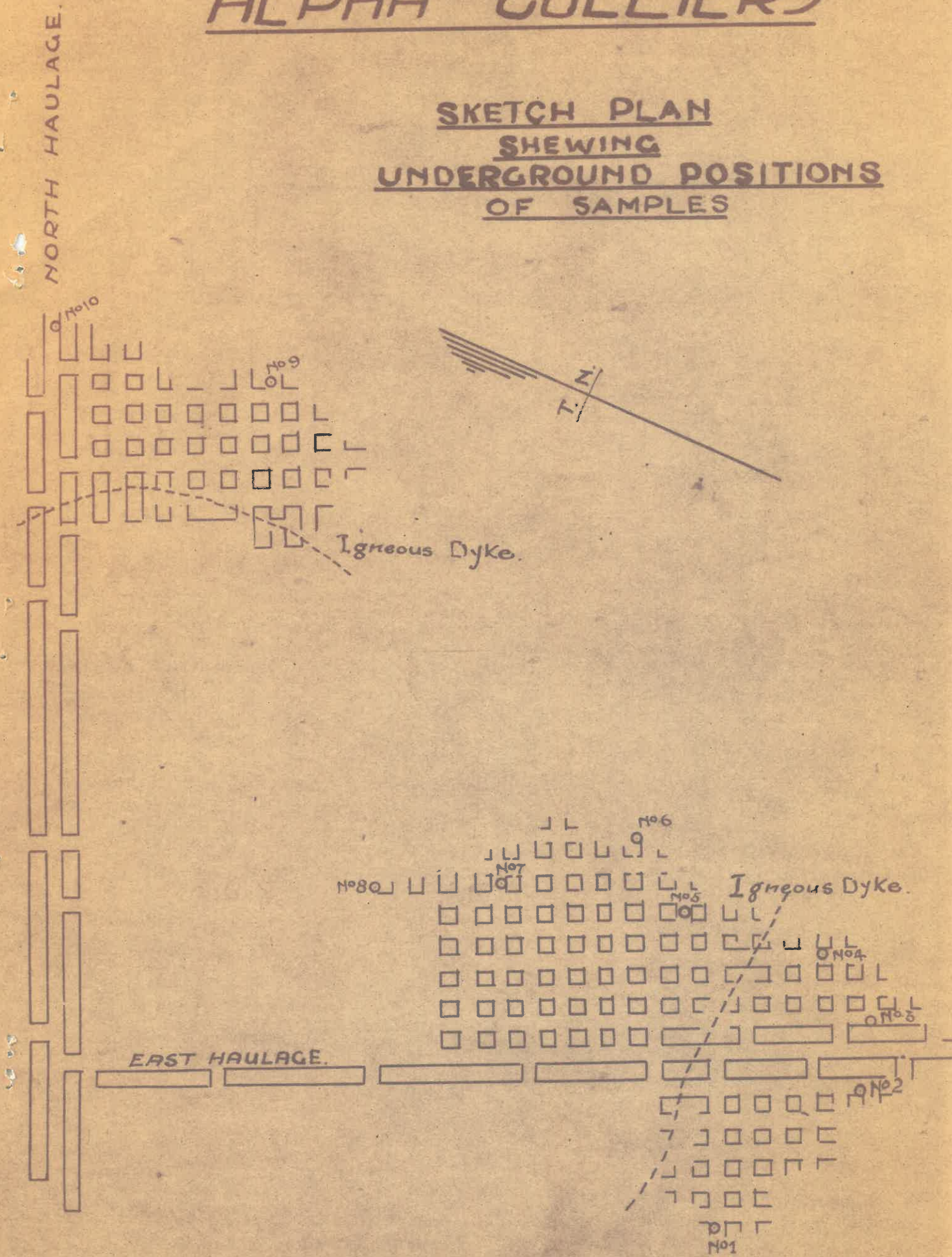
The nominal screen sizes of the smaller grades, particularly the peas, were found to vary considerably, but the qualities of these grades are so much alike that no differences in chemical analysis can be detected.

PRETORIA:

APRIL, 1949.

ALPHA COLLIERY

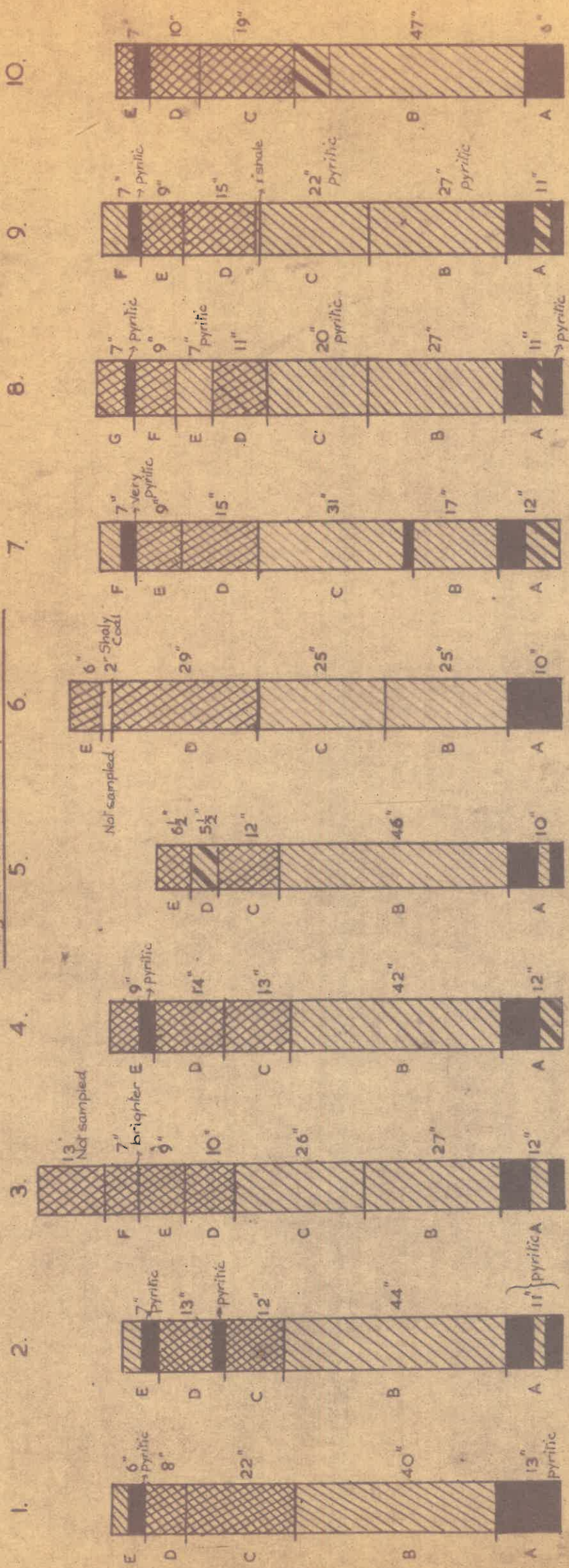
SKETCH PLAN SHOWING UNDERGROUND POSITIONS OF SAMPLES



Plan

NO.4 SEAM - ALPHA COLLIERY - WITBANK -

Diagrammatic Representation.



BRIGHT COAL.
 DULL & MAINLY DULL COAL.
 MIXED BRIGHT & DULL COAL.
 INFERIOR, GENERALLY DULL COAL. (>25% Ash Content.)
 SHALE & SHALY COAL.

Sample Nos. according to Site Plan.