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22/1/65

WUI/B/115

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 22 OF 1965.

REMARKS ON DYKE EFFECT ON A COAL SEAM (IN BRITAIN)

BY:

W.H.D. SAVAGE.

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REMARKS ON DYKE EFFECT ON A COAL SEAM.

The data on which these remarks are based are contained in a paper to the International Conference on Coal Science 1965 by J.B. Caldwell, Scottish Division, N.C.B. and entitled "Origin and Development of Coal Rank". (Library reference:- P.662:62)

In the above paper analyses of samples taken in the Wilsontown main seam, Riddochhill Colliery at sixty-nine five foot intervals from a large vertical dyke (thickness about 89 ft.) are given. The analyses comprise specific gravity; proximate analysis, mineral matter, sulphur and carbon dioxide on the air-dry basis; dry ash free calorific value and volatile matter; dry mineral matter free volatile matter; Grey-King coke types from sample 47' to sample 69; and swelling numbers from sample 47 to sample 54.

All of the properties measured can be affected by igneous intrusions, most of them directly, and the mineral components due to infiltration of waterborne minerals with deposition in the seam and possibly, near the dyke contact, of contamination with dyke material or country rock. It is unfortunate that ultimate analyses were not available, as the elementary composition of the coal substance is also affected, and interesting results may have been obtained in the high moisture zone from place 12 onwards.

Our South African coals are often affected by igneous intrusions, and I have considerable experience in assessing this effect, mainly from borehole samples where the analyses usually done are proximate analysis, calorific value and sometimes swelling numbers. Although the effects of the intrusions are not always what would be expected in degree and rate of change of effect with distance, the changes in coal properties are fairly logical in themselves. The first signs of coal being affected are a reduction in the moisture content and an increase in dry ash-free calorific value (this latter effect may not appear quite as early as the moisture effect) followed by a decrease in volatile matter content. Changes in swelling properties are usually not predictable. (Thus a coal with normally

32% air-dry volatile matter and  $2\frac{1}{2}$  swelling number may either have a higher (up to 5) or lower (down to 0) swelling number on a reduction in air-dry volatile matter to about 27%.) Also as the effects are usually found in borehole samples, and the various samples consist of coals with widely differing petrographic composition, the effects cannot be precisely evaluated, especially as the normal unaffected coal is not available for comparison - the approximate analysis of such normal coal must be estimated.

For these reasons the analytical data in this paper are very welcome. They comprise analyses on the same coal at a large number of equal intervals from a single igneous intrusion and the effects of the dyke on various properties can be easily seen.

Accepting that the analyses of the most distant sampling points are normal for unaffected coal, the effects of the intrusion on the various properties will be discussed. In this discussion only the values given in the table will be considered and not what might be the normal variation in the unaffected coal beyond place 69.

(A) Coking Properties.

As already stated, data are only available from sample 47, presumably because at points nearer the dyke these properties are very feebly developed or absent.

The coke type increases from B to G from place 47 to place 55, is then F with two D values to place 63, and subsequently is D or C. Thus from place 54 to 63 there would appear to be a slight enhancement of coking properties over normal unaffected coal.

Only 8 consecutive swelling numbers are available, the values increasing from 1 to 5 with the last two values 4 and  $4\frac{1}{2}$ . The series is too short to show anything except the fairly rapid increase in swelling properties.

(B) Mineral Matter including CO<sub>2</sub> and S.

The ash content as such does not merit any discussion, as mineral matter itself is also given, and CO<sub>2</sub> and thus carbonates vary within very large limits. It is not known how the mineral matter was derived (it could have been determined by the Radmacher method, calculated from CO<sub>2</sub> and assumed pyritic sulphur taking an assumed composition

of ...../



of the carbonates, or calculated from a general formula of the K.M.C. type), so the accuracy of these data is not known. It will be assumed that the values are reasonably accurate.

Mineral matter varies between wide limits from 38.1% at place 1 to 4.2% at place 67. Generally the higher values are associated with increased CO<sub>2</sub> and S contents, and an attempt was made to divide the mineral matter into clay minerals, carbonates and pyrites. In this calculation which was limited to samples with 10% or more mineral matter, carbonates were assumed to consist only of CaCO<sub>3</sub> and pyrite was taken as (S - 0.5) x approximately 2. The data are given in Table 2 below:-

TABLE 2.

<u>Sample No.</u>	<u>CaCO<sub>3</sub></u>	<u>FeS<sub>2</sub></u>	<u>Clay Minerals</u>	<u>Σ</u>
1	25.7	0	12.4	38.1
2	15.9	1.3	7.2	24.4
3	8.4	1.2	15.2	24.8
4	11.5	2.4	11.1	25.0
5	11.0	1.9	8.8	21.7
6	0.8	0.8	8.4	10.0
7	8.8	1.8	7.0	17.6
8	4.4	0.7	9.0	16.1
9	7.3	1.2	8.8	17.3
10	4.6	0.8	8.7	14.1
11	1.8	1.1	9.8	12.7
12	8.6	2.1	10.2	20.9
13	1.3	1.0	9.3	11.6
14	0.4	1.3	12.4	14.1
15	0.6	0.8	11.1	12.5
16	1.8	1.0	7.6	10.4
17	0.3	1.5	9.6	11.4
18	1.3	2.0	10.0	13.3
19	0.3	3.5	7.1	10.9
20	1.1	2.0	7.5	10.6
21	3.5	1.8	7.3	11.6
22	2.6	2.7	11.1	16.4
23	0.9	2.8	7.2	10.9
24	0.6	2.7	9.8	13.1
25	3.0	2.7	8.4	14.1
26	4.1	4.0	8.7	15.8
27	4.7	3.1	7.0	14.8
28	4.9	3.7	9.5	18.1
29	7.1	3.6	8.6	19.3
30	7.3	4.7	10.5	22.5
31	3.0	1.8	10.7	15.5
32	8.3	3.8	9.2	21.3
33	4.6	2.6	9.3	16.5
34	2.1	1.2	8.1	11.4
35	0.6	1.5	13.3	15.4
41	0.3	1.2	8.6	10.1
49	1.1	1.3	7.8	10.2
50 to 69	0.2	0.4	4.9	5.5

In the last line of Table 2 are given average data for samples 50 to 69, where mineral matter, sulphur and carbon dioxide are consistently low.

Although ...../

Although the total mineral matter exceeds 20% in a fair number of cases, the estimated clay minerals (and there is no claim that these estimates are accurate) are ~~less~~ than twice the average of samples 50 to 69 only in samples 18 (10.0%), 12 (10.2%), 30 (10.5%), 31 (10.7%), 4, 15 and 22 (11.1%), 1 and 14 (12.4%) 35 (13.3%), and 3 (15.2%). Although no definite pattern exists, the clay minerals tend to be highest at places 1 to 4, 11 to 18 and 28 to 35.

As there is not a very large variation in clay minerals, it is not surprising that there is a fairly close similarity between the variation of total mineral matter and CO<sub>2</sub> and to a lesser extent between these two and sulphur content. Thus mineral matter and CO<sub>2</sub> both tend to decrease from sample 1 to sample 12, to remain low to sample 20, and to be fairly high up to sample 35, with low values thereafter. In samples 44 to 49 the CO<sub>2</sub> is relatively high but the absolute values are still fairly low at 0.5% to 0.7%. Sulphur is very low in sample 1, of medium but irregular values to sample 21, high in samples 22 to 33, again medium - but a bit lower - from sample 34 to 52, and low thereafter.

(C) Specific Gravity, Moisture, Volatile Matter, and Calorific Value.

These properties are all directly dependent on the effects of the intrusion and tend to be interrelated. The specific gravity is however dependent on both the effect of the intrusion and on the amount and type of mineral matter present. In order to determine the effect of the intrusion the effect of the mineral matter must be eliminated. An approximation to this elimination was done by assuming that the mineral matter had a constant specific gravity of 2.5. This assumption is not valid as high concentrations of carbonate and pyrite will tend to increase the specific gravity above 2.5, and where these minerals are low the specific gravity may well be below 2.5. The formula used was:-

$$\text{S.G. of pure coal} = \frac{(\text{determined S.G.} \times 100) - (2.5 \times \text{air-dry MM})}{100 - \text{air-dry MM}}$$

In fact the percentage of mineral matter on the dry basis should have been used, but as this has little

effect ...../

effect (causing a reduction of 0.00 to 0.02 units for different samples) and as the assumption of 2.5 for the specific gravity of the mineral matter probably causes larger errors especially at high mineral matter contents, the above simple formula was used.

The moisture content was used as such. It would probably have been better to use the mineral matter free moisture content, but this would not change the values unduly.

The volatile matter comparison was done on the dry mineral matter free basis which is given in Table 1.

The calorific values in Table 1 are given on the dry ash-free basis. Due mainly to the high concentrations of CO<sub>2</sub> these give a distorted picture of the pure coal calorific value, and these values were converted to the dry mineral matter free basis using the following formula:-

$$\text{Calorific Value (d mm/)} = \text{C.V. d.a.f.} \times \frac{100 - (\text{Ash} + \text{M})^*}{100 - (\text{MM} + \text{M})}$$

The variations of these four properties will be discussed individually in the first instance and then their interrelations will be discussed. The values are presented graphically in Figure 1, the broken curves indicating the normally expected behaviour.

### 1. Specific gravity.

Samples 1 to 5 show wide fluctuations but tend to increase from rather more than 1.2 to nearly 1.5. The value drops from this point to 1.34 at sample 12, increases sharply at sample 13 and remains at about 1.5 to sample 20 (peaking at sample 17). The specific gravity falls fairly steadily to sample 30, varies irregularly to sample 37 but remains virtually below 1.3, drops to 1.24 at sample 41, and shows very little subsequent variation. In this latter portion of the series only selected values were calculated, but these were chosen to include the probable maximum and minimum values.

### 2. Volatile Matter.

From sample 1 to sample 4, volatiles drop from 15.5% to 6.6%, then increase erratically to 10.0% at sample 12. A rapid drop then takes place to a minimum of 2.2% at

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sample ..... /

\* M = moisture  
MM = mineral matter

sample 15. Volatiles then increase slightly irregularly and slowly to 11.9% at sample 36, more rapidly to 25.3% at sample 43, and again more slowly to a maximum of 36.1% at sample 58. Subsequent values remain high with a minimum of 34.6% at sample 69.

### 3. Moisture.

From sample 1 to sample 12 a zig-zag curve with three peaks and four troughs of fairly regular shape is evident, peak values being 2.4% to 2.9%, and trough values 1.1% to 1.3%. A very rapid rise to about 7% occurs over samples 13 and 14, and values of about 7% (with 8.8% at sample 19) persist to sample 20. Moisture drops to about 5% at sample 21, persists to sample 24, and then drops reasonably regularly to a secondary minimum of 2.6% at sample 33. The moisture content from sample 30 (before the minimum) to sample 54 shows fluctuations of about 0.5% and almost constant mean value of just over 3%, and then increases somewhat irregularly right to the end of the series where a secondary maximum of 6.7% is obtained for sample 69.

### 4. Calorific value.

Two very low values represent something outside my experience or are faulty, and possibly one or two other values are also incorrect. The curve in Figure 1 is very erratic, and it is not known in how far some of these changes are significant.

A fairly large increase occurs from sample 1 to sample 3, and values remain high to sample 12 with one discordant low value. A sudden drop then occurs and comparatively very low values (with one abnormally low value) apply until sample 20. The values then rise again with intermediate values at samples 21 to 25 (one abnormally low value) and thereafter remain high but somewhat variable to sample 49, when a sudden drop occurs. From sample 50 variation is small with a very slight tendency to decrease, this decrease possibly being below the level of significance.

### 5. Interrelations of 1 to 4.

Considering these four properties, and their variation with distance from the dyke, it becomes apparent that there are two areas of abnormal values. The first is concerned with samples 1 and 2 adjacent to the dyke. These are abnormally high in volatile matter and at the same time



low in calorific value, which appear to be contradictory; <sup>Co</sup> the moisture content can be tied up with the volatile matter, as can the specific gravity (although samples 3 and 4 are discordant here). The increase in volatile matter from sample 3 through sample 2 to sample 1 is difficult to explain on logical grounds, and I can offer no valid explanation of the data. From sample 3 to sample 12 all the properties are reasonably consistent (but the periodicity of moisture variation, and the low specific gravity of sample 3 are odd, as is the low calorific value of sample 6) and can be considered as normal effects of igneous intrusions. From sample 13 to sample 20 the coal is again abnormal, although this is an abnormality that has often been encountered in South African coals. In this area the volatiles are sharply reduced, the moisture contents are abnormally high, and calorific values are low; the specific gravities are also at a maximum. The tendency towards abnormality continues beyond sample 20. Thus calorific values remain abnormally low until sample 25 (or possibly 29), the moistures remain high until sample 29, and specific gravities high till possibly sample 28. It is difficult to estimate where the volatiles regain normality, but this point may be as early as sample 29 or as late as sample 36. This state of abnormality I have considered as being due to "oxidation" (not necessarily due to free oxygen, but taking place while temperatures are still abnormally high due to the intrusion) or to "weathering" (oxidation by percolating water after the coal has cooled down and occurring at any time up to the present) from my personal experience and from some references in the literature. The effect of such oxidation is to reduce the hydrogen content and increase the oxygen content of the coal as well as its porosity, thus leading to abnormally low volatiles and calorific values and abnormally high moistures and specific gravity. From about sample 30, when all the evidence of abnormal behaviour can be said to have disappeared, the volatile matter increases to normal unaffected values at about sample 55, and the calorific value decreases to normal at sample 50. The moisture content is still increasing at sample 69, and more distant samples would be necessary to say when normality had been reached, but it seems unlikely that this could be before sample 60. The specific gravity reaches normal values at about sample 40 or 41, but specific gravity cannot be used as a measure of the onset of the

effects ...../



effects of intrusions as significant increases in specific gravity only appear when coal reaches the lean coal or semi-anthracitic stage.

The series of samples thus shows many interesting points. For this coal and these conditions, it would appear that a reduction in moisture content is the first indication of the effects of intrusion, followed by incipient reduction in volatile matter, and that the increase in calorific value occurs only where the volatiles have already been significantly if not markedly reduced. As mentioned earlier, my experience has been that moisture and calorific value changes occur first and more or less simultaneously, with significant volatile matter changes appearing somewhat later, but due to more uncertainty as to what can be taken as significant changes in volatile matter than in the other two properties, my picture may be clouded. The onset of what I call "oxidation" at about sample 28 and its built up to a maximum at samples 20 to 14 and sudden disappearance at sample 12 with the reappearance of normal "burning" is a copybook illustration of a possibly rather rare - and certainly seldom discussed in the literature - phenomenon. Finally the peculiar (and to me unexplainable) change in properties, and especially the increase in volatile matter and decrease in calorific value, from sample 3 to sample 1 is very interesting.

(D) Coal Properties and Mineral Matter.

Beyond sample 35 the changes in total mineral matter, CO<sub>2</sub> and sulphur (as an indication of pyrites) are of a minor nature, and merit no further discussion.

The fairly high concentration of total mineral matter and CO<sub>2</sub> and the highest sulphur contents ruling in the area of samples 35 to 21 is rather surprising in view of its relatively large distance from the dyke as regards possible opening up (by cracks etc.,) of either the coal or the adjacent strata, compared with the relatively low mineral matter, CO<sub>2</sub> and sulphur contents that apply to the highly "oxidised" zone of samples 20 to 12. The increase (irregular) in mineral matter and CO<sub>2</sub> as the dyke is more nearly approached can be regarded as normal, although there is no evidence of any increase in pyrites content.

APPLICATION TO SOUTH AFRICAN OCCURRENCES.

A similar type of investigation could be conducted

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in South African coalfields. There are probably many places in Natal where the effects of thin dykes can be studied. It is not known if any suitable location for sampling near thick dykes (say 40 ft. or more in thickness) is present in Natal, but it should be possible to study the effect of the Ogie's dyke on the Witbank No. 2 Seam and possibly also on the No. 4 and No. 5 Seams. Utrecht Colliery - provided the workings are still open - may be a suitable mine to study the effect of a thick overlying dolerite sill which has a varying effect on the coal due to its tendency to dip towards the coal seam towards the east.

Two difficulties in sampling may be encountered. Firstly the coal, particularly near the dyke may not be exposed due to the necessity for adequate support. Secondly the coal if exposed, may be weathered due to long exposure, and deep trenches may have to be made to reach unweathered coal.

A further point in sampling is that most seams differ considerably in appearance (and thus in petrographic composition and properties) over the height of the seam. A persistent band of coal (or more than one) which is consistently bright or dull should be chosen. Samples should be of adequate size (possibly about 10 lb. but not less than 4 lb. in weight) for all the analyses that are planned.

The intervals between samples are obviously dependent on the thickness of the dyke. It is felt that sampling should be more intense nearer the dyke than far away. The first sample should be taken as near the dyke as possible. The frequency of sampling could be influenced by the distance of the colliery from Pretoria. Thus at Witbank it may be preferable to sample at fairly wide intervals, and if it is found desirable to have more samples a return visit may be made to the Colliery; in Natal it would be preferable to sample intensively and in the first instance possibly analyse only alternate samples. Certain practical limits are imposed on the intensity of sampling. The samples should be taken over as small a horizontal distance (from the dyke) as possible, so that the ratio between width (horizontal) sampled and intervals between samples is as small as possible. This limitation applies particularly to relatively thin dykes where samples of necessity must be taken fairly close together. A possible sample spacing would be 5 over the first half dyke

width ...../

width, 7 over the next dyke width, 10 over the next two dyke widths, with 3 or 4 more samples at intervals of one dyke width.

A wide variety of analyses could be done. As, however, most of the properties should be compared on the pure coal basis as many of the analyses as possible should be done on demineralised coal. Demineralisation could be done by the Radmacher method or more simply by float and sink separation. The latter technique should only be applied to bright coal bands where the floats (25% to 50% yield should be aimed at) may well have a more consistent petrographic composition than the raw coals. It is felt that float and sink reduction of mineral matter for dull bands may cause a less consistent petrographic composition in the floats than is present in the raw coal. Raw coal analyses could be limited to proximate analysis, sulphur and carbon dioxide determinations. On the demineralised coal the same analyses could be done (possibly just testing for CO<sub>2</sub> with acid\*) with in addition specific gravity, calorific value, ultimate analysis (mineral sulphur may or may not be included) and electrical conductivity tests. Other possible tests that may be done are petrographic composition and microhardness, perhaps also specific surface and porosity.

\*Floated coal only.

W.H.D. SAVAGE  
CHIEF OF DIVISION.

11th June, 1965.  
PRETORIA.









Figure 1.

Variation of properties with distance from dyke.

## SAMPLES OF HEAT ALTERED C

Sample No.*	Specific Gravity		Air-Dried Analysis				
	Calc. to m.m.f.	Determined	Inherent Moisture %	Volatile Matter %	Fixed Carbon %	Ash %	Mineral Matter % <i>mineral</i>
1	1.27	1.74	1.2	20.8	50.9	27.1	38.1
2	1.21	1.52	1.6	16.3	65.0	17.1	24.3
3	1.40	1.67	2.4	11.0	66.8	19.8	24.8
4	1.23	1.53	1.3	11.1	68.8	18.8	25.0
5	1.40	1.64	1.1	12.0	70.8	16.1	21.7
6	1.48	1.58	2.7	7.2	81.4	8.7	10.0
7	1.47	1.65	1.9	10.5	70.6	13.0	17.6
8	1.45	1.60	1.2	9.4	78.0	11.4	14.1
9	1.39	1.58	1.8	10.1	74.8	13.3	17.3
10	1.43	1.58	2.9	10.7	75.1	11.3	14.1
11	1.43	1.57	1.6	8.6	79.0	10.8	12.7
12	1.34	1.58	1.3	12.7	70.0	16.0	20.9
13	1.48	1.60	4.5	6.2	79.3	10.0	11.6
14	1.49	1.63	6.9	4.7	76.0	12.4	14.1
15	1.51	1.63	6.8	3.5	78.7	11.0	12.5
16	1.51	1.61	6.8	4.2	80.2	8.8	10.4
17	1.54	1.65	7.0	4.8	78.2	10.0	11.4
18	1.52	1.65	6.8	5.7	76.2	11.3	13.3
19	1.48	1.59	8.8	6.8	75.4	9.0	10.9
20	1.47	1.58	7.1	5.8	78.2	8.9	10.6
21	1.39	1.53	5.1	6.3	78.9	9.7	12.6
22	1.38	1.56	5.2	6.8	74.5	13.5	16.3
23	1.45	1.56	5.4	6.5	79.1	9.0	10.9
24	1.38	1.53	5.5	7.9	75.5	11.1	13.1
25	1.38	1.54	4.5	7.0	77.2	11.3	14.1
26	1.35	1.54	4.5	8.8	73.5	13.2	16.8
27	1.41	1.57	4.1	8.3	76.2	11.4	14.8
28	1.33	1.54	3.7	9.3	72.8	14.2	18.1
29	1.29	1.52	4.2	11.3	69.9	14.6	19.3
30	1.25	1.53	3.2	12.2	67.4	17.2	22.5
31	1.30	1.49	3.0	10.3	73.9	12.8	15.5
32	1.19	1.47	2.7	13.5	67.8	16.0	21.3
33	1.24	1.45	2.6	11.4	73.5	12.5	16.5
34	1.31	1.45	3.5	11.1	75.9	9.5	11.4
35	1.19	1.39	2.9	11.1	72.5	13.5	15.4
36	1.29	1.38	3.0	11.6	78.6	6.8	7.8
37	1.29	1.37	3.6	13.3	77.0	6.1	6.9
38	1.29	1.35	3.5	14.9	77.0	4.6	5.2
39	1.28	1.36	2.9	15.0	76.6	5.5	6.2
40	1.26	1.34	3.3	16.4	74.6	5.7	6.5
41	1.24	1.37	3.5	17.4	70.3	8.8	10.1
42	1.24	1.35	3.2	18.4	70.9	7.5	8.5
43		1.33	3.0	23.9	67.6	5.5	6.5
44		1.31	3.3	23.6	67.7	5.4	6.6
45	1.22	1.31	3.5	25.3	64.8	6.4	7.3
46		1.33	3.1	26.6	63.3	7.0	8.4
47		1.33	3.2	27.1	62.8	6.9	8.2
48		1.34	3.7	26.6	62.7	7.0	8.4
49	1.22	1.35	3.5	26.4	61.4	8.7	10.2
50	1.22	1.28	3.1	30.1	62.8	4.0	4.6
51		1.30	3.2	28.9	63.3	4.6	5.5
52	1.24	1.35	3.5	29.7	60.8	6.0	6.8

\* Samples taken at 5 foot intervals along the mine.



BLE 1.  
 ILL COLLIERY.  
 COAL FROM WILSONTOWN MAIN SEAM.

Total Sulphur (%) %	Carbon Dioxide %	Cal.Val. cal/gm		Volatile Matter %		Swelling No.	G-K Coke Type
		d.a.f.	d.m.m.f.* M/h	d.a.f.	d.m.m.f.		
0.37	11.31	7,000	8,323 34.65	29.0	15.5	-	-
1.17	7.01	7,680	8,426 35.29	20.1	12.3	-	-
1.12	3.70	8,005	8,555 35.8	14.1	7.8	-	-
1.70	5.04	7,880	8,543 35.77	13.9	6.6	-	-
1.44	4.82	8,010	8,591 35.47	14.5	8.3	-	-
0.93	0.35	8,100	8,221 34.42	8.1	6.6	-	-
1.42	3.87	7,950	8,404 35.14	13.0	7.3	-	-
0.86	1.95	8,220	8,482 35.51	10.8	7.7	-	-
1.09	3.20	8,090	8,490 35.55	11.9	7.4	-	-
0.90	2.03	8,260	8,559 35.84	12.5	9.4	-	-
1.04	0.77	8,250	8,432 35.30	9.8	7.7	-	-
1.55	3.80	8,000	8,504 35.61	15.4	10.0	-	-
0.98	0.59	8,080	8,234 34.48	7.3	5.2	-	-
1.16	0.16	7,960	8,131 34.04	5.8	3.7	-	-
0.93	0.25	8,030	8,179 34.25	4.3	2.2	-	-
0.98	0.77	7,970	8,124 34.02	5.0	3.0	-	-
1.26	0.13	7,720	7,852 32.57	5.8	4.0	-	-
1.49	0.57	7,960	8,159 34.16	7.0	4.6	-	-
2.25	0.11	7,900	8,087 33.76	8.3	6.5	-	-
1.48	0.50	8,000	8,165 34.19	6.9	5.0	-	-
1.43	1.56	8,080	8,365 35.02	7.4	4.6	-	-
1.84	1.13	8,040	8,327 34.87	8.4	5.1	-	-
1.90	0.38	7,650	7,824 32.76	7.6	5.7	-	-
1.86	0.27	8,100	8,299 34.75	9.5	7.4	-	-
1.86	1.30	8,110	8,389 35.12	8.3	5.4	-	-
2.47	1.80	8,130	8,502 35.00	10.7	7.0	-	-
2.06	2.06	8,160	8,502 35.60	9.8	6.3	-	-
2.37	2.15	8,160	8,459 35.62	11.3	7.2	-	-
2.30	3.12	7,900	8,385 35.11	13.9	9.0	-	-
2.86	3.22	8,050	8,624 36.11	15.3	9.8	-	-
1.42	1.32	8,180	8,451 35.38	12.2	9.3	-	-
2.42	3.66	8,070	8,633 36.05	16.6	11.2	-	-
1.83	2.01	8,240	8,647 36.20	13.4	10.0	-	-
1.12	0.92	8,400	8,588 35.96	12.8	10.7	-	-
1.26	0.25	8,270	8,462 35.43	13.3	11.0	-	-
0.96	0.13	8,380	8,474 35.48	12.9	11.9	-	-
0.85	0.11	8,430	8,505 35.61	14.7	13.9	-	-
0.82	0.06	8,320	8,375 35.07	16.2	15.6	-	-
0.80	0.06	8,440	8,533 35.73	16.4	15.6	-	-
0.90	0.08	8,430	8,505 35.61	18.0	17.3	-	-
1.13	0.14	8,360	8,486 35.53	19.8	18.6	-	-
0.93	0.05	8,390	8,485 35.53	20.6	19.6	-	-
1.18	0.20	8,460	8,553 35.81	26.1	25.3	-	-
0.85	0.70	8,520	8,633 36.15	25.9	24.9	-	-
0.89	0.16	8,440	8,525 35.69	28.1	27.1	-	-
0.99	0.61	8,170	8,299 34.75	29.6	28.5	-	-
0.98	0.53	8,360	8,483 35.72	30.1	29.1	1	B
1.10	0.56	8,340	8,473 35.68	29.8	28.7	1	B
1.15	0.50	8,360	8,505 35.81	30.0	28.7	1	B
0.80	0.16	8,330	8,384 35.10	32.4	31.9	3	B
1.07	0.21	8,310	8,392 35.14	31.4	30.8	3	C
0.83	0.06	8,310	8,384 35.10	32.8	32.1	5	D

*Little difference in heat*

TABLE 1

Sample No.	Specific Gravity		Air-Dried Analysis				
	Calc. to m.m.f.	Determined	Inherent Moisture %	Volatile Matter %	Fixed Carbon %	Ash %	Mineral Matter %
53	1.20	1.26	3.7	30.3	62.2	3.8	4.3
54	1.24	1.31	3.4	31.5	60.4	4.7	5.3
55		1.30	4.1	32.1	59.4	4.4	4.9
56		1.32	4.8	32.0	57.8	5.4	6.1
57		1.31	5.0	32.1	58.0	4.9	5.6
58	1.24	1.32	4.6	33.0	57.1	5.3	6.0
59		1.31	5.0	32.5	57.4	5.1	5.7
60		1.30	5.5	32.4	57.2	4.9	5.5
61		1.31	5.9	31.9	57.5	4.7	5.2
62		1.31	5.4	32.7	56.8	5.1	5.7
63		1.32	5.8	32.2	56.3	5.7	6.4
64	1.23	1.30	5.6	32.7	56.6	5.1	5.7
65		1.31	6.1	32.2	57.1	4.6	5.2
66		1.32	6.4	32.2	55.6	5.8	6.5
67	1.26	1.31	6.1	31.7	58.4	3.8	4.2
68		1.32	6.1	31.6	57.0	5.3	5.9
69	1.24	1.30	6.7	31.2	57.6	4.5	5.1

(CONTINUED)

Total Sulphur %	Carbon Dioxide %	Cal.Val. cal/gm		Volatile Matter %		Swelling No.	G-K Coke Type
		d.a.f.	d.m.m.f.*	d.a.f.	d.m.m.f.		
0.69	0.08	8,330	8,375	32.7	32.3	4	D
0.70	0.05	8,320	8,375	34.2	33.7	4½	F
0.59	0.05	8,310	8,356	35.1	34.6	-	G
0.80	0.07	8,320	8,385	35.6	35.0	-	F
0.83	0.08	8,270	8,335	35.6	35.1	-	F
0.72	0.09	8,260	8,325	36.6	36.1	-	F
0.64	0.09	8,320	8,376	36.2	35.6	-	D
0.69	0.06	8,300	8,356	36.2	35.6	-	D
0.66	0.06	8,270	8,317	35.7	35.1	-	F
0.72	0.05	8,310	8,366	36.5	36.0	-	F
0.75	0.10	8,220	8,286	36.4	35.7	-	F
0.64	0.06	8,230	8,286	36.6	36.1	-	D
0.70	0.06	8,300	8,356	36.1	35.6	-	C
0.77	0.06	8,270	8,336	36.7	36.0	-	C
0.64	0.06	8,300	8,337	35.2	34.7	-	D
0.72	0.05	8,290	8,357	35.7	35.1	-	D
0.74	0.06	8,280	8,356	35.1	34.6	-	C