F.R.I. 47.

VERSLAG No. 1 REPORT No. 1

VAN 1954 OF 1954

BRANDSTOFNAVORSINGSINSTITUUT

VAN SUID-AFRIKA.

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

ONDERWERP:
SUBJECT: SEGREGATION AND BREAKAGE OF PEA-DUFF COAL DURING HANDLING (SUMMARY).

AFDELING:
DIVISION: ENGINEERING

NAAM VAN AMPTENAAR:
NAME OF OFFICER: J. M. v.d. MERWE.

W.P.—12068—13/11/53.

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

REPORT NO. 1 OF 1954.

SEGREGATION AND BREAKAGE OF PEA-DUFF COAL DURING HANDLING (SUMMARY).

INTRODUCTION:

The degree of size segregation and degradation occuring during the handling of pea coal from the time of its production at the colliery until unloaded at a Power Station was examined in F.R.I. Report No. 13 of 1953. A similar test was later carried out on pea-duff coal and the results are summarised in the present report.

TESTING PROCEDURE:

Pea-duff coal containing some 21 % -¼" material was produced at Wolvekrans Colliery on the 8th July 1953 and was loaded into the bin described in Report No. 13 of 1953.

The bin was empty at the commencement of the test and was filled with about 500 tons of the test coal. Twelve DZ type trucks were then loaded from the bin, six each from the Northern and Southern outlets.

The twelve trucks were transported to Pretoria Power Station where they were unloaded and the contents were used for combustion tests.

Points at which samples were taken of the test consignment are indicated diagrammatically in Fig. 1. The sampling procedure adopted at each point is described below.

Sampling Point A/.....

Sampling Point A (Feed to the bin at the Colliery).

Increments, each weighing approximately 30 lb. were taken from the end of the feed conveyor at intervals of 5 minutes during the period required to fill the bin. Three increments representing "Quarter Hourly" samples were combined and each of these samples was screened separately. The various size fractions constituting each sample were recombined and the ash content of each sample was determined.

The ash content of each sample together with the proportion of -¼" material is reported in Table 1. The average screen analysis of the coal entering the bin is reported in Table 2.

Sampling Point B. (Immediately below the discharge doors of the bin).

Using special sampling devices, twenty increments were taken during the loading of each truck, increments being taken at regular tonnage intervals. Each increment weighed approximately 100 lb. and was screened separately.

The average screen analysis of the coal entering each truck is shown in Table 3.

Sampling Point C. (Truck top samples taken at the Colliery).

Using the standard procedure, forty increments of 2 lb. each were taken from the top of the coal in each of the 6 trucks loaded from the Southern outlet of the bin. Increments from each truck were combined and the resultant samples were screened with the results presented in Table 4.

Sampling Point D. (Truck top samples taken at the Power Station).

On arrival at Pretoria Power Station, Truck Top samples were again obtained from the 6 trucks previously sampled at the

Colliery/.....

Colliery. The screen analyses of these samples are reported in Table 5.

Sampling Point E. (Contents of trucks on arrival at the Power Station).

The six trucks filled from the Southern outlet were carefully unloaded by hand in 4 horizontal layers. During this operation, four increments were taken in each of twenty vertical planes parallel to the short sides of the truck and at three levels in the truck. The 12 increments obtained in each vertical plane were combined yielding 20 samples per truck, and each sample was separately screened.

The average screen analysis of the 20 samples representing each truck is reported in Table 6.

In the case of sampling Points B,C, D and E all size fractions obtained from the samples of a particular truck were recombined to form a single sample representing the contents of that truck and the resultant samples were used for ash analysis with the results reported in Table 7.

DISCUSSION:

(a) Breakage during handling.

Table 2 shows that the 500 ton consignment of coal entering the bin at the colliery contained an average of 20.8 % of -¼" material, while the same coal contained 23.4 % of -¼" material as it entered the trucks (Table 3). This increase of 2.2 % in -¼" material is ascribed to breakage of the coal while filling the bin.

Similarly Table 3 shows that the coal entering the 6 trucks loaded from the Southern outlet averaged 23 % of -¼" material, while the same coal contained 27.4 % of this size fraction

when/.....

when unloaded at the Power Station (Table 6). The indications are, therefore, that a further 4.4 % of -¼" coal was produced during loading and transportation. While the latter increase in duff content is surprisingly high, the value of the overall increase in fines during handling (i.e. about 6.6 %) agrees very well with that previously found for pea coal.

(b) Segregation.

Variation in the proportion of -¼" material in the coal entering and leaving the colliery bin is shown diagrammatically in Fig. 2. It will be observed that the -¼" fraction in the coal entering the bin tended to increase while the bin was being filled. On discharging the bin, however, the highest proportion of -¼" material was obtained in the first few trucks loaded and it then steadily decreased thereafter. At first sight this may be surprising since one would expect the coal which entered the bin first to be discharged first. The phenomena noted are probably due to segregation of sizes during loading into the bin.

In the previous test on pea coal, the coal discharged from the Southern outlet of the bin contained a significantly greater proportion of duff than the coal from the Northern outlet. This was ascribed to size segregation on the conveyor belt system. In the present test, however, there is negligible difference between the size distribution of the coal discharged from the two outlets (see Table 3 and Fig. 2).

(c) Sampling of a consignment of Pea-duff.

The ash and duff contents of the 6 trucks as sampled at various stages during handling and transportation are shown in Table 7.

From the point of view of size distribution, the truck top samples can only be compared with the samples taken during unloading (i.e. the coal actually in the truck). It will be noted that the average duff content as determined from the truck top samples agrees reasonably well with that obtained from the more thorough sampling procedure adopted during unloading. The latter method, however, indicates a substantially lower ash content for the six trucks than is obtained from the truck top samples. The average ash content of the profile samples (E) agrees with that obtained for the samples taken during loading of the trucks (B) and with the average ash content of the coal entering the bin (Table 1). It is therefore concluded that these sampling methods are more reliable than the truck top method.

It will be noted in Table 7 (sampling point E) that the ash and duff content of the coal is liable to vary appreciably from truck to truck. If reliable data relating to a consignment of coal are to be obtained it will therefore be desirable to sample a large number of trucks.

CONCLUSIONS:

(a) Storing, loading and transportation of pea-duff coal is liable to give rise to some 6 or 7 % additional duff.

(b) Truck top samples appear to be unreliable and are liable to yield too high a value of the ash content.

(Sgd.) J. M. v.d. MERWE
SENIOR TECHNICAL OFFICER.

PRETORIA.

19th January, 1954.

TABLE 1.

ASH AND DUFF CONTENTS OF QUARTER HOURLY SAMPLES TAKEN AT SAMPLING POINT A.

Sampling Point A. No. of Quarter Hourly Samples	% Ash.	% -¼"
1.	11.3	20.8
2.	11.7	16.6
3.	11.7	19.0
4.	12.1	19.1
5.	11.2	20.0
6.	12.1	20.3
7.	12.1	23.6
8.	12.2	23.4
9.	12.3	20.7
10.	12.0	19.8
11.	11.7	20.0
12.	11.5	22.4
13.	11.8	24.3
Average	11.8 %	20.8 %

TABLE 2.

SAMPLING POINT A.

AVERAGE SCREEN ANALYSIS OF COAL ENTERING THE BIN AT THE COLLIERY.

Screen Size, square	Yield %
+1"	3.4
-1" + ¾"	21.8
-¾" + ½"	27.4
-½" + ¼"	26.6
-¼" + ⅛"	6.9
-⅛" + 1/16"	6.1
-1/16"	7.8
Total -¼"	20.8

TABLE 3/.....

TABLE 3.

SAMPLING POINT B.

SAMPLES TAKEN AT MINE BUNKER-OUTLET WITH THE SPECIAL SAMPLER.

Truck No.	Southern Bunker Outlet. 1.	3.	5.	7.	9.	11.	Average over 6 trucks
Screen Size.							
+1"	2.2	1.8	2.7	2.1	2.6	3.1	2.4
-1" + ¾"	13.9	13.9	17.2	18.5	20.2	24.0	18.0
-¾" + ½"	24.7	23.7	26.5	26.3	29.0	29.8	26.7
-½" + ¼"	36.4	33.8	28.8	28.9	27.8	23.8	29.9
-¼" + 1/8"	9.4	9.1	8.0	8.0	6.3	6.0	7.8
-⅛" + 1/16"	7.5	8.2	7.3	7.4	6.0	5.3	7.0
-1/16"	6.3	9.5	8.5	8.8	8.1	8.0	8.2
TOTAL -¼"	23.2	26.8	23.8	24.2	20.4	19.3	23.0

Truck No.	Northern Bunker Outlet. 2	4	6	8	10	12	Average over 6 trucks
Screen Size.							
+ 1"	2.2	2.1	2.7	2.6	2.7	3.8	2.7
-1" + ¾"	14.7	15.0	19.3	20.3	20.7	24.5	19.1
-¾" + ½"	24.3	25.0	27.4	27.3	27.7	29.0	26.8
-½" + ¼"	31.9	29.8	26.4	26.0	27.2	24.3	27.6
-¼" + ⅛"	9.1	8.7	7.1	7.4	7.0	5.8	7.5
-⅛" + 1/16"	8.0	8.4	7.5	7.0	6.1	5.5	7.1
-1/16"	9.7	11.0	9.6	9.4	8.6	7.1	9.2
TOTAL -¼"	26.8	28.1	24.2	23.8	21.7	18.4	23.8

TABLE 3 (CONTD.)/...

TABLE 3 (CONTD.)

Average over 12 trucks (i.e. whole consignment)

Screen Size.	
+1"	2.6
-1" + ¾"	18.5
-¾" + ½"	26.7
-½" + ¼"	28.8
-¼" + ⅛"	7.7
-⅛" + 1/16"	7.0
-1/16"	8.7
TOTAL -¼"	23.4

TABLE 4.

SAMPLING POINT C.

TRUCK TOP SAMPLES TAKEN AT COLLIERY.

Truck No.	1.	3.	5.	7.	9.	11.	Average over 6 trucks.
Screen Size.							
+ 1"	0.8	1.5	2.1	1.8	2.3	2.5	1.8
-1" + ¾"	9.8	12.7	15.3	13.8	18.5	20.9	15.2
-¾" + ½"	23.8	22.9	25.5	24.2	29.4	26.2	25.3
-½" + ¼"	37.0	32.7	32.5	30.5	28.9	28.4	31.7
-¼" + ⅛"	11.8	9.5	8.5	8.7	7.0	8.1	8.9
-⅛" + 1/16"	8.1	8.7	7.6	9.0	6.2	6.7	7.7
- 1/16"	8.7	12.0	8.5	12.0	7.7	7.2	9.4
TOTAL -¼"	28.6	30.2	24.6	29.7	20.9	22.0	26.0

TABLE 5/.....

TABLE 5.

SAMPLING POINT D.

TRUCK TOP SAMPLES TAKEN AT POWER STATION.

Truck No.	1	3	5	7	9	11.	Average over 6 trucks
Screen Size.							
+ 1"	1.3	1.8	2.5	1.6	2.0	3.7	2.2
-1" + ¾"	13.1	14.6	17.0	13.7	16.9	23.3	16.4
-¾" + ½"	23.1	24.3	26.4	22.9	26.6	28.0	25.2
-½" + ¼"	36.8	32.7	32.4	31.0	29.7	27.2	31.6
-¼" + ⅛"	10.3	8.5	7.5	9.2	7.7	7.1	8.4
-⅛" + 1/16"	8.0	7.9	6.3	9.7	6.8	5.6	7.4
-1/16"	7.4	10.2	7.9	11.9	10.3	5.1	8.8
TOTAL -¼"	25.7	26.6	21.7	30.8	24.8	17.8	24.6

TABLE 6.

SAMPLING POINT E.

PROFILE SAMPLES TAKEN FROM TRUCKS AT POWER STATION.

Truck No.	1	3	5	7	9	11.	Average over 6 trucks
Screen Size.							
+ 1"	0.9	1.4	1.4	2.2	2.5	3.6	2.0
-1" + ¾"	9.9	11.8	15.1	17.0	19.0	20.9	15.6
-¾" + ½"	19.6	19.6	24.9	23.3	26.1	27.0	23.4
-½" + ¼"	37.2	34.5	31.3	28.7	28.7	28.0	31.6
-¼" + ⅛"	13.0	10.3	8.2	8.8	7.5	6.7	9.1
-⅛" + 1/16"	9.8	9.8	8.3	8.6	6.8	6.1	8.2
-1/16"	9.6	12.6	10.8	11.4	9.4	7.7	10.1
TOTAL -¼"	32.4	32.7	27.3	28.8	23.7	20.5	27.4

TABLE 7/.....

TABLE 7.

PERCENTAGE ASH AND -¼" CONTENT OF THE SAME TRUCKS SAMPLED AT DIFFERENT POINTS.

Sampling point.	B		C		D		E	
Truck No.	% Ash	% -¼"	% Ash	% -¼"	% Ash	% -¼"	% Ash	% -¼"
1	12.3	23.2	12.4	28.6	12.3	25.7	12.3	32.4
3	12.3	26.8	12.5	30.2	11.9	26.6	12.0	32.7
5	11.9	23.8	12.6	24.6	12.1	21.7	11.9	27.3
7	11.5	24.2	11.9	29.7	12.2	30.8	11.7	28.8
9	11.1	20.4	11.9	20.9	11.9	24.8	11.5	23.7
11	11.1	19.3	11.7	22.0	11.7	17.8	11.0	20.5
Average	11.7	23.0	12.2	26.0	12.0	24.6	11.7	27.4

SAMPLING POINTS

COLLIERY

POWER STATION

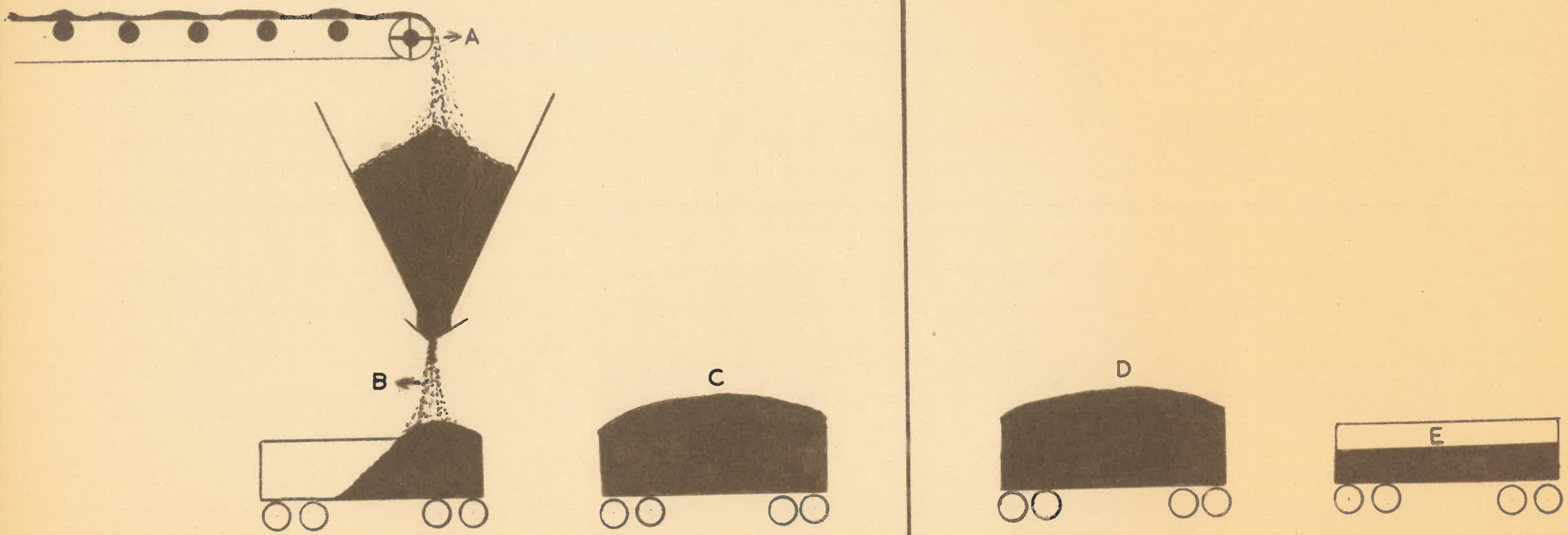

FIG. 1

VARIATION IN THE PROPORTION OF $\frac{1}{4}$" MATERIAL
IN COAL ENTERING AND LEAVING THE COAL BIN.

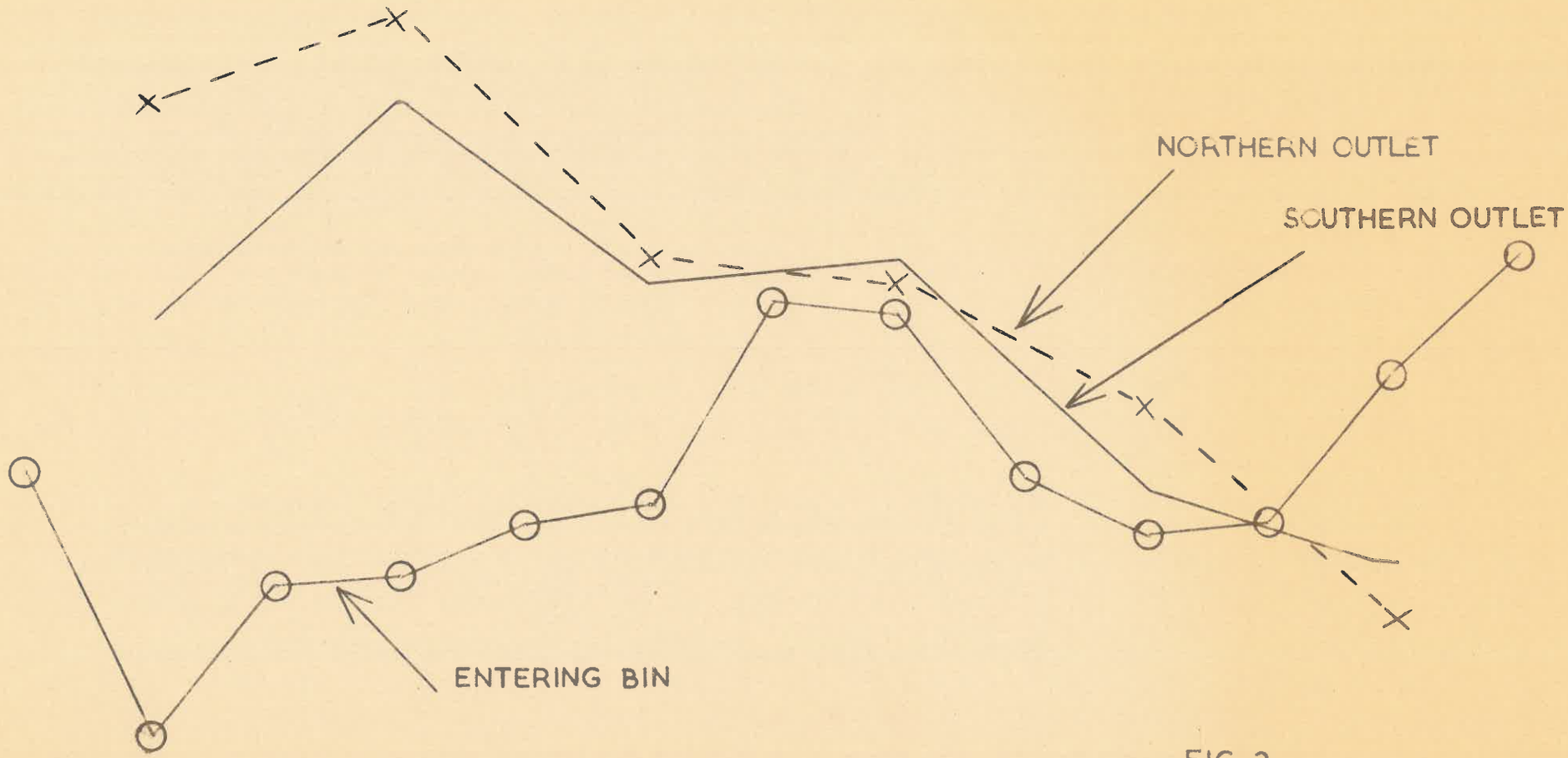

FIG. 2