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BRANDSTOFNAVORSINGSINSTITUUT VAN SUID-AFRIKA

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

ONDERWERP: THE CARBONIZATION OF COAL AND THE PRODUCTION OF COKE,
SUBJECT:

CHAR, GAS, AND BY-PRODUCTS IN SOUTH AFRICA UP TO 1972.

AFDELING:
DIVISION:

NAAM VAN AMPTENAAR:
NAME OF OFFICER: E.F.E. MULLER

S U M M A R Y

The information in this report gives a reflection of the carbonization of coal and the production of metallurgical coke, gas coke, char, gas, and by-products in South Africa during the period 1915 to 1972.

Data prior to 1954 is relatively incomplete, but from 1954 onwards fairly detailed information is given.

THE CARBONIZATION OF COAL AND THE PRODUCTION OF COKE,
CHAR, GAS, AND BY-PRODUCTS IN SOUTH AFRICA UP TO 1972.

1. INTRODUCTION

In order to obtain an insight into developments in the field of the carbonization of coal in South Africa - by South Africa is meant the Union of South Africa (1910-1961) and from 1961 the Republic of South Africa - it was decided to compile sets of tables giving statistics on coal carbonized, coke produced and the dispersal of coke, by-products, and gas produced in South Africa.

Available records show that the Fuel Research Institute requested information from producers of coke, etc., from 1954 onwards. Summaries of this fairly detailed information will be found in the first four tables.

Data prior to 1954 were available from some publications and two theses. It was thus possible to collect some data going back to 1915, the year in which, it appears, metallurgical coke production was commenced in South Africa. Previously, any coke required had to be imported.

2. ACCUMULATION OF DATA

2.1. History

In 1946 the British Commonwealth Scientific Official Conference expressed the view that specialist conferences should be called at intervals to discuss in detail collaboration in certain fields.

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Following the World Power Conference held in London in July 1950, a specialist conference on fuel research was held in London during July 1950.

At this conference it was recommended that a Commonwealth Organization be formed in order to facilitate continued liaison and collaboration in fuel research. A Commonwealth Committee on Fuel Research (C.C.F.R.) was set up, consisting of the leaders of the delegations to the 1950 Specialist Conference.

It was also recommended that the field of fuel research be divided into broad divisions, that a chief co-ordinator be appointed in each division, and that this co-ordinator, in co-operation with specialists in the various countries, arrange for the preparation of reviews of his special subjects at appropriate intervals, possibly annually. In the reviews possibilities of mutual advice and assistance in experimental work were to be indicated.

The following subject divisions were initiated immediately.

- i) Sampling and chemical analysis.
- ii) Physical testing and petrographical work.
- iii) Brown coal.
- iv) Coal washing and preparation in general.
- v) Gasification (including underground gasification).
- vi) Synthetic liquid fuel.
- vii) Gas turbines for industrial use.
- viii) Carbonization and production of coke.

The Director of the Fuel Research Institute of South Africa was appointed Chief Co-ordinator of Section viii on carbonization and production of coke.

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To have a firm basis for research then in progress on the production of coke for metallurgical processes, it was desirable that specifications for cokes for use in blast furnaces and foundries throughout the Commonwealth should be made available.

In order to obtain data for compiling a report, the co-operation of all producers and consumers of coke in South Africa was sought. A circular dated 16th March, 1951, was distributed to interested parties, and later a similar circular dated 27th August, was sent to additional parties.

A further circular, dated 13th August, 1951, was distributed to gas manufacturers to acquire a clear broad picture of all aspects of carbonization of coal in South Africa.

Similar information was obtained from the correspondents in Commonwealth countries.

The First Review on the Carbonization and Production of Coke of the Commonwealth Committee on Fuel Research appeared in January, 1952, No. CC/FR/12.

The Second Review, No. CC/FR/27, appeared in April, 1953. Subsequent reviews dealt with developments during each calendar year and are titled as follows.

Commonwealth Committee on Fuel Research
Carbonization and the Production of Coke

Review of developments during 1953	CC/FR/30
Review of developments during 1954	CC/FR/38
Review of developments during 1955	CC/FR/47
Review of developments during 1956	CC/FR/55
Review of developments during 1957	CC/FR/60
Review of developments during 1958	CC/FR/69
Review of developments during 1959	CC/FR/71
Review of developments during 1960	CC/FR/76

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The Fuel Research Institute requested statistical information from producers for the first time in a questionnaire dated 3rd January, 1955. Details such as tonnages of coal carbonized, coke produced in various sizes, and dispersal of coke for the calendar year 1954 were requested. A summary of these statistics is given in CC/FR/38 for 1954.

Subsequently these details were requested annually. In addition, gas production and by-product production figures were requested from 1956 onwards.

With South Africa becoming a Republic on 31st May, 1961, and its exit from the Commonwealth, membership of Commonwealth Specialist Committees, including the Committee on Fuel Research, ceased. With this, the Review of Developments in Carbonization and Production of Coke was discontinued. However, annual questionnaires requesting details of carbonization, etc., continued to be distributed and the information was tabulated for statistical purposes. Summaries are generally requested for the United Nations Year Book, and by the Government Mining Engineer.

Up to 1968 these figures were compiled in large tables. From the 1969 statistics onwards it was decided to compile these in another form, as F.R.I. technical memoranda. As most of the information is confidential, these memoranda are also confidential. Certain of the summarising tables can, however, be made available to interested parties. To make the summary of coke production figures more readily available, these summaries are now included in the annual reports of the Fuel Research Board. The Forty-first Annual Report for the year ending 1971 contains the first of such tables, giving the figures for 1969 and 1970. The Annual Report for 1972 gives the figures for three years, viz. 1969, 1970, and 1971. In subsequent annual reports it is the intention to give figures for the previous three consecutive years.

2.2. Data prior to 1954

After completing the tables with data for the period 1954 to 1972, it was thought desirable to also have data available for the period prior to 1954. Fortunately it was possible to obtain a certain amount of data, even though incomplete, from the following sources:

1. Union of South Africa: Report of Coal Commission 1946-1947. U.G. No. 29-1948.
2. "An Economic Study of the Commercial Energy Requirements of South Africa with particular Reference to the Consumption of Coal and Petroleum."
William S.J. Grant.
A thesis presented to the University of Cape Town in fulfilment of the requirements for the Degree of Ph.D. 1959.
3. "Energiekonsumpsie in Suid-Afrika: Historiese Oorsig en Vooruitskatting."
D.J. Kotzé.
Proefskrif ingelewer vir die graad van Magister in Handelwetenskappe aan die Universiteit van Stellenbosch. 1967.
4. Official Year Books of the Union of South Africa
Nos. 1 - 30.

The data available from each of these sources are discussed below.

2.2.1. Report of Coal Commission 1946-47

A diagram, Figure 3, shows a graphic representation of coking coal consumed and coke produced for the 32-year period 1915 to 1946. This diagram is reproduced in this present report as Figure 1. In addition, values read off from this diagram are given as approximations in thousands of short tons in Table 5. The metric equivalents are also given.

Section F, paragraphs 47 to 57, deals with the production of coking coals. A table in paragraph 53, giving the consumption of coking coal in straight coking coals, blend coking coals, and totals for the 10-year period 1937 to 1946, is reproduced as Table 6.

In Section G, paragraphs 58 to 59, the production of metallurgical coke is discussed. Tables in this section give coke production figures for the 10-year period 1937 to 1946. Dispersal of coke for a 7-year period, 1940 to 1946, is also given.

Section H, paragraphs 70 to 80, deals with the production of gas coal. Figures for consumption of gas coal for the 10-year period 1937 to 1946 are also given. No gas-coke production figures are given and gas sales for two years only, 1937 and 1946, are given.

2.2.2. Grant Thesis

In Chapter 2, part 6, Grant discusses "Coking coal - metallurgical and industrial". Table 20 gives statistical figures for coal carbonized and coke produced for the 20-year period 1937 to 1956. His sources were the Coal Commission 1946-47 Report, Official Year Books of the Union of South Africa, and a letter from the F.R.I. For the period 1937

/to 1946

to 1946 the coke production figures agree with those given by the Coal Commission, but the figures for the amount of coal consumed do not. Grant must have arrived at his coal-consumed figures from another source.

In Chapter 2, part 4, municipal gas production is discussed, and Table 14 gives coal consumed for the period 1937 to 1956. The figures for the first ten years were derived from the Coal Commission Report and for the next ten years from correspondence with the gas companies.

2.2.3. Kotzé Thesis

In Table 3 of this thesis, Kotzé gives figures for coal consumed for coke production in column 4 for the years 1940 to 1965. In column 6, coal consumed for the production of gas is listed for the years 1937 to 1965. As the main source of this information, Kotzé refers to Grant's thesis.

2.2.4. Official Year Books

The Official Year Books give coke production figures from 1916 to 1955, with a gap for the period 1941-1944. Coal-consumed figures are given for the years 1924-1929, 1940 and 1945, but whether this includes coking coal used for other purposes is not certain.

Only for the years 1946 to 1955 are figures given for coal consumed in coke ovens, gas-works, and totals as well as for the coke produced in these instances.

Concerning by-products, details are also only given for the years 1946 to 1955 under the headings crude tar, benzol, gas from coke ovens, gas from gas-works, and total gas. Some details of by-products are also given for the years 1940 and 1945. Some gas figures are

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listed for the years 1924 to 1929. Tar sales figures for the years 1919 to 1938 are listed, but as this tar was mainly derived from special tar plants, these figures have been disregarded.

3. DESCRIPTION OF TABLES

3.1. Table 1: Type of coal carbonized (1954-1972)

The types of coal carbonized are given in thousands of metric tons (tonnes) and four types are listed:

- i) Transvaal non-coking coal, used mainly by gas-works and some charring plants.
- ii) Transvaal blend coking coal used in coke ovens and for char production. Up to 1969 this type of coal was also used in gas-works.
- iii) Natal coking coal. Up to 1962 some Natal coal was also used in gas-works. Otherwise it is used exclusively in metallurgical coke production.
- iv) Anthracite. During the years 1962 to 1965 anthracite was used as a blend coal in metallurgical coke production.

For the years 1954, 1955 and 1956 no detailed information was obtained and the proportions of Transvaal and Natal coals were, therefore, estimated.

Note that for this and all other tables the figures have been rounded off, with the result that totals do not necessarily agree.

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3.2. Table 2: Coal carbonized and yield of carbonized products

The coal carbonized and/or charred is divided into three groups, viz.:

- i) Metallurgical coke subdivided into coke from beehive ovens and coke from by-product retorts.
- ii) Gas coke, and
- iii) Char.

Quantities are given in thousands of tonnes.

3.3. Table 3: Dispersal of carbonized products

The dispersal of all carbonized products is listed under various categories, in thousands of tonnes.

3.4. Table 4: Quantities of by-products and gas produced

The quantities of the major by-products produced are listed in thousands of tonnes or thousands of cubic metres.

Gas is listed in millions of normal cubic metres - see appendix for notes on units and conversions.

Gas produced in gas-works is derived mainly from coal, but some oil is also carburetted. The quantity of oil used is also listed in this table. From 1966 a proportion of gas produced from the gasification of coal is also being sold in Johannesburg and on the Reef, mainly for industrial purposes. This quantity is included in the gas figures. Note, however, that the amount of coal gasified is not listed in any of the tables.

The gas produced from gas-works is used for domestic, commercial, and industrial purposes.

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The gas produced from coke ovens is used industrially by the producers.

Other gas produced from gasification is not listed. This gas is used by the producers, essentially for various synthesis purposes.

3.5. Table 5: Coking coal used and coke produced in South Africa during the period 1915 to 1946

This table has been compiled from a diagram, Figure 3 in the Report of the Coal Commission. Figures are listed in thousands of short tons and the metric equivalents are also given. The diagram is also reproduced as Figure 1.

3.6. Table 6: Consumption of coking coal in production of metallurgical coke

This table is a reproduction of a table in paragraph 53 of the Coal Commission Report. It covers the years 1937 to 1946, listing the straight coking coals, blend coking coals, and total coal consumed in the production of metallurgical coke. Metric equivalents are also given.

3.7. Table 7: Coal consumed in coke production, 1937-1972

This table lists information derived from various sources. It commences with 1937, as the only information found for the period prior to that year was that contained in the diagram of the Coal Commission Report (see Table 3).

The eight columns, listed under source headings, are:

/Column

- Column 1: Data from the Coal Commission diagram.
- Column 2: Data from the Coal Commission table in paragraph 53.
- Column 3: Data from Grant's Thesis.
- Column 4: Data from Kotzé's Thesis.
- Column 5: Data collected by F.R.I.
- Column 6: Data from Official Year Books.
- Column 7: This column consists of selected preferred figures from the other six columns.
- Column 8: The metric equivalents of the selected figures.

The data of the Fuel Research Institute, although already listed in Tables 1 and 2, are repeated for the sake of comparison and to illustrate growth.

3.8. Table 8, A and B: Coke produced

Table 8A gives coke production figures from 1915, when the first coke in South Africa was apparently produced, to 1936. The first column gives figures taken from the Coal Commission diagram and already listed in Table 5. The second column gives figures obtained from the Official Year Books.

Table 8B covers coke production from 1937 to 1972, derived from various sources:

- Column 1: Data from the Coal Commission Diagram.
- Column 2: Data from the Coal Commission table, paragraph 53.
- Column 3: Data from Grant's Thesis.
- Column 4: Data from S.A. Year Books.
- Column 5: Data collected by F.R.I.
- Column 6: Selected preferred figures in short tons $\times 10^3$.
- Column 7: The metric equivalents of the selected figures.

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Here again the F.R.I. data up to the latest available, i.e. for 1972, are included for comparison and growth illustration.

3.9. Table 9: Coal consumed by gas-works

This table lists data from four sources, and covers the period 1937 to 1972. No information was found for the period prior to 1937.

Column 1: Data from tables in the Coal Commission report.

Column 2: Data from Grant's Thesis.

Column 3: Data from S.A. Year Books.

Column 4: Data collected by F.R.I.

Column 5: Selected preferred figures.

Column 6: Selected preferred figures converted to metric units.

3.10. Table 10: Gas coke production

As far as the production of gas coke is concerned, the only figures available apart from data collected by the F.R.I., were found in the Official Year Books, and they cover the period 1946 to 1955. The figures from these two sources, as well as the metric equivalents, are listed.

3.11. Dispersal of metallurgical coke, 1940-1946

In the Coal Commission Report, paragraph 63, a table given for the years 1940 to 1946 indicates coke sales by Natal producers to various consumers. The first two columns indicate sales to Iscor and Amcor, who presumably used most of this coke in their blast furnaces. Paragraph 64 gives a breakdown of coke produced by Natal producers and Iscor for the years 1937 to 1946. Assuming that Iscor used most of their own coke for blast furnaces and adding this to the combined coke sales to Iscor and

/Amcor

Amcor, a fair figure for coke consumption in blast furnaces is obtained. This was done to compile table 11 from the two above-mentioned tables. The units in which the dispersal is given for the years 1940-1946 are in thousands of metric tons.

No other dispersal figure for coke were discovered.

3.12. Table 12: Quantities of by-products and gas produced

Regarding by-products of coke ovens and gas-works, very little information could be uncovered. Except for gas produced during 1937 and 1946 by gas-works mentioned in the Coal Commission Report, all other information was obtained from Official Year Books.

For the period 1924 to 1929, gas produced in gas-works is given.

For 1940 and 1945, the Year Books gave figures for crude tar, benzol, tar oils, and total gas (from coke ovens and gas-works).

From 1946 to 1955 the Year Books listed crude tar, benzol, coke oven gas, gas-works gas, and total gas.

These figures are given in Table 12A. Table 12B gives these figures in metric units.

3.13. Units

All units used in tables 1 to 4 are metric. Mass is expressed in metric tons or tonnes (1 short ton = 0,907185 tonne).

Volume is expressed in cubic metres (1 gal = 0,004546 m³).

Gas volumes are expressed in normal cubic metres, based on the normal temperature of 0°C and a pressure of 760 mm Hg (1013 m bar) dry, written as m_n³.

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Please note that the gas industry proposed a new unit of volume, the standard cubic metre, written as m_n^3 . This is based on a temperature of 15°C and 1013 m bar, dry. Note also that the old unit, the standard cubic foot (S.c.f.), was based on a temperature of 60°F, 30 in Hg, saturated. Some gas conversion factors are deemed necessary.

Volume:

$$1 \text{ S.c.f.} = 0,02639 m_n^3$$

$$1 m_n^3 = 37,89 \text{ S.c.f.}$$

$$1 m_s^3 = 1,055 m_n^3$$

Energy:

$$1 \text{ B.t.u./S.c.f.} = 0,040 \text{ MJ}/m_n^3$$

$$1 \text{ kcal} = 4,187 \times 10^{-3} \text{ MJ}$$

4. GRAPHIC ILLUSTRATIONS

In a statistical survey a few diagrams to complement the tables appear to be desirable, and therefore the following graphs have been prepared:

- 4.1. Figure 1: A reproduction of the diagram, Figure 3, from the Coal Commission 1946/1947 Report, showing the coking coal used in the production of coke in the Union of South Africa for the 32-year period 1915 to 1946. The units are in 100 000 short tons per annum.
- 4.2. Figure 2: A graph showing the increasing consumption of coal in the production of metallurgical coke from 1915 to 1972, a 58-year period, in millions of short tons, and in metric tons.

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- 4.3. Figure 3: This graph covers the 19-year period 1954 to 1972 for which the F.R.I. collected data, and shows the amount of coal carbonized, the metallurgical coke produced, and the amount of coke consumed in blast furnaces. Millions of metric tons are shown. (Tables 2 and 3.)
- 4.4. Figure 4: This graph shows the coal carbonized in beehive ovens and in by-product ovens, and the total coal. As can be seen, coal consumed by beehive ovens has remained fairly constant, especially over the last ten years, whereas coal carbonized in by-product ovens has steadily increased. Quantities are shown in millions of metric tons. (Table 2.)
- 4.5. Figure 5: ^{This is} An illustration of the quantities of Natal coking coal and Transvaal blend coking coal carbonized in the production of metallurgical coke, in millions of metric tons (See Table 1.)

(SIGNED) E.F.E. Müller
PRINCIPAL RESEARCH OFFICER

PRETORIA.

3/4/1974.

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TABLE 1

TYPE OF COAL CARBONIZED (TONNES X 10³)

Year	1954*	1955*	1956*	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Transvaal non-coking coal				3	20	22	151	289	255	273	278	300	271	271	308	354	363	366	356
Transvaal blend coking coal	860	920	995	1111	1371	1584	1753	1692	1663	1717	1766	1951	2073	2154	2138	2037	2110	2138	2196
Natal coking coal	1290	1319	1418	1489	1485	1516	1451	1659	1807	1862	1922	2730	2830	2879	2840	2898	2776	3094	3054
Natal anthracite									4	10	210	2	0,2			0,4			
Total Coal	2150	2239	2413	2603	2876	3122	3355	3640	3730	3863	4175	4983	5174	5304	5287	5290	5249	5598	5606

*Distribution estimated.

Note: Figures rounded off, so sums do not necessarily agree with totals given.

/TABLE 2

TABLE 2

COAL CARBONIZED AND YIELD OF CARBONIZED PRODUCTS (TONNES X 10³)

Year	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
<u>Metallurgical coke</u>										
<u>Beehive ovens</u>										
Coal carbonized	310	353	480	517	475	416	349	399	499	631
Coke yield	170	195	274	289	258	227	198	217	285	361
<u>By-product ovens</u>										
Coal carbonized	1700	1752	1749	1894	2207	2546	2717	2820	2808	2758
Coke yield	1220	1214	1213	1327	1551	1813	1917	1990	1977	1941
Total coal carbonized	2010	2105	2229	2411	2683	2961	3066	3219	3307	3389
Total met. coke yield	1390	1409	1487	1616	1808	2041	2116	2207	2262	2302
<u>Gas coke</u>										
Coal carbonized	140	134	147	148	147	127	137	118	152	163
Coke yield	102	97	96	97	93	88	83	79	103	104
<u>Char</u>										
Coal charred	-	-	37	43	47	34	152	304	270	310
Char yield	-	-	23	26	29	21	110	210	191	212
<u>Total</u>										
Coal carbonized	2150	2239	2413	2603	2876	3122	3355	3640	3730	3863
Carbonized products	1490	1506	1606	1739	1930	2150	2309	2495	2556	2618

Note: Figures rounded off, so sums do not necessarily agree with totals given.

/TABLE 2 Cont.

TABLE 2 (Cont.)

Year	1964	1965	1966	1967	1968	1969	1970	1971	1972
<u>Metallurgical coke</u>									
<u>Beehive ovens</u>									
Coal carbonized	595	651	639	619	590	582	557	679	633
Coke yield	372	421	391	417	410	416	428	408	391
<u>By-product ovens</u>									
Coal carbonized	3086	3784	3999	4149	4144	4212	4180	4395	4437
Coke yield	2179	2726	2906	3039	3030	3044	3035	3184	3212
Total coal carbonized	3681	4435	4638	4767	4734	4794	4737	5074	5070
Total met. coke yield	2551	3147	3297	3455	3440	3460	3463	3592	3603
<u>Gas coke</u>									
Coal carbonized	150	150	161	142	132	134	138	132	120
Coke yield	96	96	109	103	95	97	91	100	89
<u>Char</u>									
Coal charred	344	398	375	394	421	362	374	391	416
Char yield	241	267	249	260	279	249	247	259	275
<u>Total</u>									
Coal carbonized	4175	4983	5174	5304	5287	5290	5249	5598	5606
Carbonized products	2888	3510	3655	3818	3814	3806	3801	3951	3967

Note: Figures rounded off, so sums do not necessarily agree with totals given.

/TABLE 3

TABLE 3

DISPERSAL OF CARBONIZED PRODUCTS (TONNES X 10³)

Year	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Blast furnaces		1088	1101	1161	1303	1444	1585	1751	1779	1764
Other metal smelters				11					19	17
Foundries	No	21	31	48	66	37	48	50	48	58
Ferro-alloy			21	26		4	74	35	36	64
Carbide Manufacturers	de-	23	19	21	40	41	27	22	21	19
Other Engineering Industries	tails	157	59	34	44	35	41	32	33	22
Gas-works		39	39	37	36	93	32	30	42	49
Explosives and fertilizers		49	53	48		75	89	184	158	167
Other gas producers			59	70	66		46	32	37	1
Domestic consumers)										
Commercial consumers)		18	10	19	26	39	26	27	36	42
(Hotels, Clubs, etc.)										
Other consumers		69	138	129	174	114	93	125	124	168
Exported					2	2	12	8	13	3
Other requirements				16		98	107	109	88	86
Put to stock		4	2	8	53	176	135	106	119	170
Taken from stock		-58	-34	-10		-11	-30	-19	-6	-17
Breeze, dust dumped		95	107	119	131	1	23	3	7	14
Breeze, dust taken										
Total	1490	1506	1605	1739	1930	2149	2308	2495	2555	2619

Note: Figures have been rounded off, therefore sums do not necessarily agree with the totals given.

/TABLE 3 Cont.

TABLE 3 (Cont.)

Year	1964	1965	1966	1967	1968	1969	1970	1971	1972
Blast furnaces	2022	2587	2678	2551	2869	2832	2677	2747	2783
Other metal smelters	71	29	61	128	36	38	46	72	68
Foundries	91	100	66	72	105	96	74	116	125
Ferro-alloy	113	142	120	136	130	116	124	147	184
Carbide manufacturers	24	23	13	9					
Other engineering industries	21	21	76	33	75	110	164	28	29
Gas-works	42	43	45	38	37	34	29	32	25
Explosives and fertilizers	183	191	171	174	174	132	122	124	132
Other gas producers	3		7						
Domestic consumers)									
Commercial consumers)	31	36	16	27	25	11			
(Hotels, Clubs, etc.)									
Other consumers	136	214	101	160	95	88	153	195	160
Exported	1	1	2		6	66	72	28	48
Other requirements	97	131	145	139	371	380	164	141	196
Put to stock	59	70	129	215	12	75	135	293	236
Taken from stock	-45	-112	-37	-1	-30		-25	-11	-106
Breeze, dust dumped	39	34	62	136	114	72	66	40	84
Breeze, dust taken					-205	-243			
Total	2888	3510	3655	3819	3814	4049	3826	3952	3967

Note: Figures have been rounded off, therefore sums do not necessarily agree with the totals given.

/TABLE 4

TABLE 4

QUANTITIES OF BY-PRODUCTS AND GAS PRODUCED

Year	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Crude tar (tonnes x 10 ³)			79	84	100	113	126	124	132	136
Naphthalene (tonnes x 10 ³)	No				0,5	4	4	5	5	5
Pitch (tonnes x 10 ³)	details			2	8	32	7	10	1	3
Road tars (tonnes x 10 ³)				0,2	3	15	11	23	32	30
Tar oils and fuels (tonnes x 10 ³)					0,1	34	70	75	67	79
Other (tonnes x 10 ³)						30	32	37	38	39
Benzol or motor spirits (m ³ x10 ³)	No		10	11	15	19	24	25	24	24
Other refined liquids (m ³ x10 ³)	details		3	3	4	6	5	4	5	5
Creosote (m ³ x10 ³)				4	7	12	6	12	7	12
Gas										
(i) ex carbonization	No									
volume 10 ⁶ m ³ _n	details		345	394	499	604	680	682	662	694
cal.val. MJ/m ³ _n			18,9	18,9	19,3	19,0	18,8	18,7	18,5	18,5
(ii) ex gas-works*	No									
volume 10 ⁶ m ³ _n	details		63	45	64	70	73	65	70	76
cal.val. MJ/m ³ _n			17,7	17,5	17,6	17,6	17,6	17,6	17,6	17,8
Oil used for carburettng gas (m ³ x 10 ³)			0,3	0,4	0,9	0,9	1	4	1	3

*The gas is obtained from coal and also from carburettng oil.

From 1966 a proportion of gas produced by gasification of coal is also being sold. This quantity is included in the gas figures.

The quantity of coal gasified is, however, excluded.

Note: By-products derived from the gasification of coal are included in this table.

/TABLE 4 Cont.

TABLE 4 (Cont.)

Year	1964	1965	1966	1967	1968	1969	1970	1971	1972
Crude tar (tonnes x 10 ³)	147	168	227	231	222	222	222	228	236
Naphthalene (tonnes x 10 ³)	5	6	8	7	8	8	8	8	6
Pitch (tonnes x 10 ³)	9	4	7	12	14	14	16	20	24
Road tars (tonnes x 10 ³)	27	24	32	28	28	17	23	22	21
Tar oils and fuels (tonnes x 10 ³)	85	26	105	121	120	119	111	113	111
Other (tonnes x 10 ³)	42	49	52	55	55	55	53	53	49
Benzol or motor spirits (m ³ x 10 ³)	27	37	44	40	48	50	51	48	50
Other refined liquids (m ³ x 10 ³)	6	72	10	12	15	15	20	16	16
Creosote (m ³ x 10 ³)	14	13	29	26	31	32	33	30	33
Gas									
(i) ex carbonization									
volume 10 ⁶ m ³ _n	766	916	1030	1201	1198	1200	1200	1270	1300
cal.val. MJ/m ³ _n	18,7	18,6	19,0	18,9	18,4	18,7	18,7	19,3	19,0
(ii) ex gas-works*									
Volume 10 ⁶ m ³ _n	80	82	96*	147	249	274	458	520	568
cal.val. MJ/m ³ _n	17,8	17,8	18,3	19,0	19,4	19,5	18,4	18,5	19,9
Oil used for carburetting gas (m ³ x 10 ³)	6	6	5	4	6	7	7	7	7

*The gas is obtained from coal and also from carburetting oil.
 From 1966 a proportion of gas produced by gasification of coal is also being sold.
 This quantity is included in the gas figures.
 The quantity of coal gasified is, however, excluded.

Note: By-products derived from the gasification of coal are included in this table.

/TABLE 5

TABLE 5

COKING COAL USED AND COKE PRODUCED IN SOUTH AFRICA FOR THE
PERIOD 1915-1946 - TAKEN FROM COAL COMMISSION DIAGRAM

Year	Short tons x 10 ³		Metric tons x 10 ³	
	Coking coal used	Coke produced	Coking coal used	Coke produced
1915	14	7	13	6
1916	8	4	7	4
1917	27	12	24	11
1918	60	28	54	25
1919	64	30	58	27
1920	73	31	66	28
1921	76	37	69	34
1922	84	41	76	37
1923	121	55	110	50
1924	143	69	130	63
1925	164	74	149	67
1926	200	84	181	76
1927	256	110	232	100
1928	247	100	224	91
1929	255	110	231	100
1930	217	100	197	91
1931	221	95	200	86
1932	135	61	122	55
1933	159	80	144	73
1934	405	235	367	213
1935	378	231	343	210
1936	445	265	404	240
1937	523	320	474	290
1938	663	374	601	339
1939	716	392	650	356
1940	812	445	737	404
1941	882	468	800	425
1942	1175	625	1066	567
1943	1195	647	1084	587
1944	1230	667	1116	605
1945	1285	696	1166	631
1946	1315	713	1193	647

/TABLE 6

TABLE 6CONSUMPTION OF COKING COAL IN PRODUCTION OF METALLURGICAL COKE

Year	Short tons x 10 ³			Metric tons x 10 ³		
	Straight coking coal (Natal)	Blend coking coal (Tvl)	Total	Straight coking coal (Natal)	Blend coking coal (Tvl)	Total
1937	274	266	540	249	241	490
1938	404	268	672	367	243	610
1939	407	321	728	369	291	660
1940	461	348	809	418	316	734
1941	513	369	882	465	335	800
1942	642	537	1179	582	487	1069
1943	640	556	1196	581	504	1085
1944	673	556	1229	610	505	1115
1945	780	501	1281	708	454	1162
1946	769	505	1274	697	458	1155

/TABLE 7

TABLE 7

COAL CONSUMED IN COKE PRODUCTION 1937-1972

(Short tons x 10³)

Year	Diagram Coal Commis- sion 1946/47	Tables Coal Commis- sion 1946/47	Grant Thesis	Kotzé Thesis	F.R.I.	Year Books	Selected figures	Selected figures metric tons x 10 ³
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1937	523	540	519				540	490
1938	663	672	612				672	610
1939	716	728	648				728	660
1940	812	809	705	704		780	809	734
1941	882	882	813	812			882	800
1942	1175	1179	1126	1126			1179	1070
1943	1195	1196	1136	1136			1196	1085
1944	1230	1229	1162	1162			1229	1115
1945	1285	1281	1205	1205		1299	1281	1162
1946	1315	1274	1225	1225		1225	1274	1156
1947			1307	1307		1307	1307	1186
1948			1406	1406		1406	1406	1276
1949			1690	1690		1690	1690	1533
1950			1775	1775		1775	1775	1610
1951			2072	2072		2072	2072	1880
1952			2131	2131		2131	2131	1933
1953			2221	2221		2221	2221	2015
1954			2061	2510	2220	2061	2061	1870
1955			2321	2510	2321	2127	2321	2106
1956			2457	2710	2457		2457	2229
1957				2810	2658		2658	2411
1958				2930	2957		2957	2683
1959				3460	3264		3264	2961
1960				3610	3380		3380	3066
1961				3780	3548		3548	3219
1962				3980	3645		3645	3307
1963				4050	3736		3736	3389
1964				4430	4058		4058	3681
1965				4555	4889		4889	4435
1966					5113		5113	4638
1967					5255		5255	4767
1968					5218		5218	4734
1969					5284		5284	4794
1970					5222		5222	4737
1971					5593		5593	5074
1972					5589		5589	5070

/TABLE 8

TABLE 8ACOKE PRODUCED (SHORT TONS X 10³)

Year	Diagram Coal Commission 1946/47	S.A. Year Books
1915	7	
1916	4	11
1917	12	15
1918	28	32
1919	30	22
1920	31	23
1921	37	25
1922	41	41
1923	55	59
1924	69	74
1925	74	78
1926	84	87
1927	110	106
1928	100	90
1929	110	103
1930	100	104
1931	95	81
1932	61	59
1933	80	99
1934	235	68*
1935	231	65*
1936	265	87*

* Probably only Natal (IsCOR started in 1934).

/TABLE 8B

TABLE 8B

COKE PRODUCED (SHORT TONS X 10³)

Year	Diagram Coal Commis- sion 1946/47	Tables Coal Commis- sion 1946/47	Grant Thesis	S.A. Year Books	F.R.I.	Selected figures	Selected figures metric tons x 10 ³
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1937	320	337	337	129*		337	306
1938	374	398	398	180*		398	361
1939	392	421	421	204*		421	382
1940	445	465	465	522*		465	422
1941	468	508	508	-		508	461
1942	625	717	717	-		717	650
1943	647	722	722	-		722	655
1944	667	743	743	-		743	674
1945	696	762	762	-		762	691
1946	713	775	775	785		775	703
1947			827	827		827	750
1948			884	884		884	802
1949			1060	1060		1060	962
1950			1142	1142		1142	1036
1951			1381	1381		1381	1253
1952			1489	1489		1489	1351
1953			1565	1565		1565	1420
1954			1525	1525	1530	1530	1390
1955			1553	1532	1553	1553	1409
1956			1633		1639	1639	1487
1957					1782	1782	1616
1958					1993	1993	1808
1959					2250	2250	2041
1960					2332	2332	2116
1961					2432	2432	2207
1962					2493	2493	2262
1963					2538	2538	2302
1964					2812	2812	2551
1965					3469	3469	3147
1966					3634	3634	3297
1967					3809	3809	3455
1968					3792	3792	3440
1969					3810	3810	3460
1970					3817	3817	3463
1971					3960	3960	3592
1972					3972	3972	3603

* Probably only Natal (Iscor started in 1934).

/TABLE 9

TABLE 9

COAL CONSUMED BY GAS-WORKS FOR GAS COKE AND GAS PRODUCTION
SHORT TONS (x 10³)

Year	Tables Coal Commission 1946/47	Grant Thesis	S.A. Year Books	F.R.I.	Selected figures	Selected figures metric tons x 10 ³
	(1)	(2)	(3)	(4)	(5)	(6)
1937	62	62			62	56
1938	68	68			68	62
1939	72	72			72	65
1940	74	74			74	67
1941	78	78			78	71
1942	87	87			87	79
1943	94	94			94	85
1944	95	95			95	86
1945	102	102			102	93
1946	106	106	103		106	96
1947		109	112		109	99
1948		117	119		117	106
1949		134	133		134	122
1950		133	136		133	121
1951		144	150		144	131
1952		152	152		152	138
1953		156	149		156	142
1954		158	154	154	154	140
1955		158	154	148	148	134
1956		169		162	162	147
1957				164	164	149
1958				162	162	147
1959				140	140	127
1960				151	151	137
1961				130	130	118
1962				168	168	152
1963				180	180	163
1964				165	165	150
1965				165	165	150
1966				177	177	161
1967				157	157	142
1968				146	146	132
1969				148	148	134
1970				152	152	138
1971				146	146	132
1972				132	132	120

/TABLE 10

TABLE 10GAS COKE PRODUCTION (SHORT TONS X 10³)

Year	S.A. Year Books	F.R.I.	Gas coke in metric tons x 10 ³
1946	54		49
1947	65		59
1948	75		68
1949	83		75
1950	81		73
1951	92		83
1952	98		89
1953	100		91
1954	112	112	102
1955	107	107	97
1956		106	96
1957		106	97
1958		102	93
1959		97	88
1960		92	83
1961		87	79
1962		113	103
1963		115	104
1964		106	96
1965		106	96
1966		120	109
1967		113	103
1968		105	95
1969		107	97
1970		100	91
1971		110	100
1972		98	89

/TABLE 11

TABLE 11DISPERSAL OF METALLURGICAL COKE 1940-1946(METRIC TONS X 10³)

Year	Blast furnaces	Explosives industry	Carbide works	Export	General trade	Total
1940	313	20	22	8	59	422
1941	346	22	22	1	70	461
1942	482	27	22	39	80	651
1943	497	28	23	26	82	655
1944	502	31	21	33	87	674
1945	488	27	22	64	89	691
1946	518	28	21	54	82	703

/TABLE 12A

TABLE 12A

QUANTITIES OF BY-PRODUCTS AND GAS PRODUCED

(From Official Year Books of South Africa)

Year	Crude tar sh. tons $\times 10^3$	Benzol gal. $\times 10^3$	Tar oils gal. $\times 10^3$	Gas cu ft $\times 10^6$		
				Coke ovens	Gas-works	Total
1924					368	
1925					381	
1926					394	
1927					385	
1928					451	
1929					494	
1937					906*	
1940	18,9	566	2416			4667
1945	34,9	1299	4886			8012
1946					1877*	
1946	32,9	1332		6097	1690	7787
1947	32,9	1400		6508	1905	8413
1948	33,7	1422		7289	2021	9310
1949	53,5	1719		7807	2182	9989
1950	59,8	2112		9000	2033	11033
1951	70,7	2782		11431	2469	13900
1952	77,9	2936		11552	2471	14023
1953	83,2	2946		12033	2418	14451
1954	82,4	2902		12978	2665	15643
1955	80,5	2934		12831	2773	15604

*Figures from Coal Commission Report.

/TABLE 12B

TABLE 12B

QUANTITIES OF BY-PRODUCTS AND GAS PRODUCED

(Table A converted to metric units)

Year	Crude tar tons x 10 ³	Benzol m ³ x 10 ³	Tar oils m ³ x 10 ³	Gas m ³ x 10 ⁶		
				Coke ovens	Gas- works	Total
1924					10	
1925					10	
1926					10	
1927					10	
1928					12	
1929					13	
1937					24	
1940	17		11			
1945	32		22			
1946					50	
1946	30	6		161	45	206
1947	30	6		172	50	222
1948	31	6		192	53	225
1949	49	8		206	58	264
1950	54	10		238	54	291
1951	64	13		302	65	367
1952	71	13		305	65	370
1953	75	13		318	64	381
1954	75	13		342	70	413
1955	73	13		339	73	412

Note: In converting gas volumes cubic feet to cubic metres the
factor 1 cu ft = 0,02639 m³ was used.

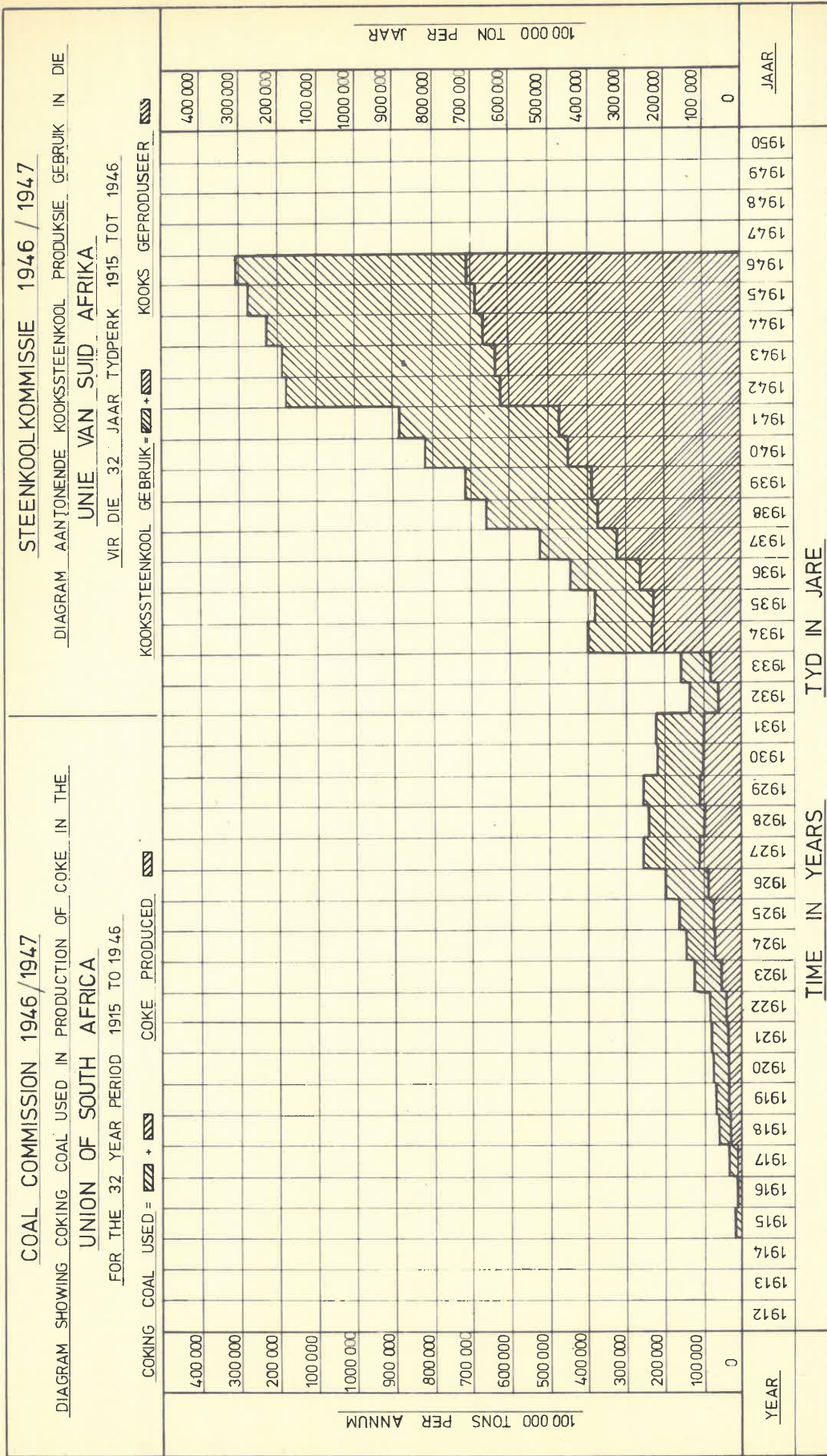


FIGURE 1

COAL CONSUMED IN THE PRODUCTION OF METALLURGICAL COKE

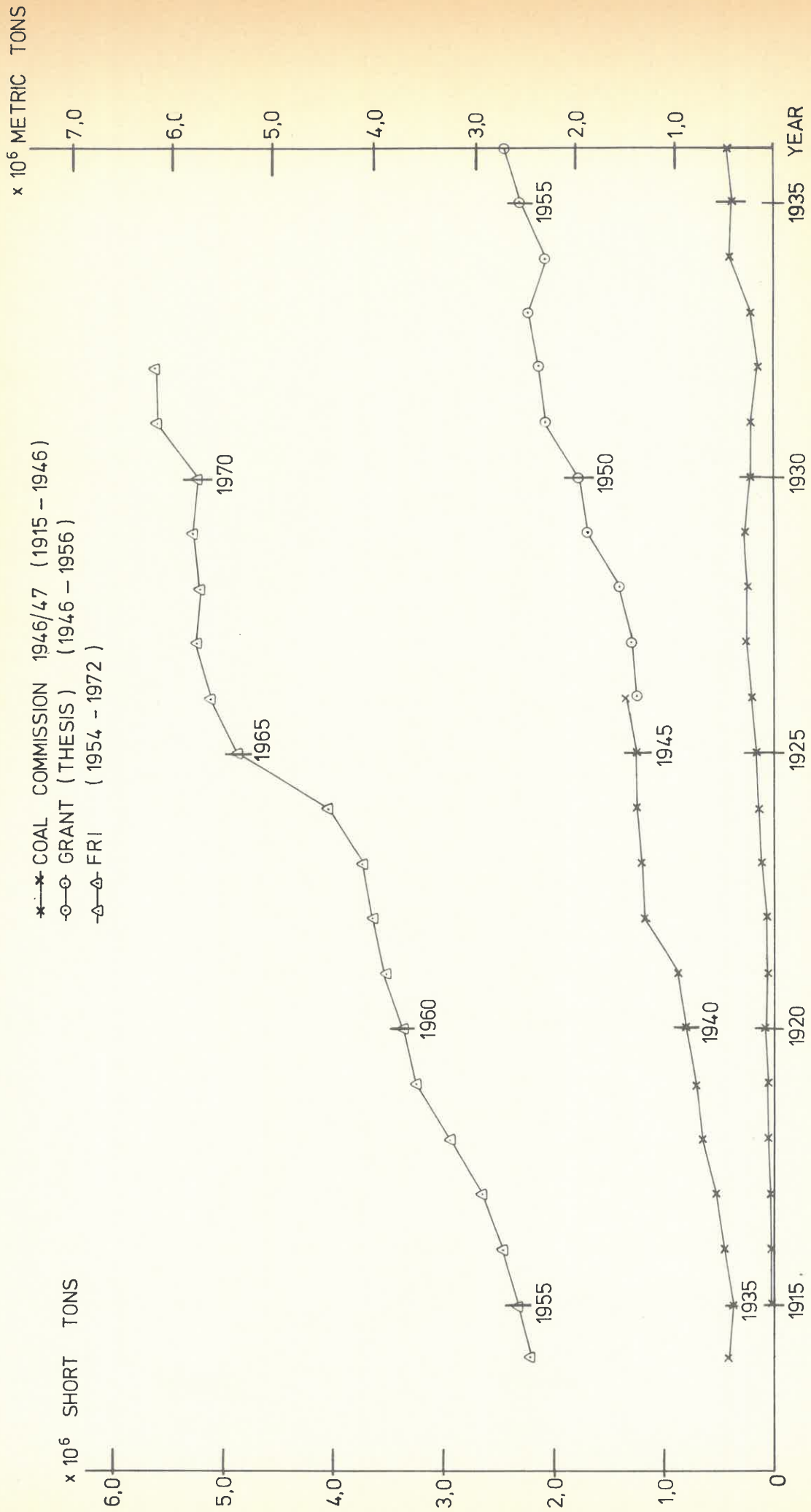


FIGURE 2

COAL CARBONIZED, METALLURGICAL COKE PRODUCED
AND COKE CONSUMED IN BLAST FURNACES.

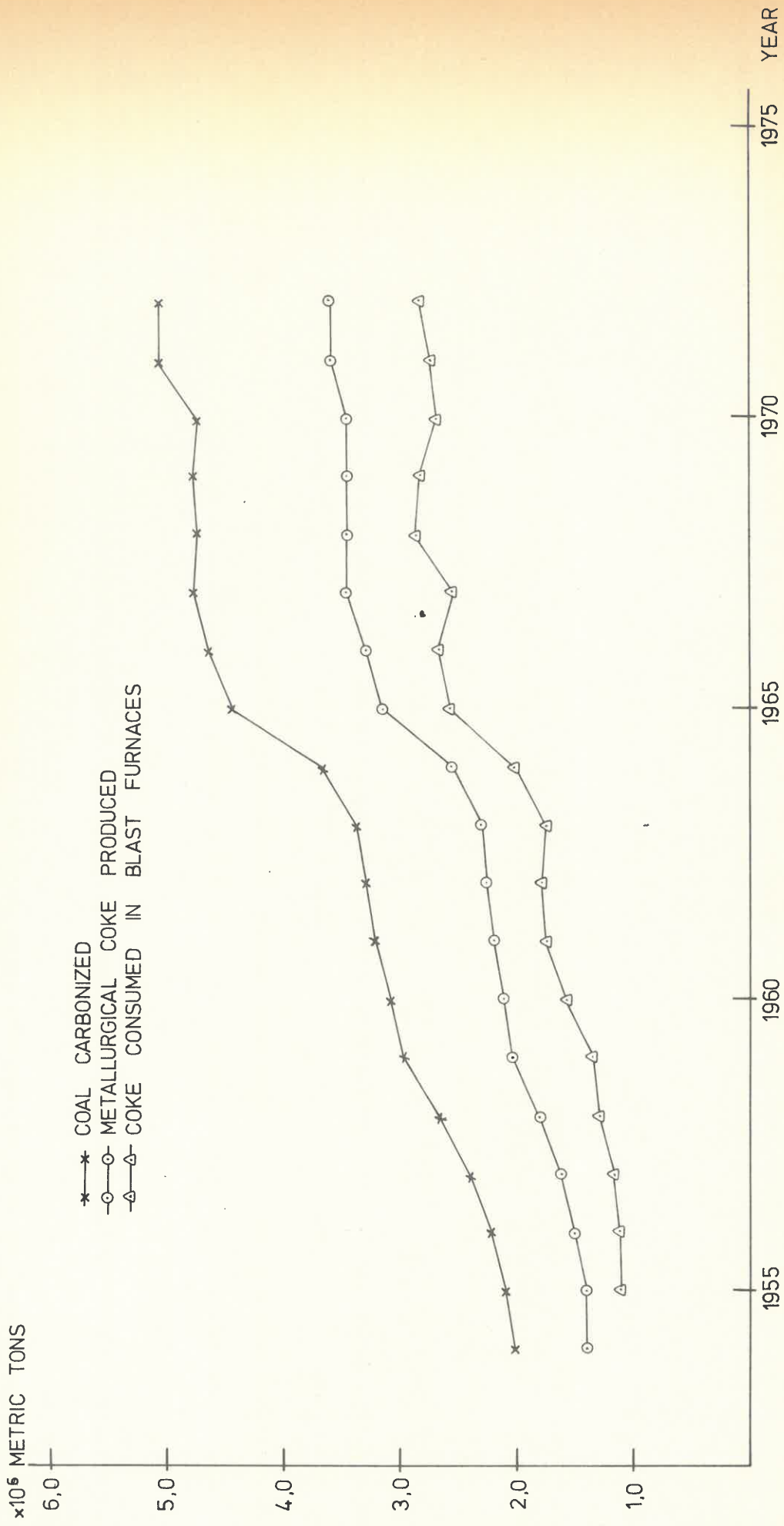


FIGURE 3

COAL CARBONIZED FOR METALLURGICAL COKE PRODUCTION:
IN BEEHIVE OVENS AND BY-PRODUCT OVENS

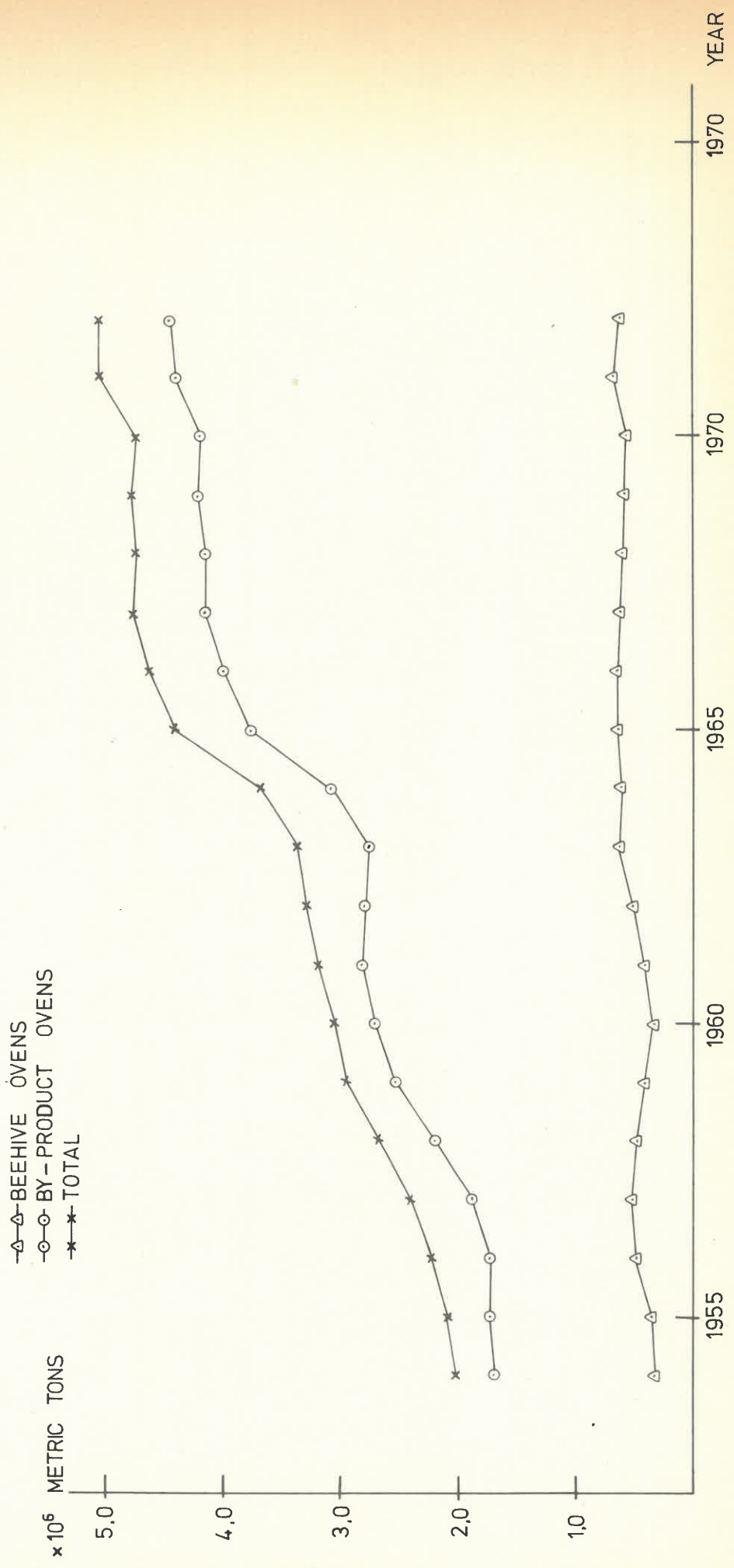


FIGURE 4

COAL CARBONIZED FOR METALLURGICAL COKE PRODUCTION
ACCORDING TO TYPE

—○— NATAL COKING COAL
—*— TRANSVAAL BLEND COKING COAL

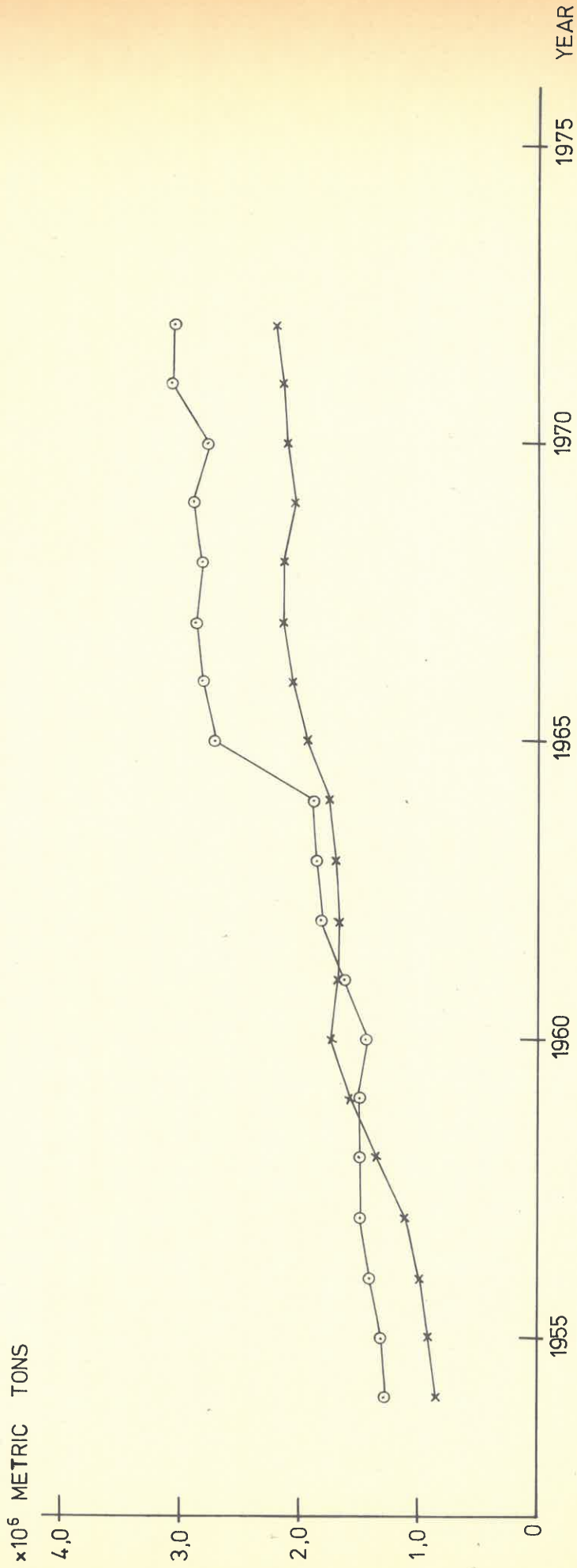


FIGURE 5