REGULARITIES IN THE CHARACTERISTICS OF SOUTH AFRICAN DIAMONDS.

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In 1970 a study of the physical characteristics of diamonds was initiated. The project was undertaken to establish whether or not the diamonds from individual sources could be separated by observations of physical parameters.

Approximately 80 000 diamonds from various southern African localities were examined initially to formulate the classification scheme. A further 68 000 stones from the Premier, Finsch, Koffyfontein and Dreyers Pan mines were then classified.

The classification scheme is based primarily on the morphology of the diamond. Additional parameters such as colour, angularity and regularity allow further sub-division to be made. The classification scheme is outlined in Table 1.

TABLE 1.

DIAMOND CHARACTERISTICS CLASSIFICATION.

PRIMARY DIVISION:

CRYSTAL FORMS:	OTHERS:
Octahedra*: Dodecahedra*	Macles
Flattened Dodecahedra* : Cubes	Spheres
Tetrahedra : Cubo-Octahedra	Irregular Forms*
Octa-Dodecahedra : Cubo-Dodecahedra	Crystal Aggregates
Cubo-Octa-Dodecahedra	

SECONDARY DIVISIONS:

(i)	Transparency	Transparent Opaque	(v) Colour	Colourless Yellow
(ii)	Crystal Angularity	Planar Rounded		Brown Green Orange and Amber
(iii)	Crystal Regularity	Regular Distorted		Pink and Mauve Blue
(iv)	Inclusion Content	None Few (1 - 3) Many (> 3)		Black Multiple Colours Grey

SECONDARY DIVISIONS: (Continued)	
	(v) Colour Smokey
	(vi) Surface Feature
	Transparent Coats
	Opaque Coats
	Graphite Coats
	Frosting

* Macle shape divisions. In addition, "triangular macle" accounts for commonly depicted form.

Prior to examining the diamonds from each source they had been screened into various size ranges. From pilot studies it became apparent that diamond characteristics for a particular source varied with the size of the diamonds.

Hence sizes of diamonds must be taken into account when comparison from different sources is made. The size ranges used are shown in Table II.

TABLE II.

SIEVE CLASS*		APPROXIMATE AVERAGE SIZE (Carat Weight)
- 23	+ 21	5,00
- 21	+ 19	2,72
- 19	+ 17	1,70
- 17	+ 15	1,30
- 15	+ 13	0,88
- 13	+ 12	0,57
- 12	+ 11	0,39
- 11	+ 9	0,23
- 9	+ 7	0,14

* Diamond sieves with round aperture openings.

Tabulations of the more general and significant relationships which emerged from the study are shown below. Extremes of diamond sieve classes are chosen to illustrate difference between the various diamond sizes; no linear relationships necessarily exist between these extremes.

1. CRYSTAL FORMS:

The following table shows the percentage of the major crystal forms per mine for diamonds in the +9 -11 diamond sieve class and the +17 -19 sieve class.

TABLE III.

	FINSCH		PREMIER		KOFFY		DR. PAN.	
	+ 9 -11	+17 -19	+ 9 -11	+17 -19	+ 9 -11	+17 -19	+ 9 -11	+17 -19
Octahedra	11	18	6	5	6	16	16	38
Dodecahedra	27	25	20	17	26	19	61	23
Flat Dodecahedra	3	3	2	2	2	2	15	13
Macles	18	17	11	22	8	13	4	18
Irregular Forms	41	37	61	54	58	50	4	8

The table shows the predominance of irregular forms at Premier and Koffyfontein and the low percentage of irregular forms at Dreyers Pan. Differences exist for the percentages of Octahedra, Dodecahedra and Macles from the different mines. In general there is an increase in octahedra and macles with increasing stone size and a decrease in dodecahedra.

2. COLOUR.

The predominant colours of the percentage of diamonds from each mine is shown in Table IV.

TABLE IV.

	FINSCH		PREMIER		KOFFY.		DR. PAN.	
	+ 9 -11	+17 -19	+ 9 -11	+17 -19	+ 9 -11	+17 -19	+ 9 -11	+17 -19
Colourless	43	28	41	40	66	78	55	52
Yellow	7	18	4	10	9	8	17	10
Brown	40	26	48	28	13	4	6	3
Green	8	16	1	6	0	0	22	35
Grey and Black	2	12	6	16	12	10	0	0

The table shows significant colour differences between the mines. Typical for Koffyfontein is the high percentage of colourless stones and the virtual absence of green diamonds. Typical for Dreyers Pan is the high percentage of colourless and green diamonds and the low percentage of brown and black. At Finsch there is a higher percentage of yellow and green diamonds than at Premier. A further characteristic of the Premier Mine is the occurrence of blue diamonds.

3. COLOUR AS FUNCTION OF MINE AND FORM:

In Table V the percentages of diamonds are shown.

TABLE V.

	FINSCH					PREMIER					KOFFYFONTEIN					DREYERSPAN.				
	O	D	FD	M	I	O	D	FE	M	I	O	D	FD	M	I	O	D	FD	M	I
Colourless	32	34	36	38	30	34	32	46	53	41	90	79	69	77	67	64	51	56	66	74
Yellow	14	20	25	15	12	5	7	11	7	8	6	11	20	14	6	9	17	16	8	10
Brown	30	29	25	25	34	52	49	34	29	35	1	3	9	3	13	4	6	8	4	12
Green	22	13	13	16	8	3	4	6	4	3	-	-	-	-	-	23	26	20	22	3
Grey/Black	2	4	1	6	16	6	8	3	7	13	3	7	2	6	14	-	-	-	-	1

O = octahedra
D = dodecahedra
FD = flattened dodecahedra
M = macles
I = irregular forms.

Overall the macles class contain the largest proportion of colourless diamonds, although at Koffyfontein the percentage of colourless octahedra is very high. Flat dodecahedra show the highest proportion of yellow diamonds. In general the colour of diamonds appears to be predominantly related to the source, and relationships between form and colour are less evident.

4. There are small but significant differences between the sources and between different sizes in respect of transparency, angularity, regularity, number of inclusions, frosting, and coats.

As a result of these investigations an attempt is to be made to identify the source of diamonds from secondary deposits where the primary source is not known. Also is is likely that a structure will be provided which will enable other relationships to be quantitatively framed. For example relationships between morphology and physical properties such as crystal perfection, optical anisotropy and luminescence.