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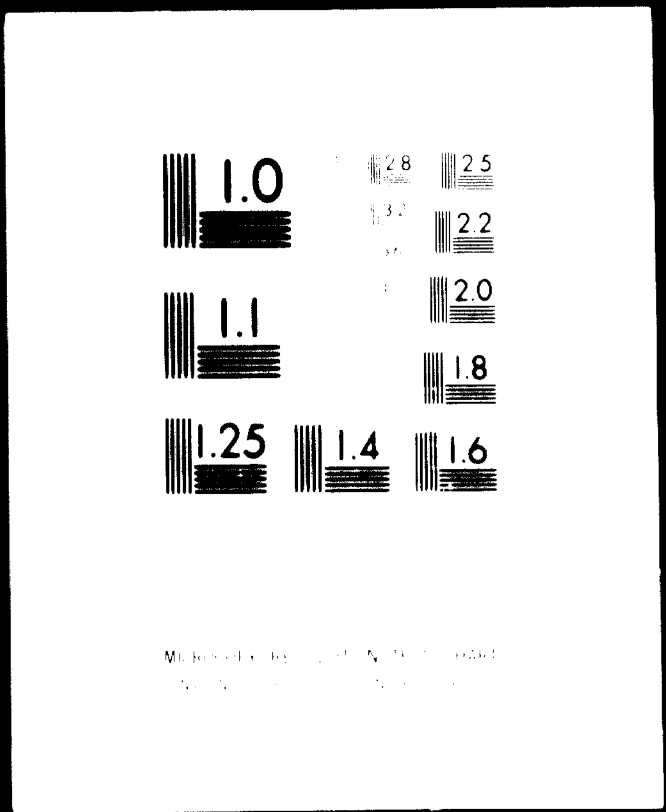
1 OF 7



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02995

(1 of 2)

Contract No. 71/1 Am. 1.

STUDY OF THE POSSIBILITIES FOR DEVELOPMENT OF METALLURGICAL INDUSTRIES IN THE STATE OF BAHIA (BRAZIL)

1971

VOLUME I
MAIN REPORT

TECNIBERIA

MADRID-SPAIN

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

STUDY OF THE POSSIBILITIES FOR DEVELOPMENT OF METALLURGICAL INDUSTRIES IN THE STATE OF BAHIA (BRAZIL)

FINAL REPORT
(in two volumes)

VOLUME I
MAIN REPORT

SEPTEMBER 1971
Contract N° 71/1

TECNIBERIA
MADRID-SPAIN

TABLE OF CONTENTS

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TABLE OF CONTENTS

.../...

TABLE OF CONTENTS

.../...

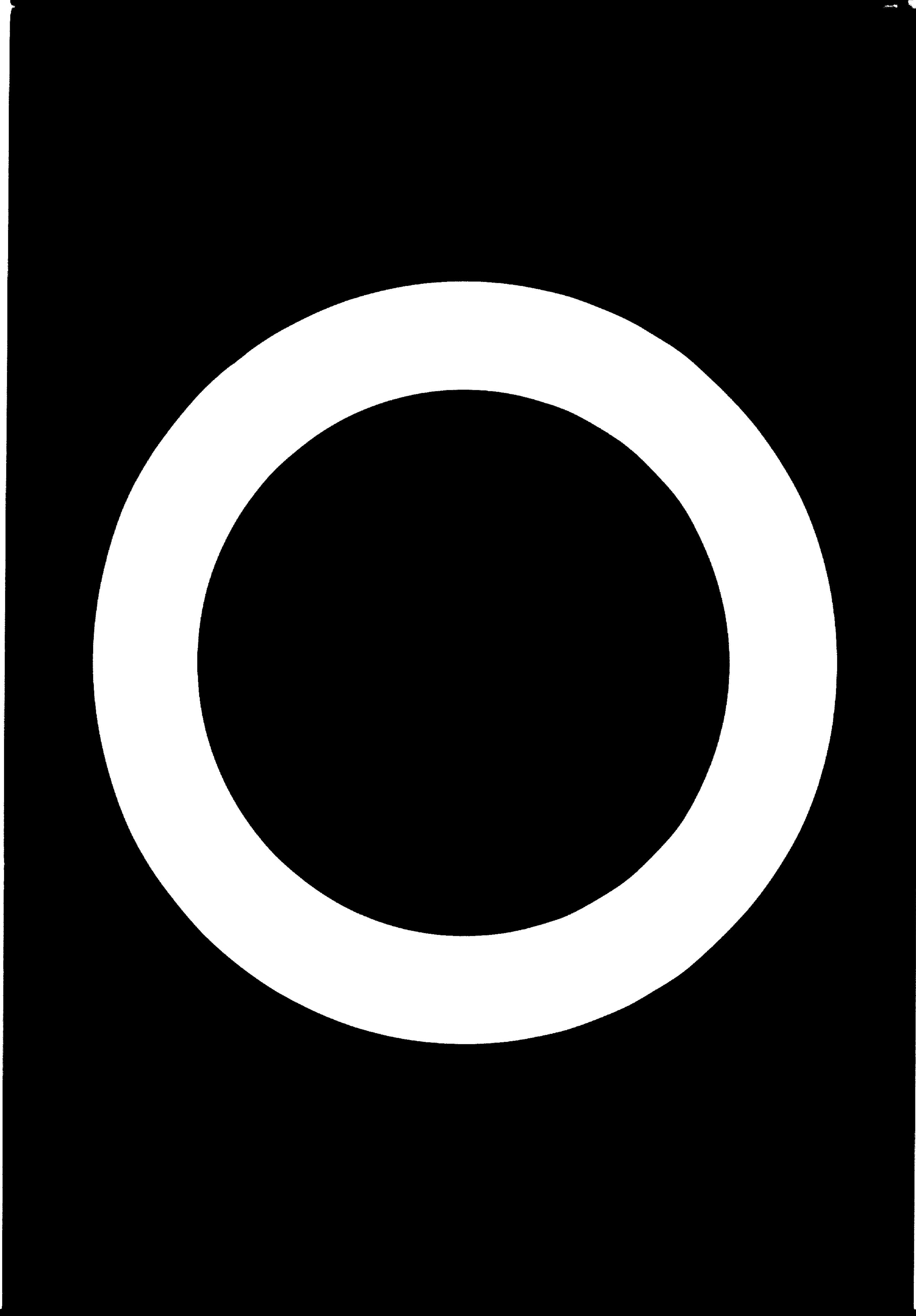
TABLE OF CONTENTS

.../...

TABLE OF CONTENTS

Page

- INTRODUCTION



TEAM COMPOSITION

This report has been realised by a Tecniberia's team of experts, integrated by the following members (listed in alphabetical order):

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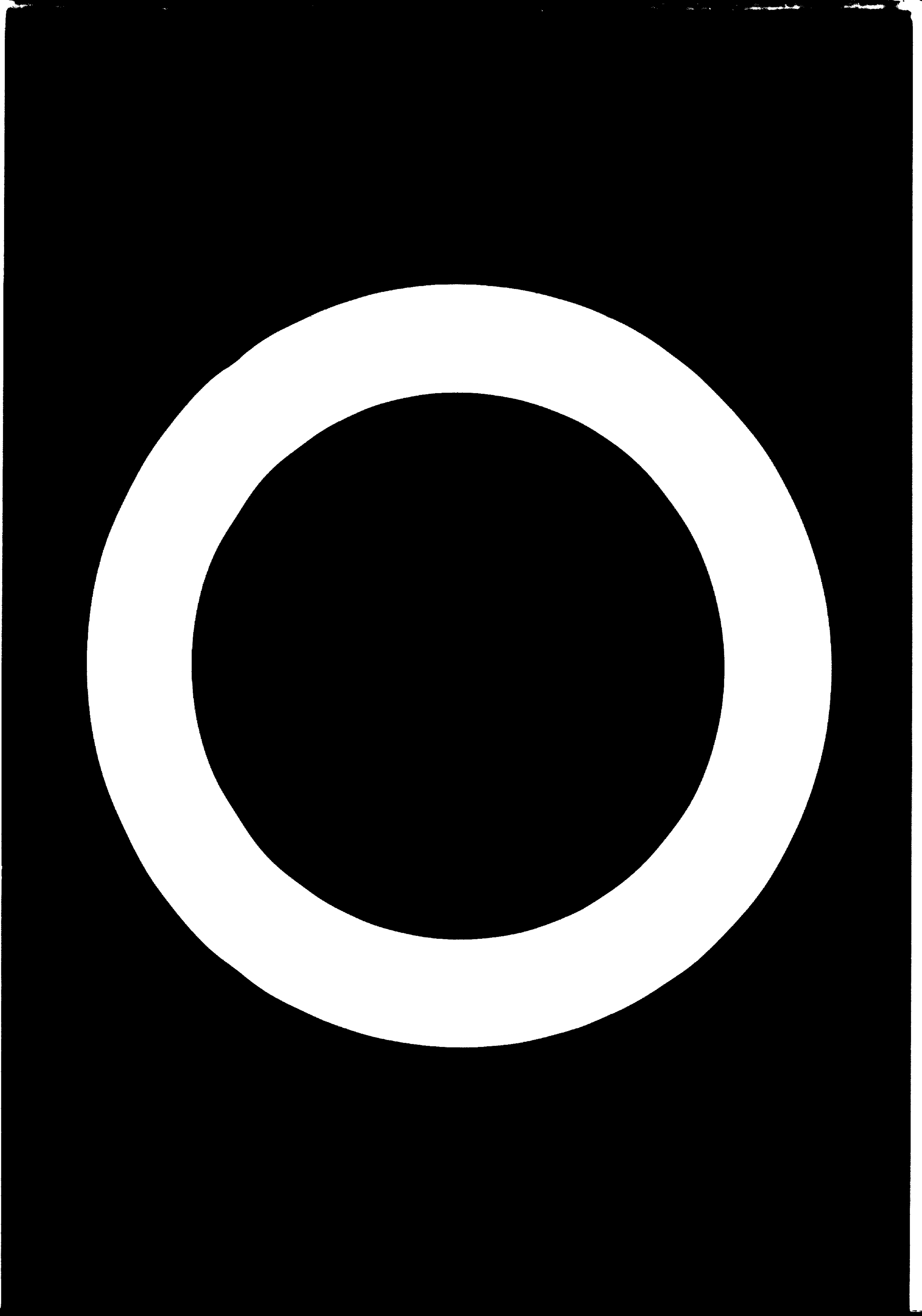

KEY TO ABBREVIATIONS USED IN THIS REPORT

- A. B. M.	- Asociação Brasileira de Metais
- A. B. S.	- Anuario Brasileiro de Estatistica
- ALALC	- Asociação Latino Americana de Livre Comercio
- BAHINT	- Boos Allen and Hamilton International
- B. N. B.	- Banco do Nordeste de Brasil
- B. N. D. E.	- Banco Nacional de Desenvolvimento Económico
- CEBRACO	- Centro Brasileiro do Cobre
- CEPED	- Centro de Pesquisas e Desenvolvimento
- CHESF	- Companhia Hidroelétrica do São Francisco
- C. I. A.	- Centro Industrial de Aratú
- COBRAC	- Companhia Brasileira do Chumbo
- COELBA	- Companhia de Eletricidade do Estado da Bahia
- COMINAG	- Companhia de Mineração e Agricultura do São Francisco
- CONSIDER	- Conselho da Industria Siderúrgica
- COSIPA	- Companhia Siderúrgica Paulista
- CPRM	- Companhia de Pesquisas de Recursos Minerais
- C. S. B. M.	- Companhia Siderúrgica Belgo Mineira
- C. S. N.	- Companhia Siderúrgica Nacional
- DERBA	- Departamento de Estradas de Rodage da Bahía
- DNPM	- Departamento Nacional de Produção Mineral
- ETENE	- Departamento de Estudos Economicos do Nordeste
- FERBASA	- Ferro-ligas da Bahia, S. A.
- FINEP	- Grupo da Finanção e Planejamento
- GCIS	- Grupo Consultivo da Industria Siderúrgica
- GEIMET	- Grupo Executivo da Industria Metalúrgica
- GIP	- Gross Internal Product
- IBGE	- Instituto Brasileiro de Geografía e Estatistica
- I. B. S.	- Instituto Brasileiro da Siderurgia
- I. C. M.	- Imposto sobre circulação de mercadorias
- I. C. Z.	- Instituto Brasileiro de Informacão do Chumbo e Zinco
- I. P. I.	- Imposto Produto Industrializado
- I. T. E.	- Impuesto de Tráfico de Empresas (Spain)
- N. I. P.	- Net Internal Product
- PETROBAS	- Petróleo Brasileiro, S. A.
- P. S. N.	- Plano Siderúrgico Nacional
- SAER	- Superintendencia de Aguas e Esgotos do Reconcavo

.../...

- **SIBRA** - **Electro Siderúrgica Brasileira**
- **SUDENE** - **Superintendencia do Desenvolvimento do Nordeste**
- **T. V. A.** - **Taxe Valeur Ajouteé (France)**
- **U. H. P.** - **Ultra High Power**
- **UNDP** - **United Nations Development Program**
- **UNIDO** - **United Nations Industrial Development Organiza tion**
- **USIBA** - **Usina Siderúrgica da Bahia**
- **USIMINAS** - **Usinas Siderúrgicas de Minas Gerais**

ACKNOWLEDGEMENTS

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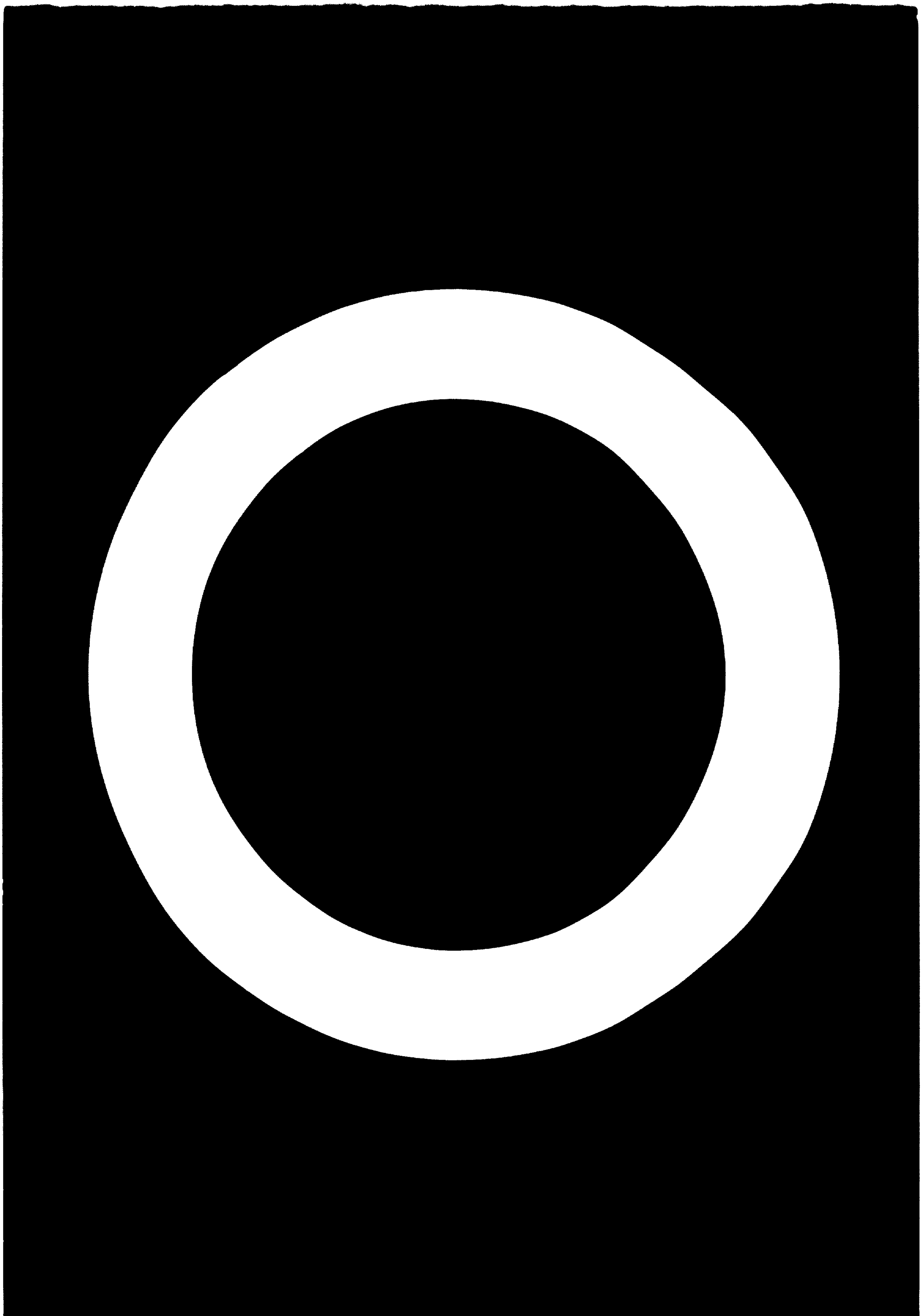
Recognition is also extended to all Directors and Members of Government agencies and professional institutions and to the Bahian and Brasilian Entrepreneurs interviewed along the survey for their cooperation.

All these persons have made possible the preparation of this report with their assistance and have helped to make it a pleasant and fruitful stay for Tecniberia's team.



ABSTRACT OF THE REPORT

This report covers the survey requested by the Government of Brazil to UNIDO on the possibilities for the development of metallurgical industries in the State of Bahia, the largest in N-E Brazil and with a population over seven million people.

The aim of the survey is the study of the prevailing conditions in the State of Bahia related to development of its metallurgical industries and the recommendation of policies leading to the further development of such industries and of the natural ressources of metallurgical raw materials (iron, copper, manganese, chrome, lead, barite, magnesite and alluminium) and of the pestaining industries to satisfy local and expanding markets.

In order to fulfill these objectives a survey of the above mentioned mineral ressources of Bahia has been made and of their possibilities of utilisation in metallurgical or related industries; of the present and projected demand of metallurgical products in Brazil and Bahia, of the infrastructure of the zone, together with an study of the existing metallurgical industry and finally an investigation on the possibilities of installation of new metallurgical industries or to expand the existing ones in order to strengthen the industrial development of the State of Bahia.

The results of this survey have revealed the following:

Mineral ressources of Bahia offer a good starting base for the installation or expansion of extractive metallurgical industries, but conditioned in almost all raw materials object of the contract to a great improvement in mining and concentration processes and in the transportation methods from the orebodies to

present or future markets, together with the urgent need of trained technical personnel and specialized man-power.

As regards market possibilities, the industrial development initiated a few years ago in Bahia is creating a growing demand of metallurgical products. Some good exports projects - exist also for some ores and transformed products.

With exception of the Reconcavo area and above all of the influence zone of the Aratu-Feira de Santana axis, the existing infrastructure shows many deficiencies.

The development of the present metallurgical industry is on a modest scale, and a need for reorganisation and/or coordination is observed in several sectors.

The promotion or expansion of metallurgical industries shows good prospects, specially for iron, steel and copper industries, in accordance with the specific recommendations of this - survey.

GENERAL INTRODUCTION

Background information

The State of Bahia has significant deposits of certain metallurgical raw materials such as copper, manganese, chromium and lead ores and others. On the other hand, with a population of 8 million people, and with an economic setting favourable to industrialization, the establishment of local metallurgical industries is necessary. It must also be pointed out that the main oil producing fields in Brazil are located in this State and this would provide a source of energy and/or reducing agents for metallurgical processing. The State is engaged in a programme of industrialization which might make of it one of the regions of Brazil with the highest economic growth indices.

In the frame of this programme the Government of Brazil through the UNDP President Representative, submitted a request to UNIDO for the study of the possibilities for development of metallurgical industries in the State of Bahia, being the Secretariat for Science and Technology of such state, the specific government agency concerned with the project.

Objectives of the study

Obtain and study available information on the present and projected demand and supply, of metallurgical products in Brazil with particular attention on their implications to the State of Bahia. Such information to be made available by the Secretariat for Science and Technology in the State of Bahia. The information should be complemented and up-dated through interviews as appropriate.

Examine available information regarding the factors of production needed for the development of the metallurgical industry in the State of Bahia, including not only extractive metallurgy but also metal transforming industries (rolling, forging, wire drawing, tube making, casting, etc.). Assess the quantities, suitability and availability of the required raw materials, utilities, transportation, etc. Obtain information on and evaluate local availability of engineering "know-how", trained personnel, etc. Obtain information in - other significant factors, if any, which may influence the development of the local metallurgical industry, analysing their implications.

Define or estimate the types and quantities of metallurgical products which can be economically produced in Bahia, through existing or new plants, to meet the State's and also national demand, wherever applicable.

Present and analyse the main industrial opportunities open to the State's metallurgical industry. The ones most attractive to the State of Bahia should be presented and evaluated in detail. Recommend the optimum pattern for development of the Bahian metallurgical industry either through expansion of existing facilities or through the establishment of new plants. Prepare estimates of the investments required and of the probable costs of production.

Scope of the study

The metallurgical raw materials and the pertaining industries to be studied covered by contract 71/1 between UNIDO and TECNIBERIA were:

Iron, copper, manganese, chromium and lead.

...(/...

Three additional raw materials, i. e., magnesite, barite, and alluminium have been included later on in the study by Amendment nº 1 to the above mentioned contract, under request of the Secretariats of Industry and Commerce and Science and - Technology of the State of Bahia.

The above selection of raw materials, some of them not being, properly speaking, the base of extractive metallurgy or metal transforming industries, has made necessary in order to complete the survey to examine the present and future situation of industrial derivatives of such raw materials, even though such derivatives are not metal transformed products.

Such is the case of barite, which main industrial utilisation is in drilling muds for oil wells, and as raw material for the fabrication of barium salts (lithopone, barium carbonate and - barium chloride).

Likewise, magnesite, founds its most important application in the basic refractories industries, and only in some special processes can be used, through its transformation in chemical compounds in the highly specialised metallurgy of metallic magnesium.

Finally, we would like to emphasize, that the iron and steel industries, not only basic or extractive but also metal - transforming (rolling, casting, forging, etc) have been minutely studied, as being the ground-work for any harmonious development process and by the very specific problems such industries present in Bahia.

<u>Methodology of the study</u>

Taking in account the great number of metallurgical raw materials and the pertaining industries to be studied in the limited time available for our team to stay in Brazil, the time factor was a basic element in this instance and thus it was neccessary to give special attention to methodology in the preparation of the study.

The accomplishment of the project was divided into stages of specific nature, each one of them being used as a basis for the next one. Detailed programming of each stage was carried out with great flexibility, stablishing weekly programs with a detailed schedule taking in account the number and diversity of actions simultaneously in process.

After a first stage of familiarization with the purpose of getting a basic knowledge of the structures of Brazil and Bahia and of the industrial lines to be surveyed, the following stages were devoted in Bahia to:

a) preparation of research

(Study of all documentation available prior to visits. Visits scheduling).

b) research

(Visits to ore deposits, existing extractive metallurgy industries, metallurgical producing and consuming industries, official bodies and trade and professionnal institutions).

c) analysis of research

(Study of all information gathered through research and stablishment of preliminary conclusions and recommendations).

General structure of the report

A glance to the general table of contents clearly -- shows the general structure of this report very much in agreement with paragraph 2. 0. 1. of the contract, previously summarized in this introduction.

Another factor which determines the order of exposition was the basic principles of report writing, specified in Annex B to contract, which we have tried to observe at all times.

Introduction to the report includes: Team composition, key to abbreviations used in this report, General Synopsis of the Study and General Introduction.

Section A, includes Problems and Recommendations.

Sections B, C and D are the body of the report.

Section B includes an analysis of the significant factors which may influence the development of the local metallurgical industry, analysing their implications. Some of this factors are from an infrastructure nature, such as population, income, transportation, communications, ports, availability and prices of electric power and water supply and are examined in section B. 1.

Other factor such as fiscal and financial incentives - are examined in section B. 2. Finally other significant factors, such as wages, local availability of engineering "know-how", basic instruction and technical training are analysed in sections B-3 and B-4 respectively.

Section C deals with the present and future industrial development plans established by SUDENE in Bahia, studying the geographical location of the industry, and its sectorial distribution with particular attention to the Aratu Development Center.

Section D of the report includes the specific study of each of the eight metallurgical substances and their related metallurgical industries, including for each of the eight substances, present and projected demand and supply of metallurgical products in Brasil with particular attention on their implications to the state of Bahia, and quantities, suitability and availability of the required raw materials.

The main industrial opportunities open to the State's metallurgical industry are presented and analysed, with detailed evaluation of the most attractive to the State.

Basic problems existing in the future development of the Bahian metallurgical industry are carefully studied with recommendations on the optimum pattern for its development, either - through the expansion of existing facilities or through the establishment of new plants.

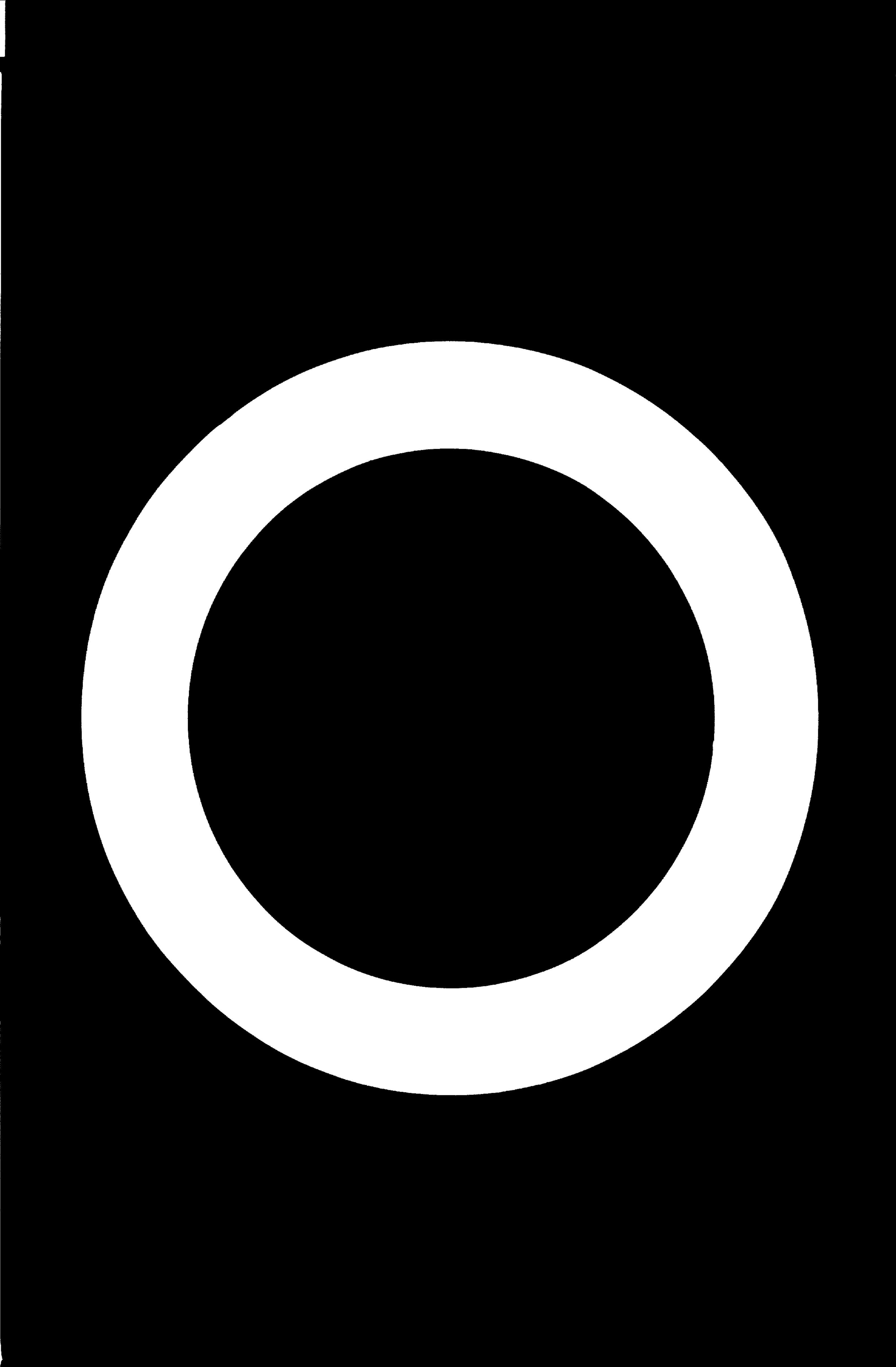
In the case where new plants are recommended, preliminary projects with general plant layouts and estimates of the required investments and of profitability have been prepared and included in the annexes of section E of this report.

Section F is the terminal section of the report, reinforcing the conclusions drawn and the recommendations made, together with a list of all the visits and contacts made.

Statistical data, graphs and tables are displayed for convenience and more accessibility of all this additional material, too detailed to be given in the text, in Volume II of this report.

Finally, a bibliography and list of references, also included in Volume II, supplement the report.

A. PROBLEMS AND RECOMMENDATIONS



A. 1. IRON

A. 1. 1. Mining

Problems

The basic problem remains the lack of research into the quality of iron deposits in Bahía state, both as far as reserves and ore grades are concerned.

Another problem that might seriously affect the usefulness of this ore is the long distances it would have to be transported, above all from the Santo Se deposits. There is also the lack of fuel, as an ore reducing agent.

Recommendations

At the moment, the prospects of iron-ore mines being established in Bahia are not optimistic. However the continued prospection in this area should be noted in case any of them were to yield favourable conditions for exploitation.

A. 1. 2. The steel industry in Bahia

Problems

The industrial conditions in Bahia do not yet justify the installation of a large integrated steel plant in the State, as such a plant to be fully profitable, should be planned for a minimum output of 2 million tons of steel per year.

USIBA'S infrastructure has been organised thinking of a future expansion up to 1. 000. 000 t/year. This output is very difficult to justify even in the case of the most optimistic perspectives for the demand in Bahia. This infrastructure has a strong negative impact on costs.

USIBA is planning for the manufacturing of semi-products (billets) which would not be absorbed in the region, obliging them to be sent to the South to be rolled into finished products, with a charge of some 10 $/ton for transport, and this fact would put it in an unfavourable position against the billets produced in the South.

An output of 280.000 t. of billets that, until recently, had been the target of production for USIBA requires --- 291,666 t/year of steel, an equivalent to 2,916 annual taps of 100 t. each, that is, 291 working days with 10 taps a day. This requires a degree of efficiency difficult to be obtained even with UHP furnaces, until having a working personnel perfectly trained in the new techniques. This would, perhaps, require several years to be achieved.

If the anticipated characteristics of the electric furnace of USIBA have not been modified, and provided that the furnace may be operated at a rate of 85 per cent (that is, during 315 days a year) and 8 taps per day, the production would not exceed the figure of

$$8 \times 315 \times 100 = 252.000 \text{ t.}$$

of steel/year, and that would be equivalent to 255.000 x 0,96 = = 240.000 t. of billets/year, whose sales, would not allow any profitability of USIBA.

<u>Recommendations</u>

1. USIBA must carry out a maximum transformation of its products and obtain products of a ready marketability in the region, by converting the billets into bars rods, wire-rods

and sections.

2. The market of non-flat products for Bahia, according to the results of the projection of demand given in the paragraph D. 1. 1. 2. 2. would amount in 1980 to 136. 000 t. Even if - these figures were higher because of the reasons stated in the said paragraph, USIBA must turn towards other more profitable production alternatives, to utilize the large investments in infrastructure already made.

3. The most logical alternative would be a plant to produce - stainless steel flat products, a production that in Brazil has not yet been provided for, at least according to the information gathered during our stay in Bahia. There are - plans, however inconcrete, for a possible reconversion of ACESITA for the production of stainless steel flats, but - they hardly could achieve a proper quality with the simple reconversion of today's existing plant.

4. The above recommendation is based on the following reasons:

   - A plant at a national scale and capable of exporting to the zone of the ALALC could be built.

   - There are in Bahia ferro-alloy plants which could serve as an adequate basis to produce low carbon ferro-chromes.

   - It is a product with a very high selling price, easily absorbing the transport costs.

   - The production can be programmed in two successive stages. In the first one, that could be quickly put into operation, only imported coils would be cold rolled.

The second phase would introduce the production of steel in an electric furnace and the continuous casting of slabs, together with the hot rolling of coils.

- The HyL process gives off a raw material, excellent in its quality, to be used to charge the electric furnace.
- There is no other similar plant in Brazil. Its products, on the other hand, could be a stimulus for demand as - soon as a local production has been achieved.
- Foreign capital interested in financing this plant, could be found.
- Nickel coming from the Caraiba copper mines could be - used in the production of alloys of this metal, indispensa ble to obtain stainless steel.

5. An increase in the production of common steel above a level of 240. 000 t/year of finished products cannot be recommen ded. Every new investment should give priority to the pro duction of stainless steel (first phase) and to the mills to be operated in the rolling of rods, bars and sections.

6. The production of special steels in bars, should not be initiated for the moment by USIBA, unless a specific and detailed market and economic study is made, indicating good possibilities for such production.

7. In Annexes E-1 and E-2 the preliminary projects of the pro posed rolling mills and stainless steel plants have been included.

A. 1. 3. Iron and steel products industries

A. 1. 3. 1. Foundry

Problems

- In Bahia, the foundry industry is based on craftmanship and, at this moment, no programs for new foundries are under consideration.

- Due to this the castings needed by industry in Bahia are being supplied by the foundry plants in operation in the - South of Brazil and, in a great proportion, by Sao Paulo itself.

- Big problems are implicit to this fact, as a consequence of the sources of supply being so far away: the receipt and forwarding of orders, the manufacture of patterns, the tests on samples, the setting and the fabrication of finish ed castings... all of them require a lot of time, reflect ed on the terms of delivery.

- The long terms of delivery of spare parts is the cause of costly interruptions in the process of fabrication in many industries.

- An important stock of spare parts must be maintained, with its corresponding impact on the value of inventories.

- This situation results in higher prices paid by the indus- tries in Bahia than the normal ones in Sao Paulo area.

Nevertheless, Bahia has, as a consequence of the existing and future industries, a growing demand for quality cas- tings that require the installation of foundry plants with heavy investments.

- Besides investments, foundry technology is important and since it is non-existent in the State, it will be necessary to obtain it from other regions in the first stage, while, at the same time providing for the urgent training of local engineers and technicians.

- Complementary technology of pattern making is also important. Even though patterns could be brought from the South at the beginning, it is necessary to strife for local production as soon as possible.

- Foundry labour also needs a high degree of specialisation. Therefore it is necessary to train personnel fully before the start up of any foundry plant.

Recommendations

1. In order to promote the development of industry in the State, it is necessary, in our opinion, to put into operation foundry industries producing iron, steel and non-ferrous castings.

2. The iron foundry will have to include mass production of castings and also hand-made castings in common iron, alloyed iron and nodular iron.

3. We consider that the steel foundry may be quite independent of the iron foundry, since their technologies are quite different.

4. A third foundry would comprise the aluminium (sand castings and chilled castings) and copper alloy castings.

5. The principal characteristics to be required from the foun

dry industries we are proposing, and the manner of compensating for the present non-existence of technicians in this sector, are included in Annex E-3.

6. It is recommended that, due to the lack of experience in foundry, the plant's equipment should consist of top quality machinery.

3.2. Forging

Problems

- The forging market in Bahia is very small, and as the automobile industry, practically non-existent in the State, with the exception of some works, devoted to the assembly of car and bus underframes, is the main consuming industry the possible series of fabrication are small and, consequently, anti-economical for a local production.

- The forging industry requires heavy investments, a very high degree of specialization, the correct use of special steels, and the additional requirement of an auxiliary - stamp and die manufacturing industry -even more- specialised than forging in itself.

Recommendations

1. We do not recommend the installation of forging plants in this moment in Bahia. Forged products have a high unit value, capable of supporting even the high present costs of transport, and whose value will probably be affected for some time by the degree of inactive capacity existing, in general, in the Brasilian forging industry. Therefore

a new forging plant might not now survive due to the - strong competion of the existing forging plants in the - South.

2. We only consider advisable the possible extension of the existing plant of Tramontina, in the form of a forging section, complementary to its present production of hand tools, and in state of supplying Bahia's small market on the basis of technology and know-how that this Group of enterprises has by its forging works in the South.

   This solution would provide the possibility of introduction in Bahia's forging market, without important initial investments and the possibility of gradual competition with forged products coming from the South.

A. 1. 3. 3. Tooling and cutlery industry

Problems

Those come from the characteristics of an incipient market for this sector of production.

Recommendations

1. To study the possible extension of the manufacturing of farming tools, now existing in Bahia, to other kinds of assembly and maintenance tools.

2. To study the possible implementation of an industry of cutting tools, in their most common types and qualities at - first, but with a later widening of its scope, according to the needs and acceptance in the market.

3. The present state of development in Bahia does not make advisable the implementation of production of measuring tools.

4. In the cutlery sector, the basis factor provided by the ro lling of stainless steels could be a stimulus, in a short term, for the implementation of subsidiary industries. Its implementation could be accelerated by the incentives offer ed by Aratú's Industrial Center, in the sense of attracting industries presently operating in the South of the country.

A. 1. 3. 4. Bar and wire drawing industry

Problems

Derived from the existence of the great idle capacity of this sector in Brasil and from the start-up of the - Açonorte plant for the production of wire products. Its zone of influence, may extend, in different degrees of intensity, from the Amazon to Bahia States.

Recommendations

At the moment, we do not recommend, the installa tion of new wire drawing producing plants in Bahia, until a substantial change in the market situation takes place.

A. 1. 3. 5. Steel tubular products

Problems

Derived from the lack of a well defined market and the very high investments needed in seamless tube producing plants.

Recommendations

1. Bahia is already well equipped in welded tube manufacturing industries, therefore, new plants are not recommended.

2. The seamless tube producing sector is self sufficient in - Brazil. The erection of new plants in Bahia is not recom mended.

A. 1. 3. 6. Steel sheets consuming industries

Outside of a few exceptions, the majority of steel sheet users have to rely for supply on shearing lines since it is only in rare cases that the three following conditions are given:

- Order above 50 tons.
- Need for normal sizes
- Rapidity of supply

Recommendations

It is recommended to install some shearing lines in Bahia, using as raw materials the coils from the large steel producing plants.

The reasons for this recommendation are the follow ing:

- The shearing lines being supplied directly in batches bigger than 50 t, have an advantage in price of 30% which the fac tories mark up on orders smaller than such a tonnage.
- With an adequate programming, a high coil utilization factor can be achieved, resulting in reducing to a minimum the -

waste offcuts.

- Furthermore, they can provide metal sheets cut to normal size, since the price differences between coil and sheets in normal cuts are important for the metallurgical companies.

In Annex E-4 the general specifications of the recommended shearing lines are included.

A.2. COPPER

A.2.1. Mining

Problems

The presence of an underground aquifer in the basin of Curaça, could present a problem on account of the level of Sao Francisco River (380 m, approx.). It would be convenient to control it before it is reached with the exploitations.

The study on noble metals grades and their possible metallurgy, seems to be not sufficiently documented.

The communications in this zone are a real problem, as the 50 km of road made by the Departamento de Estradas de Rodage da Bahía (DERBA), in order to reach the Salvador-Juaseiro road, are in bad state. The connections with the nearby towns are precarious, too.

In this region, no man-power of medium training level is available.

Recommendations

1. Not to defer the providing of the incentives foreseen by SUDENE.
2. To study the grades of noble metals and to foresee their metallurgy.
3. To construct an 80 km longitudinal road in the zone of the orebodies, connecting the towns of Bárro Vermelho, Poço da Fora, Caraiba and Santa Rosa, in order to add potential to the development of this area and of the above mentioned

towns. To connect this road to the North, with Curaça -- (50 km) and to the SW with Jaguarari (50 km).

4. To anticipate the future needs of increasing the electric power supply making it sufficient for a metallurgy of 70. 000 t, the exploitation of other mines and the development of this area.

5. To study the markets open to sulphur, including in the project its possible future beneficiation.

6. To accelerate the investigation, now being made by the -- CPRM (Projeto Cobre) in the Baçia de Curaça, and to carry out preliminary studies in Sierra Mangabeira.

7. To accelerate in the DNPM the procedures of pending applications for investigation and mining orebeds.

A. 2. 2. Extractive metallurgy

The Caraiba project bases its profitability on the uninterrupted and cheap supply of electric power. The CHESF has a 138 KV electric line coming from the hydropower plant of Paulo Alfonso. The line is 1 km away from the mine and 500 m from the industrial plants. This line is sufficient for the metallurgy of 35. 000 t/year of copper (about 30. 000 KVA); it is possible however, that it will be insufficient for the second stage of the Project of 70. 000 t/year (about 70. 000 KVA).

The capacities contemplated for air blowers will fall short, in respect to the converters to be installed.

The concentrates, with its high contents of nickel, will make necessary not only the recovery of copper sulphate in the electrolitic pots but equally the recovery of nickel sulphate.

Two Walker wheels will not be needed for anodes casting. But, on the other hand, a single anodes furnace will be insufficient and could cause bottlenecks in the process.

According to the available data on the size of the electrolitic pots, the cathodes and anodes will have to be properly dimensioned in order to leave a margin of, at least, 35 cm between the bottom of the pots and the inferior edge of the same.

Taking into account the density of current contemplated in the electrolitic refining plant, the duration of consumption cycle given in the project, of 22 days, may be rather excessive.

The use of electric furnaces to smelt the cathodes is not, in our opinion, justified due to the possible difficulty in controlling the furnace's atmosphere and the high consumption of electric power to process a cold charge.

The range of semi-manufactured products coming from the melting of cathodes has been provided in the project on the base of ingots, plates, billets and wire bars. The use of wire-bars, as a starting material to manufacture wirerod, is now in a rapid decline everywhere; being replaced by the process of continuous casting of wire-rods for its clear advantages in quality of product and improvement of the ulterior process of wire drawing.

Recommendations

1. Existing the possibility of an electric power supply more expensive in the future, together with shortages, we recommend the installation of a single Westly furnace to cover the needs of the first stage of the project and to begin without delay a detailed feasibility study with the aim of carrying out the expansions of the second stage, through the direct smelting of concentrates in converters with oxigen enriched air (up to a 34% of O_2) according to modern trends in copper metallurgy.

2. We also recommend the installation of an air blower for each converter, or a total of 3 blowers of 25. 000 c. f. m. (one of them as a stand-by). This solution allows a better use of the compressed air equipment, with better efficiencies per unit, preventing the cavitation risks in a single air blower of a greater capacity feeding two converters at the same time.

3. We recommend the provision of compressed air motors fed by an emergency tank permitting the converter to tilt and the blowing and cleaning of nozzles in the event of a power shutdown.

4. Two anodes furnaces, instead of a single one, must be installed (ons of them acting as a flywheel receiving copper). A single Walker wheel will suffice for the anodes casting.

5. We equally recommend the substitution of the cathode melting electric furnace by an ASARCO furnace or a similar one, burning propane or kerosene, which makes possible the melt

ing of cathodes with an automatic control of the furnace atmosphere.

6. The number of electrolitic cells will be a multiple of 12 in order to be able to carry out every day the same routine of cathodes and anodes reposition and making unnecessary to work on Sundays and the use of swing shifters.

7. We strongly recommend the elimination of wire-bars as a starting semi-finished product for the manufacture of wire rod, and to produce these in a plant following the "Southwire" or "Dip Forming" processes.

   In the Annex E-5, the fundamental technical and economical characteristics of these "wire-rods", manufacturing processes are summed up.

A. 2. 3. Copper transforming industries

The prime mover effect of the Caraiba project and the installation of a production unit of "wire-rod" as a final stage or the electrolitic refining plant, according to the above recommendations, will make possible in the next years the - laying-out of a transforming industry of a growing importance in Bahía State. It is impossible, however, at the sight of so many complex problems coming from the degree of the present concentration of transforming industry in Brazil, to recommend any industry of copper products, of a concrete character, to be started in Bahía; this would only be possible after a detailed analysis of the future structure of the Brazilian market of copper manufactured products and of the impact that a decentralization of production would cause on the production costs.

A. 3. LEAD

A. 3. 1. Mining

Problems

They are, fundamentally, those coming from the - lack of geological surveys, those due to the fact that the reser ves measured in Boquira will last, at the present rate, only for a little more than three years of mining, and the total of reserves measured and indicated will be sufficient only for - eight years, at the present rate, not covering the Brazilian needs.

A problem that possibly will slow the future develop ment is the one presented by the limitation in the present water supply, as far as it concerns especially to the needs of the ore washing plant.

From an infrastructure point of view, cost problems arise from the production of electric power on the base of their own means, and from the bad state, even today, of the roadway used to reach the road BR-242.

A sensible decrease in output in ton/man has been observed (partly a consequence, of the transition from mountain-mining to underground-mining), joined by the increase experienced by costs and by the decrease in ore grades (due, among other things, to the mechanization and to the increase in tonnage, and to the impoverishment of ore lodes in depth, with an increase in the Zn content).

Another serious problem is presented by the lack of stability of manpower (with a turnover of one to two times a year) and by the lack of specialized manpower.

Recommendations

1. We think a systematic geological survey in search of the lead bearing district of Sierra de Macaubas in a radius of 50-100 kms is necessary and urgent. This survey must be complemented with studies on geo-physics and geo-chemistry and with a boring prospection in order to establish the reserves and realize whether they are sufficient to face the national demand and cover the long-term expansion plans foreseen in the Santo Amaro smelter.

2. Other studies of the same nature but on a minor scale, will have to be made on the known orebodies in Bahía State.

3. Only when the results of these studies have been made available, will it be possible to assess the convenience of taking care of the infrastructure needs (electric power, water supply and roads), in agreement with the probable life of exploitation of the orebodies.

4. Studies on productivity and timing need to be recommended in order to increase the rate of output in Boquira mine.

5. Incentives will have to be established in order to stabilize the laboral population, and to attend to its literacy, work safety and specialisation.

6. Studies with the purpose of improving the present concentration methods will have to be carried out in order to get a lead grade in the tailings of the washing plant not higher than 1%. Future separation of Zn should also be considered.

A. 3. 2. <u>Extractive metallurgy</u>

<u>Problems</u>

Santo Amaro's location exerts a high incidence on primary lead production costs. The concentrates have to be sent by road from Boquira's washing plant to the smelter, 640 kms far away. That represents an incidence of $ 10/ton of lead transported to the smelter.

The technology applied is a traditional one, with no or very little automation of operations.

A very hard problem is the irregular supply of electric power, with frequent interruptions during the rainy season, affecting to the production capacity.

Even though the costs structure has not been made available to us, it can be stated without any doubt, that the productivity conditions of the Santo Amaro smelter results in little or no competition. The price CIF Sao Paulo of lead ingots coming from Santo Amaro is today $ 404,20/t. As a contrast the unitary values CIF of lead imports have been in the period 1.965-1.969, the following:

	1.965	1.966	1.967	1.968	1.969
US $	354,21	313,05	284,96	263,87	295,23

and its comparison with the price of domestic lead dispenses us to make any other comment.

The conditions of little competition of Santo Amaro smelter are fundamentally a consequence from the following factors:

a) The high incidency of transport on the product's structure of costs. It has already been said that our estimate in an incidence of US $ 10/t of lead contained in concentrates hauled from Boquira to Santo Amaro. From Santo Amaro to Sao Paulo, the main consuming point, the lead ingots have to be carried by road some 2. 000 km, equivalent -at today's transportation rates- to US $ 10/t.

b) Low productivity of man-power.

Even in 1. 970, the year in which the output reached its highest point with 14. 600 t, the efficiency by man and working day has not been in excess of 245 kg, while the corresponding figure in industry in the C. E. E. countries averages 1. 000 kg per man and working day. (The largest and best equipped of these plants in Wertern Europe, has given nowadays an index of 1. 350 kgs, per man and working day).

c) High incidence on cost of the raw materials used in the production of primary lead, all imported, with the exception of concentrates and diesel oil. This incidence is specially high in the case of coke, whose present price (CIF Santo Amaro plant) is US $ 99/t. If we analyze the costs CIF of imported coke in Brazil during the last five years the following results are obtained:

	1. 965	1. 966	1. 967	1. 968	1. 969
US $	33, 24	40, 49	42, 29	41, 41	55, 72

That is, the cost of coke CIF Santo Amaro is twice the cost CIF of imported coke, and having in mind its proximity to

Salvador, this means that <u>import duties and harbor charges</u> represent practically an incidence of 100% on the cost of imported coke.

The problem gets even worse by the high specific consumption of coke in the processing of concentrates. The stated consumption reached on 1.970 a total of 6.750 t, equivalent to a specific consumption of 462 kg/t of lead, too much in excess of the 300/350 kg/t which ought to be consumed, keeping in mind the grade of the concentrates processed.

d) A high factor of inactive capacity.

The present capacity of the Santo Amaro smelter, according to official data made available by COBRAC, is 20.000 t/year after the last extensions and improvements in the production equipment. The production capacity of the whole primary - lead industry has been estimated in the period 1.963-1.969 by the Ministerio de Planejamiento e Coordenaçao Económica (Decennial Plan of Economical and Social Development, Volume V, Number 4, page 89) to be 23.600 t/year. We estimate, on our part, that the capacity of Panelas plant has been, since 1.963, of the order of 6.000 t/year. On this base, the capacity utilisation of Santo Amaro plant since 1.963 would be expressed by the figures given in Table - Pb-7.

The high degree of inactive capacity determines, evidently, strong fixed unit costs.

Recommendations

1. According to the market studies, a shortage or lead of some 25. 000 t/year will be evident in Brazil, at the end of the present decade, and this would represent, at the present - price of imported lead, some US $ 7. 500. 000.

   Today, the necessary investments on primary lead metallurgy vary throughout the world as a function of the plant's size, between a minimum of 110 $ and a maximum of $ 215 per ton of yearly output.

   The investment to be made in order to have a plant in conditions of producing 25. 000 t/year of lead would amount to US $ 5. 400. 000, even adopting the highest figure of investment.

   It is recomended to begin the feasibility studies of a new lead smelter of the capacity indicated above, which should be scheduled to be started about 1. 975

2. If the prospections we recommend with a character of urgency in order to assess the true amount of reserves and the quality of Boquira would give favourable results, the location of the said plant could be where the Santo Amaro Smelter is now situated, provided that it could be modernized, and increasing its capacity of 36. 000 t/year, foreseen for 1. 975, up to 60. 000 t/year.

   This solution would have the advantage of using the available present infrastructure, making the total investment per ton less than the $ 215, estimated for a new plant.

3. It is necessary and urgent to take measures permitting the improvement of Santo Amaro present conditions, little or not competitive at all. We recommend, as most important:

a) The availability of a supply of electric power without any outages in order to prevent breakdowns in production and an inactive capacity.

b) The updating of present systems of agglomeration and - roasting of concentrates permitting a better recovery of lead and a higher metallurgical efficiency, with a decrease in the specific consumption of coke.

c) The urgent introduction of the recovery of residual metals in concentrates, fundamentally Ag, Cu and Sb. This would mean nearly $ 10 of subsidiary output per ton of obtained lead.

d) Include in a realistic policy of import duties all those ele ments not produced in the country intervening in the lead metallurgy. This would allow a strong reduction of their present prices, especially those of coke, whose exorbi tant present price is unbearable.

e) An adequate specialized training of man-power with the results of a better productivity.

f) The modernisation of working facilities in the Salvador harbor in order to decrease its present high incidence on the prices of elements imported via that harbor.

A. 3. 3. Manufacturing industries

The inavailability of data on consumption of lead manufactured products, makes it impossible for us to present any recommendation on the idea of implanting some industries of this kind in the State of Bahía.

We think it is important, however, to point out that the study on feasibility of an extension of the capacity of production of primary lead we recommend in paragraph A. 3. 2., should be complemented by a study on the convenience of enlarging the industrial activities of primary metallurgy into a radial system of products -pipes, plates, buckshots, etc. - or through one or several manufacturing lines, such as, for example, the ones formed by the two series of products: metal-oxides-salts-paints and metal-oxides-ceramic varnishes, either in a single plant or in several owned by the same enterprise; this, evidently, would contribute to the profitability of plants producing primary lead.

A.4. MANGANESE

A.4.1. Mining

Problems

They are, in its most part, related to the disperse geographical location of the ore masses, to the large transportation distances and to the shortcomings of the road network.

The geological and geophysical studies available to us are considered insufficient and the exploration works to be very scarce.

It is difficult to compete, in the foreign market or even with other mines in Brazil itself.

The administrative proceedings and the isolation of many mines is motive, especially in the case of many small mines, of starting the exploitation even before granting them the working permit.

Recommendations

1. To perform, at State level, the study and integral survey of manganese ores, possibly through the CPRM with aeromagnetic prospection, ground gravimetry and exploration through pits, and cataloging the orebodies and reserves with the aim of developing the ferroalloys industry. The "Projeto Manganeso" would then be a complement to the "Projeto Cromo".

2. To endeavor the constitution of "Agrupamientos Mineiros" (mining groups), and "Consorcios de Mineraçao" (mining consortions), in those zones where a diversification of mi

nes and owners existe.

3. To expedite the administrative procedures of investigations permits and mining decrees.

4. To study the possible utilisation of manganese ores with high iron content, not adequate for direct utilisation.

A. 4. 2. Extractive metallurgy

The ferromanganese industry and its specific problems

There is a heavy unbalance between the installed capacity and foreseeable demand for the next years.

The excess in production will have to be fundamentaly assigned to export.

It will be difficult to achieve this continuous and regular exportation, keeping in mind the competitive conditions existing in the foreign market.

Recommendations

1. Circumscribing us to Bahía, there is a character of urgency in respect to the manganese ores, to find a solution for their basic problems, following the lines exposed on the paragraph "Mining", along with the administrative and transport problems.

2. We do not recommend new production plants, unless an ensemble study on the future use of the country's production capacity has been performed.

The general lines of this sectorial study whould be as follows:

a) To review and put in order the partial extension programs, classifying them according to technical and economical reasons.

b) To specialize the existing plants, considering their location and resources of their own, and effecting their re-conditioning according to the most modern techniques.

c) To expand the plants, only in accordance with the results gained from the said study, in order to achieve in every single case, an optimum level of production, thinking of the international competition.

d) To reach a coordination within the sector, in order to perform the studies herein indicated.

A. 5. CHROMIUM

A. 5. 1. Mining

Problems

The available chromite has no homogeneity, neither in its chemical composition, nor, even less, in the distribution of the different saleable fractions: "metallurgical", "chemical", "refractory" and "sand".

It presents a high iron content impairing its metallurgical use and, therefore, its possibilities of export.

The exploitations in Coiteseiro are in a very rudimentary technological state.

The exploitations in Ferbasa, especially the preparation and the overburden removal operations, are not carried out according to modern techniques.

The transportation from the mine to the railway station is made by a very rough road.

The railway branch from Senhor de Bonfim to Campo Formoso, presents a limitation in transport, at today's conditions, to 10.000 t/month, a fact that may cause an incidence on a future increase of production. On the other hand, both the Campo Formoso railway station and the railway track are not capable of handling a normal traffic with 30-40 tons. wagons.

Recommendations

1. To carry through a regional aeromagnetic study in order to detect the whole of mineralised areas and to allow a

first estimative cubage of the mines.

2. To provide for other studies and explorations, as a complement to the CPRM's "Projeto Bahía", in order to define in each body the cubages of the different types of ore.

3. To perform a working plan to permit the reaching of higher banks in the overburden removal and, possibly, to use a gravity conveyor to the dump.

4. To study and test, in a pilot plant, the possibility of increasing the ratio Cr/Fe, specially aimed towards the international competition and the low-carbon ferrochrome production.

5. To try to establish a merger of the chromite mines, with common ore dressing facilities.

6. To study the possibility of a cable carrier, from the exploitations to Campo Formoso.

A. 5. 2. Extractive Metallurgy

Fundamental Problems

The problems, as a whole, are fundamentally a consequence of irregularities in composition and grain size of the available chromites, as has been pointed out above.

The existing difficulties in transport reflect themselves in the price of mineral at works, in a proportion not less than a 25% of chromites' cost at mine.

The production facilities present an obsolete technology, with a very inefficient mechanization and a high cost in -

man-power, specially in the departments taking care of the furnace's burden preparation.

The power supply, given the transport characteristics at 69 KV, represents a charge in its cost of nearly a 25% -per KWh-, in comparison with that allowed by a 220 KV transport line.

The specific consumption of electric power -estimated in 5.000-6.000 KWh/t- is too high if compared with the 4.500 KWh/t corresponding to other foreign installations.

The carbon specifications of the produced ferrochrome (6-9%) are higher than the international ones (4-6%).

Recommendations

1. The ratio Cr-Fe in the chromites cannot be substantialy improved by purely physical processing methods, as the biggest part of iron is found as a constitutive element of spinel crystals. It is then necessarv to provide for chemical processing methods. While the iron in natural chromite is not soluble in acids in an appreciable proportion, it has been known for a long time, that a controlled solution may be used in order to get a high solubility of iron, without increasing in a significative form the chrome's solubility.

   Recently, new processing methods have been developed that combine the benefits of agglomeration of fine concentrates in pellets of a controlled size, with a practical solution for the problems of roasting and leaching.

We recommend the study and test of these processes in a pilot plant, in order to establish the possibilities of increasing the ratio Cr-Fe in the chromites of good metallurgical quality, in order to dispose of the proper raw materials of the manufacturing of Fe-Cr LC.

2. With independence from the studies directed towards the improving of chromites, we recommend another feasibility study for the installation of a Fe-Cr LC production plant, in order to face the increasing demand on this type ferrochrome, keeping in mind the anticipated development in the stainless steel production in Brazil for the next years, and the possible exports to the ALALC countries.

3. This plant should be taken into consideration, even though the possibilities of improving the chromites coming from Bahía, would not give favorable results, also remembering that the added value of such a plant, would compensate by far the need of importing chromites of such a quality that would allow the Fe-Cr LC production.

4. Our opinion is that the most convenient location of that plant would be in Bahía, possibly as an extension of FERBASA present facilities where experience and know-how on the problems related to the ferrochrome production already - exist.

A. 5. 3. <u>Other chromite processing industries</u>

<u>Problems to be faced by the refractories and chemical industries</u>

According to the characteristics of the raw material, they come from a lack of homogeneity in its chemical composition and from irregular distribution of the different fractions of "chemical" and "refractory" ores.

Recommendations

To study, in cooperation with the principal chromite mining companies in Bahía, the possibility of installing a common plant to process chromite, in order to obtain concentrates with regular chemical and size specifications. This plant could also work, at miller's fee, ores coming from other local and less important orebodies, in order to reach a total amount of concentrates large enough to cover both the domestic consumption and possible exports.

A. 6. BARITE

A. 6. 1. Mining

Problems

The essential problem faced by the exploitation of barites is, no doubt, the lack of market (which is controlled in the petroleum industry by world-wide trusts) and the poor development of the barium chemical industry within the country at the present time.

A. 6. 2. Industry of barium derivatives

Problems

The problems of the barium salts market are concerned essentially with the comparatively small consumption the Brazilian market has reached to this point for such compounds. Therefore, the installation of production units for them will be feasible, from an economic viewpoint, only on a long-term basis, since all these compounds will be dependent on an economy scaled for the rational exploitation of the abundant raw material available in Bahia.

Moreover, the fabrication of salts such as barium carbonate in its more valuable form, as used in television screens, requires very much refining and the know-how, backed by wide experience, which only some major members of the chemical industry possess at the present. These applications could even be threatened by alternate products which might have certain technical advantages, among these might be the strontium carbonate.

Recommendations

The scheduled installation in Bahia of an industry - consisting of a wholly new plant for barium derivative chemi- cals will amply cover the needs for these chemicals during the coming years, not only in Bahía, but in the Brazilian market in general. On the other hand, the erection of the Quimica - Geral do Nordeste, S.A. plant will mean, in accordance with the plans of the promoting group, that Quimica Geral do Bra- sil, S. A. will stop making barium derivatives soon after the former begins its production, which obviously, will largely - reinforce its competitive position. Therefore, it is not at all advisable to recommend any other installation of barium deriva tive chemicals in Bahia for the time being.

A. 7. MAGNESITE

A. 7. 1. Mining

Problems

The specialized man-power of a medium level is very scarce.

Outputs in tons/man are low in the exploitations.

The roasted product, in conventional kilns, is of a medium quality and the fuel (wood) used to generate the gas in these kilns is becoming scarce and its price is increasing.

In the future, when new Harbison Walker units will enter in operation, the transportation of the ore from Brumado by railway, may be problematic.

Recommendations

1. To mechanize the ore sorting out of mineral, possibly by making the loadings in mine with loading shovels to tilting trucks and, later on, to proceed to a volumetric screening with a subsequent hand sorting in conveyors.
2. To intensify the investigations carried out by Magnesita, S. A. in order to take advantage of the minus 4'' fraction.
3. To study the substitution of conventional kilns for more modern installations, or, at least, to transform them for the use of fuel-oil as a combustible.
4. To organize in Brumado, with the State's help, a Workers' Professional Promotion Center enabling the specialization of personnel, not only for these mines, but also for the

neighbouring zone of manganese ores (Urandi).

5. To proceed, at the State level, in the planning of electrification in the Brumado district, thus ensuring the availability of electric power for the expansion of the existing installations.

6. To perform a detailed geological study in the Sento Se district, complemented with exploration boring of the ore masses to study their chemical composition and available reserves.

A. 7. 2. Extractive metallurgy

Problems

The raw material to be processed into metallic magnesium, will be, for a indefinite time period, the magnesium chloride imported from the United States.

Recommendations

To initiate studies with the goal of achieving an economical utilization of raw materials existing in Bahia or in the North-East (magnesite, carnallite) in the production of magnesium chloride.

A. 7. 3. The magnesite transforming industry

Problems

They arise, fundamentally, from the transportation cost of magnesian sinter to the refractories plants, and from the costs represented by the harbor-charges in Salvador, for export.

The impact of railway transportation costs from Brumado to Contagem is about US $ 11/t., from Brumado to Salvador, US $ 7/t., and the Salvador harbor-charges is 5-7 $/t. The latter figure represents more than a 10% of the selling price for export sinter.

As for Castella orebody, although we have no information on transportation costs, they must be even higher, considering the used systems.

Recommendations

Apart from the general recommendations on substructure made in the corresponding chapter, we must insist on the need of improving Salvador harbor facilities, a recommendation we already made when studying lead, and representing a general desire of industry.

The presence in the State of Bahia of magnesite orebodies which may be considered as the most important in the world, more than justifies a feasibility study for the installation of a basic refractories plant in the said State, with an easy and inexpensive way out for products to the port. Such a plant would be basically aimed at the exportation of this type of refractories to the South-American market.

This installation would represent a notable added value on magnesian products, as the difference in sales price between the magnesian sinter and the basic refractories is in the order of US $ 130 per ton.

A. 8. ALUMINIUM

A. 8. 1. Extractive metallurgy

These problems have been clearly exposed in the conclusions of the Coordination Group for the Aluminium Industry, of the Plano Decenal de Desenvolvimento in 1. 967.

Nowadays, the situation of supply of certain matters needed in the production of primary aluminium has improved, above all, the costs of electric power. Although no comparative data have been made available to us, from the gathered information, it can be estimated that for 1. 971 the cost of the elements necessary to produce a ton of aluminium will be 40% higher than the respective international costs, but in 1. 967 it was nearly 79% higher.

Recommendations

The same ones stated by the Coordination Group referring to the prices of imported elements.

A. 8. 2. Transforming industries

Problems

Bahia's cables plant had an output, from 1. 969, of the following cable tonnages:

	Gross weight (t)	Weight in Al (t)
- 1. 969 (6 months)	745	541
- 1. 970	2. 789	1. 968

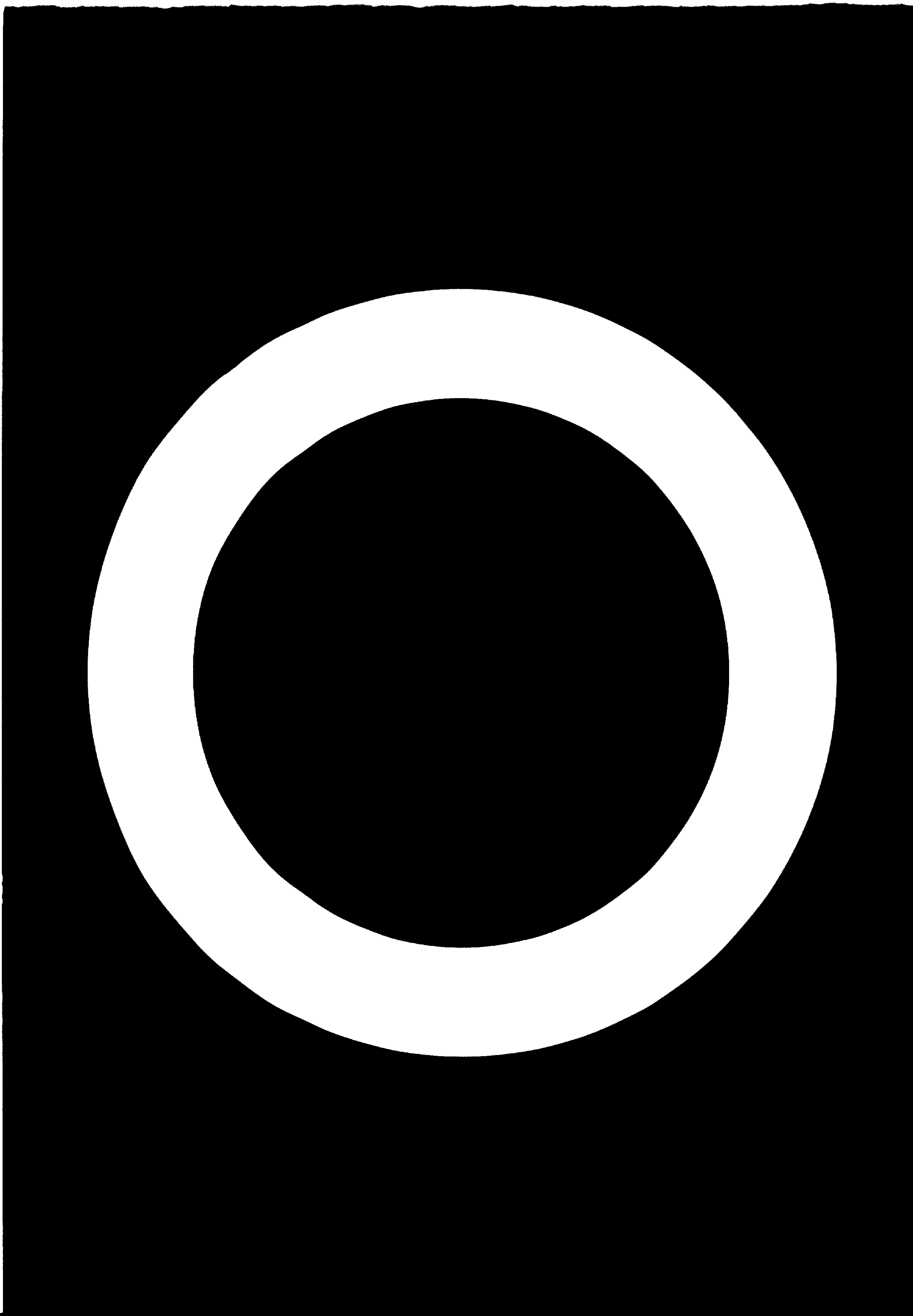
The plant has stopped its production from December, 1. 970, to March 1. 971, due to the lack of orders.

Recommendations

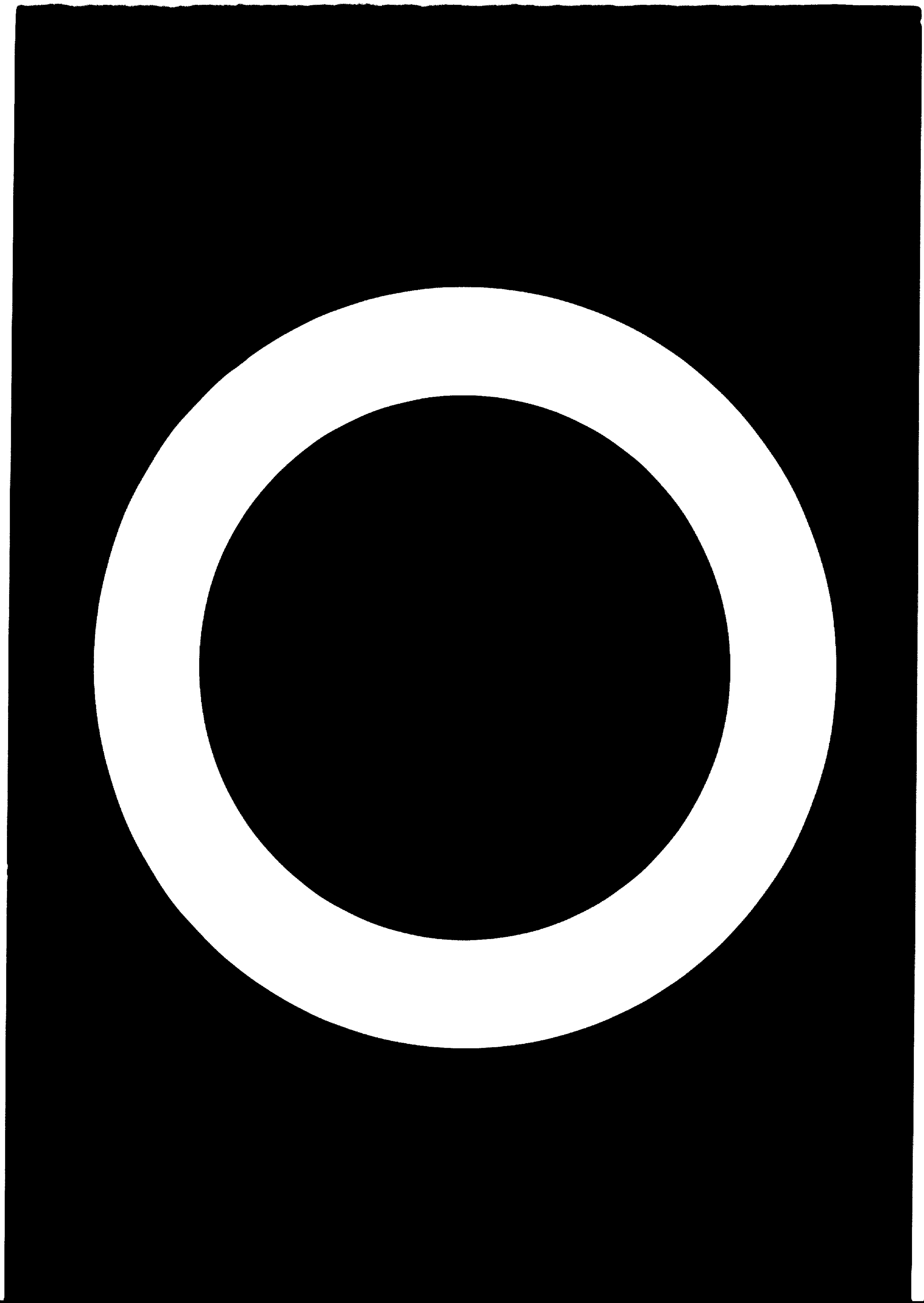
During the last two years, the aluminium manufacturing industry has experienced a strong impulse in the area of activities of SUDENE.

The prime mover effect of Aratu's primary aluminium production plant, will promote the development of this sector in Bahia; that however, must be made with a careful planning according to the market's needs, in order to prevent situations such as the one experienced by the cables plant of ALU NORDESTE.

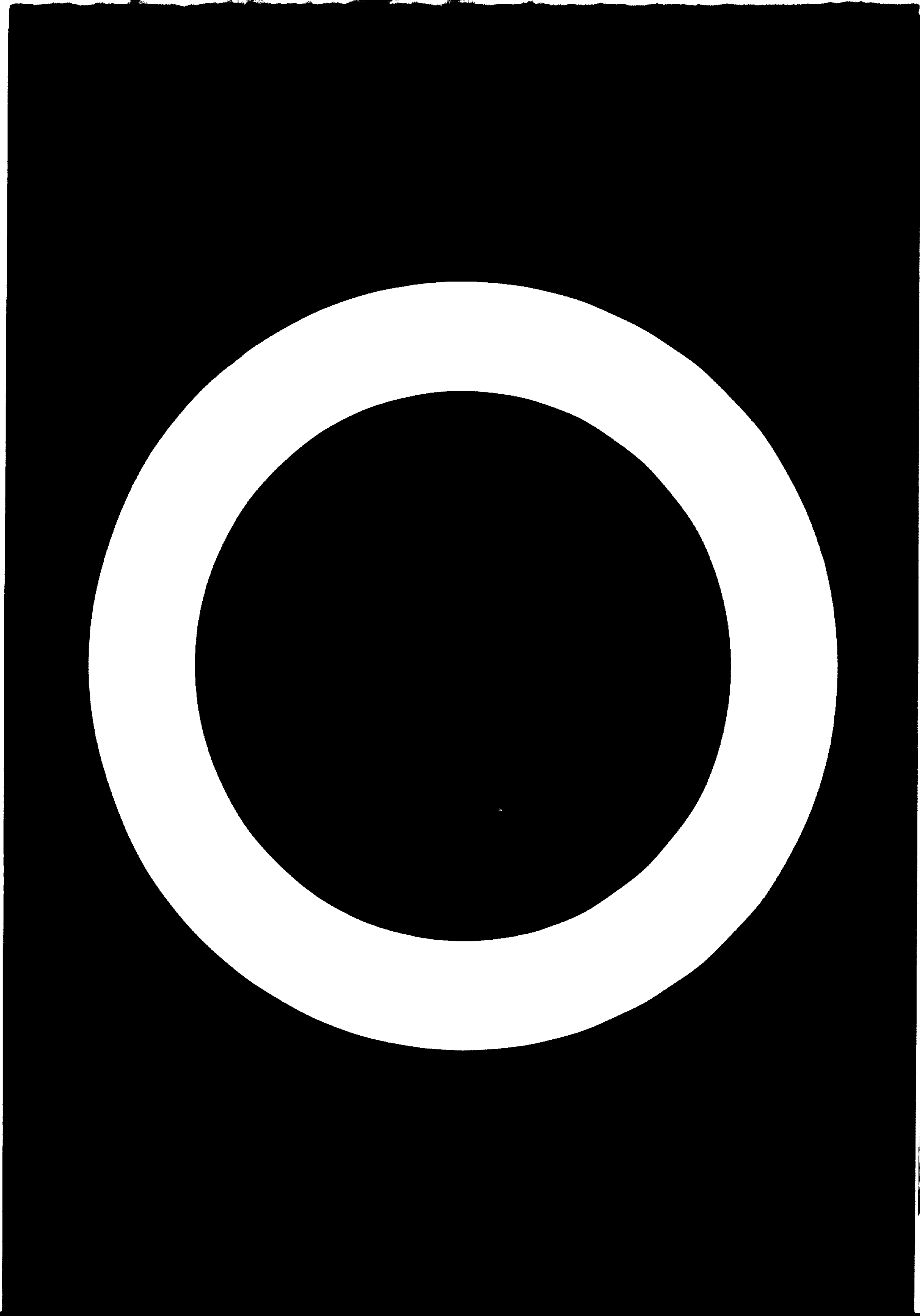
Therefore, at this moment, no specific recommendation can be made on new aluminium transforming industries in Bahia.



B - STUDY OF SIGNIFICANT FACTORS WHICH MAY INFLUENCE THE DEVELOPMENT OF THE LOCAL METALLURGICAL INDUSTRY



B.1. INFRASTRUCTURE



B.1.1. INTRODUCTION

It is not within the frame of this report to undertake an exhaustive study of Bahia's infrastructure, therefore only succinct details are given of those most relevant aspects which to a certain extent might condition the process of the State's economic development.

In the pages that follow, population, income, transport, communications, ports, electric power and water are studied. The joint conclusion is not optimistic as far as the present situation is concerned, but it is hopeful as regards the situation in the near future according to the type of infrastructure.

At present only one area affords infractructural conditions and that is the Aratu-Feira de Santana axis with some branches inland of Reconcavo.

Although even in this region the infrastructural allowances have noticeable deficiencies, they can only condition development, not prevent it. In this sense, we must say that the existing infrastructure, if not the best, is sufficient for the "take off" phase of the economic development process.

The circumstances are very different in the rest of the state, except in the Senhor do Bonfim and Juazeiro areas. However, apart from providing this remaining area with minimum levels, the main effort, due to the limited resources, must be concentrated in the above-mentioned Recóncavo district. A dispersal of efforts throughout the state might produce bottlenecks in the best equipped region which muet therefore enjoy priority.

B.1.2. **POPULATION**

B.1.2.1. **General Points**

Bahía had in 1.970, according to the census data, 7.420.906 inhabitants, which represented 8% of Brazil's population, calculated at 92.237.570 people (1). Table P-1 shows this data.

Bahía's population forms each time a smaller part of the country as a whole.

	Bahia's % population of Brazil's
1.900	12.15
1.920	10.87
1.940	9.50
1.950	9.31
1.960	8.44
1.970	8.00 (estimated)

The N.East region, of which Bahia is part, has followed a trend similar to that of the latter State. In 1.900 it possessed 38.7% of Brazil's total population and in 1.970 only 30.5%.

The decrease has been relatively more marked in Bahia than in the N.East region. Bahia's population represented the following percentages of the total N.East population in the census years shown below:

(1) This information is still not definitive, as some Amazon territories are not accounted for. However, due to the insignificant nature of uncollated data, the mentioned percentage will not vary.

	% Bahia of N. East
1.900	31.38
1.920	29.65
1.940	27.14
1.950	26.90
1.960	26.71
1.970	26.30 (estimated)

Nevertheless, in the last census, a certain trend to stabilization has been observed in Bahia's population relative weight as regards that of the N. East.

B.1.2.2. Geographic distribution of population

The state's population density was 13.2 inhab/km^2 in 1.970, higher than the average in Brazil (10.8 inhab/km^2) but clearly lower than if one excepts what has come to be called the demographic void. The density of the N. East, South East and South regions as a whole rises to 27.7 inhab/km^2.

The main centres of population in the state are:

- Salvador	1.001.000	inhabitants	in	1.970
- Feira de Santana	136.000	"	"	1.968
- Ilheus	101.000	"	"	"
- Vitoria da Cosquista	90.000	"	"	"
- Itabuna	88.000	"	"	"
- Jequié	84.000	"	"	"
- Alagoinhas	75.000	"	"	"
- Jacobina	60.000	"	"	"
- Ipirá	54.000	"	"	"
- Sto. Amaro	54.000	"	"	"

The total given by these towns accounts for approximately a 1/4 of Bahia's population.

To call this 25% an urban population, does not seem to us a defendible position, though, in effect, these centres are great agglomerations of people; but if what characterizes an urban centre are collective services of a certain quality and a modern, standardized way of life, then it is obvious to conclude that the above-mentioned towns contain population masses of a rural nature because, in general, they do not possess those services and ways of life referred to earlier. We will keep this information as a pointer, if nothing else.

B.1.2.3. <u>Demographic movements</u>

The annual accumulated growth rate for the period 1.960/1.970 in Bahia state rose to 2.2% as against 2.7% for all Brazil's.

Although the birth and death rates are not kwown with exactness (study of the census statistics has not been very great) we estimate that for Bahia thet are 4.6% and 2.0% respectively. The same rates for all Brazil are 3.9 and 1.2%.

The vegetative growth rate (birth rate minus death rate) is 2.6% in Bahia and 2.7% for Brazil. (External migrations have been without importance in the last decade so that it can be said that Brazil's population has increased exactly according to its vegetative growth rate).

In the last decade Bahia has lost 18.2% of its vegetative growth (1), about 365.000 people, the net balance of migration from the state.

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(1) $\frac{\text{Veg. growth rate - real growth rate x 100}}{\text{Veg. growth rate}}$

Although important, the migratory movements in Brazil still do not reach the foreseeable volume for a country with regions of relatively heavy industrialization and others with pre-industrial economies. Therefore, a sharp rise in these migratory movements can be forecast for the not too distant future.

The population of Salvador, capital of Bahia, increased by 345.000, from 656.000 to 1.001.000 inhabitants. This increase accounts for a quarter of the state's increased population.

The vegetative growth of Salvador was 195.000 people as it received 150.000 from the rest of the state, an internal migratory balance which, added to the migratory balance away from the state, totals up to a balance for Bahia (excluding the capital) of 515.000 people.

B.1.2.4. Active population

This information is very small and data gathered at census time has not been studied. The absence of details and figures really only prevents the exactness of quantification and not the characterisation.

The potentially active population (1) can be estimated at 60% of the total. The real active population hardly reaches 40% and even this figure conceals high percentages of underemployment and hidden unemployment.

The distribution of the active population by sectors is even more difficult to ascertain. However, through the different

(1) Population of both sexes and aged between 14-65, both inclusive.

involvement of the three basic sectors on the net internal product (NIP) of the state and the different productivities by sectors it can be estimated that each one of the sectors occupies the following parts of the active population:

Primary sector	60-65%
Secondary sector	7-8%
Tertiary sector	25-30%

An interesting piece of data still to be collated is the relative importance of child labour, a phenomenum which is seen in other countries and underdeveloped regions.

B.1.3. INCOME

In has not been possible to find statistics concerning incomes in Bahia, but using data from the Fundaçao Getúlio Vargas and the Anuario Estatístico do Brasil we have calculated with a certain margin of error the absolute NIP and the NIP per head (Table IN-1 and graphs IN-1 and IN-2), the composition of the NIP (Table IN-2), and the share of Bahia's NIP as a proportion of the whole of Brazil (Table IN-3). Brasil's NIP in 1.967 rose to 250 USA $ and Bahia's to only 135 USA $.

As can be appreciated, the situation in Bahia is much more unfavourable than in the reet of Brazil. However, its NIP has grown faster than in Brazil as a whole. This growth, comparatively higher, is accentuated if we refer to the NIP "per capita", because of the slower growth rate of Bahia's population. If this proportion between increaees is maintained, Bahia could reach the Brasilian income "per capita" within about 30 years, a worthy goal if one bears in mind the strong advances forecaet for the Brasilian economy as a whole. The period estimated could even be reduced by a heavy migratory process, (already apparent in the decade 1.960-1.970) and which will undoubtedly grow in the future.

It could be said that there is an excess of manpower in Bahia, either unemployed or without work. Thus we come to the second point worthy of commentary. Bahia (which repeats the situation in the whole country) obtains more than half its NIP from the tertiary sector; namely, what has come to be called "Services" achieves a percentage not from industrial society but from post-industrial societies. The obvious conclusion is that this sector conceals a great part of the active population out of work or underemployed, whose incomes, more than answering to the name of real services, do so to the name of apparent or superfluous or, more probably, subsidies.

Table IN-2 offers still more information. The NIP obtained from agriculture has remained at a constant proportion and the corresponding part to industry has decreased. The situation in the whole of Brazil as can ve appreciated has been quite the reverse in the last thirty years, although it cannot be said that the rate of industrialisation has been very fast. It can be noted that in Brazil the NIP obtained from agriculture has increased in the years 1.965/69 at an annual rate of 2,4%, lower than the population increase in the decade 1.960/70. Industrialisation is, therefore, the most appropriate recommendation, but without neglecting the primary sector.

It is precisely the primary sector, properly rationalised and mechanized, that could offer good opportunities for Bahia. Table IN-3 shows its growing relative participation in the national total.

B.1.4. TRANSPORT

B.1.4.1. Roads

In 1.969 the national Brazilian network of roads was the following according to information from A.E.B.:

	Paved	Unpaved	Total (km)
Federal roads	22.014	28.087	50.101
State roads	20.713	110.603	131.316
Municipal roads	3.610	904.425	908.035
Total	46.337	1.043.115	1.089.452

In the same year the road network in Bahía was the following:

	Paved	Unpaved	Total (km)
Federal roads	1.515	2.489	4.004
State roads	799	4.853	5.652
Municipal roads	16	53.884	53.900
Total	2.330	61.226	63.556

Thus, while in 1.969 Bahía represented 6,59% of Brasil's total area and 8% of its population, it only possessed 5,83% of the road system, a percentage that would be reduced to 5,02% if one only took into account the country's paved roads. This difference would be even more marked if we excluded that part of Brasil not properly explored.

Furthermore, the upkeep and signalling of the roads are bad, except for the federal highways.

The basic network is composed of:

Road BR-116-Link to the South

" BR-242-To Seabrá and Ibotirama

Road BR-324 and its branch road BA-130 which links up with Juazeiro and the North

" BR-110-To the North

" BR-101-to Sergipe

In the Recóncavo area there is a sufficient secondary network of roads.

In 1.967 Bahía possessed 48.000 passenger vehicles including motorcycles and cars and 18.000 goods vehicles.

In the same year there were 70 transport companies, of which 61 dealt with passengers and only 9 with goods traffic. Of a total of 245 transport routes (goods and passengers) only 9 were interstate.

B.1.4.2. Railways

In 1.969 Brazil had 32.015 km of railway track of which Bahía possessed 1.946 km (6,08% of the total). All of Bahía's railway system has the metric gauge, which is most common in Brazil, a country where railway facilitixes are scarce.

The quality of track in Bahía is deficient; less than 1/2 of the lines can be considered to be in good condition. The tracks is single laid almost everywhere and follows the natural geography too slavishly.

Feira de Santana, the most important communication junction in the State, is at present without railway service.

The general layout of the state network is in the shape of a centrally situated ring, with four branch lines that fan out from the cities of Mapete to Salvador, Sao Francisco to Sergipe, Senhor do Bonfin to Petrolina and the North and from Iacu to South-Central region of Brazil.

There is also in existence a line that goes from Jequie to Nasaré, without linking up with the rest of the network.

Leste Brasileiro is the federal division responsible for Bahía's railways. The Ferrocarril de Leste possessed 83 locomotives in 1.969 (6,24% of national total), of which 29 were steam powered (8,17% of national total), 155 passenger coaches (5,33% of national total) and 1.041 goods wagons (3,27% of national total).

The Ferrocarril de Leste moved 8.560.000 passengers (2,82% of national total) in 1.969 which represented ---- 218.969.000 passenger-km (2,31% of national total).

In the same year goods traffic reached 460.000 tons (1,45% Brasil's traffic) representing 247.386.000 tons/km (2,18% Brasil's total).

In 1.965 the Ferrocarril de Leste had carried --- 8.989.000 passengers and 419.000 tons, which means passenger traffic fell by 3,80% (a result of a fall in internal traffic, as suburban traffic increased) and goods traffic rose in the period 1.965/1.969 by 7,85%. During the same time the average distance travelled by ton rose by 27,12%, from 424 km to -- 539 km.

In short, the Bahía network must be reckoned as - very unsatisfactory because of its low level of maintenance, its poor productivity, its lack of modern wide gauge track and because it has not reached those areas with the best development prospects. What one finds most encouraging are the low prices which could stimulate traffic by rail; namely, 0,0127 NCr $ - passenger/km (0,3 US cents) and 0,0237 NCr $ ton/km (0,8 US cents) (prices in 1.969) which are extremely low if compared internationally, but higher, on the other hand, when compared with Brazil's average prices: 0,0103 NCr $ and 0,0291 NCr $, respectively. In any case, prices even low are only a relative encouragement, given the bad conditions of the railways in Bahía and all of Brasil.

B.1.5. **TELECOMMUNICATIONS**

In 1.968 only 62 cities in Bahía had telephone services. The telephones in operation totalled nearly 30.000 and approximately 65% were concentrated in Salvador. The regional distribution of telephones installed in the same year was the following:

Area	Area	Area
Salvador (19356)	Valença (162)	Xiqué-xiqué (40)
Feira de Santana (370)	Ribeira de Pombal (196)	Barreiras (30)
San Antonio de Jesús (561)	Senhor do Bonfim (343)	Vitoria da Conquista (1782)
Serrinha (570)	Brumado (214)	Itabuna (2357)
Itaperaba (100)	Juaseiro (550)	Medeiros Neto (370)
Jequé (860)		

In 1.968 there were 1.160.000 telephones in operation in all Brasil (1) which represents 13 telephones per 1.000 inhabitants (Spain, in the same year had 115 per 1.000 inhabitants). This figure, with reference to Bahía, was only 4 telephones per 1.000 inhabitants.

The additional demand in 1.968 was for 52.000 telephones; bearing in mind that expansion plans forecast for 1.971 a network of more than 70.000 units, which means the inetallation of more than 40.000 new telephonee. Hardly 80% of the requests made three years before will have been satisfied by that time.

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(1) All information as regards telephones in service refers to main connections and excludee extensions, etc.

The inadequacy of the service is its main feature and it cannot be said that its prospects are altogether encouraging. In the long-term a total number of 440.000 telephones is forecast for 1.988. If Bahia's population continued to increase at an annual rate of 2% (in the period 1.960/70 between censi it rose annually by 2,2%) it would have 42 for every 1.000 inhabitants in 1.988; in other words, a third of the Spanish figure 20 years earlier.

Thirty percent of the telephones installed up to 1.968 were manually operated while in the rest of Brazil this figure stood at only 10%.

In addition to the inadequate numbers and the manual operation of the exchanges, one must bear in mind the poor facilities for calling other urban centres. In 1.968 for example, Salvador was linked to only 27 of the remaining 61 urban networks within the State, which explains the very high concentration of interurban traffic. In March 1.968, out of a sample of 14 cities and a total of 70.163 minutes of conversation, Salvador managed to monopolize 88% of the traffic. In the case of calls from Itabuna to Ilheus, 99% of the traffic was made with Salvador.

In 1.968, the expansion of Bahía's interurban networks accounted for only 0,35% of the Brazilian total, although its number of telephones rose to 2,56% of the country's total. The number of circuits represented 1,90%, which seems to point to a certain investments effort, a point confirmed when we consider that its microwave circuits accounted for 6,49% of the national total. However, it must be stated that in 1.968 investments in specific telephone equipment were only 0,70% of Brazil's accumulated investments. New investments for 1.968 already represented 2,51%.

In conclusion, it can be said that Bahía's telephone system is inadequate, overloaded and not remotely comparable with international standards as far as quality is concerned. In recent years, there has been a certain renewed vigour in investments, which must be multiplied if Bahía really wishes to overcome the problems in existence and not just alleviate them.

Once again, Salvador and the Reconcavo area zone have the best equipment, while the rest of the state depends almost 100% on the telegraph.

B.1.6. PORTS

B.1.6.1. General Points

Administrative red tape, slowness in loading and unloading operations, lack of deep water and inadequate links with their respective hinterlands are the main characteristics of the ports to be found in Bahía.

The two most important ones are Salvador and Ilhéus. In the Reconcavo zone there is the privately-owned terminal, Alves Camora, where oil is shipped out and Puerto de Sao Roque where mainly mineral ore is loaded and unloaded. The following ports of lesser importance, exist in Bahía too: Valença, Taperoá, Ituberá, Canavieiras, Porto Seguro, Nilo Peçanha, Balmonte, Camamú, Caravelas, Campinho, etc.

Serious problems due to the lack of inland communica tions, especially railways, which serve the Bahía's ports have kept the growth of traffic movements at a standstill during the decade 1.960/70, in benefit of land transport. At present, the State is re-examining the situation and one of its agencies, GEIPOT, is studying the minimum network necessary for linking Bahía's ports to their hinterlands.

B.1.6.2. Existing ports

a) Salvador

It began operations in 1.913. It has a quay-length of 1.480 m and 7 km of internal rail track. The depth varies between 4 an 10 metres. In 1.969 there was a movement of 906 ships and 659.000 tons of goods, though it has facilities to accomodate up to 1.500.000 tons.

b) **Ilhéus**

It began operations in 1.925. It has 478 m of quay--length, 703 m internal rail track, is without cranes and the depth of the port varies between 2 an 3 metres. In 1.969 there was a movement of 203 ships (139 anchored outside the harbour) and 240.000 tons of merchandise.

c) **Other ports**

In the remaining ports mentioned there is very little traffic and their depths are inadequate. Only Madre de Deus and Camamú have depths of 10 m. Caravelas, which is deeper (15 metres), has an access bar limited to a depth of 1,5 m.

B.1.6.3. **Projects**

a) **Salvador**

Construction work is in progress in Sao Joaquín bay for the terminal of the Salvador-Itaparica-Nazaré Ferryboat.

Many of the transport problems in the Recóncavo area (and above all in the South of said area) will be solved when this Ferry becomes operational.

However, the development possibilities for this port are quite limited due mainly to Salvador's urban distribution and the expansion of "Downtown".

b) **Aratu**

Under the joint ownership of companies established in this industrial centre, a big terminal is being built for liquid bulk shipments in Punta de Marinho and solid ones in Ponta de Joao Pereira.

It is forecast to become operational in 1.973 with a capacity of 1.000.000 tons/year, rising in four stages to 12.000.000 tons.

It is the port with the best conditions and has an access bar 17 m deep. In its first stage it will be capable of taking ships up to 35.000 tons DWT and 12 m draught, while by the fourth stage ships up to 100.000 tons DWT and 17 m draught will be able to dock.

Adequate rail links and roads will be built, and in the future it will be Bahía's first modern well-equipped port.

c) Ilhéus

Given the nature of the old site, it has been decided to build a new port at Pontal do Malhado, which will become operational in 1.971. It will be able to take ships with up to 10 m draught. It will be used mainly for the shipping of cattle ang agriculture products.

d) Campinho

Likewise planned to become operational in 1.971. There is still the problem of road and rail links to be resolved. It will have a depth of 10 metres and will mainly be used to ship out agricultural produce from Sao Francisco Valley, cocoa from the North, and ores in which its hinterland is especially rich.

e) Other projects

The terminal at Ponta de Sapoca, property of USIBA, will take, to begin with, 350.000 tons/year of iron ore or pellets.

Terminal at Ponta de Periquito, property of MAGNESITA, S.A., to ship out magnesite.

Terminal at Hevea de Bahía for shipment of wood.

B.1.6.4. <u>River ports</u>

At present the Sao Francisco river is being dredged and signposted, for a distance of 1.200 km, between the towns of Juaseiro (Bahía) and Piraporá (Minas Gerais), to enable said river to be used as a means of transport. Two river ports are being built, one at Juaseiro and onather at Petrolina. Both will be used mainly for shipment of gipsite, it is calculated that the traffic movement per year will be 200.000 tons.

B.1.7. WATER

Thirty eight percent of the townships in Bahía state are provided with mains water supply. Another 20% have projects planned for the future and the remaining 42% have neither water supply systems nor projects.

Consequently, Bahía's water supply network is characterized in the first place by its inadequacy. Secondly, by its inefficient utilization as almost 3 million people could at present be connected to the mains but in reality less than a million are. Undoubtedly, this situation is caused by the low levels of economic development and the low incomes per capita of the population.

Ninety percent of the water used comes from captations on the surface (rivers, reservoirs, etc.) and the other 10% from underground sources. The present volume of water available is calculated at about 8 million cubic metres/month, of which a sixth is untreated.

Only Salvador and the Reconcavo zone possess water in relatively abundant quantities, as is the case with other services and supplies. The situation of "Industrial Centre" at Aratu is especially privileged; abundant water, big projects under way, and the lowest prices in the State, although they are not excessively so when one takes into account the present development levels: 0,24 NCr $/m^3$, and water to cooling purposes almost free of charge. In the rest of the State, the rates vary between 0,40 and 0,50 NCr $.

If the water supply systems are quite unsatisfactory then the means for sewage disposal are even more so. In 1.969 there were only 8 of such systems for the whole State.

In spite of the present inadequate situation one must remember the positive efforts made by SUDENE, in recent years; it has already planned and put into operation a good number of supply projects. In this respect, one can look forward to the future with a certain amount of optimism.

B.1.8. ELECTRIC POWER

B.1.8.1. General points

Bahía after producing in 1.960, 996 million KWH (5,4% of national total) and 3.407 million KWH (10% of national total) in 1.969, only consumed in the same years 248 and 857 million KWH, respectively (1,3% and 2,5% of national total). For the sake of comparison it is worth bearing in mind that Bahía possesses 8% of Brazil's population.

Installed power in the same period rose from a capacity of 230 MW to 720 MW (5,2% and 7% of national total); the latter corresponds almost entirely (665 MW) to the hydropower plant at Paulo Afonso.

Bahía more than tripled its consumption of electricity in the period 1.960/69 (tables PW-1 and PW-2), while Brazil and its most advanced states only managed to double theirs. Therefore, with these absolute consumptions, in 1.969 Bahia had reached a figure of 122 KWH consumed "per capita", three times as much as in the "take-off" year (in 1.960 42 KWH/ /inhab.), as against a much lower growth for the industrialized states (Sao Paulo had a 50% increase per capita in the same period of time) and an even less marked growth for Brazil as a whole (40% increase per capita) (see table PW-4).

This accelerated growth in Bahía, however, must be qualified by two facts;

- The starting figure for 1.960 was so small that any increase would have appeared spectacular. Even though the growth rate for Bahia was much higher than Brazil's (as a whole) the absolute increase per capita was only 80 KWH for Bahia, as against 108 KWH for Brazil and 295 KWH for Sao Paulo.
- Salvador, with a population representing less than 15% of

Bahia's accounted for 60% of the State's total consumption of electricity.

In the consumption of electric power for industrial uses there was a percentage increase even higher than in the total consumption, lifting its relative share from 38,7% in 1.962 to 49,2% in 1.969; even so these figures are still lower than those for Brazil, where the increase was in line with total consumption increases. This is repeated in the most developed states like Sao Paulo, although there the relative share is greater than the national average (see table PW-3).

It must be noted that for Salvador, industrial consumption represents only 30% of the total, while for the rest of the State the corresponding figure is 70%, very much above the national average. This fact demonstrates the low level of the use of electricity for domestic purposes, public lighting, etc.

Bahia is a state with vast possibilities as far as - electrical power is concerned, owing to the two basic factors; the Sao Francisco river is still not harnessed for its power and there are oil wells.

B.1.8.2. <u>Prices</u>

Although possibly lower than prices in other states, Bahia's charges for electricity are quite high.

Table PW-5 provides information about prices according to the different consumption percentages of power used and the different voltages of supplies. The prices in said table refer only to the consumption of electricity for industrial purposes.

There are two reasons for the high charges to the consumer: fiscal policy and invoicing system.

Taxes consist of three distinct charges:

- Electrobás	0.0371 NCr $/KWH
- Impôsto Unico	0.00212 NCr $/KWH
- Quota de Previdência	3% of invoiced total, taxes not included.

Under certain conditions it is possible to obtain from the Electricity Board up to a 98% discount on the first charge. On the surface this looks very good, but it must be qualified. Among other things, in order to claim for the partial exemptions cited, it is compulsory to fullfill the following conditions:

- Mains with tension higher than 13.800 V
- Utilisation factor higher than 30%.

Supplies at the tension mentioned and, above all, said utilisation factors can only be achieved by large plants which, furthermore, must have a sufficiently regular and constant consumption level. As will be explained below, this high level of consumption is only achieved in some instances and is an instrument that discriminates against small and medium-sized companies.

The tax charge on industrially consumed power is 0,045 NCr $/KWH and more, when the utilization factor is not very high, exceeding by itself the total price of KWH for very specific uses. For example, a plant devoted to ferroalloys manufacturing (a very special case) can even obtain an average price of 0,0375 NCr $/KWH with 69.000 V supply line.

However, although the fiscal policy significantly influences the high level of prices, the tariff system employed is much more to blame. We are of the opinion that said system is badly conceived when examined on the basis of economic and technical rationality.

Tariffs fixed at present by COELBA (Companhia de Electricidade do Estado de Bahía) are the following:

a) For tensions between 2.300 and 13.800 V

Demand: 13,00 NCr $/KW contracted

Consumption: 29,76 NCr $/1.000 KWH for first 400 KWH consumed for every KW contracted.

19,13 NCr $/1.000 KWH for KW in excess.

b) Tension higher than 13.800 V

Demand: 11,60 NCr $/KW contracted

Consumption: 19,88 NCr $/KWH for first 400 KWH consumed for every KW contracted.

9,57 NCr $/1.000 KWH for KW in excess.

After a cursory glance of table PW-5, already mentioned, one might conclude that the prices are flexible, in accordance with the level of utilization. However, this flexibility is only apparent, as even a 40% level of utilisation is very difficult to reach.

In fact, a standard industry, one that works 25 days/ /month with a daily shift of 8 hours, will contract enough power for its periods of peak demand. To suppose that its average utilisation during the 8 hours worked does not exceed 50% of the power contracted, does not seem an overadventurous hypothesis but even optimistic. Then, under these circumstances its monthly utilization factor would be 13,89% (1) and the average KWH price would increase to 0,1597 NCr $ (0,2037 NCr $ taxes included) with a supply voltage between 2.300 and 13.800 V, or 0,1359 NCr $ (0,1791 NCr $ taxes included) if the supply voltage was over 13.800 V.

This same standard industry, working 3 shifts per day, would hardly lift its utilization factor above 40% (the corresponding prices can be seen in table PW-5).

As a real example (which highly significant) we are going to indicate the following chosen from various electricity readings collected by our team during its stay in Bahia.

- Type of industry: mechanical workshop
- Power line at 13.800 V
- Consumption: 5.040 KWH
- Invoice, taxes included: 1.467,28 NCr $
- Average price of energy consumed: 0,2911 NCr $/KWH

We must insist again on the fact that the upper utilization levels are only achieved in very isolated examples (in the case, already mentioned, of a ferroalloys plant, a level of 90% could be attained), which because of their regular consumption are exceptions.

The exaggerated cost of power must be attributed to the influence of the fixed factor, since the apparent flexibility in average prices does not really exist, as can be seen in table PW-6. As can be ascertained, the fixed factor, called of

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(1) $$Uf = \frac{25 \times 8 \times 0,5\ W}{30 \times 24 \times W} \times 100 = 13,89$$

Uf = Utilization factor
W = Contracted power.

B-197

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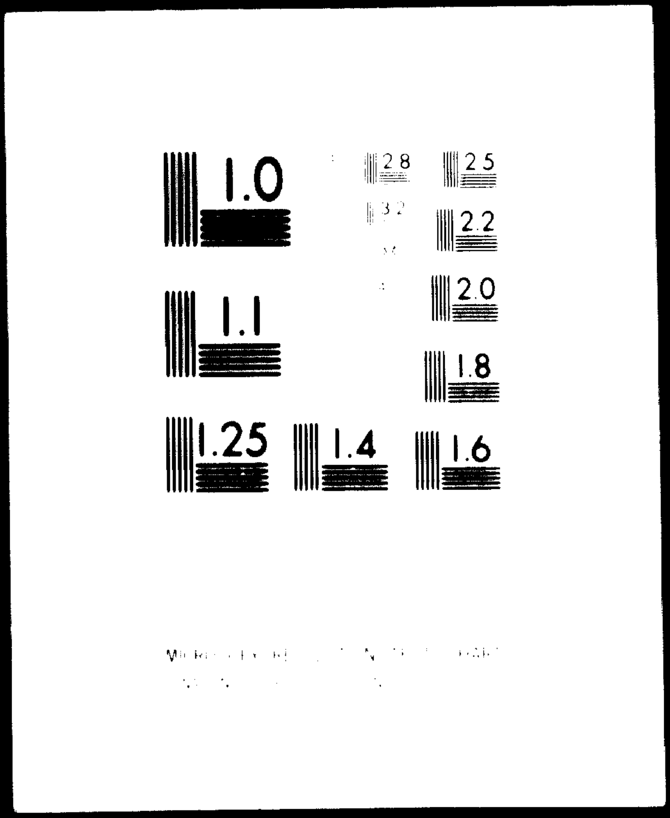

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demand, represents up to 50% of the invoiced total for the maximum utilization level (100%) and reaches 70/80% of the normal levels achieved by the standard industries; only certain types of industries, like that one mentioned of ferroalloys, can use enough power to make the fixed factor as low as 55% of the invoiced total, without including taxes.

B.1.8.3. Comparative prices and tariffs

The tariff system and the resulting prices for Bahia have already been analyzed in paragraph B.1.8.2. To that paragraph and to the pertaining tables reference is made for the following comparisons.

Although there are systems more perfect and prices more attainable than those in Spain, it is precisely the Spanish ones which will satisfy the purposes herein proposed, since it is a country that, excepting the differences involved (which undoubtedly are an important consideration), has many more analogies with Brazil than with the very industrialized countries of West Europe.

With certain qualifications we have decided to take the new Spanish tariffs as a base (so as not to make interminable comparisons); they do not as yet affect all supplies but will do so in a reasonably short length of time. In accordance with the new Spanish tariff system the total price will consist of:

$$\text{Price} = (Ap + Ae)\left(1 + \frac{r}{100}\right)$$

Ap = function of power contracted

Ae = " " " consumed

r = variable factor, according to type and use of supply

There is a base tariff on which the different tariffs for electricity for industrial uses are calculated. The base tariff includes four variants, according to power contracted, and within each variant there are two blocks of hourly utilization per month, with different Ae prices. Below we indicate this base tariff for supply tensions between 1.000 V and 45.000 V.

(The subsequent prices have been calculated from the exchange rate offered when the new Spanish tariffs were made public; that is, NCr $ = 14, 10 pts).

Power contracted	Ap $(1 + \frac{r}{100})$ in NCr $/month Kw contracted	Hours used each month	Ae $(1 + \frac{r}{100})$ in NCr $/1.000 Kwh
Up to 50 Kw	0, 7224	From 0 to 133 From 133 and above	84, 48 66, 69
From 50 Kw	0, 8545	From 0 to 250 From 250 and above	55, 77 44, 07
From 250 Kw	0, 7645	From 0 to 250 From 250 and above	50, 36 40, 47
From 500 Kw	0, 6971	From 0 to 250 From 250 and above	44, 52 36, 42

The average prices, in function of the utilization factor, are shown in table PW-7, to be compared with table PW-5, which shows average prices for Bahia. Table PW-8 shows the effect of the fixed power factor on the price of electricity, according to the different levels of utilization. This table is similar to table PW-6 for Bahia.

The conclusions are obvious. In absolute terms, in Bahía the fixed factor is 14 to 19 times what it is in Spain. Spain's variable factor, on the other hand is 1 to 9 times Bahía's, because it is precisely the variable factor that gives flexibility to the prices. Furthermore, in Spain the fixed factor never represents more than 18% for the utilization levels set down, while in Bahia it reaches 89%; and in Spain it can go as low as 1,4% while in Bahia the minimum figure is never lower than 42%; in other words, the fixed factor is much more expensive and besides influences prices a much greater degree. The differences in the variable factor hardly have an effect on the price differences, which are remarkably higher in Bahia, where normal utilisation levels are involved. Therefore, for a standard industry, working 1 shift, like that described in section B.1.8.2., Bahia's prices are 1.5 to 3.1 times higher than the corresponding Spanish ones. By working three shifts per day, electricity charges for this company would be between 0,8 and 1.5 higher in Bahia than in Spain, but this would not usually be the case; and besides it is necessary to make a qualification. The Spanish prices offered here will only really affect all supplies after 1.973. At present most contracts fix prices 10-20% lower than those applied by the new tariff.

Furthermore, so as to benefit those companies that have only limited shift working, there are special discriminating tariffs in force in Spain (which will be kept in the new system); these are based on hourly period when consumption takes place, by applying to the consumer (at his choice) the following price-correcting coefficients:

Hourly period	Coefficient
Peak (4 hours)	1,50
Flat (12 hours)	1,00
Valley (8 hours)	0,75

which are corrections that do not at all affect industries working continuously, but help those which have one of two shifts, since, given the normal working hours, these usually take place in the

"Valley" or "Flat" periods. In this respect, therefore, the figures in table PW-7 must be changed for lower utilization levels.

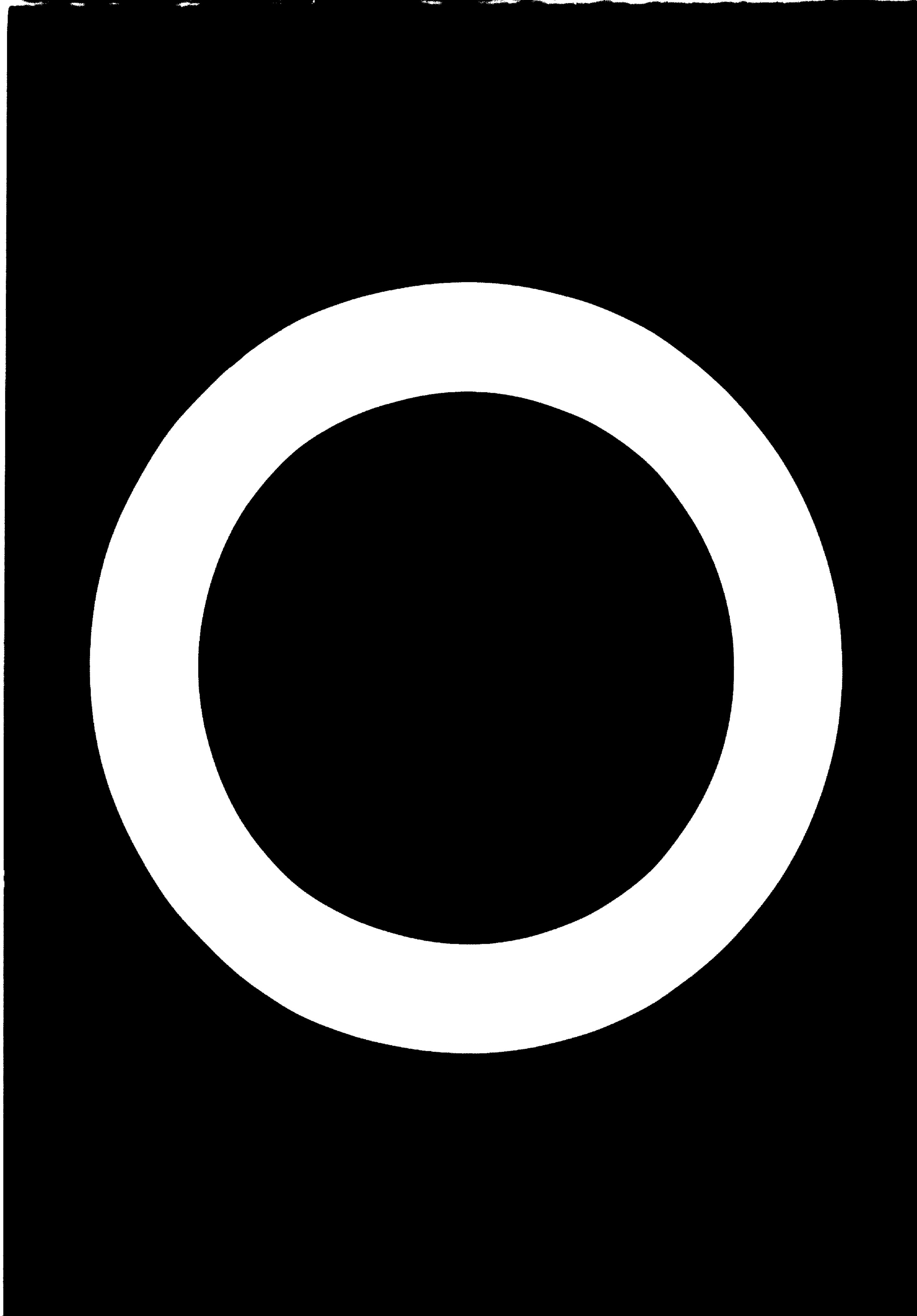
Summarizing, it can be said that the Spanish system is much more favorable for those companies with normal usages of their electricity supply and that this situation disappears when utilization levels are high. Therefore, a ferroalloys plant would find electricity costs similar in Bahia and in Spain. Bear in mind that the new Spanish tariffs have generally made supplies more expensive and for this reason they have not still been completely enforced. Besides, these types of industries enjoy special contracts, both in Spain and in Brazil.

Sfter studying the bills of two ferroalloys producing companies in Bahia, we found, taxes included, the average price of one of them to be 34,37 NCr $/1.000 KwH or somewhat lower, and for the second one 37,53 NCr $/1.000 KwH. The average price for the spanish ferroalloys' industry is placed from 36,17 NCr $/1.000 KwH to 37,58 NCr $/ 1.000 KwH, i.e., prices are similar in Bahia and in Spain, and also similar to the C.E.E. countries, that get prices about 36 NCr $/1.000 KwH or somewhat lower.

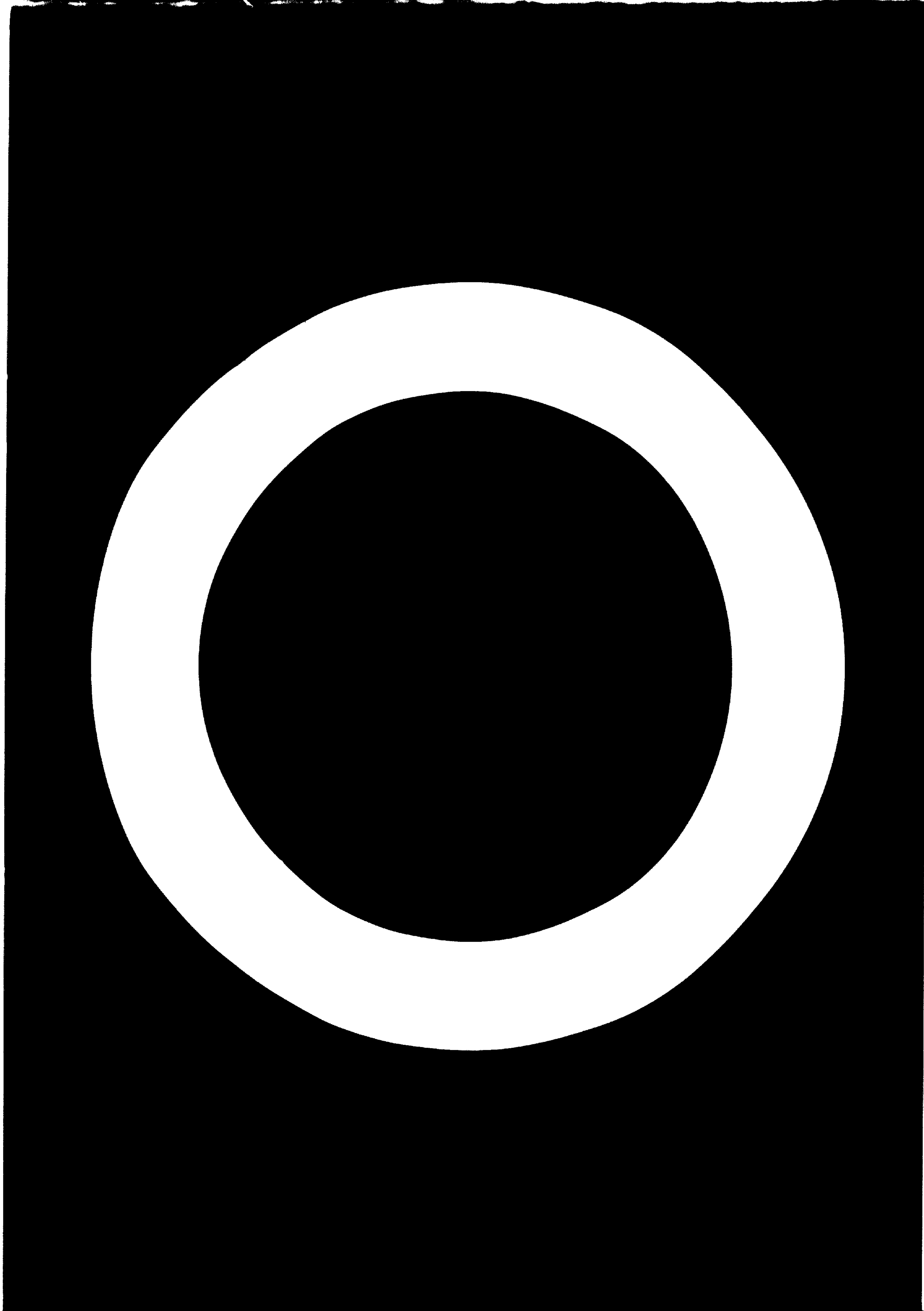
B.1.8.4. <u>Summary</u>

The tariff system in Bahia does not at all comply with the minimum requirements of an economic development policy; the prices are excessive and of course, not remotely similar to those in force in industrialized countries, burdening Bahia's industries with a basic non competitive cost, especially the small and medium-sized companies, which are precisely those that can be installed more easily in the first stage of economic development in modern, flexible, technical, economic and financial conditions. The present tariff system is terribly regressive for this type of companies and its flexibility mere fiction, as they fall within 20% (maximum) utilisation levels, levels, which, furthermore, withhold the fiscal benefits reviewed in section B.1.8.2.

It remains to be said that although Bahia's situation is a mere reproduction of the larger national picture, this cannot be a justification for not re-examining the State's tariff system with criteria absolutely different to those used at present. If this is not done, then Bahia's industrial growth will be achieved not with the aid but in spite of the prices for electricity.



B.2. FISCAL AND FINANCIAL INCENTIVES



B. 2. 1. GENERAL POINTS

In the North East, through a series of bodies (SUDENE) and its Department of Industrialisation (DI), the Federal Government of Brasil is intensifying its policy of stimulating private initiative with a view to the development, modernisation and expansion of already existing industries and in order to attract new ones.

This policy is carried out by several fiscal and financial incentives offered to industrial companies in the North East, and furthermore by giving technical assistance with the participation of state planning organisations and the Technical Department of Economic Studies (ETENE) of the Bank of North East of Brasil (BNB) which complements industrial planning in the area.

In this way, the Government tries to compensate for certain disadvantages due to location and the non-existence of external economies in the region equivalent to those found in the Centre and South of Brasil.

Apart from government incentives, the States, which form the North East region, have established another series of incentives complementary to the above and which are within the scope that constitutionally corresponds to them.

In accordance with these norms, the state of Bahia has set up a whole new fiscal and financial system with which to promote industrial growth in Bahia on the side of private initiative.

The incentives, both federal and those pertaining to the state can be divided up the following manner:

a) Fiscal stimuli

b) Financial stimuli

c) Location stimuli

We are herebelow indicating the main characteristics of these three types of incentives, which can be found in a much more detailed form in the literature already published on this matter.

B.2.2. <u>FISCAL STIMULI</u>

a) <u>Federal</u>

1.- Automatic tax exemption on those sums which Brazilian companies have to pay as profit taxes and which are to be used to finance industrial projects. Up to 50% of the sums to be paid as profit taxes cauld be directed to such purposes.

2.- Individuals can claim for tax free up to 50% of their gross income for income tax purposes if that money is invested in industrial companies.

3.- Total exemption from taxes on profits for up to 10 years (with an extension up to 15 years) for those firms which move to the North East and produce goods not before manufactured in the Region; the companies that make goods already manufactured there will only be able to claim for 50% reduction.

4.- Exemption from federal taxes and imposts on imported equipment not manufactured in Brasil.

(The first two incentives mentioned have automatic effect: the others have to be claimed from SUDENE).

b) <u>State</u>

They are based on exemptions as regards the state Tax on Goods Circulation (ICM). This tax in indirect and the percentages applied vary according to each region and within it, depend ing on whther the operations take place insider or outside the state. For Bahia, such percentages are, 17,5% and 14,5%, respectively.

Exemptions granted are:

1.- Total exemption from ICM on imported machinery and equipment not manufactured in Brazil.

2.- Sixty percent exemption from ICM, with deposit of same amount made in DESENBANCO (Development Bank of the State of Bahia). After a year said deposit can be transferred from the bank but to be invested in said company with special conditions.

3.- Permission to deduct from ICM the tax paid for purchasing Brasilian machinery and equipment.

B.2.1.2. Financial Stimuli

a) Federal

Based on the possibility of obtaining up to 75% of the total resources necessary for beginning a project, according to the importance SUDENE judges it has in the North East economic development programme. Said importance is measured by a score which depends on several factors (number of jobs it will create, consumption of local raw materials, etc.).

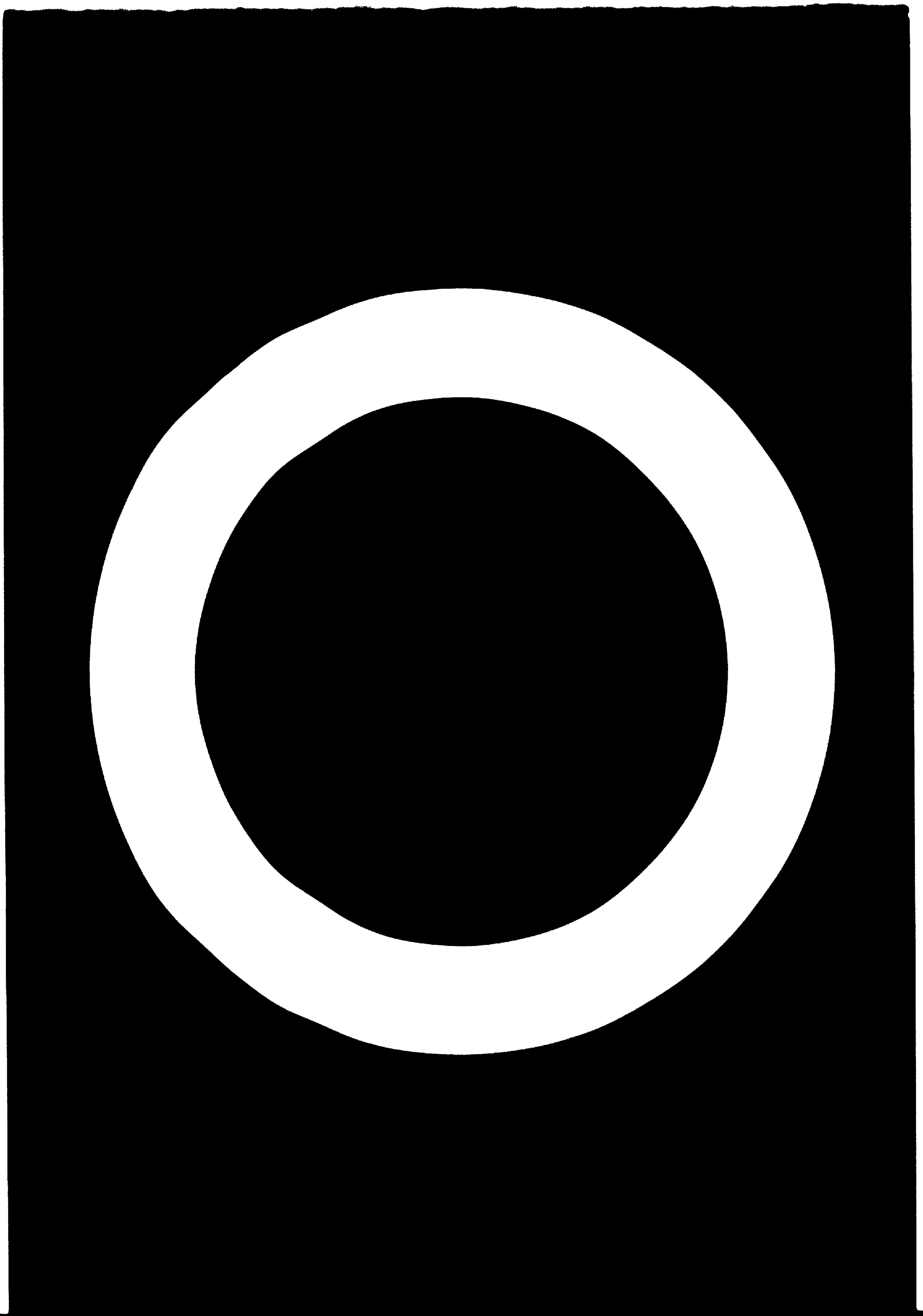
The most usual financing sources are BNB and BNDE.

b) State

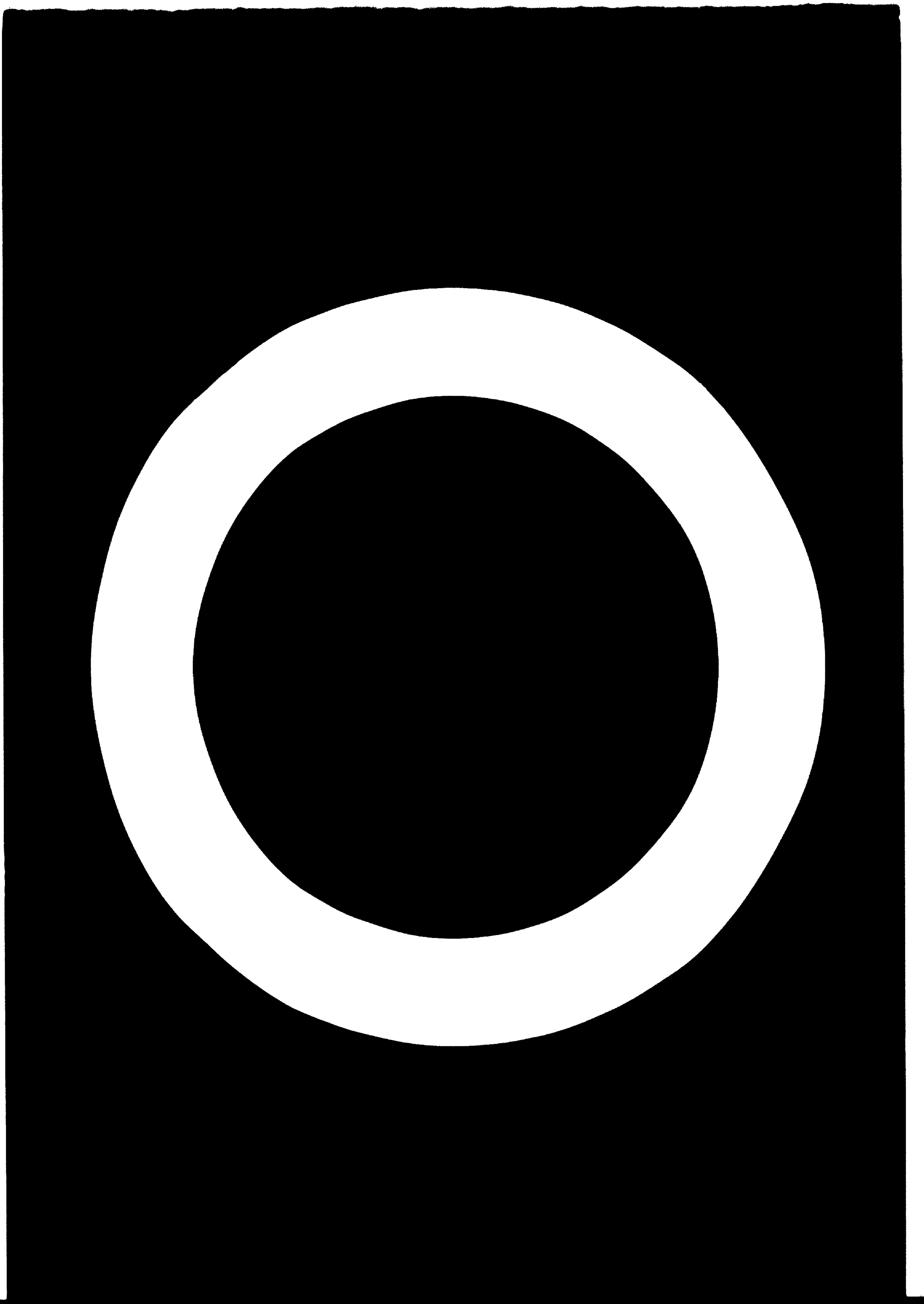
Long-term loans are offered at reduced interest rates by DESENBANCO, apart from other financial arrangements; for example, with the previous authorization of the State Industrial Development Board, there is the possibility of Bahia industries being able to sell their shares to industries that benefit from reductions in the ICM for up to 50% of the total resources necessary for a project.

B.2.1.3. Location Stimuli

These refer to assistance given by the State of Bahia in the form of low priced land, equipped with all the infrastructural services necessary in the industrial centre at Aratu and other development centres.



B. 3. WAGES



Since May 1. 970 the minimum monthly wages has been fixed by decree (30-4-70) at 144 NCr $ for the more developed cities of Bahia (Salvador, Alagoinhas, Camaçari, Feira de Santa na, Ilheus, Itabuna, etc., altogether a total of 21 townships). For the rest of the state (almost 300 townships more), the mini mum wage fixed (from same date) was 124,80 NCr $.

In Brazil's North East region the minimum wage of 144 NCr $/month is only established for the towns of Pernambuco and Olinda, besides those mentioned above, but his figure does not compare with the minimum wage paid in Brazil's most industriali-zed areas, namely 187,20 NCr $/month. Furthermore, the minimum of 124,80 NCr $, which affects most of Bahia, is the lowest in Brazil.

The actual wages received in Bahia vary quite a lot according to the industry and the skill of the person employed. It is hardly possible to give general data, but according to an enqui ry made by the "Serviço de Estatística da Previdência e Trabal ho" (results recorded in the Anuario Estatístico do Brasil) more than 40% of the workers in 1.968 earned a wage lower than 120 NCr $/month while for Brazil as a whole the corresponding figu re was 16% of all wageearners. On the other hand, 18% of Ba-hia's workers earned more than 400 NCr $/month, while the co-rresponding figure for all Brazil was only 13%. This fact, far from being paradoxical, is due to the lack of skilled labour in Bahia, which is much better paid than in the rest of Brazil.

Non-skilled personnel, therefore make up the majority of the labour force in Bahia. Their earnings in general do not exceed the minimum wage fixed by government bodies and in ma ny cases are below it, as the alternative, menacing for sure, is to accept any wage whatsoever or find oneself unemployed.

We give below the following data collated during our visits to several factories in Bahia (they refer to the beginning of 1.971).

Factories and workshops that do not demand skills from their labour force and in fact do not need specialists, given the quality of their machinery and production methods, offer varying ranges of wages, but in general, they fall between the minimum salary and a maximum of 200 NCr $/month.

Highly capitalized mechanical industries which are, therefore, very mechanized and, whose production is in mass quantities, with very strict quality control, pay their workers monthly wages within the following scale:

- Trained apprentices	150-160 NCr $
- Trained operators	170-180 "
- Assistants	220-240 "
- Skilled labourer, second class	300-320 "
- Skilled labourer, first class	380-400 "
- Specialists	480-500 "
- Highly specialized personnel	600 "

Between these two extremes there are companies that work with a reasonable level of capital and generally demand from their personnel an average amount of skill. In these companies the specialists who operate machines (welders, turners, fitters, etc.) earn between 400 NCr $ to 550 NCr $ per month. Among the industries we visited this was the situation in companies with various specialties side by side; for example, mechanical workshop and boilermaking.

For comparison's sake, we set down below the example of a Sao Paulo company:

- Type of industry: foundry
- Work: not very specialized

- Basic earnings:

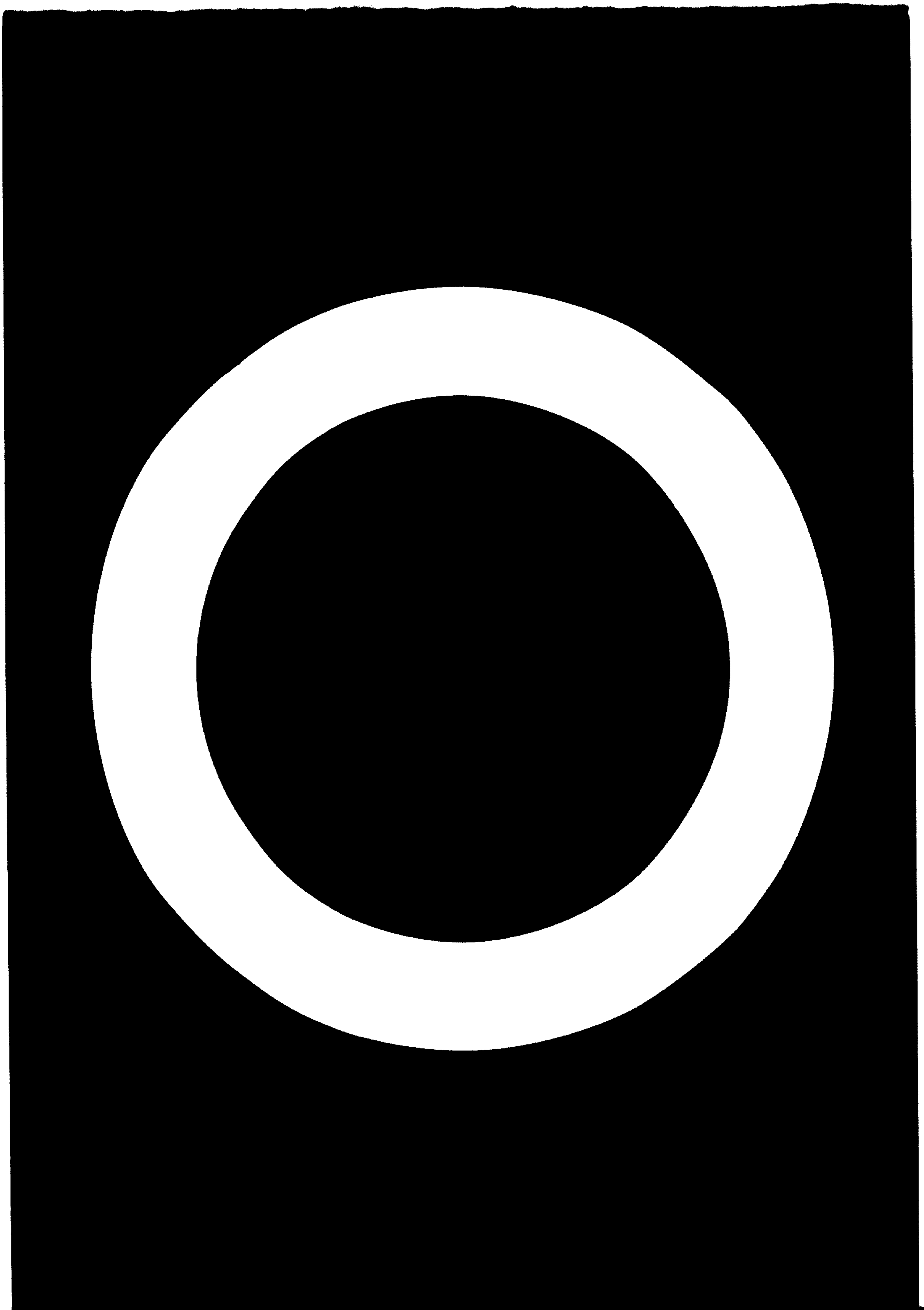
- Fettling personnel	180 NCr $
- Furnace personnel	220 "
- "Coremakers"	300 "
- Machine moulders	300 "
- Hand moulders	360 "

- Incentives: up to 25% on top of basic earnings, according to the circumstances.

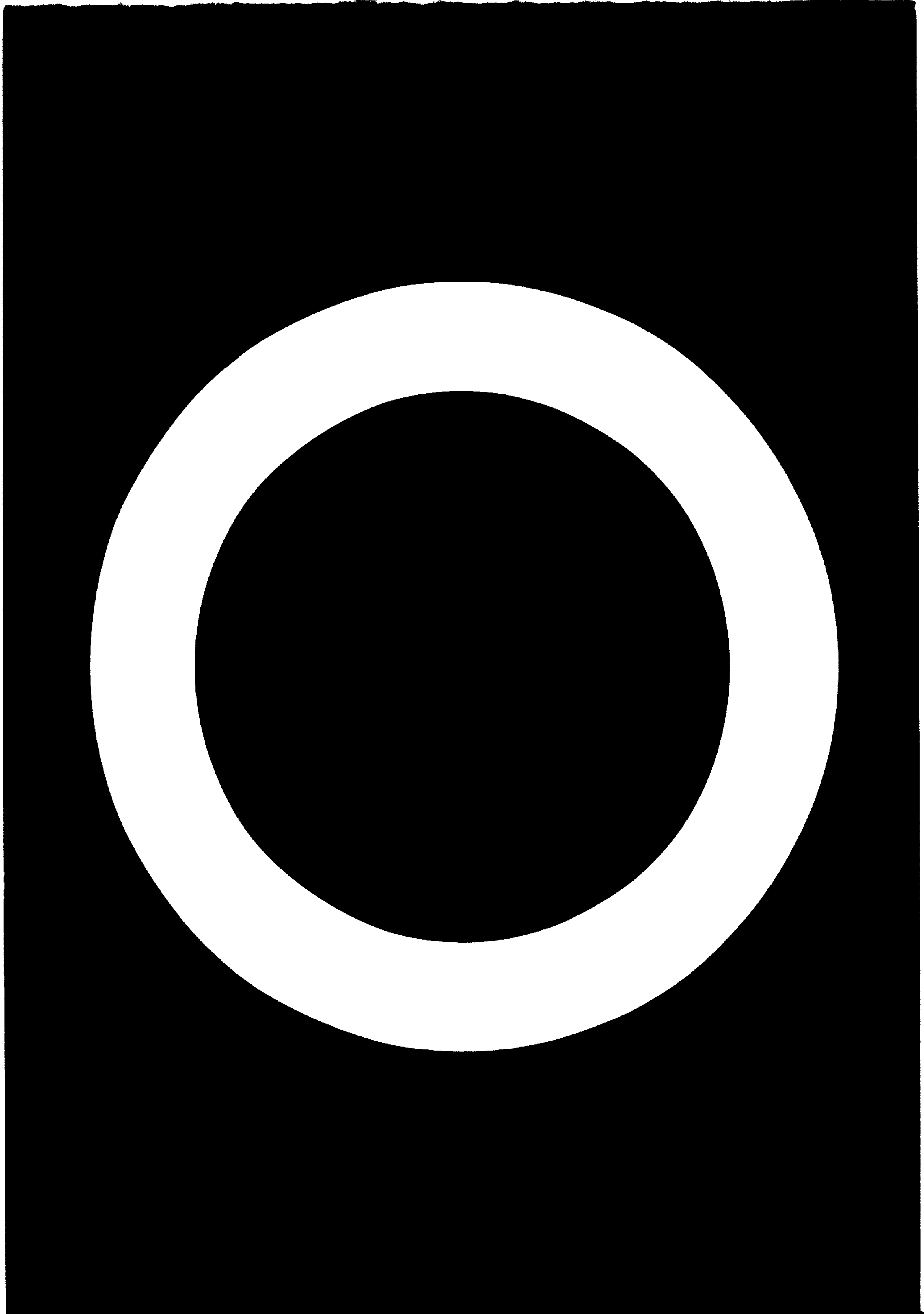
As can be seen, and in line with what we said above, the wages scale is not as wide as in Bahia; the wages in this case are not as low nor as high as they were in Bahia.

Administrative personnel is paid much better than the workers. The salaries vary widely from 150-200 NCr $ (basic monthly wage for untrained administrative job) to 800-1.000 NCr $ (monthly wage of a very well trained accountant).

Finally, the earnings of managing personnel (but not including the highest posts) rise to high levels. In this respect, one can say that the thechnicians are relatively well paid - for example, an engineer with four years training can earn between 2.000 to 3.000 NCr $ monthly.



B.4. BASIC INSTRUCTION AND TECHNICAL TRAINING



B. 4. 1. EDUCATION

a) Primary Education

The population of Bahía represents 8% of the whole country's total but comparing the different birth -and death rates in Bahia and Brazil, it does not seem over-risky to put the child population and therefore the school population at -- 10/12% of Brazil's total. That is well enough, but pupils enrolled in Primary Education Centres in 1. 968 only made up 6, 1% of Brazil's total school population.

The total of pupils in said year was 735. 000 while the population between the ages of 5 and 13 was 1. 800. 000 -- 1. 900. 000 inhabitants. In other words, only 40% of the total population of school age went to school.

Lastly, the number of teachers in Bahia was only - 22. 900 (5, 4% of Brazil's total) and the teacher/pupil ratio was 32.

b) Secondary Education

In 1. 968 Bahia had 145. 000 students in Secondary Education courses (4, 7% of Brazil's total).

The number of teachers represented 5, 7% of the country's total and the teacher/pupil ratio was 12.

c) Higher Education

The Federal University of Bahia is the only centre of higher education in Bahia.

Its 9. 700 students (degree courses) made up only 3, 5% of Brasil's total number of undergraduates in 1. 968 and the number of teachers represented a similar percentage.

The number of students who finished their studies in 1.967 was 4,3% of Brazil's total.

As far as post-graduate studies are concerned, there are practically none in Bahia; in 1.967 there were 35 students (0,8% of national total) and only 8 finished their studies in the same year (likewise 0,8% of national total).

It mus be pointed out that as far as the distribution of Higher Education students is concerned, according to the type of studies undertaken, the University of Bahia had no specialist department in mining or metallurgy; in 1.967, 87 students took degrees in engineering, only 17 in Geology and 127 in Administration and Economics.

d) Professional Training

The problem of professional training is possibly the greatest as far as education in Bahia is concerned. Until SUDENE was established, there was practically no centre which gave this sort of training.

At present, the picture is not very different but the State is beginning to set up said centres. However, there are only two establishements in operation which are modern in character. The Centre for Professional Training of SENAI and Centre for Rapid Training of Mechanics of SENAI - (the first was built by SUDENE and the second only equipped by it).

It can be observed that the predominant feature is one of inadequacy so that it is the companies themselves who continue to train their own labour, as has always been the tradition in Bahia.

B.4.2. **TECHNIQUE**

B.4.2.1. Availability of technicians, engineers, etc.

The present situation is very bad as can be understood from the previous section. Although there are not very many engineers, the problem is more of quality and skill than of quantity. Speaking of quantity, the present productive structure of Bahia's economy would possibly not require great expansion if the body of engineers, etc., worked among very specific companies and fields of activity.

However, the majority of technicians have degrees, diplomas, etc., in civil, mechanical and electrical engineering; namely, in the more general branches of this discipline when, on the other hand, there is a shortage of specialists because the latter have not followed up any specialised training and in Bahia it is not possible to study specialties within the engineering field. It must be pointed out again that mining engineering and metallurgy cannot be studied in Bahia when they are the two most potentially important fields.

Because of this extremely low number of specialists, they have to be found in the Southern states when necessary; this affects salary costs because the technical teams supplied from the South have to be paid at the higher rates normally found there.

The problem is the same if we talk about the manpower situation. As we have indicated above, the companies themselves have to train their workers or import skilled men from the South. Once again it is the costs which must rise in both situations and it even happens that even when high wages are offered it is not possible to find the necessary trained personnel.

This "bottlenedk" in the Bahia economy will not be easily solved in the short term. There is a grave shortage of professional training centres but more significantly still Bahia suffers from an enormous basic problem. As is well known, the re must exist a minimum level of knowledge before one can begin to impart a modern professional skill -this minimum at least me- and all Primary Studies completed. In this respect, just think - about the low number of children being schooled in Bahia; only less than 40% of the total number of children of school age are enrolled at the beginning of every school year. But if the whole school po pulation were enrolled the education system would grind to a halt. The teacher/pupil ratio would climb to more than 80 and it would be impossible in these conditions to teach properly.

B. 4. 2. 2. Productive technology and Institutions

a) General Points

Equipments and machinery in Bahia's industries do not attain, in general, the acceptable minimum levels for modern production methods. As we have pointed out several times in this report, many of the existing companies are no more than family concerns which belong to a pre-industrial econo my and which will disappear with the arrival of industrial development in Bahía.

However, alongside these elements (as far as the past is concerned and not the quantity which is very big) one - sees the growth of small, medium and large companies that draw on modern efficient technological methods.

Their installation and appearance on the scene has speeded up the establishment of institutions that wish to play an active role in these fields, institutions which in turn - speed up the productive use of modern technology.

The part played by SUDENE has been discussed elsewhere in this section, but it must be added that it has not limited its actions to creating or stimulating the few professional - training centres that exist in Bahia. It has also lent technical and material assistance to many agricultural cooperatives and has made studies of mineral resources, market and socioeconomic reports, has given scholarships, etc., etc.

There are other bodies which to a lesser or greater degree have collaborated in this process of spreading technical knowledge throughout the State of Bahia. CEPED stands out - among such bodies and the following point will describe its activities; it could well become the most solid scientific support at the ready disposal of Bahia's economic development and industrial growth.

b) CEPED

The need to introduce into the productive structure of Bahia a modern technology provoked the State Government into creating the Science and Technology Secretaria. One of its first fruitful results was the CEPED (Centro de Pesquisas e Desenvolvimento) project, which is financed by FINEP.

To begin with, CEPED proposes to act within the region, trying to combine and unify the States incentive schemes with the investigation and research carried out in the universities and private companies. Its final objective is the development of a science and technology properly speaking, achieved by basic research in the different productive fields, offers of services to solve specific problems caused by actual needs and the professional training of men and teams.

They plan to draw financial resources both internally and externally. The latter will come from the Public Sector or the Companies Association, which they plan to set up; the former will come from the sale of services and projects.

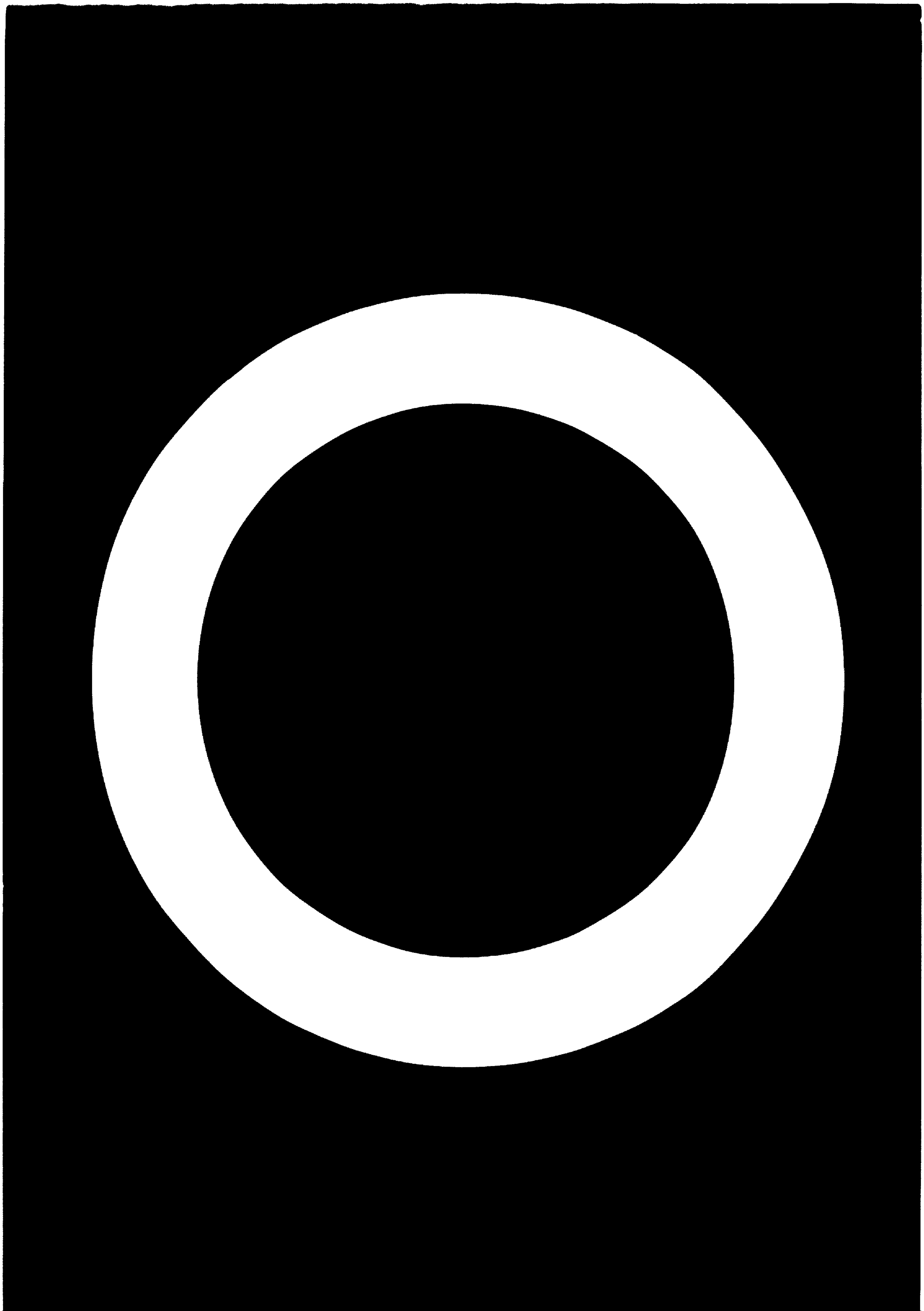
CEPED will consist of the following departments: Administration, Technical Services, Laboratories, Pilot Plants, Support Units and a Record and Information Service.

It can be seen from all that we have noted above, that CEPED has set itself very ambitious projects. It is intended that its activities will affect all economic sectors, promote international scientific and technological exchange, etc. One cannot but contrast these purposes with the limited nature of the budget forecast: 18 million NCr $ in the first year, 11,8 millions in the second. The budget structure as well is difficult to understand in institutions of CEPED's class; for example, in the first year the cost of documentation and records will represent 1,8% of total expenditure and in the second labour costs will rise to almost 50% of total expenditure

Summarizing, the activities of CEPED may well be very - efficient but we think it would be advisable to reassess the situation so that it becomes basically, more specialised and less diversified. In this line of action and taking in account the need of specialised training in foundry technology in Bahia we recommend the setting of a Foundry Educational Foundation at CEPED in order to aid the training of engineers and to encourage them to consider the foundry as a career in industry.

This Foundry Educational Foundation should be based in a well equipped foundry laboratory and in a pilot foundry. In Annex E-6 the main sections of the suggested foundry laboratory and pilot foundry are specified.

C - THE INDUSTRY IN BAHIA



C. 1. THE NORTHEAST AND BAHIA. SUDENE

The Federal Government is undertaking an ambitious economic development program in the northeast region of Brazil. The entity in charge of its execution is the SUDENE. The principal collaborators are the BNB (North-east Bank of Brazil) and the ETENE, which is the Technical Department for Economic Studies of the BNB.

The basic objectives of the SUDENE in the region are the following:

- Industrialization
- Agrarian and Cattle Improvements
- Initiation of the colonizing on a large scale of the preamazonian area.

In this manner it is planned to convert Recife, Salvador and Fortaleza into strong industrial nuclei and expanding centers that would lead to the achievement of those objectives. Fiscal and financial incentives and infrastructural works are the principal instruments of the SUDENE. In addition, the different states have established incentives complementary to those of the federal government.

Taking into account the natural imperfections, the appraisal of the achievements and projects, a traditionally marginal zone, cannot be but positive. The industrial center of Aratu, is - proof of this.

Although the influence of the SUDENE has been extended throughout the region, their efforts have been concentrated in three states, Pernambuco, Bahía and Ceara, which are precisely the most populous states in the northeast. Within each of these, priority has been given to the three capitals, Recife (1. 079. 000 in habitants in 1970), Salvador (1. 001. 000) and Fortaleza (842. 000) all with similar populations.

To date, Pernambuco has been the pole that has been given the greatest impulse having been the beneficiary of more - than 30% of the employment oportunities created by the action of the SUDENE, and of 35% of the actual investments. Bahia received a little over 25% of the new employment and also of the actual investment. Ceará, on her part, received 15% of the employment and a little less in the investments.

C. 2. EXISTING INDUSTRIES IN BAHIA

C. 2. 1. General

Until 1968 Bahia was a state that had been barely industrialized. The majority of the enterprises in the secondary sector were dedicated to the demands of construction, nutrition, electricity, textiles, and mining.

The rest of the industries were small family corporations, with the important exception of the Petrobras petroleum refinery.

With the establishment of the Industrial Center of Aratu, there are being installed a series of industries which are changing the industrial panorama of Bahia.

This development is still slow and unbalanced since it does not constitute in any way an autonomous center. In other words, it depends upon the south for many of its basic supplies and technology.

At this moment a second industrial center is being installed in Feira de Santana. In this manner the axis, Salvador-Feira de Santana, is the route towards effective industrialization of the state of Bahia.

Naturally, the entire Reconcavo zone, owing to its adequate communications and infrastructure, could complement this industrial development.

However, it is very difficult to industrialize the rest of the state at present, with the exception of specific areas with mineral resources.

C. 2. 2. <u>Geographical Distribution of Modern Industry</u>

Before the Aratu center was in operation, industry was located in the vicinity of Salvador which, in 1960, supplied over 40% of the industrial employment of the state.

At present, however, the move is towards decentralization brought about by the installation at Aratu and also at Feira de Santana.

Not having sufficient data to present a picture of the geographic distribution of all modern industries (excluding those of a family or artesan character) in Bahia, tables IB-1 to IB-5 present the more important organizations whose activities are in some way related to the metallurgic industry, bearing in mind that all industries with modern characteristics follow the same geographical pattern of distribution. In other words, the organizations found in the above mentioned tables could be taken as a cross-section of the non-artesan industries in Bahia.

The geographical distribution based on the job-availability in these types of industries would be the following as to -- plants now in production:

- Salvador 38,2%
- Aratú 36,6%
- Feira de Santana 1,9%
- Reconcavo (1) 7,8%
- Rest of the State 15,5%

The job-availability, taking into account the plants being built, would be:

- Aratú 51,5%
- Feira de Santana 42,1%
- Salvador 6,4%

Finally, considering all enterprises no matter in what stage they may find themselves from mere planning to full production the distribution would be:

- Aratú 46,8%
- Salvador 20,9%
- Feira de Santana 9,2%
- Reconcavo 4,0%
- Rest of the State 19,1%

As regards the two last distributions, it should be noted that they do not account for all enterprises in construction, approved, being studied, or being planned, since there are not sufficiently complete data of those who do not choose to avail themselves of the benefits from the SUDENE.

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(1) Without including Salvador and Aratú.

C. 2. 3. **Sectorial distribution**

There are not sufficient data available for the construction industry and electric energy industry which undoubtedly would represent a relatively strong participation in the total industrial picture.

In 1962, the extractive industries accounted for 5,4% of industrial jobs, not including those of construction and electricity, and 6,8% in 1968.

Table IB-6 presents the job-distribution of the different sectors comprising the transformation industry in its proper sense. As may be observed there co-exist two types of sections: Dynamic and Static (1).

The first group is comprised of the following sections: Non-metallic minerals, construction materials, metallurgy, mechanical, electrical supplies, transportation equipment, chemicals, pharmaceuticals, and plastics.

The second is comprised of: wood, Real Estate, paper and cardboard, rubber, leather and skins, perfume, textile, clothes and shoes, food, drinks, tobacco, printing and others.

The division may appear to be quite simple but it is sufficient for the superficial analysis being made here. From an observation of the aforementioned table, it can be gathered that in 1962 the dynamic sections accounted for 24,9% of industrial jobs. It grew to 36,6% in 1968 and in 1970 represented 83,9% of the new jobs in Aratú.

(1) This division of the different sections does not imply an appraisal of the individual enterprises found within them. For example, a section whose relative importance is on the wane may posses modern facilities with high productivity, dynamic management, commercial aggresiveness, etc.

The static sections on the contrary accounted for -- 75,1% of industrial jobs in 1962, dropped to 63,4% in 1968 and represented only 16,1% of the new jobs in Aratú in 1970.

C. 2. 4. The Industrial Center of Aratú

The industrial center of Aratú (CIA) was created in 1966. Conceived as one of the development poles of the state of Bahia, it was promoted by the Department of Finance and Commerce of that state upon which it shall depend even when its functions become autonomous and it possesses its own governing organs: a Board of Directors and a Direction. Among others, the following collaborate with the Direction: SUDENE, BNDE, BNB & BJD, - URBJS & SAER.

The CIA is quite near Salvador, being in her own bay. That is to say that it is located within the area of influence of the larger market of Bahia. Its area is planned to cover 436 sq. kms. The CIA has already acquired more than 53 sq. kms., 6 sq. kms. have been sold to the different entities, and the construction of the infrastructure comprises nearly 10 sq. kms. At present the third industrial district is under construction, the first two being already occuppied.

The annual budgets of the CIA have evolved in the following manner:

	(1,000 NCr $)	(1,000 NCr $ of 1967)
1967	18.645 (1)	18.645 (2)
1968	31.078 (1)	25.023 (2)
1969	40.500 (1)	27.000 (2)
1970	56.000 (1)	

(1) Industrial Center of Aratú: "Aratu, a Developing Pole"

(2) Our own elaboration

The expenses incurred over the budget were the following:

1967	31,5%
1968	67,6%
1969	66,3%
1970	53,0%

In close connection with the carrying out of the budget, it may be worth mentioning that in the period of 1967 to 1970 expenditures in the construction of the infrastructure amounted to 72.340 (NCr $ 1000).

<u>The enterprises of Aratú</u>

The last column of table IB-6 already mentioned provides information regarding the percentage and sectional distribution of employment in Aratú. Tables IB-7 to IB-14 contain the rest of the information available regarding the enterprises in production, in planning, or having a mere option in Aratú.

Although table IB-7 only indicates a total of 108 entities, this total may possibly be more since there may exist projects that have not yet been made public. For this reason the total entities may reach 120 or 125.

Until September 1970, the number of actual jobs created was more than 5.000. Another 5.000 corresponded to entities in the planning phase, and another 6.500 belonged to entities with options, but without having begun the planning phase. (See Table IB-8). The rate of growth may be evaluated at 50% over the preceeding year.

Well and good, if this relative magnitude seems considerable, one should take into account the low starting figures over which and increment would represent a very high percentage.

The total capital investment comprising all the enterprises no matter in what phase of development they found themselves was nearly 1.600.000 NCr $ (x 1000) (see Table IB-9). The enterprises in production merely represented 15% of the total investment. The enterprises whose construction had already begun eepresented 35% of the said total investment. Considering the continuous devaluation of the cruceiro, it is not possible to make any comment regarding the evolution of the investments - without having at hand unbiased information regarding the revaluation of fixed assets.

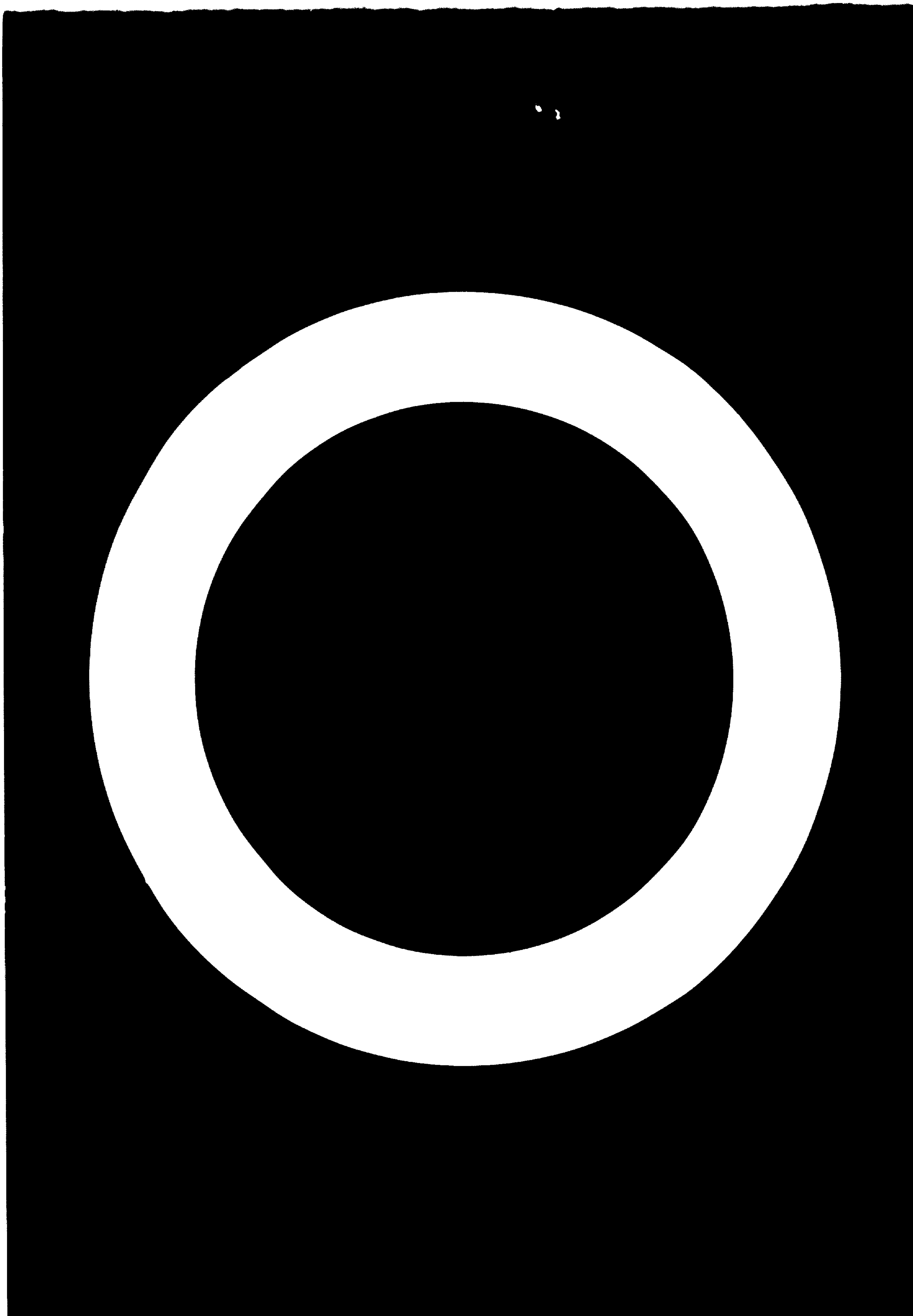
The size of the enterprises already in existence or in the planning stage is measured by the job openings (see Table IB-10) of 158 positions per company and in cruceiros of 14.687 (NCr $ 1.000) per company (see Table IB-12).

None of the enterprises in the production stage surpassed the 1.000 job-positions (see Table IB-11) and 65% do not - reach 200 job-positions. The tendency towards enterprises of lower job-positions is affirmed when we consider those in the construction stage: 80% of these do not reach 200 positions and up to 50 positions are included in more than 25% of the enterprises.

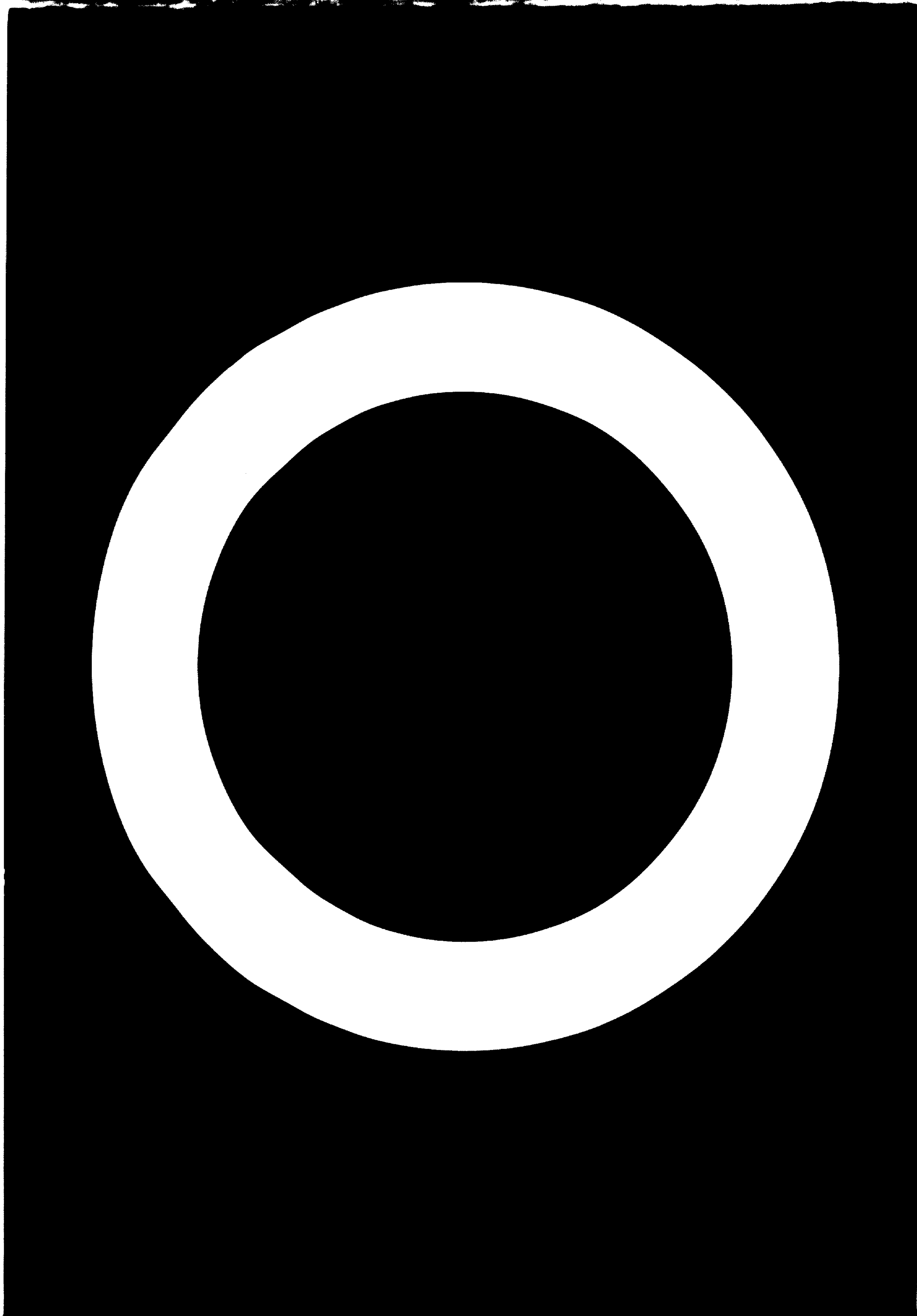
As regards the enterprises with a simple option, 75% have a projection of less than 200, and 50 positions are included in 35% of them.

As can be seen from Table IB-13, only 5 enterprises exceed 100.000 (NCr $ 1.000) in investment and 83 do not reach 10.000 (NCr $ 1000). Those 5 enterprises which represent less than 5% of the total number of enterprises, account for more than 50% of the total investments in Aratu. The latter represent 77% of the enterprises and they do not reach 16% of the total invested or to be invested.

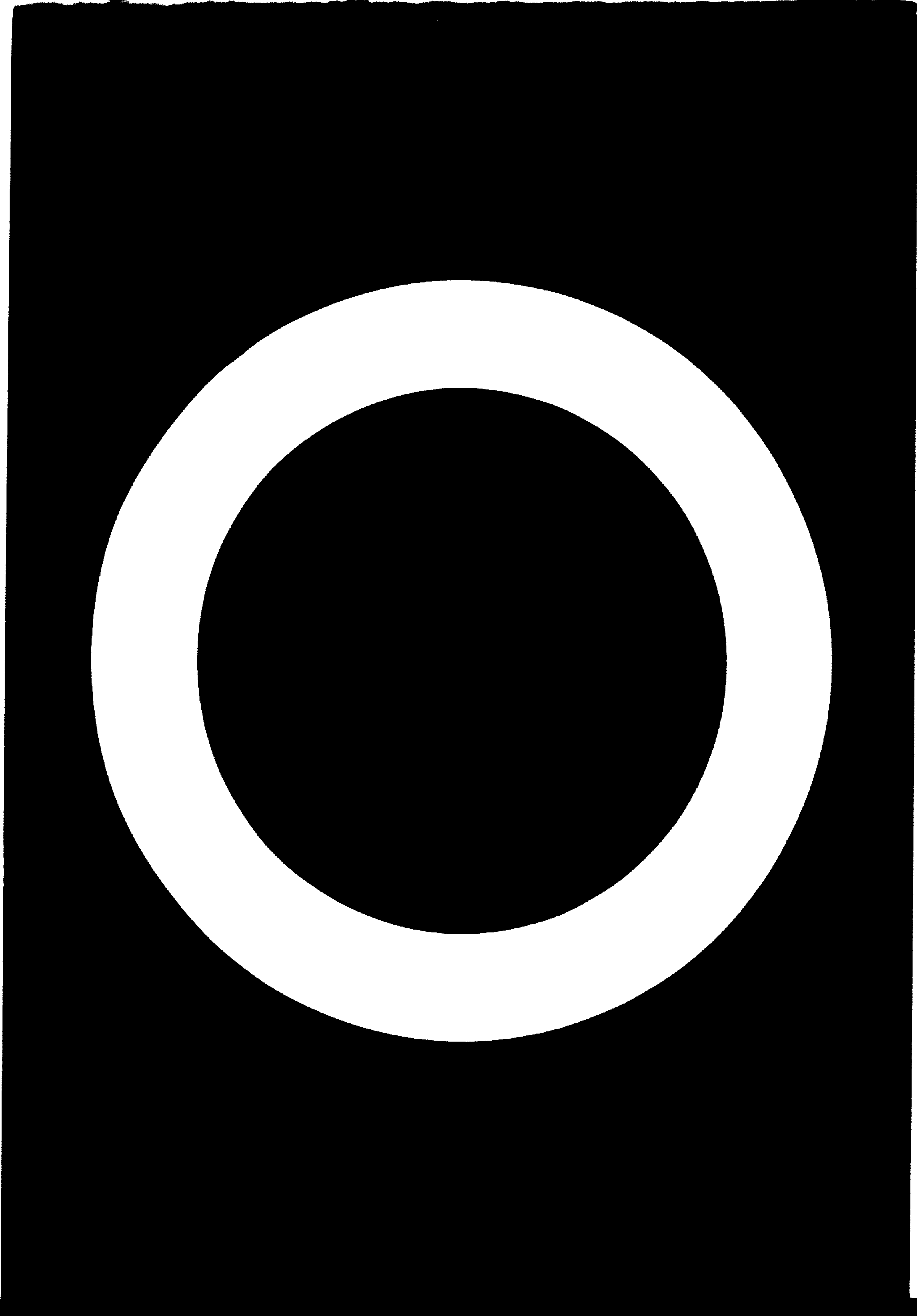
Finally, Table IB-14 presents the average investment per job position depending upon the different sections applicable to Aratú.



D - MONOGRAPHIC STUDIES



D. 1. IRON



Note:

The projected demand studies for magnesite, chrome and manganese have been originally based on the data available about the size of the steel offer according to the National Steel Plan of 1967.

Later and complementary information received on - June 1971, has changed the assumptione of the above steel plan increasing substantially the projected demand of steel for 1980.

As the size of the offer for 1975 is not yet known, corrections on the projected production of magnesite, chrome and manganese cannot be made for the moment. In any case, this corrections will not modify the general problems and recommendations included in section "A" of this report.

D. 1. 1. MARKET STUDY

D. 1. 1. 1. Historical background

D. 1. 1. 1. 1. Iron Ore

In Brazil iron ore constitutes the major source of foreign currency in the mineral ore sector, and 104 and 147 million dollars worth were exported in 1. 968 and 1. 969 respectively. In no year have exports fallen below 55% of the total production of iron ore in Brazil.

In table Fe-1, the most important statistics for the period 1. 960-1. 969 are set down, in accordance with available data.

It must be pointed that the apparent consumption appears excessive if one takes into account the production figures for pig iron and the average grade of Brazilian ores used in domestic consumption. Even bearing in mind possible stock variations, the figures seem to us rather unreliable when we do not have at our disposal the statistical data with which to compare them.

As shown in section D. 1. 2., the state of Bahía does not produce iron ore though there are contradictory figures for the reserves, still to be properly prospected.

D. 1. 1. 1. 2. Steel

Brazil

The table Fe-2 shows the growth of Brazilian steel consumption and consumption "per capita" in the period 1. 949-1. 968.

In that period consumption apparently multiplied 4.5 times, while the increase "per capita" was only 2.5 times - higher. This latter figure is very small in comparison with other South American countries, where first place is occupied by Venezuela (135 kg per inhabitant) followed by Argentine - (92 kg/inhab.) and Chile (79 kg/inhab.); data from 1.966, a year in which Brazil only managed 49 kg/inhab.

The growth in consumption of rolled steel in the period 1.961-1.969 is shown in table Fe-3.

The apparent consumption of flat rolled steel from 1.961 to 1.969 grew by 952.000 tons and that of non flat by 852.000 tons.

From this table it can be deduced that:

a) The imports of rolled steel have undergone small oscillations around 350.000 tons/year.

b) Exports have increased significantly in 1.967-1.969; exported rolled steel exceeding 300.000 tons in each of the 3 - years.

c) During the period 1.961-1.967 apparent consumption increased by only 29% while in the period 1.967-1.969 the increase was 41%.

d) There seems to have been a certain balance between imports and exports in the last years considered.

There exists a strong correlation between the behaviour of the GIP and steel consumption, as is explained in - section D.1.1.2.1. With the model $\log Y = a \log X + b$ (1),

(1) Y = Steel consumption in 000's tons.
X = GIP in millions of NCr $ (1949)

a coefficient of correlation (r= 0.981) is obtained for the period studied; almost 1, that is to say a strong correlation exists.

The table Fe-4 shows the percentage increases in the GIP and the apparent steel consumption over the previous year. Graph Fe-1 is plotted from this table.

Looking at the graph, the influences affecting growth of GIP and its amount against the growth and amount of steel consumption can be clearly deduced, although table Fe-4 and graph Fe-1 are not very informative on the relationship that connects the growth rates (temporarily outphased) of the GIP and the apparent steel consumption. It is only necessary to point out that the trend changes in the percentage increases of the GIP are shown amazingly multiplied in the percentage increase line of steel consumption; in other words, the elasticity between growth rates is very high.

Likewise, the elasticity GIP/steel consumption in - Brazil is very high. Table Fe-5 and graph Fe-2 show said for different countries and different periods of time. Brazil's as is fitting for a low development country, is higher than the average and similar to the corresponding figure for countries attempting vigourously to develop themselves. In the period 1.949-1.968 the GIP in Brazil has grown at an accumulated annual rate of 6,06% and steel consumption at a rate of 8,28%. Of course, the rates "per capita" have been more modest, given the high level of population increase.

Looking at table Fe-6, the existence of two perfectly differentiated subperiods can be seen, even when the dividing line between them is not precisely delimited. These - subperiods are the following:

1.949-1.959 - in this period the GIP and steel consumption grew respectively at 6,49% and 10,06% per annum.

1.959-1.968 - in this period the GIP and steel consumption grew respectively at 5,60% and 6,35% per annum.

Of course, the causes for the relative slump in the economy are to be sought outside in and for this reason we will make no further comments on this slower growth, except insist on the obvious need to regain the vigorous rate of this first period, which already seems to be taking place.

The above-mentioned table Fe-6 enables us to study the slowing down in the demand for steel in the period 1.959-1.968, which is relatively more marked than that of the GIP.

Bahia

Present data concerning steel consumption in Bahia is very scarce. The only data obtained which are apparently reliable are those published by USIBA in 1.967 (1) which include the North/N. East region and are not broken down into states. The period covered is likewise very short: 1.961/66.

By studying the USIBA figures in light of the ratio-industrial product of Bahia/industrial product of region, the following consumptions for Bahia are obtained:

	Flat products (tons)	Non-flat products (tons)	Equivalent ingots (tons)
1.961	5.900	7.800	17.600
1.966	13.200	16.500	38.100

(1) USIBA. Project carried out by Swindell-Dressler Co. 1.967

which in 1.966 meant a direct consumption of steel per inhabitant of 5,7 kg, a figure very remote from that of Brazil.

D. 1.1.2. Demand projection

D. 1.1.2.1. Brazil

Background details

a) In 1.966 after an agreement was signed between the Brazilian Govt. and the World Bank, a general study of Brazil's iron and steel industry was undertaken by Booz-Allen and Hamilton International (BAHINT); this included a market study which laid down possible growth rates for the demand of rolled products. The three annual rates were: 8% (conservative), 8,5% (probable) and 10% (optimistic).

The Consulting Group for the Iron and Steel Industry (GGIS) set up by the Govt. in April 1.967 to update and make a more detailed analysis of the financial/economic aspect of this report, decided to adopt the optimistic -- growth rate, as far as projected demand was concerned and with this figure as a basis forecast the demand for the different categories of rolled products for the period 1.968-1.977.

b) In 1.970 the Brazilian Iron and Steel Institute (IBS) contracted the Brazilian company TECNOMETAL to make a complete study of the market financed by FINEP with the aim of giving the right direction to the expansion policies of the iron and steel sector. This study, which was finished in April 1.971 (still unpublished), has considered various possible growth rates for demand, choosing as the most probable taht which appears in table Fe-7; also in the same table and so as to enable a comparison, we give the forecast demand arrived at by the above mentioned GGIS and taken from the Nacional Iron and Steel Plan (PSN), published in December 1.967.

c) Our own estimations

To the behaviour of steel demand in Brazil we have applied the historical models normally used by the European Coal and Steel Community (CECA). Table Fe-8 shows the adjustments obtained, measured by the corresponding coefficients of correlation. As can be seen, they are similar to those obtained by the countries belonging to Ceca.

However, interest in these models is relative given the present circumstances of the Brazilian economy. Even though they help explain the past almost perfectly, their use in forecasting future demand may be decidedly risky. Although it is still too early to confirm actual growth rates, it is necessary to take into account substantial changes that are affecting Brazil's economy and which we think will continue to do so.

The GIP (provisional figures) grew in 1.969 at a real rate of 8,4% and it seems that in 1.970 this figure had reached 9,5%; undoubtedly this increased growth has to affect consequent steel consumption in a greater proportion.

For this reason we think that the demand will probably behave according to the formula set out below:

1) Actual rate of GIP growth = 7% (lower than 1.970, but higher than growth rate in the periodo when Brazil's eco

nomy expanded the fastest; in other words in the period 1.949-1.959).

2) Steel consumption/GIP elasticity = 1,55 (similar to period 1.949-1.959).

3) Growth rate of steel consumption = 10,85% (1,55 x 7% = 10,85).

Graph Fe-3 and table Fe-9 show this projection (projection B).

Alongside its results, we set down those obtained - using the historical model which has a greater correlation coefficient (1). We consider this projection (A) more pessimistic, being the former, the probable one.

d) Conclusions

Two years is quite frankly an extremely short period in which to draw conclusions on the continuity of an economic process, but at least it is possible to put a reasonable degree of credit in the attempt to build new foundations for the Brazilian economy, whose premises are not only of a strictly economic character, but social and ideological as well.

According to the histocial model kept as indicative, if the changes forecast in the economy do not take place, an annual rate of growth of 8,7% in the GIP would be necessary in order to achieve 15,2 million tons consumption (esti-

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(1) Log Y = 1.2521 log X - 0.0763 r = 0.981
Y = Steel consumption in 000's of tons
X = GIP in millions of NCr $ (1949)

mate for 1980); in the last 25 years this growth rate was only achieved on 5 occasions and it is almost 1 1/2 times higher than the average rate for the period of highest growth i. e. 1949/59. On the other hand, it is not considered at all possible that this rate can be obtained without first restructuring the economy.

Finally, if the same population increase in this decade as in the last is maintained, a steel consumption "per capita" of 125 kg would be reached in 1980; the total consumption "per capita" in Spain rose to 260 kg in 1970. From this point of view, the 125 kg "per capita" for Brazil in 1980 seems a not disproportionate target and must be obtainable. In 1980, Brazil will have reached an income per head approximately of half the corresponding Spanish figure in 1970.

D. 1. 1. 2. 2. <u>Bahia</u>

It has not been possible to find any demand projections for steel in Bahía. However, IBS has a joint projection for the states of Bahía and Sergipe (Leste Setentrional), but the data at out disposal only includes non flat products. Basing our calculations on that projection and using certain hypothesis (1), we have obtained the following probable demands for Bahía:

(1).

1). Consumption of rails will suppose 5% of total consumption of non flat products (IBS does not include consumption of rail).

2). The ratio between flat and non flat products will change from 47,5% - 52,5% in 1970 to 52,5% - 47,5% in 1980.

3). Conversion factors for ingot equivalents: - Non flat products - 1,24
- Flat products - 1,34

4). Consumption of Bahía will suppose 90,11% of total consumption of Leste Setentrional, a proportion identical to that which in 1967 (last year for which data is available) represented its industrial product as percentage of the one of the region considered.

	Non flat products (tons)	Flat products (tons)	Ingot equivalent (tons)
1972	53.000	49.900	132.600
1975	77.800	77.800	200.700
1980	136.200	150.500	370.600

In other words, in 1980 there will be a direct consumption per head of 40 kg., a figure lower than that for the whole of Brazil in recent yeare but which likewise represents for Bahía a much more favourable proportion than that of recent years.

The demand data collated in our visits to the various industrial consumere of sheet steel in the Aratú area total up to give figures of the order of 40 to 45.000 tone/year in 1973, which would mean for the whole of Bahía figures close to - 60.000 tons for that year. It would even be necessary to modify the previoue projection in line with this increase.

If the induetrial centres, like the one at Aratú take root and succeed as can logically be expected, then probably in the period 1975/80 not only will the same growth rate be achieved as in the preceding period, but it might even be bea ten. If this is the case, steel consumption in 1980 might reach 500.000 tone and consumption per head could be higher than 55 kg.

D. 1. 1. 3. Stainless Steel Market 1970-1975

D. 1. 1. 3. 1. Generalities

As a basis we have used the information available - from some studies made on Braeilian demand for high grade steels and the projection refers to the period 1970-1975, - using 1966 as a base year.

Although the figures obtained may vary somewhat - from the results to be published from the study of the Brazilian steel market which IBS (Brazilian iron and steel Institute) has contracted with Tecnometal, with the aim of giving the right direction to expansion policies in the Brazilian iron and steel sector, the variation will not invalidate in general terms the conclusions reached in this section which only intend to determine approximately the initial production capacity of a stainless steel flat products mill to be installed in - Bahía; this capacity on the other hand will be greatly influenced by the prospects of exporting stainless steel sheet to Argentina and other ALALC countries.

D. 1. 1. 3. 2. Outline of sectorial demand

Product lines

The demand for stainless steels in Brazil can be divided in two important lines or categories: the category of non flat products which covers billet, bloom and bars and the line of flat products, i. e., in coiled sheet or plate.

The line of non flat products can be broken down into the following types of products:

a) Light rolled steel

Includes products of any kind in bars or coils, of sizes up to 1", inclusive.

b) Medium rolled steel

Includes rounds, squares and hexagons of sizes between 1" and 2 1/2", inclusive, and strip with widths 1" - 6" inclusive.

c) Heavy rolled steel

Includes rounds, squares and billets between 2 1/2" and 6".

d) Forgings

Includes bars, billet and bloom over 6" and also products called blocks for tools and dies.

Non flat rolled steel

The typical consumer sector are ornamental and cutlery which uses mainly chromium stainless steel strip for manufacturing knives and other forged or drawn articles. One must also name the sector for domestic and commercial uses with a varied consumption over 800 tons per annum.

Flat rolled steel

The major consumers are the ornaments and cutlery industries, followed by activities that include all stainless - steel boiler shop, food-stuff and transport products of which the latter uses much stainless steel sheet.

D. 1. 1. 3. 3. Projection of future demand

Methodology used

The methodology used in the studies that we have employed as background have taken into account, within parti cularities of each product or sector, the following hypotheses Historical projections, the industry's own projections and simple or multiple correlations.

From the abovementioned hypotheses the results -- shown in table Fe-10 were obtained for the two lines or categories of rolled steel products under consideration.

Taking this table as a basis, the most probable -- growth in the demand for non flat products in the years being studied would be the following (always in accordance with the studies mentioned).

Year	Tons
1968	3. 200
1970	3. 600
1972	4. 200
1975	5. 200

And for flat products:

Year	Tons
1968	8. 500
1970	9. 500
1972	12. 000
1975	15. 000

Corrections to the projection with base year 1966

Restricting ourselves specifically to demand for flat products, which interests us most, in order to determine the initial capacity of a future stainless steel plant, the figures projected in accordance with the previous paragraph seem ve-~v conservative given the rise in sheet steel imports in 1967-

1969. According to the 1970 Yearly Report of the Brazilian iron and steel Institute (I. B. S.), the imports of stainless flat products have been:

Year	Tons
1967	7.983
1968	9.551
1969	15.869

Therefore, the figures taken for estimated demand in 1975 had already been surpassed in 1969, while the 1968 achievement were above the 1970 estimates.

Even supposing that 1969 was abnormal as regards imports, it is obvious that the projection adopted as most probable for demand is in fact excessively conservative, for which reason it is logical to suppose that the most appropriate figures are nearer to the 1954-1966 exponential estimate of table Fe-10. Therefore, we calculate that in 1975, internal demand for flat rolled stainless steel products will be somewhere between 20.000 and 25.000 tons/year.

Our own exponential projection, based on the import data taken from the IBS Yearly Reports, for the period 1960-1969, confirms this supposition with the following figures:

Year	Tons
1970	12.370
1971	13.950
1972	15.740
1973	17.750
1974	20.020
1975	22.570

Even this corrected estimate might be rather conser vative, given that at present no stainless steel flat products are manufactured in Brazil, a fact that implies a depressed demand due to the logical problems of importing material. It is historically true that the mere installation of a productive industry stimulates the consumption of its very products; for this reason, the construction of a mill producing stainless - steel flats (which is what we are proposing in the recommen dations on the iron and steel industry) would greatly raise in ternal demand in a few years time.

In any case, the special different steel sectors in - Brazil forecast the possibility of high exports to Argentina and other Alalc countries, calculated at between 15.000 and 20.000 tons in 1975.

D. 1. 1. 3. 4. Initial capacity of a mill producing stainless steel sheet

From the figures given in the previous sections, it is reckoned that the initial capacity of a plant manufacturing stainless steel flat products will be 40.000 tons/year, which we have taken as a base figure for the technical-economic study of its preliminary project in Appendix E-2.

D. 1. 1. 4. Special steels market

Although in this report we don't propose mills manufac turing non flat special rolled steel products, as production of such steel is well developed in the Centre South region, we will mention as additional knowledge the possible estimate of its demand in the next few years.

If we suppose that the percentage of special steel of the total consumption in ingot equivalents continues the international pattern in the future of between 8% and 9%, the demand would reach the following figures (in ingot equivalents).

Year	Total steel (000's tons)	Special steels (000's tons)
1972	6.670	570
1975	9.080	770
1980	15.200	1.290

D. 1. 1. 5. Future balance between supply and demand of steel

The demand projections shown in section D. 1. 1. 2. will only be fulfilled by appropriate increases in productive capacity, which will be appreciably different from the industry's expansion plans forecast by P. N. S. in 1967.

For this reason and as long as we do not know the readjusted capacity for the next few years (at present under study) it is not possible to create a balance, not even an approximate one between forecast demand and supply.

Only by way of providing a pointer and supposing that productive capacity in 1972 agrees with the forecasts made by the P. S. N. for that year, we would already have for next year the balance shown in table Fe-11. From the same table, it can be deduced that if the forecasts of increased demand are fulfilled, there will be an overall capacity deficit of 357.000 tons of rolled steel, given in ingot equivalents. This figure consists of a small capacity surplus (106.000 tons) in non flat products and a capacity deficit (463.000 tons) in flat products in 1972.

D. 1. 1. 6. Structure of the steel consuming industries

According to the market studies performed in 1965 the distribution of steel consumption by sectors was the following:

Sector	% Consumption
Car industry	12,6
Shipbuilding	2,0
Railways	7,4
Railways equipment	0,6
Agricultural machinery	1,3
Press forming and canning	12,6
Domestic goods	3,6
Commercial goods	1,3
Civil engineering (construction industry)	26,1
Industrial equipment	6,9
Machine industry and boiler-making	8,1
Wire drawing	13,8
Miscellaneous	3,7

- Source: P. S. N.

The above distribution indicates the major steel consuming industries in Brasil which are the construction, wiredrawing, car, press forming and canning industries.

These 5 sectors together consume nearly 2/3 of Brasil's steel production.

If we analyse how the main consuming sectors behave in other countries we obtain the following comparisons:

Consuming sector	U.S.S.R.%	U.S.A.%	Brazil%
Industrial	61,0	69,1	63,9
Construction industry	32,5	29,7	26,1
Railways	3,3	0,9	7,4
Agriculture	0,7	0,3	1,3
Other sectors	2,5	-	1,3
Total	100,0	100,0	100,0

(Sources: I.B.S. and P.S.N.)

It is worth pointing out that Brazil due to her present stage of development consumes a greater percentage of steel in the agricultural and railway industries than the U.S.A. and U.S.S.R.

D. 1. 2. MINING

D. 1. 2. 1. Orebodies

At the moment there are no mines in production in Bahía.

To the north of Sento Sé, near the San Francisco river, there are several deposits with prospecting rights and their reserves, as yet unconfirmed, have been calculated between 5 and 40 million tons.

D. 1. 3. BRAZIL'S IRON AND STEEL INDUSTRY

D. 1. 3. 1. Present structure of production

D. 1. 3. 1. 1. General background

The iron and steel industry consists of 4 large companies (CSN, COSIPA, USIMINAS and C. S. B. M.) with single units having a capacity higher than 500.000 tons/each and a total annual capacity calculated at 4,9 million tons of steel ingots, as well as 24 other small or medium firms, integrated or not, with a joint annual capacity of 2,3 million tons of ingots.

The total installed capacity of all named factories could therefore reach 7,2 million tons of ingots per year.

The 3 great integrated iron and steel mills that are under the Federal Government's control and work with coke blast furnaces make up 63% of the national productive capacity

D. 1. 3. 1. 2. Concentration level of production

Table Fe-12 affords a view of the structure and distribution of iron and steel companies, as far as their production capacity in ingots is concerned.

If we study the industry from the point of view of geographical location we also find that it is strongly concentrated.

The South-East region, with an area of 918.808 km^2 (10,86% of total area of Brasil) and a population in 1970 of 41.473.000 inhabitants (43,51% of total population) practically monopolises this industry in its different stages. Tables Fe-13 to Fe-20 show the present geographical distribution of the iron and steel industry.

Pig iron (tables Fe-13 and Fe-14). In 1969 only 3 states were producers, namely, Minas Gerais, Rio de Janeiro and Sao Paulo, with a corresponding joint production of 111 kg "per capita", which with reference to all Brazil would only represent 40 kg/inhab. The three producing states hardly surpass a third of Brazil's population. Of the three, Minas Gerais is the most dynamic and its production percentage grows constantly due to the fact that it has large iron ore reserves.

Steel ingot (tables Fe-15 and Fe-16). Production is - rather more dispersed, among a total of 7 states, of which 6 belong to the South-S. East zone and only one, Pernanbuco, is - far geographically speaking from this region, though its production is relatively insignificant (1, 1%). The present tendency is for the rise in relative importance of Minas Gerais, Sao Paulo and Rio Grande, although the inclusion of the latter - among the most dynamic states is due more to its having developed from a low starting base.

Flat rolled products (tables Fe-17 and Fe-18). Only produced in the 3 states that produced all the pig iron; namely, Minas Gerais, Rio de Janeiro and Sao Paulo. There is a tendency for the first and last states to increase their relative - productions at the expense of Rio de Janeiro, but it is not very significant due to the latter's high production in kg/inhab; 172 kg. in 1969 as against 59 kg. for the 3 states together and 21 kg. for the whole of Brazil.

Rolled non flat products (tables Fe-19 and Fe-20). Production takes place in 8 states, which means it is less concentrated geographically speaking, both as regards the greater number of states involved, as well as the reduced participation of the South-East region in relative terms: 90,3% in 1969 as against 95,8% in steel ingots and 100% in pig iron and rolled flats.

The situation set down here does not contradict the - logic of concentration of the Brazilian steel industry, since the growing tendency in the world's most industrialized areas is to increase the relative production of rolled flats to the detriment of non flat rolled products. This trend is seen again in Brazil; the most advanced zones monopolize the production of flats and to a certain extent abandon the production of non flat products (the latter require less investments and due to transport costs are viable in the least developed consumer zones). In 1967 the S. East region represented 92% of the production of non flat products, in 1968 91,7%, and in 1969 90,3%. In any case, it is not advisable to draw hurried conclusions -- from these facts but instead bear in mind the still high level of concentration.

Minas Gerais (once more) and Rio Grande do Sul are the states which slowly increase their relative participation, while Rio de Janeiro, on the other hand, with an absolute stabilized production is the state where relative figures are decreasing most rapidly.

The following can be deduced from what has been - said above:

- The steel industry in all its different stages is concentrated in the S. East region; within this region, Minas Gerais tends to increase its relative share in all productions.

- An incipient centre is represented by Rio Grande do Sul - whose share in Brazil's production of rolled non flat products is beginning to have some importance.

- In the rest of Brazil there are hardly signs of activity as regards iron and steel production.

D. 1. 3. 2. Present production capacity

The available data from the study of the iron and steel sector drawn up by IBS refer exclusively to the production of rolled non flat products. According to these in the first 6 months of 1971 the capacity installed (balanced, taking account of availability of steel and bloom existing in some companies) is the following, (expressed in 000's of tons of rolled products).

Type of rolled products	Capacity installed
Rails and accessories	100
Wires for construction industry	864
Machine wire	580
Common steel bars	150
Special steel bars (x)	418
Light sections	235
Medium and large sections	185
Weldless tube	132
- Total	2.664

The total production capacity at present for flat and non flat products is calculated at about 5,8 million tons in ingot equivalent.

(x) - Includes bars for machinery construction, tools, stainless steel and high alloy steels.

D. 1. 3. 3. Expansion of capacity

In line with what was said in section D. 1. 1. 5. it is still not possible to calculate (at the moment of drawing up this report) what will be the new capacity development plan that will enable the projected steel demand in the next 8 years to be met.

We will only say that according to information fron CONSIDER it is the Brazilian Government's intention to obtain 1980 an installed capacity equal to 1 1/4 times the demand of th home market, which regarding the figures of forecast demand wi. require in said year an installed capacity of the order of 20 million ingot tons.

The destination of this installed capacity would be - distributed thus:

Home market	80%
Exports	10%
Reserve for periods of high demand and competitive stimulus - among firms	10%

D. 1. 3. 4. The iron and steel industry in Bahía

The only firms producing ingots and rolled steel in the state are:

- Compania Siderurgica da Bahia (COSIBA)
- Siderurgica de Santo Amaro
- Usina Siderurgica da Bahia, S. A. (USIBA) (under construction)

COSIBA

This company, located in Salvador, suspended its production activities in 1970 changing its name to SOECIA, S. A.

During our visit it was only ware-houeing steel products.

Siderurgica de Santo Amaro

Situated in Santo Amaro town, it is an electric steel works devoted to manufacturing rolled products and cast steel - parts.

Its manufacturing sections consist of:

Steelworks

- 1 Electric-arc furnace with maximum capacity of 1.300 kg. Production: 200 tons/month. Metallic charge: very varied local - scrap.
- Casting bay for steel ingots 100 x 50 x 1000 mm. and 40/50 kg weight.

Rolling-Mills

- 1 Three-high blooming mill with ø 280 mm. rolls and 250 HP engine at 180 rpm.
- Four-stand finishing-mill (3 Three-high and 1 Two-high) with ø 860 mm. rolls and 350 HP engine at 240 rpm. Approx. capacity: 1000 kg/hour (3/8") to 1500 kg/hour (1"). Working 10 - hours/day.
- 1 Fuel-oil furnace to reheat billets. Capacity 1500 kg/hour. - Manufacturing capacity in one shift is of the order of 2000-3000 tons/year.
- 1 Machine for making corrugated bars for reinforced concrete.

Foundry

Moulding area, sand bay, pattern shop, core stoves, etc.

Ancillary services

Laboratory equipped for mechanical tests and chemical analyses and mechanical repair shop.

Santo Amaro's production concentrates mainly on bars for construction use (normal and corrugated) and cast steel parts. On occasions it has rerolled old rails and wagon coach axles.

In bars, the range is between ø 1/4" and ø 1", max. lengths of 12 m. in carbon steel.

In the foundry, its capacity is of the order of 10 tons/ mth. the biggest part manufactured being of 1 ton. weight.

Total personnel (productive and non productive) consists of 145 employees.

USIBA

a) General

This company was born as a result of the initiative of SUDENE with the aim of providing the N. East with an iron and steel industry that would guarantee the supply of steel, a basic condition in order to achieve a faster industrialization of the region.

The principal shareholders of USIBA are: SUDENE - (74%); Companhia Vale do Rio Doce (24%) and Companhia Side rurgica Nacional (0,35%).

The USIBA project, already under construction, contemplates the establishment of an integrated iron and steel - plant with an annual capacity of 1 million tons of raw steel in the final stage.

The plant is situated in the municipality of Simoes Filho in the industrial centre of Aratu, near Salvador. It will receive pellets from the Companhia Vale do Rio Doce in Vitoria, Espiritu Santo State, unloaded at a shipping terminal on its own land, a few kilometres from the plant area itself. The pelletized ore will be reduced with reformed natural gas (hydrocarbons) by the HyL process which, as it is known, has been developed by Hojalata y Lamina de Mexico. The natural gas will be delivered by Petrobas, a company that has installations in the region. The iron sponge produced in the HyL reducing unit will be converted into liquid steel in an electric furnace, which will feed a 6 strand continuous casting machine for the production of billets.

USIBA's industrial installations are built on a total area of 350 hectares, near the coast and Salvador and it is only 12,6 km from the rail network that links this city with the North and South of the country. Electrical power will be supplied by CHESF (Companhia Hidroelectrica do Sao Francisco) along a 220 kV transmission line. Water for industrial use will be supplied by SAER (Superintendencia de Aguas e Esgotos do Reconcavo) by an aqueduct exclusively used by USIBA. Likewise, the 6 km. gas pipeline which will carry the natural gas from Petrobas to the HyL reducing unit will be exclusively for USIBA. The plant's infrastructure already constructed, is dimensioned, bearing in mind future expansions that would take its annual capacity to 1 million tons of crude steel.

b) <u>Evolution of USIBA</u>

The formation of USIBA, initiated in 1963, for the construction of a plant, aimed to the production of sheet and tinplante, has undergone several alternatives that have delayed both its start up and the definition of precise production programs.

At the beginning, the MW. Kellogg company, made for SUDENE, a favorable feasibility report about the project. Later on this report were completed by the Swindell-Dressler Co, with the collaboration of USIBA and the consulting advice of Batelle Memorial Institute. This studies were fundamentally focused to the problems presented by the prereduction of the Itabira's iron ore from Vale do Rio Doce Co. Industrial tests, at a minor scale, were made in the mexican TAMSA plant, which works normally, with brazilian iron ore from 1968.

As a result of those studies and tests, the initial production project was established in June 1967, approved by SUDENE on December of that year. Such project established the following production program:

Product	t/year
Hot rolled sheets	48.600
Cold rolled shsets	40.000
Tin plate	53.900
- Total	142.900

This program, with small variations on the above production figures, was valid until the beginning of 1969, when it was abandoned, probably by the small flat rolled products demand projection at the North-East and fundamentally by the - small plant size that made unprofitable the rolling of flat pro ducts.

The construction was initiated in 1969, with site preparation, and general infrastructure work. The second production program established in 1970, decided to produce only billets for sale, with the following basic equipment units:

- 1 direct HyL reduction unit for iron sponge (230.000 t/year), using as raw material, Itabira iron ore pellets (377.904 t/year).
- 1 electric furnace, 100 t. capacity and 42 MVA for a production of 290.000 t/year.
- 1 continuous, six strands, casting machine for billets --- (280.000 t/year) 80 x 80 to 160 x 160 mm. The billets would be sent to the South for subsequent rolling into finished products (probably to the Ferro y Aço Co. of Vitoria).

This project is under installation, (steel furnace and continuous casting machine) to be followed by the erection of the HyL reduction unit.

The last available informations, however indicate new changes in the above plans, as now apparently, raw steel production should to be raised up to 330/380.000 t/year and a part of the billets produced would be rolled into construction bars - and wirerod.

The start-up of the steel plant would take place in - August 1971 and the HyL unit in November of this year. The steel plant will melt 100% scrap at the start-up, with a gradual increment in sponge utilisation up to 60/65% of the metallic - charge.

We do not know either the "product-mix" presently stablished for billets, bars and wirerod, that probably will be still modified in the near future, nor the changes introduced into the furnace installation in order to increase its production capacity up to the new figures now foreseen.

c) Profitability of USIBA in several production alternatives

In accordance with the preceeding paragraph, the production alternatives presently considered for USIBA are, apparently:

1. Billets production and its sale as semiproduct without - further transformation at USIBA in rolled products.

2. Billets production and rolling of part of the same at USIBA for selling billets, bars and wirerod.

1) Production of billets for sale

The production of 280.000 t/year of billets, fixed as USIBA'S program until a few months, would need, with a 96% efficiency in continuous casting, 291.666 t/year of electric furnace steel, equivalent to 2.916 taps/year of 100 t. each, i.e. 291 working days at 10 taps per day. This is an efficiency very difficult to get, even with ultra-high power (UHP) furnaces, till the operating personnel is fully trained in the particularities of the new production techniques. Such training can last a long time.

If the known characteristics (100 t. 42 MVA) of the electric furnace are not modified, the most probable production would not surpass, even with an 86% utilization - factor of the furnace (315 working days per year) and 8 taps per day

8 x 315 x 100 = 252.000 t/year

that would give 240.000 t/year of billets in continuous of billet production is given in table Fe-21.

Table A, analyzes of results to be obtained by the sale of the theoretical production of 280.000 t/year of billets.

This analysis is based on the data published in the booklet "A presentaçao do projeto USIBA, e sua influencia no desenvolvimento do Nordeste e do pais" (July 1970), but with the important difference of taking in account the transportation costs of the billets to the rolling plants of the - South of Brazil. Such costs are not included in the profitability study of the above mentioned publication, and their amount, even in the most optimistic assumption, will be - not less than 10 U.S. $/t. It is evident that such transportation cost must be USIBA'S debit, as the rolling mills in the South can find billets at the same sales price of USIBA (109 US $/t) and also at lower prices.

Therefore, USIBA will not be able to repercuss -- freight costs in its billets' sale price.

Column B is based on the same above data, but in the assumption that the actual billet production will be - 240.000 t/years. This is as already pointed out, the most probable production figure, unless the steel furnace is fully revamped. With such production, and, as it can be deducted from last line of columns A and B, USIBA would pass from a meager profit to a sizeable loss. Moreover, it is convenient to point our that the 109 U.S. $/t, given as sales price by USIBA, should be qualified of very optimistic, and probably can not be maint· ned in the future. Therefore even with the theoretical billet production of 280.000 t per year, great losses would be resulting, and with the more realistic production of 240.000 t per year, the registered capital would be depleted in five or six years.

2) Composite production (billets and rolled products) for sale

The profitability of this alternative would be intermediate between the resulting from alternative a) above and that obtained, by rolling all billets produced into bars, wire-rod and sections for sale. Therefore, for brevity's sake, we shall analyze this last assumption, been easy to deduct the profitabilities in case of scheduling variable percentages of billet production for direct sale.

Column D, shows the most important data relative to the installation of a bar and wire rod mill for a production of 120.000 t/year and of a section mill for 100.000 t/year that would roll the total billet production of 240.000 t/year. Figures of column F are given in some instances as absolute figures and in other cases as increment (or decrement), on corresponding figures of alternative a), above.

Column E, includes data from columns B (production of 240.000 t/year of billets) and F (rolling mills). Apparently, USIBA could reach a not great profitability, but sufficient enough to survive. From the observation of the data of the rolling mills only, such profitability seems, essentially also clear, but this inference needs, however some aditional precisseions. The difference between the average sales price of finiehed products and their average cost amounts to 8,8 U.S. $/t. This is a reasonable difference, but of - course, artificial, and can only be maintained at the present circumstances of the steel markets in Brazil and Bahia. This statement is fully backed by the data included in the column C.

Column C, shows what USIBA ought had to be both from an investment viewpoint and from market reasons. It presents the basic data of a plant for rolled products based in scrap utilization (mini-steel plant). It has been assumed that the total investment would be made with own capital, as the necessary one in such case, does not amount to the fourth part of the USIBA'S registered capital.

A mini-steel plant, with electric steel shop, continuous casting and bars and sections rollings mills, on a much more lighter infrastructure that the present one of USIBA could have been the best and much cheaper solution for the steel market problems of Bahia, as that plant could sell directly in the state bars and sections with no transportation costs. In the case of billets sale only, a double repercusion in price is to be found: billets transportation to the southern rolling mills and return freight costs of rolled products.

From the assumed total production of the ministeel plant, i.e. 100.000 t/year, 70.000 t. would be consumed by Bahia (estimated demand for 1975, as it has already been indicated in the steels demande forecast paragraphs) and the balance would be sent to nearby markets.

In this case, the difference between the average sales price and the average cost amounts to 69,5 U.S. $/t. much higher than the 8,8 U.S. $/t above. This means that in a perfect market situation, covered by plants of the mini steel type, USIBA would be displaced to an extramarginal situation and, therefore, placed in a situation of severe losses. (Such situation can be present, in the future, by the existence in the Northeast region of plants with much lighter investments than USIBA, as for instance Aço-Norte).

Therefore the installation of rollings mills is not a solution but a mere palliative. Evidently, if USIBA could survire with difficulty selling rolled products in a market of the above characteristics, its position would be even worse selling only billets produced at a higher price that the one made possible for rolled products from a ministeel -- plant.

The inexistence of a market of sufficient dimensions and the burden of an excessive infrastructure, geared to a production of 1 million tons/year, condition the present position of USIBA and its future evolution, where a very limited profitability or less losses than in the case of billet sales are only possible.

Columns F and G table Fe-21 are only the translation of D and E, on the assumption of a production of --- 280.000 t/year of billets. This assumption, as it has already been mentioned seems not probable.

Therefore, USIBA must decide urgently the adoption of better production alternatives.

We strongly recommend the installation of a plant for stainless steel flat products.

The reasons that back our recommendation are based on the demand's forecast, already studied, and which, even calculated in a conservative basis, allow the erection of a plant for the rolling of 40.000 t/year of stainless steels - sheets.

Furthermore, this is a production not contemplated in Brasil, at least according to the information gathered during our stay, with the exception of the not well defined pro-grams to reconvert ACESITA for the production of stainless steel flat products. This solution would be inadequate from a quality standpoint with the mere reconversion of the present ACESITA'S installations.

The advantages of the installation of the stainless steel plant at USIBA are among other, the following:

- The plant would have a nation-wide market and excellent possibilities for export to the ALALC area.
- There are ferroalloys plants in Bahia then can serve as a base for the production of low-carbon ferrochrome.
- It is a product of high sales price, that absorbs easily freight charges.
- The production can be programmed in two phases:

In a first one, of rapid installation, only imported hot rolled coils would be cold rolled.

The second stage would start the production of steel in electric furnace, the continuous casting of slabs, and the hot rolling of coils.

- The HyL process produces a raw material of excellent quality for the metallic charge of the electric steel furnace.
- There is no any similar installation in Brazil, and moreover the product has a great possibility of stimulating the demand as soon as domestic production will be available.
- Foreign capitals would be interested in the financing of such plant.
- Nickel from the Caraiba copper ores could be used for the alloys of that metal, necessary in stainless steel fabrication.

Column H of the table studies the profitability of the first phase of the stainless steel plant proposed.

(For this plant and also for the rolling mills of column F, it has been assumed that all necessary equipment would be financed by loans promoted or granted by the manufacturers. The balance of the investments would be financed by an extension of USIBA'S corporate capital.

This is, of course, an assumption that could be - substituted for any other without an important change in these conclusions).

Column H is self explanatory and the extremely high profitability, great sales margin, low transport incidence, etc., must induce USIBA to plan urgently the partial recon version of its objectives and to begin the construction of an stainless steel plant which taking advantage of part of the present infrastructure, will have a production capacity of 40.000 t of flat rolled products in its 1 st. phase. From this production, 20.000 t would be assigned to the domsstic market, and the balance to export.

This plant would, not only assure the USIBA'S futurs but also allow that the country could receive a foreign cu-rrency income higher than 30 million US $ per year. On the other part and without great detriment of USIBA'S profi tability, the production of the plant could be sold in Bahia and in the rest of the country, at much lower prices than those existing to-day, stimulating therefore the growing of the consuming sectors which are, precisely, the most dina mic in modern economies.

Even the next future domestic market of stainless steel in Brazil is estimated in 20.000 t/year, it is evident that once production will start, a domestic demand will be developped, that would allow to expand the initial production stage to higher production stages. Such has been the trend in other countries that have started such process.

Table Fe-21 contains a last column, where the as-sumptions relatives to the stainless steel plant and to USI-BA'S present structure more the billet rolling mills are put together. All comments on this column have already been made.

D. 1. 3. 5. Feasibility of installation of a big integrated steel plant in Bahia

In the present circumstances the installation of a big integrated steel plant is not feasible.

Such an installation would be justificable when any of the following conditions would be present and in the following sequence:

a) Sufficient market size local or within the plant influence area.

b) Raw materials abundance

c) Regional development grounds

d) Possibilities of export

e) Low manufacturing costs, profit earning capacity and capital's availability.

1. Market conditions

For the time being, the conditions of point a) above are not present in Bahia, as a big integrated steel plant must have a minimum economic size and must be mainly devoted to the production of flat rolled steel products together with an smaller production of rolled sections.

The minimum economic size of such a plant under the present conditions of Brazil would be for a production of two millions tons of steel per year

Nevertheless, the local market and the influence areas of such plant would have a much lesser consumption until the region has a more advanced industrial development.

The production of rolled sections is mainly assigned to construction and industrial use. Present consumption of wide flange I sections is very low and its production nonexistent. The consumption for this type of rolled sections will develop strongly in the future, but the location of its production in Bahia with transportation of the products to the South of Brasil is controvertible

2. Raw materials availability

Bahia is lacking of basic raw materials, coal and - iron ore, for the installation of a big integrated steel plant. Coal is also scarce in other areas of Brasil for new steel production plants. Other processes not based on coal are not relevant, as USIBA will use the natural gas available in Bahia.

3. Regional development grounds

A big integrated steel plant is not an important focus of regional development, as the necessary manpower for such a plant is in the order of 4.000 employees, that for an investment of 300 US $ per ton of steel, amounts to 150.000 US $ for each job opening.

It is much more important to develop in Bahia transforming industries, with a much lower investment, and with much greater job creation capabilities.

4. Possibilities of export

Brazil can export plain steel products with difficulty as its production has a low profit-earning characteristics. - When there is an excess of steel products big producing countries sell at "dumping". Brasil need great amounts of capital for its industrialisation plans, and even endowed with big -

iron ore reserves will find an strong competition with other South-American countries, that have also launched ambitions steel development programs and also have sizeable iron ore reserves.

5. Manufacturing and financing costs

An steel plant of the above characteristics cannot have low manufacturing costs as it needs great investments -- which burden heavily the loans granted for its installation.

It can be concluded from the above that Brazil should better decentralize is steel production facilities. The steel - consumption will experiment in the coming years, a big expansion, taking in account the big population's increment.

In order to achieve succesfully such decentralization process it is before necessary to decentralice the transforming industry, and create strong steel consuming industries, such as automobile industries, shipyards and domestic appliances.

Only with these conditions present, the installation of a big integrated steel plant will be feasible in the Northeast region. Bahia would have optimum conditions with its future harbor to receive big ore and coal freight vessels.

As such factors rely upon a nation wide policy it is not possible to establish in this survey when those conditions will be present.

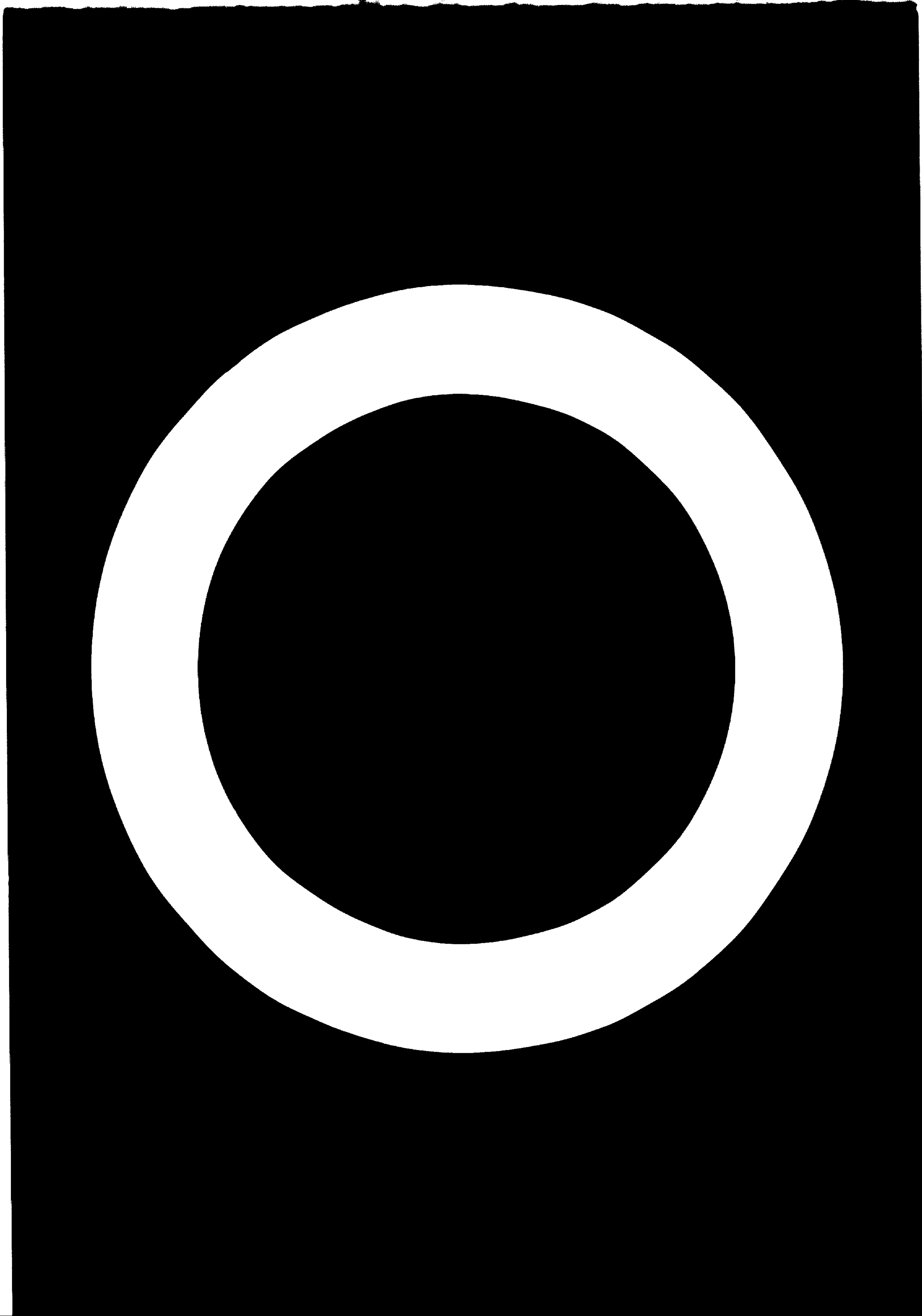
D. 1. 3. 6. Prices of rolled steel products

D. 1. 3. 6. 1. Prices in Brasil, in other countries and in the international market

Tables Fe-22 to Fe-24 report on the ruling at the time in the brasilian and spanish markete, and when relevant, in other countries and in the international market.

The products selected are limited to thoee that are in more common use in Bahia, without pretending at any moment, to give the impreesion that thie is an exhauetive - study of prices for all steel products. However, as general enunciation, those selected are sufficient to indicate the notable differences existing in prices to the detriment of the brasilians. All the prices are ex-mill prices, before the indirect taxes incentives or subsidiee, as for inetance, ICM and IPI in Brasil, ITE in Spain and TVA in France.

The above-mentioned tablee are sufficiently eelf-explanatory. The price differences between Spain and Brazil oscillate between 15% to 80% depending upon type of product and sise. These differences may be attributed to several causes, among which will be found the important traneportation burden in the final selling price and the insufficient and inadequate size of the offer in Bahia.



D. 1. 3. 6. 2. **Prices in Bahia**

Transport

Among the many problems facing the steel products' supply in the State of Bahia, that of transportation is foremost, with sufficient weight to relegate any other problem to second place including channels of distribution.

In another section of this report the system of communications between the State and the rest of Brazil has been described within its infrastructure. That system was classified as "non-satisfactory", and affects the transportation tariffs, which in turn, in relation to the volume of traffic nowadays, are such that no substantial reductions in - their amount are permissible. Also, the great geographic distances in some cases must be taken into account.

The transportation tariffs of steel products to Bahia are fixed upon the following rates depending upon - point of origin:

- Santo Amaro (Bahía)	15	NCr $/t
- Recife (Pernambuco)	60	"
- Volta Redonda	110	"
- Minas Gerais	120	"
- Sao Paulo	135	"
- Rio Grande do Sul	180	"

Now, given the manner of levying the ICM and the form in which the metallurgical warehouses charge for their margins, the incidence of these freight charges over the retail price is increased by 40-70%.

These freight charges, not liable to alteration at the moment, bring the cost up to a non-competitive level for the enterprises that use metallurgical products; a problem that would not be serious if only products of very high value were concerned, since their high pr.ce would enable them to absorb, the high cost of freightage; but the consuming enterprises of Bahia, as a rule, do not belong to this type.

Naturally, this problem is doubled if the enterprise that uses the metallurgical product has to sell the finished product of part of it in the south of the country, -- should the demand in Bahia not be sufficient to absorb the supply.

Price of steel products

Tables Fe-25 to Fe-27 present the retail market price in Bahia and Sao Paulo for different not flat rolled - products. As may be observed, the prices for some products are similar in Bahia and Sao Paulo, while in others like angles and flats, the prices in Bahia are higher by up to 50% over those of Sao Paulo.

The products that require more working are precisely the ones that reach higher quotations in Bahia, like the example of angles and flats. The reason is logical, as Bahia (nor neighboring areas) is not a producer of these and therefore, transportation has a great incidence on the prices, incidence that adds to more difficult marketing practices.

There is a certain amount of production of bars in Bahia and their prices are not very much higher than in Sao Paulo, and in some cases they are even lower. However two circumstances must be taken into account. First, that Açonorte is capable of placing in Bahia bars at prices similar to or less than the prices of the own production of the State.

Second, without entering into the question of quality standards, and much more important, is the insufficiency of the Santo Amaro production. That is to say, that although it sells its products at lower prices, it does not have a production sufficient for the needs of its consumers - who have to acquire additional supply from other very distant points in Brazil at higher prices, and upon which the transportation costs have their adverse effects once more.

D.1.4. THE INDUSTRY OF METALLURGICAL PRODUCTS IN BAHIA

D.1.4.1. Introduction

Up to 1.967, when the Industrial Center of Aratu started its development, this industry hand almost only exclusively local characteristics. Nevertheless, the previous existence of cement industries, ferroalloys, and lead smelting should be mentioned. These industries, however do not properly incorporate metallurgical products to their production processes, even though they are consumers of spare parts, some times manufactured in their own maintenance shops, or in small local shops, but coming in a great proportion from the South of Brazil. Building and construction industries, boiler and steel structures shops, shipyards and the small metallurgical shops in the area are consumers of metallurgical products, mainly iron and steel products (bars, sections, pipe, sheets and plate) with a modest consumption, generally speaking, with the exception of the steel structure and boiler shop industry, represented in Bahia by an important plant (CESMEL), with a yearly consumption of sections (4.000 t/year) and plates (3.500 t/year).

The location of industries in Aratu is changing rapidly the above picture, an will do it even more in the future, with a growing demand of metallurgical products, as it has been ascertained during the visits or our team to the more representatives industries in Bahia. This demand can be clasified as follows:

- Steel rolled products

  Flat products (sheet and plates, hot and cold rolled)

  Non flat products (rods, sections, wire-rod, wire, rails and alloy and stainless steel bars).

- Castings

  In grey, alloy and nodular iron, plain and alloy steel; copper and alluminium alloys.

- Forgings
- Tubular products
- Tools

Having already studied in general, the steel rolled products demand in Bahia, in preceding paragrahs (See D.1.1.1.2.) the situation of the remaining sectors above mentioned is examined below, both in Bahia and Brasil, in order to draw the opportune conclusions and development recommendations, if any, in the frame of this report.

The following sectors are considered:

Foundry, Forgings, Tools, Bars and wire drawing, Steel tubular products, and steel sheets consumers.

D.1.4.2. Foundry industries

D.1.4.2.1. Introductory note

The foundry industries have presented a very quick development in the last twenty years in the country, as a consequence of the strong industrial development achieved in that period.

The available statistical information comes from the Associação Brasileira de Metais (A.B.M.). Through a direct inquiry conducted in every foundry in the country, this Association is collecting the data on the annual production of steel castings, iron castings and non-ferrous castings.

Even though the degree of attention given to these inquiries in the form of questionnaries is variable, taking into account that only foundry works of lesser importance give no answer to the questions (having most of them craftmanship characteristics and devoted nearly the whole of them to non-ferrous castings), it can be concluded that the per cent of enterprises answering the questionnaries -as far as it concerns to iron and steel, at least- is higher than a 95 per cent of the country's industry.

As some foundries have in their programms not only iron and steel castings, but other metals castings, too, in order to make an analysis of dimension of every one of them it would be necessary to put together the distinct types of castings. That data has not been made available to us, and the analysis of the foundry industry has been made by type of products and not by plants.

D.1.4.2.2. The foundry industry in Brasil

Present outputs

In Tables Fe-28, Fe-29 and Fe-30 the figures corresponding to the several metals for 1.969 outputs have been indicated, State by State. As far as it concerns to Sao Paulo, the data have been grouped for the capital and for the rest of the State.

Degree of concentration of production

Just as it happens with other industrial sectors, the foundry industry is strongly concentrated in Sao Paulo. The Table Fe-31 is a summary, in percentage, of the degree of concentration reached by the production of steel, iron and other metals castings.

The said Table gives a clear view of the extraordinary degree of concentration presented by Sao Paulo, having in mind thet the said State occupies only a 2,91 per cent of Brazil's area and has a 22,9 per cent of its population.

It must be pointed out that, as far as it concerns to copper, sinc and aluminium, the results offered by Table Fe31 may be higher if we consider it statistically, because of the absence of data referring to other foundries situated too much apart. Their impact, however, cannot be very important, for the totality of them are small in size.

The results given on magnesium are real, for the three foundries existing in the country, with a very high degree of specialization, are located in Sao Paulo.

As far as it concerns to iron castings, we must have in mind that the weight of ingot moulds reached the figure of 123.000 t in 1.969. This constitutes a deviation of the degree of concentration, since Minas Gerais and Rio de Janeiro produce a higher quantity of steel ingots than Sao Paulo. If we let aside the ingot moulds, the 31,98 per cent indicated in the Table Fe-31 would be 35,16 per cent for Sao Paulo.

Evolution of the foundry industry

This evolution has been collected in the Table Fe-32. If we compare the figures of production corresponding to 1.969 and 1.962, the following results are obtained:

Type of material	Increase (+) or decrease (-)
- Common steel castings	-5,05%
- High and low alloy steel castings	+147,98%
- Common iron castings	+28,95%
- Alloy iron castings	+75,83%
- Malleable iron	+18,15%
- Nodular iron	+851,02%
- Copper alloys	+59,38%
- Zinc alloys	+8,25%
- Aluminium alloys	+136,80%
- Magnesium alloys	+883,21%

Substracting from the production of iron castings the ingot moulds output included in it, for the rest of this material's castings, the increase represents only a 12,32 per cent.

If we compare the evolution of these outputs with the one corresponding to the Gross Industrial Product (G. Ind. P.) with a growth of a 44,70 per cent in the period 1.962--1.969, we get the following results:

<u>Common steel castings</u>

A marked decrease is observed in comparison with the G. Ind. P., a fact verified all around the world because of the substitution of steel castings through weldings, nodular iron and alloyed irons.

<u>High and low alloy steels</u>

A strong development is observed, as corresponds to an industry in demand of products of better quality.

<u>Common iron</u>

A 12,32 per cent lower than the G. Ind. P., that is a very normal fact verified all around the world. It is patent the competition presented by weldings, aluminium and even plastics.

<u>Ingot moulds</u>

91,97 per cent, a strong development following the steel industry production.

<u>Alloyed iron</u>

175,83 per cent. An increase superior to the G. Ind. P., such as it corresponds to a higher degree of development in industry.

Malleable iron

+18, 15 per cent. As a result from the strong competition presented by nodular castings, the development of malleable castings has not followed the increasing demand, though the automative industry has grown strongly.

Nodular iron

+851, 02 per cent. A clear acceptation in industry during the last years in Brasil.

Copper alloys

+59, 38 per cent. - Higher than the G. Ind. P.

Zinc Alloys

+8, 25 per cent. A normal figure all around the world.

Aluminium alloys

+136, 80 per cent. It reveals an acceleration of industrialisation during the last years.

Magnesium alloys

+883, 21%. It is an industry in full development, driven by the automobile industry.

The consuming industry and its structure

According to a sectorial study conducted in Sao Paulo, the consumption of castings is distributed among the diverse users given in detail in the Fe-33, where the steel castings have not been included because of the absence of data.

The most important consuming sector is transport, with the mechanical and metallurgical industries absorbing an important part of production.

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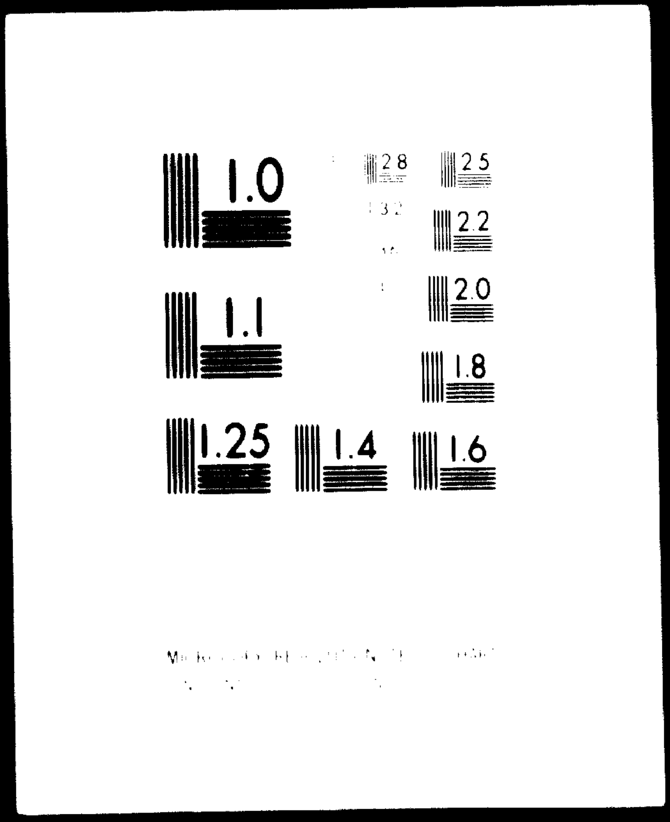

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Perspectives for this industry

In spite of the strong development reached by the foundry industry, the specific consumption in Brazil is still low. Referred to the iron castings concretely, it amounts in Brazil to 5 kg/inhabitant, a figure very far away from the one reached by strong industrialized countries, of 40-60 kg/inhabitant. There is, therefore, a wide marge for the development of this industry, since the demand will quickly grow up in the measure of an industrial development of the country.

D.1.4.2.3. **The foundry industry in Bahia**

Existing foundry works

The following foundry works are in operation in the State of Bahia:

Name	Location	Iron	Aluminium	Metals	Number of workers
1. Sao Caetano	Salvador	x	x	x	14
2. Administraçao do Porto de Ilheus	Ilheus	x			36
3. Antonio Rodrigues	Victoria da Conquista	x			12
4. Fundiçao San Jose	Santo Amaro	x		x	15
5. V. Boaventura & Cía. Ltda.	Salvador			x	6
6. Rede Ferroviaria Federal Leste Brasileiro		x			

Among them, the second one is working for the Management of the Port of Ilheus, and the last one for the LESTE Railway; their customers are, therefore, exclusive. The industry, in general, has to be supplied by the other four.

All of them use hand molding methods, without any proper quality control. They are, in fact, foundries relying on craftmanship, with a very low capacity of output, with an equipment technically rudimentary and obsolete, not being in condition of taking care, nor in volume of production nor in quality, of the growing requirements of industry in the State.

In respect to steel foundries, Siderúrgica de Santo Amaro has a complementary steel castings shop. Nevertheless its quality is not adequate for the present and future needs of Bahía.

It may be stated, then, that the foundry industry is practically inexistent.

Outlook of demand in Bahia

On occasion of our visits, it was clear the existence of a growing demand of castings as a consequence of the State's industrial development, with the following general characteristics:

a) Loose iron castings, diverse in their qualities and up to 3 t in weight.
b) Run produced iron castings.
c) Run produced high quality iron castings
d) Steel castings
e) Special steel castings: for instance, of manganese steel.
f) Nodular iron castings
g) Aluminium sand castings
h) Run produced aluminium chilled castings
i) Copper castings.

To-day's needs of this type of castings are covered from de South of Brasil and, in a great part, from Sao Paulo itself.

D.1.4.3. Forging industry

D.1.4.3.1. Introductory note

The forging industry, practically developed in Brazil during the last 20 years, is nowadays self-sufficient, presenting even an inactive capacity that, up to now, has not been absorbed by exports. The imports have been showing a decreasing trend during the last years, limited at present to very specialized forgings.

The forging industry is supplying the totality of the national market, both in quantity and in quality, with the automobile industry -its most important client- absorbing the 70 per cent of its production.

At the beginning of 1.960, the output showed the figure of 20.000 t/year; in 1.969 it reached the figure of 120.000 t, that is, an average cummulated annual increase of a 22 per cent in the said period.

D.1.4.3.2. The forging industry in Brasil

Just as in other sectors studied in this Report, the forging industry is strongly concentrated in Sal Paulo: 26 of the 30 registered enterprises are located in the said capital or in its surroundings. The sector gives occupation to some 11.000 persons and makes use of raw materials coming from national sources in its totality.

The equipment provided in the big works is modern and the products are of an adequate quality.

As far as it concerns to the structure of the sector, 6 out of the 26 above said forging works may be qualified as important ones, 10 are of a medium sise and the rest are of rather small importance, corresponding to 3 of the first ones the biggest volume of production, supplying the 85 per cent of the needs of the automobiles industry and the 60 per cent of the whole market.

The said 3 enterprises represent the 73,7 per cent of the total forgings output, with the following distributión:

- Krupp Metalúrgica	38,5%
- Sifco do Brasil, S.A.	20,6%
- Braseixos Rockwell	14,6%
	73,7%

Both Krupp and Sifco have ambitious programs of expansion for the next 5 years, being expected that demand will increase in a 9 and 10 per cent.

The sector's rentability -of a 7 per cent- has been heavily influenced by the great effort of growth accomplished.

D.1.4.3.3. The forging industry in Bahia

Properly speaking, no forging industry is existing in the State.

D.1.4.4. The tooling and cutlery industry

D.1.4.4.1. General

This sector is related, in some aspects, to forging and, in some cases, forging shows, as a complementary production, the manufacture of tools.

There are, however, enterprises devoted only to the manufacture of tools and/or cutlery, and we are going to refer specifically to it in this section. Its different specialties can be divided into:

a) Cutting tools (industrial shears, milling cutters, boring bits and hard metal compacts).

b) Assembling and maintenance tools (wrenches, pliers, hammers, etc., and farming tools).

c) Measuring tools (calipers and gauges)

d) Cutlery.

D.1.4.4.2. <u>The sector in Brasil</u>

<u>Tools</u>

The tool manufacture was begun in 1.919, its production being now strongly concentrated in Sao Paulo, where the 80 per cent of existing plants is located (95 out of a total of 120). Sao Paulo is, too, the principal center of consumption.

6.900 men are employed in this specialty in Sao Paulo, and 7.700 in the whole country. 72 men are, then, employed, as an average, in Sao Paulo works, and 32 in the rest of the country; these average values, however, would be rather lower if other additional enterprises, whose data are not available, had been included.

The capacity of production is 21.000 t/year for the sector in its totality, existing a 29 per cent of inactive capacity.

The Table below is a summary of the available data on production and foreign trade in this sector.

Year	Production (t)	Imports (t)	Exports (t)
1.960	7.500		n.a.
1.964	12.500	200 (annual ave.)	n.a.
1.965	n.a.		n.a.
1.966	n.a.	5.500	n.a.
1.967	n.a.	5.000	n.a.
1.968	n.a.	10.000	233
1.969	15.000	6.000	600
1.970	n.a.	n.a.	1.000 (estim.)

In the period 1.960/1.964, the output experienced a swift increase, with imports rather unimportant. From 1.965 on, the annual growth has been of a 3,5 per cent, with a 12 per cent corresponding to the cutting tools.

As far as it concerns to imports, its volume experienced a great increase from 1.966 on, bringing about a crisis in the sector in 1.968, which grew progressively better in 1.969 and 1.970. The imports are fundamentally centered in cutting and special tools, that in many types belong to qualities not manufactured in the country (measuring tools, gauges, etc.).

In order to soothe the said crisis, the sector began in 1.968 to export to different American countries, with good prospects for the future.

The quality may be considered as acceptable; it exists, however, a manufacture of tools for a normal use, which lies under the standards normally required in production. This type of tools, however, is not supplied to the great industry.

The sector, as far as it concerns to cutting tools, is deficient; in spite of it, its development is quick, because of the growing demand. In a near future, it will be in state of covering the national market, except in special qualities.

Finally, we shall point out that the incidence of costs of raw materials on the cost of production, gives a clear index of development, still incipient in this sector, in certain qualities.

In Brasil we have a 48 per cent, compared with a 25,6 per cent in Europe. This is a clear indication of the fact that manufacturing processes are still simple, with an added value in plant rather small.

Cutlery

This sector gives occupation to 3.000 persons distributed into 10 enterprises. Its yield is small, with the exception of the most important enterprise in this sector (HERCULES), representing more than a 50 per cent of the sector (NCr $ 4,5 million/month). The trend shown by some works looking for their survival has been an intense diversification of their production (electroplating plants, forgings and even electric motors).

The exports of cutlery products have no importance, with no permanent orders.

Only two enterprises are insisting in getting new machinery. The cutlery works are concentrated in Sao Paulo and in Rio Grande do Sul.

D.1.4.4.3. <u>The sector in Bahia</u>

There is only an enterprise manufacturing hand-tools (spades, diggers, etc.).

It is the Tramontina Nordeste Industrial Ltda. located in the C.I.A. and an affiliated company of an industrial group, that owns three forging shops in Rio Grande do Sul manufacturing hand-tools, forgings and cutlery respectively, which in a first phase, has started the production of such tools with the purpose of, later on, enlarging its programm. It has the proper equipment and is employing, as raw material, recuperation rails, adquired at a very low price that allows it to sell a product at a price out of every competition.

The scheduled production of the Aratú plant is 300 t/month with a total staff of 150 people (120, direct labor).

The rest of hand-tools in the country is manufactured as an article of pure crafmanship, with obsolete methods.

No production of cutting tools, cutlery or precision tools is existing in the country.

D.1.4.5. <u>Rod and wire-drawing</u>

D.1.4.5.1. <u>Introduction</u>

The global production of drawn products (bars, plain wire, barbed wire and derivatives) reached in 1.969 a figure of 435.000 t with imports in the same year of 55.000 t, according to data supplied by CACEX.

The percentage of steel processed into wire is in Brasil one of the highest in the world; it represented in 1.969 the 10 per cent of the total production of steel. Is this a characteristic common to every country in its phase of development (representing in some of them even a 12 per cent of the total steel production), while in countries with a high level of development it is only of a 4-6 per cent. The reason of this difference is to be attributed to the fact that in the industrialized countries, the introduction of new materials as a substitute (plastics and nylon) decrease the proportion of steel processed into drawn products.

As far as it concerns to bars-with the automobile industry as its first consumer, followed by the mechanical and electric appliances industries- its production has been showing a slower growth, due to the absence of modern technics in the processing of special steels, more and more asked for in the market, even though this lower production is compensated with increasing imports.

The available data on production and imports for the period 1.960/1.969 are summarized in the following table. The exports in this sector are negligible.

	Bars		Plain wire		Barbed wire	
Year	Produc. (t)	Imp. (t)	Prod. (t)	Imp. (t)	Prod. (t)	Imp. (t)
1.966	18.000	3.000	100.000	(n.a.)	35.000 (x)	43.000
1.969	25.000	10.000	350.000	9.500	47.000	35.000

(x) Estimated.

D.1.4.5.2. **Rod and wire-drawing in Brasil**

Bars

The heavier concentration of bar-drawing works is in Sao Paulo, absorbing the 80 per cent of the total production and 17 out of the 26 plants existing in the country.

The three most important Firms-Bardella, Trefil and Ipiranga- have their plants in the said State. The principal problem they must face is their dependency on a market with strong fluctuations in demand, promoting very high percentages of inactive capacity (representing some time the 50 per cent of installed capacity).

Plain wire

Its capacity shows a rather wider dispersion than in the case of bars, since 26 plants are distributed among 5 States: Sao Paulo, Pernambuco, Minas Gerais, Rio de Janeiro and Rio Grande do Sul. The production, however, appears in this case also, strongly concentrated, from the point of view of the number of enterprises.

The most important enterprise, the Belgo-Mineira, works in its plants in Minas Gerais and Sao Paulo. The total production of the Group was in excess of 200.000 t in 1.969 and is now putting into operation new plants with the purpose of reaching the 500.000 t at the end of 1.971.

The second Group in importance -the "Sul-Riograndense" has three plants: Porto Alegre (RS), Arames Sao Judas (SP) and Açonorte (RC). Its installed capacity is 120.000 t, with a production of 90.000 in 1.969.

The third Group -"Siderurgica Barra-Mansa"- is starting the production in its new plants, whose possible production has been estimated in more than 70.000 t.

Barbed wire

The installed capacity in 1.969 was of 90.000 t/year, with a consumption of 80.000 t. The exports to Brazil from the European Eastern Countries (in a "dumping" system, according to the Brazilian manufacturers) make possible, however, to get a wire at the same price that the domestic one, but in a better quality, in the opinion of the users. This made that in 1.969 the production were not in excess of 47.000 t, representing an idle capacity of a 48 per cent.

The production is distributed among 44 enterprises, 11 out of them being the most important in production. In this case, the big Groups are also the "Belgo-Mineira" and "Sul--Riograndense".

D.1.4.5.3. <u>The sector in Bahia</u>

An enterprise located in the C.I.A. -Aços do Brasil- is just now going to put into operation a wire-drawing plant. It will be a special wire employed as a backing or reinforcement of tyres, 0,037" thick. The estimated uotput, working in a single shift, is 4.500 t/year.

With the exception of this plant, whose products have a very specific and specialized destination, no other wire-drawing plant is in operation in Bahia.

It must be taken into account, however, the presence in the North-East market of the Firm "Siderurgica Aconorte, S.A.", whose programms of expansion provide for a production of the order of 120.000 t of carbon steel laminates in 1.975, according to the following distribution:

Product	Production (t)
Bars and sections	19.200
Rods	68.000
Plain wire	4.200
Galvanised wire	2.700
Barbed wire and grips	14.100
Nails	10.000
Total	118.200 t/year

D.1.4.6. **Steel tubular products**

a) **Welded tubes**

The demand in Brazil for welded tubes, found though a market study made by BAHINT on behalf of the BWE in 1.966 was the following evolution of the consumption:

Years	t (x 1.000)
1.966	113, 1
1.967	132, 1
1.968	153, 5
1.969	177, 4
1.970	201, 0
1.971	227, 5
1.972	254, 2
1.973	280, 5
1.974	310, 3
1.975	342, 3

The demand for the Northeast of the country was estimated as a 7% of Brazil, i.e.:

Years	t (x 1.000)
1.970	14
1.971	16
1.972	18
1.973	20
1.974	22
1.975	24

In Bahia, Tuperba, S.A. is already inproduction. The plant is located at the Aratú Industrial Center, well equipped and with a present production program of 8.000 t/year, with future expansion to 18.000 t/year. This industry will sell only 30 to 40% of its production in Bahia and the balance to other States.

Also in Bahia, METUSA (Feira de Santana) is under erection. This plant will produce, among other things, helical tube of bigsizes. Its scheduled production of 5.000 t/year will be sold mainly out of Bahia.

Therefore in the welded tubular sector Bahia is - selfsufficient.

b) Seamless tubes

The available statistics are:

Year	Production (x 1.000)	Imports (x 1.000)	Exports (x 1.000)
1.967	70	5	1
1.968	96	11	1
1.969	113	16	2

Brasil is self sufficient in seamless tubes. The only imports are stainless steel tubes of bigger sizes than the presently produced in the country and some special qualities.

D.1.4.7. Steel sheets consuming industries

Bahia has to be supplied with steel sheets from the following steel plants:

- Companhia Siderurgica Nacional	CSN
- Companhia Siderurgica Paulista	COSIPA
- Usinas Siderurgicas de Minas Gerais	USIMINAS

These companies produce hot and cold rolled sheets in coils and sheets cut to size.

The sizes of the rolled sheets are standard and therefore all requirements which are outside of these sizes will not be undertaken by these companies.

It would be therefore profitable to install in Bahia some shearing lines which use as raw materials the coils - from the steel plants.

The reasons justifying this recommendation are the following:

- The shearing lines being supplied directly in batches bigger than 50 tons. have an advantage in price of 30% which the factories mark up on orders smaller than such a tonnage.
- With an adequate programming a high coil utilisation factor can be achieved, resulting in a reduction to a minimum of waste offcuts.
- Furthermore, they can provide metal sheets cut to normal sise, since the price differences between coil and sheets in normal cuts are the following for the metallurgical companies.

Price differentials between hot rolled sheets at standard sizes and hot rolled coils

Thickness (mm)	N Cr $/t
4,76	67,50
4,55	66,50
4,18	71,50
3,80	74,50
3,42	74,00
3,04	77,00
2,66	79,00
2,28	80,00
1,90	81,50

- Note: Extra charges for non-standard sizes:

by width: 34.00 N Cr

by length: 34,00 N Cr

Price differentials between cold rolled sheet at standard sizes and cold rolled coils

Thickness (mm)	N Cr $/t
2,66	55,00
2,28	48,50
1,90	34,00
1,71	39,00
1,52	45,50
1,37	48,50
1,21	55,50
1,06	58,50
0,91	64,00

Thickness (mm)	N Cr $/t
0,84	73,50
0,76	78,00
0,68	77,50
0,61	79,00
0,53	83,00
0,46	85,50
0,42	73,00
0,38	72,50

- Note: Extra charges for non-standard sizes:

by width; 40,50 N Cr

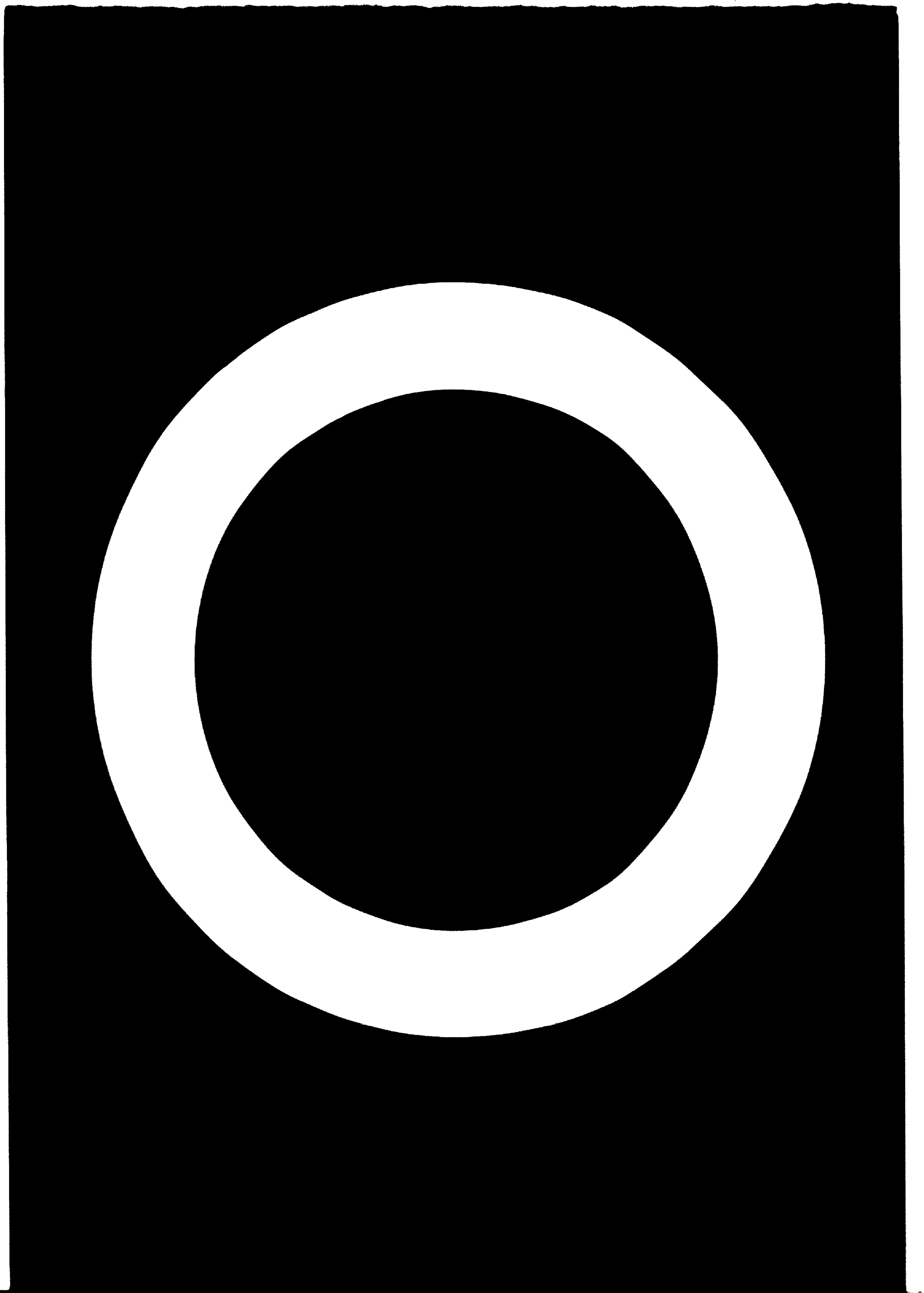
by length: 40,50 N Cr

It is clear that outside of a few exceptions, the majority of metal sheets users have to rely for supply on the shearing lines, since it is only in rare cases that the three following conditions are given:

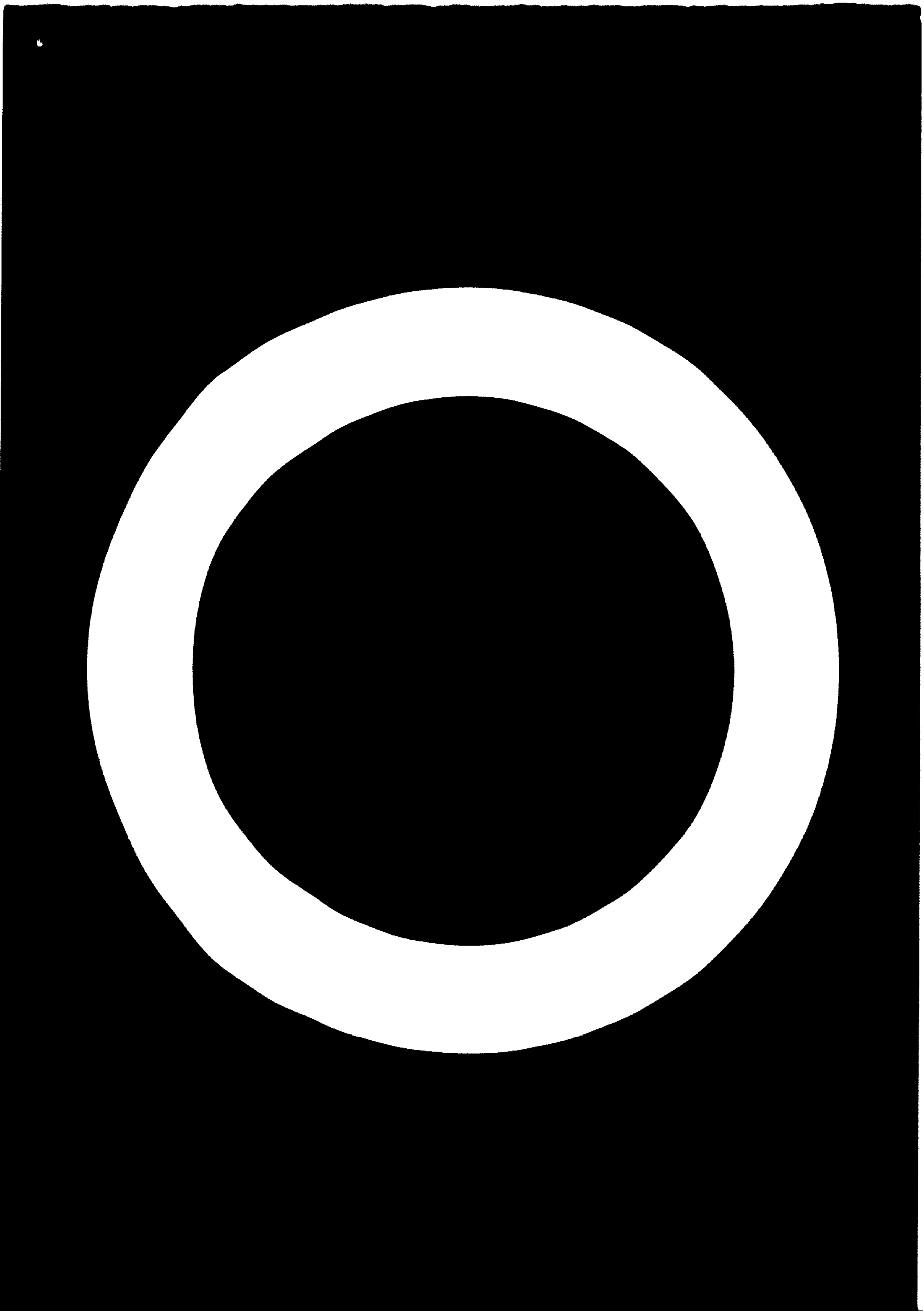
a) Order above 50 tons

b) Need for normal sizes

c) Rapidity of supply



D. 2. COPPER



D. 2. 1. MARKET STUDY

D. 2. 1. 1. Historical data

Copper, a raw material fundamental for any process of industrial development, is not produced in Brazil in quantities covering in an important quantity the country needs.

Tables Cu-1 to Cu-6, represent basic statistical information about the available data on the Brazilian copper - market.

From the said tables the following fundamental aspects are deduced:

a) The Brazilian production of copper ores has passed from 70.000 t., approximately, corresponding to 1.961, to --- 163.000 t. in 1.968.

b) Such figures include, as ores produced in Bahía, the -- amounts that for the said State, are given in Table Cu-1. Such tonnages, however, represent ores stacked at mine and other coming from exploratory workings; it cannot be said, then, that Bahía may have really contributed, up to now, to the national production of copper ores, which are only supplied by the Camaqua mine, in the State of Rio - Grande do Sul, near the border with Uruguay.

c) The copper orее produced are processed in its totality by the metallurgical plants of Itapeva (anodes) and Santo André (cathodes), both of them situated in Sao Paulo State. They had a production in 1.969 of 3.500 t. of refined copper.

d) The greater part of copper consumed in Brazil is supplied by imports, of an order of 50.000 t. in 1.969. Exports -

are practically inexistent, except some sporadic ones performed in 1.968 and 1.969, not in excess of a total of 500 t.

In the same year, the apparent consumption of copper increased to 79.500 t., being included in this figure the copper coming from scrap recovery.

e) The negative balance of copper foreing trade represented in 1.968 an amount of almost U.S. $ 60 million, unfavorable balance and a sign increasing even more en 1.969. Copper, among the products studied in this report, has become the substance with the greatest negative influence on the Brazilian balance of payments.

D.2.1.2. Projections of demand

Taking into account that the Decennial Plan of Development only includes the previsions of demand of primary metal, without considering the one eventually covered by scrap recovey, we have been obliged to leave aside the projection offered by the said Decennial Plan.

The projection presented in Table Cu-7 has been obtained on the base of the apparent consumptions given in Table Cu-5, making abstraction of the year 1.965 (the conflictive situation of Brazil and that year's difficulties of imports and prices, oblige us to consider it as a year of anomalous consumption and, consequently, not to be taken into account). During the period 1.963-1.969, the apparent consumption of copper in the form of metal increased at a cumulative yearly rate of a 8%. In the projection of Table Cu-7, the same rate of increase is maintained, being, on the other hand, exactly the geometrical mean of the rates presented by CEBRACO -

(10%) and by the Decennial Plan (6,4%), with the latter, evidently, too modest.

D.2.1.3. Balance between the estimated demand and the offer

The inminent starting of mining and metallurgical projects of Caraiba orebodies in Bahía State, presented by Caraiba Metais, S.A., a member of Pignatari Group and approuved by the Deliberative Council of SUDENE on September 23, 1.970, will make that the situation, as far as it concerns to the copper offer in Brazil, may improve in a fundamental way.

On the base of programmed expansion of production detailed in paragraphes D.2.3.3. and D.2.3.4., the Table Cu-8 has been made; in it, the projections of production are presented, following the Decennial Plan and the new projects of expansion. Projection II contemplates the achieving on 1.975 of a production of 83.000 t. what would mean, if the projects are confirmed in practice, that an equilibrium in the ratio national offer/demand could almost be reached, with the consequent decrease in imports and savings in foreign currency.

Table Cu-9 gives us the projection of scrap recovery for the period 1.971-1.976, a projection made supposing that the said recovery will maintain a constant ratio with demand, which we estimate, according to the observed trend, in a 30% of the latter.

Table Cu-10 presents the foreseeable balance between Production/Demand in the period 1.971-1.976, a balance coming to confirm the urgency of carrying out the Caraiba Metais Project for, even in the case of the said project being accomplished, the balance would continue being unfavourable to Brazil, with a great reduction of shortage in 1.975, but with a new dislocation after 1.976.

D.2.1.4. The copper consumption; its structure

D.2.1.4.1. Consuming sectors

The demand on copper semi-manufactured products has been constantly increasing during the last five years due to the expansion of big consuming sectors such as the automotive industry, civil works, electric and electronic industries, communications, naval industry and supply and distribution of electric energy. In the Table Cu-6 the evolution is indicated by sectors. The most important consuming sector is formed by the electric and electronic industries, together with the supply and distribution of electric energy, absorbing a 58% of consumption.

Table Cu-11 shows the apparent consumption of semimanufactured products for 1.968 made by the electric industry.

D.2.1.4.2. Sources of supply

Three sources of copper supply are available in Brazil to face consumption: imports, internal market of scrap and copper production itself.

In 1.970, with imports reaching a figure of about 50.000 t. and a national production of an order of 4.000 t., the recovery of scraps was nearly of 25.000 t.

Imports

Copper and copper alloys imports follow a very varia ble pattern; some of the consuming enterprises periodically import with quotes generally equal; others, on the contrary, make it sporadically, originating peak values on some mon ths, as it can be seen in the chart Cu-12, corresponding to the year 1.969 and first quarter of 1.970.

The Brazilian imports of copper come fundamentaly from Chile, even though variable quantities are purchased in other South-American and European countries. Table Cu-13 gives in a very clear form the volume and origin of Brazilian imports of copper in the period 1.962-1.969.

Scrap recovery

The recovery is achieved through the remelting of scrap coming from returns in the transformation processes and from materials belonging to discarded, obsolete equipment, etc., such as electric motor windings, bronze pieces and others.

Its recovery is rather difficult at the normal prices as far as it concerns to copper and copper alloys, and easier, in the case of alloys where recovery is more complex, such as bronze, etc.

Domestic production

Up to date, it is rather low, and its present structure and prospects are given in paragrphe D.2.3., Extractive Metallurgy.

D.2.2. MINING

D.2.2.1. Orebeds

The biggest copper reserve in Brazil to-day is the Caraiba/mine ($37,7 \times 10^6$ t of ores) whose exploitation is inminent in Bahía State. Its characteristics are detailed in the attached data card.

This mine is situated in the bassin of Curaça River where in an area of 100 x 30 km., several other important masses of ores are to be found (property of Caraibas Metais S.A., Peñarroya and Carneiro da Cunha, among the most important). Except the mass of Poço da Fora ($12,3 \times 10^6$ t of ore) and other area in dispute cubed by borings by CPRM (1.10^6 t of ore), the reserves in the rest of the area have not been estimated.

Other copper-bearing areas quoted by, or on which a verbal information has been obtained, are:

1) Watershed to the West of Santo Onofre River, to the North of Riacho de Santana town (together with filites, limestone and iron oxide).

2) Sierra Mangabaira, from Caetité to Paramirin, Ibiajara, Ibitiara and Ouricuri do Ouro (in rocks of the group of dacites, rhyolites, volcanic tuffs and quartz veins cutting through quartzites and schists).

3) Zone of Vavá-Canudos (in mafic and ultramafic rocks).

4) To the West of Maracás, in the direction of Caritendo de Sincorá (disseminated in baryte).

5) Zone of Maracás (associated to vermiculite).

D.2.2.2. Data card and map

In the following data card all basic relevant data on the visited Caraiba orebed are summarised. Attached map shows its location on Bahía State and other additional data of interest.

Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Cu

Name of Mine
CARAIBA (30 km^2) POÇO DE FORA (32 km^2), other (4 km^2)

Master Plan Identification

Owner Caraibas Metais, S.A. Industria e Comercio (Pignatari Group).
Rua Antoni do Godoy 88, 14 and. Sao Paulo (S.P.) (Brazil).

Geographical Location

Fazenda Caraiba, locality of Jaguarari, district of Senhor do Bon Fim. Curaça River Basin (a tributary of Sao Francisco River). Some 500 km far from Salvador, by road, and 390 km to the North-East of Salvador, in direct flight (Poço de Fora, 30 km to the North of Caraiba).

Coordenates

X = 39º 53' 57" W
Y = 9º 51' 40" S
Z = 456 m

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Geological Description

An area of gneiss and migmatites, in metamorphic facies of anphibolite-almandine, with granites and pegmatites of intrusive characteristics, possibly anatexic. Apparently at the time of regional metamorphism, or before it, concordant intrussions (sill type) of maphic rocks, reacting with the gneiss, orignated rocks between maphic and felsic. The copper mineralization would come from the magmatic segregation of maphic rocks.

There are quartz lodes (dike type) and diabase dikes without any association with mineralization.

Ore Body Geomorphological Description

Area of some 150 km long (in a N-S direction) x 30 km wide, where copper mineralizations are present in masses more or less lenticular in nature, with digitations and arborescences.

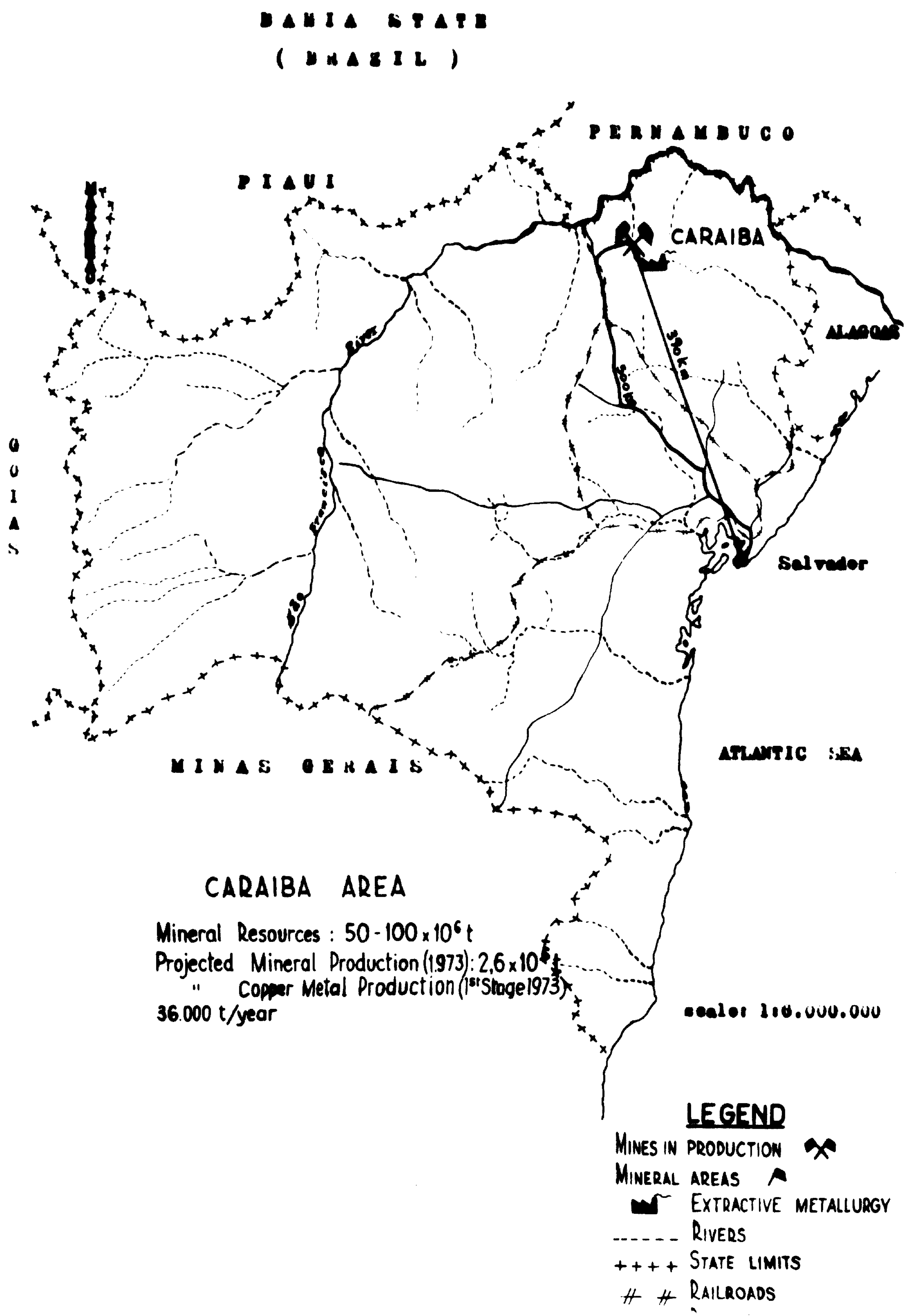
Topographical and Climatical Description

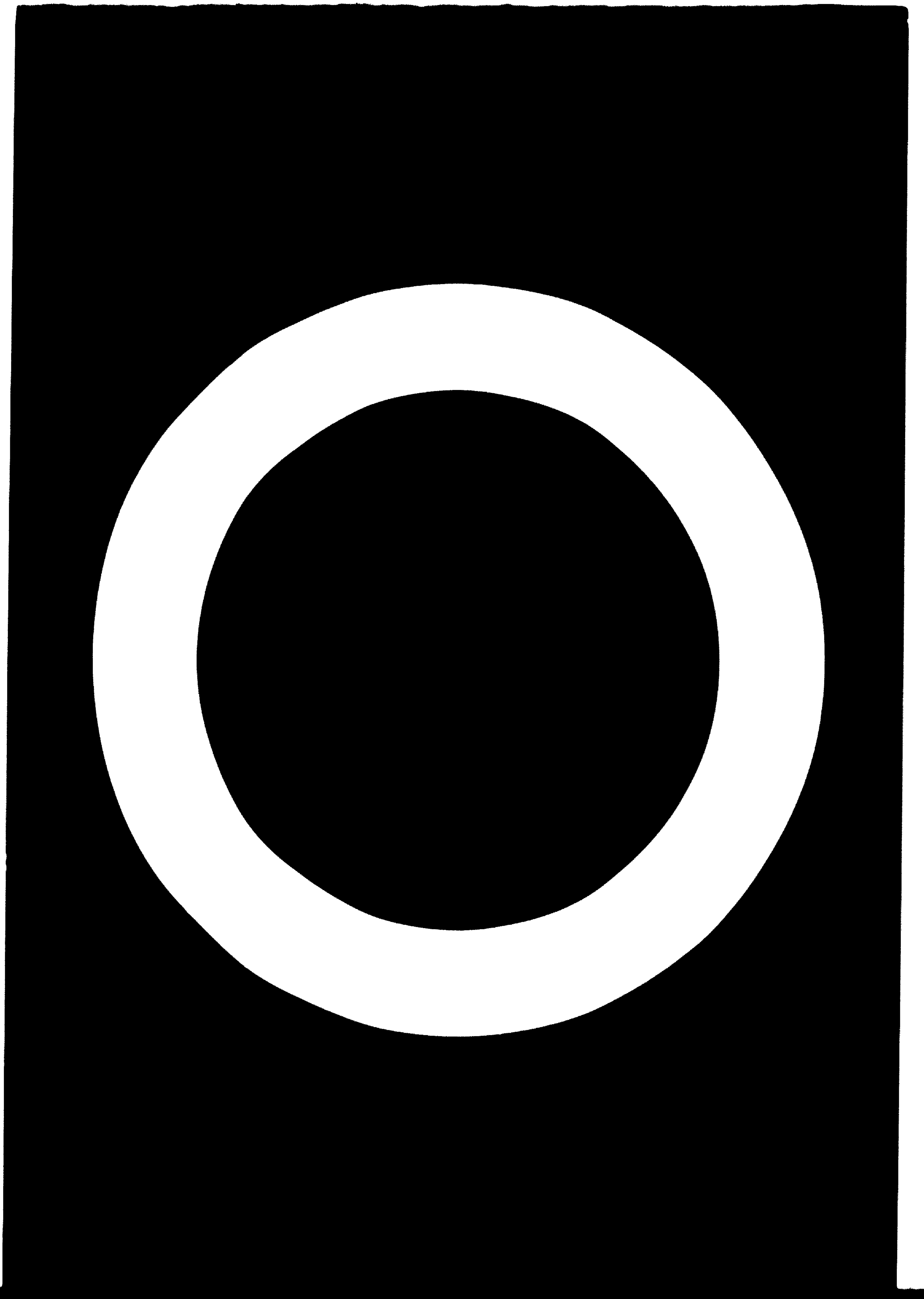
A zone of a smooth relief (with an slope less than a 3%) except in the proximity of dry brooks and in the hill sides of "inselbergs" type.

Thickness of the ground inferior to 1,20m; an altered and oxidized zone down to 10-15 m.

Annual rainfalls: 250-500 mm. (October-April). Temperature generally inferior to 33º C, descending in May-August down to 16º C (min.) - 22º C (max.). [illegible] vegetation.

COPPER


BAHIA STATE
(BRAZIL)
PERNAMBUCO
PIAUI
CARAIBA
ALAGOAS
GOIAS
Salvador
ATLANTIC SEA
MINAS GERAIS
CARAIBA AREA
Mineral Resources : 50 - 100 x 10⁶ t
Projected Mineral Production (1973): 2,6 x 10⁶ t
" Copper Metal Production (1st Stage 1973)
36.000 t/year
LEGEND
MINES IN PRODUCTION
MINERAL AREAS
EXTRACTIVE METALLURGY
RIVERS
STATE LIMITS
RAILROADS



INVESTIGATIONS

Chemical Analyses

The ore appears disseminated in the basic rock, with grades in Caraiba of 1,5% Cu; 0,05% Ni; Co 0,01%; Au and Ag 2,5 g/t (with a prevalence of the first one), at a level of 440-400 m. Richness in copper increasing (down to the level of 340), decreasing afterwards in depth. The rock mineralogical analysis is: biotite, 54%; plagiocalse, 23%; pyroxene, 17%; opaque 6%

The ore of Poço de Fora has a Cu content of 0,9-1,0%.
The analysis have been made in Sao Paulo by Laminaçao de Metais (Pignatari Group).

Geological Studies

The geological structure, together with the photo-interpretation, serves as a good guide towards a fundamental delimitation fo the zones of basic rocks.

The geological studies have been initially carried out by the DNPM, through the Federal University of Bahia.

Later on, Caraibas Metais has prividen the obtention of geological maps (on a direct contract basis), at the scale of 1:50.000 and 1:25.000.

Geophysical Survey

Studies on self potential (PS), induced potential (IP), electroresistivity and electromagnetics have not yielded the expected results.

Geochemical Survey

The best results have been achieved by geochemical investigations, through a direct survey of copper. A local survey has been carried out, and a detailed prospection of the most favorable areas is in an advanced phase. (It is expected that it will be finished by July 1971).

Investigation of Bore Holes Pits and Galleries

Up to the end of 1970, 27 km of borings of a diameter AX (20 in Caraiba and 7 in Poço de Fora) had been carried out. This work is pursuing now and it is to be expected that a total of 30 km will have been bored beween 1971 and 1973. The network in Caraiba is 50 km of interspace, with bores up to 500 m in length, with a gradient of 45º to the East.

A but entry up to the level 425 has been made in Caraiba, followed by a gallery of some 300 m, in a North-South direction with transversal developments.

Pilot Plant

No tests have been made in precessing plants. Only discontinuous sample winning tests.

Investigations and Studies Proposed

Once the borings stabilized, it is recommended to perform studies on piezometric leves, which could influed be by the base level of the Sao Francisco River. The ore enrichment up to the 340 level would correspond to the ore cementing zone.

MINERAL RESOURCES

Resources description

It exists a zone above the 440 level of oxidized mineral (alteration zone) with a tonnage (in Caraiba, Barauna and Imburana) of 1,6 . 10^6 t, with a 1,54% Cu and a contents of metallic Cu of 25,000 t. The tonnage of sulphates already estimated aomunts to some 50 . 10^6 t, with a contents metallic Cu 850,000 - 900,000 t. The most recent studies have not given yet any cubage. It is expected, though, that it might be in excess of 100 . 10^6 t.

	Caraiba	Poço da Fora
Verified Tonnage	[illegible],4 . 10^6 t (down to 156 m in depth).	2,5 . 10^6 t
Probable Tonnage	9,0 . 10^6 t (from 156 down to 216 m).	5,6 . 10^6 t
Possible Tonnage	14,3 . 10^6 t (from 216 down to 316 m).	4,2 . 10^6 t

TECHNICAL TABLE

Description of Explotation Methods

It has been provided to intiate the exploitation in the second semester of 1973

The sulphates will be open pit mined, in amphytheatre, with working floors 12 m hig (the rock presents good support characteristics), until reaching the limit ratio steriles/mineral of 3/1, at a depth of about 150 m, that is expected to be reached in a term of 10 years. Subsequently the exploitation would have to be underground although the expectations are that, by then, the existence of other masses proper to open pit mining.

As for the ore forming the oxidized overburden, it has been provided its removal and piling up, in order to be processed by leaching and cementation.

Mining Extraction Tonnage

It has been estimated that the open pit exploitation in Caraiba will give 5,2 . 10^6 t of steriles, and 2,6 . 10^6 t of ore.

Concentration or Process Method Description

The concentration plant will be located in the proximity of Caraiba Mine.

The process will be as follows: primary and secondary crushing (maximum size 3,8 cm), in closed circuit; homogeneization by thin layered bleding and change of piling through a traverse grab; concentration with crushing to a grain size proper to let free the copper ores; suspension of mineral in water, with additives forming a pulp to be transferred to big flotation cells, with the concentrate coming from them to be filtered and dried.

Tonnage, Concentrated or Processed

It has been estimated that 120,000 t/year of concentrates will be obtained, with a 32% Cu and arecovery in the concentration of 87%.

Description of Transport Methods to Metallurgical Factory or Sales Destination

In the open pit the ores will be loaded with shovels in 60 t tilting trucks, to be carried to the primary crusher along the amphytheatre ramp (900 m long and 7,5% slope) and a level track (300 m long).

The steriles will be hauled from the open pit exit to the waste dump along a track 400 m long in ramp (7,5% slope), and a level part (400 m long).

MISCELLANEOUS

Personnel (Technicians and Workers)

A total payroll of 1,800 men has been estimated

Machinery

Bucyrus 150 B electric loading shovel and Caterpillar 988 shovels will have to be adquired.

The transportarion will use 65 short t. (59 long t) tilting trucks.

Water Supply

The water will be pumped from Sao Francisco River with an initial head of 150 m, up to a head reservoir; a gravity fed tubular system -20 km in length- will then take the water to eh different consuming points.

Power Supply

An electric line coming from the hydropower plant of Paulo Alfonso is owned by the CHESF. This 138,000 V line is at a distance of 1 km from de Caraiba Mine, and of 500 m from the industrial plants. This line is sufficient for the metallurgy of 35,000 t of metalic copper (some 30,000 KVA); it will possibly be insufficient for a metallurgy of 70,000 t of metalic copper (70,000 KVA aprox.).

Other Supplies (Fuel, oil, explosives, wood....)

Explosives of amonium nitrate blended with burnt lubricating oil have been foreseen.

REMARKS

Caraiba is the most important copper reserve in Brazil.

The civil works will be begun, according to the previsions, on the month of April or May 1971, and the exploitation on the second semester of 1973 (it could be started earlier if SUDENE incentives are not deferred).

It has been provided for the recovery of nickel (1,000 t year), cobalt and noble metals.

Is still doubtful the recovery of sulphur because of the lack of a present local consumption and of the economical competition of other markets.

Client: U.N.I.D.O.	Consulting Firm. TECNIBERIA	

D.2.3. **EXTRACTIVE METALLURGY**

D.2.3.1. The present structure of production

In the Bahía State no metallurgical plants for the processing of copper ores are available to-day. The whole of the production and refining are to be found in Sao Paulo State.

Itapeva's plant receives the copper ore concentrates (35% Cu, 25% S) coming from Camaqua Mine, after being hauled in railway-wagons for nearly 1.400 km. In Itapeva, the concentrates are roasted in Herreschof furnaces, with a reduction in sulphur to an average value of 4%. The roasted concentrates are later on sintered and classified in sintering blocks of an approximate size of 90 x 60 mm before being taken to reduction furnaces, together with limestone, rich slags and coke, in order to obtain black copper of 95% grade.

This copper is refined in Apelt or Lurgi furnaces in order to obtain anodes, as a final product of Itapeva plant.

The anodes are refined by electrolitic methods in Santo André plant, near Sao Paulo, 300 km away by road from Itapeva, obtaining cathodes with a 99,99% of Cu.

D.2.3.2. **Present capacity of production**

D.2.3.2.1. Itapeva Metallurgical Plant

Sections	Monthly capacity
Roasting	576 t (concentrate)
Sintering	460 t (roasted) + 1.000 t (concentrate)
Reduction (MACE-APELT)	2.550 t (sinter)
Refining (APELT-LURGI)	1.020 t (copper)

D.2.3.2.2. Electrolitic refining (Santo André)

It constitutes a part of Utinga's industrial complex, with the following basic divisions:

A - Electrolitic copper refining

B - Metals foundry

C - Hot and cold rolling

D - Presses and wire-drawing

E - Radiators

F - Yorkshire

G - Powder metallurgy

H - Auxiliary services

The electrolitic refining plant has been built for a production of 390 t/month of cathodes.

D.2.3.3. Expansions contemplated on present plants

D.2.3.3.1. Itapeva plant

This plant has a capacity sufficient to absorb, on a continuous basis, the whole of future production of concentrates of Camaqua Mine. No expansion plans have been foreseen.

D.2.3.3.2. Electrolitic refining

The expansion of the plant for electrolitic copper production has been divided into two stages. The first of them, under the heading of enlargement, is now being carried out, being the second the one referred to as duplication.

The enlargement stage will increase the present cathodes output form 390 t/month to 630 t/month. This output will be available at the end of 1.971.

The duplication stage has been scheduled to obtain - 1. 100 t/month of cathodes; even though its starting date has not been precisely defined, we have estimated that it will be wholly available at the end of 1. 973.

According to the above estimations, we should have the following annual capacities of output, as far as it con-- cerns to the present production of electrolitic copper:

1. 970	4. 560 t/year
1. 971	7. 650 t/year
1. 973	13. 200 t/year

D. 2. 3. 4. The Caraiba Metais, S. A. Project

The concentrates obtained in Caraiba Mine will be pro cessed in the metallurgical plant to be set up in its proximi- ty. The location to be chosen for the electrolitic refining -- plant has been discussed, as it envolves economic factors - such as its proximity to the biggest consuming market of se mi-fabricated products and to the processing industries, all of them situated in the Central-South part of the country. - When this report is being drawn up, it seems that its site has been fixed in the proximity of the metallurgical plant.

According to the information gathered, the approved project anticipates, for a first stage to be running on 1. 973, a cathodes production of about 36. 000 t/year. In a second stage, whose final date has not yet been defined, pending as it is of the complete surveying of Caraiba orebody, 70. 000 t/year would be produced. We have supposed that the said production would be available at the end of 1. 975.

On the base of the estimated production figures of -

the Caraiba project and the ones indicated in paragraphe -- D. 2. 3. 3. for the expansions of the present plants, Table - Cu-8 has been obtained giving the estimates for copper production in 1. 971-1. 976.

D.2.4. TRANSFORMING INDUSTRIES

D.2.4.1. Degree of concentration of production

The copper manufacturing industry in Brazil is concentrated almost in its totality in the Middle-South of the country.

According to sectors, the industries dealing with laminated, extruded or drawn products, are located in its totality in Sao Paulo and Guanabara States, and fundamentally in Sao Paulo.

In the sector of electric conductors and wire products. among the 90 known plants, 77 of them are situated in Sao Paulo, 4 in Guanabara, 4 in Río Grande do Sul, 2 in Paraná, 1 in Minas Gerais and 1 in Pernambuco.

D.2.4.2. Installed capacity and man-power

According to the available information, the copper manufacturing industries are, as far as it concerns to their dimension and capacity, sufficient to supply the Brazilian market in its present expansion and to export to foreing markets.

This sector employs more than 20.000 persons.

D.2.4.3. Expansion plans and investments

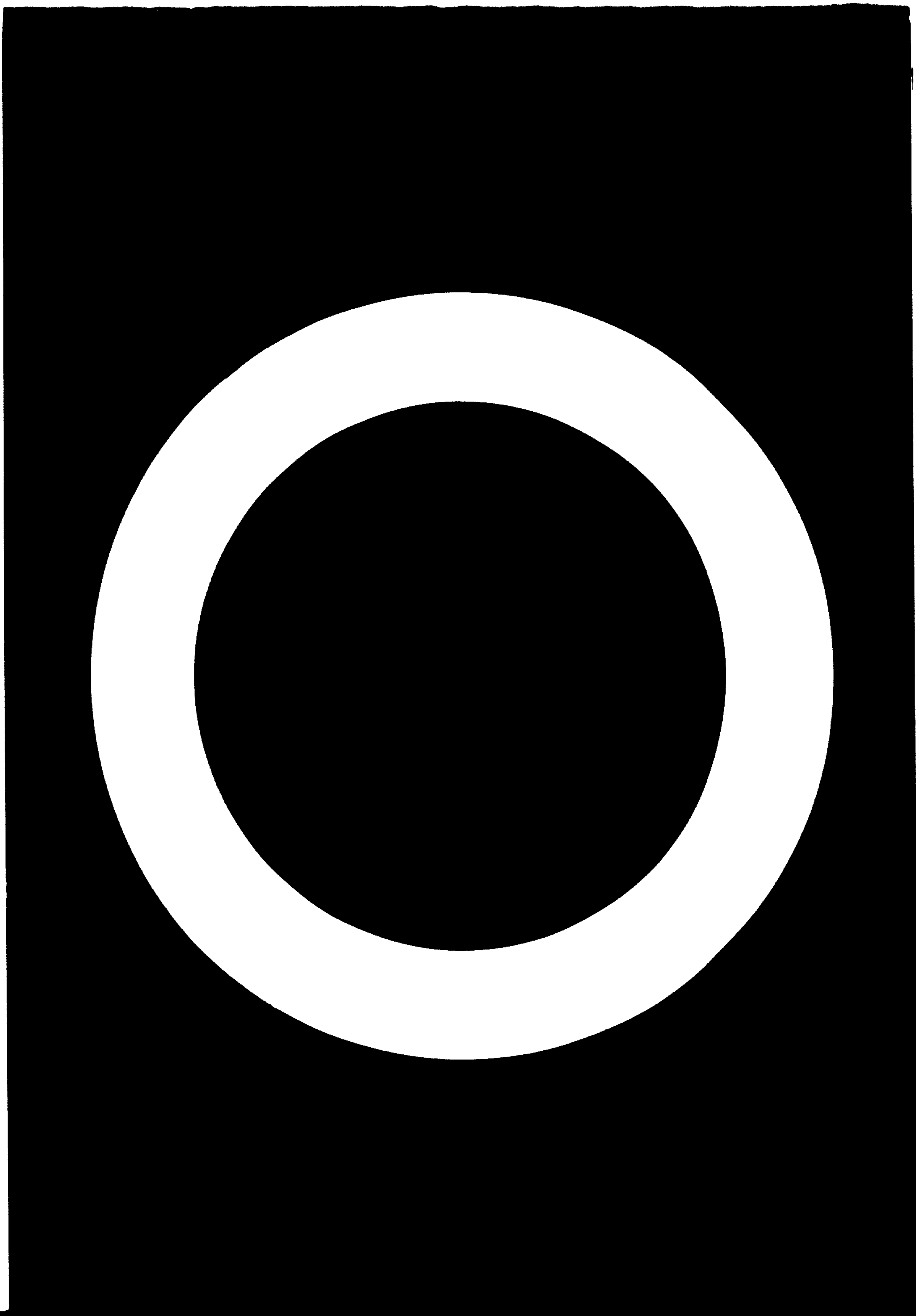
The sector has been continuously expanding its productive capacity, following the demand, with the purpose of maintaining that policy during the next five years.

The anticipated investments have been estimated for the whole of the sector in US $ 60 million for the period 1.971--1.975.

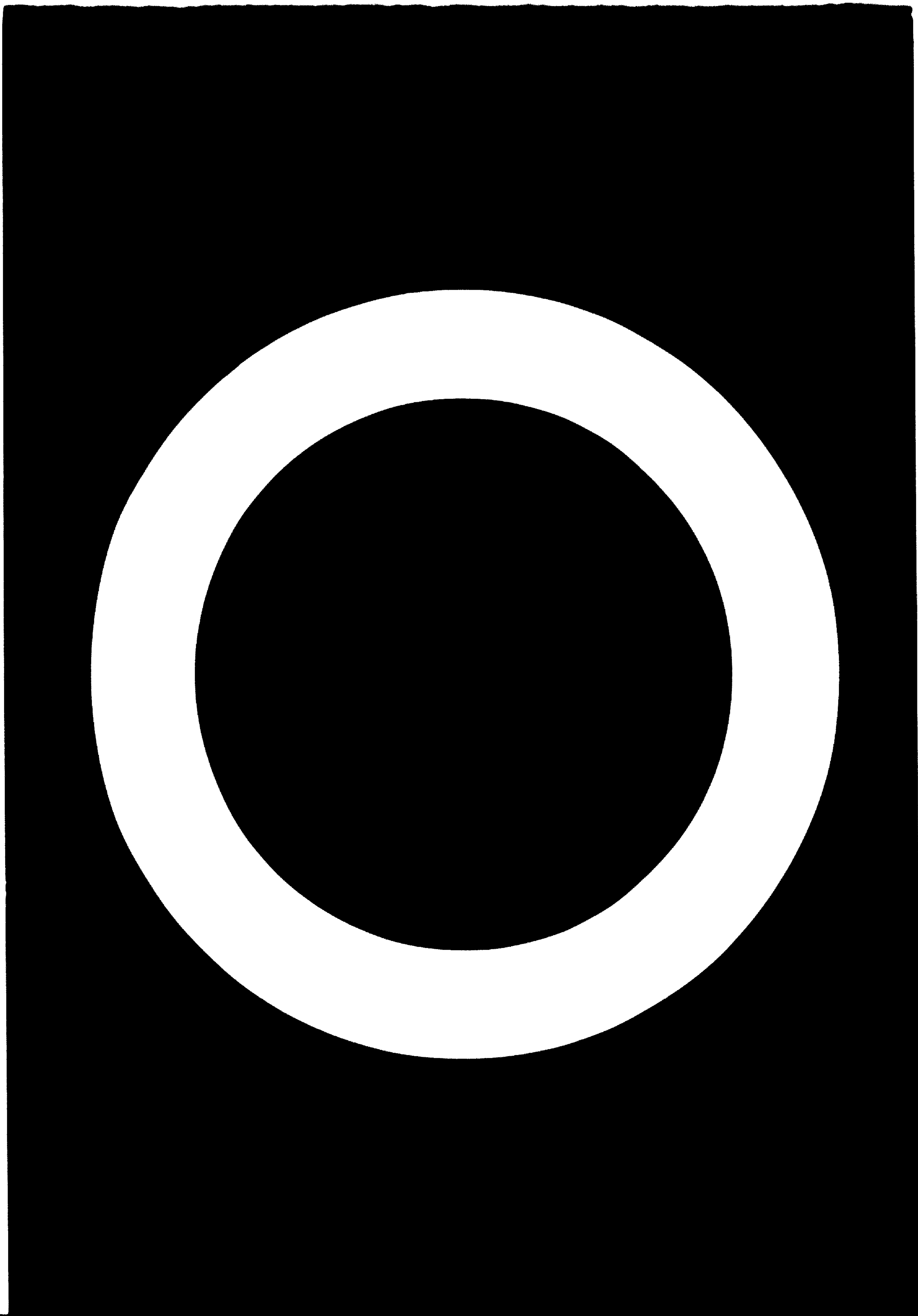
D.2.4.4. The industry of copper manufactured products in Bahía

It is practically inexistent in Bahía and very reduced in the Northeast of Brazil. According to the report "Perspectiva de Desenvolvimento do Nordeste até 1.980 - Metalurgia" prepared by the Economic Studies Department (ETENE) of the Banco do NORDESTE DO BRASIL, S.A. in 1.971, only two industries are working in the manufacture of metallurgical products, one of them in Pernambuco and the other in Bahía. One of them was operating in 1.970 and the starting of the other has been scheduled for 1.971.

As for the enterprises devoted to scrap recovery to produce copper and its alloys, there is one working in Pernambuco and another one (still in a stage of project) will be established in the Industrial Polygon of Aratu (Bahía), the second one of very modest characteristics with a total investment of Cr. $ 133.000 and a payroll of 12 people.



D. 3. LEAD



D.3.1. MARKET STUDY

D.3.1.1. Historical data

Just as can be seen in Tables Pb-1 and Pb-2, Bahía has been, historically, the principal supplier of lead to the Brasilian market, both in its mining and primary metallurgical aspects (Boquira mine and Santo Amaro smelter respectively). The most characteristic features of this substance are the following:

a) Bahía is the main national supplier of lead ores and lead ingot (71,75% of the total of minig production in 1.968 and 75,25% of ingot output in 1.970) and as it can be infered from Tables Pb-1 and Pb-2, its relative importance is increasing.

b) The exports as far as it concerns to ores, have an importance practically negligible. In fact, the available data show us that exports of lead concentrates to Europe were only made on 1.965, 1.966 and 1.969, with 13.040 t, 4.816 t and 4.000 t respectively. (On 1.965, the said exports were prompted by the strikes that stopped Santo Amaro metallurgical plant). No data on imports of concentrates of this metal in Brazil are available.

   On the other hand, lead imports in the form of metal show a net balance clearly unfavourable to the Brasilian trade balance.

c) As a consecuence of the above said, the national consumption of metal depends on the foreign offer in a very important percent, as it is shown by Table Pb-3, with an average annual disbursement of foreign currency superior to US $ 2 million in the period 1.959/1.968.

D.3.1.2. Projection of demand

The real demand -with the exception of the year 1.967- perceptibly adjusts itself to the figures foreseen in the Decennial Plan of Economic and Social Development, as can be seen on Table Pb-4. On this basis, it is considered wise to maintain the estimate, unless the possible aceleration of the nation's process of industrialization may achieve an excess on the figures corresponding to the last five years (1.976-1.980).

According to this conservative criterium, the figures of the Table Pb-5 have been calculated for the years 1.977 to 1.980, having maintained the same cumulative rate of annual increment.

D.3.1.3. Balance between the estimated demand and the offer

The available data on estimates of production, gathered through contacts with executive personnel of companies producing primary lead, foresee a maximum capacity of production of 36.000 t/year in Santo Amaro plant, for 1.975, having been scheduled for 1.971 a production of the said plant of 22.000 t/year. We estimate that the maximum capacity of Panelas Plant (Paraná) is 6.000 t/year, and having in mind these figures an the no-existent of other known plans on increases in capacity of production, on Table Pb-6 a tentative balance has been established between demand -the estimated demand- and the capacity of production of primary lead for the period 1.971-1.980 (supposing a gradual increase in Santo Amaro output, from 22.000 t in 1.971 up to 36.000 t in 1.975).

This analysis makes us infer that in 1.980, the unbalance existing between production and demand may attain figures of an order of 37.000 t. As it can be seen in the same Table, the proportion that the secondary production of lead has meant in the Brazilian total output, between 1.958 and 1.970, is of a

28 percent. Supposing that this percent might be maintained in the decade 1.970-1.980, the real shortage to be covered by imports would present in 1.980 the following figures:

- Primary lead	42.000 t/year
- Secondary lead (28%)	11.760 "
- Total of national output	53.760 "
- Shortage to be imported	24.990 "

representing at to-day's prices CIF Brazil, for imported lead, an expense of foreign currency of an order of US $ 7.500.000.

D.3.1.4. Lead consuming industry. Its structure

Within the category of lead consuming industry, the following sectors of fabrication may be envisaged:

- Batteries and accumulators
- Lead-sheathed electric cables and conductors
- Laminates, tubes and other half-finished products
- Lead salts and pigments
- Lead alloys
- Miscellaneous lead manufactures.

According to data made available by the BNDE the sectorial consumption of lead in Brazil, presented in 1.961 the following distribution:

- Batteries	40,2%
- Lead tetraethyl	6,4%
- Chemical products	5,1%
- Buckshots	5,9%
- Packing	0,8%
- Cables and conductors	4,1%
- Alloys	5,9%
- Miscellaneous	31,6%

The above distribution has suffered several modifications on last years. According to data made available by the "Instituto Brasileiro de Informaçao do Chumbo e Zinco" (ICZ), to-day's distribution of lead consumption can be established as follows:

- Batteries manufacture	50%
- Cable sheathing	10%
- Tubes and plates	10%
- Lead alloys	5%
- Salts and pigments	5%
- Miscellaneous	20%

It is probable that the percent distribution may be subject to alterations on next decade, having in mind the trends on lead consumption in the different sectors, that are indicated below:

<u>Batteries and accumulators</u>

Batteries may be classified into three groups:

- SLI - batteries for the automotive industry and similar uses
- TB - batteries for industrial traction
- SB - stationary batteries to be used in emergency equipment and telephone installations.

The SLI batteries will necessarily follow the increase to be experienced by the Brazilian automobile park during the next years; it must be realized, however, that the output of batteries is supplied in a 25%, approximately for new vehicles and the remaining 75%, for spare parts. According to international indexes, 80-90% of the total batteries lead comsumption is assigned to SLI type.

Cable sheathing

Lead, as a conductor sheathing, has to face other materials as competitors (aluminium and plastics); up to this moment, however, it is maintained the use of lead as a sheathing in many types of cables (telephones and H.V. cables), because the substitution materials do not surpass the advantages offered by lead.

Pipes and plates

Lead has been decreasign in its use as a building material in the form of pipes, and is being replaced by other materials (plastics and copper). In the form of plates, however, it will be increasingly used, both in the building and chemical industries.

Lead alloys

An increase may be foreseen, both in absolute and relative terms, in the use of lead in this form, specially as a soldering metal (lead and tin alloy).

Salts and pigments

A decrease of the relative figure of lead consumption in this form may be foreseen taking into account the heavy competitive quality of titan and zircon salts against lead silicates. It is almost sure, however, that the global consumption will remain stationary thanks to sectors where lead salts will continue being used, such as the glass sector and in the plastics field where lead salts are employed at an increasing rate as stabilizing agents, etc.

D. 3. 2. MINING

D. 3. 2. 1. Orebeds

Boquira, in Bahía State, is the only lead orebed mined in the Northeast of Brazil. Its characteristics are detailed in the attached card.

In the same region a series of ore indications - exist (Sierra Macaubas, specially), within a radius of 60-100 Kms. where some local prospections have been carried out.

There are also indications of galena spread on hydrothermal milky quartz in Santo Sé region.

Studies of SUDENE show the existence of lead ore in other places in Bahía. Their reserves and grades are unknown.

D. 3. 2. 2. Data cards and map

In the following card all basic available data on the visited Boquira orebed are put together. The corresponding - map shows its location on Bahía State and other additional data of interest.

Study of the possibilities for development of **DATA CARD**
METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Pb

Name of Mine BOQUIRA

Master Plan Identification

Owner Mineraçao Boquira, S.A. (Peñarroya Group)
Praça de la Republica 270, 2º Sao Paulo S.P.

Geographical Location

It is situated in the municipality of Boquira, in the Sierra Macaubes, 720 km far from Salvador, by road, and 470 km to the West of Salvador, in direct flight.

Coordenates

X = 42º48' W
Y = 12º48' S
Z = 600/700 m

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Geological Description

Mineralization of hydrothermal origin, in lodes with veins and concentrations of galena, sphelurite and, in a lesser proportion, chalcopyrite and pyrite. Gangue, in the case of the lode, integrated by chlorite schist, tremolite, clay, quartz and itabirite.

Country rock well defined and compact, integrated by irony quartzite and amphibolite belonging to the Precambrian C.

Ore Body Geomorphological Description

Three sub-vertical lodes, well defined, of about 1 m of average thickness, called (from East to West) CRUZEIRO, SOBRADO and PELADO, with direction N-S at N 25º W (PELADO).

Without transversal ramifications.

Topographical and Climatical Description

The mine is situated in the Sierra Macaubas, on its eastern side, in a dry region.

INVESTIGATIONS

Chemical Analyses

The mineral is fundamentally galena. The lodes present a Pb grade of a 9-10% (the minimal grade, economically compensating, has been presently fixed by Mineraçao Boquira S.A. in a 8%). The Ag content is very low. The Zn content, just as it has been ascertained, increases with depth (it passes from 1% to a 2% between the 600 and 700 levels and in the borings it has reached a 5%).

Geological Studies

The studies carried out until this moment appear as very insufficient ad lacking of systematics.

Geophysical Survey

Data not available.

Geochemical Survey

Data not available.

Investigation of Bore Holes Pits and Galleries

7 oblique bore holes were made in 1968 and 2 other in 1969, cutting the mineralized lodes at the foreseen depths sensibly increasing the indicated reserves. Galleries and back-stopes are the mining workings made to gage the measured reserves (Cubage).

Pilot Plant

Concentration studies have been made in washing plant.

Investigations and Studies Proposed

A geological study and survey of orebodies within a radius of 50-100 km, fundamentally along the Sierra Macaubas. An electromagnetic study complemented by another magnetic one (having in mind the association with itabirite) on the favourable zones. A geochemical study in zones with mineral traces (guide ores possibly germanium, cadmium and zinc). Exploratory boring.

MINERAL RESOURCES

Resources description The development of preparation labours gives the verified tonnage of mineral; then it is mantained very constant every year. The indicated tonnage (probable) is the result of investigations made through bore holes (1968/69) and, due to this fact, it has decreased subsequently, when passing to verified tonnage. The inferred tonnage (possible) is a consequence of extrapolations.

Verified Tonnage (September 1970)

935,320 t with a 9,91% Pb and 92,689 t of Pb

Probable Tonnage (Idem)

1,016,500 t with a 9,29% Pb and 94,433 t of Pb

Possible Tonnage (Idem)

350,000 t with a 9,03% Pb and 31,605 t of Pb

TECHNICAL TABLE

Description of Explotation Methods

Up to 1960, there was some open pit exploitation. Nowadays the exploitations is wholly underground, in the mountain, and through pits, too (SOBRADO lode, with skip winding).

The exploitation method used is the one called "Shrinkage Stoping", climbing from galleries or sub-levels every 6 meters, being thus possible a better adjudstment to the lode body, a greater number of faces and an increased safety in work.

Two shifts have been adopted, with a total of 80 hammers/day. Two firings a day are made, with some 40 blasts per face.

The ratio mineral/steriles in the lodes is 2%, and the ore recovery in the exploitation is of 90%.

The investment in exploitation for 1969 was of 496.000 NCr.

The exploitation cost in 1969 was 15,43 NCr/t.

Mining Extraction Tonnage

Year	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Tonnage	70.570	102.460	123.140	157.560	165.890	180.140	180.550	200.330	230.000	245.000	257.000
Pb grade %	11,9	12,6	12,0	11,3	10,9	10,6	9,6	9,6	9,8	9,5	9,0
Ag (gr/t)	-	-	-	-	-	-	-	50	21	-	-

Concentration or Process Method Description

The mineral passes to a gravity solution washing plant (a property of COBRAC, and rented to Mineraçao Boquira, S.A.).

From the silo (sizes 0-400 mm) it passes to a closed circuit with a double crushing process to be reduced to the size of 0-10 mm. The product passes then to a ball mill together with the addition of sodium sulphide and zinc sulphate; the pulp is subsequently separated with rakes, addition of xanthates, separation in flotation cells, in closed circuit with additives. The concentrate passes then to thickeners suffering a final filtration with centrifugal pumps.

The concentration ratio is 7,2 and the enrichment ratio 5,8.

The concentration costs (1969) were: Direct costs, 922.000 NCr; Indirect Costs, 1.146 NCr.

The concentration cost (per ton of mineral processed) (1969) was 8,35 NCr.

Tonnage, Concentrated or Processed

Year	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Processed tonnage	77.350	99.950	113.740	169.850	156.540	179.710	193.640	196.700	217.630	247.650	267.500
Concentr. tonnage	11.410	18.115	18.132	25.420	26.193	26.515	25.660	26.960	30.220	32.750	32.575
Pb Grade % (concent.)	52,9	53,7	55,0	56,6	51,7	56,2	56,2	54,4	57,3	55,1	59,4
Pb Grade % (steriles)	4,8	3,4	3,9	3,3	2,7	2,8	2,6	2,5	2,2	2,5	2,1
Pb recovery, (%)	65,4	77,4	72,8	75,1	79,1	77,9	76,8	77,8	81,0	76,9	80,0

Description of Transport Methods to Metallurgical Factory or Sales Destination

At the working faces (sub-levels) a first transport in 250 l trolleys takes place. The ore is then passed to 500 l trolleys in galleries of floorings (with human traction) and it is taken out along the master galleries, in 2.500 kg waggons, with Diesel traction.

From the pit-head silo to the washing plant, along a distance of 3 km, it is hauled in tilting trucks, with a capacity of 10 t.

From the washing plant to Santo Amaro Smelter (640 km) it is hauled in trucks, along a road now being in construction, to the junction with the paved road BR-242 (Salvador-Brasília).

Destination of concentrates (tons)	1965	1966	1967	1968	1969	1970
COBRAC (St. Amaro, Bahia)	7.703	19.271	25.152	21.240	23.806	27.852
PLUMBUM (Adrianopolis, Paraná)	4.472	4.046	1.041	8.980	5.444	5.723
Export (Europe)	13.040	4.816	-	-	4.000	-

MISCELLANEOUS

Personnel (Technicians and Workers)

The higher personnel is composed fundamentally by french and brazilian technicians.

The local, non-specialized, man-power has a turn-over of 1 to 2 times a year.

Year	1965	1966	1967	1968	1969	1970
Number of workers (average)	173	174	223	304	290	330 aprox.

Machinery

3 compressors KSB, 24 m^3/min (2 electric)
3 compressors PR 600 Atlas Copco, 17 m^3/min
1 compressor PT 900 Atlas Copco, 25 m^3/min
1 electric generator
3 tilting, 10 t, Mercedes Benz trucks
1 tractor
3 frames Vulcan Denver
2 frames of Brazilian manufacture

Water Supply

A water concession (shared with other users) is available at a distance of 9 km, with a 6" duct. It seems to be insufficient for the development of the mine (washing plant). It would be necessary to get more water and to use a 8" duct, or to work out water-winnings in the sub-soil (the region presents very dry periods).

Power Supply

A generator for the electric power supply is available.

COELBA has in project a 69.000 V line of about 85 km in length joining Boquira to Bom Jesus da Lapa, already electrified.

Other Supplies (Fuel, oil, explosives, wood....)

Data not available.

REMARKS

This mine is the only lead orebed now in exploitation in the North-East of Brazil.

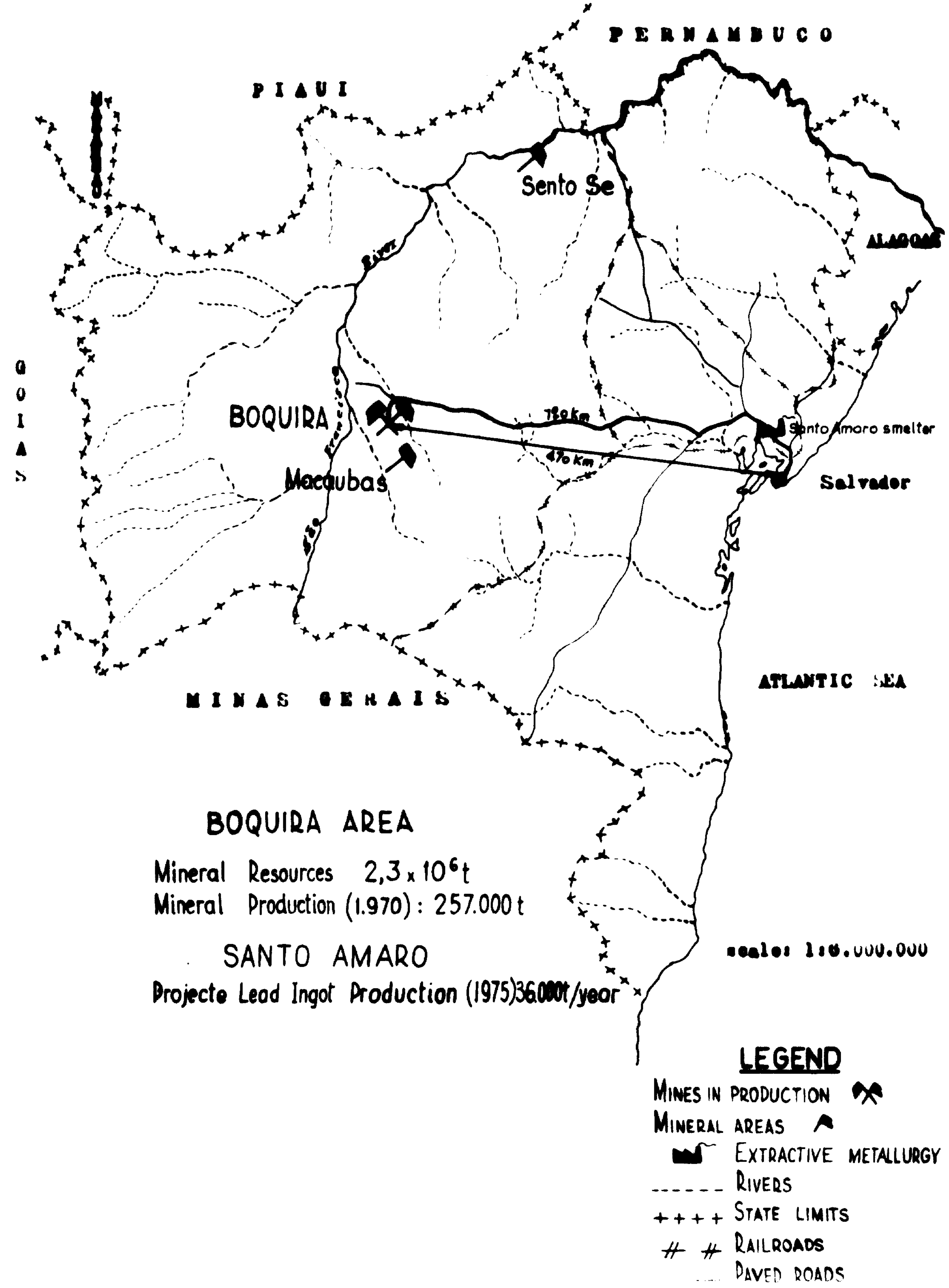
The investigation of the orebed is insufficient (geology, geophysics, geochemistry, boring holes).

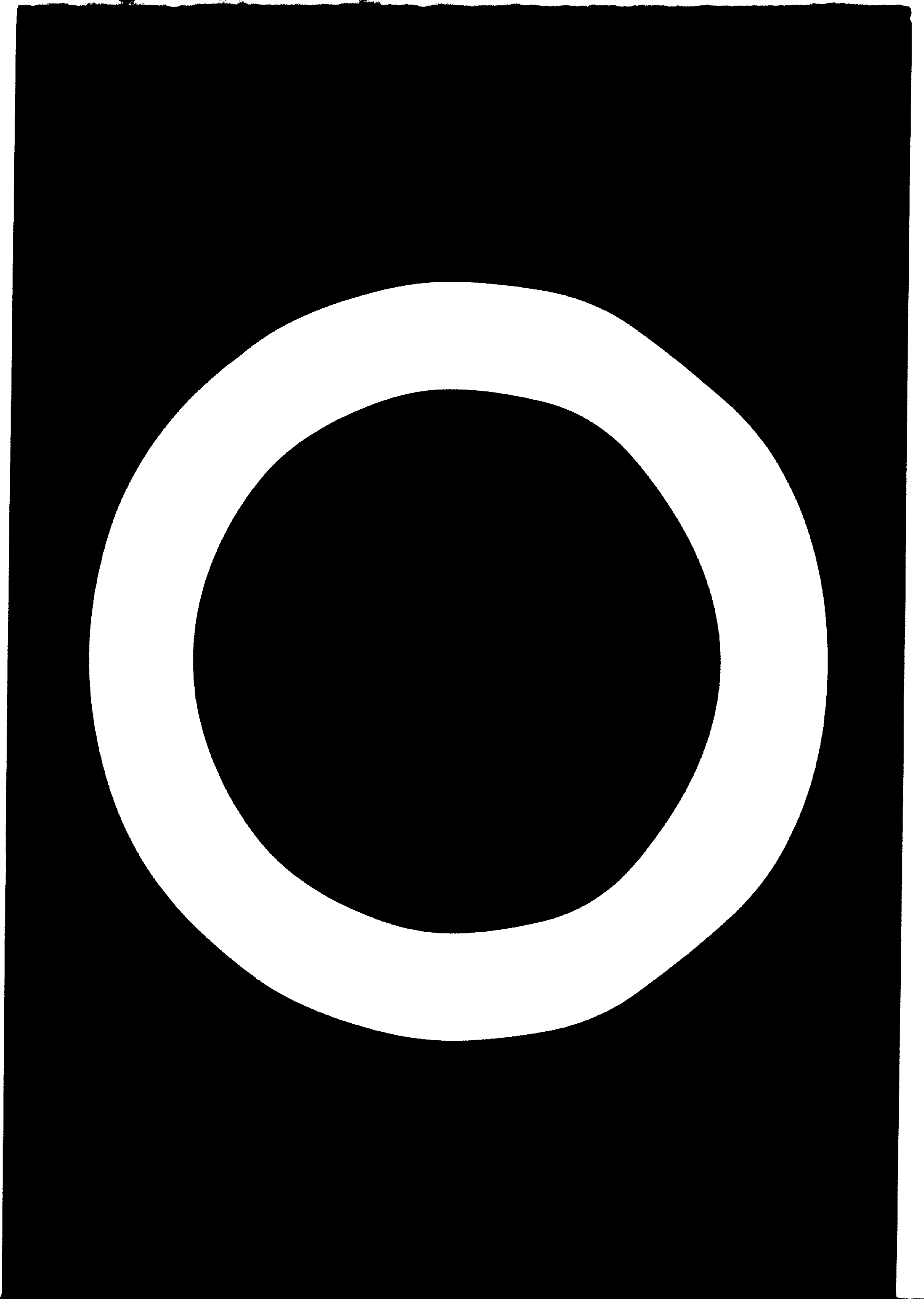
Client: U.N.I.D.O.

Consulting Firm. TECNIBERIA

BAHIA STATE

(BRAZIL)





D. 3. 3. EXTRACTIVE METALLURGY

D. 3. 3. 1. Production structure

Santo Amaro de Purificaçao plant in Bahía State, based on the processing of lead concentrates coming from Bo quira, is the most important smelting plant for primary lead in Brazil. It is a property of the Compañía Brasileira de -- Chumbo (COBRAC).

A part of the Boquira concentrates are sent to the smelting plant of Panelas (Paraná), a property of PLUMBUM S.A. member of the same financial group of COBRAC and co nnecced to the Societé Minière et Metallurgique de Peñarroya (France) and to the Auto-lite Co. (U.S.A.).

Just as it has been indicated before, Bahía is the principal supplier of primary lead of Brazil in its Santo Ama ro Plant, for the output of Panelas smelter is only about -- 4.500 tons/year.

Typical analysis of Boquira concentrates processed in Santo Amaro smelter, corresponding to the same month, - are as follows:

Pb%	Cu%	Ag (g/t)
54,6	0,04	183
54,3	0,05	202
54,9	0,05	184

Santo Amaro smelter was started on 1.959. It has produced since that year, the following tonnages of refined - lead ingots in form of ingots.

Year	Metric Tons
1.959	660
1.960	5.871
1.961	7.642
1.962	8.669
1.963	11.971
1.964	9.290
1.965	3.840 (x)
1 966	9.574
1.967	12.207
1.968	10.795
1.969	11.617
1.970	14.600
1.971	22.000 (scheduled)

(x) A reduced output, due to strikes

The estimated production increases will perhaps attain a maximum of 36.000 t/year in 1.975. It is rather improbable that this figure may be surpassed as it depends on Boquira's concentrates production which increase, seems not possible unless larger reserves in lead orebodies may be found.

In Santo Amaro smelting plant, of a simple and obsolete conception, no one of the other metals accompanying lead (Ag, Cu, Zn) in concentrates is recovered.

The general lines of process are:

1) Preparation of charges

With an equipment of ore staking, coveyors, feeding conveyors.

2) Roasting and agglomeration

1 Dwight Lloyd machine with air suction and auxiliary ele ments.

3) Smelting

1 "Water-Jacket" furnace and auxiliary elements.

4) Refining and desilvering

Softening, decoppering and desilvering vats.

Desilvering crostar Parkes and decoppering skins are forwarded to Panela's smelter, Paraná, to be processed in order to recover Ag and Cu.

D.3.4. MANUFACTURING INDUSTRIES

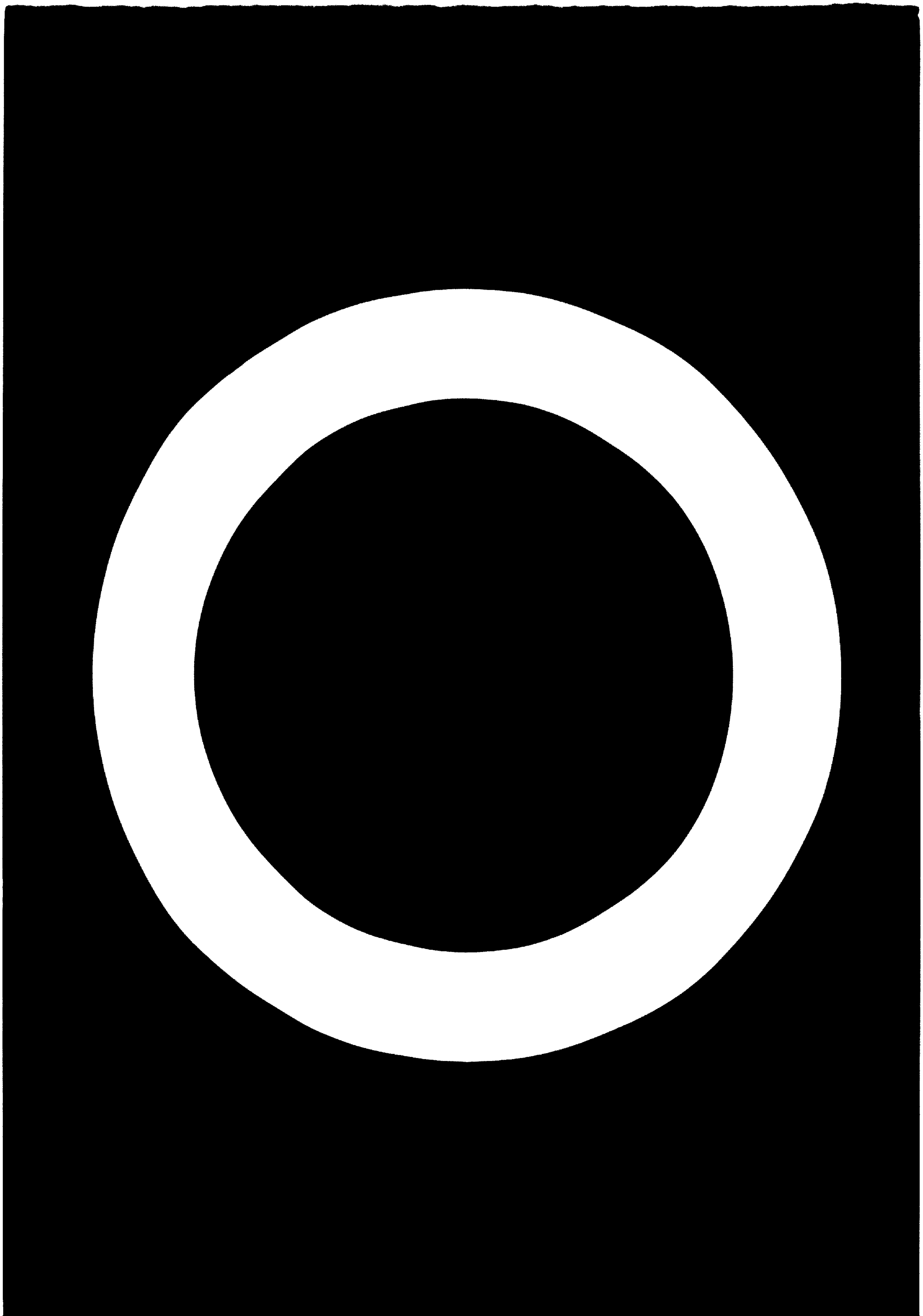
There is no enterprise in Bahía operating on the manufacture of lead products. The most important enterprises devoted to the recovering of metal, that is, secondary manufacturers, are in Sao Paulo and Guanabara States, being the two most important:

- FAE, S.A. - Industria e Comercio de Metais
- A. TONOLLI, S.A. - Industria e Comercio de Metais

The recovery is made, too, by many other minor enterprises, some of them associated to the above mentionned.

One of the most important of this enterprises produces laminates and miscellaneous manufactured products, including buckshots.

D. 4. MANGANESE



D. 4. 1. **MARKET STUDY**

D. 4. 1. 1. Historical Background

D. 4. 1. 1. 1. Manganese ores

It is not manganese, framed within this study, one of the substances contributing most esentially in Bahía to the Brasilian mineral production. One must point out, on the -- other hand, that the level of knowledge presently existing on the reserves of the State of Bahía is very low and, in most cases, contradictory.

The most important peculiarities of the production of manganese ores, according to Tables Mn-1 and Mn-2, are as follows:

a) At to-day's rate of exploitation, the Brazilian production is totally sufficient to cover the necessities of its own and, at the same time, to supply an intense export market that, in 1.969, brought to the country foreign currency reaching the figure of U.S.$. 17 million.

b) Bahía's contribution to the manganese ore production has been, up to now, small.

D. 4. 1. 1. 2. Manganese ferro-alloys

The production of manganese ferro-alloys in Brazil has been limited, up to this moment, to standard or carbon ferromanganese, (Fe-Mn-HC) and to ferrosilico-manganese (Fe-Si-Mn).

Table Mn-3 gives the data pertaining to production, foreign market and apparent consumption in the cases where it has been possible to obtain them, having in mind existing statistical deficiency.

Bahía's contribution to the production of Fe-Mn-HC and Fe-Si-Mn began in 1.969, with the outputs of FERBASA and SIBRA, partially assigned to export.

D. 4. 1.2. Demand's forecasts

On the basis of specific consumptions, estimated through a comparison of ferroalloy consumption and the total production of steel ingots in the last years, the average coefficients of consumption of the different ferroalloys given in Table Mn-4, are obtained.

Supposing that the said coefficients may remain - without suffering a great variation during the next five years, and taking into account the evolution of the total demand on steel, of production capacities and of the offer, according to the "Plan Siderurgico Nacional" -Table Mn-5- Table Mn-6 can been made, establishing the estimated projection of ferroalloys demand for the period 1.971/1.975, in tons and MWh.

D. 4. 1. 3. Balance between the estimated demand and the offer

The analysis of the situation of the ferroalloys enterprises and of their production capacities, based on the studies made by the Ministerio da Industria e Comercio, allows to establish the Table Mn-7. It may be deduced from it that in the period 1.971/1.975 a high excess in capacity will be evident; -- which on the basis of consumption estimates referred to above, would not be in balance before 1.975.

Therefore, the domestic demand of conventional ferroalloys will be covered in its whole with to-day's extension plans, and letting a wide margin of capacity susceptible to be devoted to possible exports.

D. 4. 1. 4. <u>The manganese consuming industry and its structure</u>

The ferroalloys industry, whose characteristics are given in D. 4. 3., is the main market for manganese ores.

D. 4. 2. MINING

D. 4. 2. 1. Orebeds

In the State of Bahía the most important orebeds, known and in exploitation, are located in the zones of Urandi, Licinio de Almeida, Caculé and Jacaraci, with the characteristics described in the enclosed data card.

Several other mineralized masses are in exploitation too in the region of Jacobina (see the enclosed data card) and Santo Antonio de Jesús.

Surveys have been carried through in the municipality of Marau (district of Tremembé), at a distance of 8 Km. from the seaside, where a reserve of 1,8 x 10^6 t. has been estimated, without any guarantee of its reliability, as far as it concerns to us.

Another potential mining area is located in the region of Tavapé, with an estimate of 4 x 10^6 t. with the same reserves as before on our part.

D. 4. 2. 2. Data cards and Maps

On the enclosed data cards, the most important data on the visited orebodies in the zones of Urandi and Jacobina have been summarized, with an indication on the corresponding map of their location within the State of Bahía together with other additional data of interest.

Study of the possibilities for development of METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

DATA CARD

Mineral: Mn

Name of Mine Pedra Preta; Barnabé; Barreiro dos Campos; Cedro Santo Efigenia; Lagoa Dantas; Olivio; Pardim; Pedra de Ferro; Tavá; Vai Quem Quer; Ventador; Vereda de Imbauba

Master Plan Identification

Owner Mineracao Urandi, S.A. (Antunez Group)
Rua Chile 29, s/102 Salvador (Ba)

Geographical Location

The different mines are situated in a band area following, in general, a North-South direction, that stretches itself frum Urandi (Barreiro dos Campos), in a length of 60 km, towards Caetité (Lagoa Dantas).

The zone is at a distance of about 760 km from Salvador, by road, and of 470 km in direct flight, to the WSW of Salvador.

Coordenates

X = 42º 30' W
Y = 14º 41' S
Z = 600/900 m

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  Relatorio Anual de Lavra 1.965/69
  Verbal information 1.971
- DIRECT INFORMATION 1.971

Geological Description

The ore appears tied to the Precambrian of the Minas Gerais series and its origin is, seemingly, metasedimentary. The most persistent rock in the series is quartzite. The prothomineralized is, in general, magnesipherous dolomite from chemical precipitation (4 - 6% Mn), with a subsequent enrichment on exposure to atmospheric influences passing from carbonate to oxide. In the eastern zones and, as a function of the existing rocks, the methamorphism originated gondite, a very siliceous ore, that, later on, under the influence of atmospheric agents, grew richer and became an oxide. In the mines with a high content of iron, carbonate, magnetite or jacobsite are to be found. The ore is in contact with mica and meteorized schists. In the same zone, gneiss and amphibolites crop out, besides quartzites.

Ore Body Geomorphological Description

The mineralizations form something like a pier in a direction North-South, continuing along down to Diamantina, as lenticular, isolated masses. There is enriched ore "in situ", stratiform, and in other types of presentation (compact, friable, botryoidal) and other ores of a "chippings" type, together with others eluvial and aluvial in nature. The thickness of the mineralized masses is variable from mine to mine and from type to type. The upper ones can be estimated from 1/2 to 4 m thick. The stratiforms are more variable (we have seen some ones of about 6 m thick).

Topographical and Climatical Description

It is a zone, in general, of a very rugged topography and morphology rendering difficult the access to it.

The tracks are seriously affected by rains, obliging to discontinuities in work in some mines during the rainy season.

INVESTIGATIONS

Chemical Analyses

Variable from mine to mine. The average analysis are 42% Mn and 7% Fe.

Mine	Mn %	Fe %	SiO_2 %	Al_2O_3 %	P %	S %
Barnabe	40	14	3	4	0,03	Traces
Cedro Santa Efigenia	45	6	3	4	0,05	0,6
Olivio	41	13	3	4	0,03	Traces
Pedra Preta	46	2,5	4	3	0,05	Traces

Geological Studies

The studies performed present a very local and disperse character. A general study of the whole of the zone, including the investigation of many parts of it with a difficult access because of the vegetal cover, is needed.

Geophysical Survey

The association of magnetite to jacobsite allows magnetometric investigations. Some local studies have already been made (Bernabé, Pau de Rego, Lagoa, Vereda...), it seems that with positive results.

Geochemical Survey

Data not available.

Investigation of Bore Holes Pits and Galleries

Before the exploitation, exploration pits are normally dug out in mines of aluvial concentration, and galleries in the mountain mines (Pedra Preta).

Pilot Plant

Pilot studies are at present being made in order to try to work the fines and the "crippings".

Investigations and Studies Proposed

Mineracao Urandi S.A. has a junior geologist, on a contract basis, to develop an investigation and surveys programm.

It would be very convenient to make an aeromagnetic study, complemented with ground gravimetry, and exploration boring.

MINERAL RESOURCES

Resources description

An estimate of 1. 10^6 t., with a grade higher than 40% Mn could be made joining together the diverse owners in the region.

The most important single mine reaches 200.000 t, and the biggest aggregate is centered in Lagoa Danta, with 500.000 t (300.000 t of them with a grade susceptible of being economically beneficiated).

Verified Tonnage 35.000 t (Pedra Petra mine)

Probable Tonnage 20.000 t (Pedra Petra mine)

Possible Tonnage 10.000 t (Pedra Petra mine)

TECHNICAL TABLE

Description of Explotation Methods

Exploitation in open pit, adopted to the morphology and type of ore. In the several mines with and enriched overburden, the eluvial cover is removed with loading shovels. The mineral is ripped away with picks and shovels; the blocks bigger than 6" are broken with picks and mallets, helped with wedges and crisels.

In the manganese mines with deep stratiform ore, the crown steriles are removed in amphitheatre, with banks of maximum height of 12 m, and ripping out subsequently the ore just in the same way that in the other mines.

The steriles are taken to the waste heaps in buckets, with trucks equiped with LUGGER-BROOKS frames.

The ratio steriles/ore varies as a function of the mine and phase of exploitation, between 1/10 and 6/1.

Mining Extraction Tonnage

Year	1965	1966	1967	1968	1969
Mineral production	35.606	29.933	23.167	7.398	19.354
Steriles production	35.677	54.190	71.444	12.982	57.804
Ratios steriles/mineral (1)	1:2/2:1	1:1/4:1	3:1/4:1	1:10/6:1	1:10/6:1

(1) Annual average for the different mines (Extreme values)

Concentration or Process Method Description

A manual picking-up is carried out in the mine, in order to separate the fraction < 1/2" (fines and "chippings") which is then stored waiting for a possible washing to eliminate the clay and limonitic materials and an eventually possible future sintering.

The fraction > 6" is broken in order to reduce its granulometry (occasionally, a size up to 10" is admitted).

The present recovery of ore can be estimated in a 60 - 70%

The cost of ore (1969) in the shipping place (without including the general administration expenses) was 35,26 NCr/t, and the selling price 53,13 NCr/t.

Tonnage, Concentrated or Processed

See above.

Description of Transport Methods to Metallurgical Factory or Sales Destination

The transport is made in trucks (of a tilting type), or in buckets (trucks with a LOGGER-BROOKS device), both from the work faces to the stacking piles, and to the shipping railway station.

This transport is made in trucks of their own (8 tilting ones and 12 with frames) or in rented trucks (8 in number).

From Licinio de Almeida (and occasionaly from Caculé) the ore is transported by railway waggons to the metallurgical centers: 70% to Sibra an Ferbasa, in Bahia, and 30% Aluminio M.G., in Minas Gerais. During our visit 6.000 t/month were transported.

MISCELLANEOUS

Personnel (Technicians and Workers) The non-specialized man-power is easy to obtain under contract at any moment, and more speciall, during the dry season, except in Brejinho das Amatistas, because of the activities in the "garimpos" (it is taken from Licinio de Almeida).

The exploitation of some mines, it is sub-contracted on a piece work basis, as a consequence of the difficulties of control. There is no specialized man-power in the region (it must be previously trained or brought from Belo Horizonte). Man-power (196?) under a direct contract: 48.

Machinery

8 tilting trucks; 12 trucks equipped with LOGGER-BOOKS frames for the transport of buckets.

Water Supply

Insufficient at present. It represents a real difficulty for the provision of a washing plant (Insufficient volume and the problem arising from the disposal of waste waters).

Power Supply

Three Diesel generator sets are available, a property of Mineraçao Urandi, in a more or less efficient condition.

The nearest electric supply line is in Guarambi, 60 km far away, but a extension of it has been anticipated, passing at a distance of 30 km from Licinio de Almeida.

Other Supplies (Fuel, oil, explosives, wood....)

No explosives are used.

REMARKS

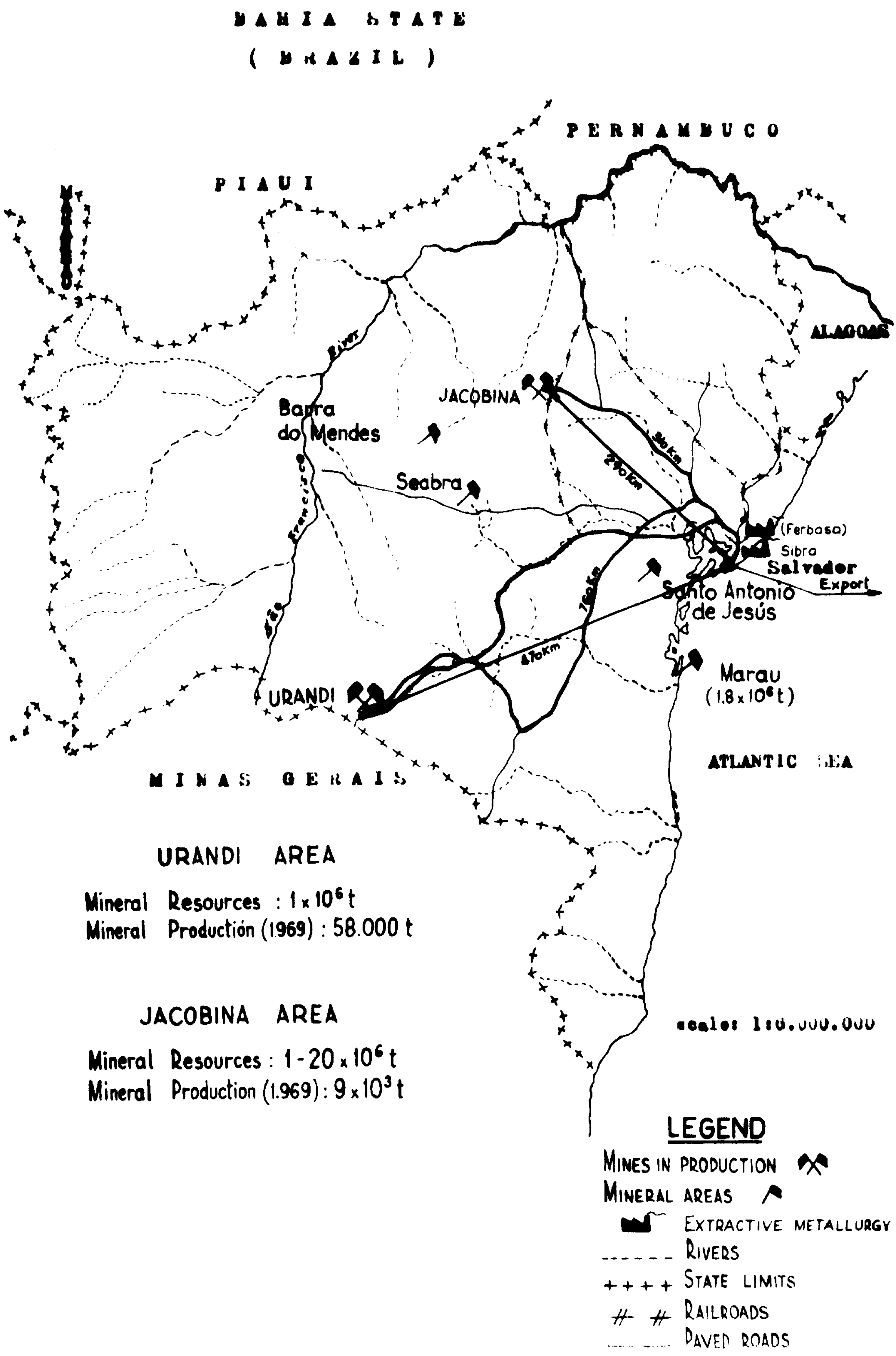
The ore in this area was discovered on the occasion of the construction of the railway line of LESTE Brasileiro, although at first it was considered as being coal.

Mineraçao Urandi began its activities in 1959.

The exploitation is now (1971) in a very active phase with sales figures up to 8,000 t/month. The domestic market demand is even greater (Sibra, Ferbasa, Aluminio, M.G., Prometal, Cosipa, etc).

Client: U.N.I.D.O.	Consulting Firm. **TECNIBERIA**

MANGANESE

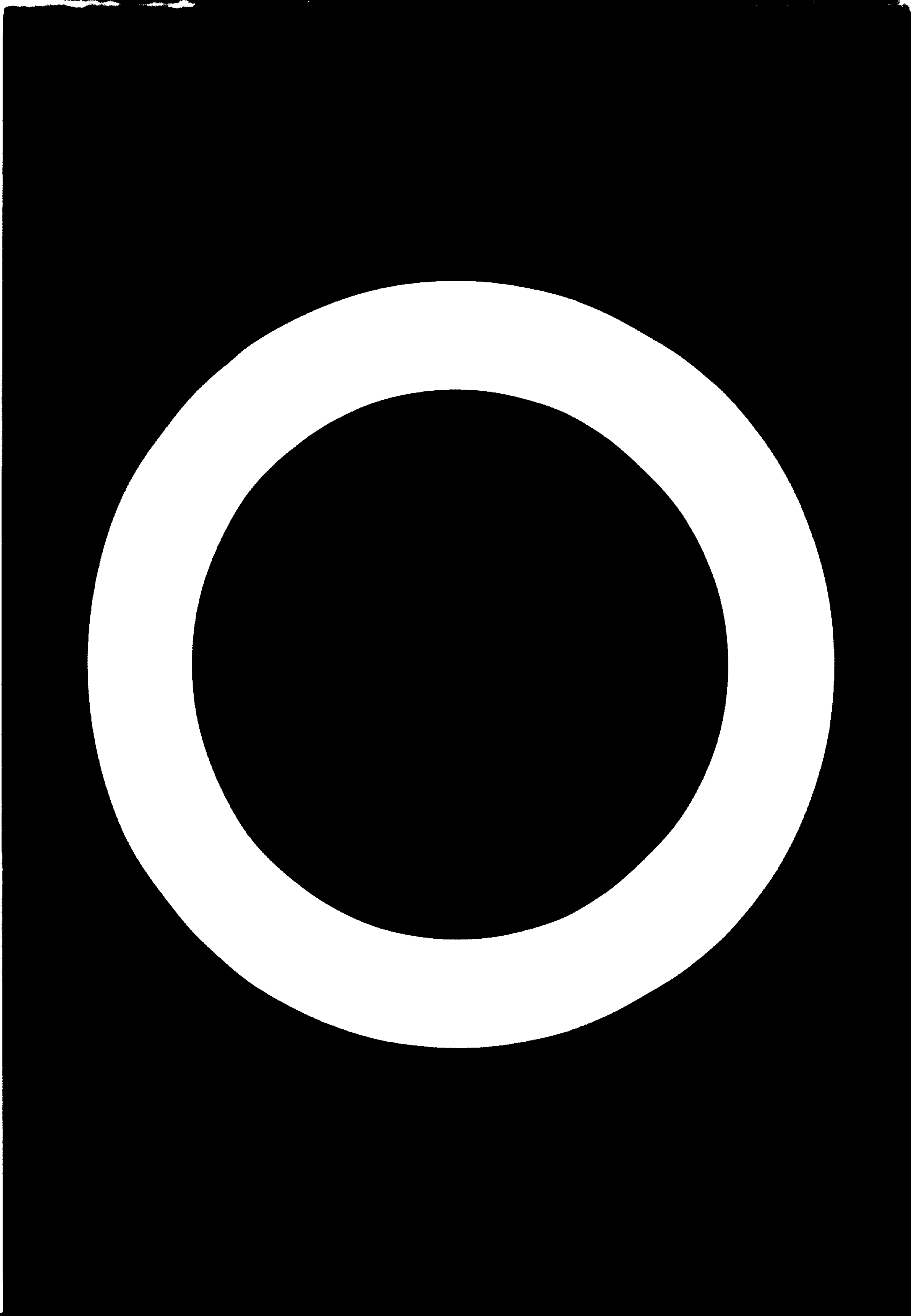


URANDI AREA

Mineral Resources : 1×10^6 t
Mineral Production (1969) : 58.000 t

JACOBINA AREA

Mineral Resources : $1 - 20 \times 10^6$ t
Mineral Production (1.969) : 9×10^3 t



Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Mn

Name of Mine 1) CABAVIEIRA; 2) ITAPURA; 3) OLHOS D'AGUA; 4) DO PADRE

Master Plan Identification

Owner Arditti Minéiros S.A. (ARMISA)
Rua Chile 22 s/905 Salvador (Ba)

Geographical Location

1) Fazenda Mandacau; municipality of Mirangaba; district of Taguarandi (60 km from Jacobina). 2) Municipality of Miguel Calmon, district of Utapuna (70 km from Jacobina). 3) and 4) Municipality of Jacobina (54 and 5 km from Jacobina, respectively). Jacobina region is at a distance of some 310 km from Salvador, by road, and 290 km in direct flight, to the NW of Salvador.

Coordenates

X = 40º 31' w
Y = 11º 11' .
Z = 500/700 m

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  Relatorio Anual de Lavra, Minas Itapura y Do Padre 1.968/69 and 1.966/69.
- DIRECT INFORMATION: 1.971

Geological Description

No geological studies are available.

Ore Body Geomorphological Description

The ore (Olhos d'Agua) is forming a cap type pod in an area of 400 x 600 m, more than 4 m. thick in some areas (that is the depth reached by pits).

In Do Padre mine it appears in the form of tabular veins cropping out in some points and disappearing in others. The gangue is ferro-siliceous, with a low per cent of alumina.

Topographical and Climatical Description

In Itapura and Padre, the rains oblige to a temporary interruption of works.

In Do Padre mine, the exploitation was totally interrupted by climatical (and economical) reasons between 1963/65.

INVESTIGATIONS

Chemical Analyses

- Itapura ore (1969): 46-48% Mn; 5,8% SiO_2; 1,12% Fe; 0,08% P.
- Do Padre ore (1969): 39-45% Mn.

Geological Studies

No geological studies have been made available.

Geophysical Survey

No geophysical surveys have been made.

Geochemical Survey

No geochemical surveys have been made.

Investigation of Bore Holes Pits and Galleries

The mines, in general, have been very little investigated; pits and galleries are digged out when a location of mineral is needed for an imminent exploitation.

Pilot Plant

No pilot plant studies have been made.

Investigations and Studies Proposed

Geological mapping to define the ore masses and a network of pits in order to define reserves and grades.

MINERAL RESOURCES

Resources description

No information available.

According to the data provided by Froes de Abreu (1960), a tonnage of manganese in the zone between Jacobina and Bonfim of 100.000 t. can be estimated. In the opinion of F. Soares de Andrade (verbal information, 1971), a figure of 2 x 10^6 t. can be estimated.

Verified Tonnage

Probable Tonnage

Possible Tonnage

TECHNICAL TABLE

Description of Explotation Methods

The most important explotation is the one of Olhos d' Agua mine.

The exploitations are made in open pit, by hand, with picks and shovels, loading the mineral in buckets with are subsequently transported in trucks.

In Olhos d'Agua, per ton of material ripped out, 200 kg. of ore are obtained, with a monthly output of about 150 tons of ore.

This openpit exploitation, making the best of local topographical ondulations, where work faces are established, is combined with an underground exploitation through directional galleries (Do Padre and Itapura).

The ratio steriles/ore in 1.969 was: Itapura 2:1; Do Padre 1:1.

Mining Extraction Tonnage

See below, tonnage concentrated or processed.

Concentration or Process Method Description

The mineral coming from Olhos d'Agua is washed at Jacobina. In the other mines, the ores are directly washed in the own area.

The coarse ore is previously broken with mallets, a picking up is made by hand, removing with hand hammers the steriles inclusions and laying aside the lean ores.

Tonnage, Concentrated or Processed

Mine	Year	1.966	1.967	1.968	1.969
Itapura				-	555
Do Padre		757	?	8.131	682

Description of Transport Methods to Metallurgical Factory or Sales Destination

At the mine, the transport is made by DECAUVILLE lorries, or with buckets on trucks.

From the stockpilings it is transported to Jacobina by truck, continuing then by train to Sao Roque or Salvador, to be loaded in ships and exported.

The selling price (1969) to the United States was 47,60 N Cr/t.

Personnel (Technicians and Workers)

A notorious lack of technical direction is patent.

According to verbal information (February 1971), the personnel is distributed in the following manner: Canovieira 10 men; Itapura 30 men; Olhos d'Agua 20 men; Do Padre 10 men.

Machinery

Data not available.

Water Supply

Insufficient in some exploitations.

Power Supply

The visited mine has no power supply available.

Other Supplies (Fuel, oil, explosives, wood ....)

Data not available.

REMARKS

Only the Olhos d'Agua mine has been visited.

Client: U.N.I.D.O.	Consulting Firm. TECNIBERIA	

D. 4. 3. EXTRACTIVE METALURGY

D. 4. 3. 1. Present production structure

D. 4. 3. 1. 1. General

The manganese's metallurgy is fundamentally constituted by industries producing manganese ferroalloys, in -- electric reduction furnaces, with ores, reducing agents and fluxes as raw materials.

The Brazilian ferroalloys industry produces, up to this moment, only high carbon ferromanganese alloys (Fe-Mn HC), with 75/80% Mn and carbon contents of a 7-8% Silicomanganese (Fe-Si-Mn) is also produced with 18/20% Si and 65/70% Mn.

The State of Bahía is substantially contributing, since 1.967, to the ferroalloys' production, with a 7.500 KVA furnace, owned by the company "Ferro-ligas de Bahía" (FERBASA), devoted to the production of Fe-Mn HC. Other company, the "Electro-Siderurgia Brasileira" (SIBRA) started later on in 1.970, the operation of four furnaces, of a nominal unit power of 5.400 KVA, in the polygon of ARATU, to produce Fe-Mn HC and Fe-Si-Mn.

The remainder ferroalloys producing plants are located in the States of Minas Gerais and Sao Paulo, either in the form of independent companies or as a part of integrated steel plants following a policy of self-sufficiency in ferroalloys, (as in the case of the Cía. Siderúrgica Nacional).

D. 4. 3. 1. 2. Short description of Bahía plants

Circumscribing ourselves to the sector of conventional ferroalloys (for in Bahía, at Aratu, there is also a special ferroalloys producing plant with a capacity of 600 t/ year), we shall point out the following data, corresponding to producing companies.

a) Ferroligas de Bahía, S.A. (FERBASA)

Plant. - In Pojuca (60 Km. approx. from Salvador)

Productions. - Fe-Mn HC (74/78% Mn; 6,5/7,5% C)

High carbon ferrochrome (Fe Cr HC) is also produced and, sporadically, some batches of ferrosilicon (Fe Si).

Furnaces:

1 of 7.500 KVA (Lectromelt, USA) - (Fe Mn HC)
1 of 4.500 KVA (national) - (Fe Cr HC)
1 of 3.000 KVA (national) - (Fe Cr HC)
1 of 2.500 KVA (national) - (Fe Cr LC) (out of action)

1.971 Program

10.800 t. Fe-Mn HC - Brasil
9.600 t. Fe-Cr HC - Brasil (3.600 t)
U.S.A. (5.400 t)
Argentine (600 t)

b) Electro-Siderurgica Brasileira (SIBRA)

Plant. - Aratu industrial polygon

Productions: Fe-Mn HC (75/80% Mn; 7/7,5% C)
Fe-Si-Mn (65/70% Mn; 18/20% Si)
Fe-Si (discontinued)

Furnaces:	3 of 5.400 KVA (Fe-Mn HC)	
	1 of 5.400 KVA (Fe-Si-Mn)	
1.971 Program:	7.500 t.	Fe Mn HC (Venezuela)
	7.500 t.	Fe-Si-Mn (Venezuela)
	6.000 t.	Fe-Mn-HC (Brazil)

SIBRA has a 50% capital participation of Industrias Siderúrgicas Grassi, (Argentine).

The manganese ores supplied to SIBRA and FERBASA come integrally from Bahía mines.

Charcoal is used in both plants as reducing agent coming in a great part from nearby forestry works owned by the ferroalloys companies.

D. 4. 3. 2. Present capacity of production

At the end of 1.970, and according to the above mentioned study of the Ministerio da Industria e Comercio, the ferroalloys production capacity in Brazil is that one shown in Table Mn-8.

D. 4. 3. 3. Expansion of capacity in existing plants

The data available to us provide only in a global form the projected expansions of capacity of the ensemble of Brazilian ferroalloys industry, and have been compiled in Table Mn-7.

On the occasion of our visit to SIBRA, we were told about their intentions to install two new furnaces with a nominal capacity of 18.000/20.000 KVA, but without any indication of a definite date of installation. We know nothing about expansion plans in FERBASA.

D. 4. 3. 4. <u>New installations in project</u>

Without any defined plan.

D. 5. CHROMIUM

D. 5. 1. **MARKET STUDY**

D. 5. 1. 1. **Historical background**

D. 5. 1. 1. 1. **Chromite**

According to the available statistical data (in spite of their doubtful reliability inferred from the simple reading of Table Cr-1), Bahía is the State in Brazil contributing the most to the chromite production in that country, a contribution that, according to our estimates, represents, since -- 1.965, a figure in excess of a 95%.

The quality of Bahía's chromite and the lack of - efficient exploitation and concentration methods practised up to now, have been an obstacle to its export.

In fact, and as it can be deduced from Table Cr-1, the chromite output has reached a relative maximum in 1.963 with a gradual decrease starting in that year and ending in 1.968, with a trend, however, towards a very clear recuperation in the period 1.969/1.970.

This evolution is an indication -temporal at least- of the discontinuance of the marginal exploitations of a worse quality.

The data on the foreign market, on the other hand, (see Table Cr-2) show chromite's imports, starting in 1.966 with growing tonnages, attaining in the last three years figures of the order of 7.000 t/year. This chromite, of very special characteristics, is supplied preferently to the manufacture of high quality refractory bricks.

D. 5. 1. 1. 2. Chrome ferroalloys

The production, as far as it concerns to ferrochrome, has been limited up to now in Brazil to high carbon qualities (Fe-Cr HC).

Some batches of low-carbon ferrochrome (Fe-Cr LC) have been made, but in technically improper installations and with very high energy consumptions, without any possibility, on the other hand, of controlling the carbon contents, with variations from 0,05% to 0,5% among the different heats.

The total production has not been in excess of 500 t. In view of such unfavourable results, production of low-carbon ferrochromes has been discontinued.

The Table Cr-3 reviews all available data on production figures, foreign market and apparent consumption in those cases where it was possible to obtain them in view of the scarcety of statistical data available.

Bahía's contribution to the ferrochrome production since 1.966 in Brazil is a predominant one, in excess of, according to the available information a 95% of the whole production.

According to the statistical data, the ferrochrome exports have been rather limited. It must be pointed out, however, that the 1.966 and 1.968 outputs have been superior to the estimated needs of consumption as a function of steel production; we must, therefore, infer that during those years, the exports might have reached a greater volume than the one reflected in the available statistics.

As far as it concerns to imports, there is no possibility, with the available statistics, of differentiating the ones corresponding to Fe-Cr HC and Fe-Cr LC. We have supposed that their total is referred to the LC ones; we estimate, however, that its volume is too high, if compaired with the ingot steel production, except in 1.964-1.965, where the figures reflect the crisis suffered by the steel industry during the said years, joined to the difficulties suffered by Mannesman, (main consumer of ferrochrome) and the policy of stocks reduction.

D.5.1.2. Demand's forecasts

Following the same method used at D.4.1.2. to determine the projection of ferromanganese consumption, the probable demand for the period 1.971/1.975 has been established for Fe-Cr HC and Fe-Cr LC (Table Cr-4). The projections adopted by the Ministry of Industry and Commerce have been also included in the same Table showing out a very good correlation between both of them.

It must be pointed out that these projections of demand have been based on two assumptions:

a) That the offer will follow the evolution predicted by the National Steel Plan.

b) That the consumption coefficients on Fe-Cr HC and Fe-Cr LC might be maintained in the period 1.971/1.975 without any variation from the values of 0,5 Kg and 0,2 Kgper ton of steel produced.

We can have another estimative trend of the possible evolution of demand, by comparing the preceding estimations with the foreseen evolution of consumption of ferrochrome in the

Spanish steel industry. The Spanish evolution of apparent consumption of ferrochromes (HC and LC) has been estimated as follows:

Year	Total of steel production ($x/10^3$ t)	Demand of Fe-Cr (t)
1.970	7.380 (actual)	7.900 (0,107%)
1.971	8.700 (est.)	8.300 (0,095%)
1.972	9.700 (est.)	9.000 (0,092%)
Total	25.780	25.200 (0,098%)

Applying this average coefficient to the estimated figures of steel production in Brazil for the period 1.971/1.975, we have:

Year	Total of steel ($x10^3$ t)	Demand of Fe-Cr (t)
1.971	5.223	5.100
1.972	6.483	6.400
1.973	6.483	6.400
1.974	7.203	7.060
1.975	8.184	8.000

The demand of Fe-Cr LC in Spain, as a percentage of the total ferrochrome consumption, will amount, according to the estimates made, from 24% to 35%. If the same trend is followed by the brazilian steel industry, the demand for Fe-Cr LC would vary from 1.900 t to 2.800 t. in 1.975.

In any case, we estimate that the demand of Fe-Cr LC will not exceed 3.000 t. in that year.

D. 5. 1. 3. Balance between the estimated demand and the offer

Given that for the moment, no plans of production of Fe-Cr LC are contemplated, there will be an important excess of production capacity in 1. 975, as far as it concerns to Fe-Cr HC.

From preceeding paragraph we can conclude that the Fe-Cr HC demand will vary in that year between 6. 100 t. and 5. 200 t. At to-day's specific power consumption, this would require 30. 500 MWh and 26. 000 MWh respectively, and only - FERBASA has an installed capacity for Fe-Cr HC of 7. 500 KWA that is, 37. 600 MWh (considering cos φ = 0, 8; efficiency, 0, 88; load factor 0, 90 and 7. 920 h/year of operation).

D. 5. 1. 4. The chromite consuming industry. Its structure

Chromite is supplied to the three following consuming industrial sectors:

a) Chrome ferroalloys
b) Refractories industry
c) Chemical industry (chrome salts)

Their characteristics and perspectives are studied in paragraphes D. 5. 3. and D. 5. 4. below.

D. 5. 2. MINING

D. 5. 2. 1. Orebodies

The most important orebodies are to be found in the area between Campo Formoso and Saudé, along a 50 Km. wide strip, where the Ferbasa and Coitezeiro exploitations are located. Their characteristics have been included in the attached data cards.

Other orebodies are to be found 9 Km. far from the East of Queimados, where some exploratory workings have already been performed.

The existance of orebodies in the region of Abaré, near Curaça has also been mentioned.

With the CPRM's "Projeto Cromo" in due course of execution, it is possible that new orebodies may be put in evidence in a near future.

D. 5. 2. 2. Data cards and maps

In the attached data cards, the most important features of the visited orebodies of Ferbasa and Coitezeiro have been included. The attached map shows their location in Bahia, together with other relevant data.

Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral
Cr

Name of Mine
PEDRINHAS, CASCABULHOS, CAMPINHAS

Master Plan Identification

Owner Companhia de Ferroligas da Bahia, S.A. (FERBASA)
Rua Miguel Calmon, 40 S. 1 Salvador (Bahia)

Geographical Location

Municipality of Campo Formoso. At a distance of 12 km from this town is located the principal mine (PEDRINHAS) and its plants; 6 km far away is CASCABULHOS Mine, and at a distance of 12 km to the S.W. of Campo Formoso is CAMPINHAS Mine.

The zone is situated at a distance of some 400 km by road, from Salvador, and 350 km in direct flight to the NW.

Coordenates

X = 40º 23' W
Y = 10º 11'
Z = 730 m aprox.

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  Relatorio Anual de Lavra 1.965/69 Verbal information 1.971
- DIRECT INFORMATION 1.971

Geological Description

The mineral has been formed by magmatic segregation, of ultrabasic (maphic) rodks, presenting a striped structure and situated under quartzites.

The ultrabasic rocks have an apparent thickness, as explored by boring holes, of at least 250 m, and a longitudinal development of 50 km, where the presence of mineral has been scanned, but without knowing its cross section.

The ultrabasic rock has suffered an intense alteration and, in its origin, it could have been a dunite or chromiferous peridotite.

Ore Body Geomorphological Description

The mineral presents itself in beds (2 or 3) of metallurgical chromite, within the chromite disseminated in serpentine, and presenting a 50º dip to the South, sinking under the mountains.

Topographical and Climatical Description

It is a zone of a rugged topography, with mines situated on the hills sides. Local problems of slope sliddings roused when digging the base of the hills.

INVESTIGATIONS

Chemical Analyses

Average analysis of a representative boring; Cr_2O_3: 46,89%, FeO: 14,47%, SiO_2: 0,73%, R (Cr/Fe): ,66%. Analysis of concentrated "chemical" ore: Cr_2O_3: 47,9 - 51,9%, FeO: 23,4% - 21,3%, SiO_2: 2,2% - 2,5%, R (cr/Fe): 1,64%.

The average grades (1,969) in exploitation have been: "metallurgical" ore; 38% Cr_2O_3, "friable" mineral: 22,7% Cr_2O_3.

Geological Studies

Studies have been carried out by the Geological School of Bahia University.

More recent is a study of the CPRM (unpublished at this moment).

FERBASA has carried through studies, at the scale 1:2,000, by its own geologists, oriented towards the exploitation. It has under study other exploration concessions.

Geophysical Survey

Gravimetric and magnetic studies were performed initially, in order to check the interpretations with borings; when the magnetic studies brought better results, these studies have been intensified with success.

Geochemical Survey

In other zones, more to the North, studies have been carried through by Geological School of Bahia University.

Investigation of Bore Holes Pits and Galleries

Borings have been carried through by the CPRM in PEDRINHAS and CASCABULHOS, but the report has not been published yet. At this moment holes are being bored in other areas within the "Projeto Cromo".

FERBASA has now a drill searching in PEDRINHAS, and other three in zones of exploration. In 1,968, a 30 m square network of borings, was made and it permitted the cubage of 786,700 t of "friable" ore, 236.000 t of contact ore and 26,000 t of "metallurgical" ore.

Pilot Plant

A study on concentration has been carried through in a pilot plant (the concentration, up to 1,963, had been processed by hand). Pursuant to the results obtained, a washing plant has been installed and it is in operation since 1,966.

Investigations and Studies Proposed

A geophysical aeromagnetic regional study, complemented by boring holes, would be recommendable, in order to make a detailed exploration of the whole of the ultrabasic rocks.

It is recommended to carry out pilot plant studies in order to better the Cr/Fe ratio.

MINERAL RESOURCES

Resources description

The reserves are now being estimated and it is expected that their cubage will be finished after three years of investigation.

Verified Tonnage

$1,3.10^6$ t (PEDRINHAS and CASCABULHOS)

Probable Tonnage

$10,0.10^6$ t (PEDRINHAS and CASCABULHOS)

Possible Tonnage

TECHNICAL TABLE

Description of Explotation Methods

The exploitation is performed in open pit, in 3-4 m high stopes (variable in height in order to avoid the clay zones). The digging is made, in part, manual and, in part, with tractors and shovels. (The overburden in CAMPINHAS is estimated in 8 m).

The ore is ripped away with picks and shovels, for both the disseminated ore and the rock embedding it, are soft, and the metallurgical ore is present in pockets with a great dispersion (except in CASCABULHOS, where a harder ore requires the use of a hammer and compressor).

The ratio ore/steriles in CASCABULHOS (1.969) was 1/6; in PEDRINHAS, the ratio friable/steriles is 1/2, and the ratio metallurgical ore/steriles is 1/2.

The recovery of metallurgical ore is total; the one corresponding to the friable ore (in the exploitation) is of a 90 per 100.

Mining Extraction Tonnage

	PEDRINHAS			CASCABULHOS		CAMPINHAS			
Year	Friable	Metall.	Refrac.	Sand	Metall.	Friable	Metall.	Refrac.	Total
1965					3.436				
1966	13.502	305	-	-	6.239		1.500		21.546
1967	14.814	-	-	-	1.442		1.200		17.456
1968	19.194	-	-	-	4.835		1.418		25.447
1969	22.775	3.458	-	-	3.825	900	600	400	31.958
1970	≃ 57.600	11.028	94	609	2.516	-	415	684	72.946

Concentration or Process Method Description

The friable ore is transported in trucks to be piled up; in these piling places, by gravity and with the help of a tractor HD-3 it is taken to silos, from which it passes to a trommel through a feeder. It passes then to a clay separation station. Mecanically it is transferred to an helical washer, with water in counter-current; it passes then to a re-washing trommel, from which the mineral is separated down to a thickener.

The recovery in the washing plant is of 93 per 100.

The plant's maximum possible capacity is 200 t/day of concentrates. The production varies according to demand (a figure of 16,000 t/month of friable mineral ripped out can be reached, depending the metallurgical ore on the production of friable ore).

The concentration ratio in the washing plant is 2/1. The average grade attained in the products is: refuse, 3% Cr_2O_3; concentrate: 46% Cr_2O_3; having both in mind, the enrichment ratio is 46/ (46 + 3)/2 = 2,87/1.

Tonnage, Concentrated or Processed (PEDRINHAS)

Year	1,966	1,967	1,968	1,969	1,970	Total
Friable ore	13,502	14,814	19,194	22,775	≃ 57.600	127,885
Concentrate	8,439	9,229	9,527	8,483	21,337	57,015

Description of Transport Methods to Metallurgical Factory or Sales Destination

The mineral is hauled from the mine in trucks (DECAUVILLE barrows in CAMPINHAS) to the picking up place or to the washing plant. The metallurgical ore and the concentrate coming from the washing plant are hauled in trucks (subcontracted) to Campo Formoso. From this place it is transported by railway to the FERBASA plant, at Pojuca (at a distance of 80 km from Salvador, Ba). The concentrate is transported by return trucks to Rio de Janeiro (BAYER DO BRASIL), a circunstance with a trend to decrease due to the fact of the progressive development in the North - East.

The refractory ore, or "baixo", of a low content in Cr_2O_3 is taken to storing places.

In 1,969, the metallurgical ore was destined to:

FERBASA: 8.917 t; Load or Charge: 4.746 t; Triagem: 296 t.

MISCELLANEOUS

Personnel (Technicians and Workers)

The total of persons working in the mines, together with the devoted to exploration and administrative tasks, in 1971, is of 328 men. In 1969, the men employed in PEDRINHAS and CASCABULHOS were 140 (109 of them non-specialized), and in CASCABULHOS in 1968, were only 30.

Within the district there is no specialist level; they are trained in the mine.

Machinery

1 tractor D 7 F CATERPILLAR; 2 tractor D 5, 1 tractor HD-3. 2 BUCYRUS excavators; 1 CATERPILLAR loading shovel 966, 1 ATLAS compressor, with a hammer (in CASCABULHOS).

Water Supply

FERBASA has an accumulation dam, of 500,000 m^3 in capacity; it can be made four times larger if the retaining wall is increased 3 m in its height.

The water coming from the washing plant passes through decantation ponds and it is recycled to the washing process.

Power Supply

It exists an 138,000 V electric line joining the Paulo Alfonso power-house to Campo Formoso; another line starting from the latter place has been provided (COELBA) to supply FERBASA an COITIZEIRO plants.

Other Supplies (Fuel, oil, explosives, wood ....)

Only in CASCABULHOS explosives are used.

REMARKS

Four types of ore have been differenciated. Their characteristics are as follows:

"Metallurgical"

FERBASA type: $> 39\%$ Cr_2O_3; $Cr/Fe > 2{,}7$
Charge type: $> 38\%$ Cr_2O_3; $2{,}7 > Cr/Fe > 2$
It is separated in mine manually, and it is destined to Pojuca (FERBASA), for ferroalloy production.

"Chemical" or "friable"

It must be able to give concentrates with $> 40\%$ Cr_2O_3 and a yield $> 25\%$ of concentrate (the raw ore must have, therefore, more than 12,5% of Cr_2O_3).

It is sent to Rio de Janeiro (BAYER DO BRASIL) and its export is being prepared.

"Chromite sand"

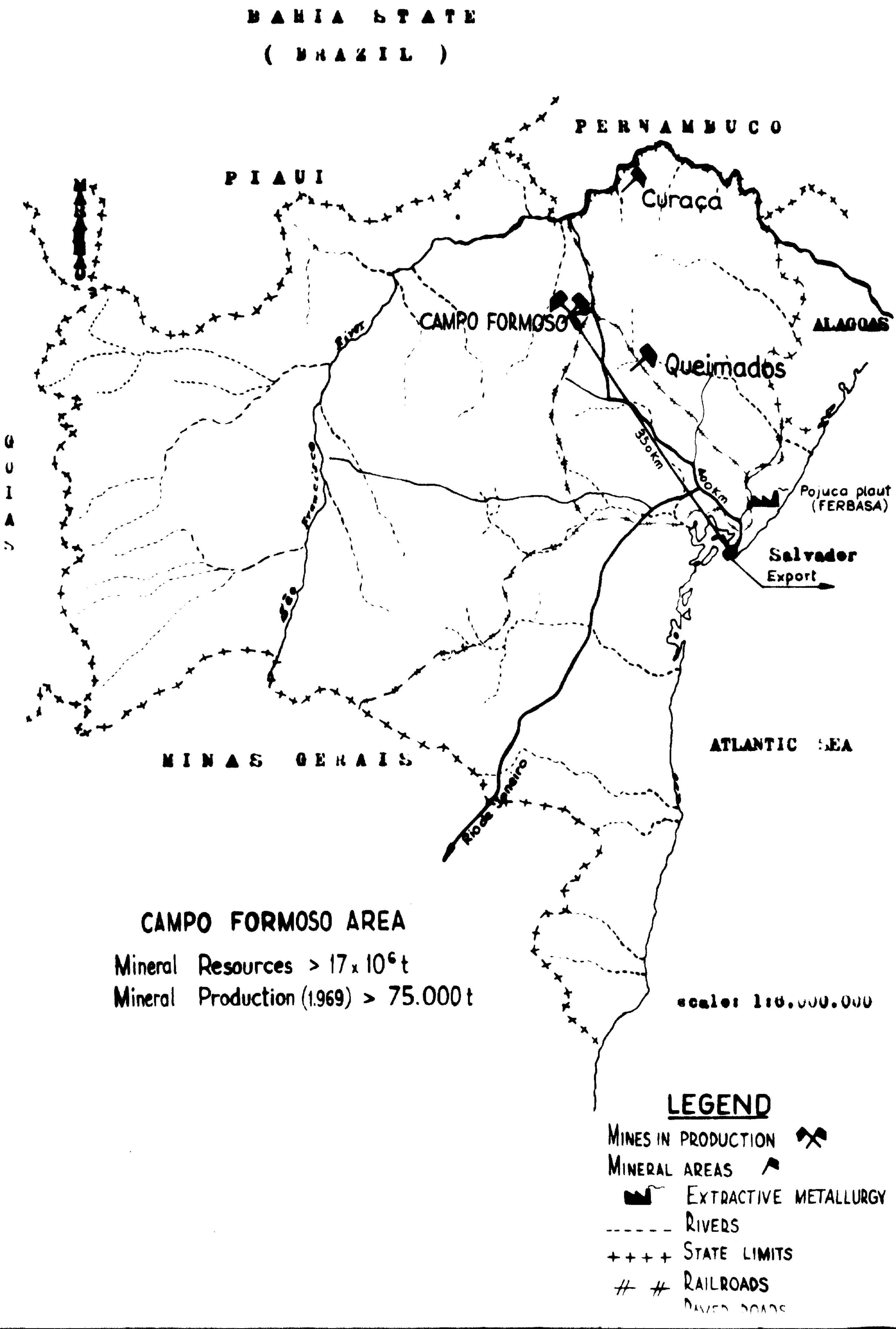
It is supplied to foundries as a substitutive of zircon sand.

"Refractory"

It has $< 38\%$ Cr_2O_3 and $Cr/Fe < 2$.

Client: U.N.I.D.O.	Consulting Firm. TECNIBERIA	

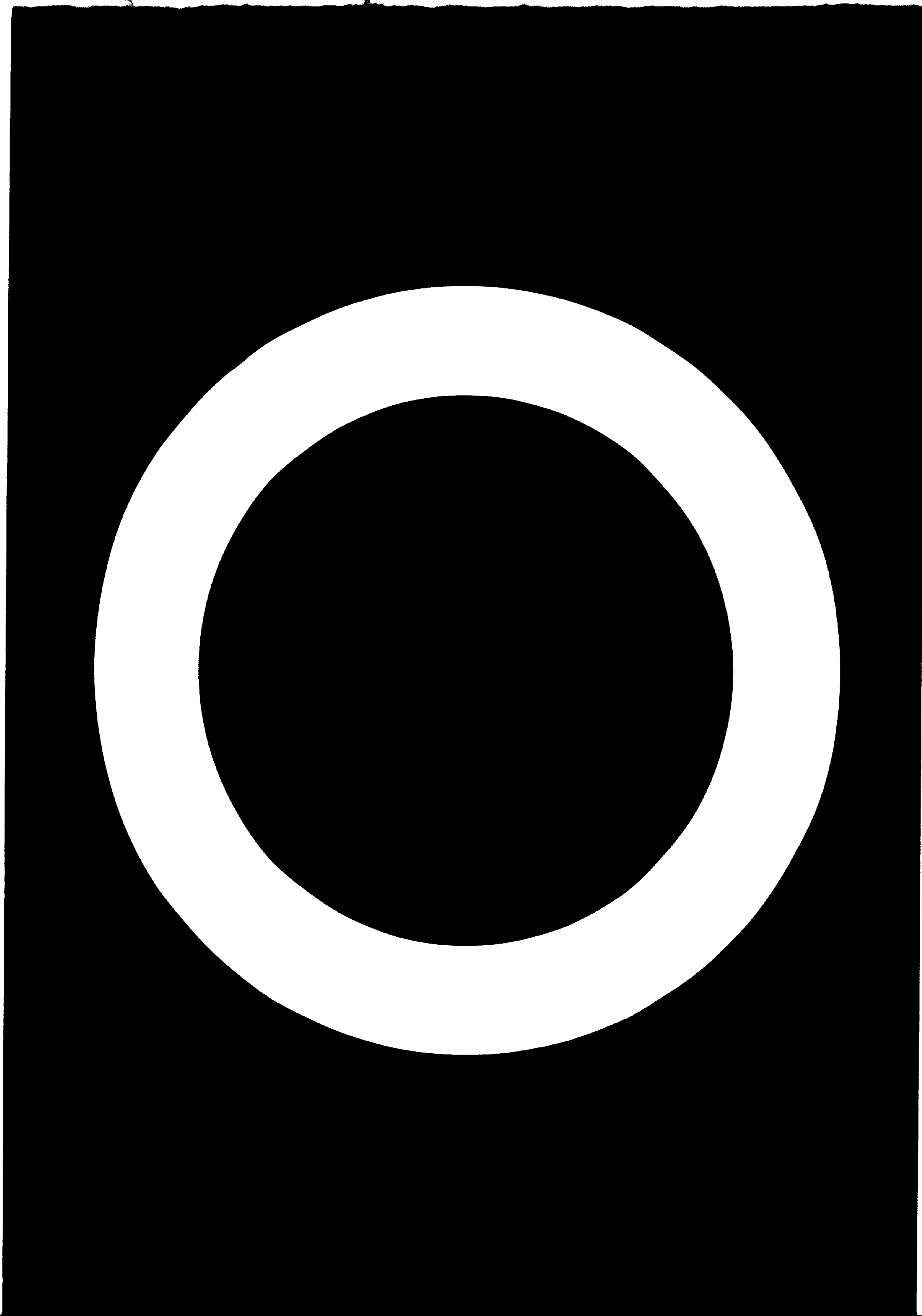
CHROMITE



CAMPO FORMOSO AREA

Mineral Resources > 17×10^6 t

Mineral Production (1.969) > 75.000 t



Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Cr

Name of Mine
COITEZEIRO

Master Plan Identification

Owner Coitezeiro Mineracao S.A. (COMISA) (Bayer do Brasil Group).
Rua Conde D'Eu. 1º Andar. Salvador (Bahia).

Geographical Location

Municipality of Campo Formoso. 16 km away from this town.

The area is at a distance of 400 km aprox. from Salvador, by road, and 350 km in direct flight towards the NW.

Coordenates

X = 40º 23' W

Y = 10º 31' S

Z = 750 m

Bibliography and References

- COITIZEIRO

Relatorio Anual de Lavra 1966/69

- DIRECT INFORMATION 1971

Geological Description

The same that the one corresponding to Pedrinhas, Cascabulhos and Campinhas Mines (Ferbasa).

Ore Body Geomorphological Description

The ore appears in two or three stratoid beds, similar to the ones exploited by Ferbasa.

Topographical and Climatical Description

The exploitations are situated on the Northern slopes of the mountains, in a zone of rugged morphology.

INVESTIGATIONS

Chemical Analyses

"Chemical" ore (friable and semifriable in nature): 18-20% Cr_2O_3 - "Chemical" ore (compact): 34-38% Cr_2O_3. Concentrated ore: 41-35% Cr_2O_3. 24% aprox. FeO, 9% aprox. SiO_2; 7% aprox. Al_2O_3; 7% aprox. H_2O.

Geological Studies

Data not available.

Geophysical Survey

No geophysical surveys have been made.

Geochemical Survey

No geochemical surveys have been made

Investigation of Bore Holes Pits and Galleries

The CPRM has worked out several borings that apparently have shown the continuity of mineralizations, (No pertinent report is available yet).

Pilot Plant

Data not available

Investigations and Studies Proposed

None

MINERAL RESOURCES

Resources description

According to data coming from the annual mining report, the reserves are as follows;

Verified Tonnage

419,000 t (356,150 of friable and semifriable; 62,850 of compact).

Probable Tonnage

4,200,000 t

Possible Tonnage

1,370,000 t

TECHNICAL TABLE

Description of Explotation Methods

Two near mines are now in operation, one of them of "compact" ore, and the other with "compact", "friable" and "metalurgical" ores.

The exploitation is made in open pit, removing the steriles (1 to 3 m) with caterpillar tractors and hauling them to the waste heaps with tilting trucks.

The mineral is ripped of with picks and double picks and taken by hand carts (the "compact" to the picking area, and the "friable" to the washing plant).

The ratio exploitable mineral/steriles is 1/6, and the recovery of mineral is of a 82%.

Officially, the exploitation was started in 1966 (it is possible, however, that the works were begun in 1961).

Mining Extraction Tonnage

Year	1966	1967	1968	1969	TOTAL
Chemical ore	1,843	1,868	1,913,5	2,964,5 (1)	8,589
Compact ore	-	1,750	1,944	1,856,5	5,550,5

(1) 2,405 Semifriable; 1,559,5 Friable.

Concentration or Process Method Description

A very obsolete washing station is available, short of water in summertime, in order to concentrate the friable ore with destination to the chemical industry.

The washing is carried out in a rotating trommel, with a capacity of 750 l, where 300 kg of ore are hand-loaded, to obtain 100 - 150 kg of concentrate, after a washing cycle of less than 5 minutes.

In 1969, an average of 14 t/day was loaded, with a recovery of concentrate, in weight, in proportion to the mineral "in natura", of 1/2,5.

The month of January 1969, gave the maximum figure of concentrastes, with 257 t.

Part of the compact ore (metallurgical) is added to the chemical fraction.

Tonnage, Concentrated or Processed

Data not available.

Description of Transport Methods to Metallurgical Factory or Sales Destination

The concentrated and the compect ores are taken in trucks to Campo Formoso (16 km aprox.), and from that place, the "metallurgical" one, is hauled to Pojuca (Ba) by railway, and the "refractory" to Contagem (M.G.), by truck. The "chemical" one to Belford Roxo (R.J.), by trucks.

MISCELLANEOUS

Personnel (Technicians and Workers)

47 men are working in the exploitation, together with 4 men of productive labor.

Machinery

1 Mercedes Benz truck, and 3 buckets, of a capacity of 4 m^3 each.

Water Supply

Not sufficient. Water is from spring wells.

Power Supply

In the proximity of the exploitation there is an electric line, a property of Coelba. Coitezeiro, however, has not been yet connected to it.

Other Supplies (Fuel, oil, explosives, wood....)

Data not available.

REMARKS

None

Client: U.N.I.D.O.	Consulting Firm. TECNIBERIA	

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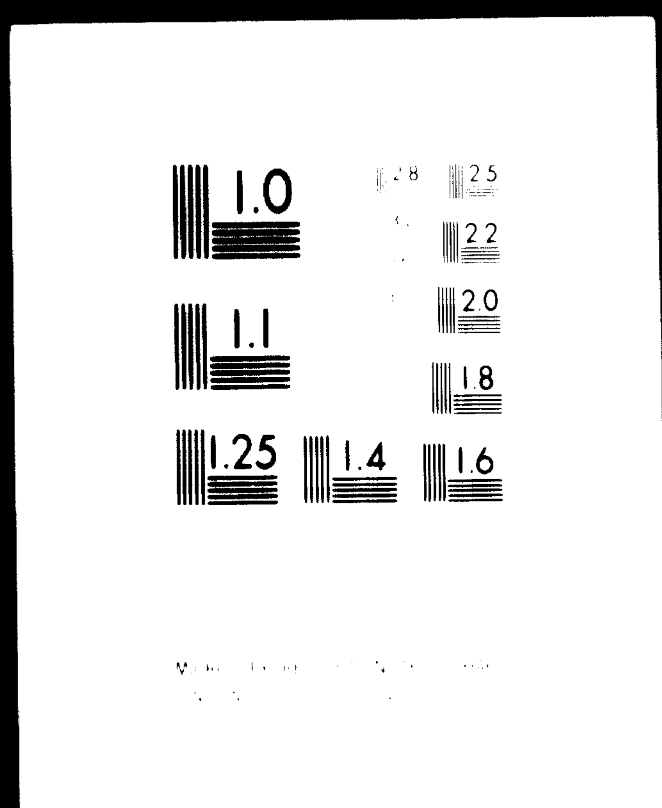

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D. 5. 3. EXTRACTIVE METALLURGY

D. 5. 3. 1. Present production structure

D. 5. 3. 1. 1. General

The chrome metallurgy is aimed fundamentally to the ferrochrome production.

Presently, only high carbon ferro-chromes (Fe-Cr HC, 60/65% Cr and 6-9% C) are being produced.

Bahía is preponderant from 1.965 in the ferrochromes production through the firm "Ferro-ligas de Bahía" -- (FERBASA), with two 7.500 KVA furnaces (nominal power) for the production of this type of alloys. No information is available about ferrochrome production in other States of - Brazil.

D. 5. 3. 1. 2. Production plants in Bahía

It has already been summarised in paragraph D. 4. 3. 1. 2. (manganese).

The chromites supplied to the FERBASA furnaces come from orebodies located in the Campo Formoso area, with an average analysis of 42/43% Cr_2O_3, 10% SiO_2 (max.) and a Cr/Fe ratio from 2,2 to 2,7. It is an ore of a very irregular composition and granulometry, that requires a very careful preparation of the furnace burden.

The electric power is supplied from a 69 KV line; it has been provided, however, for an undetermined date, the availability of a new 220 KV line, making thus lower the price of power supply.

D. 5. 3. 2. <u>Present production capacity</u>

The present production capacity, according to the data given in D. 5. 1. 3., amounts to 37. 600 MWh, available to the Fe-Cr HC production.

D. 5. 3. 3. <u>Enlargement of present plants</u>

No enlargement plans have been defined.

D. 5. 3. 4. <u>New plants in project</u>

Without definition up to this moment.

D. 5. 4. OTHER CHROMITE PROCESSING INDUSTRIES

D. 5. 4. 1. Degree of concentration of production

Apart from the ferrochrome industries, no other chromite consuming plants exist in Bahía, such as, for example, chemical industries working on chrome chemicals or refractories. The latter are to be found in the Central-Southern zone of Brazil (States of Rio de Janeiro, Sao Paulo and Minas Gerais).

a) Refractories industries

They are studied section D. 7 (magnesite). We will simply say that the most important industry manufacturing chromo-magnesite and chromite basic refractories (Magnesita S. A.), imports from the Philippines Islands the most part of its chromite needs, because the characteristics of these minerals adapt themselves better to their specifications. The rest of the chromite consumed comes from the mines that this Company owns in Goiás and from Cromita do Brasil - (FERBASA) with difficulties in the delivery time and in the quantities supplied.

b) Chrome chemicals

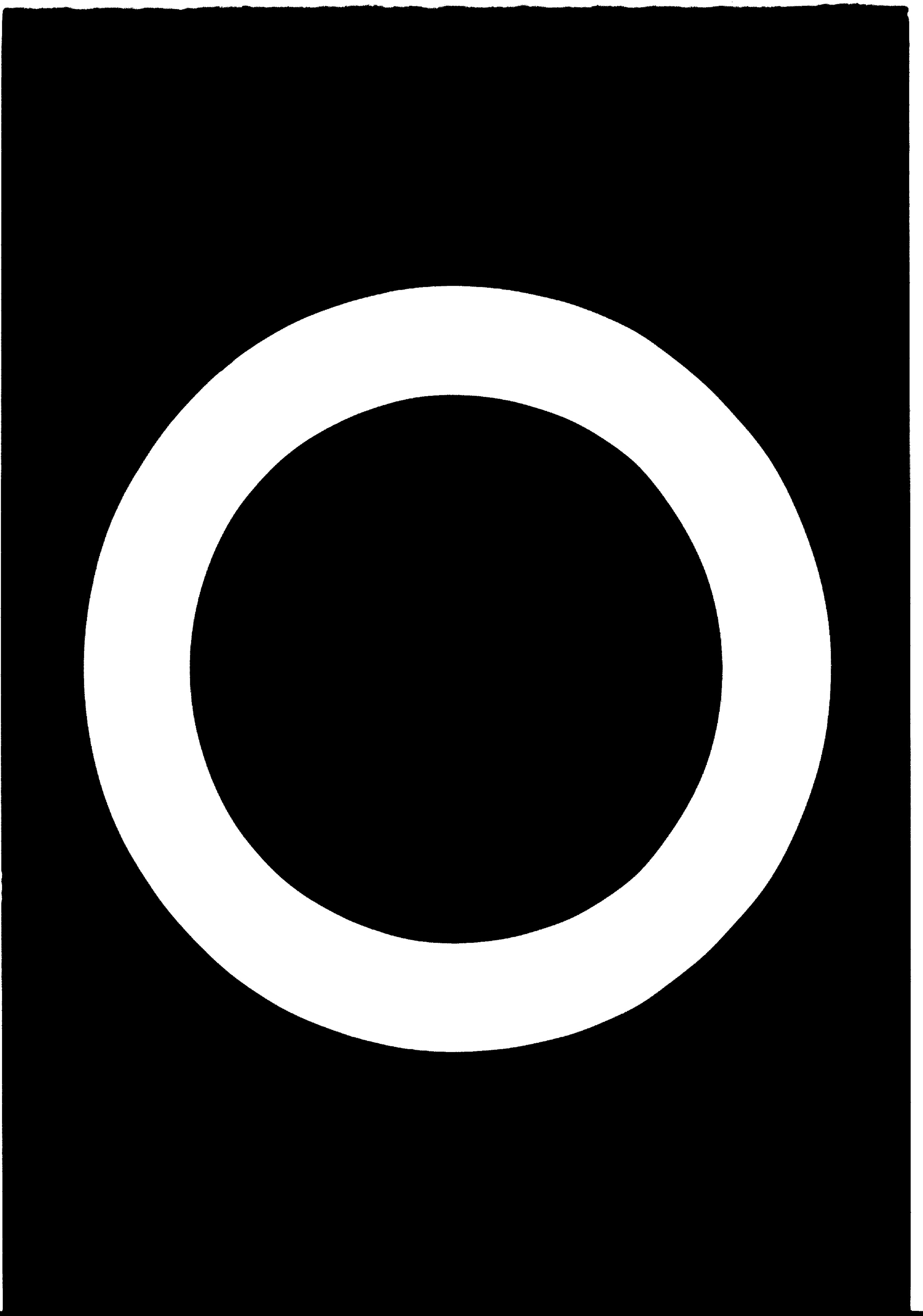
Bayer do Brasil, S. A. is the only firm in Brazil processing chrome to obtain chemicals fundamentally sodium and potassium dichromat, to be employed as a tanning agent. The plant is located in Belford Roxo (R. J.).

18. 000-24. 000 t/year are the average consumption of chromite: an 80% supplied by FERBASA and the remaining 20% by "Mineraçao Coitezeiro".

This chemical chromite has an average Cr_2O_2 content of 47/48%, Bayer concentrates this cromite in shake tables. The average analysis of the chromites supplied to Bayer in 1.969, gave ths following fluctuations:

H_2O	Cr_2O_3	FeO	MgO	SiO_2	Al_2O_3	Volatiles
5%	43/48%	25-29%	7-9%	2-3%	8-10%	1-3%

D.6. BARITE



D.6.1. **MARKET STUDY**

D.6.1.1. Historical background

As it may be seen from Tables Ba-1, Ba-2 and Ba-3 Bahia is the only Brasilian state which produces barite.

Since Brazil's production exceeds its needs, the country is a traditional exporter of barite, although the exported tons have decreased while imports have increased in recent years; however, the balance continues to be favorable to Brazil

In fact, it could be said that, until 1.956, the Brasilian production of barites was mined exclusively for the external market, which consumed 92,50% of it during the period 1.956-1.964.

This orientation towards the external market is confirmed by Tabls Ba-3, which shows sudden variations in the consumptions of years shown, usages which even became negative, as in 1.956, 1.960 and 1.964.

D.6.1.2. Demand Forecasts

The major problem faced by the barite mining industry is the close dependence on a market which consietes almost exclusively of drilling mud for oil wells, whose location change the geographical demand from time to time.

A great number of the more important barite mines in the world are either directly owned or associated with a half dozen companies which have their main offices in the United States, and which dominate the international market for oilwell drilling mud. These companies, highly specialized, furnish services to drilling operations all over the world, barite being one of the many chemicals and minerals supplied for making drilling mud.

On an international scale, the prevailing suppliers are "Baroid Division of the National Lead Co" (which was the pioneer to introduce barites in drilling mud); "Dresser Industries Inc's Magcobar Division" (although an important part of this business is taken by "IMC Drilling Mud Inc"); "Milchem Inc"; "Barium Supply Co.", and two or three additional companies of lesser importance. Since the unit value of barite is very low and cannot absorb, consequently, the cost of transportation for long distances, even by sea, the suppliers of drilling mud products have to face a number of problems such as finding and developing economically exploitable barite deposits near the main consumption centers, maintaining low extraction and transportation costs and ensuring themselves of satisfactory reserves to ensure continuity of supply within an advantageous range of prices.

The most important producer in Brazil is Pigmina, S.A. (Pigmentos Minerais Industrial e Comercial, S.A.), an affiliate of Baroid with crushing plants in both Trinidad and Venezuela. The crude barite from Pigmina is sent to these plants and, occasionally to the Baroid crushing plants in the United States. A small quantity is also supplied to Petroleo Brasileiro S.A. (Petrobas), a Brazilian oil company. The main factor in deciding on the exploitation of the deposits at Camamú Bay was that the milling plant could be located by deep water, which allows low loading and transportation costs.

Taking into account the special circumstances involved in the use of barites in Brazil and other countries of the world, an acceptable forecast of demand for the forthcoming years cannot be made, since the probable usage in other consuming areas has no importance percentagewise when compared with the leading market which the petroleum industry continues to be

D.6.1.3. The market for chemical barium derivatives

D.6.1.3.1. General

In addition to being used as a component for drilling mud and, to a smaller proportion, as a filler and body in the paint, rubber, floor covering, and brake lining industries etc., and as a flux, oxidiser and clarifier in the glass industry, barite is a raw material for the fabrication of various barium salts used in the industry, specially heavy white for the fabrication of lithopone (a mixture of $BaSO_4$ and $ZnSO_4$), white pigment for paints, barium carbonate (glass and television industries) and barium chloride (steel hardening, smelting of metallic magnesium and for water treatment).

The few data available on the market for barium salts in Brasil are shown in Tables BA-4 to BA-6.

Production of lithopone is practically nonexistent in Brasil, and the domestic market is being supplied with imports. Data in Table BA-4 show that the importance of this product has decreaeed greatly among imports as a whole, both in quantity and value, because of the growing tendency of the paint industry to subetitute for it titanium oxide which has a covering power four to five times greater, althourgh it is three times more expensive.

The consumption fo barium carbonate has greatly increased over the last 12 years as shown by Table BA-5, at an average yearly rate of 36%. The projections of consumption in the forthcoming years show tendencies toward stabilisation, and the manufacturers of this product in Brasil agree on the probability of an average growth rate of 18% over the period 1.970-1.975, which would correspond to half the yearly average of 1.958-1.969.

According to this forecast the consumption probably would be as follows:

Year	Metric tons
1.970	6,580
1.971	7,768
1.972	9,166
1.973	10,816
1.974	12,763
1.975	15,060

Finally, barium chloride has experienced increasing imports over the last six years, as can be seen from Table Ba-6. We have no data on the production of this salt in Brasil, but estimate that the currently installed capacity is near 1,600 tons/year, in accordance with oral reports received from the two manufacturers. Because of the lack of historical data on apparent consumption, it is impossible to establish an acceptable demand projection for the forthcoming years.

D.6.1.3.2. Regional market distribution

Although statistical data on barium consumption in the various states of Brazil are not available, the barium processors estimate that the user market shows the following over all structure;

- Sao Paulo State	85% of sales
- Guanabara State	5% of sales
- Rio Grade do Sul State	5% of sales
- Others combined	5% of sales
	100% of sales

D.6.2. MINING

D.6.2.1. Deposits

The main deposit being worked in Bahia State is located in the Camamú Islands. Almost all the ore is intended for the preparation of drilling mud. Its characteristics are described on the attached card.

Another deposit whose operation has begun is Altamira, where the mineral is intended for the chemical industry. Its characteristics are also described on the attached cards.

There is a great number of deposits, which are either in operation or pending approval of their operational permits. The following may be mentioned:

- Distric of Remedios in Ibitiara. It seems to have a reserve of 1,4 x 10^6 tons, with surface impurities of specular hematite.
- Region of Contendas of Soncorá.
  On the railway right of way, with a reserve of several hundred thousand tons.
- Region of Macaubas.
  With good deposits already claimed.
- Region of Seabra.
- Region of Itapura, 30 km from Jacobina; it seems to have a reserve of 1,8 x 10^6 tons.

D.6.2.2. Cards and maps

The essential data on the deposits of Camamú and Altamira, which were visited, are compiled on the attached cards, and the map identifies them in Bahia State.

Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Ba

Master Plan Identification

Name of Mine CAMANU (Ilha Pequenha de Camamú)
TUPU AND PRINCIPAN (Ilha Grande de Camamú)

Owner Pigmentos Minerais Industrial e Comercial (PIGMINA S.A.)
Miguel Calmon 19, 11º And. Salvador (2º).

Geographical Location

In Camamú Islands, separated 150 m in their shortest distance and situated on the Northern way out of Camamú Bay, 1 h 20 m far from the town of the name in a motor-boat journey. This town is 270 km far from Salvador, by road, and 120 km far from Salvador to the SSW, in a direct flight.

Coordenates

X = 38º 57' N

Y = 13º 51' S

Z = 0/30 m

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  Barite deposits of Camamú Bay, State of Bahia, Brazil U.S.G.S. Bull 960 - A, Washington 1948.

- DINIZ, X.

  Mineraçao
  Introductory redaction. Recife 1970

- ROBERTO CRUZ, P.; LEWIS Jr., R.W.; RODRIGUES DA SILVA U

  Localidades minerais do Estado do Bahia (Projetc Bahia) In preparation

- PIGMINA S.A.

  Relatorio Anual da Lavra 1965/69
  Verbal information 1971

- DIRECT INFORMATION 1971

Geological Description

The orebody has been formed by hydrothermal sybstitution of mesozoic sandstones or of arkosic limestones.

The orebody is covered by a layer of clay and lime up to 20 m thick, locally denuded by erosion that has eliminated locally the ore.

The mineralized zone, submarine in part, covers an area of about 2,5 x 1 km.

Ore Body Geomorphological Description

The orebody appears in a stratiform morphology, in an anticlinal position in the islands (sinclinal in the intermediate marine area).

In Ilha Grande, the anticlinal axis is about 1.500 m long.

The mineralized body is 5 m thick in some parts of it and its exploitation is economic from a thickness of 1 m aprox.

Topographical and Climatical Description

The island present an smooth morpholocy in the direction N - S, more rugged in the direction E - W.

During the rainy season, the stripping of steriles and the working of ore discontinued, bu stockpiling has been provided in order to supply the processing plant.

INVESTIGATIONS

Chemical Analyses

$SO_4Ba \simeq 94.5\%$ (as a function of its iron contents)

Specific gravity: 4.5 (min.). It complies with the OCMA specifications.

According Froes de Abreu: 96.1% SO_4Ba; 0.6% SiO_2; Fe_2O_3 0.8%; calcination losses 1,5%.

Geological Studies

No available.

Geophysical Survey

No geophysical surveys have been done.

Geochemical Survey

No geochemical surveys have been done

Investigation of Bore Holes Pits and Galleries

The tractor stripping employed as a preparation for exploitation complemented with handmade exploratory pits, in order to determine the thickness of the sterile layer (2,000 m in 1968 in Camamú Mine) are the exploratory works that enable to make a gradual cubage of reserves.

Pilot Plant

Data not available.

Investigations and Studies Proposed

No other investigations are recommended unles the market demand might increase.

If the said demand would increase, a gravimetric study would be advisable, in order to determine the areas of a maximum baryte content.

MINERAL RESOURCES

Resources description

The total of reserves could be estimated in more than 1.10^6 t (there is not, however, a very clear notion).

According to the mining reports, the reserves are as follows:

	Camamú (1969)	Tupu (1967)	Principal (1968)
Verified Tonnage	187.000 t	3.284 t	36.856 t
Probable Tonnage	100.000 t		60.000 t
Possible Tonnage	100.000 t		

TECHNICAL TABLE

Description of Explotation Methods

The exploitation was started 25 years ago. It is an open pit exploitation, stripping the sterile by tractors and excavators. The orebody is broken through bores charged with dynamite (previosly bored with neumatic hammers), and with the help of excavators the ores are loaded and hauled in EUCLID trucks to the processing plant, at the North of Ilha Grande.

For the next [illegible] years the exploitation will be concentrated in Ilha Pequena, with the purpose of transfering the whole of the ores to the processing plant (Ilha Grande) before than the bridge joining the two islands might be affected by corrosion.

Mining Extraction Tonnage

Data not available.

Concentration or Process Method Description

For the physical separation of a part of lime impurities, a washing plant is employed.

So, after breaking the ore in crushers, it is passed to a counter-current washing operation (in a trough with transfer by helical screw), with a flow of sea-water of 600 l/min., returned to the sea. The final grade is a 96% of SO_4Ba.

The bulk ore is previously piled up before being taken aboard of ships, but the one provided to be sold as a powder is transferred to a vertical kiln, heated by fuel-oil, subsequently to a mill and, finally, filled into sacks. Sometimes, it is put on board directly in powder form.

An additives plant is being built, fundamentally for the ore sold to Petrobras.

During the washing step a reduction of a 30% takes place (muds).

Tonnage, Concentrated or Processed

Year	1965	1966	1967	1968	1969	1970
Export (M.T.)	22.086	54.864	48.980	24.584	?	18.292
Domestic Market (M.T.)	7.386	10.477	8.426	8.690	?	6.188
Total	29.472	65.341	57.406	33.274	37.102	24.480

Description of Transport Methods to Metallurgical Factory or Sales Destination

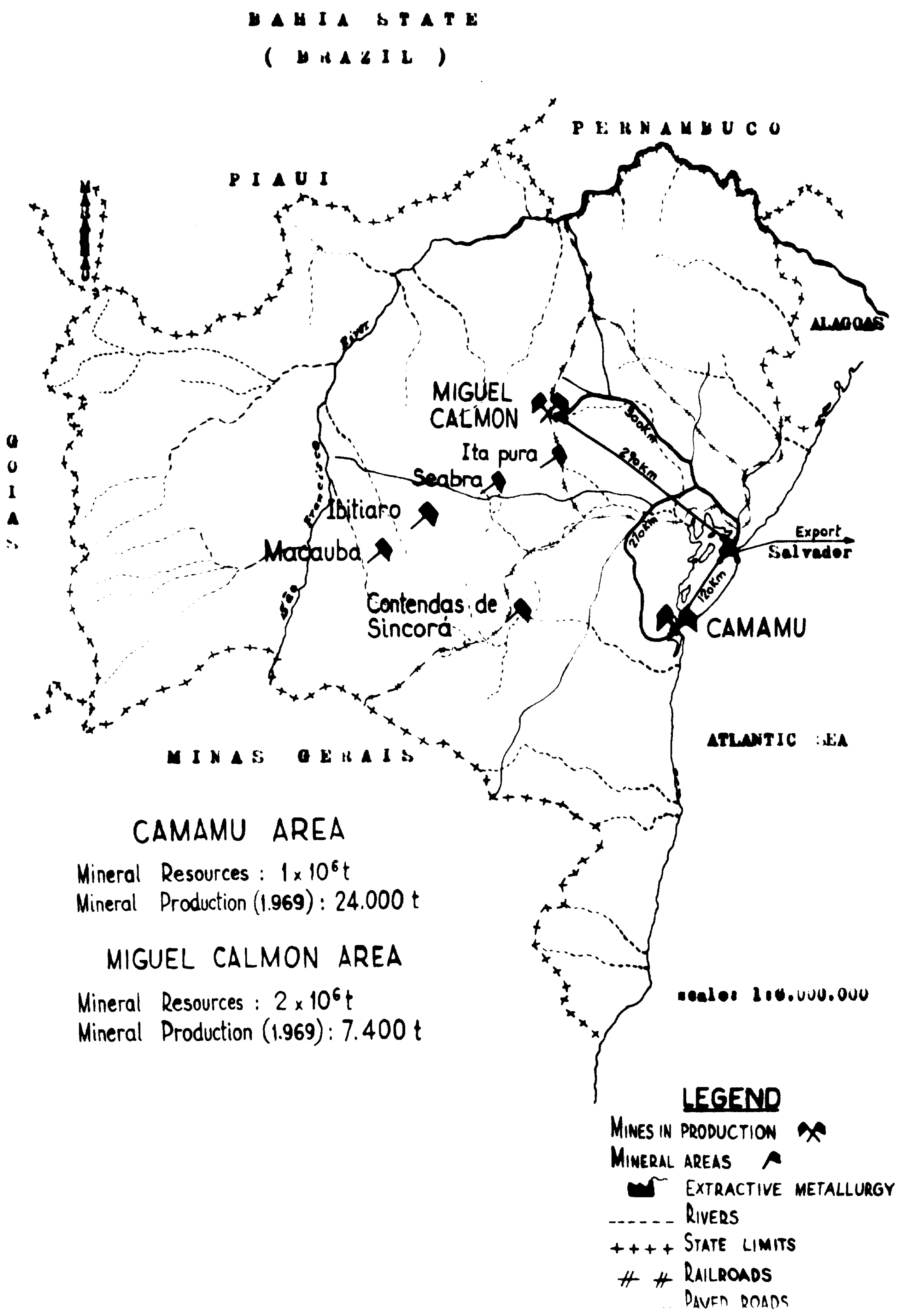
Up to the processing plant (less than 2 km from Ilha Pequeña and less than 1,5 km from Ilha Grande), the ore is hauled in EUCLID trucks. A bridge 150 m long joining both islands has been built (the exploitation of Ilha Pequeña was then started in 1970).

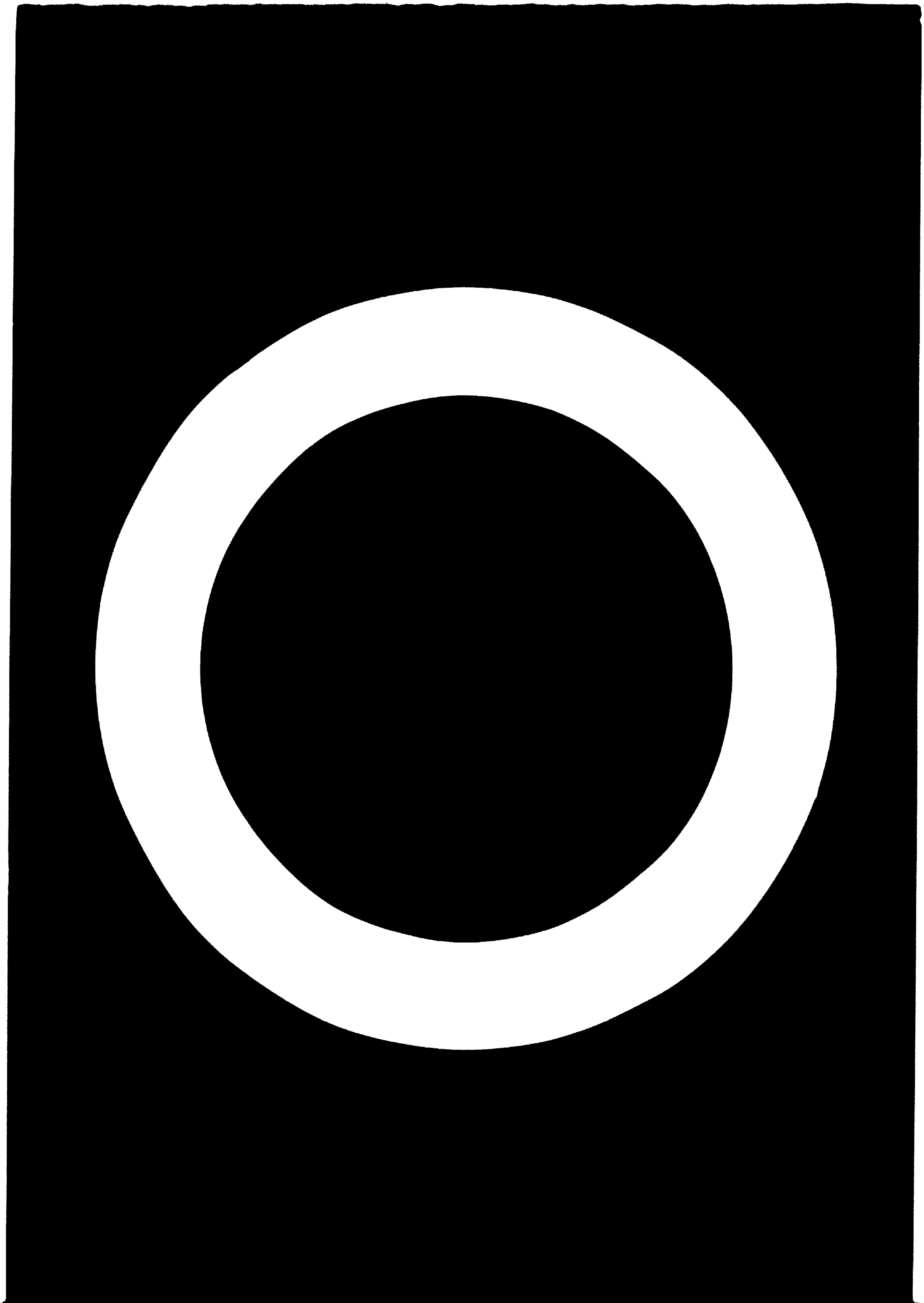
From the processing plant to the loading dock it is transported by conveyors (150-200 m).

The transport is made on ships with a loading capacity of 6,000 t (12.000 t ships could equally approach to the pier).

The ore is generally exported in bulk (Trinidad, Venezuela, USA, Argentine), and the ore supplied to the domestic market (Petrobras and others) is transported on 7 sailers to the ports of Sao Roque and Salvador.

BARYTE


BAHIA STATE
(BRAZIL)
PERNAMBUCO
PIAUI
ALAGOAS
GOIAS
MINAS GERAIS
ATLANTIC
MIGUEL CALMON
Ita pura
Seabra
Ibitiara
Macaúba
Contendas de Sincorá
CAMAMU
Export
Salvador
300Km
270Km
270Km
120Km
CAMAMU AREA
Mineral Resources : 1 x 10⁶ t
Mineral Production (1.969) : 24.000 t
MIGUEL CALMON AREA
Mineral Resources : 2 x 10⁶ t
Mineral Production (1.969): 7.400 t
LEGEND
MINES IN PRODUCTION
MINERAL AREAS
EXTRACTIVE METALLURGY
RIVERS
STATE LIMITS
RAILROADS
PAVED ROADS



MISCELLANEOUS

Personnel (Technicians and Workers)

A total of [illegible] men are working, with techniciens trained "in situ" (55 men doing productive labor and 11 persons devoted to administrative work).

It is a stabilized man-power, with a very high receptive capacity in its training.

Machinery

1 tractor D.7, Caterpillar; 1 transcavator (2 yards); 1 excavo-elevator Hough (2 yards); 1 excavator Bucyrus Erie 22 B (3/4 yards); 6 Euclid trck 1 UD (12 t); 1 Euclid truck R-13 (12 t), 3 air-compressors (350 cm/min, in total); 1 universal crusher 14" x 24"; 1 Symons crusher Cone 36"; 1 Raymond mill, 5 rolls 50" Ø; 1 hammer mill 607 Prater; 1 mixer.

Water Supply

The washing plant is suplied with sea-water (600 1/min) which is directly returned together with lime and sand in suspension (no additive are used).

For human consumption, water coming from the subsoil is available, without any apparent problem as far as it concerns to quality.

Power Supply

3 generators of 75 Kw each and 1 generator GM of 44 KW (a total of 269 KW) constitute its own powersupply.

The average annual consumption are 315,000 KWh.

Other Supplies (Fuel, oil, explosives, wood ....)

Fuel supply is made directly by Petrobras, from ships. (Diesel-oil: 480,000 1/year).

Dupont Explosives (40%): 4,000 kg/year.

REMARKS

The available information at the mine was rather incomplete and its completion has not been possible even after ulterior visits to main Office at Salvador.

Client: U.N.I.D.O.	Consulting Firm. TECNIBERIA	

Study of the possibilities for development of **DATA CARD**
METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral
Ba

Name of Mine
ALTAMIRA

Master Plan Identification

Owner
Mineraçao Itaitú, Ltda.

Geographical Location

Fazenda Altamira. District of Itapura. Municipality of Miguel Calmon. At a distance of 300 km from Salvador by road, and 290 km to the NW of Salvador, in direct flight.

Coordenates

X = 40º 31' W
Y = 11º 24' S
Z = m

Bibliography and References

- IACOB, K

  A brief sketch of the mineral resources of Bahia, Recife, 1962
- MINERAÇAO ITAITU

  Relatorio Anual de Lavra (1968/69)

Geological Description

The ore appears crystallized in big crystals, frequently translucid, white, colourless, rosy; with a characteristic brightnes or milky white.

The impurities are formed by quartzites (an intermingled body of crown quartzites and wall quartzites), and by inclusions of quartzite nodules and interstitial iron hydroxide.

Ore Body Geomorphological Description

The barytine presents itself in ledes and round stones, the latter coming from the same.

Topographical and Climatical Description

INVESTIGATIONS

Chemical Analyses

The ore grade "in natura" is variable between 80% and 93% of SO_4Ba. I's density amounts to 4,2.

According to the mining reports, the ore gives the following anlysis; 97,8% SO_4Ba; 0,7% SiO_2; 0,4% Fe_2O_3.

Geological Studies

Data not available.

Geophysical Survey

No geophysical surveys have been made.

Geochemical Survey

No geochemical surveys have been made .

Investigation of Bore Holes Pits and Galleries

Data not available.

Pilot Plant

Data not available.

Investigations and Studies Proposed

None

MINERAL RESOURCES

Resources description

According to JACOB's data, there are more than 2×10^6 t.

Verified Tonnage

Data not available

Probable Tonnage

$1,4 \times 10^6$ according to mining reports

Possible Tonnage

Data not available

VII. COST AND SELLING PRICES

As has been shown, the selling price has available the following margins:

1. For orders lower than 50 tons: 30%
2. For made-to-measure cuts: 12 to 20%
3. For special cuts: variable margins according to sheet utilisation

The above provide for an ample margin which is not - easy to evaluate here since the factors which must be considered in the cost are:

- Cutoffs
- Electric power, lubrication, etc.
- Personnel
- General expenses
- Amortisations and other costs

The determination of these factors depends on the rate of utilisation of the cutting capacity of each installation.

One shearing line operating at full capacity, from which data have been taken, has a cost of 170 Cr/t over the purchase pri- ce of the coil.

The basic price of the strip in 5/2/71 was:

- Cold rolled coil: 905 Cr/t
- Hot rolled coil: 682 Cr/t

MISCELLANEOUS

Personnel (Technicians and Workers)

An average of 10 men. Specialized man-power is not available.

Machinery

Data not available.

Water Supply

Data not available

Power Supply

Data not available.

Other Supplies (Fuel, oil, explosives, wood....)

Data not available

REMARKS

This mine has not been visited. All information has been gathered through DNPM (National Department of Mineral Production).

Client: U.N.I.D.O	Consulting Firm. TECNIBERIA	

D.6.3. BARIUM DERIVATIVES INDUSTRY

D.6.3.1. Organization of production

The production of barium salts is concentrated at present in three companies: two of them situated in Guanabara State (Quimica Geral do Brasil, S.A. and Naegeli, S.A.), and the third in Sao Paulo (Usina Colombina, S.A.).

Usina Colombina, S.A. manufactures and imports a wide range of chemicals, especially barium chloride and barium carbonate, zinc sulphate, aluminium sulphate and zinc chloride.

The plant is situated in San Caetano do Sul and has a capacity for the combined production of barium carbonate and barium chloride of some 120 tons/month, with a staff of 150 people (technicians and operators).

Naegeli, S.A. makes, among other chemicals, sodium sulphite, used for textile dyes. Barium chloride is obtained as a by-product. The company has a capacity of 100 tons/month and 140 laborers working at the plant. Naegeli, S.A. is a subsidiary company of Martin Marietta Corp., U.S.A.

Quimica Geral do Brasil, S.A., started up in 1.965, and its production includes barium carbonate, sodium sulphite, barium chloride, barium sulphite (black ash) and crushed barite. Barium carbonate is the main production, having reached 1,800 tons in 1.970.

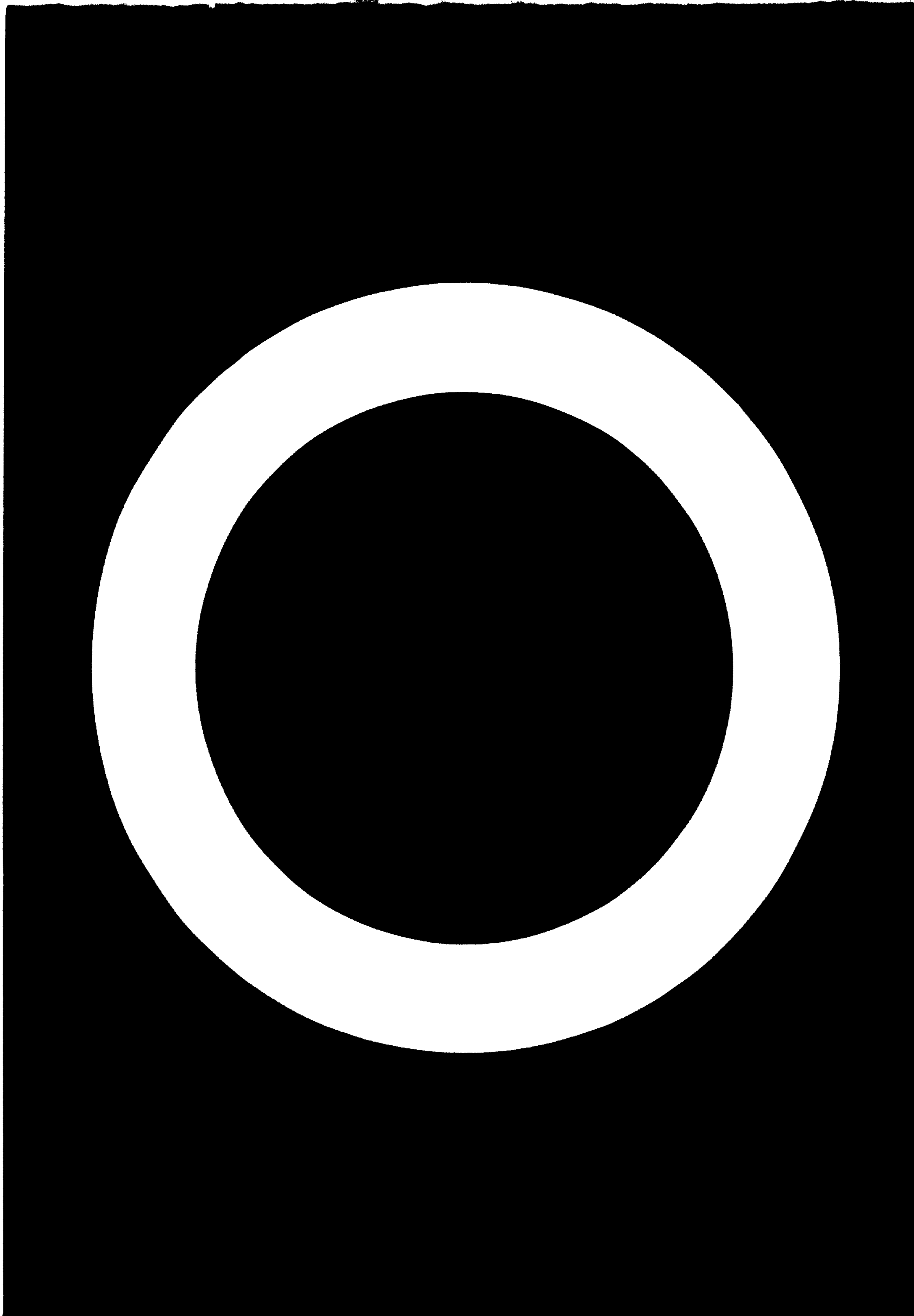
D.6.3.2. Expansion plans

The only company contemplating important expansion plans in the next few years is Quimica Geral do Brasil S.A., which has submitted a project to the Advisory Council of Sudene for the erection of a new plant in Feira de Santana (Bahia) under the firm name of "Quimica Geral do Nordeste, S.A." for the manufacture of the following chemicals:

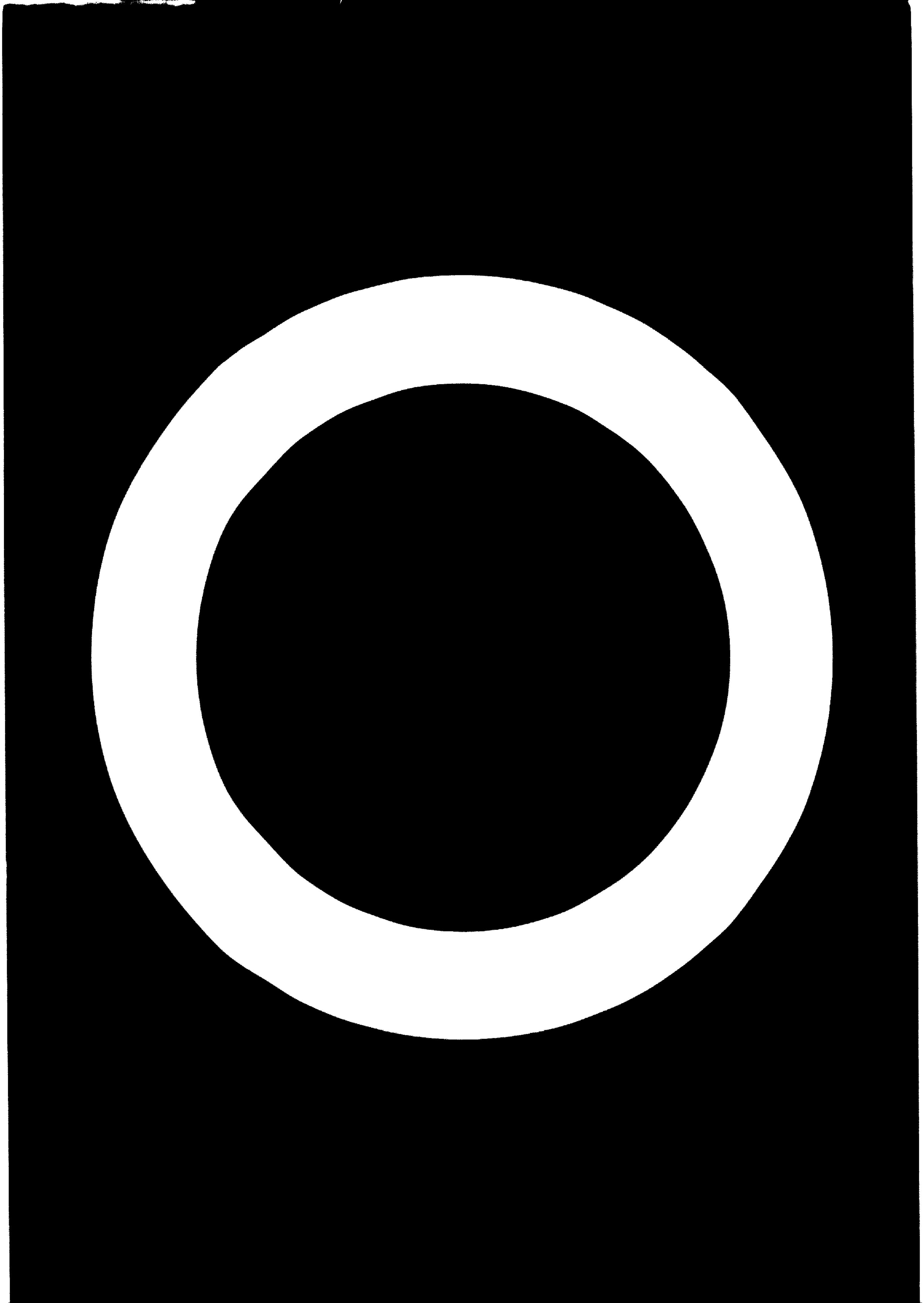
- Barium carbonate .... 12,000 tons/year
- Barium chloride .... 1,200 tons/year
- Barium sulphite .... 600 tons/year
- Sodium sulphite .... 4,550 tons/year
- Ground barites .... 7,000 tons/year

This production will involve a comparatively important consumption of barites from Bahia, in the order of 30,000 tons/year.

The plant is scheduled for starting operation in 1 973, and the investment is in the order of $ 3 million, U.S.



D.7. MAGNESITE



D.7.1. MARKET STUDY

D.7.1.1. Historical background

The State of Bahía is the most important magnesite producer in the country, as was the case for baritine. Its relative importance has been increasingly growing during the last years until reaching a 97% of the total domestic production, as it is shown in Table Mg-1.

Such a production, very much in excess of the Brasilian needs, has permitted the export of an increasing tonnage from 1.968 of dead burned magnesite to different european and south-american markets (to Argentine, fundamentally). In Table Mg-2 these export are shown, on the basis of data available - from the Statistical Yearbook of Brazil and other data provided by the most important refractory products manufacturer in the country (Magnesita, S.A.), owner of the main magnesite orebodies in the State of Bahía.

D.7.1.2. Demand's forecasts

Magnesite is the raw material that is used to produce magnesian sinter (dead burned magnesite) employed in the manufacture of basic refractories. The magnesian sinter market is, in fact, identified with the basic refractories market, whose trend may be analyzed on the basis of the steel industry behaviour. This argument is based on the fact that the Brazilian - steel industry consumes about 70% of the basic refractories produced in the country, being supplied the rest of the output to other metallurgical, cement, ceramic, textiles, etc. industries.

Consequently, the future production of steel in Brasil, must be the starting point to study the probable demand of magnesite.

According to the steel consumption figures estimated by the National Steel Plan published by the Ministry of Commerce and Industry 1.967, supposing a consumption of 5 kg. of basic refractories per ton of ingot steel produced and that each kilo of magnesian refractory requires 1,5 kg. of sinter, the Table Mg-3 has been stablished summarizing the refractories and magnesian sinter needs in Brazil for the period 1.970/1.975, estimated on the basis of the specific consumptions and industrial sectorial distribution above mentioned.

D.7.1.3. Balance between the estimated demand and the offer

The extension plans anticipated by the two most important enterprises in Brazil, processing magnesian sinter and refractory materials, show important increases in their outputs for the inmediate next years. According to these extension plans, given in detail in the heading D.7.4.3., the Table Mg-4 has been established as a comparison between the estimated demand for 1.970/1.975 and the offer.

From the Table can be inferred that in the inmediate next years the production will be in excess on the domestic estimated demand. This balance will be used to fulfil the export plans of magnesian sinter to the european and american markets of this product, with a very promising once the newly erected roasting plants and others in project will guarantee a very high quality sinter (with a specific weight higher than 3.2.).

The magnesian sinter export market has already achieved in Brazil a certain tradition, specially from 1.965 on, just as it is shown in Table Mg-2.

A considerable increase in exports is foreseen in the plans for 1.971 and following years, with figures of the order of 40.000 - 45.000 t/year, to be fundamentally exported to Europe and Argentine. In the 1.970/1.971 campaign the exports will be destined to the following countries: Spain (7.800 t.), - Italy (5.000 t.), Germany (2.000 t.), France (2.800 t.), England (7.000 t.), Belgium (7.000 t.) and Argentine (7.000 t.).

The prices may vary according to qualities, between US $ 50 and US $ 60/ton, FOB Salvador (Bahía).

D.7.1.4. The market regional distribution

According to the data made available to us by Magnesita S.A., the refractories (basic and of other types) regional market distribution was in 1.970 the following:

State	Billings (per cent)
Rio de Janeiro	40,4
Minas Gerais	25,5
Sao Paulo	16,0
Branabara	10,6
Paraná/S. Catarina	1,1
Pernambuco	2,7
Rio G. do Sul	2,6
Bahía	1,1
- Total	100,0

The above distribution brings out the consuming importance of the steel industry in the State of Rio de Janeiro (Barra-Mansa and Volta Redonda).

D. 7. 2. MINING

D. 7. 2. 1. Orebodies

The most important magnesite orebody in Brazil, and one of the most important in the world, is Brumado's (Serra das Eguas); its characteristics are described in the attached data card.

Sento Se (Castella) is another of the orebodies in exploitation in the State of Bahia; its characteristics are equally described in an attached data card.

According to verbal references, it is possible the existence of an important orebody in an area between Brumado and Sento Se.

D. 7. 2. 2. Data cards and maps

The available data on the visited Brumado and Santo Se orebodies have been sumarised in the annexed data cards. Their geographical situation within the State of Bahía is indicated in the attached map, together with other complementary data of interest.

Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Mg

Name of Mine
CASTELLA

Master Plan Identification

Owner Companhia de Mineraçao e Agricultura do Sao Francisco (COMINAG).
Rua Miguel Calmon 459 S/506. Salvador, Bahia (Brazil)

Geographical Location

Fazenda Castella, District of Americo Alves, Municipality of Sento Sé (at a distance of 73 km, of Sento Sé town, up-stream Sao Francisco River). At a distance of some 615 km from Salvador, by road, and 510 km to the North-West to Salvador, in direct flight.

Coordenates

X = 41º 50' W
Y = 9º 46' S
Z = 500 m aprox.

Bibliography and References

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  Recursos Minerais do Brasil, (page 302)
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- ROBERTO CRUZ, P.; LEWIS Jr., R.W.; RODRIGUES DA SILVA, U.
  Localidades Minerais do Estado da Bahia (Projeto Bahia) (In preparation).
- COMINAG
  Relatorio Anual de Lavra (1965/69)
  Verbal Information (1971)
- DIRECT INFORMATION (1971)

Geological Description

Ore formed by hydrothermal substitution of limestones belonging to the Bambui group, embedded in dolomite.

Ore Body Geomorphological Description

The ore is distributed into three beds with a dip of 45º: "Camada" J, 1,300 m in length and 300 m thick, "Camada" J_2, 600 m in length and 600 m in cross section, "Camada" 3, formed by several pods.

Topographical and Climatical Description

Tough exploitation area and with dry climate.

INVESTIGATIONS

Chemical Analyses

The average analysis in 1969 (Relatorio de Lavra) were: Mined ore: Fire losses, [illegible]1,20%. Residual was MgO, [illegible].10%; SiO_2, 0,35%; Al_2O_3, 0,6%; Fe_2O_3, 4,35%; MgO_2; 0,6%; CaO 1,8%.

Geological Studies

Surface geological studies have been carried out, with a systematic sampling network in order to delimitate the different beds. The geological investigations are being pursued.

Geophysical Survey

No geophysical survey has been carried out.

Geochemical Survey

No geochemical survey has been carried out.

Investigation of Bore Holes Pits and Galleries

Only an exploration gallery in bed J_1 and the sampling in the surface network have been made.

Pilot Plant

No pilot plant studies have been made.

Investigations and Studies Proposed

The geological investigation is considered insufficient; it is recommended to proceed to a general survey, with the aim of discovering other masses, and to an investigation by boring in order to assess the cubage of the ones already known, and to a study on the variation of grades in the ore mass (specially Fe).

MINERAL RESOURCES

Resources description

According to the estimation made by the resident engineer, they can reach the figure of $60,0 \times 10^6$ of ore, evenly distributed in the three beds.

According to the mining reports, the reserves are distributed in the following manner (1969):

Verified Tonnage

13×10^6 t

Probable Tonnage

3×10^6 t

Possible Tonnage

$35,3 \times 10^6$ t

TECHNICAL TABLE

Description of Explotation Methods

The exploitation is only carried through in bed [illegible], in open pit. The absence of an overburden makes easier the ore stripping, but the surface configuration, considerably irregular (fissures, channels, crevices) having its origin in the carbonates solution, makes more problematic the opening on faces. During our visit, the topographical conditions were good enough to employ pneumatic compressors (250 c ft/min) operating four hammers ([illegible] kg) to make 4 m bores to be loaded with Dupont explosives and electrical detonators.

After the manual picking up of mineral, a 10% waste is carried to the waste heaps (sometimes a 30%). It is fundamentally formed by the dolomite and talc fractions.

The total of ore digged out from the beginning of the explotation in 1964, can be estimated in 180.[illegible] t.

The raw ore cost (1969) was 16,58 NCr/t.

Mining Extraction Tonnage

Year	1965	1966	1967	1968	1969
Ore Production (t)	16,009	26,323	16,009	19,71[illegible]	25,691

Concentration or Process Method Description

The calcination is carried through in 10 intermittent, circular, vault kilns, built with common bricks and lined with refractory bricks. 8 of the kilns present an inner diameter of 6 m, 2 doors and 4 hearths, with a capacity of 36 tons of caustic magnesite. The other 2 present an inner diameter of 7 m, [illegible] doors and 6 hearths, and a capacity of 50 t of caustic magnesite.

The kiln loading is made by hand, and wood is used as combustible (2,6 m³ of wood per ton of caustic magnesite produced). The temperature is 900ºC. The calcination cycle lasts for 105 hours, and the average total cycle is 9 days.

After being picked up by hand and filled into 60 kg sacks it is stored.

During the calcination process a reduction of about a 50% in weight takes place.

The present output is 1.500 t of calcined magnesite per month.

The total cost in 1969 was 1[illegible]1,56 NCr/t of worked ore.

Tonnage, Concentrated or Processed

Year	1965	1966	1967	1968	1969
Ore production (t)	8,004	12,489	7,657	9,904	9,952

Description of Transport Methods to Metallurgical Factory or Sales Destination

The ore is transported from the mine to the silos in trucks, in buckets. Buckects and tilting trucks are employed to transport it from the silos to the kilns (16 km).

The calcined magnesite is tranported to Sao Paulo (SP) in two different ways; either up-stream Sao Francisco River, with loading depends on de river level, up to Pirapora (MG), a journey of 1,300 km. The transport is then continued by railway to Sao Paulo (Ceramica Sao Caetano).

The other means of transport employs motor-ships or sailing ships up to Juaceiro; from this place, it is transported by trucks to Sao Paulo.

The transport represents an important over charge on the ore's price.

The selling price (1969) is 168 NCr/t of worked ore.

MISCELLANEOUS

Personnel (Technicians and Workers)

The man-power is distributed in the following manner

Annual average	1965	1966	1967	1968	1969	1970
In mine			40	2	14	
Ore working	67	110	88	72	78	
Auxil. serv. and admin.			140	111	90	
Total			268	205	182	≃ 230

Machinery

Water Supply

The water is taken from Sao Francisco River, in the proximity of the metallurgical factory.

Power Supply

5 generator sets, with a total of 180 KVA, are available.

Other Supplies (Fuel, oil, explosives, wood....)

Fuel and explosives are shipped from Juazeiro

Wood for the kilns comes from the zone itself.

REMARKS

It has been foreseen, with SUDENE's help, an increse in output in calcinated magnesia up to 4.000 t/month, in a period of two years, with fuel-oil kilns, capable of performing a sintering operation at 1.350º C.

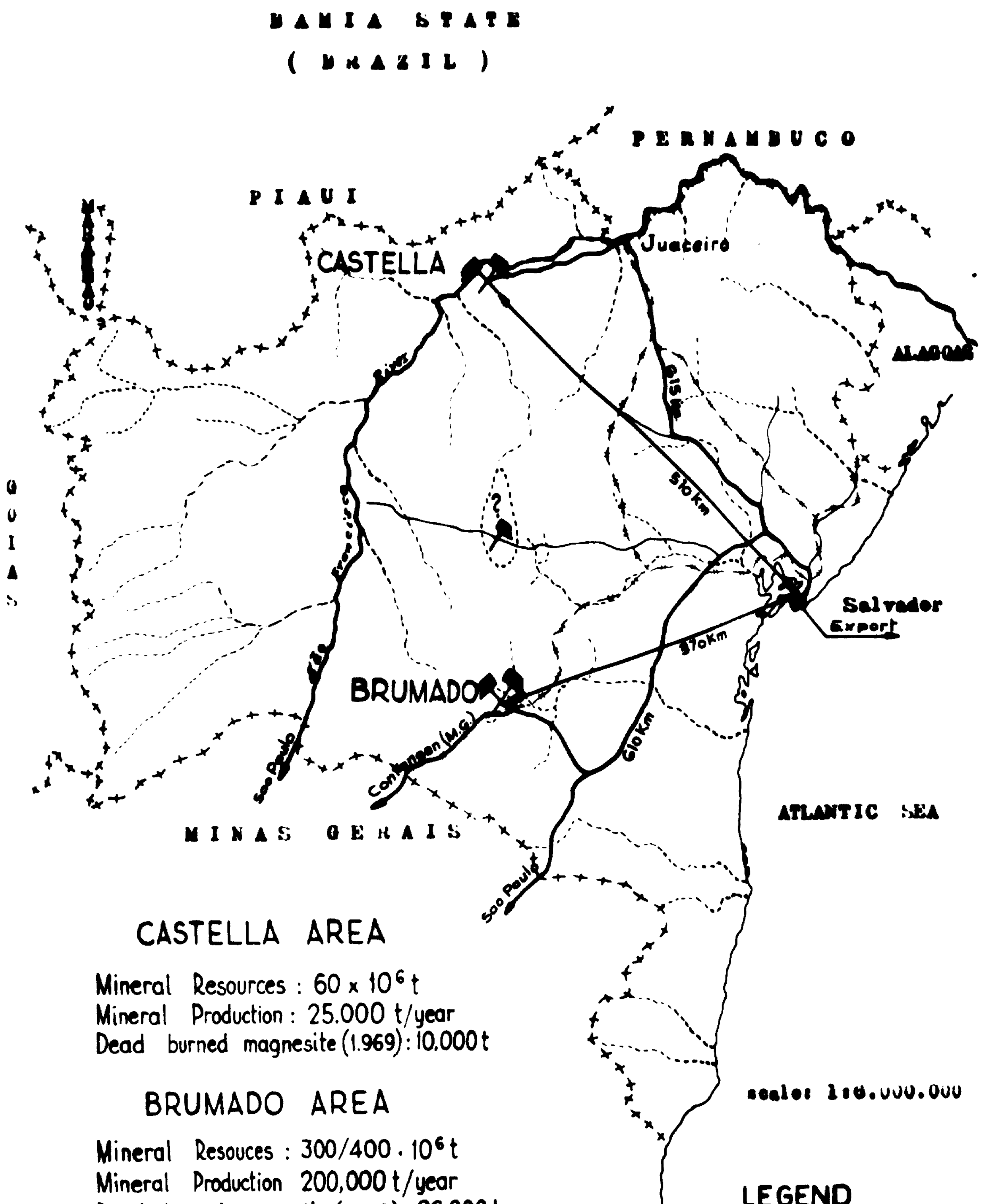
The most important problem presented by the ore in exploitation is its high contents in iron, with an impoverishement of quality in the refractories.

A series of improvements in Juazeiro-Castella road are being in roduced. They will make easier the transport of supplies to the mine and the way out of ore. The works are being carried out as a consequence of an agreement between DERBA and COMINAG.

Client: U.N.I.D.O.

Consulting Firm TECNIBERIA

MAGNESITE



CASTELLA AREA

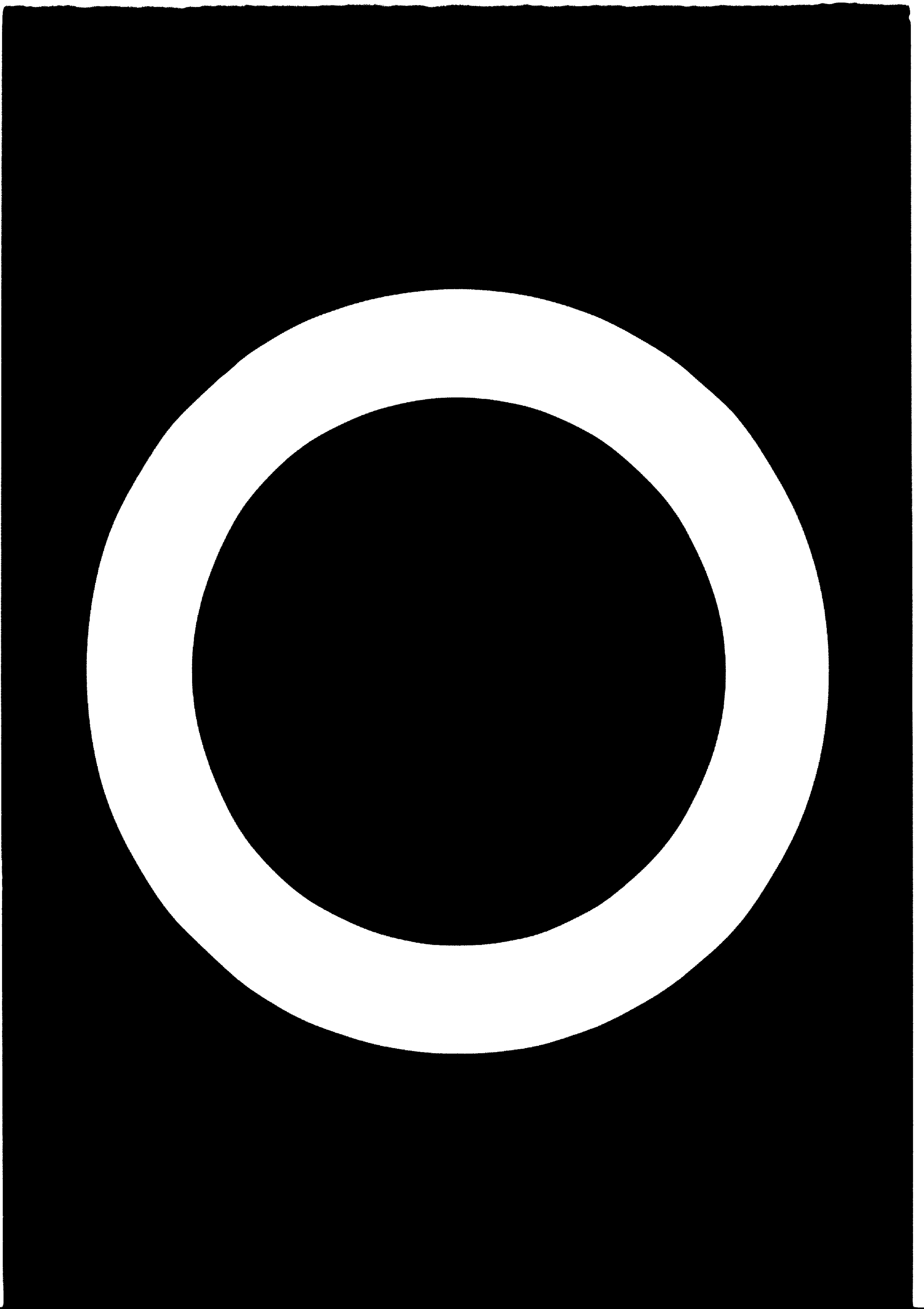
Mineral Resources : 60 x 10^6 t
Mineral Production : 25.000 t/year
Dead burned magnesite (1.969) : 10.000 t

BRUMADO AREA

Mineral Resouces : 300/400 . 10^6 t
Mineral Production 200,000 t/year
Dead burned magnesite (1.969) : 96.000 t

LEGEND

Mines in production
Mineral areas
Extractive metallurgy
Rivers
State limits
Railroads
Paved roads



Study of the possibilities for development of **DATA CARD**

METALURGICAL INDUSTRIES IN BAHIA (BRAZIL)

Mineral: Mg

Name of Mine Baía-Pe; Boa Vista; Cabeceiras; Catiboaba; Cordeiros-Tamboril; Covil das Oncas; Fabrica; Gravatá; Pedra Rodada; Piraié; Salgada; Sao Lourenco.

Master Plan Identification

Owner
Magnesita S.A. Praça Louis Ensch. 240. Belo Horizonte (MG)

Geographical Location

The different mines are situated along the Serra das Equas, District of Brumado, at a distance of about 610 km from Salvador, by road, and 270 km to the West-Southeast of Salvador, in direct flight. (Catiboaba is at a distance of 9 km from Brumado).

Coordenates

X = 41º 43' W
Y = 14º 12' E
Z = 500/700 m

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- BODENLOS, A.J.

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- ROBERTO CRUZ, P; LEWIS Jr. R. W; RODRIGUES DA SILVA, U.

  Localidades minerais do Estado de Bahia (Projeto Bahia) (In Preparation)

- MAGNESITA S.A.

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Geological Description

The Serra das Equas, where the set of mines is located, shows a series of ocurrences of gneiss, quartzite, amphybolite, amphybolschist, dolomite and the magnesite-talc complex.

The magnesite is phaneritic in texture, with perfectly differenciated grains, red-flesh in colour, red-ash, grey, white, varying as a function of the iron content. In other mines, it is fine-grained, sometimes sacharoiceous.

The mineral has been formed by hidrothermal substitution of dolomites belonging to the Precambrian C, and there are traces of a neumatolithic action.

Ore Body Geomorphological Description

The mineral presents itself in big masses, associated to the sedimentary dolomite

Topographical and Climatical Description

The most part of the mines are located at the sides or in the interior ravines of the Serra das Equas.

INVESTIGATIONS

Chemical Analyses

The average analysis of Pedra Preta Mine (the most important in production) in 1969 was: Fire losses 50,69% MgO 44,94%; SiO_2 1,01%; Al_2O_3 0,48%; Fe_2O_3 1,50%; MnO 0,8%; CaO 0,60%. Other analyses may be found at the end of this card.

Geological Studies

Data not available.

Geophysical Survey

Data not available.

Geochemical Survey

No geochemical survey has been made

Investigation of Bore Holes Pits and Galleries

In Pedra Preta Mine exploratory and cubage boreholes have been made. with core anlysis (7 in 1967, with a total of 736,91 m)

Pits and boreholes have also been carried out in Gravatá (1969) and Fabrica Mines (1969)

Pilot Plant

A pilot plant is in operation with the aim of fixing up the line of future use of ores with a granulometry < 4" ("cascalho").

Investigations and Studies Proposed

None

MINERAL RESOURCES

Resources description

The available reserves, according to the most recent data provided by Magnesita S.A., can be estimated, in Petra Preta, in 100 x 10^6 t., and in the total of mines, in 300/400 x 10^6 t.

According to the mining reports (1969), the reserves are as follows:

	Pedra Preta Mmine	Other mines	Total
Verified Tonnage	18,7 x 10^6 t	41,3 x 10^6 t	60 x 10^6 t
Probable Tonnage	35 x 10^6 t	89,4 x 10^6 t	124,4 x 10^6 t
Possible Tonnage	25 x 10^6 t	53,9 x 10^6 t	53,9 x 10^6 t

TECHNICAL TABLE

Description of Explotation Methods

The most important mine is Pedra Preta (a concession of 500 ha), located at 1· km from Brumado; its exploitation is made in open pit, in 21 banks 8 m high. After overturden removal, a primary boring is carried out for faces blasting, followed by a secondary boring, at the bank's base, in order to reduce the size of blocks.

A hand-made sizing is subsequently carried out, according to the chemical composition (colour and texture) and size (6" - 8" for conventional kilns and Hartisor Walker kilns, with more than a 94,0% MgO). It is hand loaded in buckets, separating in this way the talc, the latter following another line of winning process.

Pedra Preta's output, from a 93,7% of the total corresponding to 1965, has passed to a 97,9% of the total corresponding to the year 1969.

Pedra Preta's output may be broke down in the following manner:

Year	Conventional	Idem H.W.	"Cascalho" (- 4")	Steriles	Total
1969	133.334 (38%)	66.630 (19%)	100.915 (29%)	50.428 (14%)	351.306 t (100%)
1970	134.077	47.189	89.171	84.156	354.601

Mining Extraction Tonnage

Year	1965	1966	1967	1968	1969	1970
Pedra Preta's useful ore	96.750	91.107	84.798	108.617	199.964	181.266
Other mines' useful ore	6.488	5.496	4.750	4.463	4.391	?
Ratio Useful Ore/steriles (Pedra Preta)	73/27	70/30	51/49	67/33	57/43	51/49

Concentration or Process Method Description

The production of sinter takes place in conventional kilns (charcoal gas as combustible), 4 in Pedra Preta and 1 in Catiboaba. This conventional sinter, after a selection in bulk, is processed in a mechanical crushing, granulometric clasification, sampling and analysis, filling in sacks and storing.

The ore with destination to the Harbison Walker plant in Catiboaba, after being crushed down to a size minus 10 mm, is transferred to silos feeding a Herreschoff vertical kiln to be burned (using fueloil as a combustible), with an ouput of 200 t/day of caustic magnesia; it is again tranferred to silos feeding presses producing caustic briquettes to be sold directly, or fed to a dead burning shaft kiln (petrol as combustible), with an output of 160 t/day of high quality sinter (bulk density, 3,2 - 3.3).

The sinter production means a reduction in weight of about a 50 %.

Tonnage, Concentrated or Processed (Dead Burned Magnesite) (1)

Year	1965	1966	1967	1968	1969	1970	1971	1972
Sinter output (t)	53.400	48.300	49.800	58.500	96.000	96.000	96.000	96.000

Year	1973	1974
Sinter output (t)	96.000	96.000

(1) - Completed according to the scheduled output

Description of Transport Methods to Metallurgical Factory or Sales Destination

Pedra Preta Mine and Pedra Preta kilns are separated by a distance of 2 km and the distance to Catiboaba kilns is 15 km. The Magnesita S.A. roads are in a very good state.

The mineral is transported in 14 Mercedes Benz trucks (8 of them of a tilting type, 10 t and the other 6 with 6 t frames) and in 8 Tarex trucks (of a tilting type, 22 t). The trucks belong to Magnesita S.A. and are operated, on a sub-contract basis, by TRANSAS and VITU.

The transport between Catiboaba and Salvador (sinter export) and Contagem (MG) (manufacture of refractories) is made by railway LESTE Brasileiro (the latter with a transfer in Monte Azul).

MISCELLANEOUS

Personnel (Technicians and Workers)

The mine employs 240 workers, and the total of hour-hands in the exploitation is 1.400 men (50 of them in office-work). There is no specialized manpower in the district and it is not an easy task to ask for it outwards. The non-specializaed man-power is continuously changing, for it is incorporated to agricultural work during the rainy season The personnel has a good aptitude for training, after which it remains more permanently tied to the enterprise.

Machinery

8 tilting, Mercedes Benz, 10 t trucks; 6 Mercedes Benz, 6 t frames; 8 Terex, 22 t trucks; 1 Michigan loading shovel, 175-II; 2 Allis Chalmers TL 645; 1 Michigan 180-III tractor; 1 Caterpillar D 6-B tractor; a Carterpillar D 4-B tractor; 1 excavator 22-B.

The following Atlas Copco drilling equipment is available: 4 RH 658-4L; 4 RH 571-3L; 1 drilling carriage ROC-600 12 hammers BBD-12-LH; 1 column hammer Bencher and 2 Cobra. The following Atlas Copco compressors are available: 1 stationary, electric CT-4; 1 portable Dd 225 and another PR 600 Gd; togeher withan Ingersol-Rand Giro-Flo.

Water Supply

An accumulation dam, 500.000 m^3 in capacity, in Rio do Antonio, 3 km far from Catiboaba is available; it is sufficient, according to Magnesita, S.A., ever in drought periods; the adduction is made with a head of 1[illegible]

The fresh water for human consumption is supplied by an own water-spring well.

Power Supply

Four new Diesel sets are available, with a global output capacity of 384KVA, supplying the whole of the installations. It is considered sufficiant for the present capacity, but not for future extensions. The nearest electric line (COELEA) is at a distance of 100 km, in Vitoria da Conquista.

The power consumption, in its present phase, amounts to 2 10^6 kWh.

Other Supplies (Fuel, oil, explosives, wood....)

- Fuel oil	16.320 t/year	- 26.000 Cr.
- Diesel oil	4.985.159 t/year	- 11.740.000 Cr. (included the Diesel generators consumption)
- Gasoline	300.000 t/year	200.000 Cr.

REMARKS

Mineral average analysis (1969) of other mines (in %)

Mine	Pedra Rolada	Sao Lourenço	Cabeceiras	Bate Po
I.L. (1)	51,00	51,00	51,00	50,00
MgO	43,74	43,17	45,90	49,61
SiO_2	1,10	1,90	0,30	0,42
Al_2O_3	0,50	0,50	0,66	0,20
Fe_2O_3	1,65	0,47	0,87	0,85
FeO	-	0,53	-	1,30
MnO	0,17	0,23	0,70	1,70
CaO	1,84	2,20	0,57	0,92

(1) Losses on ignition

Client: U.N.I.D.O.

Consulting Firm. TECNIBERIA

D. 7. 3. EXTRACTIVE METALLURGY

D. 7. 3. 1. General

Magnesium is a metal of a relative recent application in Brazil; in the last few years, however, it has come to represent a value occupying an important place (fourth in order) in the list of imports. In Table Mg-5, the evolution experienced by metallic magnesium imports, from 1.961, has been shown. It is almost exclusively supplied to the castings manufacture by the most important automobile industry in Brazil (Volkswagen).

Up to this moment no production of metallic magnesium exists in Brazil nor in the other South American countries.

D. 7. 3. 2. Projected plants

Dow Productos Quimicos Ltda. (100% Dow USA) - projects to erect in Aratú's industrial polygon, a plant to obtain electrolitic metallic magnesium, with a production capacity of 20.000 t/year, in order to satisfy the Brazilian demand and to export the production surplus to the zone of the ALALC.

Magnesium chloride imported from U.S.A. will be the raw material for the metallic magnesium production.

An investment of 140 million NCr has been estimated, together with a payroll of 212 employees.

The project is now being analysed on a Federal base by the "Geimet".

This plant would be complemented by another installation to produce chlorine and caustic soda, with an investment of 168 million NCr and 208 employees.

D.7.4. THE MAGNESITE'S DERIVATIVES INDUSTRY

D.7.4.1. Production structure

The magnesite produced in Brazil is supplied almost in its totality, to the production of magnesian sinter, a part of which is exported and the rest employed in the manufacture of refractories. Two companies, MAGNESITA S.A., with a plant in Contagem, Belo Horizonte (Minas Gerais), and CERAMICA SAN CAETANO, S.A., with a plant in San Caetano do Sul (Sao Paulo) are the main refractories manufacturers.

Magnesita S.A.'s production of basic refractories is far bigger than the output of Ceramica San Caetano, S.A. the latter having magnesite roastings plants not in condition of working at a high temperature and producing a sinter of low density, not suitable to be employed in some types of basic refractories.

D.7.4.2. Existing plants

D.7.4.2.1. Magnesita, S.A.

This Company has plants in several parts of the country. Its principal industrial aggregate is situated in Contagem (MG), with the following divisions:

- Plant M - Magnesite refractories
- Plant D - Calcined dolomite
- Plant SA - Silico-alumina refractories
- Plant S - Silica refractories
- Plant LD - Refractories for LD convertors and electric furnaces.
- Plant MM - Magnesian mass

The total payroll are 1.300 employees (900 workers and 400 technicians and administrative personnel).

In 1.969, a 60% of the billings corresponded to magnesite basic refractories. The total billings were US $ 18.860.000.

The magnesite roasting plants to produce magnesian sinter are located in Brumado (Bahía), where the most important orebodies belonging to the company are to be found.

Pedra Preta's mine is the most important supplier of ore, as it is the only one giving an ore suitable in its characteristics to be fed in conventional vertical roasting and sintering furnaces and in vertical furnaces, type Harbison - Walker (the latter requiring a minimum contents in MgO of a 94%). One of these furnaces is already in production (July 1.970), and 1 or 2 (1 probable) other installations, parallel to the present one, will be available at the end of 1.973, according to a project.

At a distance of two kilometers from Pedra Preta are the conventional furnaces installations and integrated by 2 Azbe kilns and other 2 of a model patented by the Eng. Alberto del Prado, using charcoal gas as combustible. In the same zone two roofed storage areas for charcoal, are available, their capacity being 9.000 cu.m. each, and another one of 1.000 cu.m. to feed directly the kilns. An electric substation and workshops are available there.

The conventional sinter obtained in Pedra Preta, after being hand sorted, is transported to Catiboaba to be processed through a mechanical crushing plant and granulome tric classification, sampling and analysis, filling of sacks and storing before being supplied to the consuming centers.

At Catiboaba's plant, 15 km far from Pedra Preta Mine, another conventional vertical kiln (Patent registered by Alberto de Prado, Eng.) and a complete Harbison Walker installation are available. Both of them are complemented by crushing equipment, sack-filling and shipping facilities for sinter, together with workshops, medical services, administrative services, housing, etc.

The ore to be fed to the H. W. kilns in Catiboaba, after being submitted to a primary crushing, passes to another crusher of a capacity of 160 t/hour working in a closed circuit. The ore minus 10 mm. passes then to two storage silos with a capacity of 350 t. each, from them on, the ore is fed to a vertical calcining kiln, type Herreschoff, with an output of 200 t/day of caustic magnesia. It passes then to another silo and continuing later on to a system of presses to form caustic briquets which subsequently are, either filled in sacks to be sold as caustic magnesia, or fed to a shaft kiln, with an output of 160 t/day, to be dead burned in order to obtain a high quality sinter (Dead burned magnesite).

The plant has been mechanized and equiped with dust collectors.

Fuel oil is used as a combustible in the Herreschoff kiln, and gasoline in the shaft kiln.

The estimates on magnesite consumption in the H. W. plant are about 12.000 t/month. The dead burning process supposes a reduction in weight of about a 50%.

The refractories produced to be used in S. M. furnaces is of a high quality and durable. As far as it concerns to the L. D. furnaces, the use of conventional kilns presented a quality problem, specially due to the low apparent specific weight; the new sinter has now a suitable specific weight of 3,20 to 3,30.

The domestic market is still being supplied with caustic magnesite, of an inferior quality and a lower price.

96.000 t/year of dead burned magnesite are produced in the existing installations; it is transported in railway wagons to Salvador (Bahia) to be exported, and to Contagem -- (Minas Gerais) to be processed into refractories.

D.7.4.2.2. Cerámica San Caetano, S.A.

This Company's activities are the manufacture of refractories of very different types: silico-alumina, alumina, silica, basic, insulating, anti-acid and special refractories.

Its basic refractories production is being limited by the small volume of production of dead burned magnesite coming from CASTELLA Mine, a property of COMINAG, in Bahia, by the quality of the ore with a very high iron content, and by the magnesian sinter obtained in conventional kilns at a temperature of 900º C.

The highest production obtained of burned magnesite was 12.500 t (1.966).

The transport of the sinter to Sao Paulo is long and difficult, being two the transportation ways employed: the - first one along San Francisco River, down to Pirapora (MG), covering a distance of 1. 300 km. From this point is hauled in railway wagons to the Sao Paulo plant. The second one employs motor ships or sailing ships as far as to Juazeiro, continuing then in trucks to Sao Paulo.

D. 7. 4. 3. Extensions provided for the existing plants

D. 7. 4. 3. 1. Magnesita, S.A.

It has the project of enlarging its present output of magnesian sinter, from 96. 000 t/year to 112. 000 t/year with a new Harbison-Walker unit capable of obtaining a high quality, high specific weight sinter to be exported in its greater part.

The types of sinter to be obtained are as follows

Quality	Destination	t/year	esp. weight	MgO (min)
M-10	National market	16. 000	2. 8/2. 95	93, 5%
M-20	" "	48. 000	3. 2/3. 3.	94, 5%
M-20	Export	48. 000	3. 2/3. 3	94, 5%
- Total		112. 000		

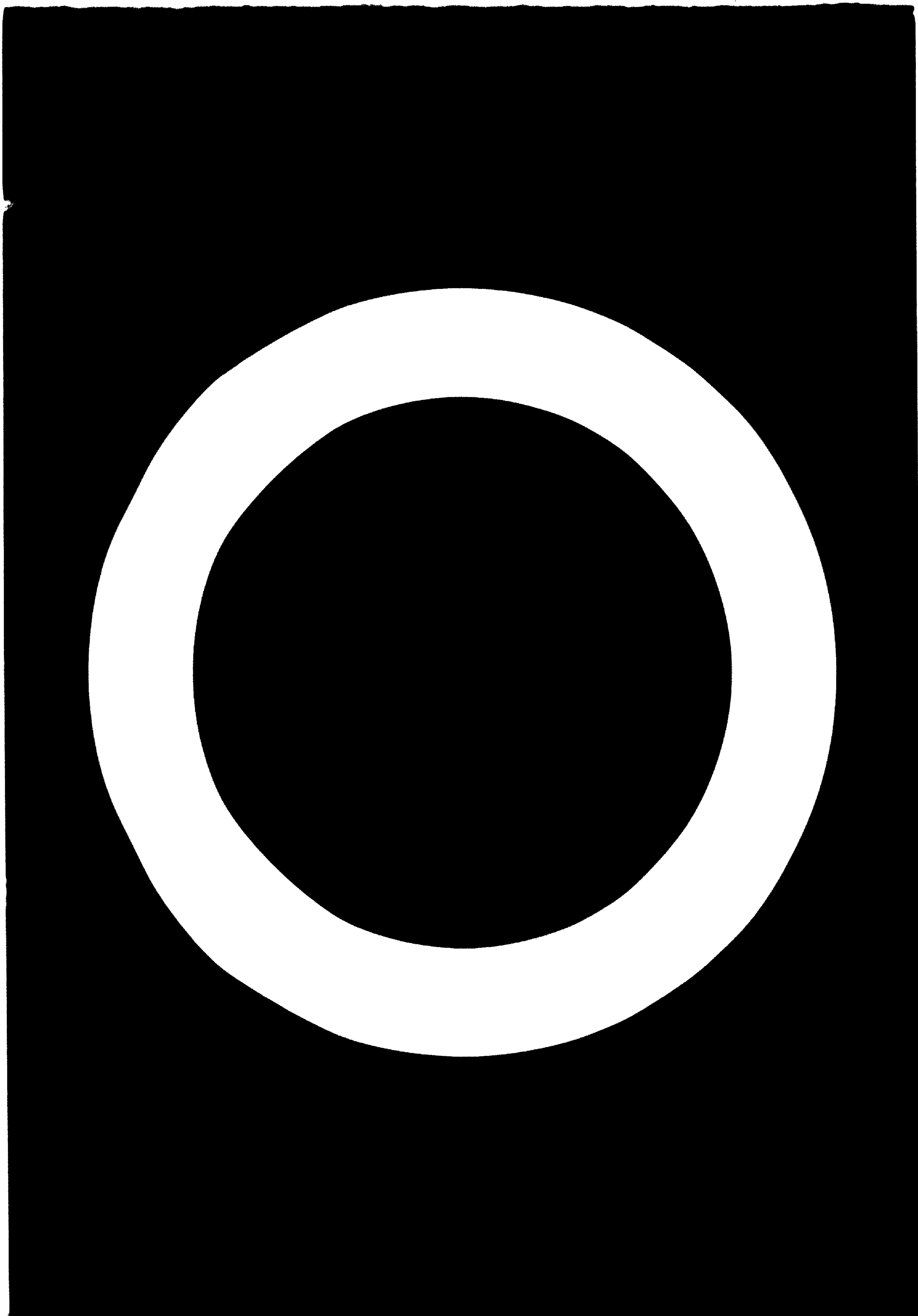
The putting in operation of this extension has been provided for the end of 1. 973.

D. 7. 4. 3. 2. Cerámica San Caetano, S.A.

Within a period of two years, the magnesian sinter output in Castella will be extended to 48. 000 t/year, with - fuel-oil kilns and temperatures of the order of 1. 350º C

No decision has been taken yet on the type of kilns to be installed due, as it seems, to difficulties in the award of foreign manufacturing and "know-how" licences.

D.8. ALUMINIUM



D 8. 1. MARKET STUDY

D 8 1. 1. Historical background

The statistical data pertaining to aluminium have been included in Tables Al-1 to Al-6. As far as it concerns to the past, the information available in them can be summarized in the following terms:

a) The State of Bahia, in particular, and the North-East, in general, have no production of bauxite.

b) Up to this moment, no primary aluminium is produced in Bahia.

c) The bauxite exports lack of importance, what is an indication -at least up to this moment- of the fact that the output is supplied for the self-consumption.

d) The aluminium consumption is presenting a marked process of acceleration during the last years, a process that the local output has not been in state to meet, in spite of having doubled its real production during the last six years

e) The difference is covered with imports, increasing in importance during the last years. Such imports meant a net outflow of foreing currency of an order of US $ 32 million, and a dependency on the foreign countries that has been estimated in a 60% (data corresponding to 1 968) The Table Al-6 is a breakdown of the said imports distributed into types of products.

f) Within the scope of substances covered by this study, the aluminium is, second to copper, the most important element in value, under the heading of imports.

D.8.1.2. **Demand's forecasts**

Establishing a comparison between the figures on primary aluminium provided by the "Plano Decenal de Desenvolvimento", and the ones really obtained in the period 1967-1969, the results are as follows:

Years	Estimated demand	Real demand	Deviation (%)
1.967	78.000	65.346	+ 16,22
1.968	83.000	71.988	+ 13,26
1.969	88.400	91.556	- 3,75
	249.400	228.890	+ 8,22

that is, while in the year 1.969 the apparent consumption of primary aluminium has been slightly in excess of the figure estimated for the demand, for the triennium 1.967-69, it has been, taken as a whole, inferior. We have, therefore, estimated that it would be reasonable to maintain the estimates established in the "Plano Decenal".

This decision would put the projection of primary aluminium demand in accordance with the following figures

Years	Tons
1.971	100.000
1.972	106.500
1.973	113.500
1.974	121.000
1.975	129.000
1.976	137.400
1.977	146.300
1.978	155.800
1.979	165.900
1.980	176.700

D.8.1.3. Balance between the estimated demand and the offer

The production estimates for the period 1.971/1.975 according to the "Plano Decenal de Desenvolvimento" have been collected in Table A1-7, together with the most recent made available to us by ALCAN, whose specification has been detailed in Table A1-8.

According to this, the balance output/demand for the years 1.971/1.975 (Table A1-9) indicates that, provided that the enlargement plans may be accomplished on the predicted dates, Brasil will be self-sufficient from 1.973, but with a new off balance if the production's capacity is not increased from 1.977.

D.8.2. MINING

D.8.2.1. Orebeds

Although some unprecise bibliographical references on the possibilities of existence of Bauxite orebeds in the State of Bahia are available, the several inquiries realised have given a general answer in the sense that the orebeds explored lack of economical interest because of their low grade or the small amount of reserves.

D.8.3. EXTRACTIVE METALLURGY

D.8.3.1. Present structure of production

The following enterprises are producing primary aluminium in Brazil:

Aluminio Minas Gerais, S.A. (Aluminas)

This society, under the control of ALCAN, had in 1.970 an output of 25.130 t It is located in Saramenha (MG)

Cía Brasileira de Aluminio (C.B.A.)

Located in Sao Paulo, it gave in 1 970 an output of 23.130 t.

Cía Mineira de Aluminio (Alcominas)

Belonging to the ALCOA Group, it started its production in 1 970 with 7.900 t.

The total output of the three enterprises in 1 970 was 56.150 t.

D.8.3.2. Present production capacity

- Aluminas	28.000 t/year
- C.B.A.	25.000 t/year
- Alcominas	25.000 t/year

D.8.3.3. Anticipated extensions of present installations

Aluminas is planning a third reduction line, with 25.000 t/year; its installation, however, was deferred sine die because of lack of fiscal incentive. The preferential expansion of the ALCAN Group will be made, in the future, in the State of Bahia.

C.B.A. is enlarging its capacity of production up to 40.000 t, a level it is expected to be reached in 1.972/1.973.

Alcominas pretends to rise its initial capacity of

25.000 t to 50.000 t/year. The time for this extension is unknown at present.

D.8.3.4. New plants in project

The fourth company in Brazil to process primary aluminium will be an enterprise belonging to the ALCAN Group. Aluminio do Brasil Nordeste, S.A. Its plant is now in a very advanced state of erection and it is expected to start the production in 1.971/1.972, at a level of 10.000 t/year. It will the first Brazilian alumina reducing plant situated at the seaside what will make easier the supply of raw materials. Its initial capacity will be 25.000 t/year of primary aluminium, but its layout has been planned to expand its production up to 150.000 t/year.

D. 8.4. TRANSFORMING INDUSTRIES

D. 8.4.1. Degree of concentration of production

Up to 1.969 no aluminium transforming industry was in existence in Bahia, the whole of the production of aluminium manufactured products being concentrated in the States of Minas Gerais and Sao Paulo, with the main representative enterprises ALUMINAS and C.B.A.

D. 8.4.2. Installed capacity and employment

The information referring to ALUMINAS, the only enterprise whose data have been made available to us, indicated that its capacity of output in 1.969 was as follows:

- Laminates	15.000 t/year
- Sheet	4.000 t/year
- Extrusion	5.000 t/year
- Domestic appliances	2.500 t/year-
- Aluminium paste	2.050 t/year
- Pieces for industrial refrigeration and motor cars	400 t/year
- Miscellaneous	800 t/year
- Cables and conductors	10.000 t/year

The 60% of laminates is, later on, transformed into sheets, domestic appliances and miscellaneoue articles.

The number of employees is 3.000.

D. 8.4.3. Extension plans

Referring always to ALUMINAS, its plans for 1.971 provide the following extensions:

- Laminates	10.000 t/year
- Extrusion	5.000 t/year
- Sheet	2.400 t/year

The investments corresponding to these extension plans are unknown to us.

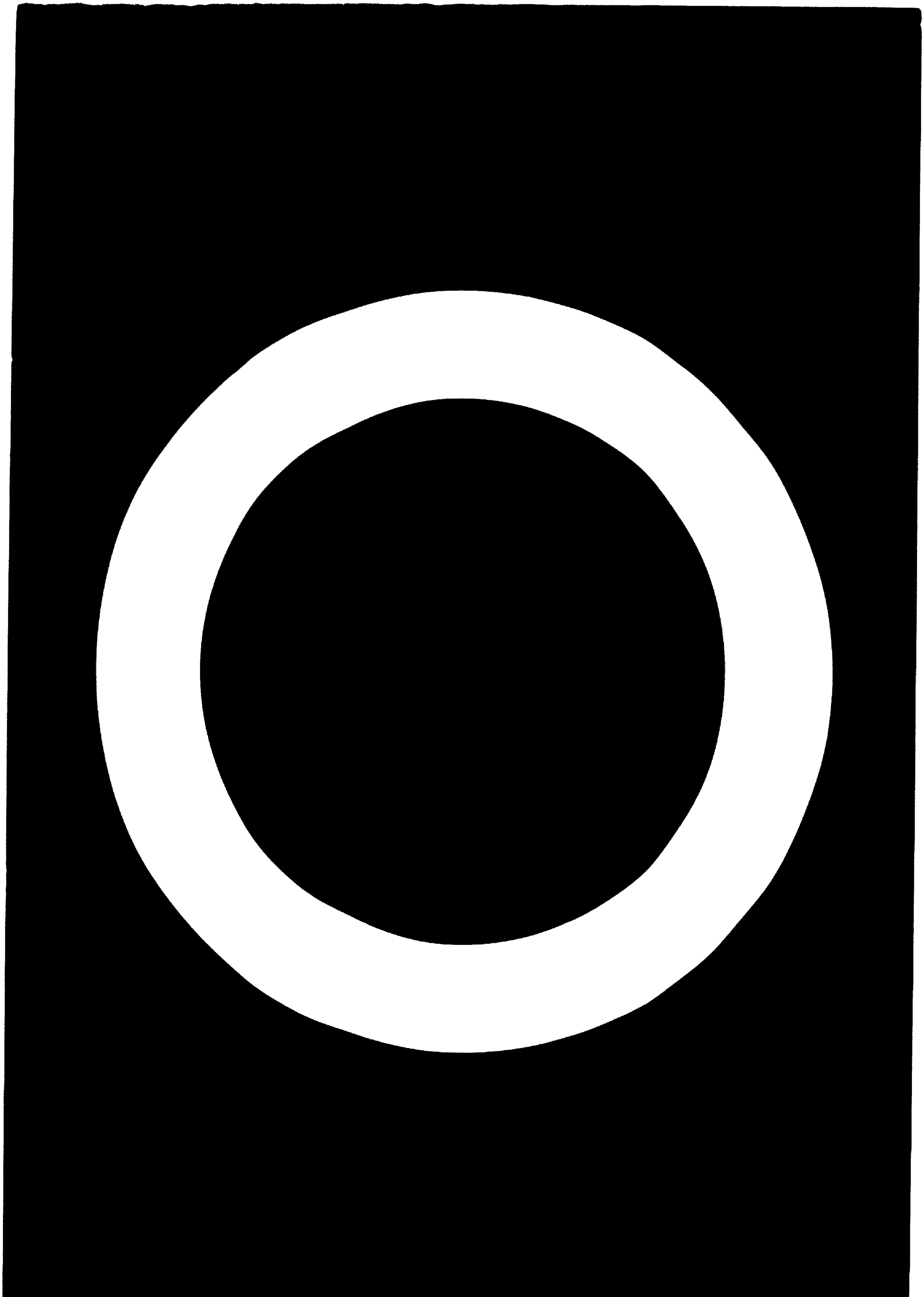
D. 8. 4. 4. <u>The transforming industry in Bahia and in the North-East</u>

Within the Sub-sectors of Laminates and Extrusion two enterprises are framed, one of them in Pernambuco, producing laminates and open and tubular pressed pieces, and the second in Bahia, producing aluminium conductor cables.

The cables producing plant, Aluminio do Brasil Nordeste, S.A. (ALCAN Group) was started in July 1 969 with a program of production of 6. 000 t/year of steel core aluminium cables.

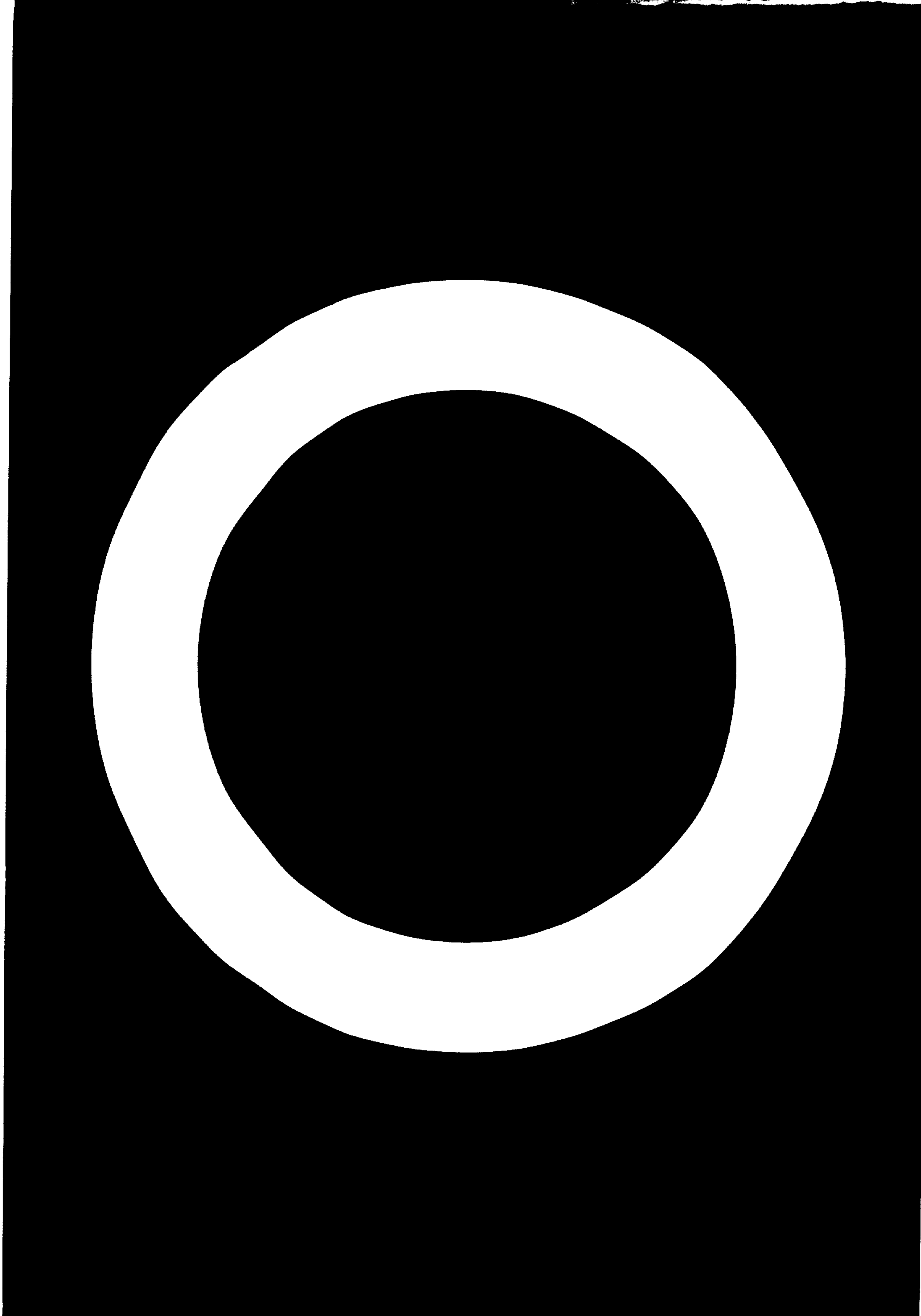
An enterprise located in Pirapora (MG) intends for 1 971 to start the production of aluminium alloys (Al - Si, 3. 200 t/year, and 1. 100 t of Si metal), in a plant out of Bahia, but still in the N E

E - ANNEXES



ANNEX E-1

PRELIMINARY PROJECT OF A BAR AND SECTION ROLLING MILL INSTALLATION AT THE USIBA PLANT



PRELIMINARY PROJECT OF A BAR AND SECTION ROLLING MILLS PLANT

1 GENERAL

In the analysis made in preceding section of possible solutions in order to improve USIBA's profitability, it has been recommended to roll all the billets produced by the continuous casting machine into bars, wire rod and sections, instead of sending the billets to the South of Brasil for further transforming.

The most probable billet production (240.000 t/year) - would be scheduled to a bar and wire rod mill for 120.000 t/year and to a section mill for 100.000 t/year of finished products respectively.

The products to be rolled are as follows:

- Bars from 5 to 12 mm. delivered in reels or in bars. The lesser diameters could be used to feed future wire and cable plants and the bigger for construction purposes.
- Bars from 13 to 30 mm. delivered in bars with a length from 12 to 16 m. to be used for construction purposes and in some cases, for shafts in higher quality steels.
- Sections from 40 to 120 mm. in lengths from 15 to 18 m rolled in a second rolling mill, to be used for construction purposes.

In the following paragraphs the preliminary project for the installation of a rolling mills plant to obtain the above products is analysed.

2. EXISTING INSTALLATIONS

2.1. Steel plant

The steel to be rolled in the proposed rolling mills - will be produced in the USIBA'S steel plant under erection, with a 100 t. electric furnace and an estimated steel production of 250.000 t/year.

2.2. Continuous casting

The steel produced in the above plant will be processed into billets at the USIBA'S 6 strand continuous casting machine.

The upper dimensions to be obtained in such machine would be as follows, taking in account the speeds and casting times limits to day availables:

120 ∅ mm. billets (60/70 min casting time and 2,48/2,14 m/min speed).

160 ∅ mm. billets (60/70 min casting time and 1,39/1,19 m/min speed).

The billet production to be obtained from the machine will be in the order of 240.000 t/year.

3. PROPOSED NEW INSTALLATIONS

3.1. Bar and wire rod mill

3.1.1. Description

The mill will consist of the following production units

- 1 Billet reheating furnace, 35 t/hour capacity, for 120 x 120 x 5.000 mm. billets.
- 1 Roughing three high stand 500 x 1.200 mm., 1.200 HP motor with roller feed (entry side) and manipulator (exit side). In this stand, billets are rolled in 50 x 50 mm. square bars.
- 1 Continuous 6 stands section with the following distribution:
  - 2 400 mm. stands with 600 HP motor (d. c.)
  - 4 300 mm. stands with 2 x 300 HP motor (d. c.) with independent speed regulation.

This line will be used as intermediate section for 5.5 to 22 mm. bars, and as finishing section for 22 to 30 mm. bars.

At the exit side of this section a flying shear will be placed for cropping of semifinished bars or for cut to the cooling table length for finished products.

- 1 continuous 4 stands section, 300 mm. each, with a common d. c. 300 HP motor drive.

This section is preceded by a loop where a diamond or a round is passing according the type of finish. This line works always as intermediate section.

- 1 continuous 2 stands section, 300 mm. each, driven by a common d. c. 300 HP motor and with automatic speed control.

This section will be used as intermediate for 5 to 12 mm. bars, and as finishing line for 12 to 22 mm. bars.

At the exit side one flying shear is placed to crop the semifinished products or for cutting to final lengths of the finished products.

Finished products can be delivered either to a cooling table for bars or to the two existing reels.

- 1 continuous wire section, with 6, 200 mm., stands, of higher speed, driver by 250 HP d.c. motor and with manual speed control.

The line is preceded by a loop, with photoelectric cell speed control of the preceding line driving motor.

The line ends in two reels (the same as above for 5 to 12 mm bars) with speed control according to the product diameter to coil.

The main auxiliary equipment is as follows:

1 Cooling table for bars, 42 m. long.

1 Roller conveyor following the cooling table and equipped with shear, to obtain comercial sizes from 12 to 15 m.

1 Hook conveyor for coils with charge, discharge and surge elements.

Spare parts section, roll shop, etc will also be considered.

3. 1. 2. Buildings

The equipment will be located in two bays. The rolling mill bay will be 170 x 20 m. and the stock bay (billets and finished products) 170 x 15 m. In the latter one, the roll shop, offices and other ancillary elements will be located.

The stock bay will be equipped with a 15 t. travelling crane for billet and a 5 t. crane for finished products handling.

3. 1. 3. Production capacity

The production capacity of the rolling mills depends of the "product-mix " to be obtained.

At two-shift operation, the maximun production capacity is limited by the billet reheating furnace, i. e. 150. 000 t/year.

This reheating capacity allows a maximum finished production of 120. 000/130. 000 t/year.

One tentative "product-mix" could be as follows:

- 5 to 12 mm. wire coils scheduled mainly to wire productions	35.000 t/year
- 12 to 12 mm. bars for construction purposes.	20.000 "
- 12 to 20 mm. bars " "" ""	40.000 "
- 20 - 30 mm. bars " "" ""	15.000
- 22 - 30 mm. bars for shafts etc.	10.000
- Total	120.000 t/year

3.1.4. <u>Investments</u>

The estimated investments are as follows (in US. $)

- Buildings	480.000
- Civil engineering (equipment)	620.000
- Ancillary services	325.000
- Main equipment (rolling mill)	3.050.000
- Ancillary equipment	135.000
- Transportation and packing	135.000
- Erection, engineering and technical assistance for start up	550.000
- Total	5.860.000 US $

3.1.5. <u>Manpower</u>

The estimated manpower, at two-shift operation is the following:

- Supervisors	4
- Reheating and mill shift service	40
- Roll shop and ancillary services	14
- Electrical and mechanical maintenance ...	10
- Other personnel	12
- Total	80

3. 1. 6. **Production costs**

The estimated production costs, according to the different rolling diameters are as follows, in US $.

	5, 5 mm.	12 mm.	30 mm.
- Fuel	1, 04	1, 04	1, 04
- E. Power	1, 92	1, 92	1, 32
- Rolls	0, 80	0, 68	0, 54
- Materials:	0, 60	0, 60	0, 60
- refractories			
- water			
- c. air			
- oil			
- Labour	2, 20	1, 44	1, 18
- Plant overhead	1, 00	1, 00	1, 00
- Total	7, 56	6, 68	5, 68

3. 2. **Section mill**

3. 2. 1. **Description**

This rolling mill will consist of the following production units:

- 1 Billet reheating furnace, 4 m. wide, 25 t/hour production capacity.
- 2 Three-high 550 mm. stands in line with manipulators, at both sides driven by a single 1. 200 HP a. c. motor.

  For product handling between the two stands a tappet system will be used.

- 5 two-high, 360 mm. stands, with a 1.200 HP motor for driving the three first stands and a 600 HP motor for the two last stands

Handling between the stands will be made by tappets. Product handling between the two sections will be by rollers. The same system will be used at the exit of the 360 mill over the correspon ding cooling table.

The main ancillary equipment will be

- Roll turning and spare parts shop
- Flying shears in both sections
- Shear at the exit side of the cooling table (the most common lengths are 15 and 18 m)
- Scale

The type of sections that could be produced by this rolling mill, depending of the initial billet size, are:

- Angles, U and JPN from 80 to 120 mm. (in the 2º stand of 360 mill)
- Angles and U from 40 to 80 mm (in the 5º stand of 360 mm. mill).

3.2.2. **Buildings**

The following buildings are to be considered

1 Bay 140 x 20 m. for the section mill

1 Bay 140 x 20 m. for billet and finished products storage and for the roll grinding shop and ancillary services. This bay will be provided with 1, 20 t. travelling crane for billets handling and 1, 10 t. travelling crane for finished products.

If both bar and section mills are installed together, it would be possible the erection of only one common bay, 170 x 25 m. This solution could reduce the corresponding investments.

3.2.3. Production capacity

As for the bar mill, the production capacity depends of the type of rolled products to be made. Nevertheless, taking in account the proposed furnace and rolling mill, the maximum production is estimated at a maximum of 100.000/110.000 t/year, at two shifts operation.

One tentative production program could be the following:

I and U (100-120 mm)	20.000 t/year
L, I, U (80-100 mm.)	25.000 "
L, I, U (40-80 mm.)	55.000 "
- Total	100.000 t/year

3.2.4. Investments

The necessary investments are as follows

- Buildings	425.000 US $
- Civil work (equipment)	490.000 US $
- Auxiliary services	300.000 US $
- Main equipment (rolling mill)	2.200.000 US $
- Auxiliary equipment	435.000 US $
- Packing and transportation	110.000 US $
- Erection, engineering and technical assistance for start up	435.000 US $
- Total	4.395.000 US $

3.2.5. Manpower

The necessary personnel for the section rolling mill installation is a follows:

- Supervisors	4
- Reheating and mill shift service	30
- Roll shop and ancillary services	12
- Electrical and mechanical maintenance.	8
- Other personnel	10
- Total	64

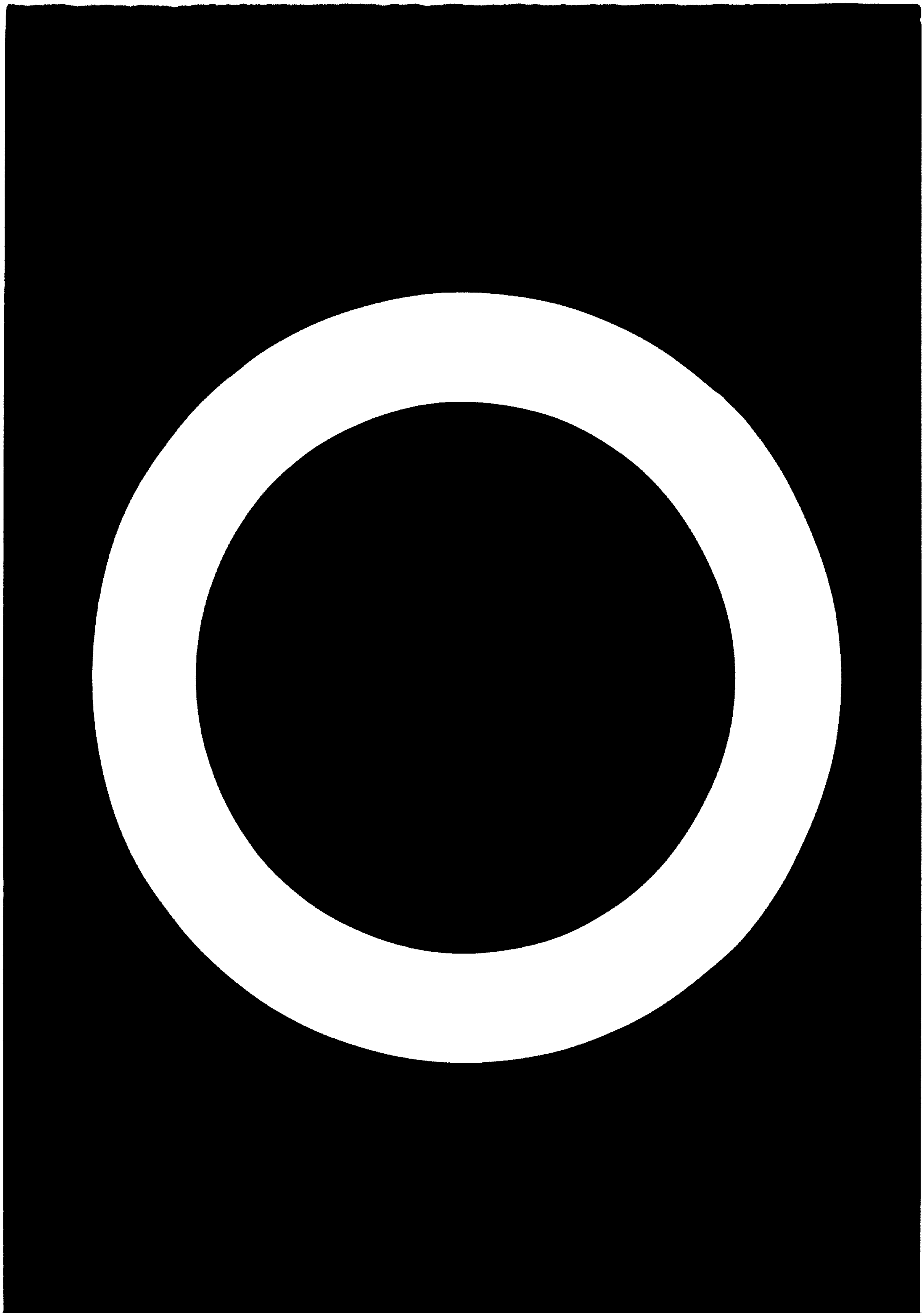
3.2.6. Production costs

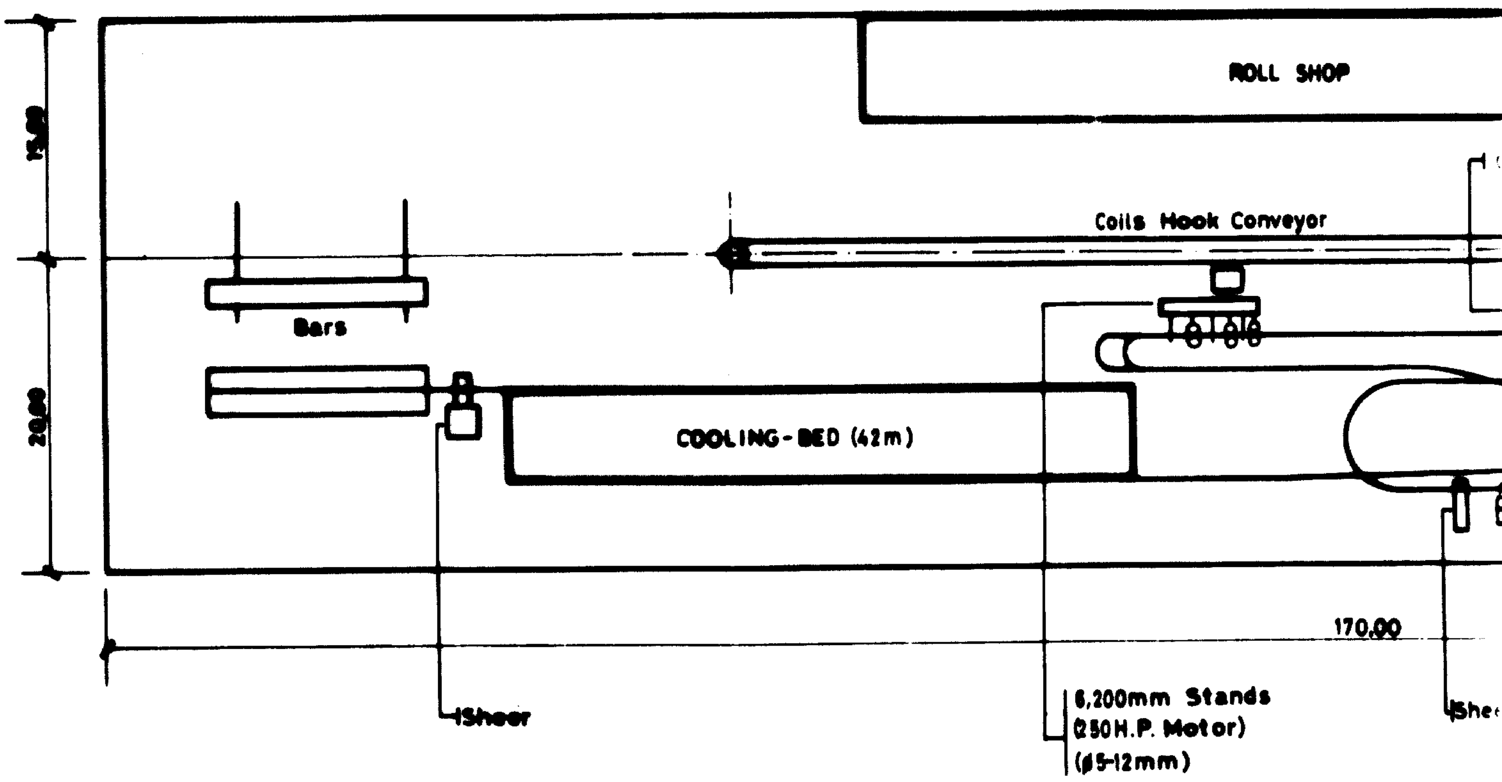
The following are the estimated costs for the different sections to be produced, in US $ per t.:

	80 - 120 mm.	40 - 80 mm.
- Fuel	1,00	1,04
- Electric power	1,25	1,70
- Rolls	0,35	0,50
- Materials	0,55	0,55
- refractories, water, c. air, oil.		
- Labour	1,00	1,10
- Plant overhead	1,00	1,00
- Total	5,15	5,89

3.2.7. General layout

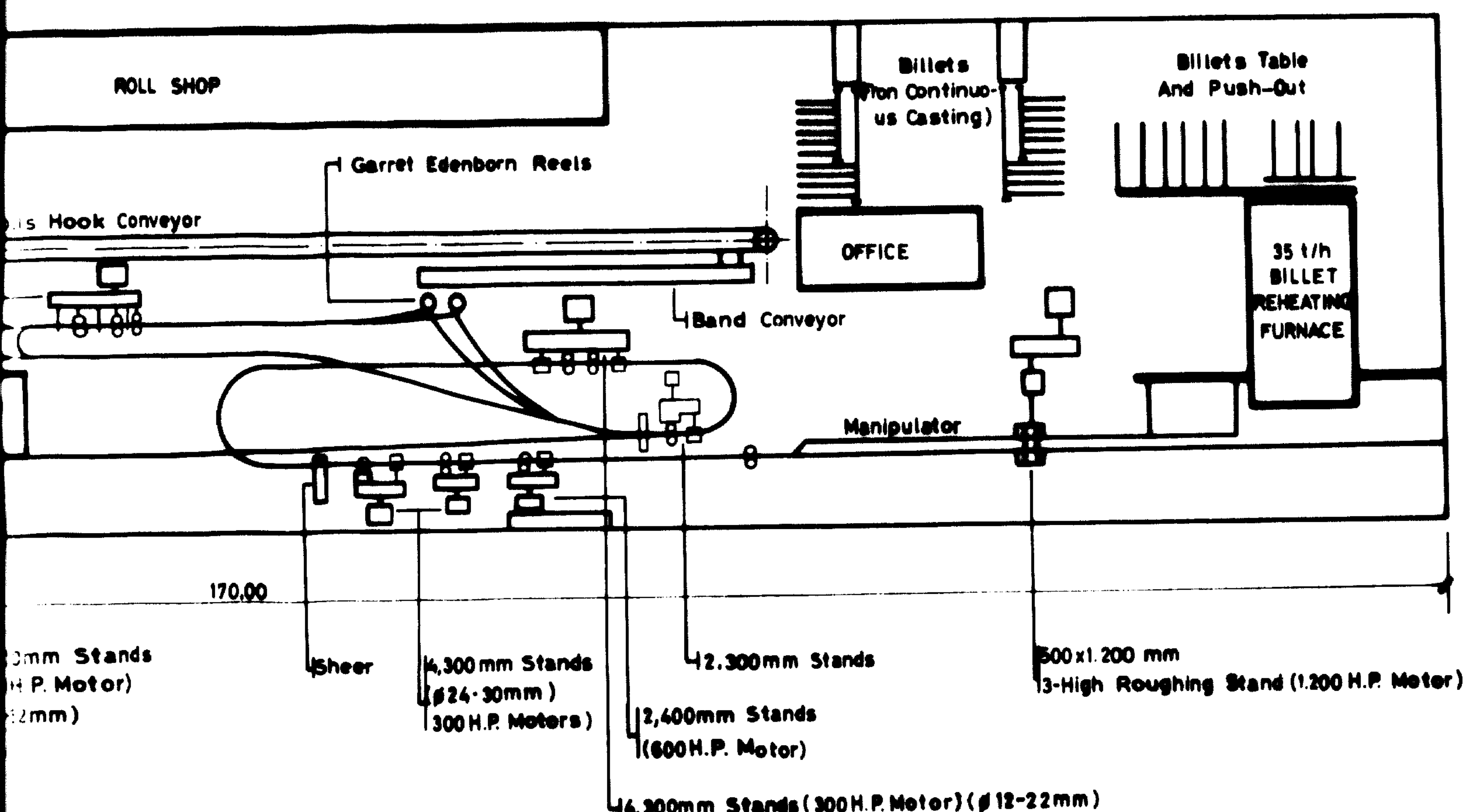
In the annexed drawings, the general plant and equipment layout for the bar and section mills are given.





15,00
20,00
ROLL SHOP
Coils Hook Conveyor
Bars
COOLING-BED (42m)
170,00
1Sheer
6,200mm Stands
(250H.P. Motor)
(ø5-12mm)

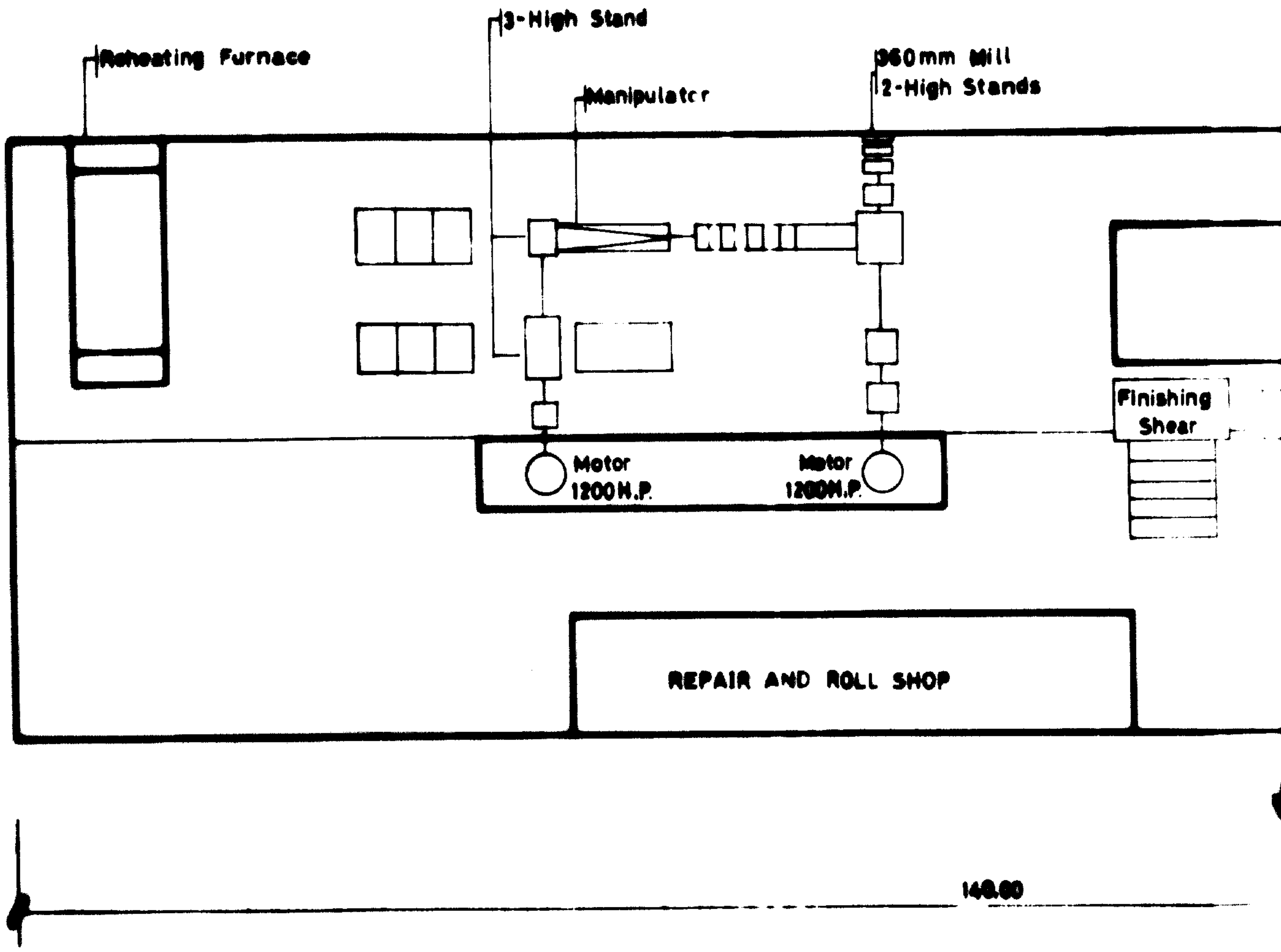
SECTION 1



GENERAL LAYOUT OF BAR AND WIRE ROLLING MILL PLANT

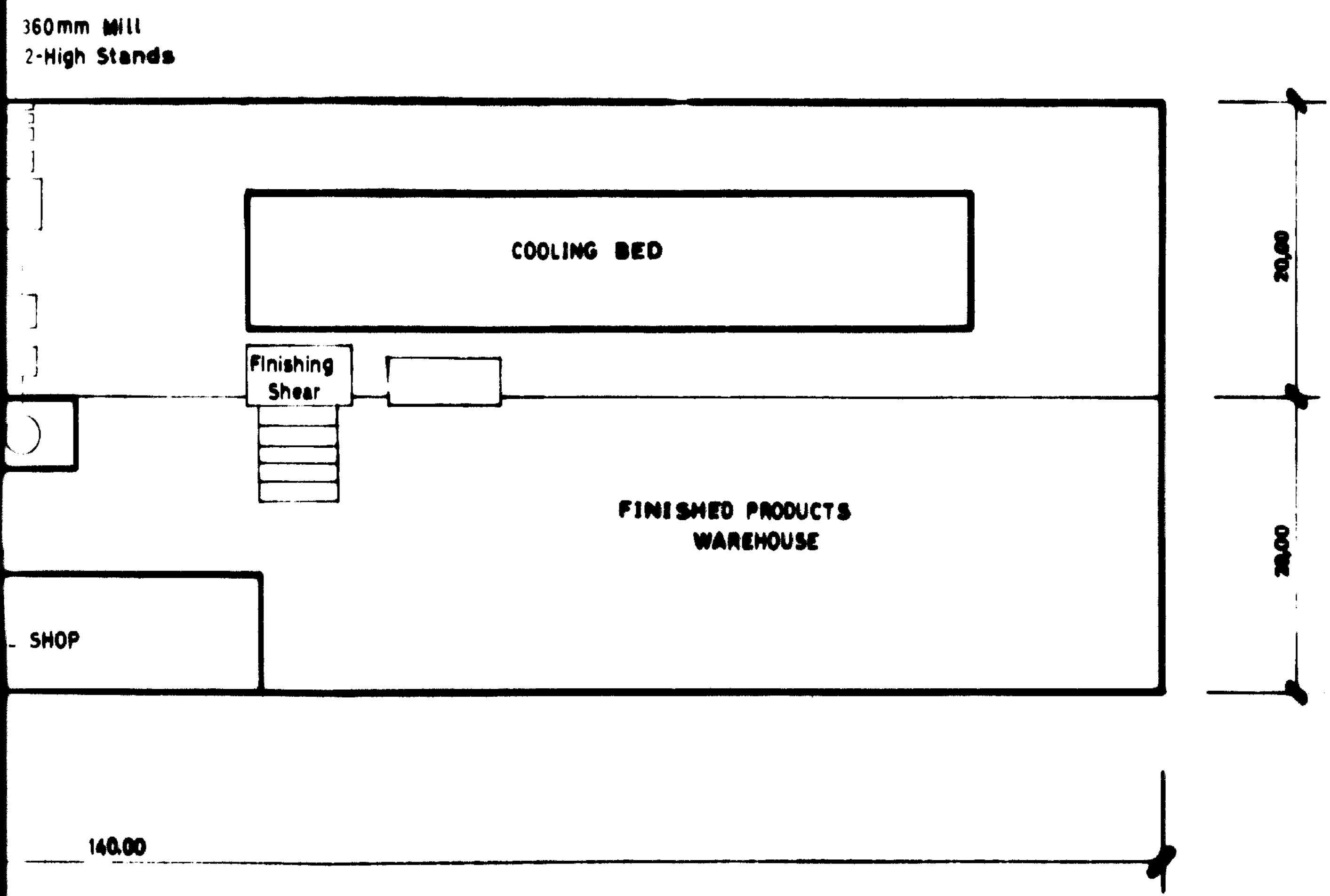
SECTION 2

SCALE = 1:500



Reheating Furnace
3-High Stand
Manipulator
360mm Mill
2-High Stands
Finishing
Shear
Motor
1200 H.P.
Motor
1200H.P.
REPAIR AND ROLL SHOP
140.00

SECTION 1



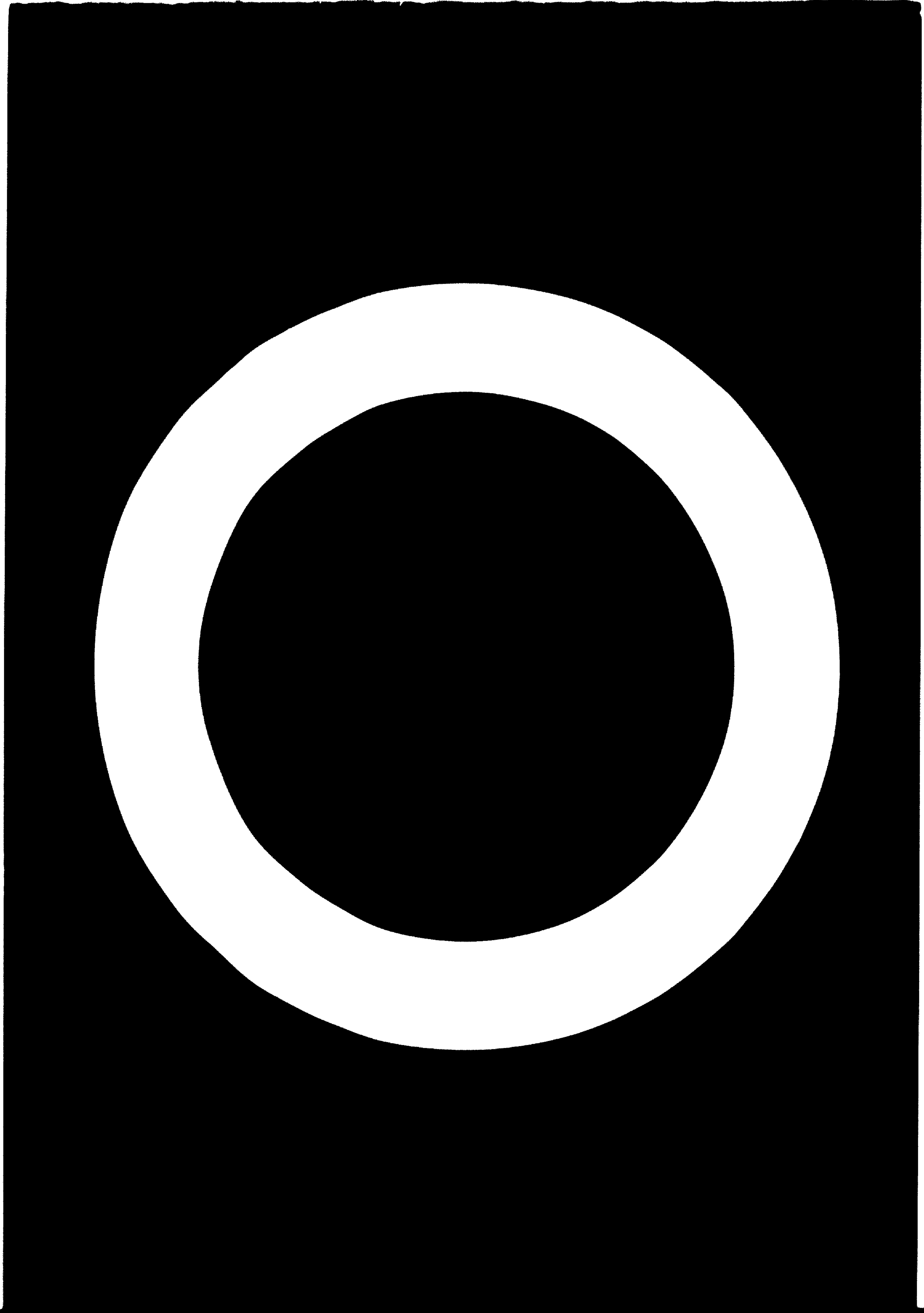
GENERAL LAYOUT OF SECTIONS ROLLING MILL PLANT

SECTION 2

SCALE = 1:500

ANNEX E-2

PRELIMINARY PROJECT OF AN INSTALLATION FOR THE PRODUCTION OF COLD-ROLLED STAINLESS STEEL SHEET AT THE USIBA PLANT



1 INTRODUCTORY NOTE

As it has been pointed out in the analysis of USIBA'S alternatives of production in order to improve its profitability, the most promising solution would be the construction of a stainless steel sheet rolling plant, which taking advantage of part of the present USIBA's infrastructure, will have a production capacity of 40.000 t/year of flat rolled products in its first phase. From this production 20.000 t. would be assigned to the domestic market, and the balance to export.

Consequently this plant could provide the stainless steel sheet requirements of Brasil.

The high selling prices of such production would offset the expense of additional transports costs of the final product from the State of Bahia to the rest of the country.

This preliminary project is therefore, devoted to the study of a 40.000 t/year plant, to produce cold rolled, stainless steel sheet.

The study has been divided into two phases:

- The first one provides for a plant in condition of producing 40.000 t/year of cold rolled, stainless steel sheet employing as starting material imported hot-rolled stainless steel coils.

This plant would, fundamentally consist of

- Box-annealing furnaces
- Pickling plant
- SENDZIMIR mill
- Cutting, packing and storing section

- The second phase provides for another plant, complementary to the first, intended to produce hot-rolled coils to feed the above mentioned first plant.

Its fundamental elements will be:

- Electric arc furnace
- Continuous Casting Machine for slabs
- Slab reheating furnace
- Planetary rolling mill
- Auxiliary elements

At the same time, the areas needed for the location of both phases which, taken as a whole, represent an aggregate production unit, have been studied.

It must be pointed out that the electric arc furnace process is the most idoneous to obtain stainless steel and, at the same time, the continuous casting of Slabs has been incorporated, together with the hot-rolling in a planetary mill and cold-rolling with a SENDZIMIR mill, because all of them represent the most advanced technics, according to the plants of the same type installed in Japan, and to another one being now erected in Spain.

We proceed now to the description of both plants.

II. DESCRIPTION OF THE PROCESS

II. 1. Phase 1 (cold rolling)

The hot-rolled coils pass directly to the line where the coils are to be prepared, previously to the cold rolling.

Every coil thus prepared passes through the nº 1 continuous line to be annealed and pickled.

The coils, after being annealed and pickled, are passed, all of them through the SENDZIMIR mill of the type ZR-22B-50.

The coils presenting considerable defects on their surface after the first rolling passes, are sent to a grinding line, and again to the nº 1 annealing and pickling line (or even to the line nº 2, in function of the relative occupation of both lines). They proceed, later on, to the SENDZIMIR mill and to the nº 2 annealing and pickling line.

The coils that after the first passes in the SENDZIMIR mill present no defects, will be annealed and pickled again in the continuous line nº 1 or 2, according to the respective degree of occupation.

The coils of an intermediate final thickness permitting the performance of every pass without any exterior hardening, pass directly to the next phase.

The coils with a small thickness will be rolled once and again in the SENDZIMIR mill, receiving a final annealing and pickling in the line nº 2.

The coils being rolled in the SENDZIMIR mill, after being annealed and pickled, may follow two destinations: either to the transversal shearing line or to the temper mill, when the final product requires a previously determined degree of surface hardness

Sheets without the requirement of a surface hardening, pass directly to the transversal shearing line, just as it was said above.

Sheets of 0,3 - 0,5 mm in thickness, after being cut into pre-determined lengths, with their edges squared and leveled do not require an ulterior treatment, and pass directly to storage.

Sheets of a thickness higher than 0,5 mm. must pass now to the transversal shearing line, across the traction leveling line, and re-squaring line, where they are submitted to a more perfect leveling and, in the four plate shears available in the line, they are cut into the exact order sizes. Once packed, they pass to storage.

Coils requiring a surface hardening -just as it has been said above-pass to the temper mill. They can follow, later on, two different paths: through the transversal shearing line, to be cut in pre-determined lengths. This quality is then packed and stored. - When the need arises of producing narrow sheets or bands, the - coils coming from the temper mill pass through the longitudinal - shearing line to be directly sent to storage, those being 0,3 - 0,5 mm. thick.

The ones thicker than 0,5 mm will go through the traction leveling and resquaring line and, later on, to storage.

Sheets to be finished by polishing will go directly from the temper mill, either to the transversal shearing line or to the longitudinal shearing line, according to the width order. Every sheet thus processed will go through the traction leveling and resquaring line and, later on, to the sheet polishing station and, again, to the traction leveling line.

Finally, strips or beaded sheets in the form of coils can be obtained, passing the coils, after being processed in the temper mill, through the longitudinal shearing line. The products thus obtained go then to storage.

It can, therefore, be seen that there are two final qualities, depending on the coils or sheets having been processed or not through the temper mill.

II. 2. Phase 2 (Steel plant and hot-rolling plant)

Scrap coming from outside will stored in scrap pits located in a hall readily accesible from outside and, if necessary, accessible from the railway line.

At the same time, the ferro-alloys to be added -fundamentally ferro-chrome and ferro-nickel- will be stored in this hall, for stainless steel has in its analysis a contents of a 18% Cr and a 8% Ni.

The charge of scrap and additives is taken to an electric-arc furnace by means of a travelling crane transferring the load with a basket in two times.

After making, at least, two slags and when the furnace charge has been sufficiently refined, in a time estimated of 4 h 20'. from tap to tap as an average, the metal will be cast into a ladle hanging, too, from the crane.

In this project, the casting will be made through an one strand Continuous Casting Machine for Slabs, where a product with the optimal size to feed the planetary mill will be obtained.

A re-heating furnace has been provided for the heating of the slabs feeding the planetary hot-rolling mill. Their movement is performed by stringers, according to the most modern system of exclusion of water-joints by means of the appropriate form or shape of the stringers. This furnace will burn fuel-oil and it will include two heating zones.

The heated, slabs will be rolled in a planetary mill whose backing rolls will have a diameter of about 1.290 mm and the working rolls a diameter of 185 mm, with a 1.400 mm face

The capacity of output of this mill is far superior to the one necessary for the cold rolling plant anticipated, but with planetary mills it is not possible to pass into lower capacities, and a mill of this capacity is necessary to obtain the desired qualities.

At first, the mill could be in one shift operation and. later on, with the purpose of duplicating its output, make it work in two shifts, together with the installation of a second electric-arc furnace.

The sheets, after being finished, will be coiled up and taken to the cold-rolling bay described in the preceding paragraph.

II. 3. Plant layout and dimensions

The area corresponding to the Phase 1 (cold rolling) is of about 31.500 m^2, including the following bays:

- One bay for the box annealing furnaces, 105 m. long and 30 m. wide.
- One bay for the annealing and pickling continuous lines, 270 m. long and 25 m. wide.
- One bay where the SENDZIMIR and temper mills will be located, 270 m. long and 30 m. wide.
- One bay for the motor room and miscellaneous equipment, 270 m long and 20 m. wide.
- One finishing and storage bay 270 m. long and 30 m. wide.

The four last bays are backed against each other, in a longitudinal direction. The box furnaces bay is perpendicular to the preceeding ones and is situated at the head of them.

The area corresponding to the phase 2 (steel plant and hot-rolling plant) is of about 22.512 m^2.

In the annexed drawing, the general disposition of phases 1 and 2 of the proposed plants is shown.

III. SPECIFICATIONS

III. 1. Phase 1 (cold rolling)

III. 1. 1. Box annealing furnaces

They are intended for the annealing of the ferritic stainless steel coils, in groups of three, piled or stacked per furnace:

- Number of furnaces	4 units
- Max. annealing temperature	900 ºC
- Outer diameter of the coil	1. 350 mm (max.)
- Inner diameter of the coil	610 mm.
- Width	1. 370 mm (max.)
- Thickness	3 to 5 mm.

III. 1. 2. <u>Coil preparation line, previous to cold rolling</u>

- Types of steel to be treated: AISI, series 300 and 400
- Production capacity: 3. 500 metric tons/month (based on an average thickness of 3 mm.)

<u>Inlet products</u>:

A) Hot rolled coils of the following characteristics:

Inner diameter	610 mm.
Outer diameter	1. 397 mm.
Width	660 to 1. 370 mm.
Thickness	2 to 5 mm.
Weight	6. 500 kg (max.)

B) Sheets of the following characteristics:

Width	600 to 1. 370 mm.
Thickness	2 to 5 m.
Length	10. 000 mm. (max.)
Weight	540 kg (max.)

<u>Exit products</u>:

Coils and sheets of the following characteristics:

Inner diameter	610 mm.
Outer diameter	635 to 1. 270 mm.

Thickness	2 to 5 m.
Weight	6.500 kg (max)
Working speed	12 to 36 m/min
Threading speed	12 m/min
Driving side	Right hand

III. 1. 3. <u>Continuous annealing and pickling line</u>

<u>Materials to process</u> Stainless steels, series AISI 300 and 400

<u>Characteristics of the coils</u>:

Hot-rolled coils, with an inner diameter of 610 mm., an outer diameter of 1.100 mm. 635 to 1.270 wide and 2 to 5 mm. thick, with a maximum weight of 6.500 kg.

<u>Working speeds</u>:

Inlet section	3 to 60 m/min
Processing section	3 to 26 m/min
Exit section	3 to 60 m/min
Threading	30 m/min
Starting speed under load	6 m/min
Slow speed	3 m/min

III. 1. 4. <u>SENDZIMIR mill ZR-22B-50, for cold-rolled strip</u>

<u>Rolls diameters</u>:

Working rolls:	
∅ 54 mm.	Table 1.394 mm.
First inner rolls:	
∅ 102 mm.	Table 1.439 mm
Driving rolls:	
∅ 173 mm.	Table 1.344 mm

Idler rolls:

ø 173 mm. Table 1.380 mm.

Support bearings:

ø 300 mm. Width: 172,64 mm

6 per axis, that is, a total of 48

Distance inter bearings:

216 mm.

Data on the coils

Height of the pass-line: - 900 mm

Material to be rolled: Low carbon stainless steels, series AISI 300 and 400.

Max. outer diameter of the coil: - 1.300 mm. without paper, 1.400 mm. with a sandwiched paper.

Inner diameter of the coil: 610 mm.

Max. weight: - 7.500 kg.

Width: - 610 to 1.270 mm.

Max. feeding thickness: - 6,35 mm.

Normal working thickness: - 5 mm., in stainless steel.

Final thickness: - 0,4 mm. in stainless steel 1.250 mm. wide;
0,3 mm. in stainless steel 1.000 mm. wide

Mill's specifications

Main motor: Direct current, 2.250 H.P.

Rolling speed: 0/150/300 r.p.m.

Coiling tension: Max. 34.000 kg., at 300 r.p.m.
Min. 1.700 kg.

Winder's motor: Direct current, 80 H.P.

Winder's tension: Max. 4.000 kg.

Min. 1.000 kg.

III. 1. 5. Grinding and polishing lines

A line proper to eliminate surface defects. It may be also used to polish the strip.

Material: Stainless steel

Strip thickness	0,8 to 3,0 mm
Strip width	600 to 1.320 mm
Coils: Inner diameter	610 mm
Outer diameter	max. 1.360 mm.
Speed	6,1 to 24,4 m/min
Feeding speed	10 m/min. aprox.

III. 1. 6. Temper mill

Two-high reversible, for low-carbon stainless steels

Rolls: 700 mm. diameter

Table: 1.420 mm

Coils: Inner diameter, 610 mm.

Max. outer diameter, 1.690 mm

Max. outer diameter, with paper, 1.800 mm.

Max. weight, 6.500 kg.

Rolling width: 600 to 1.320 mm.

Thickness: 0,18 to 2,3 mm.

Rolling speed: 0/100/150 r.p.m.

Main motor: Direct current, 220 kW, 0/600/900 r.p.m.

Coilers' motors: (2) direct current motors: 110 kW, 0/300/1.200 r.p.m.

Coiling tension: Max. 6.000 kg. a 110 m.p.m.

Min. 600 kg.

The mill is of the single driving roll type This charac-teristic, unadvisable in the case of rolling mills, is no inconve-nience in the case of temper mills, taking into account that the higher difficulty in the entry side and its lower reductions pre-sent no objection in this kind of operation.

It presents, on the other hand, the advantage of a much lower cost, due to the absence of a pinion box, which has been substituted by a simple speed reducer. Another advantage is - that being both rolls mechanically independent, their diameter may be slightly different, without any harm to its operation, -- thus reducing the maintenance costs, with a better efficiency and a better finishing.

Many other advantages offered by this type of mill must be omitted, letting them for the final project, in order to pre-vent that this description may result too prolix.

III. 1. 7. Transversal shearing line

Output:	3.000 t/month, based on a 0,8 thickness
Raw material:	Stainless steel coils, series AISI 300 and 400.
	610 mm. inner diameter
	1.690 mm. max. outer diameter
	600 to 1.320 mm. wide
	0,1 to 2,3 mm. thick
	6.500 kg. max. weight
Max. cutting length:	10.000 mm + 100
Min. cutting length:	1.800 mm.

Max. stacking length:	5.100 mm
Inlet leveler speed:	24 - 61 m.p.m.
Table roller speed at the shear's exit:	Max. 70 m.p.m.
Exit leveler speed:	Max. 80 m.p.m.
Threading speed:	15 m.p.m.
Max. stacking height:	460 mm
Driving side:	Right hand

III.1.8. Longitudinal shearing line

The cutting is made by traction, the bands being cut into the required number of narrower bands, perfectly coiled afterwards in the several mandrels at the exit side.

The inlet material is formed by coils, ∅ 1.690 mm without paper and ∅ 1.800 mm. when a sheet of paper has been sandwiched inter coils.

Coils. inner diameter	610 mm
max. weight	6.500 kg.
width	600 - 1.320 mm
Thickness	0,18 - 3,00 mm
Line speed	25 - 50 m.p.m.
Threading speed	15 m.p.m.
Max. number of cuts:	10 cuts in a material 3 mm. thick, at 25 m.p.m.

In order to assure a good efficiency, the change in this machine is made very quickly: not more than 5 minutes are needed. This is achieved with the provision of two cutting heads, permitting that the knives may be ready before the assembly.

Its traction system does not require a control or hand-setting of the speed, as it is the case of other types making use of resharpened knives. The bands of a thickness up to 1, 6 mm. if they want to get a perfect cut, must only depend on the griping rolls. When they are 1,6 - 3,00 mm. thick, the operation is helped by a tension coiling unit; it is not required, however, the forming of a loop nor the employment of larger diameter - knives.

III. 2. Phase 2 (Steel plant and hot rolling plant)

III. 2. 1. Steel plant

Electric furnaces:

Units:	1
Capacity:	35 t.
Shaft diameter:	4, 5 m.
Electrode diameter:	450 mm.
Transformer capacity:	19. 000 kVA
Weight of mechanical part: (without refractory)	200 t.
Input voltage:	30. 000 V
Output voltage:	270/96 V
Water (cooling):	1 m^3/h/t
Rotation of roof:	57 deg.
Tilting onwards:	42 deg.
Tilting backwards:	15 deg.
Load regulation:	in 16 steps
Reactance coil capacity:	2. 000 kVA

The charging of the electric furnace will be made in two times with a 30/5 t. portal crane presenting the following characteristics:

Main lifting speed:	3 m.p.m. with a 30 H.P. electric motor
Auxiliary lifting speed:	12 m.p.m. with a 30 H.P. electric motor
Trolley's translation speed:	30 m.p.m. with a 6 H.P. electric motor
Crane's translation speed:	60 m.p.m. with a 16 H.P. electric motor
Crane total weight:	36 t.
Control:	Of a indirect type, with master controls

III. 2. 2. Casting bay

Continuous casting machine:

- Number of machines:	1
- Casting radius:	6 or 8 m.
- Number of strands per machine:	1
- Casting dimensions:	1.250 x 120 mm.
- Extraction speed:	0,5 - 1 m/min
- Casting temperature:	1.515º C
- Type of casting ladle:	Stopper
- Ladle capacity:	35 t.
- Casting time:	max. 60 minutes
- Number of distributors:	2
- Distributor capacity:	526 l.
- Ingot moulds:	copper, plates type

The casting bridge will have 2 hooks, 50/10 t. presenting the following characteristics:

- Main lifting speed:	6 m.p.m. with a 102 H.P. electric motor.
- Auxiliary lifting speed:	12 m.p.m. with a 35 H.P. electric motor

- **Trolley's translational speed:** 30 m.p.m. with a 8 H.P. electric motor
- **Bridge translational speed:** 60 m.p.m. with a 35 H.P. electric motor
- **Portal crane weight:** 80 t.
- **Control:** Of a indirect type, with master controllers

At the same time, there will be another portal crane, 10 t. for the service of the hall, presenting the following characteristics:

- **Lifting speed:** 15 m.p.m. with a motor of 40 H.P.
- **Trolley's translational speed:** 40 m.p.m. with a 20 H.P. electric motor
- **Bridge's translational speed:** 80 m.p.m. with a 15 H.P. motor
- **Portal crane total weight:** 25 t.
- **Control:** Direct

- Emergency pits for the Continuous Casting Machine, in the immediate proximity of the machine; in case of inconvenients presented in the last moment, the casting will be made into them.
- Ladles and stoppers heating pits.
- Ladle preparation equipment
- Distributors preparation equipment (M.C.C.)
- Scale for ladles full of liquid steel in the hook of the 50 t. portal crane.

III. 2. 3. Rolling bay

Heating furnace for semiproducts:

- Type of furnace: Continuous
- Product to be heated: Slabs of 1.250 x 0,120 x 6 m.
- Quality of steels: Stainless 18/8 or similar
- Output: 80 t/hour
- Charge temperature: Ambient
- Heating temperature: 1.350º C
- Charging into the furnace: Frontal
- Discharge from the furnace: Frontal
- Fuel: Fuel-oil of 10.000 kc/kg

Dimensions:

- Useful length: 150,00 m.
- Useful width between walls: 25,00 m.
- Max. total width: 28,00 m.

Rolling mill:

- Type of mill: Planetary
- Max. capacity of output: 420.000 t/year (in 3 shifts)
- Backing rolls: ∅1.290 mm.
- Working rolls: ∅ 185 mm.
- Number of working rolls: 24 per backing roll
- Rolls width: 1.420 mm.
- Feeding rolls: 4
- Feeding rolls diameter: 875 mm.
- Inlet product: Slabs of 1.250 x 0,120 x 6 m.
- Exit product: Coils, 3 to 5 mm. thick and 1.370 mm. wide.

- **Rolls pressure:** Through hydraulic cilinders
- **Pressure force:** 1,5 times rolling force
- **Auxiliary elements** Edger rolls
  Head and tail shear
  Coiler
  Coil transfer
  Levelers
  Roller conveyor
  Sheet cutting station
  Sheet stacker

- **Portal crane**

Two 15 t. portal cranes of the following characteristics will be installed:

- **Lifting speed:** 12 m. p. m., with a 50 H. P. electric motor
- **Trolley's translational speed:** 80 m. p. m. with a 25 H. P. electric motor
- **Total weight:** 30 t.
- **Control:** Indirect, with master controllers

IV. INVESTMENTS

The estimated investments for the erection of both phases are the following:

IV. 1. First phase (cold rolling

Structures:

- Steel	US $	550. 000
- Concrete	US $	240. 000
- Pits, roofs and brick-work	US $	150. 000
- TOTAL	US $	940. 000

Equipment:

- Box heating furnaces	US $	236. 500
- Coil preparation line	US $	850. 000
- Annealing and pickling continuous line (nº 1)	US $	3. 877. 800
- Annealing and pickling continuous line (nº 2)	US $	4. 275. 000
- SENDZIMIR mill	US $	4. 575. 800
- Grinding and polishing line	US $	935. 000
- Temper mill	US $	1. 545. 000
- Longitudinal shearing	US $	375. 000
- Transverse shearing line	US $	621. 500
- Traction leveling and re-squaring line .	US $	625. 500
- Roll grinding machine (Sendsimir mill).	US $	116. 500
- Roll grinding machine (Temper mill) ..	US $	245. 600
- Sheet polishing machine	US $	102. 700
- TOTAL	US $	18. 381. 900
- Transport and assembling of cranes ..	US $	757. 000
- Civil works equipment	US $	1. 450. 000
- Water supply installation	US $	1. 125. 000
- Electric supply installation	US $	1. 825. 000
- TOTAL	US $	24. 478. 900
- Contingencies (10%)	US $	2. 447. 890
- TOTAL 1st. PHASE	US $	26. 926. 790

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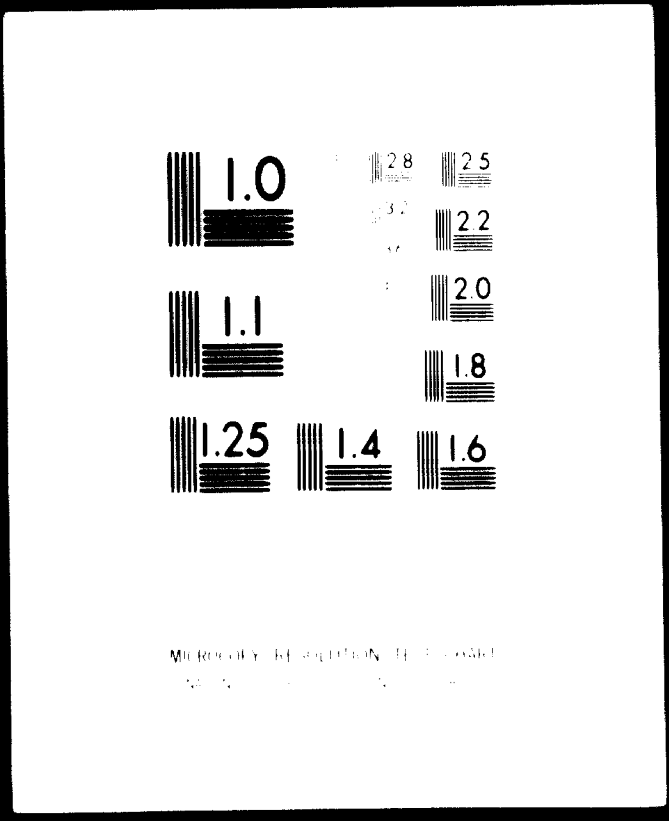

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IV. 2. **2nd. Phase (Hot rolling plant)**

Structures:

- Steel	US $	280.000
- Concrete	US $	100.000
- Pits, roofs and brickwork	US $	90.000
- TOTAL	US $	470.000

Equipments:

Steel plant:

- Electric furnace 35 t., transformer included	US $	500.000
- Civil works, assembling and service pipes	US $	100.000
- Transport and electric auxiliary works.	US $	100.000
- Portal cranes	US $	140.000
- Ladles, baskets, scales	US $	60.000
- TOTAL	US $	900.000

Continuous casting:

- Continuous casting machine	US $	1.900.000
- Water auxiliary equipment	US $	50.000
- Water treating plant	US $	50.000
- Electric equipment	US $	40.000
- Civil works	US $	90.000
- Transport and assembling	US $	110.000
- Portal cranes	US $	120.000
- TOTAL	US $	2.360.000

Rolling plant:

- Planetary mill including:	US $ 10.900.000
Reheating furnace	
Planetary mill	
Coilers	
Baskets installation	
- Total auxiliary services planetary mill..	US $ 650.000
- Piping, cabling, etc.	US $ 500.000
- Portal cranes	US $ 100.000
- Civil works, transport and assembling..	US $ 500.000
- TOTAL	US $ 12.650.000

Miscellaneous elements:

- Laboratory	US $ 200.000
- Offices	US $ 50.000
- TOTAL	US $ 250.000
- TOTAL	US $ 16.630.000
- Contingencies (10%)	US $ 1.663.000
- TOTAL 2nd. PHASE	US $ 18.293.000
- TOTAL 1 st. AND 2nd. PHASES	US $ 45.219.790

V. COST AND SELLING PRICES

We are going to study, under this heading, the estimated cost to be obtained in the cold rolling plant (Phase 1), that is, on the basis of employing as starting material hot rolled coils coming from outside the plant in question.

The study of prime cost has been limited to the Phase Number 1, since the starting point of the Phase Number 2 is perhaps to be deferred 7 or more years in relation to the first. An anticipation of the said starting point would be senseless, since the needs of cold rolled products before that moment are not big enough to justify a hot rolling plant of a rentable minimum capacity. It would be convenient, then, before proceeding to its installation, to follow the evolution presented by the market of stainless steel flat products, and to increase the capacity of cold rolling, according to demand, until reaching figures capable of being economically covered by the production of the hot planetary rolling mill.

The prime costs have been determined on the basis of the 40.000 t/year of output supposed in principle, and taking values susceptible of application to the case of Spain, not differing very much from the case of Brazil.

The costs of materials and man-power per ton of cold rolled sheet are as follows:

- Hot rolled coil, flat cost	US $ 863,70
- Water supply, electric power, etc.	US $ 14,20
- Other supplies (tooling, rolls, etc.)	US $ 31,50
- Man-power	US $ 22,00
- General expenses	US $ 55,00
- Total unit cost	US $ 986,40

As far as it concerns to amortizations, a rate of a 8 per cent annual for equipments, and of a 6,75 per cent for civil - works, auxiliary installations, etc., have been estimated.

The total investment on Phase nº 1 is US $ 26.926.790 to be distributed in the following manner:

- Equipments	US $ 19.138.900
- Balance	US $ 7.787.890

The annual amortisation rates will be:

- Equipments (8%)	US $ 1.531.112
- Balance (6,75%)	US $ 525.683
- Total	US $ 2.056.790

The amortisation per ton (40.000 t/year) results into US $/t. 51,42.

Given that the buying of imported equipments will have been made through financing in the origin countries, a financing charge of a 7 per cent on the investment in equipment will have to be taken into account.

- Equipments	US $ 19.138.900
- 7 per cent (Financing Companies)	US $ 1.339.723
- Per ton of output	US $ 33,50

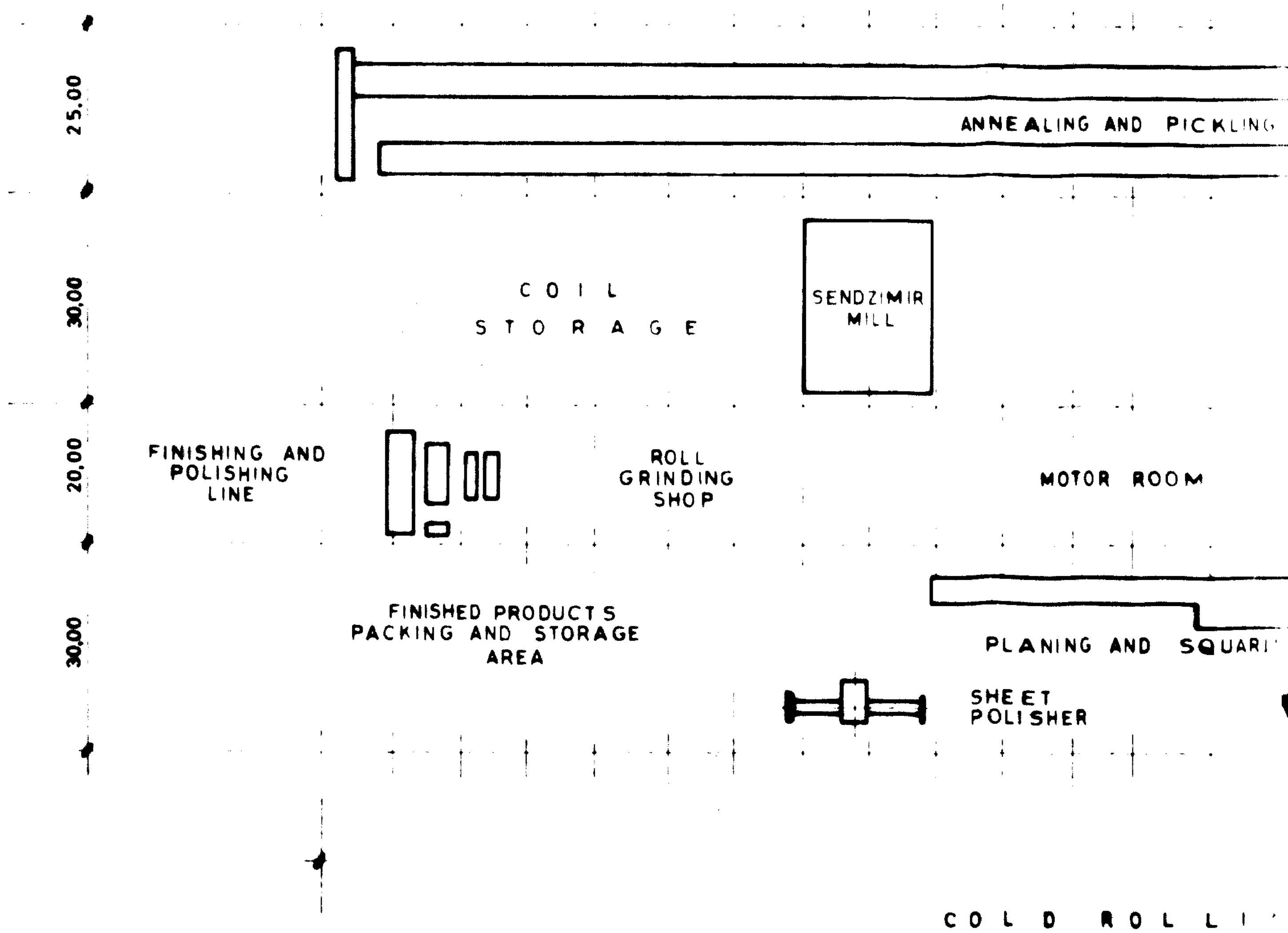
We would, then, have in total, the following costs (per ton of output):

- Materials	US $ 986,40
- Amortisations	US $ 51,42
- Financing charges	US $ 33,50
	US $ 1.071,32

In order to find the selling price, the following items ought to be added:

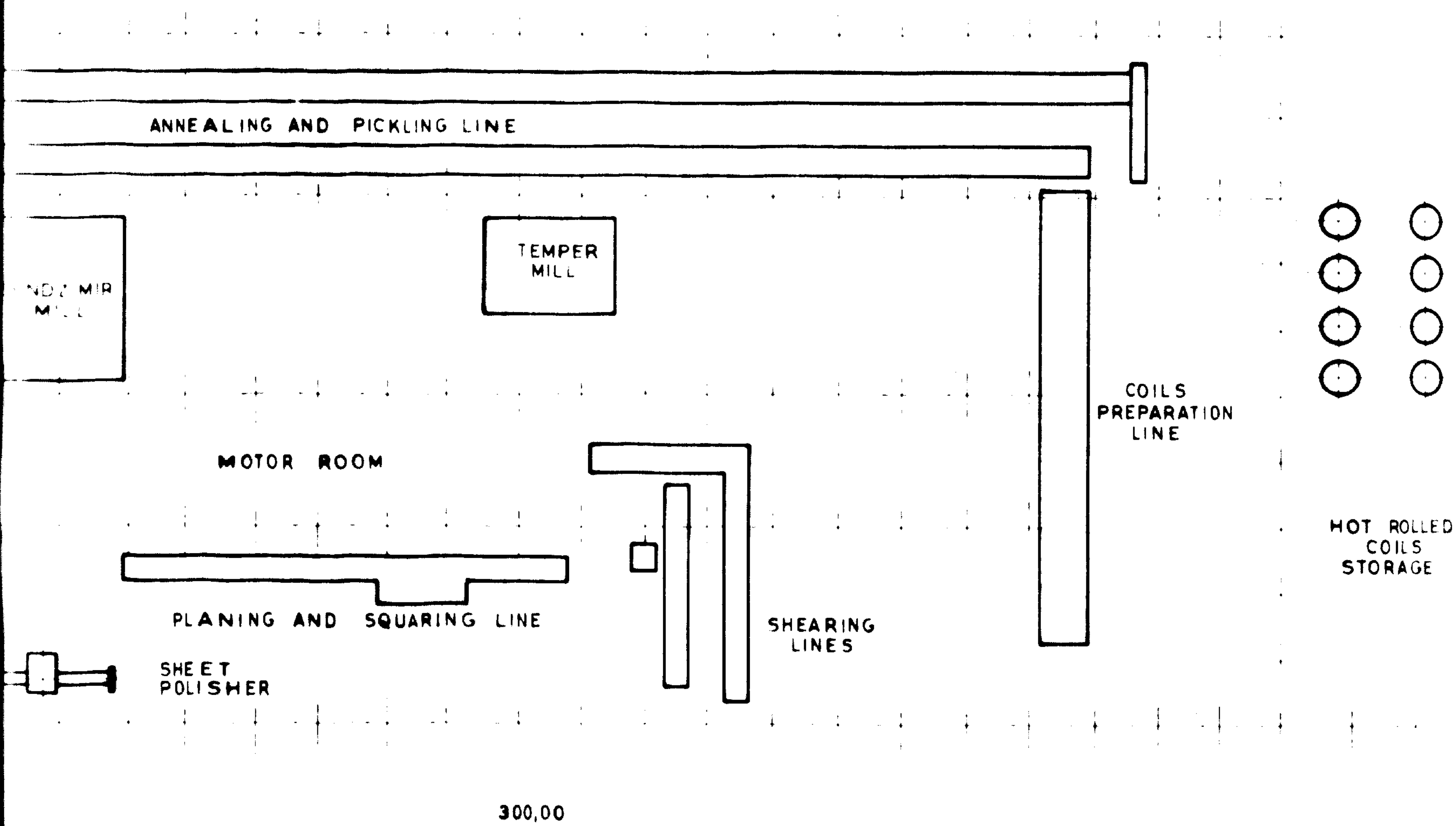
- Taxes
- Profits
- Credits for rolling capital

We have supposed a final selling price of US $ 41 1,760.



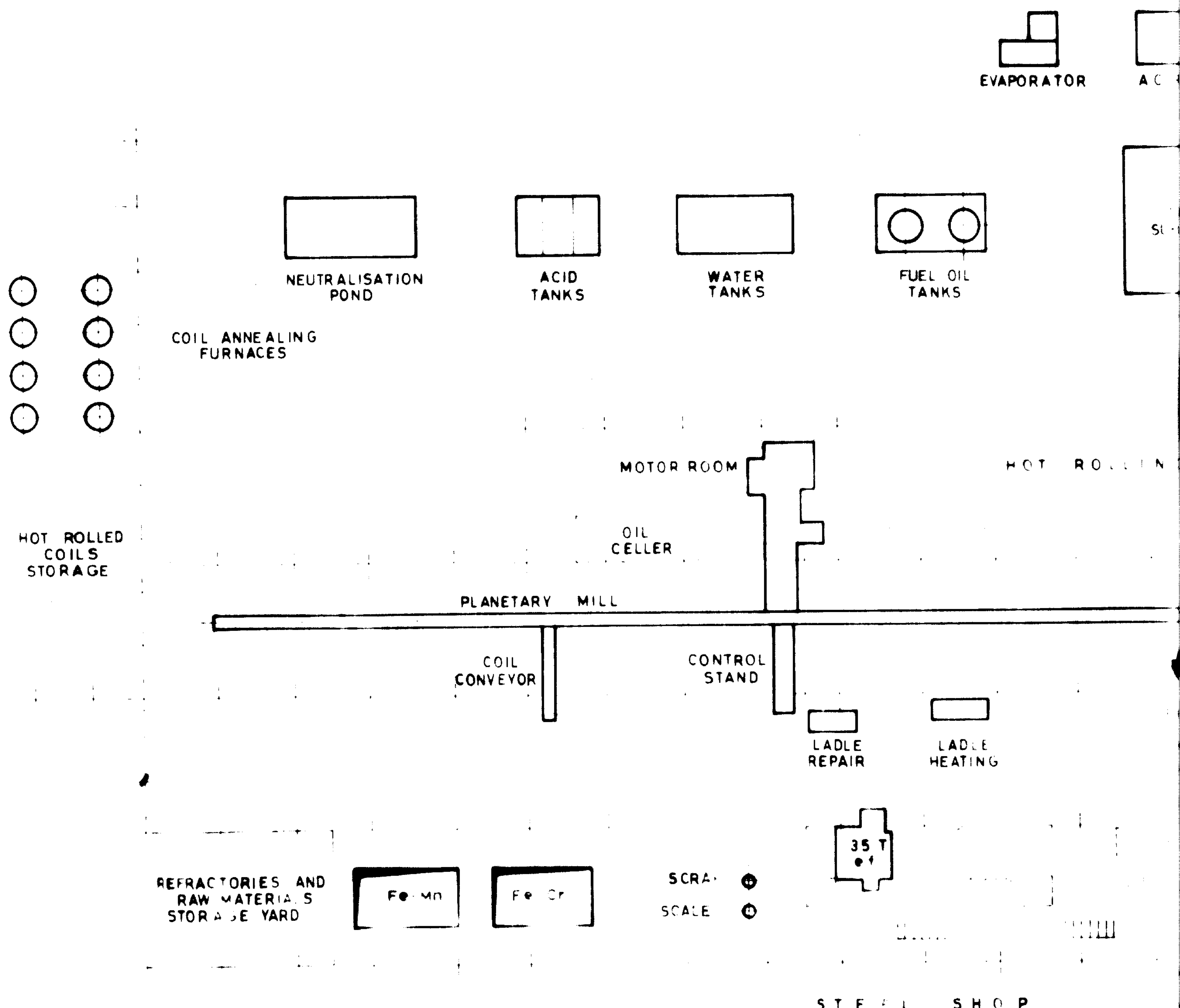
25,00
30,00
20,00
30,00
ANNEALING AND PICKLING
COIL STORAGE
SENDZIMIR MILL
FINISHING AND POLISHING LINE
ROLL GRINDING SHOP
MOTOR ROOM
FINISHED PRODUCTS PACKING AND STORAGE AREA
PLANING AND SQUARI
SHEET POLISHER
COLD ROLLI

SECTION 1

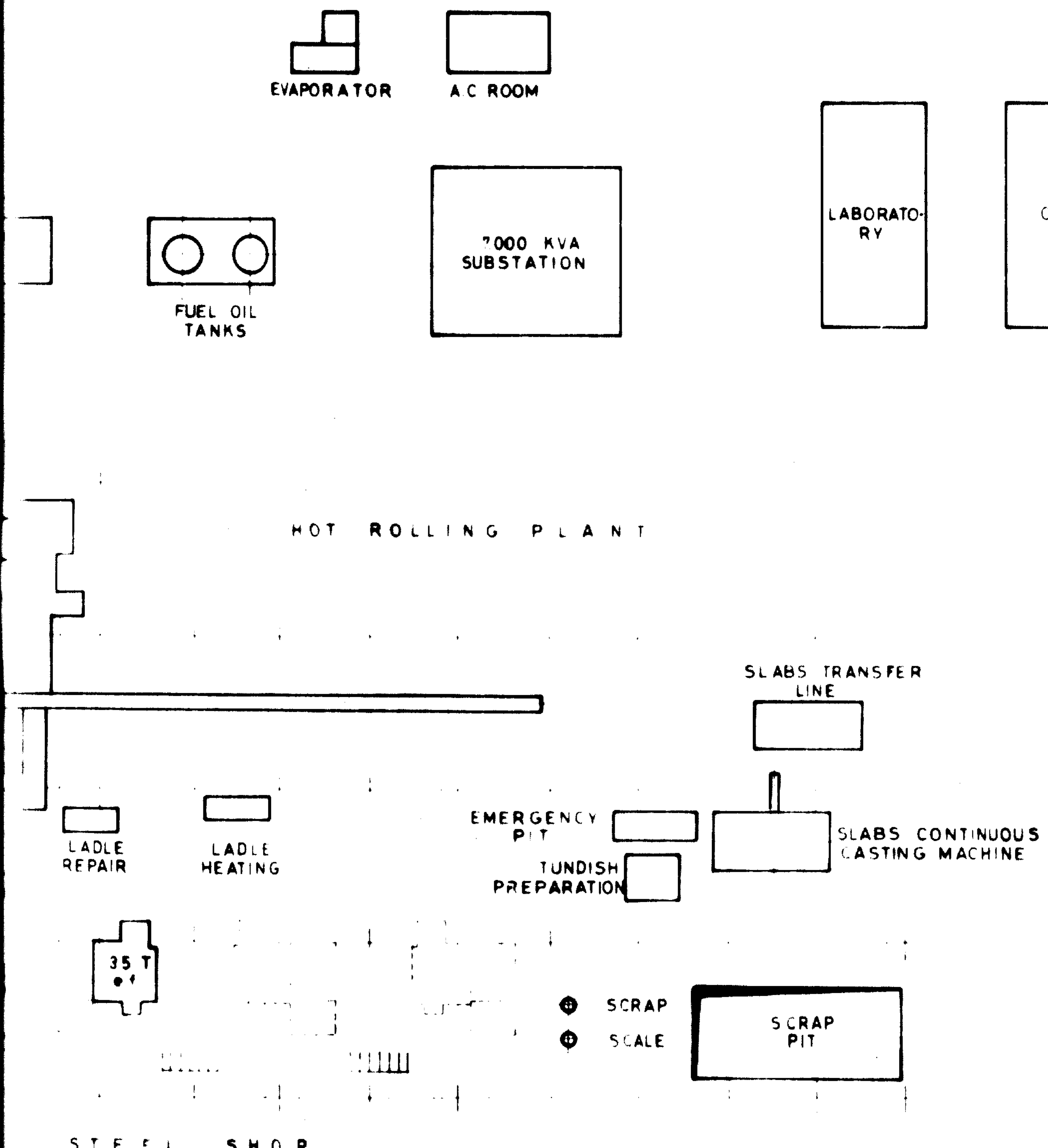


COLD ROLLING PLANT

SECTION 2


EVAPORATOR
NEUTRALISATION POND
ACID TANKS
WATER TANKS
FUEL OIL TANKS
COIL ANNEALING FURNACES
MOTOR ROOM
OIL CELLER
HOT ROLLED COILS STORAGE
PLANETARY MILL
COIL CONVEYOR
CONTROL STAND
LADLE REPAIR
LADLE HEATING
35 T
REFRACTORIES AND RAW MATERIALS STORAGE YARD
Fe Mn
Fe Cr
SCALE
STEEL SHOP

SECTION 3


EVAPORATOR
A.C ROOM
LABORATORY
OFFICE
7000 KVA SUBSTATION
FUEL OIL TANKS
HOT ROLLING PLANT
SLABS TRANSFER LINE
EMERGENCY PIT
SLABS CONTINUOUS CASTING MACHINE
TUNDISH PREPARATION
LADLE REPAIR
LADLE HEATING
35 T
SCRAP
SCALE
SCRAP PIT
STEEL SHOP

SECTION 4

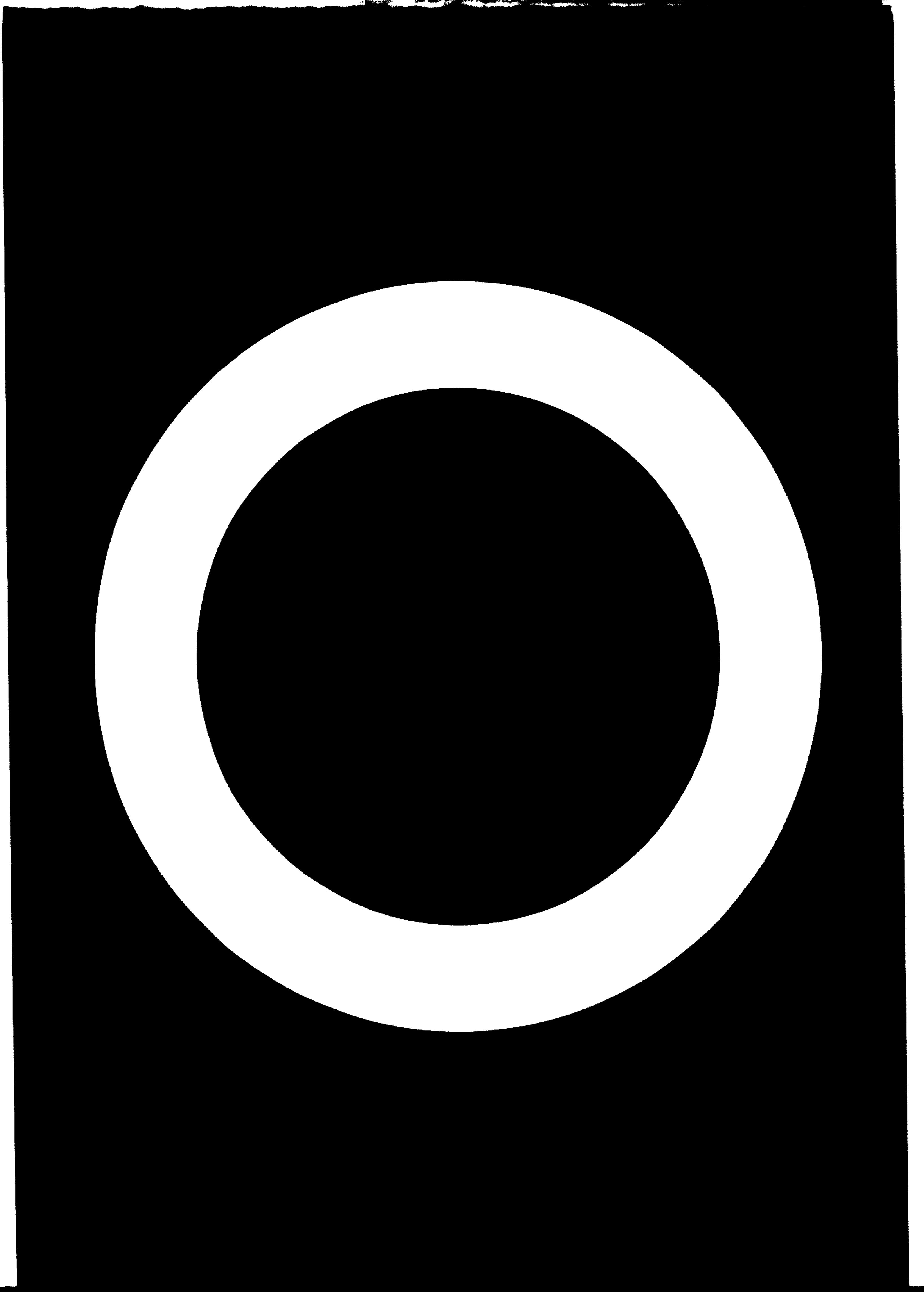
PROPOSED LAYOUT FOR AN STAINLESS STEEL
FLAT PRODUCTS PLANT

SECTION 5

SCALE = 1 : 1000

ANNEX E - 3

F O U N D R I E S



E. 3. 1. INTRODUCTION

Having visited the different industries in Bahia, it has been observed, as noted previously, that there is a lack of foundry industries. Those in operation are artisan and very rudi mentary. However, through our interviews we gathered that there is a sufficient demand for castings which at the moment are being acquired from the South.

Owing to the great distance, numerous problems ari se like additional costs, delays, necessity for warehouse facilities, and difficulties in communication while the selected prototypes are being checked out.

The foundry industry is one of those typical auxilliary industries which is very close to the clients, as its products are subject to drawing specifications, and need quality and dimen sion controls.

The local foundry industry has neither technology nor installations that would permit it to face the problems of its development and so what is most indicated is the establishment of new foundry industries and plants with and adequate technology and equipment.

Undoubtedly, the principal problem arises from the lack of technology to plan and properly operate a foundry, bearing in mind that the industries already established and still to be established in Aratu and Feira de Santana require in many cases a product of very high quality.

Therefore, the first problem to be solved is that of hiring the neccessary specialists for the new foundry plants.

This could be solved in one of two ways

a) Hiring the necessary specialists in Sao Paulo where they can be found in sufficcient number, though their transfer to Bahia would necessitate higher remuneration.

b) That some of the foundries in Sao Paulo open new plants in Aratu

The second problem is that of getting the foundry plants into operation, since it is necessary to make use of local labor, and in this industry, a professional formation is specially required

This point should be closely looked into, since the qua lity of the first products manufactured could play a vital role in the future of the enterprise.

We recommend the establishing of the following types of foundries.

- Iron foundry
- Steel foundry
- Non-ferrous metals foundry

This separation into three foundries is, in our opinion, necessary, since to unite them in one single plant would give rise to more disadvantages than advantages.

These foundries should be located in Aratu's Industrial Center, in order to adequately supply the present and future mar ket of castings created by the erection of the new industries of - such center. One exception would be the location of the steel - castings foundry, that could use as starting point the Siderurgica de Santo Amaro, provided that their present facilities were totally revamped and adapted to the new industrial thinking that the foundry industry needs in Bahia. If that if not possible, the present installa tions of Santo Amaro would be useless from a modern foundry's point of view, and Aratú should be chosen as locating point.

E. 3. 2. IRON FOUNDRY

I. Production

The type of products will be:

- Gray iron castinge
- Alloy iron castinge
- Nodular iron castings

Malleable iron has not been considered necessary because of the difficulties it entails and type of market it commands (principally the automobile), and besides, it can be substituted in many cases by the nodular. Also, there is not a sufficient demand to justify its installation which generally is very costly.

As regards moulding systems the procedure should include hand moulding as well as machine moulding for run produced castings.

The foundry should be projected for reaching 500 t/mo. in three stages. These stages are:

1) 125 t/mo. of good castings (1 shift)
2) 250 t/mo. of " " (2 shifts)
3) 500 t/mo. of " " (2 shifts)

II. Equipment

The departments and equipment to be installed are the following:

Raw materials yard

Equipped with the usual installations with the possibility of adding a 3 ton. crane with a lifting magnet.

Furnaces

A 600 KVA, 3-ton coreless low frequency induction furnace should be installed for the first two stages. Two furnaces will be needed in the 3rd stage. The reasone for this selection are the following:

- It is capable of producing all qualities proposed.
- Easy to operate.
- Assures uniform quality
- Permits intermittent working.
- Does not require coke.
- Achieves high melting temperatures.

As has been mentioned before, given the lack of technologists in Bahia, it is necessary to supplement this with an equipment that would insure the quality of the products from the first moment. Melt requirements:

1st.	Stage:	125	tons/mo,	equivalent to	200 tons of melt
2nd.	"	250	" "	"	" 400 "
3rd.	" :	500	" "	"	" 800 " " "

Work is to follow the following schedule:

1st.	Stage:	1 furnace;	10 operating hours;	14 hrs.		maintenance
2nd.	" :	1 "	18 " "	6	"	"
3rd.	" :	2 furnaces;	18 " "	6	"	"

Sand preparation

1 complete sand installation with one mixing mill in the 1 st. stage and two in the 3rd stage. It shall be provided

with:

- Silos for new sand
- Silos for used sand
- Silos for additional sand
- Mixing mill
- Prepared sand distributor for the machines and the sands-linger.
- Recovery channel for sand falling from machines.
- Recovery channel for used sand
- Cooling system
- Disintegrator
- Screening

In the second stage dust absorption points should be provided.

Moulding

a) **Machine moulding**

Considering the productions, the intermittent operation of the furnaces, and the several qualities of metals, we are in favor of a mechanised installation with roller - conveyors.

Number of semi-automatic machines working in - pairs: 6

	Gross Weight	Boxes/Hr.	Prod/Hr.
(2 machines) for casting boxes up to:	8 kg	30	240
(2 machines) for casting boxes up to:	15 kg	20	300
(2 machines) for casting boxes up to:	40 kg	10	400
			940 kgs

Number of machines (2nd stage): 12. Production - 1.880 kg/hr.

Production

1st. Stage: 1 shift 8 hours: 7,5 t/day; 188 t/mo.

2nd. Stage: 2 shifts 16 hours: 15,4 t/day;376 t/mo.

3rd. Stage: 2 shifts 16 hrs.: 30,0 t/day; 752 t/mo.

The machines should be equipped with the necessary riggings and other elements that would permit the movement of the boxes and their closures.

b) Moulding of individual pieces

This will be done with a Sandslinger and a pattern drawing machine.

It should be capable of handling a gross weight of 2 tons of individual pieces, in the first stage. In the second stage, depending upon the circumstances, working with 2 furnaces, it should be capable of producing up to 4 tons (gross).

Complementary to this section there should be another of hand moulding of miscellaneous pieces, which could produce:

	t/day	t/month
1st. Stage, in 8 hrs.	4	100
2nd. Stage in 16 hrs.	8	200
3rd. Stage in 16 hrs.	16	400

readily expandable depending upon the need.

The total gross capacity of the two sections (Manual and Machine) should be:

	t/month	% on melting
1st. Stage (in 8 hrs)	288	144
2nd. Stage (in 16 hrs)	576	144
3rd. Stage (in 16 hrs)	1.152	144

Naturally, the moulding capacity is greater than that of melting by 44 %, and this is due to the fact that the problems usually arise in moulding owing to a multitude of causes.

Core preparation

Depending upon the run sizes, the following core types should be used:

a) CO_2 cores

b) Cold box cores

c) Hot box cores

In the manufacture of cores it is necessary to use high quality systems with which, depending upon the run sizes it is possible to work efficiently.

Stripping

Done by vibrating grates with connections in all moulding zones with the sand recovery installation.

Fettling

a) In the 1st stage with sandblasting.

b) Later, a drum will be added.

Besides, complementary grinders and fine fettling stations should be installed.

Heat treating

For nodular iron a double carriage furnace for heat treating for 24-hour cycles and a production of 50 t/month shall be installed.

In the second stage, depending upon market demands, the furnace that is judged most convenient may be installed.

Laboratories

a) Chemical

In the platform of the furnaces the carbon and silicon shall be analyzed by rapid methods.

In the third stage a direct reading spectrometer - which can give the analysis of 10 elements in 5 minutes should be installed. This equipment is of primordial importance for nodular iron production.

b) Sand testing laboratory

c) Metallographic laboratory

d) Mechanical testing laboratory

Manufacture of Plates

This is a basic section for the correct working of the plant, needing highly specialized technology that will require the recruiting of well trained supervision and subordinate personnel.

III. Investments and profitability (end of 3rd. stage) (in US $)

- Total Investment 1.700.000
- Value of Production (500 t) 2.000.000

- Direct cost of production....	650.000	
- Labor	550.000	
- General Expenses	200.000	
- Amortization	255.000	
- Total		1.655.000
- Yearly Benefits		345.000

E. 3. 3. STEEL FOUNDRY

I. Productions

The demand for steel castings is quite low at the moment, and very inferior to that of iron castings. However the rhythm of growth of the demand makes it advisable to ins tall within three years a steel castings foundry. In any case, a detailed study of the market is necessary, otherwise the ins tallation may not turn out profitable.

One solution that could be used as a starting point is the Siderurgica de Santo Amaro with revamping of its installa- tions and hiring of specialized technicians in its payroll.

This foundry could supply industries in general with the necessary spareparts and the mining industry with manga- nese steel parts.

The process for producing steel castings is difficult, and it is imperative that the necessary technology be assured from the very start to avoid initial failures.

The initial capacity may be estimated at 75 tons of pieces per month (in 2 shifts), starting with 40 tons/month. The installation should be expandable depending upon needs.

II. Equipment

In summary form, only the most important are indi cated:

- 1 Electric furnace with a capacity of 1 ton, 500 KVA. Tap- ped every 3 hours. In 2 working shifts (18 hrs), it produces 6 tons of metal equivalent to 3 tons of finished castings or 75 tons/month.

- 1 Moulding area divided into 2 sections:

  Machine moulding with 2 machines in the 1 st stage (run pro duced pieces); sandslinger moulding (individual units).

- 1 Sand installation equipped in the beginning with only one sand preparation mill. The sand will be transported by means of a crane to the utilisation points.

It shall be provided with an adequately located stripping grate, transferring the sand to the mill after screening and disintegration.

- 1 Installation for cores preparation using in the first stage only selfdrying oils for greater process economy. The installation would be completed with other means in a second stage.

- 1 Fettling installation with sand blasting booth for greater economy in labor.

- 1 Furnace for heat treatment.

- Laboratories for chemical analyses, sand and metallographical testing.

III. <u>Investments and profitability (1 st stage) (in US $)</u>

- Total investment		600.000
- Value of production		1.100.000
- Direct coat of production ...	700.000	
- Labor	80.000	
- General expenses and others.	100.000	
- Amortization	90.000	
- Total		970.000
- Yearly profits		130.000

These profit, which is quite limited in the 1st stage, would favorably change as production increases, reaching adequate figures.

E. 3.4. NON FERROUS METALS FOUNDRY

I. Productions

During our visits we have observed that there shall be a future demand for aluminium die castings, and in the more distant future for aluminium pressure castings. There also exists a demand for replacement parts in brass and in bronze.

Consequently, it is advisable to install a non ferrous metals foundry in Bahia, as this would solve the problems of the new industries in erection. Otherwise they would be constrained to depend upon the South for their replacement parts and run produced pieces. By its own right, this metal smelter would have a relative justification. It should be borne in mind however, that Bahia needs an automobiles spare-parts industry that can also manufacture, liners pistons and rings. Such an industry is highly interesting for Bahia because of the rapid growth of its automobile park, and besides, in almost all the countries of the world, that industry does not depend upon the automobile industry. Such an industry would require centrifugally cast iron rings for liners and rings and aluminium die castings for the manufacture of pistons.

Consequently, the foundry would be tied up with the manufacture of liners, pistons and rings and they could fill out outside orders for aluminium sand castings and aluminium die castings.

In a more distant future, aluminium pressure castings could be produced if there should be a demand for these series.

A foundry with the following units should be installed:

- Aluminium foundry
- Copper alloys foundry
- Centrifugal iron foundry

II. Basic installations

Aluminium foundry

1º) Die castings foundry

Core induction furnaces of 50 KW, in sufficient number to insure production shall be installed. It is possible to commence with 2 furnaces and add until the necessary units are reached. The die casting machines will adjoin the furnaces.

The necessary sections will be fettling and heat treatment

2º) There shall be installed a moulding section for aluminium sand castings to be developed according to the demands of the market.

Copper and Brass Foundry

Equipped with 2 crucible furnaces with a moulding area joined to that corresponding to the aluminium sand castings.

Centrifugal iron castings

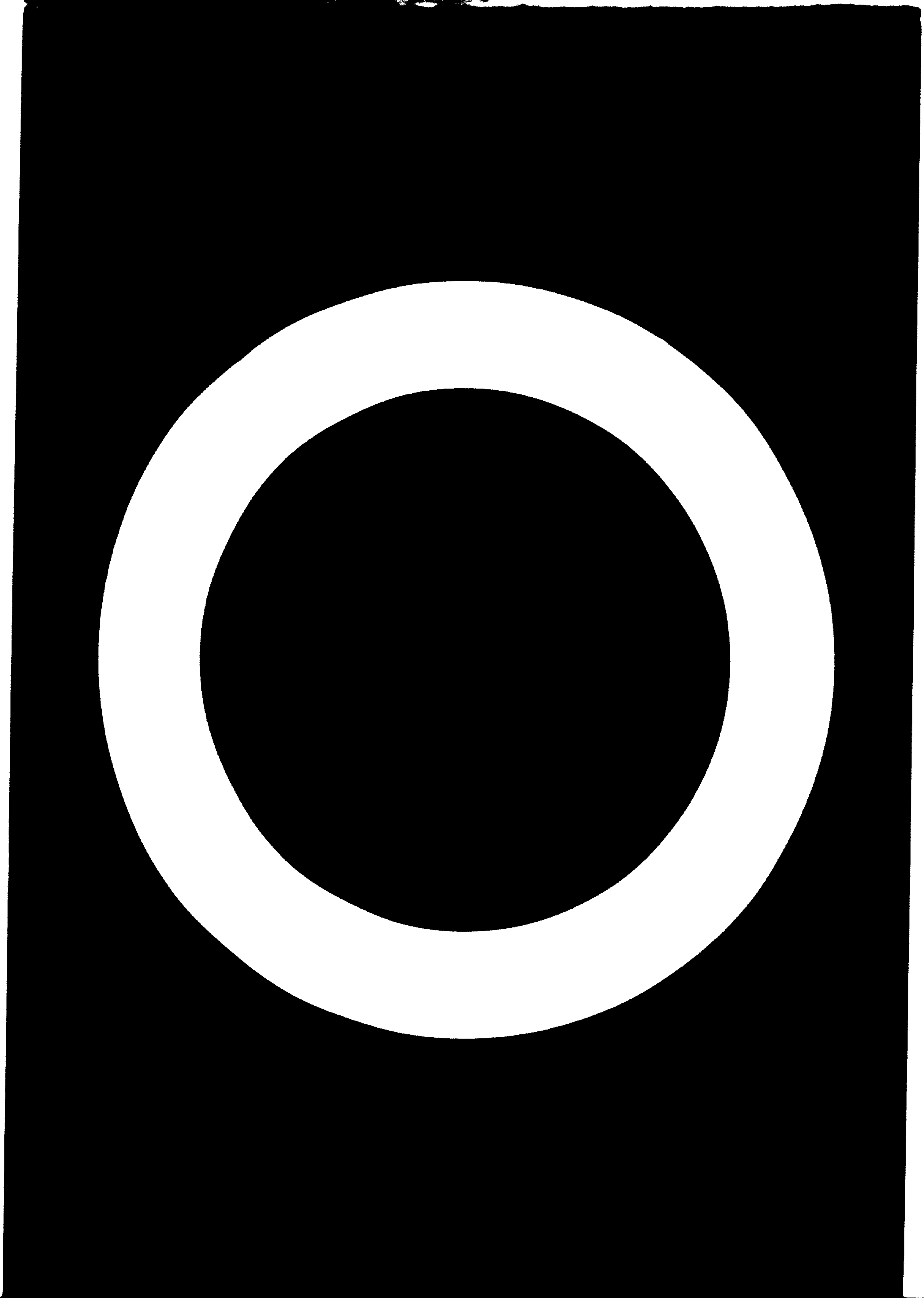
This should be planned in accordance with the dimensions of the machining installation for liners and rings recommended earlier. However, this industry is not the object of this report. Once the adequate capacity of this industry is determined, it is easy to establish the dimensions of the cen-trifugal iron rings foundry.

It should be composed of the following sections

- Induction furnaces
- Centrifugation machines
- Sandblasting
- Head-cutting lathes
- Heat treating furnaces

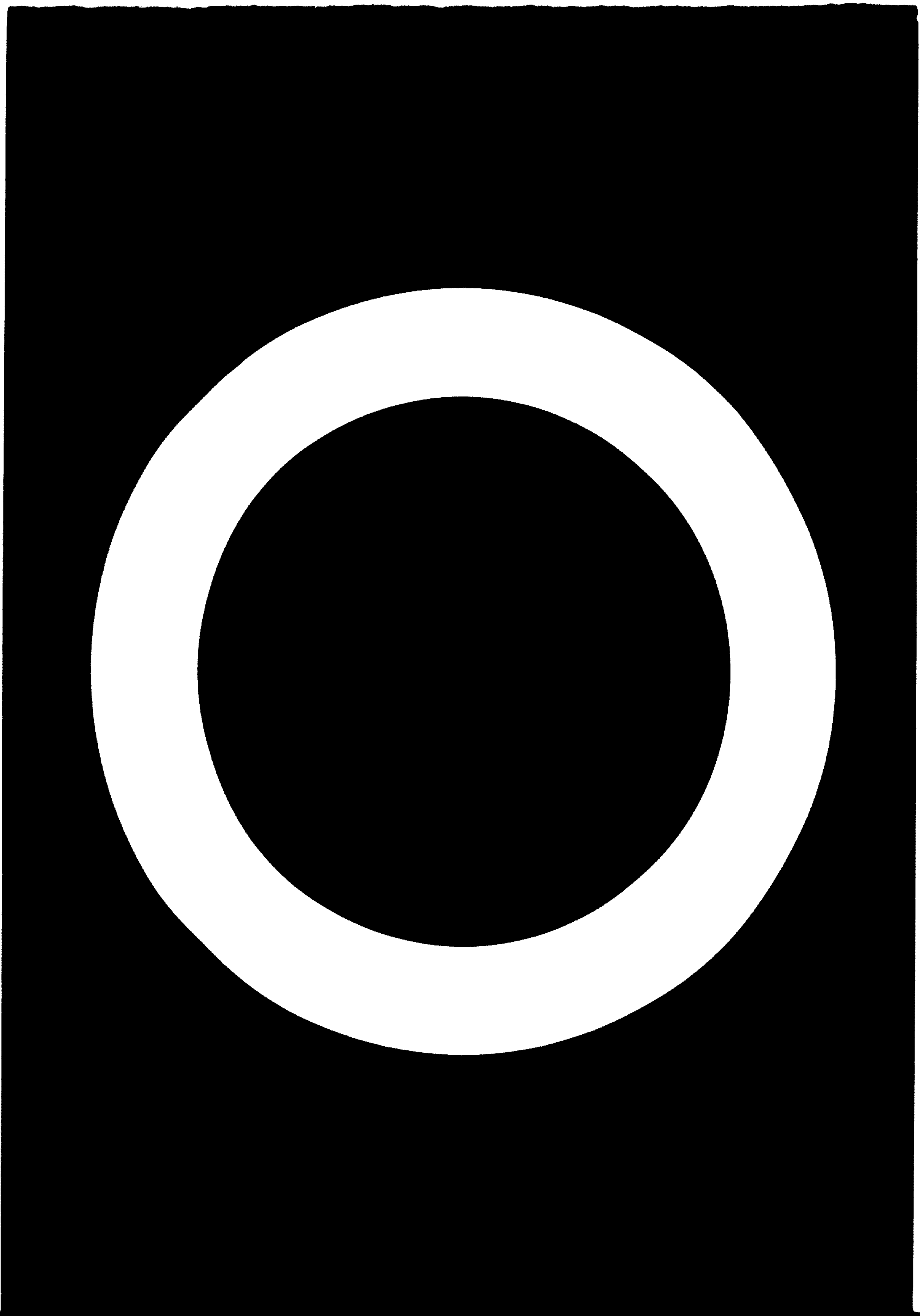
III. Investments and profitability

Without a more thorough study of market demands, we consider it risky to speak of dimensions and profitability of the above foundries. In any case, the installations should always be able to rely upon the technical assistance of an internationally renowned firm who would be in charge of providing the necessary "know-how" for the manufacture of liners pistons and rings.



ANNEX B-4

SHEARING LINES



INTRODUCTION

As it has been pointed out in paragraph D. 1. 4. 7. it would be profitable to install in Bahia shearing lines using as raw materials the coils furnished by the leading steel plants located in the South region.

Outside a few exceptions, the majority of metal sheet users could take advantage of using as source of supply the proposed shearing lines plant, as only in rare cases the orders of such users would be higher than 50 tons.

Furthermore the need for non standard sizes is frequent, with the inconvenient that all requirements which are outside standards are not accepted normally by the big steel companies, and if they are accepted, it is with a longer delivery and extra charges.

In the following paragraphs the basic installations of the proposed shearing lines plant are described.

This plant should be located in Aratú, in order to cover the needs of the several sheet using industries presently erected and the foreseable new ones to be located in the future in such industrial center.

1. **BASIC INSTALLATIONS**

The present installation is based on an average annual production of from 30 to 40 M tn of cut sheet - from either cold rolled or hot rolled coils, as well as skelp obtained from longitudinal cuts of the cold or hot rolled coils.

Even if the serviced market may be very variable according to its requirements, a typical distribution pattern is discerned in the following:

Usage	Cold rolled sheet (%)	Hot rolled sheet (%)
Containers	-	10
Stamping	10	3
Metal furniture & appliances	15	-
Metal shelves	2	-
Industry in general (steel ware houses & boiler shops)	30	30
	57	43

The installations consist of a longitudinal shearing line and two transversal shearing lines, one of which is for the cutting of cold rolled coils and the other for hot rolled coils.

The longitudinal shearing line has the primary objective of serving as the preparatory line of the transversal cutting lines and also of the production of skelp for sale.

Three manually operated shears shall be installed as auxiliary elements of the shearing lines for filling orders of special cut sizes.

II. **BASIC EQUIPMENT:**

Longitudinal line

This line cuts longitudinally both the hot and cold rolled coils and consistes of the following elements:

- Inlet decoiler
- Leveler
- Circular shear
- Outlet coiler mandrels

The resulting coils subsequently pass on to the transversal shearing lines of either the cold or hot rolled coils, respectively, and the skelps, if these latter are produced, go to the warehouse of products for sale.

Transversal shearing lines for cold and hot rolled coils

These consist of the following elements:

- Inlet decoiler
- Leveler
- Shear
- Conveyor plane
- Outlet stacker

Both lines make as end products, metal sheets of standard sizes with a 2:1 ratio between length and width.

Auxiliary Shears

Three hand-operated shears will be installed, two of which will be utilised for straight cutting and the third, circular in shape, for bottoms and domes cutting.

III. SPECIFICATIONS

Longitudinal line

- Maximum width of coils .... 1.500 mm
- Speeds:
  - Maximum .... 90 m/min
  - Actual .... 70 m/min
  - Minimum .... 20 m/min
- Thicknesses (several cuts) .... 0.5-8 mm.
- Thicknesses (slitting) .... 5/6 mm(max.)

Transversal line (hot rolled coils)

- Maximum width of coils .... 2.000 mm
- Maximum speed .... 18 m/min
- Thicknesses .... 2 to 8 mm

Transversal line (cold rolled coils)

- Maximum width of strips .... 1.500 mm
- Maximum speed .... 50 m/min
- Thicknesses .... 0,4 - 3 mm

Production capacities

The maximum capacity of the two transversal lines is estimated at 3.000 t/month on one 8-hour shift, with the capacity of the longitudinal line being more than sufficient, given its high cutting capacity, to take care of the preparatory work for the maximum production of the transversal lines indicated above and for the existing skelp market.

IV. **PLANT DISPOSITION AND DIMENSIONS**

The covered tract required is 6.300 sq. m. with the lo-cation of the equipment in three bays of 100 meters long and [illegible] me-ters wide each, in accordance with the attached schematic drawing. The storage of the hot rolled coils is done in the first area, which is serviced by a bridge crane of 20 tons. capacity. The cold rolled coils are stored in the center bay, which also has a 20 ton bridge crane. The third bay provides for the storage of finished products and the three auxiliary shears, and is serviced by two bridge cra-nes with a capacity of 5 tons each.

V. **INVESTMENTS**

- Industrial equipment	$ 2.000.000
- Buildings and auxiliary services	$ 1.000.000
	$ 3.000.000

VI. **START UP**

The installation of this plant can be done in stages - seeking the most profitable shearing line in order to proceed gra-dually with the investments.

VII . **COST AND SELLING PRICES**

As has been shown, the selling price has available the following margins:

1. For orders lower than 50 tons: 30%
2. For made-to-measure cuts: 12 to 20%
3. For special cuts: variable margins according to sheet utilisation

The above provide for an ample margin which is not - easy to evaluate here since the factors which must be considered in the cost are:

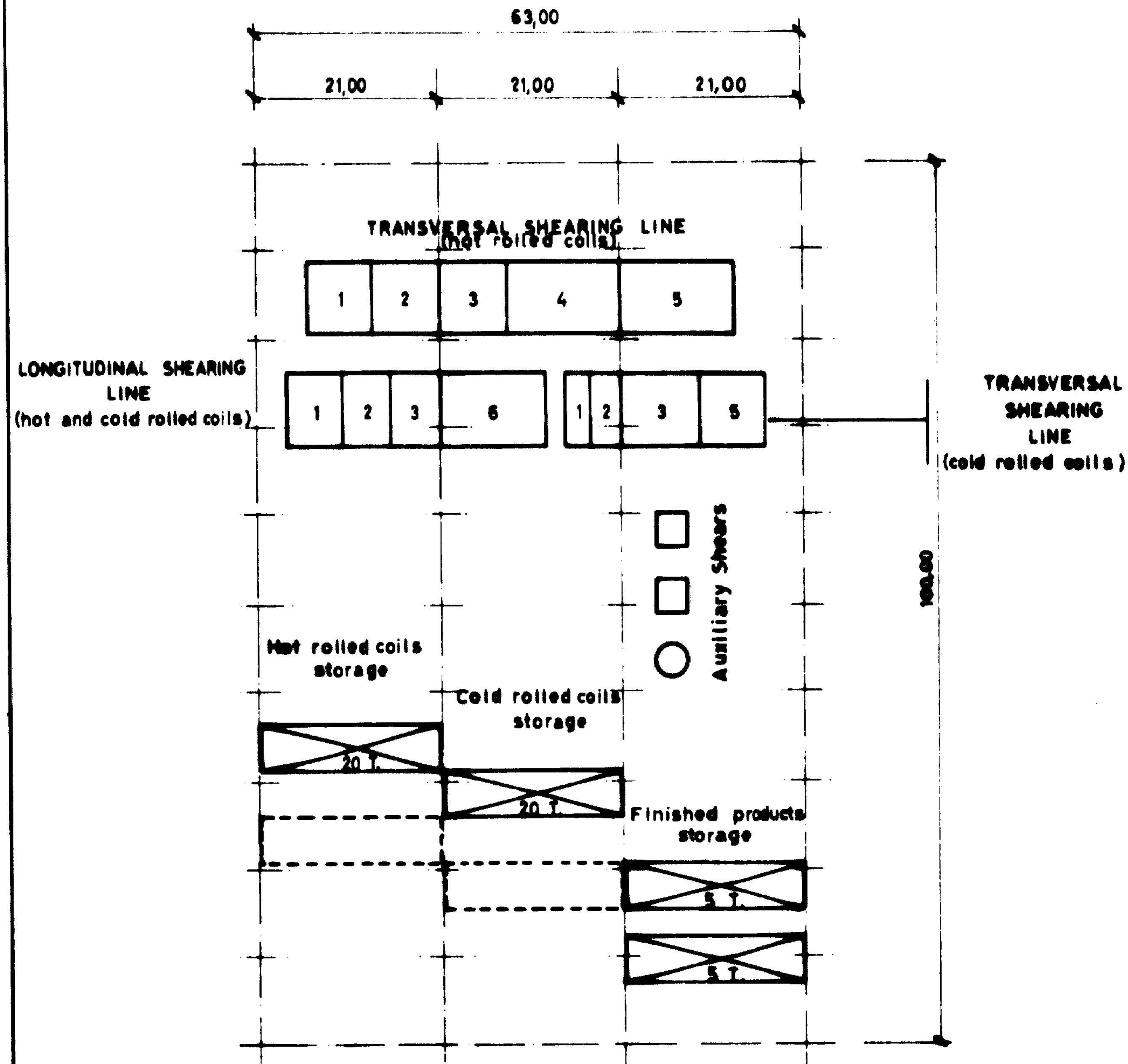
- Cutoffs
- Electric power, lubrication, etc.
- Personnel
- General expenses
- Amortizations and other costs

The determination of these factors depends on the rate of utilisation of the cutting capacity of each installation.

One shearing line operating at full capacity, from which data have been taken, has a cost of 170 Cr/t over the purchase pri- ce of the coil.

The basic price of the strip in 5/2/71 was:

- Cold rolled coil: 905 Cr/t
- Hot rolled coil: 682 Cr/t

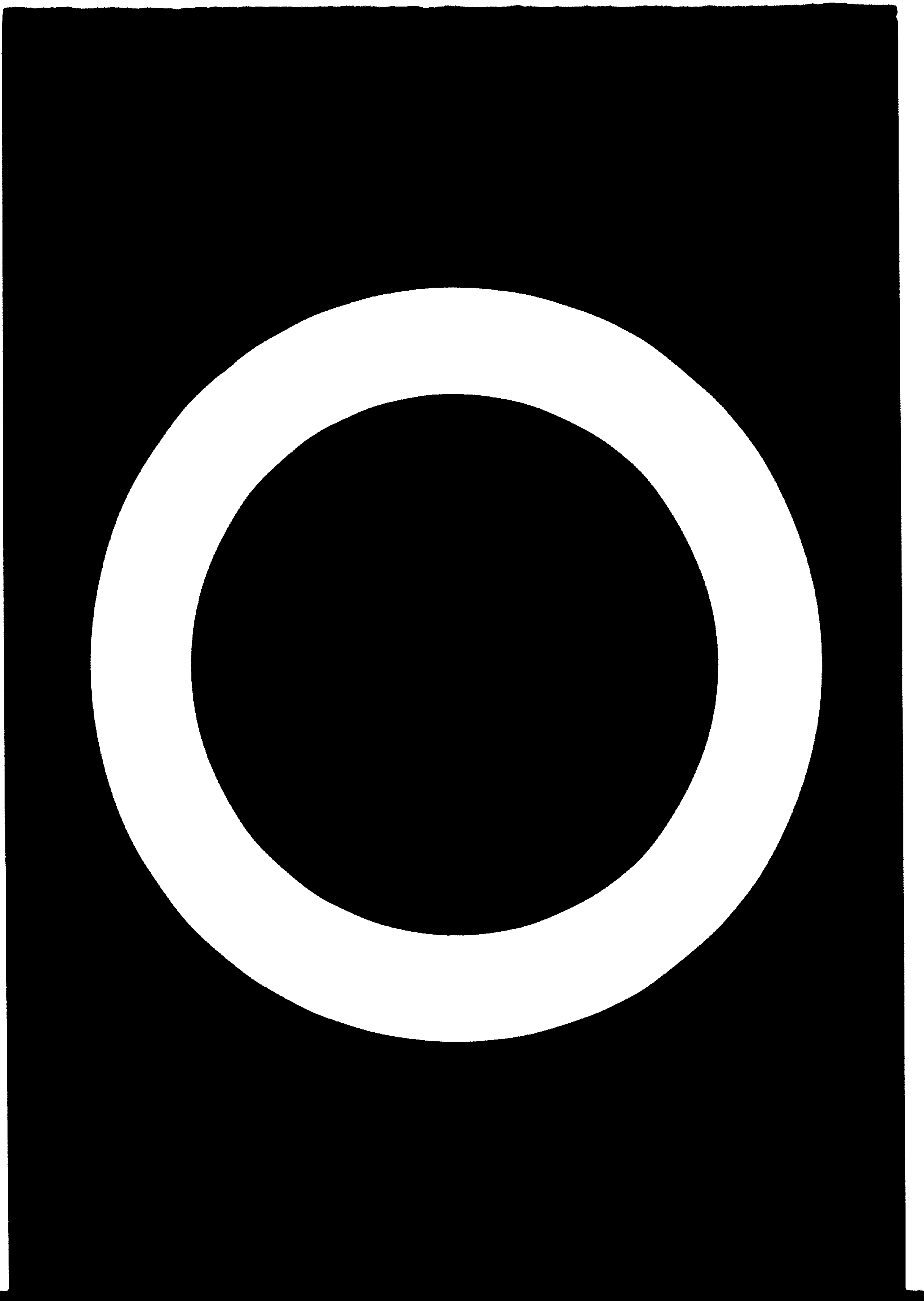


LEGEND

1 Decoiler
2 Leveler
3 Shear
4 Conveyor
5 Stacker
6 Exitcoiler

GENERAL LAYOUT OF SHEARING LINES PLANT

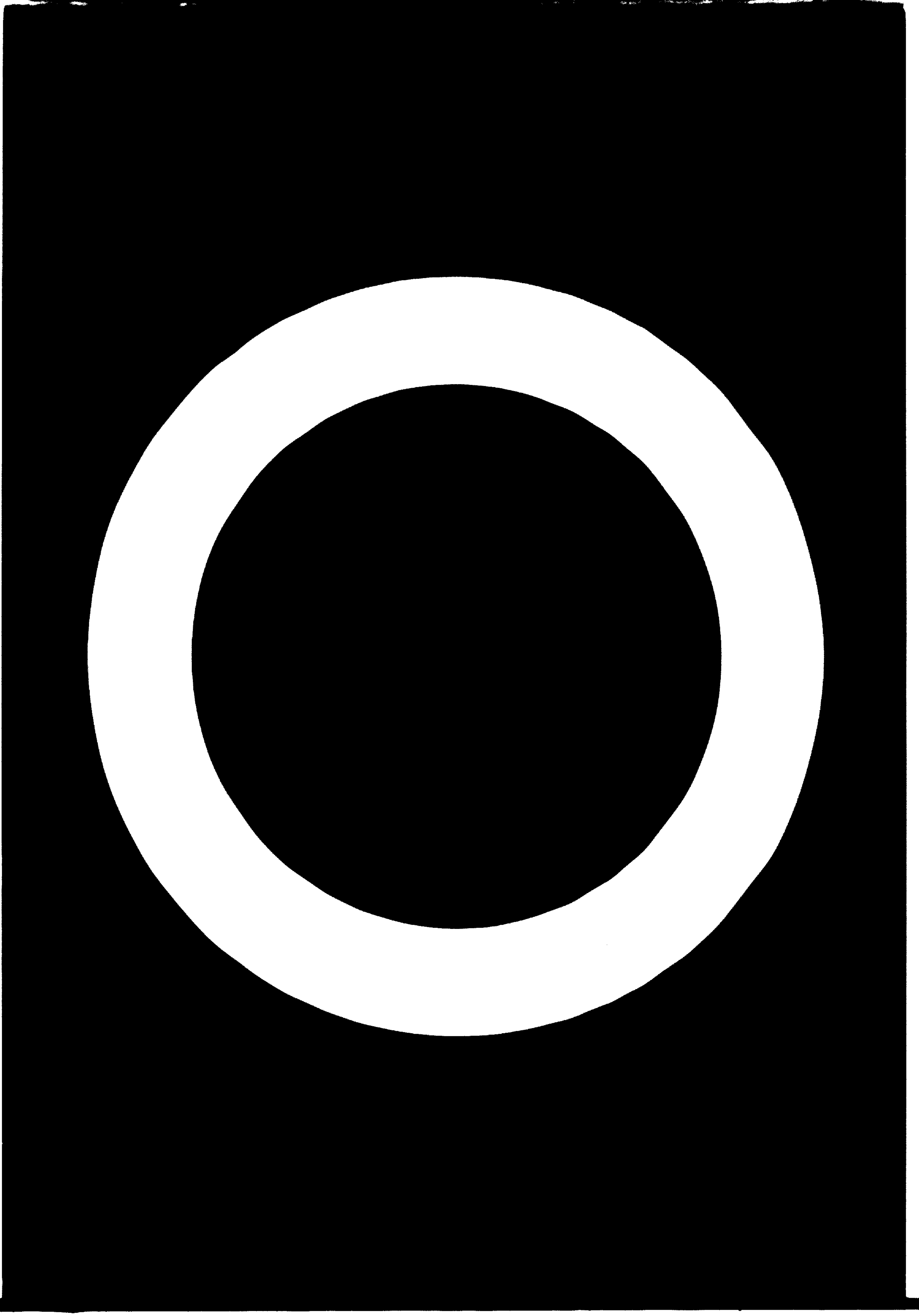
SCALE = 1:750



ANNEX E-5

PRELIMINARY PROJECT OF A CONTINUOUS

COPPER WIRE-ROD PLANT



PRODUCTION OF WIRE-ROD BY CONTINUOUS PROCESSES

INTRODUCTION

The fundamental lines of a preliminary project made by one of the principal Spanish companies producing electrolitic copper (named in the following as company "A"), have been gathered in this Annexe.

Even though the figures of installed capacity, investments and costs would vary in the conditions existing in Brazil, it is interesting, in our opinion, to underline the similitude of basic conditions existing between both countries and the convenience of proceeding without delay in the case of Caraiba Metais Project, to an installation study of equipment for the continuous production of wire rod, in line with our recommendations of paragraphe D.2.5.2., recommendations duly justified by the study we are exposing in the following lines.

BACKGROUND

Company "A" has just started the production of electrolitic copper with an annual capacity of 45.000 t/year in two plants, one of them producing copper anodes and the other one producing electrolitic copper cathodes.

The said company has been continuously studying the situtation of national and international copper markets and the different technological improvements achieved during the last years, in an effort to incorporate to its project any improvements compatible with its development at every moment.

Following this policy and as a result of the last contacts established with the Spanish consumers of copper, a conclusion has been reached: the necessity in a near future, of a prompt expansion and, above all, the modernization of national equipment of production of copper wire production if we want to be up-to-date, as far as it concerns to the needs of demand, not only in quantity but in quality of the semi-manufactured product.

In this situation and as a result of multiple contacts with the Spanish copper trasnformers, it has been reached the conclusion of the necessity of the immediate installation of a modern plant big enough to produce the copper wire that the Spanish industry will need in future years. With such an aim in view, the pertinent steps to create a new corporation with the contribution and participation of other national enterprises interested in the activities of copper manufactured products have been initiated.

JUSTIFICATION OF THE INSTALLATION

Just as it has been said in the preceeding section, the demand of copper wire and, above all, the requirements of quality by the consumer market, recommend a putting up-to-date through new production methods, following the most recent technology

Nowadays, the enterprises consuming copper wire have the limitation represented by the intermediate stage, almost unavoidable up to this moment, of using wire-bars as a starting material in the production of copper wire, with its inherent limitations on the size of the wire reels to no more than a hundred kilos, what, in any case, carries in itself an unequal distribution of impurities (cuprous oxide specially) in the wire. This has prompted the study and development of new production techniques in order to prevent these drawbacks; some of these technicques find themselves now in a stage of sufficient development enough to be considered as a reality.

Company "A" eager to incorporate the most advanced techniques, thinks it is wholy justified the installation of one of those continuous processes on the new plant it projects to erect, together with the transforming industries.

MARKET STUDY

The market of wire-rod produced by the continuous casting processes offers two advantages, one of them of a technical character and the other of an economical type.

The technical one, described later on in this Annexe, has its origin in the physico-chemical qualities of the material and in the advantage it presents in comparison with the conventional methods, in that the wire coils obtained, theoretically have no limitation in length.

The other advantage, of an economical nature, are the savings it permits, compared with the conventional rolling methods because of the elimination of the copper bar step, equivalent to the suppression of a melting operation and another operation of casting.

The advantages offered by this new technology, take us, therefore, to a product of a better quality, more adequate to the needs of an ulterior wire-drawing, at a better price.

These circumstances, considered as a whole, let us foresee that in a near future, the copper as wire-bars will have totally disappeared all around the world.

Looking at the copper consumption all over the world, we can see that the percent corresponding to copper wire as a part of the whole, is about a 50%, a law that has been realized individually and with a normal margin of elasticity in every one of the copper finished products manufacturing countries. According to a study of METRA SEIS dealing with the copper market in Spain, sponsored by the Commision of Basic Industries of Non-Ferric

Metals and their Ores, belonging to the Spanish Development Plan, it appears that the consumption of copper wire, against the total consumption in the countries we list below, is:

U.S.A.	46,6%
Great Britain	47,7%
France	51,5%
Italy	52,7%
Spain	54,5%

It must be pointed out that developing countries consume a higher percent of copper wire than those having achieved a saturation in the consumption of copper "per capita", a figure -just as it has been recently established- of 9/10 kg/person, already reached by the US of America.

If to the figures of total estimated consumption of copper semi-manufactured products, as far as it concerns to -- Spain, for the next two years, we incorporate the percent corresponding to copper wire, we obtain the following figures

Year	Estimates on copper consumption in semi-manufactured products. (in metric tons)	Consumption of copper wire, on the base of the - 54,5% of the left figures (in metric tons)
1.969	109.274	59.554
1.970	118.777	64.733
1.971	128.734	70.160

These figures speak by themselves about the market potentials, having in mind that in the year 1.968, about 54.000 t of copper wire were produced, that is, 16.000 t less than the estimated figure for 1.971. This difference will amount to 27.000 t in 1.973, that is, just in the moment of starting the projected new plant, if the cumulative yearly increase of 8% just as it has been up-to-now the increase of demand, is maintained.

Within the copper wire market, both domestic and foreign, it must be stressed the necessity of having a product of a very high quality to be processed into enamelled wires. For this end product, the wire obtained by continuous casting process is idoneous.

Spain's consumption of this product is, approximately, 16.000 t/year, but it is to be expected that in the following years the increase will be yearly of the order of a cumulative 12%.

We can, therefore, conclude that the estimated consumption of enamelled wire for the next years, would recommend, by itself, the installation of a wire producing plant by continuous casting processes.

If we add to what has been said above that the manufacturers of other kind of cables would wellcome the possibility of beneficying themselves in getting this product directly in Spain, and the fact that the wire and cables producers would rely on a raw material of first quality for their exports, and at an advantageous price. the installation is wholly justified.

PROCESS DESCRIPTION

General

It is not very far away the time when the only viable way to produce wire-rod was to obtain an ingot, of a square section, slightly thinned at its ends, wheighing a little more than a hundred kilos, that was subsequently rolled to obtain a wire 6-8 mm thick.

This process presents two basic technical drawbacks.

1. While the ingot is cooling a segregation of impurities takes place towards its surface and, at the same time, being an no-homogeneous cooling, the size distribution of crystals is far from being an homogeneous one. This is the cause of

difficulties in the case of very thin wires and leads to an operation of ingot plane cleaning in order to eliminate the surface impurities

2. The limitation in weight of the ingots makes a great number of weldings necessary in the case of very long wires: this weldings, later on, are the origin of disturbances during the subsequent wire frawing in the form of wire breakage, carrying with themselves the stopping of wire mills, and from the lack of homogeneity in the welding zones.

Recently, a new system of wire rod production has been started with the aim of finding a solution for the first one of these difficulties on the basis of producing ingots of a circular section (billets) which, subsequently, are stretched in an extrusion press. The wire rod obtained is of better quality, but still has the drawback of the limitation in weight of the wire coils.

In this circumstances, the copper manufacturers efforts have been directed towards the production of the wire rod by a continuous process with the exclusion of the intermediate phase of ingot production, as a solution to these drawbacks.

There are several systems in a phase of development, but only two of them have reached the stage of production, and worth while to be considered. They are described below.

The "South-Wire" Process

In this process, the cathodes coming from the electrolitic pots are melted in a shaft furnace, with a combustible exempt of sulphur (propane, kerosene, etc.), in a controlled atmosphere in order to prevent the copper from being oxidized during the melting process. This type of furnace has been developped by the American Smelting and Refining Company, and it is known under the name of ASARCO furnace.

The capacity of these furnaces varies as a function of the needs and of its eventual usage but, within certain limits, its capacity is determined by the number of burners in the furnace. In the case of the projected plant, it would be a furnace of a capacity of 22 t/hour.

Once the copper meltel, it is fed to another furnace with two principal objectives: to serve as a flywhel between the metal produced in the ASARCO furnace and the casting wheel and, at the same time, to control exactly the bath temperature. This furnace's capacity, also propane heated, is 15 t.

From the flywheel furnace, and through a special carbon nozzle, the casting wheel is fed. The latter is a copper wheel with an iron rim in its periphery in the form of a channel closed in a part of its contour by an steel endless band. The copper falls in a continuous flow into the box formed by the wheel rim and the steel band, resulting in a continuous copper band of a square section (about 26 sq. cm.).

It is easy to understand that a perfect synchronism between the feeding of melted copper throught the nozzle, the wheel's turning velocity and its cooling, must be maintained, if the continuous ingot has to be taken from the wheel at a temperature adequate for its subsequent rolling.

The bar or continuous ingot enters subsequently in a Morgan rolling mill, with 14 stands, where it takes alternatively an oval and round form, before making its exit as a wire rod 6 mm. thick.

The principal problem presented by this phase is the synchronism between the rolling mill and the forming wheel.

The produced wire rod enters then in a transition conduct where it is cooled and pickled simultaneously before reaching the coiling equipment.

The segregation of impurities and the uneven distribution of crystals, two of the principal drawbacks, are practically eliminated, as the bar has a very small section and enters still hot to the rolling mill.

As for the size of the unwelded wire coils, it is theoreticaly unlimited, being its only limitation in its handling.

Paralel to the rolling mill, a wholly conventional casting wheel for "wire bars", could be installed to supply the market while the consumption of wire rod has not wholly saturated the plant.

The plant will be situated in a 130 m long x 30 m wide building, formed by a structure covered with ondulated sheet, with a portal crane of 10 t of capacity along it.

The building will be ventilated by extractors situated in the cover.

The internal transport will be carried out through 300 kg lifting vans.

The electric supply will come from a transformer station of 7.500 KVA with a transformation ratio of 6/0.4 KV

The General Electric Company Process (Dip-Forming)

This process consists, essentialy, in an electric furnace to melt the cathodes fed to it across a pre-heating chamber heated by means of propane. Both this chamber and the furnace are kept with a reducing atmosphere very closely controlled in order to prevent the cuprous oxide to be formed because it would make the copper impure and impossible its subsequent processing.

The melted copper passes through a closed channel and with a controlled atmosphere, to the crucible or casting chamber, induction heated, where the control of temperature is close, too. The atmosphere in this forming chamber is also controlled, as in the following processes to which the copper is submitted.

Throught the bath, in a vertical direction and upwards. a copper wire of about 12 mm thick, previously plated in order deposit in an uniform manner and without any solution of continuity in its adherence, is passed.

On this wire a layer of copper is solidified while passing through the melted copper bath, making its diameter to be increased up to 16 mm approx.

When the copper bar leaves the moulding chamber it is bent in an angle of 90º and passes to a seven stands rolling mill to be transformed into a wire rod 8 mm thick.

A part of the production has to be used in the production of the starting wire. The product obtained in this process is free from oxigen ($\angle$ 2 ppm) and its limitation in length depends, in the same way that in the South Wire process, on the capability of handling the coils.

The size of the building for this plant is very similar to the one employed in the South Wire process.

<u>Equipment's origin</u>

The most important part of equipment must be imported whatever the process (South Wire or G.E.C.) may have been chosen, because there is no firm in Spain manufacturing this type of machinery.

The special equipment for the South Wire process would have to be bought in Germany, the rolling mill included. The ASARCO furnace would be adquired in the United States; part of it, however, could be made in Spain with the aid of drawings and know-how of the American Smelting Co.

The ratio of value between imported and national equipment is 3:1, and the impact of the imported part on the project's total cost is a 45%.

If the G.E.C. Process would have been chosen, the whole of special equipment would come from U.S.A., and the impact on the project's total cost would be a 41%.

Technical alternatives

Just as it has been indicated in the preceeding paragraph, two methods of direct and continuous production of wire rod worth to be considered presently, can be employed One of them has been developped by the South Wire Company and the other by the General Electric.

If the choice in the project would fall on the South Wire process, the electrolitic copper cathodes would be melted in a furnace, ASARCO type, wholly similar to the one provided for the electrolytic plant of "A" Company.

In this case, the logical thing would be not to duplicate the equipment and the casting wheel for Wire-Bars would be installed in the new plant. In this way, the copper not to be transformed directly into wire rod in the first stage of production would be transformed into Wire Bars to feed the rolling mills presently existing in the market.

Plant's capacity

The plant capacity has been one of the most delicate points of decision on the project, due to the following considerations:

1. The equipments of continuous production of wire rod have, up to now, a limited capacity.

2. The plant's capacity must be appropiate not only to to-days needs but to the estimates of future demand.

3. It is type of plant whose extensions are only possible by multiplication of complete units.

Having in mind that the hourly capacity of the two methods considered in this project is about 15 t/h, and considering that the work in this plant, will not be necessaribly uninterrupted, for, on the contrary, it can be organized on the basis of one or two working shifts and one maintenance shift. the plant's capacity would be between 22.500 t/year and 45.000 t/year. That means that at the start only one shift would be necessary. but with the possibility of progressively enlarging the output, according to the market needs until its whole saturation

Electric power needs, water, raw materials, etc.

The only raw material necessary to the operation of the plant is electrolitic copper in the form of cathodes; the possibility of using electrolitic copper scrap, provided it is of a good quality, has not been discarded

The basic consumptions, just as they have been estimated, are as follows:

Electrolitic copper	45.000 t/year
Electricity	8.000.000 KWH/year
Propane	2.500 t/year
Water	360.000 c.m./year

Royalties and Know-how

The use of anyone of both processes, according to the proposed contract offered by the licensing firms, would have to be made on the basis of royalties payment per each ton of wire produced and, independently, on a contract of technical assistance and know-how.

PRELIMINARY BUDGET

Grounds and sites

The grounds where the cathode forming plant will be built are the ones awarded to the "A" Company, as an administrative concession through the payment of a yearly rental rate for an unlimited term. The only expenses to be made on this item, are the costs of ground leveling and compacting works.

	US $ (x 1.000)
Leveling and ground preparation	50,8
Industrial buildings	
Piling and foundations	598,6
Steel structures	684,1
Roofings and walls	427,5
	1.710,2
Other constructions	
Roadbeds and passages	81,3
Miscellaneous auxiliary buildings	223,6
Draining and sewage	60,9
	365,8
Machinery (domestic origin)	
Cooling equipment	170,7
Mobile equipment	32,8
Cranes	177,3
Pumps and piping	401,3
Equipment for electric substation	348,6
Electric equipment for the plant	164,0
	1.294,7

Machinery (imported)

	US $ (x 1.000)
Cathodes furnaces	458,1
Southwire System	2.715,2
Wire-bars casting wheel	836,9
Test and control equipment	254,1
	4.264,3

Summary

1.	50,8
2.	1.710,2
3.	356,8
4.	1.294,7
5.	4.264,3
Total	7.676,8

If the Dip-Forming Process (General Electric) would have been adopted, the basic estimate would have been very similar to the one given above.

ECONOMICAL STUDY

Estimated production and consumptions (annual) and values

Just as it has been said above, the maximum capacity of production of the plant will be 45.000 t/year of wire rod with the alternative of producing wire bar in dependence of the market's demand.

Just at this moment it is not possible to estimate production value, having in mind the stark fluctuation registered by the price of copper. As a basis of calculation, the price of £ 500/ton for the wire bar and a charge of £ 29 per ton of wire rod, has been adopted.

The cathode's price has been estimated on the same basis, with a discount of £ 5.

The production value, on the adopted basis and making 1 £ = 2,4 US $, gives us a figure of 57,1 million/ /year US $ for the foreseen production.

<u>Estimated unit costs</u>

The unitary costs have been calculated on the following assumptions:

Its is estimated thot not only for the raw materials but also for the finished product, the price of copper in the international market will remain unaltered in £ 500/t of refined copper.

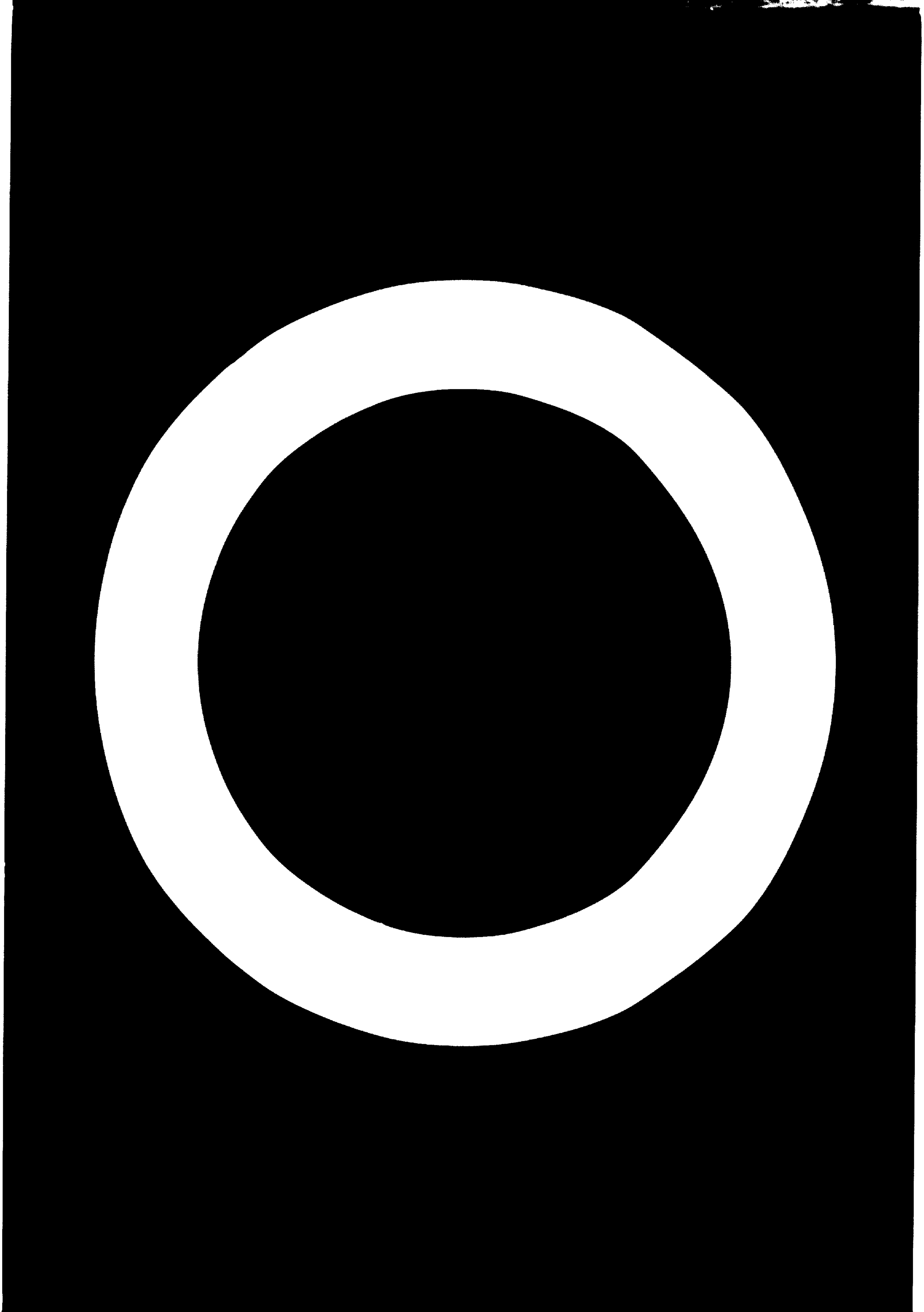
An amortisation term of 10 years for the plant, from its entering in operation has been considered.

According to these assumptions, the estimated unitary cost will be as follows:

Concept	US $
Man-power	7,00
Power	8,28
Raw materials and miscellaneous	1.182,00
Amortisation, etc.	74,57
Total	1.271,85/t

ANNEX E-6

FOUNDRY LABORATORY AND PILOT FOUNDRY



I. INTRODUCTION

In paragraph B. 4. 2. 2., in conection with CEPED'S training objectives it has been recommended the installation of a foundry laboratory and pilot foundry that could offer services to solve - specific problems caused by actual need of professional training of foundry technicians.

The main sections of the laboratory and foundry are summarized below:

II. FOUNDRY LABORATORY

The laboratory will be equipped to conduct the following basic tests and analysis:

a) Chemical and spectrographic analysis

Determination of carbon, silicon, manganese, phosphorus and sulfur. Of these, carbon and sulfur content are of particular importance. Adequate equipment must be provided so that an analysis of carbon and sulphur can be made quickly and accurately during the melting operation. (Three minute carbon and sulphur determinators).

Additionaly a direct reading spectrometer which can give analysis of 10 elements in 5 minutes could be installed. This equipment is of primordial importance for nodular iron production.

b) Sand Testing (Molding and core)

For molding sand, moisture content, permeability, compression and shear strength, clay content and sand-grain size and distribution.

For core sand, tensile strength, transverse strength, collapsability, permeability and gas-forming properties.

c) Metallography

Metallographic equipment for iron and non ferrous - alloys investigation.

d) Mechanical testing

Conventional equipment (Amsler tester, etc) for tensile strenght, transverse strenght, etc. testing.

e) Non destructive inspection methods

Non destructive inspections methods provide a means of checking sample castings without destroying it. Gamma-ray, magnetic-particle and fluorescent penetrants techniques should be considered.

f) Heat treating

Heat treating equipment for gray iron, nodular iron, steel castings and non ferrous castings (aging).

III. PILOT FOUNDRY

This foundry is designed to realize in connection with the laboratory, training and teaching work.

It should include melting equipment for foundry and molding practice. The equipment list which follows is not exhaustive, since a complete list would be prohibitive in length. Numerous substitutions could easily be made; hence the items mentioned are suggestions only.

Common Materials

1. Molding Sand:

Any reliable general purpose natural molding sand can be used in the following lessons.

2. Sharp Sands:

There should be a variety of washed and graded silica sands available to suit intended applications of coremaking, - shell molding and other uses.

3. Sand Binders:

A supply of a variety of sand binders for special applications is needed. This should include cereals, Bentonite clays, core oils, thermosetting resins, and others.

4. Molding-sand Additives and Facings:

Such materials include graphite (plumbago), sea coal, talc, and proprietary materials as needed.

5. Other common materials:

These include parting dust, some brand of core paste liquid parting for metal patterns, and other items.

6. Maintenance Materials:

These include lubricating oil, paints for patterns and machines, lumber for patterns and molding boards, cupola patch, nails, screws, and other hardware items.

7. Casting Alloys:

Alcoa 43 aluminium alloy is recommended along with aluminium scrap, brass pig and scrap, any good grade of pig iron and scrap iron as necessary for cupola work.

8. Alloys Additives:

These include ferrosilicon, ferromanganese, and ferrocarbon, preferably in briquette form.

Small Tools and Equipment

1. Flasks:

Hines Popoff or equivalent, approximately 10 by 14 inches.

Sterling steel or equivalent, approximately 20 by 20 inches and 20 by 30 inches, for floor work.

2. Jackets:

Metal or wooden jackets to fit flasks in use

3. Boards:

Bottom and mold boards to fit flasks in use.

4. Benches:

Portable or stationary molding benches to suit space available.

Coremaking bench, converted molding bench, or specially built bench to provide space for making cores.

Benches for special jobs and maintenance work in selected areas to suit needs.

Service bench for each machine or other major item of equipment.

5. Hand Toole:

Includes bench molding, coremaking, and floor-molding tools.

Rammers. Hand and pneumatic rammers for ramming sand in flasks for bench and floor work.

Slicks. Variety of molder's tools in sufficient quantity to serve the number of students in class.

Clamps. Common C clamps and flask clamps in a variety of sizes.

Hammers, draw spikes, draw screws, vent rods, strike-off bars, sprue cutters, bulb swabs, and miscellaneoue han tools.

Major Equipment

1. Melting Equipment:

Whiting cupola Nº 3 or equivalent, with blower and controls.

Stationary crucible furnace fired with gas (other fuel if desired).

Tilting-type crucible furnace.

Induction furnace.

2. Molding Machines:

International jolt-squeeze molding machine, 8-inch cylinder.

Jolt-squeeze molding machine.

Jolt-squeeze molding machine, 10-inch cylinder

Squeeze molding machine, 8-inch cylinder.

Rollover-pattern-draw molding machine, 14 by 26 inches maximum flask size.

3. Other Machines:

Centrifugal-casting machine, hydraulic drive, 30-inch-diameter table.

Shell-molding dump box or shell-molding machine, with patterns and a means of curing shells.

Core blower, bench model with core boxes and sand cartridges.

4. Other items:

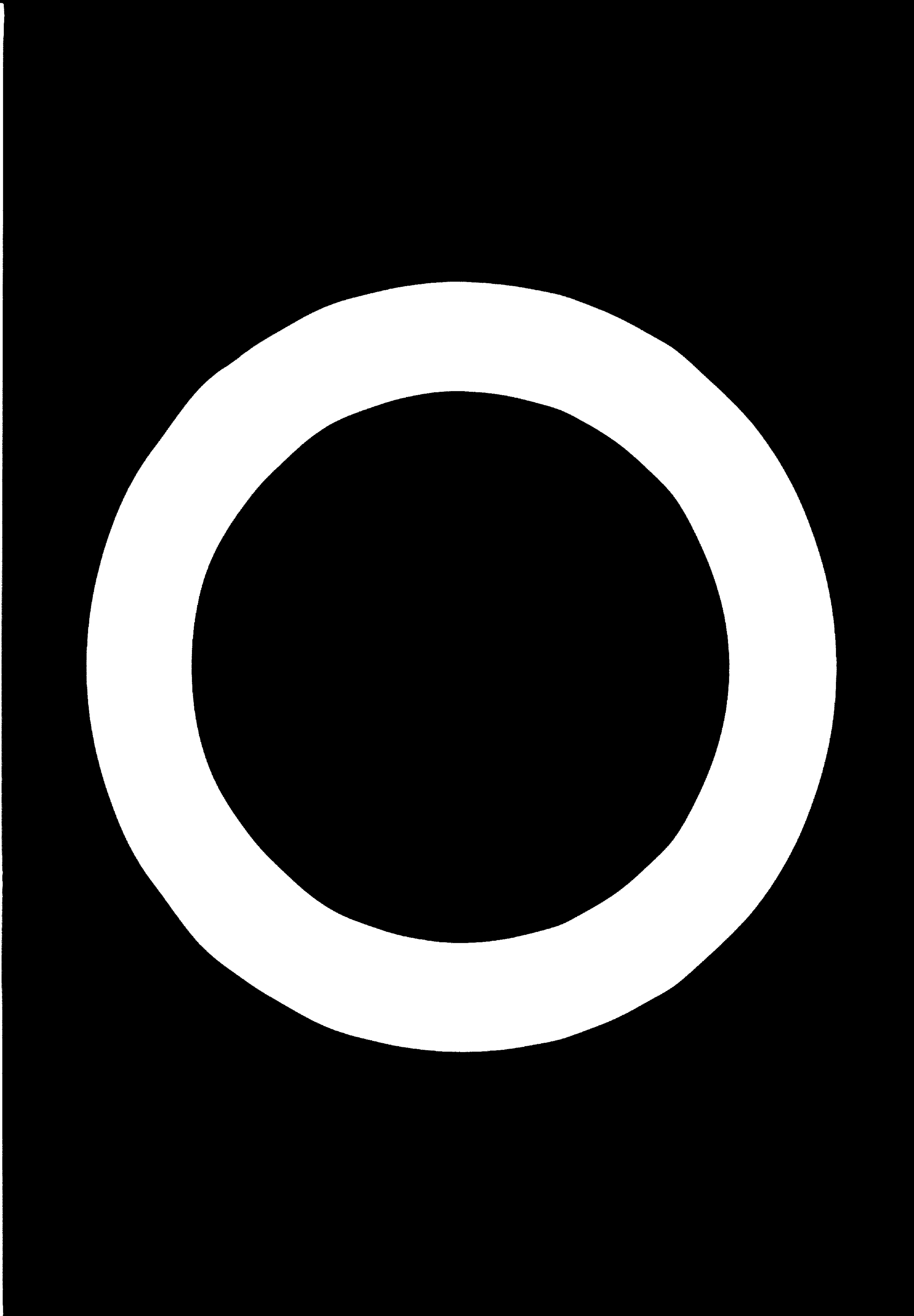
Core-baking oven, gas fired.

Sand conditioner.

Tumbling barrel, 36 by 48 inches.

Stand grinder, 8-inch wheel size.

F. TERMINAL SECTION



F. 1. SUMMARY OF RECOMMENDATIONS

Mineral resources of Bahia offer a good starting base for the installation or expansion of extractive metallurgical industries, but conditioned in almost all the raw materials object of this report, to a great improvement in mining and concentration processes and in the transportation methods from the orebodies to the present or future markets, together with the urgent need of trained personnel and specialized man-power.

As regards the installation or expansion of metallurgical industries shows good prospects, specially for iron, steel and copper industries in accordance with the specific recommendations made in section A of this report and which are briefly summarized below:

F. 1. 1. Iron and steel

USIBA plant must carry out a maximum transformation of its products, rolling sections of a ready marketability in the region, such as bars, wire-rods and sections. Taking in account the limited market of non flat products foreseeable by 1980, USIBA must turn towards other more profitable production alternatives, to utilize the large investments in infrastructure already made. The most attractive alternative would be a plant to produce stainless steel flat products.

With respect to other iron and steel products industries it is recommended the installation of foundry industries producing iron, steel and non-ferrous casting.

The installation of forging plant in Bahia is not recommended in Bahia in this moment.

For the tooling and cutlery industries, only the study of the possible extension of the manufacturing of forming tools, now existing in Bahia, to other cutting, maintenance, and cuttlery tools, can be recommended always with a previous careful study of the needs and acceptance in the market. At the moment, it is not advisable the installation on new wire-drawing and steel tubular products plants in Bahia State.

As regard the sheet steel consuming industries it is recommended the installation of some shearing lines that could fill the needs of the above industries.

F. 1. 2. Copper

Caraiba's metallurgical project should carry out the expansion of its second stage, though the direct smelting of concentrates in converters with oxigen enriched air.

Wire-bars as a starting semi-finished product for the manufacture of wire-rod should be eliminated. It is recommended the production of wire-rod by continuous casting processes.

New copper transforming industries cannot be recommended in Bahia, without a detailed analysis of the future structure of the brazilian market of copper manufactured products and of the impact that a decentralisation of production would cause on the production costs.

F. 1. 3. Lead

If the prospections we recommend with an urgent character to assess the true amount of reserves and the quality of Boquira orebodies would give favourable results, it is recommended the expansion of the present Santo Amaro lead smelter increasing its capacity up to 60.000 t/year by 1975.

In any case we recommend to improve Santo Amaro smelter present conditions in order to better its competitive position. A realistic policy of import duties should be adopted for all the elements, specially coke, not produced in the coun try and intervening in the lead metallurgy, together with an - adequate specialized training of man-power, aiming to a better productivity.

F. 1. 4. <u>Manganese</u>

There is a character of urgency in respect to manga nese ores in Bahia to find a solution for their basic mining, administrative and transport problems.

New ferroalloys production plants are not recommend ed, unless an ensemble study of the future use of the Brasil's production capacity has been performed.

F. 1. 5. <u>Chromium</u>

It is recommended to study and test at pilot plant scale the proper processes in order to establish the feasibility of increasing the Cr/Fe ratio in the chromites of Bahia, in - order to dispose the proper raw materials for the manufactur ing of low carbon ferrochromium. With independence of such study a feasibility study should be carried out, for the installa tion of a Fe-Cr LC producing plant, possibly as an extension of FERBASA present facilities

The present problems faced by the refractories and chemical industries should be also considered in order to obtain chromite concentrates with regular chemical and size specifica tions.

F. 1.6. Barite

The problems faced by the exploitation of barites is the lack of market, which is controlled in the petroleum indus try by world-wide trusts. The scheduled installation in Bahia of a wholly new plant for barium chemicals, which will amply cover the needs for these chemicals during the coming years, makes not advisable to recommend any other installation of barium chemicals in Bahia for the time being.

F. 1.7. Magnesite

The presence in the State of Bahia of magnesite ore-bodies which may be considered as the most important in the world, justifies the recommended feasibility study for the installation of a basic refractories plant in the said State aimed to export.

The projected metallic magnesium plant to be erected in Bahia should be complemented with the proper studies for the economical utilization of raw-materials existing in Bahia or in the North-East for the production of magnesium chloride.

F. 1.8. Alluminium

The present plans of extractive metallurgical and ma nufacturing plants, in an advanced state of development, do not allow, to make, at this moment, any specif recommendation, on new alluminiun industries in Bahia.

F.2. LIST OF VISITS AND CONTACTS

A) OFFICIAL AND PROFESSIONAL AGENCIES

- DNPM (National Department of Mineral Production)

Central office: Av. Pasteur, 404 (Urca). - Tl. 226-7175. - Rio de Janeiro (GB).

Regional office: Rua Alberto Tôrres, 7 (Matatu). - Salvador (BA)

Contacts: Rio de Janeiro.- General Manager: Sr. Francisco Chagas Pinto Coelho. - Assistant to Director: Sr. J. Paulo Brandão Juhasz. - Geologist: Sr. Urias Rodrigues da Silva.

- CPRM (Company of Mineral Ressources Investigations)

Office: Rua Salgado Filho, 2. - Bôa Vista de Brotas. - Salvador (BA).

Contacts: Salvador. - Dr. Alvimir Alves Oliveira.

- UNIDO (United Nations Industrial Development Organization)

Office: Av. Rui Barbosa, 910. - Rio de Janeiro (GB).

Contacts: Representative: Sr. Bonini. - Assistant representative Sr. J. Gabriel Velazquez.

- Institute of Geosciences

Office: Federação. - Salvador (BA).

Contact: Srta. Teresa Cardoso (Geomorfologia).

- ABC (Brasilian Copper Association)

Office: Rua General Jardim, 703-2º andar. - São Paulo (SP).

Contact: Executive Secretary: Dr. Vadim da Costa Arsky.

- CEBRACO (Copper Brasilian Center)

Office: Rua General Jardim, 703-2º andar. - São Paulo (SP).

Contact: Executive Director: Dr. Carlos L. Schnyder.

- ICZ (Lead and Zinc Brasilian Information Institute)

Office: Rua General Jardim, 703-2º andar. - São Paulo (SP).

Contact: Executive Director: Dr. Ettore Bresciani Filho.

- CIP (Interministerial Price Council)

Office: Ed. Ministério da Fazenda. 10º andar. - Rio de Janeiro (GB)

Contacts: Dr. Alvaro David Silva Filho. - Dr. Alcides Figueiredo.

- IPEA (Economic and Social Planning Institute)

Office: Rua Melvin Jones, 5. 28º and. Ed. BEG. - Rio de Janeiro (GB)

Contact: Coordinator of Non Ferrous metal sector: Dr. Fabiano Pegourier.

- Centro Brasileiro de Forjaria. Sindicato dos Forjadores

Office: Viaduto D. Paulina, 80-16º andar. - Palácio Mauá - FIESP Sao Paulo.

Contacts: Dr. Jorge Cintra. - Dr. Sebastião.

- Engineering School. Mechanical Engineering Department (Sao Paulo University)

Contact: Dr. Vicente Chiaverini.

- Institute of Technological Investigation (Sao Paulo University)

Contacts: Dr. Alberto Pereira de Castro. - Dr. Ciro Guimarães (Also ABM Secretary).

- ABIFFA (Brazilian Iron and Steel Foundry Industries Association)

Office: Av. Paulista.

Contact: Dr. Milton Ayres

- A. B. M. (Brazilian Metals Association)

Office: Rua Cel. Fernandes Prates, 110

Contacts: Dr. Fábio Decourt (Executive Secretary). - Dr. Pedro Dias de Souza (President of A. B. M. and Director Superintendent of COSIPA).

- M. I. C. (Ministry of Industry and Commerce)

Office: Praça Mauá, 7-17º andar. - Rio de Janeiro

Contact: Dr. Luiz Botelho (General Secretary)

- <u>CONSIDER (Steel Industry Council)</u>

<u>Office</u>: Praça Mauá, 7-15º andar - Rio de Janeiro

<u>Contact</u>: Dr. Renato Wood (Consultant)

- <u>Ministry of Planning and General Coordination</u>

<u>Office</u>: Av. Presidente Antônio Carlos, 375. - Ministério da Fasenda. 6º andar s/637. - Río de Janeiro

<u>Contact</u>: Sr. Sidônio

- <u>BNDE (National Economic Development Bank</u>

<u>Office</u>: Av. Rio Branco, 53. sala 1504. - Río de Janeiro

<u>Contact</u>: Dr. Sebastião Soares

- <u>SUDENE</u>

<u>Office</u>: Edificio do INPS. - Av. Dantas Barreto. - Recife

<u>Contacts</u>: Engº Hugo de Almeida (Diretor do Departamento de Industrialização) - Dr. Manoel Sílvio Campelo Netto (Diretor do Departamento de Recursos Naturais. Setor de Irrigação). - Diretor do Departamento de Energia (cartão).

- <u>Irrigation Commission</u>

<u>Office</u>: Edificio Sulacap 2º andar. - Recife

<u>Contact</u>: Dr. Geraldo Pedrosa

- <u>BNB (Banco do Nordeste do Brasil S/A)</u>

<u>Office</u>: Rua Senador Pompeu, 590. - Fortalesa

Contacts: Dr. Antonio Talmaturgo Nogueira (Chefe Adjunto do ETENE). - Dr. Moacir Borges Júnior (Analista de Projeto do Carim. Recife). - Dr. Paulo de Tarso (Técnico do ETENE).

B) MINING AND METALLURGICAL COMPANIES

- Mineração Boquira, S/A. - Cia. Brasileira de Chumbo. COBRAC

Offices: Praça da República, 270-2º and. Sao Paulo (SP). - Rua Miguel Calmon, 19 s/201. Salvador (BA).

Contacts: Salvador: Sr. Djalma Barreto Coelho (Procurator). - Santo Amaro: Sr. Louis Barnabé (General Manager), Sr. Oscar Pelisário (Production Manager). - Boquira: Sr. André Prieto (General Manager), Sr. Vicente Pons (Exploration Superintendent). - São Paulo: Sr. Eduardo Pacciuli (General Director).

- Caraibas Metais S/A

Office: Rua Antônio de Godoy 88 - 14º and. São Paulo (SP).

Contact: Dr. Nuclair Martins Pereira (Vice-President)

- Companhia de Mineração e Agricultura do S. Francisco (COMINAG)

Offices: Rua Miguel Calmon 459 s/506. Salvador (BA). - Rua José Petitinga 430. Juazeiro (BA).

Contact: Sento Sé: Sr. Carlos Chagas de Freitas (Engineer Administrator)

- Cerâmica São Caetano

Office: Av. Paulista 1754 - 1º andar. São Paulo (SP).

Contact: São Paulo: Dr. Paulo Rocha Azevedo (Commercial Manager).

- Magnesita, S/A

Offices: Praça Pio X, 98-8º and. Rio de Janeiro. - Rua da Espanha, 2 s/1001-Edf. Martins. Salvador (BA). - Praça Louis Ensch, 240. Belo Horizonte (MG).

Contacts: Rio de Janeiro: Dr. Jorge Lamasier. - Catiboaba: Dr. Walter de Andrade (General Manager), Dr. Onofre. - Belo Horizonte: Dr. Manfredo Kayser (Marketing Manager), Dr. Hélio Pentagna Guimarães (Sales Manager).

- Dow Química do Brasil

Office: Av. Rio Branco, 147-18º and. Rio de Janeiro (GB).

Contact: Dr. Renato Hauptmann (Planning Manager).

- **Mineração Urandi S/A**

Office: Rua Chile, 29 s/102. Salvador (BA).

Contact: Sr. Adelmo Rodrigues da Silva (Geologist)

- **Arditti Minérios S/A (ARMISA)**

Office: Rua Chile, 22 s/905. Salvador (BA). - Largo da Estação. Jacobina (BA).

Contacts: Salvador: Sr. Isaac Arditti. - Jacobina: Sr. João Soares. - Santo Antonio de Jesús: Sr. Francisco.

- **Pigmentos Minerais S/A (PIGMINA). - Baroid do Brasil (Domestic Sales Agency)**

Office: Rua Miguel Calmon, 19-11º and. s/1102. Salvador (BA)

Contacts: Ilha Grande (Camamu): Engº William Gans (Exploration Manager). - Salvador: Sr. Tomaz de Aquino Barros (Financing and Administration Assistant to President), Sr. Federico G. Luz (Mining Director). - Campo Formoso: Dr. Júlio França. - Pojuca: Dr. Francisco Lizardo Neto (Director).

- **Coitezeiro Mineração S/A (COMISA)**

Office: Rua Conde D'Eu, 1º and. Salvador (BA)

Contact: Campo Formoso: Sr. José da Silva Marques

- **Bayer do Brasil**

Office: Rua Dom Gerardo, 64-7º and. Rio de Janeiro (GB). - **Plant**: Estrada da Boa Esperança, 650. Belford Roxo (RJ).

Contact: Belford Roxo: Dr. Alberto B. Glismann (Technical Director).

- **Usina Colombina**

Office: Rua Silveira Martins, 53/2º and. São Paulo (SP).

Contact: São Paulo: Kurt Wissmann (Manager)

- **Naegeli S/A**

Office: Av. Beira Mar, 200-7º and. Rio de Janeiro (GB)

Contact: Rio de Janeiro: Sr. Carlos Culvas

- Quimica Geral do Brasil

Office: Rua Debret, 23/1116. Rio de Janeiro (GB)

Contact: Rio de Janeiro: Eider de Araújo Rangel (Industrial Director), Richard Paul Matheson (Director).

- Companhia Ferro-Ligas da Bahia (FERBASA). - Cromita do Brasil S/A

Office: Rua Miguel Calmon, 40 s/1. Salvador (BA). - Plant: Pojuca (BA).

Contact: Eng. Francisco Lizardo Neto (Pojuca Plant).

- Eletro Siderúrgica Brasileira S/A (SIBRA)

Office: Rua Miguel Calmon, 61-10º and. Salvador. - Plant: Centro Industrial de Aratu.

Contacts: Salvador: Economist Roberto Dias (Assistant to Director) Centro Industrial de Aratu: Dr. Ernesto Cláudio Drehmer (Superintendent).

- Aluminio do Brasil S/A (ALCAN)

Office: Av. São João, 473-14º and. São Paulo (SP).

Contact: Dr. Waldemar Cardoso (Sales Manager).

- Elevadores Apolo

Plant: Aratú Industrial Center (CIA). Salvador (BA).

- Brastemp Nordeste

Plant: (CIA)

Contact: Dr. George C. de G. Calmon (General Superintendent).

- Magirus Deutz

Plant: (CIA)

Contacts: Sr. Arthur Giabani (Industrial Relations Manager), Sr. Giuseppe Ferrero (Planning Manager)

- Indústrias Reunidas Pery

Plant: Lardo de Roma. Av. Tiradentes, 21 A. Salvador.

Contact: Sr. Bartolomeu Soares

- Cesmel

Plant: Br. 324, Estrada de Campinas (Salvador).

Contact: Dr. Saldanha (Technical Director).

- Biselli

Plant: Av. Heitor Dias s/n. Salvador

Contacts: Sr. Torello. - Sr. Leon (Director).

- Cimba

Plant: Estrada de Barreiras, km 2. Mata Escura do Retiro s/n. Salvador.

Contact: Dr. Carlos Brandão (Director)

- IMS (Indústrias Metalúrgicas de Salvador S/A)

Plant: Jardim Eldorado, Quadra 8, Lotes 5, 6 e 7.

Contact: Sr. Henning Kreling (Superintendent).

- Brasquip

Plant: Av. Heitor Dias s/n. Salvador.

Contact: Sr. Carlos Leal (Production Manager).

- Metalúrgica Invicta

Plant: Rua Tio Juca s/n, Jardim Eldorado (Salvador).

- Metalúrgica Ramos

Plant: Rua Regis Pacheco, 2 Uruguai (Salvador).

Contact: Sr. Cândido Ramos (Owner and Director).

- Cía. Siderúrgica da Bahia (COSIBA)

Plant: Rua do Uruguai, 29 (Salvador)

Contact: Dr. Rinauro Marques (Director)

- Tubos e Perfilados da Bahia S/A (TUPERBA)

Plant: (CIA)

Contact: Dr. Diego Aguiller (economist)

- Tramontina Nordeste Industrial Ltda.

Plant: (CIA)

Contact: Engº Osvaldo Sfoggia

- Usina Siderúrgica da Bahia S/A (USIBA)

Plant: (CIA)

Contact: Engº Vilaça

- Aluminio do Brasil S/A - Albra Nordeste

Plant: (CIA)

Contact: Engº Antônio Pinto Ribeiro Neto

- Aluminio do Brasil Nordeste S/A (ALCAN)

Plant: (CIA)

Contact: Engº Fernando

C) MISCELLANEOUS

- Mr. W. M. Clemens

American Consulate. - C. p. 84. - Salvador (BA).

- Dr. Irton Leão

Salvador (BA)

- Dr. Francisco Pessoa de Souza

Rua 24 de Maio, 276 - 3º and. - ARATU Industrial Center Representative. - São Paulo (SP).

- Dr. Fausto Soares de Andrade (Mining Engineer) (SOMICOL)

Rua Dr. Vital Rêgo ou Eng. João Pimenta Bastos, 24. - Barbalho Salvador (BA).

- Sr. Sylvio de Queiróz Mattoso

Indústria Nordeste de Calcário S/A "INORCAL". - Caixa Postal 1161. - Salvador (BA).

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UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Contract No. 4/1
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02995

(2 of 2)

STUDY OF THE POSSIBILITIES FOR DEVELOPMENT OF METALLURGICAL INDUSTRIES IN THE STATE OF BAHIA (BRAZIL)

VOLUME II
TABLES AND CHARTS
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SEPTEMBER 1971
Contract N° 71/1

TECNIBERIA
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TABLE OF CONTENTS

page

I. TABLES AND CHARTS

I. TABLES AND CHARTS

TABLE Nº P-1

DEMOGRAPHIC CENSUS (17-12-70)

FEDERATION UNITS	POPULATION				
	Total		Increments		
	1.960	1.970	Absolute figures	% on total	Average annual geometric increment rate
Rondônia (1)	70.783	95.311	24.528	34,65	
Acre (1)	160.208	203.900	43.692	27,27	
Amazonas (1)	721.215	714.803	6.412	0,88	
Roraima (1)	29.489	40.855	11.366	38,64	
Pará (1)	1.550.935	1.984.745	433.810	27,97	
Amapá	68.889	116.481	47.592	69,08	5,4
Maranhão (1)	2.492.139	2.883.211	391.072	15,69	1,5
Piauí	1.263.368	1.735.568	472.200	37,37	3,2
Ceará	3.337.856	4.440.286	1.102.430	33,02	2,9
Rio Grande do Norte	1.157.258	1.603.094	445.836	38,53	3,3
Paraíba	2.018.023	2.383.518	365.495	18,11	1,7
Pernambuco	4.136.900	5.208.011	1.071.111	25,89	2,6
Fernando de Noronha	1.389	1.239	150	10,79	1,1
Alagoas	1.271.062	1.606.165	335.103	26,36	2,4
Sergipe	760.273	900.119	139.846	18,39	1,7
Bahia	5.990.605	7.420.906	1.430.301	23,87	2,2
Minas Gerais	9.798.880	11.279.872	1.480.992	15,11	1,4
Espírito Santo	1.188.665	1.597.389	408.724	34,38	3,0
Rio de Janeiro	3.402.728	4.694.089	1.291.361	37,95	3,3
Guanabara	3.307.163	4.296.782	989.619	29,92	2,7
Sao Paulo	12.974.699	17.716.186	4.741.487	36,54	3,2
Paraná	4.277.763	6.741.520	2.463.757	57,59	4,7
Santa Catarina	2.146.909	2.911.479	764.570	35,61	3,1
Rio Grande do Sul	5.448.823	6.652.618	1.203.795	22,09	2,0
Mato Grosso (1)	910.262	1.475.117	564.855	62,05	
Goiás	1.954.862	2.989.414	1.034.552	52,92	4,3
Distrito Federal	141.742	544.862	403.120	284,40	14,4
BRASIL (2)	70.967.185	92.237.570	21.270.385	29,97	2,7

(1) Data collection not yet completed
(2) Including 384.297 persons censed at Serra dos Aimorés (litigation zone among M.G. and E.S. States).

TABLE NºIN-1

NET INTERNAL PRODUCT (NIP) AT FACTORS COST (AT 1.949 PRICES)

Year	NIP in millions of NCr/$		NIP (Base 1.948 = = 100)		NIP "per capita" in NCr/$		NIP "per capita" (Base 1.948 = 100)	
	Brasil	Bahía	Brasil	Bahía	Brasil	Bahía	Brasil	Bahía
1.948	184,02	7,40	100	100	3,71	1,60	100	100
1.955	288,77	10,88	156,9	147,-	4,80	2,02	129,4	126,2
1.960	385,41	16,32	209,4	220,5	5,53	2,77	149,1	173,1
1.961	435,05	16,18	236,4	218,6	6,05	2,69	163,1	168,1
1.962	460,14	16,85	250,0	227,7	6,21	2,75	167,4	171,9
1.963	468,13	16,10	254,4	217,6	6,13	2,57	165,2	160,6
1.964	474,92	18,53	258,1	250,4	6,03	2,90	162,5	181,2
1.965	482,69	19,80	262,3	267,6	5,94	3,04	160,1	190,0
1.966	494,83	20,58	268,9	278,1	5,90	3,10	159,0	193,7
1.967	526,47	22,16	286,1	299,5	6,08	3,27	163,9	204,4

SOURCE: Own elaboration.

TABLE Nº IN-2

NIP COMPOSITION AT FACTORS' COST

	Agriculture %	Industry %	Services %
Brasil			
1.939	25,8	19,5	54,7
1.948	27,7	21,4	50,9
1.955	25,1	24,4	50,5
1.960	22,6	25,2	52,2
1.965	22,3	24,4	53,3
1.966	19,1	27,1	53,8
1.967	19,2	26,2	54,6
Bahía			
1.939	38,5	10,5	51,-
1.948	42,7	7,9	49,4
1.955	40,6	11,-	48,4
1.960	39,8	12,1	48,1
1.965	39,8	8,9	51,3
1.966	38,-	9,1	52,9
1.967	38,4	7,7	53,9

SOURCE: Own elaboration.

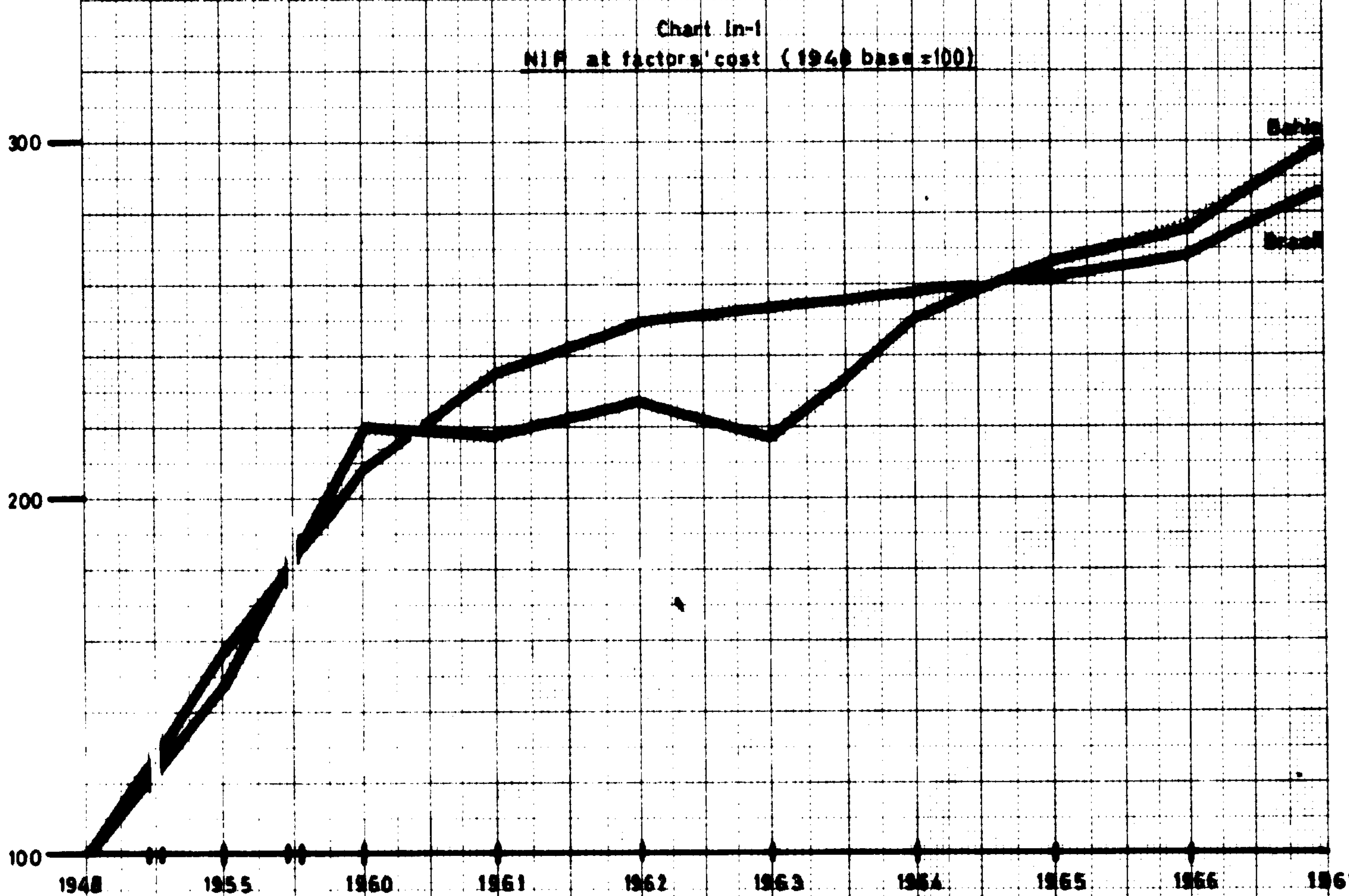
Chart In-1
NIP at factors' cost (1948 base = 100)
Bahia
Brasil
300
200
100
1948
1955
1960
1961
1962
1963
1964
1965
1966
1967

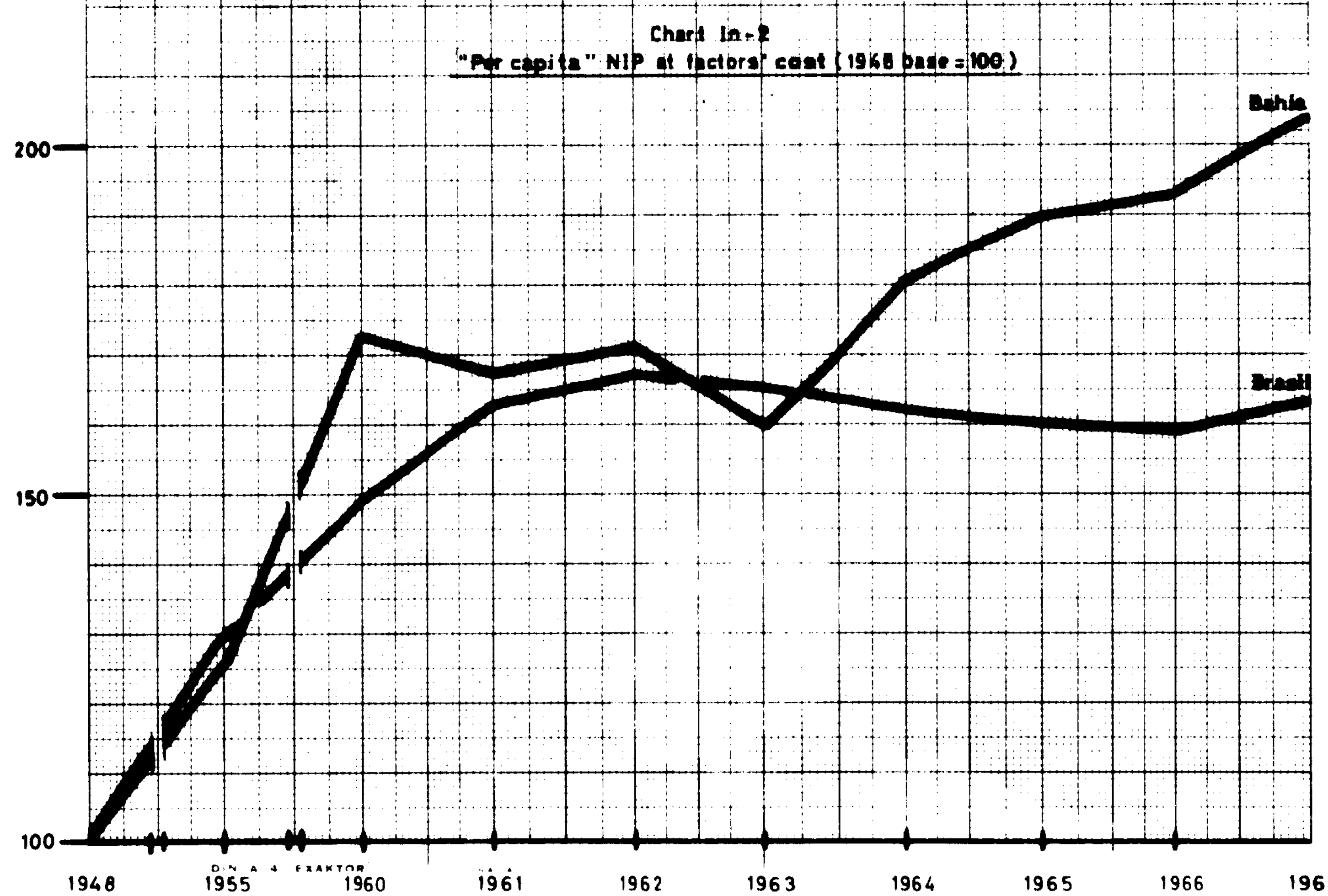
Chart In-2
"Per capita" NIP at factors' cost (1948 base = 100)
Bahia
Brasil
200
150
100
1948
1955
1960
1961
1962
1963
1964
1965
1966
1967

TABLE Nº III-3

PARTICIPATION OF BAHIA IN BRAZIL'S NIP

Year	Total NIP %	Agriculture %	Industry %	Services %
1.939	4,5	6,0	2,5	4,4
1.948	4,0	5,4	1,7	4,-
1.955	3,8	5,2	1,9	3,7
1.960	4,2	6,1	2,4	4,-
1.965	4,1	5,9	1,8	4,1
1.966	4,2	6,5	1,6	4,1
1.967	4,2	6,7	1,4	4,2

SOURCE: Own elaboration.

TABLE Nº PW-1

ELECTRIC POWER CONSUMPTION (IN MWH)

		1.960	1.961	1.962	1.963	1.964 (1)	1.965 (2)	1.966	1.967	1.968	1.969
Total consumption	Bahía	247.612	283.482	325.918	406.574	408.289	833.369	380.985	680.109	757.939	857.000
	Pernambuco	357.509	434.773	539.673	578.213	724.915	627.378	764.354	783.380	956.003	1.066.000
	Sao Paulo	7.880.958	8.797.640	9.807.378	10.297.553	10.433.086	10.909.891	12.253.766	12.838.783	14.278.851	15.700.000
	Brasil	18.345.534	19.629.555	21.856.739	22.617.891	23.520.877	24.267.903	26.498.109	27.987.514	31.399.261	34.201.462
Industrial consumption	Bahía	n. a.	n. a.	126.289	174.475	231.160	562.160	267.116	269.865	375.771	413.286
	Pernambuco	n. a.	n. a.	232.552	293.632	390.959	305.606	372.842	388.790	439.823	469.069
	Sao Paulo	n. a.	n. a.	5.513.882	5.634.369	5.605.299	5.751.439	6.820.374	6.889.606	8.087.543	8.724.001
	Brasil	n. a.	n. a.	11.269.155	11.555.120	11.958.204	12.108.300	13.996.500	13.861.124	16.115.596	17.265.980

- Source: IBGE, A.E.B.
- Notes: (1) - The 1.964's consumption for Pernambuco seems exaggerated, been higher than the figure for some of the following years
  (2) - The 1.965's consumption for Bahia seems exaggerated, been higher than the figure for some of the following years

TABLE Nº PW-2

ELECTRIC POWER CONSUMPTION. PERCENTAGES OF INCREMENT ON PRECEDING YEAR

		1.961	1.962	1.963	1.964 (1)	1.965 (2)	1.966	1.967	1.968	1.969	1.969/ 1.960	1.969/ 1.962
Total consumption	Bahía	+14,5	+15,0	+24,7	+20,1	+70,7	-30,3	+ 6,7	+22,2	+13,1	+246,1	+163,0
	Pernambuco	+21,6	+24,1	+7,1	+25,4	-13,4	+21,8	+2,5	+22,0	+11,4	+197,8	+97,3
	Sao Paulo	+15,1	+11,5	+5,0	+1,3	+4,6	+12,3	+4,8	+11,2	+10,0	+99,1	+60,2
	Brasil	+7,0	+11,2	+3,5	+4,0	+3,2	+9,2	+5,6	+12,2	+8,9	+86,4	+56,5
Industrial consumption	Bahía	n.a.	n.a.	+38,2	+32,5	+143,3	-52,5	+1,0	+39,2	+10,0	n.a.	+227,2
	Pernambuco	n.a.	n.a.	+26,3	+33,1	-21,8	+22,0	+2,7	+14,9	+6,0	n.a.	+102,0
	Sao Paulo	n.a.	n.a.	+2,2	+0,9	+1,2	+18,6	+1,0	+17,4	+7,9	n.a.	+58,2
	Brasil	n.a.	n.a.	+2,5	+3,5	+1,3	+12,3	+1,9	+16,3	+7,1	n.a.	+53,2

- **Source**: Own elaboration
- **Notes**: (1) - See note (1) of Table PW-1

  (2) - See note (2) of Table PW-1

TABLE Nº PW-3

PERCENTAGE OF INDUSTRIAL CONSUMPTION ON TOTAL ELECTRIC POWER CONSUMPTION

	1.962	1.963	1.964 (1)	1.965 (2)	1.966	1.967	1.968	1.969
Bahía	38,7	42,9	47,3	67,5	46,-	43,5	49,6	48,2
Pernambuco	43,1	50,8	54,-	48,7	48,8	48,9	46,-	44,1
Sao Paulo	56,2	54,7	54,5	52,7	55,7	53,7	56,6	55,5
Brasil	51,6	51,1	50,8	49,9	51,3	49,5	51,3	50,5

- Source: Own elaboration
- Notes:

(1) See note (1) of Table PW-1

(2) See note (2) of Table PW-1

TABLE Nº PW-4

"PER CAPITA" ELECTRIC POWER CONSUMPTION (IN KW)

	1.960	1.961	1.962	1.963	1.964 (1)	1.965 (2)	1.966	1.967	1.968	1.969
Bahía	42	47	53	65	76	128	87	91	110	122
Pernambuco	88	105	127	134	165	140	168	169	202	221
Sao Paulo	619	668	720	731	717	725	788	798	859	914
Brasil	263	268	295	296	298	298	315	323	351	371

- Source: Own elaboration
- Notes:

(1) See note (1) of Table PW-1

(2) See note (2) of Table PW-1

TABLE Nº PW-5

AVERAGE POWER PRICE IN BAHIA ACCORDING TO UTILIZATION FACTOR (IN NCr$/Kwh)

Utilization Factor	Voltage from 2.300 to 13.800		Voltage higher than 13.800	
	Average price (1)	Average price (2)	Average price (1)	Average price (2)
10%	0,2103	0,2558	0,1810	0,2256
20%	0,1200	0,1628	0,1004	0,1426
30%	0,0899	0,1317	0,0736	0,1150
40%	0,0749	0,1163	0,0602	0,1012
50%	0,0659	0,1070	0,0521	0,0928
60%	0,0591	0,1000	0,0460	0,0865
70%	0,0534	0,0942	0,0408	0,0812
80%	0,0491	0,0897	0,0369	0,0772
90%	0,0458	0,0863	0,0338	0,0740
100%	0,0431	0,0835	0,0314	0,0715

- **Source:** Own elaboration
- **Notes:** (1) - **Taxes not included**
  (2) - **Taxes included**

TABLE Nº PW-6

REPERCUSSION OF FIXED FACTOR ON POWER PRICE (1) IN BAHIA ACCORDING TO UTILIZATION FACTOR

Utilization Factor	Voltage from 2. 300 to 13. 800 V.		Voltage higher than 13. 800 V.	
	Average repercussion NCr$/Kwh	% on average price	Average repercussion NCr$/Kwh	% on average price
10%	0, 1805	86	0, 1611	89
20%	0, 0902	75	0, 0805	80
30%	0, 0601	67	0, 0537	73
40%	0, 0451	60	0, 0402	67
50%	0, 0361	55	0, 0322	62
60%	0, 0300	51	0, 0268	58
70%	0, 0257	48	0, 0230	56
80%	0, 0225	46	0, 0201	54
90%	0, 0200	44	0, 0179	53
100%	0, 0180	42	0, 0161	51

- Source: Own elaboration
- Note: (1) - Taxes not included

TABLE Nº PW-7

AVERAGE PRICES (1) OF ELECTRIC POWER IN SPAIN ACCORDING TO UTILIZATION FACTOR AND CONTRACTED POWER (VOLTAGE OVER 1 KV)

Contracted power	Up to 50 Kw	From 50 to 250 Kw	From 250 to 500 Kw	From 500 Kw
Utilization factor				
10%	0,0945	0,0676	0,0609	0,0542
20%	0,0881	0,0617	0,0556	0,0493
30%	0,0810	0,0597	0,0539	0,0477
40%	0,0778	0,0571	0,0517	0,0458
50%	0,0752	0,0545	0,0494	0,0439
60%	0,0738	0,0528	0,0479	0,0427
70%	0,0728	0,0515	0,0469	0,0418
80%	0,0720	0,0506	0,0461	0,0411
90%	0,0714	0,0499	0,0454	0,0406
100%	0,0709	0,0493	0,0449	0,0402

- Units: NCr$/Kwh (1 NCr$ = 14,10 pesetas)
- Source: Own elaboration

(1) Note: Taxes not included

B-197

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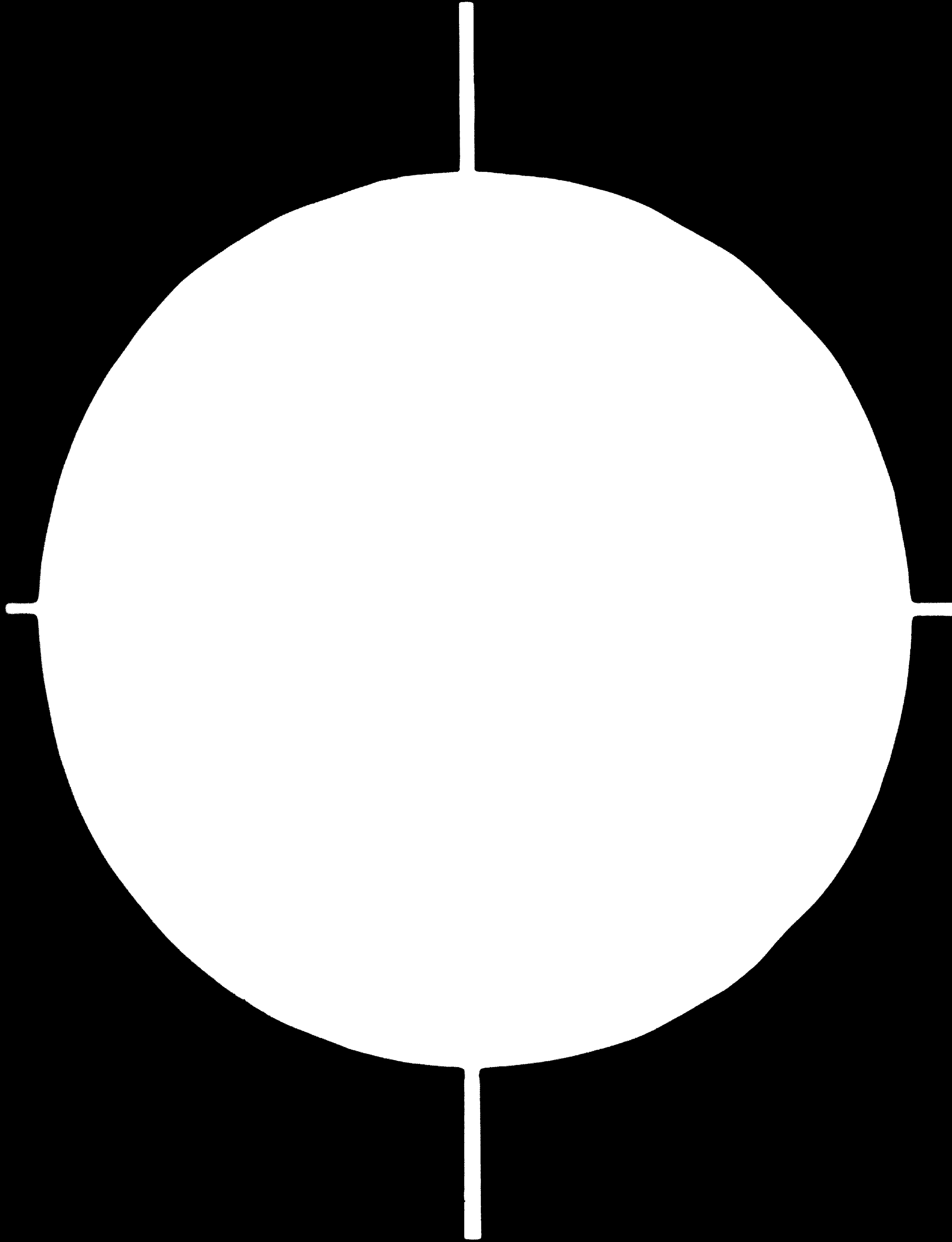

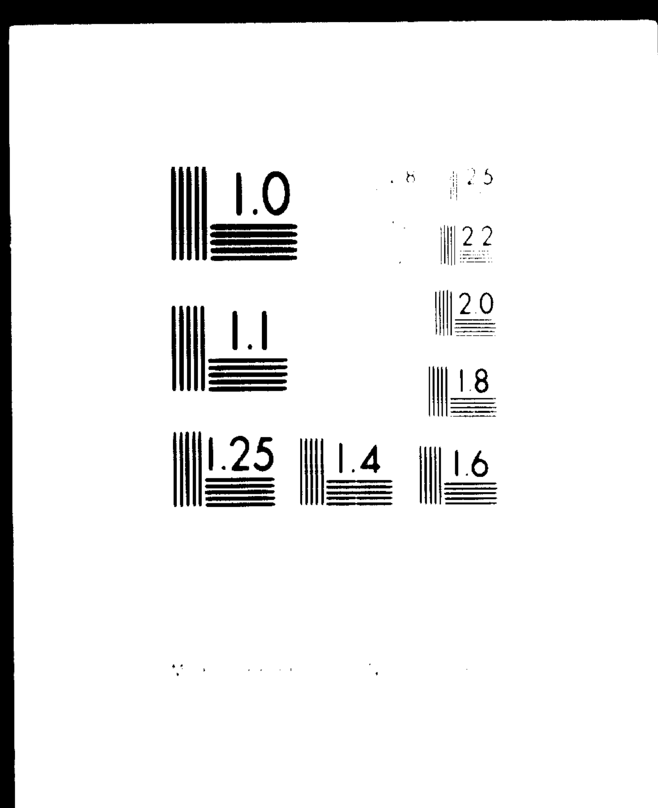

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TABLE Nº PW-8

FIXED FACTOR REPERCUSSION IN ELECTRIC POWER PRICES (1) IN SPAIN

ACCORDING TO UTILIZATION FACTOR AND CONTRACTED POWER IN % OF TOTAL COST

Contracted power	Up to 50 Kw	From 50 to 250 Kw	From 250 to 500 Kw	From 500 Kw
Utilization factor				
10%	10,6	17,5	17,4	17,9
20%	5,7	9,6	9,5	9,8
30%	4,1	6,6	6,6	6,8
40%	3,2	5,2	5,1	5,3
50%	2,7	4,3	4,3	4,4
60%	2,3	3,7	3,7	3,8
70%	2,0	3,3	3,2	3,3
80%	1,8	2,9	2,9	2,9
90%	1,6	2,6	2,6	2,6
100%	1,4	2,4	2,4	2,4

- Source: Own elaboration

(1) Taxes not included

TABLE Nº IB-1

INDUSTRIES IN ARATU INDUSTRIAL CENTER (CIA)

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpower	Remarks
101	SIBRA-Eletro Siderúrgica Brasileira, S.A.	08.65	Ferromanganese, ferrosilicon, Ferrosilicomanganese	1.000	P
102	Termoligas Metalúrgicas, S.A.	05.67	Special metallic alloys	57	P
103	TUPERBA-Tubos y Perfilados da Bahia, S.A.	09.67	Welded steel tubes and special sections	182	P
104	Aluminio do Brasil Nordeste S.A. ALBRA-NORDESTE (I)	05.67 01.69	Aluminium cables and conductors	130	P
105	Brastemp Nordeste-Ind. de Aparelhos Domésticos S.A.		Air conditioners and heaters	132	P
106	Industria Automotores do Nordeste S.A. - MAGIRUS DEUTZ	12.66	Buses and trucks chassis	822	P
107	Aços do Brasil S.A. - Ind. e Com.	10.67	Steel rolled and drawn products (wire, copper coated strip)	143	I.P. 1971
108	Aluminio do Brasil Nordeste S.A. (II)	01.69	Alumina reducing plant	176	I.P. 1971/72
109	OIAMETA S.A. Organizaçao Industrial de Artefatos Metálicos	05.68 04.70	Metallic caps and miscellaneous products	41	I
110	Tramontina Nordeste Industrial Ltda.	04.69	Hoes and spondes	105	P
111	USIBA-Usina Siderúrgica da Bahia S.A.	01.65	Steel Plant	700	I
112	BATOR-Cía. Bahiana de Motores	12.68	Berning engines	179	D
113	CEM-Cía. de Equipamentos Mecánicos	09.70	Oil drilling and extraction equipment	69	I
114	Industria de Elevadores Apolo S.A.	07.68	Elevators, lifts and travelling stairs	117	P
115	Instalux Nordeste, S.A.	01.68	Electrical goods and lamps	91	P.I. 971
116	TECFRIL Norte-Ind. e Com. Ltda.	12.69	Air conditioning and refrigeration installations	167	P.I. 971
117	Industrias Rocco do Nordeste	01.69	Castings and machine tools	261	A
118	Machado da Costa S.A. Estructuras Metálicas	10.68	Ship repair, boiler shop and steel structure	275	A
119	Vigorelli do Nordeste S.A.	01.67	Sewing machines	95	A
120	Metalurgica Invicta, S.A.	11.69	Normalized aluminium sections	125	I
121	Cía. Brasileira de Construçao Fichet & Schevartz Hantmont		Safes, Safety locks, locks mithing	495	E
122	Cía. Ferro Industrial Salgueiro. Cofersal		Pressed steel and iron sections, cold pressed sections, flanges and discs	31	E
123	ECANOR-Industrie e Comercio S.A.		Oil industry equipment and alloy steel castings	120	E
124	Heral, S.A. Industria Metalúrgica		Nuts and screws and drawing products	73	E
125	Indumetal - Industria e Comercio Metalurgica - Bahia Ltda.		Non ferrous castings, scrap recovery and parts production	12	E

TABLE Nº IB-1 (Continued)

INDUSTRIES IN ARATU INDUSTRIAL CENTER (CIA)

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpower	Remarks
126	Madeiras S.A. Industria e Comercio		Springs, screws, nails and bushings	50	E
128	Apesa Nordeste S.A.		Electric portable tools, photoelectric relais, hydrometers, disyunctors and fans	335	E
131	Postes Nordeste S.A.	12.66	Concrete poles	199	P
132	Ind. de Carrocerias de Bahia S.A. INCABASA	10.69	Bus bodies repair	112	I. P. 1971
133	Aratu Estaleiros Navais da Bahia S.A.		Ship yard	768	An
135	Ind. de Carrocerias do Nordeste Pluma S.A.		Omnibus bodies	175	An
136	Tubulares Aratubrás Ltda.		Tube and upholstered furniture, industrial cotton and wood turnings	32	E
138	S.A. White Martins Nordeste	06.66	Graphite electrodes, anodes and connection nipples	315	P

Notes:

P. In production	3.059
I. In erection	1.624
A. Project approved by SUDENE	631
An. Project under analysis by SUDENE	943
E. Project under elaboration	1.148
D. Project held	179
	7.584

TABLE Nº IB-2

INDUSTRIES IN SALVADOR

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpower	Remarks
201 (26-2)	Cimba. Cía. Industrial Metalúrgica de Bahia	09.63	Steel furniture, galvanized buckets and containers	167	P
202 (26-2)	Metalúrgica Semfin, S.A. Canada	05.66	Taps and cocks	84	P
203 (26-2)	Brasquip. Ind. Brasileira de Equipamentos	05.67	Oil industry general equipment	84	P
204	FNV. Quipamentos Industriaa, S.A.	09.65	Transmission equipment	234	P
205	Rodema, S.A. Material Rodante Ind. e Com.	05.67	Wheels	36	P
206	Friusa. Armazeus Gerais Frigorificos Uniao S.A.	08.64	Cold storage and ice production	48	P
207	Biselli Nordeste S.A. Viaturas e Equipamentos Industriais	12.67	Special bodies	203	I
208	Luso Brasileiro S.A. Ind. de Cofres e Móveis de Aco.	07.69	Safes, file cabinets, lockers, etc.	160	P
209	Ind. Bahiana de Lajes	05.69	Concrete slabs, concrete joist floor, etc.	58	P
210	Adalberto de Andra de Noguira. Oficina Mecaruca Sao Caetano	not entilled to fiscal incentives	Steel, bronze, copper and aluminium castings	14	P
211	Metalúrgica Ramos	id.	Steel castings, containers, shafts	20	P
212	Cosiba. Cía Siderúrgica de Bahia	id.	3/16" and 5/8" concrete reinforcing bars	61	P
213	Comercia e Industrial de Salvador	id.	Nuts and screws	23	P
214	Famab. Fábrica de Arames e Moles de Aco da Bahia Ltda.	id.	Steel wire and springs	11	P
215	IMS. Industria Metalurgica de Salvador, S.A.	id.	High pressure ball valves (600 to 10.000 p)	210	P
216	Luis Campelo & Cía. Ltd.	id.	Nails	10	P
217	Metalúrgica RAF Ltd.	id.	Sanitary and both products, fancets, lead ingots, etc.		P
218	R. Santiago & Cía. Ltd.	id.	Stamped and enameled plates	11	P
219	V. Boaventura & Cía. Ltd.	id.	Bronze plates and letters	6	P
220	Belmonte Industria e Comerdio Ltd.	id.	Metallic structures, silos, tanks (water and oil products) piping, scaffolding structures, etc.	19	P
221	Cesmes, S.A. Industrie e Comercio	id.	Metallic structures, tanks, cranes and boiler shop	344	P
222	Ferman S.A. Indutria e Comercio	id.	Metallic structures	44	P
223	Prontoferro S.A. Industrie e Comercio	id.	Reinforcing structures for concrete	59	P
224	Acondicionadora Industrial Ltd.	id.	Metallic locks and bolts	5	P
225	Aluminio da Bahia S.A.	id.	Stamped aluminium domestic goods	43	P
226	Cofres Luzitanos Ltd.	id.	Steel safes and furniture	10	P
227	Esquadrias Padronizadas da Bahia Ltd.	id.	Normalized sections	6	P
228	Fabaraco, S.A. Industrie de Arames, cabos e molas	id.	Wire and springs for matressos	11	P
229	Industrias Químicas Labor	id.	Sanitary cabinets	26	P
230	Industrias Reunidas Pery Ltd.	id.	Stainless steel sinks	27	P

TABLE Nº IB-2 (Continued)

INDUSTRIES IN SALVADOR

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpo-wer	Remarks
231	Fábrica de Cofres e Moveis de Aco Ferrado	id.	Safes	5	P
232	Metalúrgica Fonte Nova Ltd.	id.	Cabinets, window grates, doors, sections, etc.	31	P
233	Metalúrgica Independente Ltd. Metalim	id.	Cabinets, cabinet doors, top railings, metallic sections and structures	20	P
234	Metalúrgica Invicta, S. A.	id.	Aluminium sections, anodised cabinet doors	59	P
235	Metalúrgica TAT Ltd.	id.	Hardware and lamps appliances	6	P
236	Renda Priori & Cía Ltd. (Metalúrgica Sta. Margarita)	id	Cans	40	P
237	Boufim Estalinos Navais (Rubens Freire de Carval ho Fourruho)	id.	Fuel tanks	110	
238	Biselli, S.A. Viaturas e Equipamentos Industriais	id.	Tanks, buckets and refrigerated trucks	91	P
240	Amoedo e Cía. Ltd.	id.	Lifts, hoists, etc.	25	P
241	Lorentino Conociacao	id.	Steel furniture, sochets, etc.	8	P
242	Metalmar. Beck Estaleiros Navais	id.	Metallic structures, ships construction and repair	80	P
243	Aratu Estaleiros Navais de Bahia S. A.	id.	Shipyard	54	P
244	Judabe, S. A. Industria de Artefatos de Borracha	id.	Oil drilling and automobile parts	26	P
245	Sociedad Técnica Industrial de Eletricidade Ltd.	id.	Light boards, fluorescent lamp cases, panels	58	P
246	J. J. L. Engenereria Ind. e Com. Ltd.	id.	Furniture, electric installations, lamps	38	P
247	Cía. de Navegaçao Bahiane	id.	Ships	627	P
248	Fábrica de Moles de aco Ltd.	id.	Automobile springs	11	P
249	Fábrica de Moles Pareibana. (Manederias e Fillos Ltd.)	id.	Spring bands and automobile springs	36	P
250	Fabrica de Moles St. Antonio (Inecio Genuino de Silva)	id.	Vehicle springs	11	P

Notes:

P. In production 3.189

I. In erection 203

TABLE Nº 1B-3

INDUSTRIES IN FEIRA DE SANTANA

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpower	Remarks
301	METUSA. Metalúrgica de Tubos S.A. Ind. e Com.	12.68	Connection pipes, asphalted pipe for radiofrecuency	114	I
302	Aratu Motores, Veículos y Máquinas do Nordeste		Small tractors, pumping and generator sets, engines	603	I
303	Peterco do Nordeste Produtos Elétricos Ltda.		Light and electric appliances	524	I
304	Fábrica de Esquadrias e Torres Metálicas AMOACO		Sections		P
305	Fábrica de Torres FETMA		Sections	5	P
306	Joao S. Andrade		Sections	5	P
307	Fotaferro Industria e Com. Ltda.		Sections and metallic structures	17	P
308	Serralharía Itagibá (Wilson Oliveira Pereira)		Sections, doors and metallic structures	8	P
309	Francisco Lopes dos Santos e Cia. Ltda. Fábrica de Moles - Universal		Springs, spring bands, agricultural implements, rope, etc.	15	P
310	Tamayo Ind. Reunidas S.A.		Speed reducers and variable speed devices	88	I
311	Fábrica de tanques. Progresso Ltda.		Metallic tanks, and auxiliary equipment	13	P
312	Ind. de Pecas e Accessorios Autoviarios ORION Ltda.		Wheels, drive supports, machining shop	9	P
313	Endocia Mendonça Silva. Fábrica Moles Continental		Vehicle springs	5	P
314	Fábrica de Moles Universal		Automobile springs		P
315	Fábrica de Moles Parcibana (Joao Galdino de Souza		Automobile springs	7	P
316	Serraria Sto. Antonio (Antonio Alves de Oliveira)		Truck bodies	17	P
317	Serraria Monfort		Truck bodies	17	P
318	Serraria Princesa Ltda.		Truck bodies	39	P
319	Fábrica de Molas Primo (Santos Sobrino & Cia. Ltda)		Vehicle springs and spring bands		P

Notes: I (In erection) 1.329

P (In production) 157

TABLE Nº IB-4

INDUSTRIES IN RECONCAVO AREA

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpower	Remarks
401	Compañía Brasileira de Chumbo COBRAC		Lead in ingots	161	P
402	Comercial e Industrial Monira - Ltda.		Steel wire (galvanised, burnished, annealed) for nails	7	P
403	Fundicao Sao José (Ricardo Neto Cavalcante)		Iron and bronze castings	15	P
404	Siderúrgica Sto. Amaro		Concrete reinforcing bars, iron and steel castings	130	P
405	Cia. de Ferro-Ligas de Bahia FERBASA		Ferrochrome, Ferrosilicon and concentrate ore	200	P
406	Metalúrgica Pereña		Sections	5	P
407	Serralharia Laque Sao Jorge		Sections	5	P
408	Metalgráfica Matarazzo de Bahia S.A.		Cans	101	P
409	Metalúrgica de Bahia S.A. METALBASA		Drums and piping	24	P
410	Serralharia Jorge Nascimento de Melo		Iron gates, grids and swinging doors		P

Note: P. In production 648

TABLE Nº IB-5

INDUSTRIES IN OTHER MUNICIPALITIES OF BAHIA

Code nº	COMPANY NAME	Date of approval	PRODUCTS	Manpower	Remarks
501	Caraibas Metais S.A. Ind. e Comercio	.70	Electrolitic copper and copper sulphate	1.808	A
502	Magnesita, S.A.	01.65	Magnesite and dead burned magnesite	400	P
503	Cia. de Mineraçao e Agricultura do Sao Francisco COMINAG	09.63	Caustic magnesite	297	P
504	Pigmentos Minerais Industrial e Comercial - PIGMINA, S.A.	11.67	Ground barite		P
505	Administraçao do Porto de Ilheus		Iron Castings	36	P
506	Industria Metalica de Bahia Ltda. METALBA		Sections and metallic structures	17	P
507	Oficina Luz		Rubber rolling press	11	P
508	Serralharia Delta		Sections and iron gates. Tilting gates	6	P
509	Schezma Oficina Mecánica e Fundiçao de Ferro e Bronze (Antonio Rodrígues Schezma)		Iron castings	12	P
510	Serralharia Bandeirante		Sections	5	P
511	Serralharia Marilene		Sections and gates	5	P
512	Serralharia Brasilia Ltda.		Sections	8	P
513	Serralharia Metropolitana Ltda.		Sections	8	P
514	Jequié Pregos e Artefatos S.A. Industria e Comercio		Nails	5	P
515	IMOFERRO-Industria de Móveis de Ferro Ltda.		Sections	15	P
516	Aládio Goncalves de Assis (Serralharia Sr. do Boufim)		Iron gates, tilting gates, metallic structures, boiler shop	5	P
517	Artefatos de Cimento e Ferro Boufim Ltda.		Iron gates, sections and tilting gates	10	P
518	E. Souza & Irmeo Ltda.		Tilting gates	5	P
519	Valdeir José da Silva (Fábrica Luz-Mar)		Iron gates	14	P
520	Asclepíades Monteiro Matos (Reformadora de Moles e Oficina Usiao)		Vehicle springs	9	P
521	Braulio Moreira de Silva (Metalúrgica Ypiragua)		Iron gates, tilting gates, metallic structures, boiler shop	9	P
522	Fernando Gonçalves da Silva		Sections		P
523	Serralharie Jorge Nascimento de Melo		Gates and tilting gates		P
524	Waldemar Moreira Continho (Serralharia Conquiste)		Gates and tilting gates		P
525	Companhia de Navegaçao do Sao Francisco		Barges and tug boats	109	P
523	Rede Férrea Federal S.A. Leste Brasileiro		Casting and railway cars	130	P
524	Fábrica Paraiba (Filadelfo Bispo dos Santos)		Vehicle springs	7	P
525	Industria de Moles Sao José		Vehicle springs		P
526	Dendhévea S.A. Agricultura Indus. e Comercio		Truck bodies	130	P
527	Industrial Madereira Ltda.		Truck bodies	23	P
528	Isaac Barboza de Luisa		Truck bodies	5	P
529	Luis Macena-Carrocería Sao Luis		Body frames	5	P
530	Nilo Coelho Comercio e Industria Ltda.		Truck bodies	6	P
531	Renovadora de Moles Sao Paulo (Raimundo Lima)		Springs and spring bands	7	P

Notes: A. Project approved by SUDENE 1.808
P. In production 1.299

TABLE Nº IB-6

BAHIA. SECTORIAL DISTRIBUTION OF MANPOWER AMONG TRANSFORMING INDUSTRIES (IN % OF TOTAL)

INDUSTRIES	Bahia 1962	Bahia 1968	Aratu September 1970(1)
01. Non metallic ores and - construction materials	7,6	12,7	13,7 (2)
02. Metallurgical	3,5	5,3	24,3
03. Mechanical	-	1,1	5,9
04. Electrical and communications material	-	0,2	4,7
05. Transportation material	0,5	2,1	14,1
06. Wood	3,3	5,2	4,8
07. Furniture	2,0	2,7	0,9
08. Paper and paperboard	1,0	1,2	- (3)
09. Rubber	0,4	1,2	0,5
10. Leather, skins and similar	2,8	1,9	1,7
11. Chemical	13,1	14,7	19,3
12. Pharmaceutice products	0,2	0,2	0,5
13. Perfumes	0,7	1,0	-
14. Plastics	-	0,3	1,4
15. Textile	17,9	14,8	2,1
16. Clothes and footwear	3,7	3,7	0,9
17. Food products	20,3	11,9	2,0
18. Beverages	3,3	3,8	-
19. Tobacco	14,9	11,3	-
20. Printing	3,5	3,4	3,2
21. Other	1,3	1,3	-
	100,0	100,0	100,0

- Source: Own elaboration
- Notes:

(1) Including both industries already in production or in erection and those that have granted option letter.

(2) Not including 2 industries with manpower figure unknown, but representing 7% of total investment in Aratú

(3) Not including 1 industry with manpower figure unknown and representing 0,1% of total investment in Aratú.

TABLE Nº IB-7

INDUSTRIES

SECTORS	Projects under ela-boration	Projects under ana-lysis	Approved projects	In erection	In production	Total
01. Non metallic ores and cons-truction materials	6	-	5	6	5	22
02 Metallurgical	6	2	-	8	4	20
03. Mechanical	2	-	2	4	-	8
04. Electrical and communications material	-	1	1	-	2	4
05. Transportation material	1	1	1	1	1	5
06. Wood	-	-	-	2	2	4
07. Furniture	2	-	-	-	-	2
08 Paper and paperboard	1	-	-	-	-	1
09. Rubber	1	-	-	1	-	2
10 Leather, skins and similar	1	-	-	-	-	1
11. Chemical	3	4	1	9	4	21
12. Medicine and pharmacy products	-	1	-	1	-	2
14. Plastics	-	1	1	-	-	2
15. Textile	-	-	-	1	-	1
16. Clothes, footwear and fabrics	-	-	-	-	1	1
17. Food products	3	-	-	3	1	7
20. Publishing and printing	-	-	2	1	-	3
Sub total Transforming Industries	26	10	13	37	20	106
03. Avicultura	1	-	-	1	-	2
Subtotal agropecuarian	1	-	-	1	-	2
TOTAL	27	10	13	38	20	108

- Source: Own elaboration based on C.I.A. booklet "Empresas" - (September 1.970)
- Notes:
  - The adopted classification is the same of C.I.A. publication, "Empresas" (September 1.970)
  - In the transforming industries group none in the following sectors are found:
    13. - Perfumes, soaps and candles
    18. - Drinks
    19. - Tobacco
  - In the agropecuarian industries none in the following sectors are found:
    01. - Agricultura
    02. - Cattle
    04. - Apiculture
    05. - Sericultura

TABLE Nº IB-8

MANPOWER

SECTORS	Projects under ela-boration	Projects under ana-lysis	Approved projects	In erection	In production	Total
01. Non metallic ores and construction materials	221(1)	-	332	526	1. 141	2. 220 (1)
02. Metallurgical	790	228	-	1. 549	1. 387	3. 954
03. Mechanical	123	-	440	396	-	959
04. Electrical and communications material	-	90	320	-	354	764
05. Transportation material	220	768	275	154	882	2. 299
06. Wood	-	-	-	267	514	781
07. Furniture	144	-	-	-	-	144
08. Paper and paperboard	- (2)	-	-	-	-	- (2)
09. Rubber	37	-	-	41	-	78
10. Leather, skins and similar	280	-	-	-	-	280
11. Chemical	748	665	68	1. 171	491	3. 143
12. Medicine and pharmacy products	-	31	-	54	-	85
14. Plastics	-	192	40	-	-	232
15. Textile	-	-	-	342	-	342
16. Clothes, footwear and fabrics	-	-	-	-	143	143
17. Food products	53	-	-	180	98	331
20. Publishing and printing	-	-	277	245	-	522
Subtotal Transforming industries	2. 616(1)(2)	1. 974	1. 752	4. 925	5. 010	16. 277(1)(2)
03. Aviculture	159	-	-	124	-	283
Subtotal agropecuarian	159	-	-	124	-	283
TOTAL	2. 775(1)(2)	1. 974	1. 752	5. 049	5. 010	16. 560

- Source: Own elaboration on corrected and extended data of C. I. A. booklet "Empresas" (September 1. 970)

(1) - In this sector and phase two companies are listed with investments of 110. 000 and 4. 000 NCr $ (x 1000) whose manpower figures are unknown. They represent the 95% of investment in this sector and phase.

(2) - In this sector and phase one company is listed with an investment of 1. 690 NCr $ (x 1000) which manpower figure is unknown.

TABLE Nº IB-9

INVESTMENTS IN NCr $ (x 1000)

SECTORS	Projects under elaboration	Projects under analysis	Approved projects	In erection	In production	Total
01. Non metallic ores and construction materials	120.100	-	18 081	29 150	70.715	238.046
02. Metallurgical	19.525	143.370	-	351.435	29.149	543.479
03. Mechanical	2.700	-	15.700	10 412	-	28.812
04. Electrical and communications material	-	3.067	7.000	-	13.820	23.887
05. Transportation material	5.000	23.100	4.800	3 213	24.800	60.913
06. Wood	-	-	-	24.355	31.224	55.579
07. Furniture	1.750	-	-	-	-	1.750
08. Paper and paperboard	1.690	-	-	-	-	1.690
09. Rubber	815	-	-	6 900	-	7 715
10. Leather, skins and similar	8.590	-	-	-	-	8.590
11. Chemical	167.500	208.404	1.400	91.673	59.816	528.873
12. Medicine and pharmacy products	-	711	-	2.780	-	3.491
14. Plastics	-	20.919	1.400	-	-	22.399
15. Textile	-	-	-	23 339	-	23.339
16. Clothes, footwear and fabrics	-	-	-	-	610	610
17. Food products	1.340	-	-	7.400	1.222	9.962
20. Publishing and printing	-	-	14 650	3 721	-	18.371
Subtotal Transforming Industries	329.010	399.651	63.111	554.378	231.356	1.577.506
03. Aviculture	4.200	-	-	4.500	-	8.700
Subtotal agropecuarian	4.200	-	-	4 500	-	8.700
TOTAL	333.210	399.651	63 111	558.878	231.356	1.586.206

- Source: Own elaboration on corrected and extended data of C.I.A. booklet "Empresas" (September 1.970)

TABLE Nº IB-10

DIMENSION OF C.I.A. COMPANIES MANPOWER AVERAGE

SECTORS	Projects under elaboration	Projects under analysis	Approved projects	In erection	In production	Total
01. Non metallic ores and construction materials	55 (1)	-	66	88	228	111 (1)
02. Metallurgical	131	114	-	194	347	198
03. Mechanical	61	-	220	99	-	120
04. Electrical and communications material	-	90	320	-	177	191
05. Transportation material	220	768	275	154	882	460
06. Wood	-	-	-	133	257	195
07. Furniture	72	-	-	-	-	72
08. Paper and paperboard	(2)	-	-	-	-	(2)
09. Rubber	37	-	-	41	-	39
10. Leather, skins and similar	280	-	-	-	-	280
11. Chemical	249	166	68	130	123	150
12. Medicine and pharmacy products	-	31	-	54	-	42
14. Plastics	-	192	40	-	-	116
15. Textile	-	-	-	342	-	342
16. Clothes, footwear and fabrics	-	-	-	-	143	143
17. Food products	18	-	-	60	98	47
20. Publishing and printing	-	-	138	245	-	174
Subtotal Transforming Industries	114(1)(2)	197	135	133	250	158 (1)(2)
03. Aviculture	159	-	-	124	-	141
Subtotal agropecuarian	159	-	-	124	-	141
TOTAL	116(1)(2)	197	135	133	250	158 (1)(2)

- Source: Own elaboration

(1) - Two companies with an unknown manpower figure, but that represent a 95% of investment, are not listed Evidently the number of jobs average would be greatly increased if that companies were included.

(2) - Manpower unknown for the only companig listed under this sector

TABLE Nº IB-11

CIA INDUSTRIES DISTRIBUTION ACCORDING TO MANPOWER

	Below 50	51 to 100	101 to 200	201 to 350	351 to 500	501 to 1000	Total
Industries in production							
- Nº of industries	2	2	9	4	1	2	20
- Nº of jobs	68	155	1. 434	1. 113	358	1. 882	5. 010
Industries in erection							
- Nº of industries	10	11	10	5	1	1	38
- Nº of jobs	325	848	1. 452	1. 327	397	700	5. 049
Projected, under analysis or approved industries by SUDENE but not yet in erection							
- Nº of industries	16	11	9	8	2	1	47
- Nº of jobs	468	863	1. 340	2. 120	942	768	6. 501
Total							
- Nº of industries	28	24	28	17	4	4	105
- Nº of jobs	861	1. 866	4 226	4 560	1. 697	3. 350	16. 560

- Source: Own elaboration

TABLE Nº IB-12

PER COMPANY INVESTMENTS' AVERAGE (NCr $ x 1000)

SECTORS	Projects under elaboration	Projects under analysis	Approved projects	In erection	In production	Total
01. Non metallic ores and construction materials	20.016	-	3.616	4.858	14 143	10.820
02. Metallurgical	3.254	71.685	-	43 929	7 287	27.174
03. Mechanical	1.350	-	7 850	2 603	-	3.601
04. Electrical and communications material	-	3.067	7.000	-	6 910	5.972
05. Transportation material	5.000	23.100	4.800	3 213	24.800	12.183
06. Wood	-	-	-	12.177	15.612	13.895
07. Furniture	857	-	-	-	-	857
08. Paper and paperboard	1.690	-	-	-	-	1.690
09. Rubber	815	-	-	6.900	-	3.857
10. Leather, skins and similar	8 590	-	-	-	-	8 590
11. Chemical	55 833	52.121	1 400	10.186	14.954	25.184
12. Medicine and pharmacy products	-	711	-	2.780	-	1.745
14. Plastics	-	20.919	1.400	-	-	11.199
15. Textile	-	-	-	23.339	-	23.339
16. Clothes, footwear and fabrics	-	-	-	-	610	610
17. Food products	447	-	-	2 467	1.222	1.423
20. Publishing and printing	-	-	7 325	3 721	-	6.124
Subtotal Transforming industries	12 654	39.965	4 855	14.983	11.568	14.882
03. Aviculture	4 200	-	-	4.500	-	4.350
Subtotal agropecuarian	4.200	-	-	4 500	-	5.350
TOTAL	12.341	39.965	4 855	14 707	11 568	14.687

- Source: Own elaboration

TABLE Nº IB-13

DISTRIBUTION OF INDUSTRIES IN C.I.A. ACCORDING TO INVESTMENTS IN NCr $ (x 1000)

	Below 10.000	10.001 to 50.000	50.001 to 100.000	100.001 to 200.000	More than 200.000	Total
Industries in production						
- Nº of industries	14	4	2	-	-	20
- Nº of jobs	51.131	68.024	112 201	-	-	231.356
Industries in erection						
- Nº of industries	29	8			1	38
- Nº of jobs	80.572	229.177			249.119	558.878
Projected, under analysis or approved industries by SUDENE but not yet in erection						
- Nº of industries	40	6	-	4	-	50
- Nº of jobs	116.514	106.668	-	572 800	-	795.972
Total						
- Nº of industries	83	18	2	4	1	108
- Nº of jobs	248.217	403.869	112 201	572 800	249.119	1.586.206

- Source: Own elaboration

TABLE Nº IB-14

PER JOB INVESTMENT AVERAGE (IN NCr $ x 1 000)

SECTORS	Projects under elaboration	Projects under analysis	Approved projects	In erection	In production	Total
01. Non metallic ores and construction materials	28 (1)	-	54	55	62	56 (1)
02. Metallurgical	25	629	-	227	21	137
03. Mechanical	22	-	36	26	-	30
04. Electrical and communications material	-	34	22	-	39	31
05. Transportation material	23	30	17	21	28	26
06. Wood	-	-	-	91	61	71
07. Furniture	12	-	-	-	-	12
08. Paper and paperboard	- (2)	-	-	-	-	- (2)
09. Rubber	22	-	-	168	-	99
10. Leather, skins and similar	31	-	-	-	-	31
11. Chemical	224	313	21	78	122	168
12. Medicine and pharmacy products	-	23	-	51	-	41
13. Plastics	-	109	37	-	-	97
14. Textile	-	-	-	68	-	68
15. Clothes, footwear and fabrics	-	-	-	-	4	4
16. Food products	25	-	-	41	12	30
20. Publishing and printing	-	-	53	15	-	35
Subtotal Transforming Industries	82 (1)(2)	202	36	113	46	90
03. Aviculture	26	-	-	36	-	31
Subtotal agropecuarian	26	-	-	36	-	31
TOTAL	78 (1)(2)	202	36	111	46	89

- Source: Own elaboration
- Notes:

(1) - Two industries whose manpower are unknown are not listed. This two industries represent the 95% of the sector and phase, 50% of the sector in all its phases and 7% of the industry's total investment.

(2) - By the same reason, one industry, with an investment of 1 690 NCr $ (x 1 000) is not listed

TABLE Nº Fe-1

PRODUCTION, EXPORTS AND APPARENT CONSUMPTION OF IRON ORE

YEAR	Production (A)	Exports (B)	(B)/(A) %	Apparent consumption
1. 960	9. 345. 117	5. 160. 266	55	4. 184. 881
1. 961	10. 220. 481	6. 236. 834	61	3. 983. 647
1. 962	10. 736. 842	7. 527. 858	70	3. 208. 984
1. 963	11. 218. 936	8. 207. 094	73	3. 011. 842
1. 964	16. 962. 276	9. 729. 630	57	7. 232. 646
1. 965	20. 753. 551	12. 731. 228	61	8. 022. 323
1. 966	23. 254. 386	12. 910. 465	55	10. 343. 921
1. 967	22. 297. 562	14. 279. 231	64	8. 018. 331
1. 968	25. 123. 213	15. 049. 735	59	10. 073. 478
1. 969	n. a.	21. 477. 576	-	-
1. 970	n. a.	23. 673. 238(1)	-	-

- **Units**: Metric tons.
- **Source**: Anuario Estatistico do Brasil

(1) Vale do Rio Doce Co. only.

TABLE Nº Fe-2

BRAZILIAN STEEL CONSUMPTION "PER CAPITA"

Year	Population (x 1000 hab)	Apparent consumption (x 1000 t)	"Per capita" consumption (Kg/hab)
1.949	50.769	973,2	19,2
1.950	51.944	1.147,7	22,1
1.951	53.496	1.375,8	25,7
1.952	55.095	1.433,7	26,1
1.953	56.741	1.363,2	24,0
1.954	58.437	2.034,3	34,8
1.955	60.183	1.679,3	27,3
1.956	61.981	1.716,8	27,7
1.957	63.833	2.002,4	31,4
1.958	65,740	1.947,7	29,6
1.959	67.704	2.536,9	37,4
1.960	70.967	2.847,8	40,2
1.961	73.088	2.935,1	40,2
1.962	75.271	2.941,6	39,1
1.963	77.521	3.465,3	44,6
1.964	79.837	3.534,0	44,2
1.965	81.301	3.041,0	37,5
1.966	83.890	4.104,0	49,4
1.967	86.580	3.954,0	45,7
1.968	89.376	4.416,0	48,4

- Source: BNDE, IBGE

Chart FF-1

% of increment on preceding year

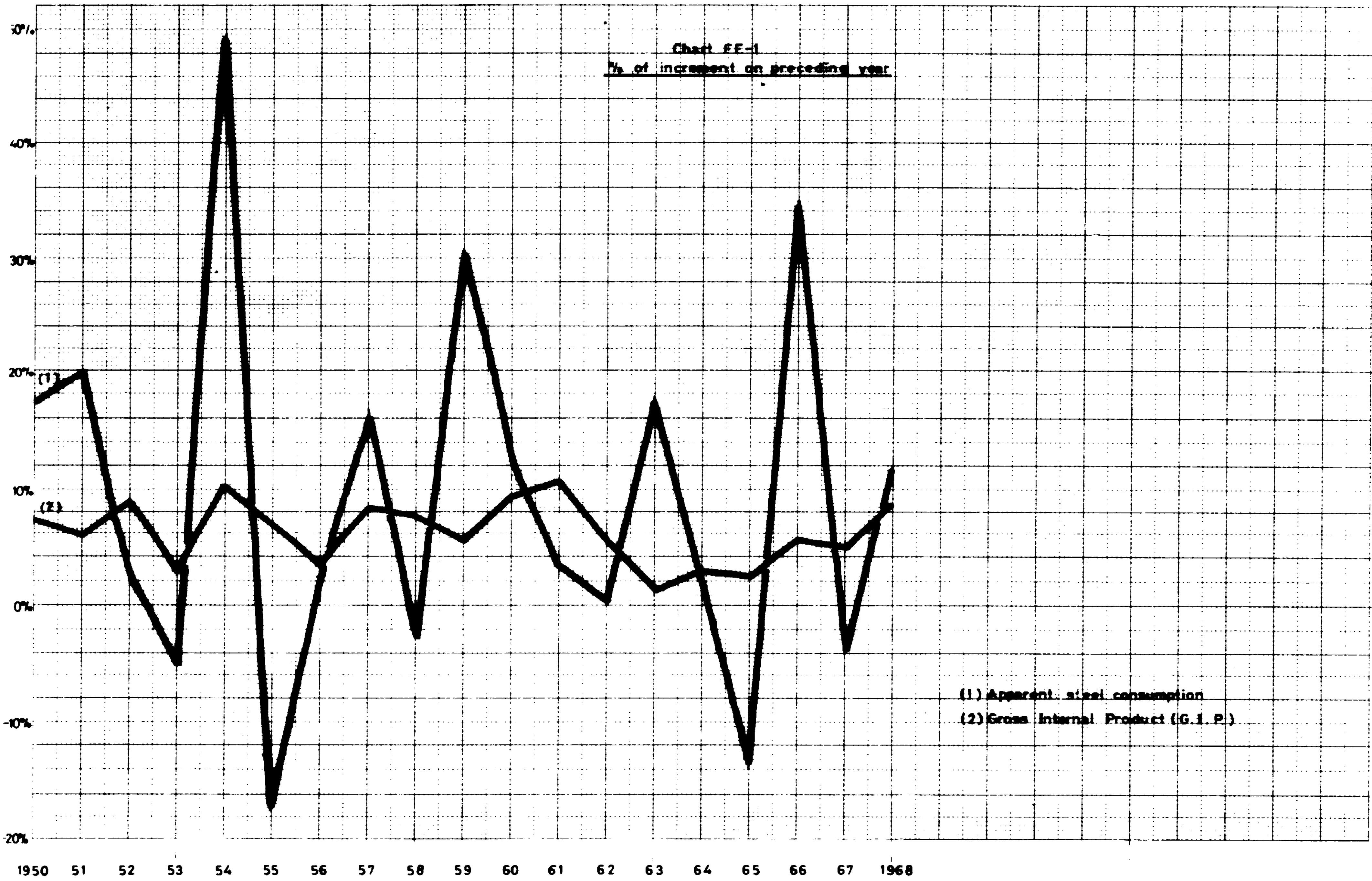

Chart Fe-2

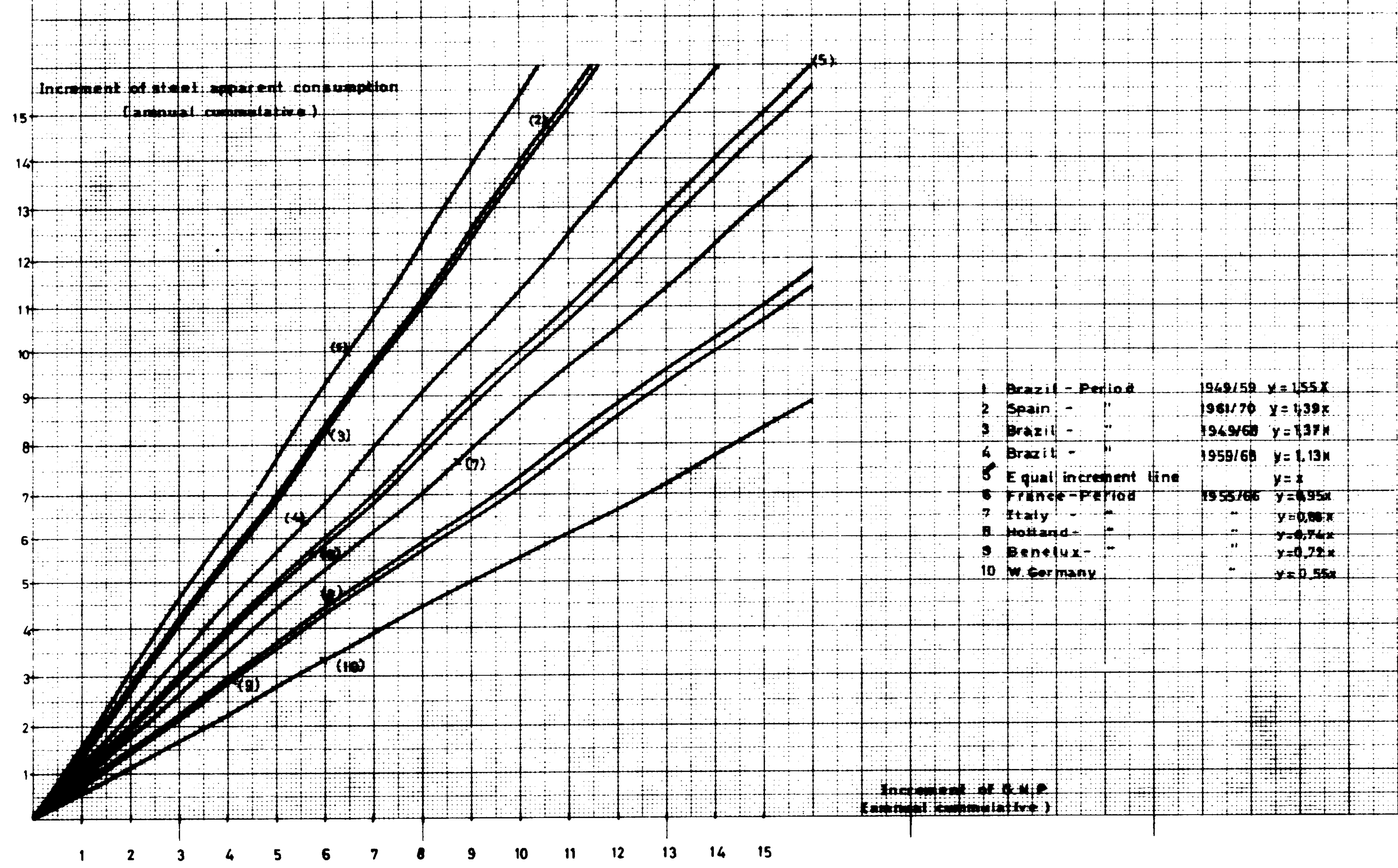
Increment of steel apparent consumption
(annual commulative)
Increment of G.N.P.
(annual commulative)
1 Brazil - Period 1949/59 y = 1,55X
2 Spain - " 1961/70 y = 1,39x
3 Brazil - " 1949/68 y = 1,37x
4 Brazil - " 1959/68 y = 1,13x
5 Equal increment line y = x
6 France - Period 1955/66 y = 0,95x
7 Italy - " " y = 0,88x
8 Holland - " " y = 0,74x
9 Benelux - " " y = 0,72x
10 W. Germany " y = 0,55x

TABLE Nº **Fe-3**

APPARENT CONSUMPTION OF STEEL ROLLED PRODUCTS

Year	Flat rolled products (1)			Apparent consumption	Bars, sections and tubes (2)			Apparent consumption	Total rolled products			Apparent consumption
	Production	Imports	Exports		Production	Imports	Exports		Production	Imports	Exports	
1.961	834	166	0,02	1.000	974	164	2,50	1.136	1.808	330	2,52	2.136
1.962	910	142	0,30	1.052	1.072	134	1,20	1.205	1.982	276	1,50	2.257
1.963	1.029	290	0,23	1.319	1.070	200	0,20	1.270	2.099	490	0,43	2.589
1.964	981	134	35	1.080	1.216	163	7	1.372	2.197	297	42	2.452
1.965	1.032	124	158	998	1.095	136	86	1.145	2.127	260	244	2.143
1.966	1.377	177	97	1.457	1.306	137	25	1.418	2.683	314	122	2.875
1.967	1.334	161	306	1.189	1.446	176	35	1.587	2.680	337	341	2.776
1.968	1.779	189	272	1.696	1.705	164	33	1.836	3.484	353	305	3.532
1.969	1.976	231	255	1.952	1.885	173	70	1.988	3.861	404	325	3.940

- **Units**: **(x** 1000) metric tons of **rolled products**.
- **Source**: I. B. S. Yearbook (1.970) **and** I. B. S. **Bulletin (June/**1.969)

(1) - **Plate, sheet, strip,** coils, galvanized **sheets, tinplate, skelp,** narrow **strip and welded tubular products**.

(2) - **Bars, sections,** rails **and fittings, wire and seamless tubes**

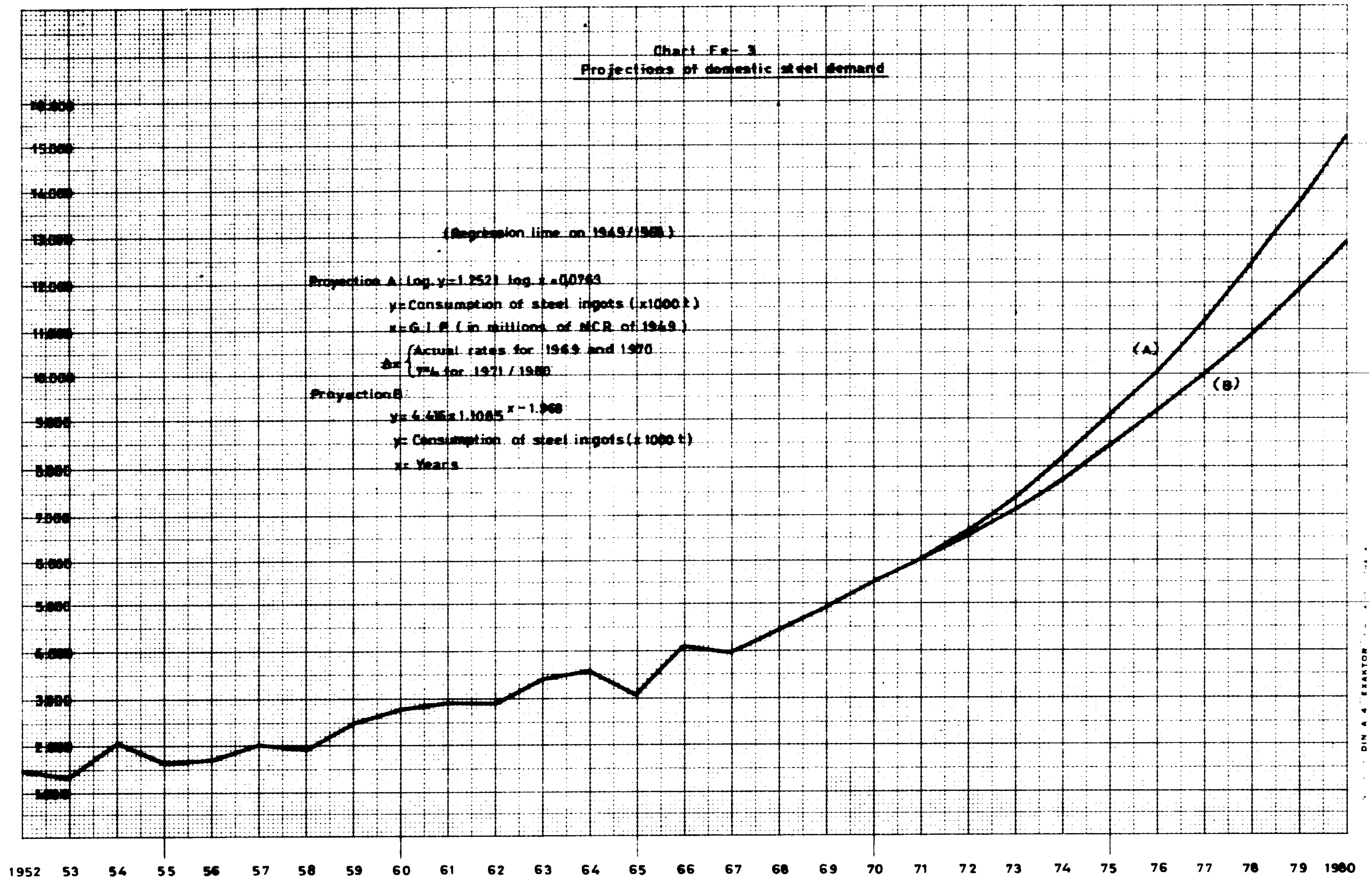
Chart Fe- 3
Projections of domestic steel demand
(Regression line on 1949/1968)
Proyection A: log. y=1.2521 log. x +0.0763
y=Consumption of steel ingots (x1000 t)
x=G.I.P (in millions of NCR of 1949)
Δx {Actual rates for 1969 and 1970
7% for 1971 / 1980
Proyection B
y= 4.416 x 1.1085 x - 1.968
y= Consumption of steel ingots (x 1000 t)
x= Years
(A)
(B)
16.000
15.000
14.000
13.000
12.000
11.000
10.000
9.000
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1980
DIN A 4 EXAKTOR

TABLE Nº Fe-4

YEARS	Increment rate on preceeding year (%)	
	GIP	Apparent steel consumption
1. 950/49	6, 48	17, 93
1. 951/50	5, 92	19, 87
1. 952/51	8, 72	4, 21
1. 953/52	2, 52	-4, 92
1. 954/53	10, 10	49, 23
1. 955/54	6, 85	-17, 45
1. 956/55	3, 18	2, 23
1. 957/56	8, 07	16, 64
1. 958/57	7, 70	-2, 73
1. 959/58	5, 58	30, 25
1. 960/59	9, 70	12, 26
1. 961/60	10, 30	3, 07
1. 962/61	5, 25	0, 22
1. 963/62	1, 55	17, 80
1. 964/63	2, 92	1, 98
1. 965/64	2, 74	-13, 95
1. 966/65	5, 11	34, 96
1. 967/66	4, 78	-3, 65
1. 968/67	8, 39	11, 68

- **Source:** Own elaboration.

TABLE Nº Fe-5

	Cummulative rates of yearly increment (%)		
	G.N.P. A.	Apparent steel consumption B.	B/A (1)
Brazil (2) 1.949/1.968	6,06	8,28	1,37
Brazil (2) 1.949/1.959	6,49	10,06	1,55
Brazil (2) 1.959/1.968	5,60	6,35	1,13
Spain 1.961/1.970	10,60	14,69	1,39
Germany 1.955/1.966	6,01	3,30	0,55
France 1.955/1.966	5,75	5,49	0,95
Italy 1.955/1.966	8,69	7,65	0,88
Holland 1.955/1.966	6,16	4,53	0,74
Benelux 1.955/1.966	4,12	2,97	0,72

(1) - Relation B/A can be considered as elastic derivative having homogeneized the starting bases.

(2) - For Brazil, GIP instead of GNP has been used.

- Source: Own elaboration

TABLE Nº Fe-6

YEARS	Index 1.949 Base = 100	
	G.I.P. (1)	Apparent steel con- sumption (2)
1.949	100	100
1.950	106,5	117,9
1.951	112,8	141,4
1.952	122,6	147,3
1.953	125,7	140,1
1.954	138,4	209,-
1.955	147,9	172,6
1.956	152,6	176,4
1.957	164,9	205,8
1.958	177,6	200,1
1.959	187,5	260,7
1.960	205,7	292,6
1.961	226,9	301,6
1.962	238,8	302,3
1.963	242,5	356,1
1.964	249,6	363,1
1.965	256,4	312,5
1.966	269,5	421,7
1.967	282,4	406,3
1.968	306,1	453,8

- Sources:

(1) Laboratorio de Estatística de Fundaçao IBGE

(2) Own elaboration.

TABLE Nº Fe-7

PROJECTED DOMESTIC STEEL DEMAND (1.972/1.980)

	Bars, Sections and pipes (c)		Flat rolled products		Total	
	Rolled prod.	Ingots	Rolled prod.	Ingots	Rolled prod.	Ingots (b)
1.972	2.567 (2.451)(a)	3.181,5 (3.077)	2.730 (2.303)	3.658,2 (3.082)	5.297 (4.754)	6.839,7 (6.159)
1.975	3.484 (3.251)	4.315,8 (4.077)	3.810 (3.099)	5.105,7 (4.149)	7.294 (6.350)	9.421,5 (8.226)
1.980	5.558 (n.a.)	6.882,8 (n.a.)	6.187 (n.a.)	8.290,8 (n.a.)	11.745 (n.a.)	15.173,6 (n.a.)

UNITS: Metric tons (x 1.000)

SOURCES: I.B.S. (market survey, March 1.971) and National Steel Plan (December 1.967)

NOTES: a) Figures (   ) are demand projections as per National Steel Plan.
b) Ingot figures do not include small amounts scheduled to produce semifinished products.
c) Seamless pipes only.

TABLE Nº Fe-8

Equation estructure	y = ax + b	log y = a log x + b	y = a log x + b
- Correlation coefficient			
Brazil (1) 1.949/1.968	0,979	0,981	0,959
Brazil (1) 1.959/1.968	0,916	0,914	0,903
Germany (2) 1.950/1.964	0,976	0,978	0,982
France (2) 1.950/1.964	0,978	0,972	0,984
Italy (2) 1.950/1.964	0,984	0,991	0,972
Holland (2) 1.950/1.964	0,976	0,977	0,976
Benelux (2) 1.950/1.964	0,920	0,918	0,908

- **Sources**: Own elaboration (1). - Communauté Européenne du Charbon et de l'Acier: "Mémorandum sur les objectifs de 1.970". (2).

TABLE Nº Fe.9

PROJECTIONS OF STEEL INGOTS DOMESTIC DEMAND

YEAR	A	B
1.971	6.020	6.020
1.972	6.550	6.670
1.973	7.130	7.390
1.974	7.760	8.190
1.975	8.450	9.080
1.976	9.190	10.070
1.977	10.010	11.160
1.978	10.890	12.370
1.979	11.850	13.710
1.980	12.900	15.200

- **Units**: (x 1000) metric tons.
- **Source**: Own elaboration

Notes:

- **Projection A**: $\log Y = 1{,}2521 \log x + 0{,}0763$ (Equation of 1.949/1.968 period)
  - Y = Steel ingot consumption
  - X = PIB in millions of NCr \$ of 1.949
  - $\Delta x = 7\%$
- **Projection B**: $Y = 4{,}416 \cdot 1{,}1085^{x - 1.968}$
  - Y = Steel ingot consumption
  - X = Years

TABLE Nº Fe-10

PROJECTED DOMESTIC DEMAND OF STAINLESS STEEL (1.968/1.975)

ASSUMPTIONS	Bars and sections				Flat products			
	1.968	1.970	1.972	1.975	1.968	1.970	1.972	1.975
Sectorial projection(1)	2.540	2.910	3.320	4.060	8.100	9.300	10.700	13.250
Sectorial projection (2)	3.430	3.950	4.500	5.500	-	-	-	-
Projection from industries	2.670	3.000	3.450	4.150	9.183	10.460	12.100	14.700
Correlation with flat products demand	3.400	3.800	4.400	5.400	-	-	-	-
Straight line (1.954 / 66)	-	-	-	-	7.600	8.100	9.400	10.800
Exponential (1.954/66)	-	-	-	-	9.600	12.100	15.200	21.300
Parabole (1.954/66)	-	-	-	-	8.500	9.900	11.500	14.000

- Units: Metric tons of products.

(1) - Calculated on the base of actual demand in 1.966
(2) - Idem, on the base of apparent consumption

TABLE FE-11

ESTIMATED BALANCE BETWEEN PROJECTED DEMAND AND OFFER OF STEEL ROLLED PRODUCTS FOR 1.972

	Demand		Installed capacity	Available capacity (90%)	Balance
	Rolled prod.	Ingots	Ingots		
Flat rolled products	2.730	3.658	3.550	3.195	-463
Sections, bars, etc	2.567	3.182	3.653	3.288	+106
Total	5.297	6.840	7.203	6.483	-357

UNITS: (x 1.000) metric tons.

SOURCE: Own elaboration based on I.B.S. market study (1.971) and P.S.N. (1.967) figures.

TABLE FE-12

INDUSTRIES' DISTRIBUTION VERSUS ESTIMATED PRODUCTION CAPACITY (1.971)

Especification	More than 500 (1)	100 to 500 (1)	Less than 100 (1)	Total
Nº of Plants	4	7	17	28
Production capacity (1)	4.170	1.110	523	5.803
% of total capacity	71,8	19,2	9,0	100

(1) UNITS: (x 1.000) metric tons of steel ingots

SOURCE: P.S.N. (1.967)

TABLE FE-13

REGIONAL CONCENTRATION OF PIG - IRON PRODUCTION

State	Production (x 1.000)			Kg/hab.		
	1.967	1.968	1.969	1.967	1.968	1.969
Minas Gerais	1.584	1.788	2.095	141	156	179
Rio de Janeiro	1.006	1.042	1.016	232	232	217
Sao Paulo	479	539	606	30	33	38
Total 3 states	3.069	3.369	3.717	97	103	111
Total Brasil	3.069	3.369	3.717	35	38	40

SOURCES: Own elaboration based on I.B.S. and A.E.B. data

TABLE FE-14

PERCENTUAL DISTRIBUTION OF PIG IRON PRODUCTION

State	1.967		1.968		1.969	
	% Production	% Population	% Production	% Population	% Production	% Population
Minas Gerais	51,6	13,-	53,-	12,9	56,3	12,7
Rio de Janeiro	32,8	5,-	30,9	5,-	27,4	5,1
Sao Paulo	15,6	18,6	16,1	18,6	16,3	18,6
Total 3 states	100,-	36,6	100,-	36,5	100,-	36,4
Other States	-	63,4	-	63,5	-	63,6

SOURCE: Own elaboration based on I.B.S. and A.E.B. data

TABLE FE-15

REGIONAL CONCENTRATION OF STEEL INGOTS PRODUCTION

state	Production (x 1.000 t)			Kg "per capita"		
	1.967	1.968	1.969	1.967	1.968	1.969
Pernambuco	41	51	53	9	11	11
Minas Gerais	1.384	1.646	1.910	123	143	163
Rio de Janeiro	1.346	1.502	1.553	310	333	332
Guanabara	16	15	28	4	4	7
Sao Paulo	837	1.091	1.226	52	66	71
Santa Catarina	6	3	-	2	1	-
Rio Grande do Sul	104	145	155	16	22	23
Total 7 estates	3.734	4.453	4.925	76	88	94
Total Brasil	3.734	4.453	4.925	43	50	53
S.E. region (1)	3.583	4.254	4.717	95	109	117
S. region (2)	110	148	155	7	9	9
Other regions	41	51	53	0,5	0,6	0,6

SOURCE: Own elaboration based on I.B.S. and A.E.B. data

(1) Minas Gerais, Serra dos Aimorés, Espirito Santo, Rio de Janeiro, Guanabara and Sao Paulo.
(2) Paraná, Santa Catarina y Rio Grande do Sul.

TABLE FE-16

PERCENTUAL DISTRIBUTION OF STEEL INGOTS PRODUCTION

state	1.967		1.968		1.969	
	% Production	% Population	% Production	% Population	% Production	% Population
Pernambuco	1,1	5,4	1,1	5,3	1,1	5,2
Minas Gerais	37,1	13,-	37,-	12,9	38,8	12,7
Rio de Janeiro	36,-	5,-	33,7	5,-	31,5	5,1
Guanabara	0,4	4,6	0,3	4,6	0,6	4,6
Sao Paulo	22,4	18,6	24,5	18,6	24,9	18,6
Santa Catarina	0,2	3,-	0,1	3,-	-	3,-
Rio Grande do Sul	2,8	7,4	3,3	7,3	3,1	7,3
Total 7 estates	100,-	57,-	100,-	56,7	100,-	56,5
S.E. region (1)	95,9	43,6	95,5	43,6	95,8	43,5
S. región (2)	3,-	18,2	3,4	18,4	3,1	18,7
Other regions	1,1	38,2	1,1	38,-	1,1	37,8

SOURCE: Own elaboration based on I.B.S. and A.E.B. data

(1) Minas Gerais, Serra dos Aimorés, Espirito Santo, Rio de Janeiro, Guanabara y Sao Paulo.
(2) Paraná, Santa Catarina y Rio Grande do Sul.

TABLE FE-17

REGIONAL CONCENTRATION OF FLAT ROLLED PRODUCTS

State	Production (x 1.000 t)			Kg "per capita"		
	1.967	1.968	1.969	1.967	1.968	1.969
Minas Gerais	469	618	705	42	54	60
Rio de Janeiro	589	713	803	136	158	172
Sao Paulo	277	454	469	17	27	27
Total 3 states	1.335	1.785	1.977	42	55	59
Total Brasil	1.335	1.785	1.977	16	20	21

SOURCE: Own elaboration based on I.B.S. and A.E.B.

TABLE FE-18

PERCENTUAL DISTRIBUTION OF FLAT ROLLED PRODUCTS

State	1.967		1.968		1.969	
	% Production	% Population	% Production	% Population	% Production	% Population
Minas Gerais	35,1	13,-	34,6	12,9	35,7	12,7
Rio de Janeiro	44,1	5,-	40,-	5,-	40,6	5,1
Sao Paulo	20,8	18,6	25,4	18,6	23,7	18,6
Total 3 states	100,-	36,6	100,-	36,5	100,-	36,4
Other regions	-	63,4	-	63,5	-	63,6

SORUCE: Own elaboration based on I.B.S. and A.E.B. data.

TABLE FE-19

REGIONAL CONCENTRATION OF ROLLED SECTIONS PRODUCTION

State	Production (x 1.000 t)			Kg/per capita		
	1.967	1.968	1.969	1.967	1.968	1.969
Pernambuco	34	42	46	7	9	10
Minas Gerais	514	724	739	46	63	63
Espirito Santo	107	84	87	74	56	57
Rio de Janeiro	409	418	408	94	93	87
Guanabara	12	14	19	3	3	5
Sao Paulo	420	596	546	26	36	32
Santa Catarina	5	3	-	2	1	-
Rio Grande do Sul	87	123	148	14	19	22
Total 8 states	1.588	2.004	1.993	31	38	37
Total Brasil	1.588	2.004	1.993	18	22	21
S.E. region (1)	1.462	1.836	1.799	39	47	45
S. region (2)	92	126	148	6	8	9
Other regions	34	42	46	0,4	0,5	0,5

SOURCE: Own elaboration based on I.B.S. and A.E.B. data

(1) Minas Gerais, Serra dos Aimorés, Espirito Santo, Rio de Janeiro, Guanabara and Sao Paulo.
(2) Paraná, Santa Catarina and Rio Grande do Sul.

TABLE FE-20

PERCENTUAL DISTRIBUTION OF ROLLED SECTIONS

State	1.967		1.968		1.969	
	% Production	% Population	% Production	% Population	% Production	% Population
Pernambuco	2,2	5,4	2,1	5,3	2,3	5,2
Minas Gerais	32,3	13,-	36,2	12,9	37,1	12,7
Espirito Santo	6,7	1,7	4,2	1,7	4,4	1,7
Rio de Janeiro	25,8	5,-	20,9	5,-	20,5	5,1
Guanabara	0,8	4,6	0,7	4,6	0,9	4,6
Sao Paulo	26,4	18,6	29,7	18,6	27,4	18,6
Santa Catarina	0,3	3,-	0,1	3,-	-	3,-
Rio Grande do Sul	5,5	7,4	6,1	7,3	7,4	7,3
Total 8 estates	100,-	58,7	100,-	58,4	100,-	58,2
S.E. region (1)	92,-	43,6	91,7	43,6	90,3	43,5
S. region (2)	5,8	18,2	6,2	18,4	7,4	18,7
Other regions	2,2	38,2	2,1	38,-	2,3	27,8

SOURCE: Own elaboration based on I.B.S. and A.E.B. data

(1) Minas Gerais, Serra dos Aimorés, Espirito Santo, Rio de Janeiro, Guanabara and Sao Paulo.
(2) Paraná, Santa Catarina, and Rio Grande do Sul.

TABLE Nº Fe-21

PROFITABILITY OF USIBA IN SEVERAL ALTERNATIVES OF PRODUCTION

	A	B	C	D	E	F	G	H	I
				Billets: 200.000 t.		Billets: 260.000 t.			
	Billets	Billets	Mini-Steel plant, bars	Rolling mills for bars and sections	Present Usiba's plant (B) + rolling mills (D)	Rolling mills for bars and sections	Present Usiba's plant (A) + rolling mills (F)	Stainless-steel plant (1 st. phase)	E + H
o. Production	200.000 t	240.000 t	100.000 t	220.000 t	220.000 t	260.000 t	260.000 t	40.000 t	-
1. Investments (own capital)	33.970.000	33.970.000	8.000.000	2.610.000	36.580.000	3.000.000	36.970.000	7.787.890	44.367.890
2. Investments (loans)	15.800.000	15.800.000	-	7.465.000	23.265.000	8.000.000	23.800.000	19.138.900	42.403.900
3. Total fixed investments	49.770.000	49.770.000	8.000.000	10.075.000	59.845.000	11.000.000	60.770.000	26.926.790	86.771.790
4. Investments per ton	178	207	80	46	272	42	234	673	-
5. Amortization of fixed investment	3.730.000	3.730.000	6.000.000	773.375	4.503.375	842.500	4.572.500	2.056.790	6.560.165
6. Interests on loans	1.130.000	1.130.000	-	522.550	1.652.550	560.000	1.690.000	1.339.723	2.992.273
7. Transportation costs	2.800.000	2.400.000	300.000	-900.000 (1)	1.500.000	-900.000 (1)	1.900.000	200.000	1.700.000
8. Manufacturing costs, working capital financial costs, general expenses, etc	22.000.000	22.000.000	7.250.000	1.413.600	23.413.600	1.670.000	23.790.000	40.170.000	63.583.600
9. 5+6+7+8 per ton	106,2	121,9	81,5	8,2	141,2	8,4	122,7	109,4	-
10. Sales price per ton (ex-mill)	109	109	150	31,1 (6)	150	32,6 (2)	150	1.690 (8)	-
11. Profit per ton	2,8	-12,9	69,5	22,9 (7)	8,8	24,2 (3)	27,3	596	-
12. Sales figure (0 x 10)	30.520.000	26.160.000	15.000.000	6.840.000 (4)	33.000.000	(4) 8.480.000	39.000.000	67.600.000	100.600.000
13. Own capital turnover (12:1)	0,90	0,77	1,87	2,62	0,90	2,83	1,05	8,68	2,27
14. Fixed investment turnover (12:3)	0,61	0,53	1,87	0,68	0,55	0,77	0,64	2,51	1,16
15. % of installation amortization and interest on sales figure ($\frac{5+6}{12}$ x 100)	15,9%	18,6%	4 %	18,9%	18,7%	16,5%	16,1%	5%	9,5%
16. % of transportation costs on sales figure ($\frac{7}{12}$ x 100)	9,2%	9,2%	2 %	-13,2 %	4,5%	-10,6%	4,9%	0,3%	1,7%
17. Own capital profit before taxes (0 x 11, or 12-5-6-7-8)	780.000	3.100.000	6.950.000	5.030.475 (5)	1.930.475	(5) 6.307.500	7.087.500	23.833.487	25.763.962
18. Own capital return before taxes ($\frac{17}{1}$ x 100)	2,3%	-9,1%	86,9%	192,7%	5,3%	210,2%	19,2%	306%	58,1%

- Notes:
  (1) Reduction in transportation costs, by sending to the South, rolled products instead of billets.
  (2) Increment on product sales price. $150 - 109 \frac{200.000}{200.000} = 32,6$
  (3) Increment in profit per ton of products: 32,6 - 8,4 = 24,2
  (4) Increment in sales figure
  (5) Increment in own profits
  (6) Increment in product's sales price
  (7) Increment in profit per ton of product: 31,1 - 8,2 = 22,9 or $8,8 - (-12,9 \times \frac{240.000}{220.000}) = 22,9$
  (8) Average price resulting from the export of 20.000 t at 1.620 US $/t and the sales in the domestic market of 20.000 t at 1.760 US $

- Units: US $ and metric tons
- Source: Own elaboration

TABLE Nº Fe-22

REINFORCEMENT BARS, EX-FACTORY PRICES IN US $/t

BRAZIL		SPAIN	
ø "	Price	ø mm.	Price
3/16	184	5,5-6	134
1/4	176	6-6,5	131
5/16	164	6,5-7	130
3/8	160	7 - 8	128
1/2	154	8 - 9	126
5/8	148	9 - 10	124
3/4	144	10 - 12	123
7/8	140	12 - 13	122
1	140	13 - 16	120
		16 - 20	119
		20 - 30	118

- Source: Own elaboration

Notes:

(1) Prices in other countries:

- France..... 120-124
- Italy 108-127
- W. Germany. 128-134

(2) International market FOB prices: 101-102

TABLE Nº Fe-23

CORRUGATED BARS. EX-FACTORY PRICES IN US $/t

BRAZIL		SPAIN	
ø "	Price	ø mm.	Price
1/4	249	6 - 7	137
5/16	237	7 - 8	134
3/8	214	8 -10	131
1/2	206	10 -12	128
5/8	194	12 -13	126
3/4	188	13 -18	124
7/8	184	28 -30	123
1	184		

- Source: Own elaboration
- Note: International market FOB prices.- 100-103

TABLE Nº Fe-24

ANGLES AND FLATS. EX-FACTORY PRICES IN US $/t

BRAZIL		SPAIN	
	Price		Price
Angles		**Angles**	
5/8" x 1/8"	198	20 mm x 3 mm	133
2 - 3" x 3/8"	178	55-80 mm x 8-10 mm	118
Flats		**Flats**	
1/2" x 1/8"	237	12-14 mm x 3-4 mm	154
1 1/4-3" x 5/8"	191	30-120 mm x 11-21 mm	121

- Source: Own elaboration

TABLE Nº Fe-25

REINFORCEMENT BARS CA-24, RETAIL PRICES IN NCr $/t

∅"	BAHIA			SAO PAULO
	A	B	C	
3/16	-	1.670-1.740	1.650-1.990	1.420
1/4	-	1.600-1.670	1.550-1.880	1.340
5/16	-	1.460-1.520	1.500-1.810	1.290
3/8	1.330-1.440	1.260-1.320	1.480-1.780	1.270
1/2	1.300-1.400	1.250-1.300	1.570-1.710	1.220
5/8	1.250-1.350	1.200-1.260	1.510-1.650	1.160
3/4	1.250-1.350	1.170-1.220	1.450-1.590	1.120
7/8	1.180-1.280	1.170-1.220	1.430-1.560	1.090
1	1.180-1.280	1.170-1.220	1.430-1.560	1.020

A. Bars from Santo Amaro mill (Bahía). Freight: 15 NCr $/t

B. Bars from Açonorte mill (Recife). Freight: 60 NCr $/t

C. Bars from C.S. Belgo-Mineira mill (Minas Gerais). Freight: 120 NCr $/t

- Source: Bahía prices obtained through inquiry among warehouses
Sao Paulo prices based on "Maquinas & Metais" data-January 1971

TABLE Nº Fe-26

CORRUGATED BARS CA-50. RETAIL PRICES IN NCr $/t

ø "	BAHIA			SAO PAULO
	A	B	C	
1/4	-	2.020-2.120	-	1.770
5/16	-	1.940-2.030	-	1.740
3/8	1.620-1.690	1.730-1.810	1.850-1.940	1.700
1/2	1.560-1.630	1.670-1.740	1.800-1.880	1.650
5/8	1.510-1.580	1.550-1.630	1.680-1.750	1.530
3/4	1.450-1.520	1.520-1.580	1.640-1.720	1.490
7/8	1.430-1.490	1.480-1.550	1.600-1.680	1.450
1	1.430-1.490	1.480-1.550	1.600-1.680	1.450

A. Bars from Santo Amaro mill (Bahia). Freight: 15 NCr $/t

B. Bars from Açonorte mill (Recife). Freight: 60 NCr $/t

C. Bars from C.S. Belgo-Mineira mill (Minas Gerais). Freigth: 120 NCr $/t.

- Source: Bahia prices obtained through inquiry among warehouses
  Sao Paulo prices based on "Maquinas & Metais" data-January 1.971

TABLE Nº Fe-27

FLATS AND ANGLES. RETAIL PRICES IN NCr $/t

	BAHIA	SAO PAULO
Flats		
1/2" x 1/8"	2.180-2.250	2.110
1 1/4-2" x 5/8"	1.800-1.860	1.520
2-3" x 5/8	1.800-1.860	1.200
Angles		
5/8" x 1/8"	1.860-1.920	1.630
2" x 3/16"	1.700-1.760	1.550
3" x 5/16"	1.700-1.760	1.380

- Source: Bahia prices obtained through inquiry among warehouses
  Sao Paulo prices based on "Maquinas & Metais" data-January 1.971

TABLE Nº Fe-28

STEELS CASTINGS PRODUCTION IN 1.969

	CARBON STEEL				Average production per foundry	LOW ALLOY STEEL				Average production per foundry	HIGH ALLOY STEEL				Average production per foundry
	t.	%	nº of foundries	%		t.	%	nº of foundries	%		t.	%	nº of foundries	%	
Sao Paulo (capital)	20.651	58,47	10	22,72	2.065	7.654	64,80	10	40	765	745	27,52	10	41,66	74,5
Sao Paulo (capital excluded)	3.853	10,91	9	20,45	428	527	4,46	4	16	137	132	4,87	3	12,50	44,0
Guanabara & Rio Janeiro	4.049	11,46	8	18,18	506	1.592	13,48	4	16	398	188	6,94	2	8,33	94,0
Minas Gerais	1.288	3,64	6	13,63	214	594	4,60	4	16	136	724	26,74	4	16,66	181,0
R. Grande do Sul	1.389	3,93	6	13,63	231	57	0,48	1	4	57	364	13,44	1	4,16	364,0
Other States	4.087	11,57	5	11,36	817	1.436	12,15	2	8	718	554	20,46	4	16,66	138,5
T O T A L	35.314	99,98	44	99,97	802	11.810	99,97	25	100	472	2.707	99,97	24	99,97	112,0

- Source: Own elaboration

TABLE Nº Fe-29

PRODUCTION OF IRON CASTINGS (1 969)

STATES	GRAY IRON			ALLOY IRON			MALLEABLE			NODULAR		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
Sao Paulo (capital)	71. 459	17, 97	1. 880	33. 038	61, 79	1. 943	14. 347	40, 77	2. 391	12. 403	51, 34	652
Sao Paulo (capital excluded)	55. 723	14, 01	2. 063	11. 711	21, 90	1. 673	216	0, 61	72	4. 339	17, 96	1. 084
Guanabara and Rio de Janeiro	131. 632	33, 10	6 581	4. 014	7, 50	501	65	0, 18	65	6. 005	24, 85	1. 201
Minas Gerais	113. 432	28, 52	9. 452	4. 141	7, 74	690	66	0, 18	66	791	3, 27	263
Rio Grande do Sul	13. 163	3, 31	526	39	0, 07	19	-			315	1, 30	63
Other states	12. 245	3, 07	720	520	0, 97	130	28. 489	58, 23	10. 244	303	1, 25	60
Brazil	397. 654	99, 98	2. 860	53. 463	99, 97	1. 215	35. 183	99, 97	2. 706	24. 156	99, 97	561

NUMBER OF IRON FOUNDRIES (1 969)

STATES	(d)	(e)		(d)	(e)		(d)	(e)		(d)	(e)	
Sao Paulo (capital)	38	27, 33		17	38, 63		6	46, 15		19	44, 18	
Sao Paulo (capital excluded)	27	19, 42		7	15, 90		3	23, 07		4	9, 30	
Guanabara and Rio de Janeiro	20	14, 38		8	18, 18		1	7, 69		5	11, 62	
Minas Gerais	12	8, 63		6	13, 63		1	7, 69		7	16, 27	
Rio Grande do Sul	25	17, 98		2	4, 54		-			3	6, 97	
Other states	17	12, 23		4	9, 00		2	15, 38		5	11, 62	
Brazil	139	99, 97		44	99, 88		13	99, 98		43	99, 96	

- Source: A. B. M.
- Notes: (a) production in metric tons; (b) %; (c) average production per foundry; (d) number of foundries; (e) % of foundries located in the state.

TABLE Nº Fe-30

NON FERROUS METAL CASTINGS PRODUCTION (1.969)

STATES	COPPER			ZINC			ALLUMINIUM			MAGNESIUM			OTHER METALS		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
Sao Paulo (capital)	6.119	76,48	165,37	2.114	90,63	162,61	10.217	90,49	300,50	4.292	100	1.430,66	469	52,99	52,11
Sao Paulo (capital excluded)	276	3,45	27,60	25	1,07	8,33	100	0,89	11,11				201	22,71	67,00
Guanabara and Rio Janeiro	512	6,40	30,11	38	1,62	6,35	501	4,44	41,75				128	14,46	32,00
Minas Gerais	258	3,22	28,66	35	1,50	17,50	9	0,07	2,25				1	0,11	1,00
Rio Grande do Sul	544	6,80	60,44	112	4,80	56,00	349	3,09	49,85				22	2,50	7,33
Other states	292	3,65	22,46	9	0,38	9,00	115	1,02	16,42				64	7,23	21,33
Brazil	8.001	100	84,22	2.333	100	64,80	11.291	100	159,02	4.292	100	1.430,66	885	100	38,47

NUMBER AND PERCENTAGE DISTRIBUTION BY STATES OF N.F. METAL CASTINGS FOUNDRIES (1.969)

STATES	COPPER		ZINC		ALLUMINIUM		MAGNESIUM		OTHER METALS	
	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(e)
Sao Paulo (capital)	37	38,95	13	48,15	34	46,58	3	100	9	39,13
Sao Paulo (capital excluded)	10	10,53	3	11,11	9	12,33			3	13,04
Guanabara and Rio Janeiro	17	17,89	6	22,22	12	16,44			4	17,40
Minas Gerais	9	9,47	2	7,41	4	5,47			1	4,35
Rio Grande do Sul	9	9,47	2	7,41	7	9,59			3	13,04
Other states	13	13,69	1	3,70	7	9,59			3	13,04
Brazil	95	100	27	100	73	100	3	100	23	100

- Source: A. B. M.
- Notes: (a) - production in metric tons; (b) - %; (c) - average production per foundry; (d) number of foundries; (e) % of foundries located in the state.

TABLE Nº Fe-31

REGIONAL CONCENTRATION OF METALS CASTINGS PRODUCTION (1.969)

STATE	STEEL				IRON					OTHER METALS					
	Carbon	Low alloy	High alloy	Total	Grey iron	Alloy	Malleable	Nodular	Total	Cu	Zn	Al	Mg	Other	Total
Sao Paulo (capital)	58,47	64,00	27,52	58,29	17,97	61,79	40,77	51,34	25,71	76,47	98,61	98,48	100	52,99	86,60
Sao Paulo (capital excluded)	10,91	4,46	4,87	9,05	14,01	21,90	0,61	17,96	14,10	3,44	1,07	0,88	-	22,71	2,24
Guanabara & Rio Janeiro	11,46	13,48	6,94	1,69	33,10	7,50	0,18	24,85	27,76	6,39	1,62	4,43	-	14,46	4,39
Minas Gerais	3,64	4,60	26,74	5,12	28,52	7,74	0,18	3,27	23,20	3,22	1,50	0,07	-	0,11	1,13
Rio Grande do Sul	3,93	0,48	13,44	3,63	3,31	0,07		1,30	2,64	6,79	4,80	3,09	-	2,48	3,83
Other	11,57	12,15	20,46	12,19	3,07	0,97	58,23	1,25	6,57	3,64	0,98	1,01	-	7,23	1,79
- TOTAL	99,98	99,97	99,97	99,97	99,98	99,97	99,97	99,97	99,98	99,95	99,98	99,96	100	99,98	99,98
Total Sao Paulo	69,38	69,26	32,39	57,34	31,98	83,69	41,38	69,30	39,81	79,91	91,68	91,36	100	75,70	88,84

TABLE Nº Fe-32

PRODUCTION OF METAL CASTINGS IN BRAZIL (1.962/1.969)

MATERIAL		1.962	1.963	1.964	1.965	1.966	1.967	1.968	1.969
		125 foundries	146 foundries	136 foundries	147 foundries	157 foundries	142 foundries	n. a.	n. a.
Steel	Carbon	37.197	35.981	32.351	31.919	32.044	33.266	38.802	35.317
	Low alloy	5.054	5.400	12.711	6.276	6.460	9.493	11.497	11.880
	High alloy				1.037	1.126	1.221	1.144	2.707
Iron (1)	Grey	300.361	276.259	275.137	282.250	323.435	305.323	306.994	397.654
	Alloy	30.405	38.204	32.795	34.599	29.150	30.164	29.001	53.463
	Malleable	29.777	25.746	25.004	27.650	38.743	33.131	33.294	35.103
	Nodular	2.540	1.667	2.027	2.309	3.960	5.162	14.203	24.156
Non Ferrous Metals	Copper alloys	5.020	5.270	6.216	9.361	5.697	4.903	8.957	8.001
	Zinc alloys	2.155	2.505	1.357	851	2.002	2.360	2.116	2.333
	Alum. alloys	4.760	4.660	4.817	4.100	5.872	5.623	7.403	11.291
	Magnesium alloys	540	1.416	1.526		2.434	2.856	3.540	4.292
	Other	1.866	1.425	550	2.149	720	1.424	1.282	n. a.

- Source: A. B. M.
- Note: (1) - Including ingot molds and tubes.
- Units: metric tons.

TABLE Nº Fe-33

STRUCTURE OF CASTING CONSUMING SECTORS (IN %)

	Gray Iron	Alloy Iron	Malleable Iron	Nodular (ferritic)	Nodular (pearlitic)
1. Metallurgy	16,33	23,91	29,62	1,29	19,85
2. Boiler shops, valves, domestic appl.	2,72	2,41		1,45	-
3. Mechanical	16,61	2,68	0,28	9,59	24,26
4. Electrical	0,81	1,34	7,19	7,11	0,69
5. Transportation	46,30	65,57	55,89	62,01	39,91
6. Civil Works	0,17	-	-	1,09	-
7. Other	17,03	4,05	7,00	17,44	15,27
TOTAL	99,97	99,96	99,98	99,98	99,98

TABLE Nº Cu-1

PRODUCTION OF COPPER ORE

YEARS	A. BAHIA	B. BRAZIL
1.957	n.a.	51.643
1.958	n.a.	65.663
1.959	n.a.	71.818
1.960	n.a.	70.241
1.961	3.773 (1)	68.773
1.962	802 (1)	65.802
1.963	568 (1)	84.760
1.964	134 (1)	110.631
1.965	26 (1)	126.227
1.966	2.000 (1)	119.529
1.967	1.015 (1)	119.206
1.968	2.623 (1)	162.842
1.969	n.a.	n.a.
1.970	n.a.	n.a.

- Units: Metric tons.
- Source: Anuario Estatistico do Brasil.

(1) - Ore from exploration work and stocked at mine.

TABLE Nº Cu-6

COPPER CONSUMPTION IN BRAZIL ACCORDING TO SECTORS

YEAR	Electricity	Mechanics	Civil Works	Other	Total
1.960	45	25	18	12	100
1.961	47	24	18	11	100
1.962	49	23	17	11	100
1.963	51	22	15	12	100
1.964	54	21	13	12	100
1.965	55	23	10	12	100
1.966	53	26	9	13	100
1.967	56	23	10	11	100
1.968	58	24	9	9	100
1.969	58	25	8	9	100

- Source: CEBRACO.

TABLE Nº Cu-5

APPARENT CONSUMPTION OF COPPER (METAL)

YEARS	Total Copper availability	Apparent consumption	Stocks variation	% of scrap recovery on apparent -- consumption.
1.963	56.100	55.000	+1.100	10,9
1.964	42.000	47.000	-5.000	25,5
1.965	39.100	44.000	-4.900	31,8
1.966	70.400	58.000	+12.400	41,4
1.967	59.700	56.000	+3.700	37,5
1.968	78.200	74.000	+4.200	33,8
1.969	80.850	79.500	+1.350	33,3

- Units: Metric tons.
- Source: - CEBRACO
  - Own estimations.

TABLE Nº Cu-4

PERCENTAGE OF SCRAP RECOVERY IN COPPER AVAILABILITY

YEARS	A Scrap Recovery	B Import + Production	$\frac{A}{A+B}$ (%)
1.963	6.000	50.100	10,7
1.964	12.000	30.000	28,6
1.965	14.000	25.100	35,9
1.966	24.000	46.400	33,7
1.967	21.000	38.700	35,2
1.968	25.000	53.200	31,9
1.969	26.500	54.350	33,4

- Units: Metric tons.
- Source: CEBRACO
  Own estimations.

TABLE Nº Cu-3

FOREIGN COMMERCE OF COPPER (METAL)

YEARS	BRAZIL		
	Export	Import	
		(a)	(b)
1.955	n. a.	16.840	n. a.
1.956	-	22.064	-
1.957	-	30.364	-
1.958	-	28.524	-
1.959	-	21.209	21.200
1.960	-	30.926	31.000
1.961	-	37.335	38.000
1.962	-	44.299	42.000
1.963	-	48.754	48.100
1.964	-	28.255	28.000
1.965	-	23.229	22.100
1.966	-	43.399	43.400
1.967	-	36.905	36.900
1.968	292 (1)	50.434	49.700
1.969	250 (1)	48.060	50.650
1.970	n. a.	n. a.	n. a.

- Units: Metric tons.
- Source: (a): Banco Nacional do Desenvolvimento Econômico. Cited by I. B. G. E.
  (b): CEBRACO
  (1) - Amounts disregarded in our calculations of apparent consumption

TABLE Nº Cu-2

PRODUCTION OF COPPER (METAL)

YEARS	BRAZIL	
	(a)	(b)
1.954	n. a.	n. a.
1.955	339	-
1.956	1.349	-
1.957	1.960	-
1.958	1.500	-
1.959	1.800	1.800
1.960	1.212	1.200
1.961	1.659	1.700
1.962	2.000	2.000
1.963	2.000	2.000
1.964	3.000	2.000
1.965	3.000	3.000
1.966	3.000	3.000
1.967	2.000	1.800
1.968	3.000	3.500
1.969	3.250	3.700
1.970	n. a.	n. a.

- Units: Metric tons.
- Source: (a): Banco Nacional do Desenvolvimento Econômico. Cited by I B.G.E.
  (b): CEBRACO

TABLE Nº Cu-7

PROJECTION OF COPPER DEMAND

YEARS	PROJECTED DEMAND
1.971	92.700
1.972	100.100
1.973	108.100
1.974	116.700
1.975	126.000
1.976	136.100
1.977	147.000
1.978	158.800
1.979	171.500
1.980	185.200

- Units: Metric tons.
- Source: Own estimations

TABLE Nº Cu-8

PROJECTIONS ON COPPER PRODUCTION

YEARS	Projection I	Projection II		
		Itapeva	Caraiba	Total
1.971	11.892	7.560	-	7.560
1.972	18.504	7.560	-	7.560
1.973	34.248	13.200	36.000	49.200
1.974	34.248	13.200	36.000	49.200
1.975	48.780	13.200	70.000	83.200
1.976	48.780	13.200	70.000	83.200

- Units: Metric tons.
- Projection I: Plano Decenal de Desenvolvimento
- Projection II: Own estimations based on Caraiba project and Itapeva extension.

TABLE Nº Cu-9

SCRAP RECOVERY PROJECTIONS

YEARS	SCRAP RECOVERY
1.971	27.810
1.972	30.030
1.973	32.430
1.974	35.010
1.975	37.800
1.976	40.830

- Units: Metric tons.
- Source: Own estimations.

TABLE Nº Cu-10

BALANCE BETWEEN FORESEEN DEMAND AND PRODUCTION OF COPPER

YEARS	A	B	C	D = A - (B + C)	$E = \frac{D}{A}$ (%)
1.971	92.700	7.560	27.810	57.330	61,8
1.972	100.100	7.560	30.030	62.510	62,4
1.973	108.100	49.200	32.430	26.470	24,5
1.974	116.700	49.200	35.010	32.490	27,8
1.975	126.000	83.200	37.800	5.000	3,9
1.976	136.100	83.200	40.830	12.070	8,9

- Units: Metric tons.

- A: Foreseen demand
- B: Foreseen national production (Own estimations based on Caraiba project)
- C: Scrap recovery (Own estimations)
- D: Foreseen imports (Own estimations)

TABLE Nº Cu-11

APPARENT CONSUMPTION OF COPPER OF THE ELECTRICAL INDUSTRY IN BRAZIL (1.968)

Origin	COPPER					COPPER ALLOYS					Total copper consumption
	Wire	Bars and sections	Plates and sheets	Pipe	Total Copper	Wire	Bars and sections	Plates and sheets	Pipe	Total copper in alloys	
Production	34. 310	2. 350	2. 720	570	39. 950	230	280	2. 450	90	3. 050	43. 000
Imports	3. 290	386	360	64	4. 100	30	35	225	10	300	4. 400
Exports	194	13	18	6	231	22	23	15	1	61	292
Apparent consumption	37. 406	2. 723	3. 062	628	43. 819	238	292	2. 660	99	3. 289	47. 108

- Units: Metric tons of copper content
- Source: CEBRACO

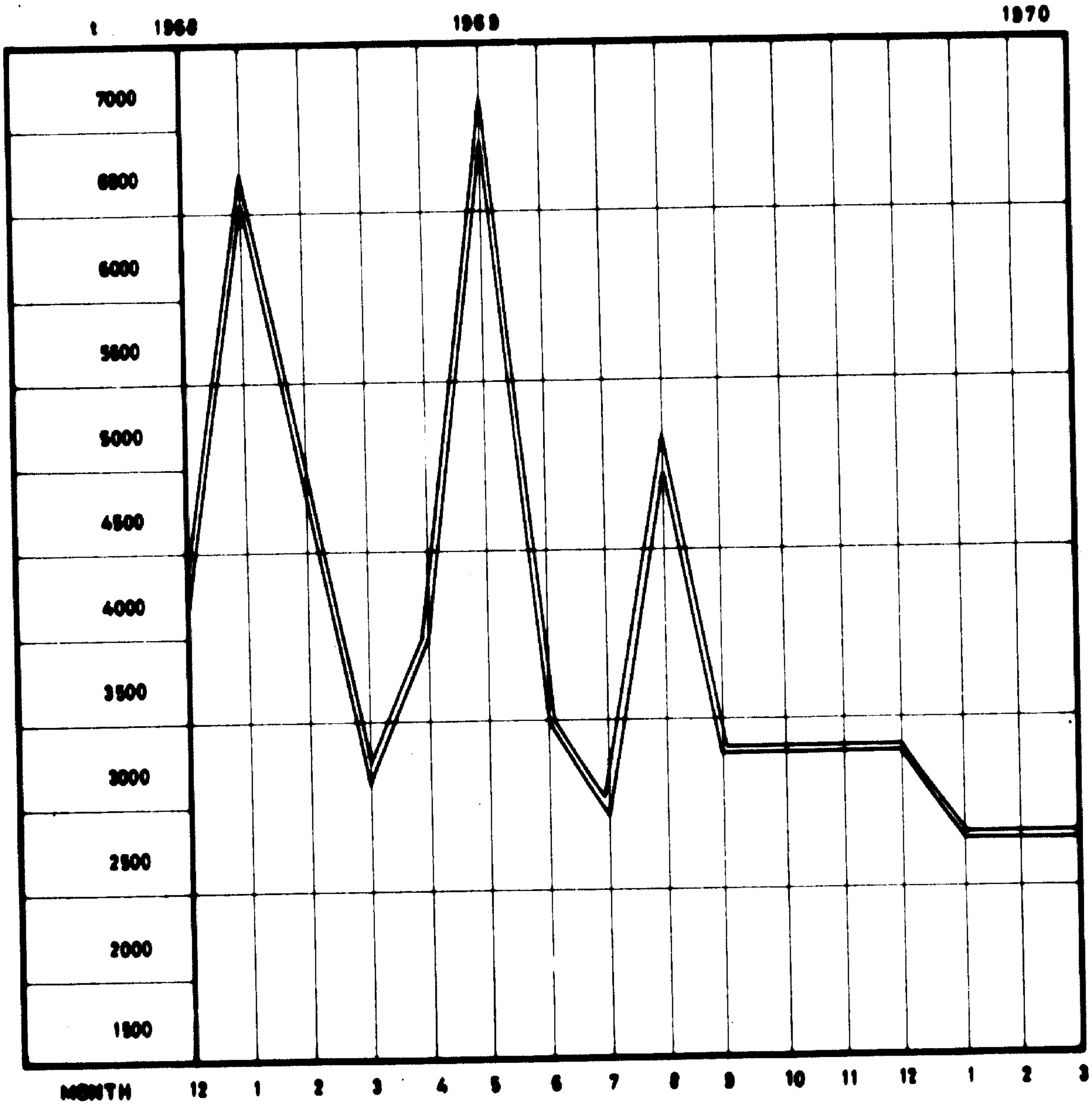

Chart Cu-12

COPPER AND COPPER ALLOYS IMPORTS (1969/70)

TABLE Nº Cu-13

BRAZILIAN COPPER IMPORTS (1.962-1.965)

(EXCLUDING SCRAP AND COPPER MATTES)

	1.962		1.963		1.964		1.965	
	Kg.	US $ CIF	Kg.	US $ CIF	Kg.	US $ CIF	Kg.	US $ CIF
Angola	-	-	-	-	-	-	-	-
Argentina	226.666	156.482	495.542	303.054	-	-	-	-
Belgium-Lux.	392.826	270.205	14.915	10.468	-	-	1.658.214	1.561.400
Canadá	373.030	250.723	251.846	168.195	-	-	-	-
Canadá-Terranova	-	-	-	-	-	-	-	-
Congo (ex. Belgium)	877.133	604.435	-	-	-	-	-	-
Congo (ex. F.)	-	-	-	-	-	-	-	-
Chile	13.979.476	9.768.111	32.084.241	21.804.949	22.357.183	16.706.961	14.406.727	18.129.962
Finland	-	-	-	-	-	-	-	-
France	7.588	6.238	-	-	-	-	-	-
Germany (W).	4.278.337	2.927.737	827.811	659.501	75.000	56.517	534.944	607.950
Great Britain	-	-	76.329	64.074	22.911	20.078	199.820	271.411
Holland	-	-	-	-	-	-	-	-
Israel	30.021	21.615	-	-	-	-	-	-
Italy	-	-	-	-	-	-	-	-
México	2.462.203	1.850.532	4.120.797	2.944.792	984.062	780.174	688.260	814.544
Netherlands	-	-	-	-	-	-	-	-
Perú	8.154.188	5.729.737	9.067.598	6.289.816	3.880.887	2.925.901	1.741.195	2.152.205
Spain	-	-	-	-	-	-	-	-
South Africa	-	-	-	-	-	-	-	-
Sweden	-	-	-	-	2.738	1.969	-	-
United Kingdom	854.784	598.988	-	-	2.955	2.966	-	-
U.S.A.	5.306.666	3.622.270	1.177.577	799.718	279.455	201.213	2.496.729	3.072.010
Zambia	5.069.157	3.325.618	-	-	-	-	609.159	605.233
Zanzibar	-	-	-	-	-	-	-	-
T O T A L	42.012.075	29.132.691	48.116.656	32.954.561	27.605.191	20.615.779	22.335.048	27.214.795
Average annual price of 1 ton. CIF Brazil in US $.	693		685		746		1,218	
Percentage of increase verified in period 1.965-1.969, 20,7% (in US $)								

- Source: Serviço de Estatística do Ministerio da Fazenda
  Prepared by A.B.C. (Brazilian Copper Association)

TABLE Nº Cu-13 (continued)

BRAZILIAN COPPER IMPORTS (1.966-1.969)

(EXCLUDING SCRAP AND COPPER MATTES)

COUNTRIES	1.966		1.967		1.968		1.969 (x)	
	Kg.	US $ CIF	Kg.	US $ CIF	Kg	US $ CIF	Kg.	US $ CIF
Angola	-	-	-	-	-	-	50.000	73.150
Argentina	-	-	-	-	-	-	-	-
Belgium-Lux.	105.482	126.161	4.108.500	4.438.293	3.394 804	4 038.977	2.325.000	3.506.319
Canada	24 494	27.115	1.208.727	1.220.760	953 683	1.069.194	1 483.500	2.085.817
Canada-Terranova	-	-	-	-	-	-	255.200	385.587
Congo (ex. B.)	-	-	-	-	-	-	50.000	64.950
Congo (ex. F.)	-	-	74.974	121.171	-	-	-	-
Chile	5.589.918	8.413.223	6.468.380	7.413.086	7.970 084	9.755.632	11.067.150	15.901.741
Finland	9.936	12.380	49.866	53.055	-	-	-	-
France	-	-	-	-	200	1.126	-	-
Germany (W).	3.431.386	5.322.132	8.152.445	9.829.238	7 240 227	9.712.052	3.416.101	5.063.909
Great Britain	199.632	289.326	1.688.629	2.146.530	-	-	-	-
Holland	-	-	430.912	517.502	-	-	-	-
Israel	-	-	-	-	-	-	-	-
Italy	221.562	293.636	10	25	-	-	100.000	133.480
Mexico	-	-	-	-	-	-	-	-
Netherlands	-	-	-	-	407 900	577 011	-	-
Peru	-	-	-	-	49 998	15 049	-	-
Spain	-	-	286.990	369.566	24 917	34 884	-	-
South Africa	24.987	40 379	-	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	555 584	7[illegible] 460	91.550	146.525
U.S.A.	30.279.070	48.342.126	7.743.574	9.304.874	23 093 580	26 346 739	18.575.181	27.793.219
Zambia	2.777.142	3.166.654	6.108.060	6.788.061	5 991 888	7 318 617	7.508.800	10.911.426
Zanzibar	-	-	-	-	-	-	-	-
T O T A L	42.663.609	66 033 132	36.341.067	42.202.161	49 682 865	59.591.741	44.922.482	66.066.123
Average annual price of 1 ton. CIF Brazil in US $.	1,547		1,161		1,199		1,470	

Percentage of increase verified in period 1.965-1.969: 20,7% (in US $).

(x) In 1.969 authorised imports licenses are considered, by lack of official reports on actual debarkments

- Source: Serviço de Estatística do Ministerio da Fazenda
Prepared by A.B.C. (Brazilian Copper Association)

TABLE Nº Pb-1

PRODUCTION OF LEAD ORE

YEARS	BAHIA (a)	BRAZIL (b)	(a)/(b) (%)
1.960	70.570	140.903	50,08
1.961	102.460	175.422	58,41
1.962	123.140	204.193	60,30
1.963	157.560	240.282	65,60
1.964	165.890	236.144	70,25
1.965	180.140	266.919	67,49
1.966	180.550	332.937	54,23
1.967	200.330	295.706	67,74
1.968	230.000	320.553	71,75
1.969	245.000	n.a.	-
1.970	257.000	n.a.	-

- Units: Metric tons.
- Source: Mineraçao Boquira S.A. and Anuario Estatistico do Brasil

TABLE Nº Pb-2

PRODUCTION OF PRIMARY LEAD

YEARS	BAHIA (a)	BRAZIL (b)	(a)/(b) (%)
1.959	660	5.588	11,81
1.960	5.871	9.976	58,85
1.961	7.642	12.527	61,00
1.962	8.669	13.346	64,95
1.963	11.971	16.862	70,90
1.964	9.290	14.876	62,44
1.965	3.840 (1)	9.656	39,76
1.966	9.574	17.464	54,78
1.967	12.207	17.171	71,09
1.968	10.795	16.135	66,90
1.969	11.617	18.497	62,80
1.970	14.600	19.400	75,25

- Units: Metric tons.
- Sources:
  - I.B.G.E. Anuario Estatistico do Brasil
  - Produçao Industrial do Estado de Bahia
  - Plano Decenal de Desenvolvimento Economico e Social. COBRAC

(1) - Production reduced by strikes.

TABLE Nº Pb-3

PRODUCTION OF PRIMARY AND SECONDARY LEAD, IMPORTS, AND APPARENT CONSUMPTION (1.958-1.970)

YEARS	National Production		Imports (a)	Apparent Consumption (b)	(a) / (b) in (%)
	Primary	Secondary			
1.958	5.837	1.500 (1)	11.840	19.177	61
1.959	5.526	1.500 (1)	12.170	19.196	63
1.960	10.074	2.000 (1)	8.727	20.801	41
1.961	12.655	2.000 (1)	13.524	28.179	47
1.962	13.693	2.000 (1)	8.082	23.775	33
1.963	16.862	1.708 (2)	15.853	34.423	45
1.964	14.876	3.453 (2)	4.216	22.545	18
1.965	9.656	2.900 (2)	2.171	14.727	14
1.966	17.464	3.683 (3)	5.553	26.700	20
1.967	17.171	4.333 (3)	6.508	28.012	23
1.968	16.135	4.904 (3)	11.761	32.800	35
1.969	18.497	9.500 (4)	9.129	37.126	25
1.970	19.400	9.900 (4)	9.000	38.300	23

- Units: Metric tons.
- Source: EPEA, ICZ, our own estimations

(1) - Estimated; (2) - EPEA investigation; (3) - Own estimations; (4) - ICZ estimation.

TABLE Nº Pb-4

LEAD (METAL) DEMAND ON 1.967:

A COMPARISON BETWEEN FIGURES FORESEEN AND THE AVAILABLE REAL DATA

YEARS	FORESEEN DEMAND (A)	REAL DEMAND (B)	A - B/B (%)
1.967	31.500	28.012	+12,45
1.968	33.800	32.800	+2,96
1.969	36.300	37.126	-2,28
1.970	38.950	38.300 (1)	+1,67

- Units: Metric tons.
- Source:
  - Anuario Estatistico do Brasil. I.B.G.C.
  - Plano Decenal do Desenvolvimento Economico e Social

(1) - Own estimation.

TABLE Nº Pb-5

PROJECTION OF LEAD DEMAND ACCORDING TO THE LAST AVAILABLE DATA

YEARS	PROJECTION 1.967
1.971	41.800
1.972	44.850
1.973	48.100
1.974	51.600
1.975	55.400
1.976	59.400
1.977	63.700 (1)
1.978	68.500 (1)
1.979	73.400 (1)
1.980	78.750 (1)

- Units: Metric tons.
- Source: - Plano Decenal de Desenvolvimento Economico e Social

(1) - Our own estimates

TABLE Nº Pb-6

BALANCE BETWEEN FORESEEN DEMAND AND PRODUCTION CAPACITY OF PRIMARY LEAD

(1.971 - 1.980)

YEARS	Foreseen Demand (a)	Production Capacity (b)	Balance (b) - (a)
1.971	41.800	28.000	-13.800
1.972	44.850	31.000	-13.850
1.973	48.100	34.000	-14.100
1.974	51.600	38.000	-13.600
1.975	55.400	42.000	-13.400
1.976	59.400	42.000	-17.400
1.977	63.700	42.000	-21.700
1.978	68.500	42.000	-26.500
1.979	73.400	42.000	-31.400
1.980	78.750	42.000	-36.750

- Source: our own estimations.

TABLE Nº Pb-7

ESTIMATED CAPACITY OF SANTO AMARO'S LEAD FOUNDRY AND % OF CAPACITY UTILISATION (1.963-1.970)

YEARS	Production Capacity	Production	% of capacity utilisation
1.963	17.600 (1)	11.971	68,0
1.964	17.600 (1)	9.290	52,4
1.965	17.600 (1)	3.840 (2)	21,8
1.966	17.600 (1)	9.574	54,4
1.967	17.600 (1)	12.207	69,4
1.968	17.600 (1)	10.795	61,3
1.969	17.600 (1)	11.617	66,0
1.970	20.000	14.600	73,0

- Sources: EPEA, COBRAC, own estimations

(1) Estimated

(2) Production greatly reduced by strikes.

TABLE Nº Mn-1

PRODUCTION OF MANGANESE ORE

YEARS	A. BAHIA	B. BRAZIL	A/B (%)
1.954	8.630	162.529	5,31
1.955	17.700	212.507	8,33
1.956	51.900	310.783	16,70
1.957	8.803	918.017	0,96
1.958	9.634	882.159	1,09
1.959	15.426	1.032.966	1,49
1.960	10.593	999.163	1,06
1.961	8.110	1.016.353	0,80
1.962	6.846	1.170.688	0,58
1.963	28.078	1.254.390	2,24
1.964	34.148	1.349.071	2,53
1.965	39.863	1.396.062	2,85
1.966	47.817 (30.690)	1.454.895	3,29 (2,1)
1.967	9.989 (21.167)	1.358.370	0,74 (1,56)
1.968	3.429 (16.069)	2.096.595	0,16 (0,7)
1.969	20.771	n.a.	-
1.970	n.a.	n.a.	-

- Units: Metric tons.
- Sources: Anuario Es[illegible]istico do Brasil
  - Figures ( ) from production data of ARMISA and URANDI mines.

TABLE Nº Mn-2

FOREIGN COMMERCE OF MANGANESE ORE

YEARS	BRAZIL		
	Export	Import	Balance
1.954	94.379	-	↓94.379
1.955	176.544	-	↓176.544
1.956	260.344	-	↓260.344
1.957	798.067	-	↓798.067
1.958	663.689	1.510	↓662.179
1.959	914.215	693	↓913.522
1.960	866.318	2.033	↓864.285
1.961	868.501	1.507	↓866.994
1.962	759.915	1.820	↓759.095
1.963	840.709	1.638	↓839.041
1.964	823.918	1.681	↓831.237
1.965	1.067.763	879	↓1.066.884
1.966	956.558	686	↓955.872
1.967	542.017	287	↓541.730
1.968	1.123.909	297	↓1.123.612
1.969	860.619	3.421	↓857.198
1.970	762.881 x	n. a.	-

- Units: Metric tons.
- Source: Anuario Estatistico do Brasil

x January - July

TABLE Nº Mn-3

APPARENT CONSUMPTION OF FERROMANGANESE ALLOYS (1.961-1.969)

Fe/Mn HC	1.961	1.962	1.963	1.964	1.965	1.966	1.967	1.968	1.969
Production	18,5	23,0	21,0	21,0	23,3	28,2	32,1	35,3	38,0
Imports (1)	-	-	-	-	-	-	-	-	-
Exports	-	5,9	0,6	-	7,3	0,8	0,3	-	-
Apparent consumption	18,5	17,1	20,4	21,0	16,0	27,4	31,8	35,3	38,0
Fe-Si-Mn	**1.961**	**1.962**	**1.963**	**1.964**	**1.965**	**1.966**	**1.967**	**1.968**	**1.969**
Production (2)	6,5	5,0	6,2	6,6	11,2	7,3	5,3	6,7	7,6

- Units: Metric tons (x 1000) (Amounts below 100 t. have been neglected).
- Source: Anuarios IBS (1.969-1.970)
- Notes: (1) All imports of ferromanganese have been assumed as low-carbon type (Fe-Mn LC) and therefore excluded from this table.
  (2) Data not available on foreign commerce of Fe-Si-Mn.

TABLE Nº Mn-4

SPECIFIC CONSUMPTION COEFFICIENTS OF FERROALLOYS IN BRAZIL

Ferroalloy	Kwh/t	Kg/t of crude steel
Fe-Mn	3.400	7,30
Fe-Si-Mn	4.500	2,00
Fe-Si 45	5.400	1,90
Fe-Si 75	9.000	1,80
Fe-Si 90	12.300	0,16
Fe-Cr HC	5.000	0,50
Fe-Cr LC	8.000	0,20

- Source: Instituto Brasileiro de Siderurgia

TABLE Nº Ma-5

PROJECTED OFFER AND DEMAND OF STEEL 1.970-1.975

Years	Projected demand	Projected production capacity	Projected offer
1.970	5.097	4.927	4.435
1.971	5.616	5.803	5.223
1.972	6.159	7.203	6.483
1.973	6.808	7.203	6.483
1.974	7.457	8.003	7.203
1.975	8.226	9.053	8.148

- Units: Metric tons (x 1000)
- Source: National steel Plan (1.969)

TABLE Nº Mn-6

PROJECTED DEMAND OF FERROALLOYS 1 970/1 975

Units	Ferroalloy	1. 970	1. 971	1. 972	1. 973	1. 974	1. 975
Metric tons.	Fe-Mn	32. 376	38. 128	47. 326	47. 326	52. 582	59. 480
	Fe-Si-Mn	8. 870	10. 446	12. 966	12. 966	14. 406	16. 296
	Other	20. 225	24. 818	29. 593	29. 593	32. 846	37. 155
	- Total	61. 471	73. 392	89. 855	89. 855	99. 834	112. 931
Mwh	Fe-Mn	110. 078	129. 635	160. 908	160. 908	178. 779	202. 232
	Fe-Si-Mn	39. 915	47. 007	58. 347	58. 347	64. 827	73. 332
	Other	114. 272	169. 902	210. 879	210. 879	234. 297	265. 040
	- Total	294. 265	346. 544	430. 134	430. 134	477. 903	540. 604

- Source: Instituto Brasileiro de Siderurgia

TABLE Nº Mn-7

BALANCE BETWEEN PROJECTED DEMAND AND OFFER OF FERROALLOYS

(1.970/1.975)

Years	Projected demand (a)	Projected offer (b)	Increased capacity (b)	Balance
1.970	294.247	423.346	-	+ 129.099
1.971	346.544	433.260	9.914	+ 86.716
1.972	430.134	(1) 532.404 (2) 642.949	99.144 209.689	+ 102.270 + 212.815
1.973	430.134	(1) 532.404 (2) 642.949	99.144 209.689	+ 102.270 + 212.815
1.974	477.903	(1) 532.404 (2) 642.949	99.144 209.689	+ 54.501 + 165.046
1.975	540.604	(1) 532.404 (2) 642.949	99.144 209.689	- 8.200 + 102.345

Units = Mwh.

Source: (a) Instituto Brasileiro de Siderurgia
(b) Ministry of Industry and Commerce (E.V. Ponbel report)

(1) Most unfavorable estimate.
(2) Most favorable estimate.

TABLE Nº Mn-8

PRODUCTION CAPACITY OF CONVENTIONAL FERROALLOYS (1.970)

STATE	Nº of furnaces	Nominal Capacity (KVA)	Total Capacity (Mwh)
I) Furnaces in operation			
- Minas Gerais	14	43.200	209.689
- Bahía	8	39.700	201.262
- Sao Paulo	1	2.500	12.395
	23	85.400	423.346
II) Furnaces not in operation or making other products			
- Minas Gerais	3	26.000	128.887
- Sao Paulo	6	14.200	70.391
	9	40.200	199.278
- TOTAL	32	125.600	622.624

- Source: Ministry of Industry and Commerce (E. V. Ponbel Report)

TABLE NºCr-1

PRODUCTION OF CHROMITE

YEARS	A. BAHIA	B. BRAZIL	A/B (%)
1.954	780	1.912	40,79
1.955	1.675	4.124	40,62
1.956	2.010	4,115	48,84
1.957	2.500	7.936	31,50
1.958	4.020	5.291	75,98
1.959	5.390	6.224	86,60
1.960	3.810	5.666	67,24
1.961	7.600	15.456	49,17
1.962	19.155	24.839	77,11
1.963	42.050	44.040	95,48
1.964	23.051	25.791	89,38
1.965	29.212	32.049	91,15
1.966	22.488 (23.000)	24.239	92,78
1.967	13.323 (21.000)	15.025	88,67
1.968	13.514 (29.000)	17.032	79,34
1.969	- (37.000)	n.a.	-
1.970	- (73.000)	n.a.	-

UNITS: Metric Tons
SOURCE: Anuário Estatistico do Brasil
Note: Figures ( ) based on production data of FERBASA and COMISA mines.

TABLE Nº Cr-2

FOREIGN COMMERCE OF CHROMITE

YEARS	BRAZIL		
	EXPORTS	IMPORTS	BALANCE
1.954	-	-	-
1.955	-	-	-
1.956	-	-	-
1.957	-	-	-
1.958	-	-	-
1.959	-	-	-
1.960	-	-	-
1.961	-	-	-
1.962	-	-	-
1.963	-	-	-
1.964	-	-	-
1.965	-	-	-
1.966	-	2.031	-2.031
1.967	-	6.193	-6.193
1.968	-	7.181	-7.181
1.969	-	7.324	-7.324
1.970	n.a.	n.a.	-

UNITS: Metric Tons
SOURCE: Anuário Estatístico do Brasil

TABLE Nº Cr-3

APPARENT CONSUMPTION OF FERROCHROME ALLOYS (1.961/1.969)

Fe-Cr HC	1.961	1.962	1.963	1.964	1.965	1.966	1.967	1.968	1.969
Production	984	2.014	1.711	130	2.184	3.026	1.617	3.642	2.221
Imports	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	47	38	60	65
Apparent Consumption.	984	2.014	1.711	130	2.184	2.979	1.579	3.582	2.156
Fe-Cr LC	**1.961**	**1.962**	**1.963**	**1.964**	**1.965**	**1.966**	**1.967**	**1.968**	**1.969**
Production	-	-	-	-	-	-	-	-	-
Imports (1)	895	910	1.000	480	247	1.192	789	1.598	1.456
Apparent Consumption.	895	910	1.000	480	247	1.192	789	1.598	1.456

- Units: Metric tons.
- Source: Anuario IBS
- Notes: (1) All figures on ferrochrome imports have been estimated as low carbon type.

TABLE Nº Cr-4

EVOLUTION OF INTERNAL DEMAND: FERRO-CHROME

YEARS	I		II
	Ferro-Chrome HC	Ferro-Chrome LC	Total Ferro-Chrome
1.971	2.612	1.045	4.505
1.972	3.242	1.297	4.760
1.973	3.242	1.297	5.185
1.974	3.602	1.441	5.695
1.975	4.074	1.630	5.950

- Units: Metric tons.
- Source: I - Bulletin IBS, september 1.968. Estimate based on internal production of steel. National Steel Plan.

  II - Ministry of Industry and Commerce (Relatorio Preliminar sôbre Ferro-Ligas. E.V. Pembel).

TABLE Nº Ba-1

PRODUCTION OF BARYTINE

YEARS	A. BAHIA	B. BRAZIL	A/B (%)
1.954	12.000	12.158	98,70
1.955	2.933	3.583	81,85
1.956	14.579	14.694	99,21
1.957	50.052	50.212	99,68
1.958	62.235	62.260	99,95
1.959	50.684	50.811	99,75
1.960	39.520	39.758	99,40
1.961	62.393	62.445	99,91
1.962	54.542	54.650	99,80
1.963	34.111	34.111	100,00
1.964	33.537	33.537	100,00
1.965	64.360	64.360	100,00
1.966	65.293	65.293	100,00
1.967	86.005	86.005	100,00
1.968	99.980	99.980	100,00
1.969	n.a.	n.a.	-
1.970	n.a.	n.a.	-

UNITS: Metric Tons
SOURCE: Anuário Estatistico do Brazil

TABLE Nº Ba-2

FOREIGN COMMERCE OF BARYTINE

YEARS	BRAZIL			
	EXPORTS		IMPORTS	BALANCE
1.954	-		-	-
1.955	-		-	-
1.956	14.858		-	+14.858
1.957	21.550		-	+21.550
1.958	60.562		-	+60.562
1.959	47.051		-	+47.051
1.960	47.802		-	+47.802
1.961	42.393		-	+42.393
1.962	51.002		-	+51.002
1.963	27.112		2.475	+24.637
1.964	58.888		1.741	+57.147
1.965	22.087	(22.087)	2.919	+19.168
1.966	48.768	(54.864)	3.242	+45.526
1.967	49.068	(48.980)	4.533	+44.535
1.968	12.292	(24.584)	4.243	+ 8.049
1.969	18.292	(n. a.)	4.677	+13.615
1.970	n.a.	(18.292)	n.a.	-

UNITS: Metric Tons

SOURCE: Anuário Estatistico do Brazil. - Pigmina S.A. Figures ( )

TABLE Nº Ba-3

APPARENT CONSUMPTION OF BARYTINE

YEARS	BRAZIL
1.954	12.158
1.955	3.583
1.956	-164
1.957	28.662
1.958	1.698
1.959	3.768
1.960	-8.044
1.961	20.052
1.962	3.648
1.963	9.474
1.964	-23.610
1.965	45.192
1.966	19.767
1.967	41.470
1.968	91.931
1.969	-
1.970	-

UNITS: Metric Tons
SOURCE: Own estimations

It is assumed that there are important stock changes, which amount and intensity is unknown.

TABLE Nº Ba-4

BRAZILIAN IMPORTS OF LITHOPONE (1.961-1.969)

YEARS	METRIC TONS	US $ (x 1.000)
1.961	9.693	1.267
1.962	9.775	1.376
1.963	7.832	1.141
1.964	6.587	1.010
1.965	6.078	956
1.966	5.535	876
1:967	3.496	526
1.968	3.605	518
1.969	2.325	317

- Source: Anuario Statistico do Brasil

TABLE Nº Ba-5

APPARENT CONSUMPTION OF BARIUM CARBONATE (1.958/1.969)

YEARS	National Production (a)	Imports (b)		App. consumption (c) = (a) + (b)
1.958	n. a.	189	-	189 (1)
1.959	-	676	-	676 (1)
1.960	-	1.043	-	1.043 (1)
1.961	-	537	-	537 (1)
1.962	-	1.407	-	1.407 (1)
1.963	-	879	-	879 (1)
1.964	-	954	106 (2)	954 (1)
1.965	40	1.381	150 (2)	1.421
1.966	658	2.174	260 (2)	2.832
1.967	87	3.556	446 (2)	3.634
1.968	1.600	3.482	419 (2)	5.082
1.969	2.117	3.462	386 (2)	5.579

- Units: Metric tons. and US $ (x 1.000). (2)
- Source: Anuario Statistico, Ministerio da Fazenda, Banco do Brasil - Cacex, Química Geral do Brasil S.A.

(1) - Estimated

TABLE Nº Ba-6

BRAZILIAN IMPORTS OF BARIUM CHLORIDE (1.964/1.969)

YEARS	METRIC TONS	US $ (x 1.000)
1.964	389	57
1.965	999	143
1.966	1.068	164
1.967	877	143
1.968	761	127
1.969	1.215	186

- Source: Anuario Statistico do Brasil

TABLE Nº Mg-1

PRODUCTION OF MAGNESITE

YEARS	A. BAHIA	B BRAZIL	A/B (%)
1.954	n. a.	n. a.	-
1.955	n. a.	n. a.	-
1.956	n. a.	n. a.	-
1.957	n. a.	n. a.	-
1.958	42.266	48.186	87,71
1.959	40.019	48.424	82,64
1.960	49.200	63.315	77,70
1.961	58.172	76.702	75,84
1.962	79.352	93.756	84,63
1.963	77.050	90.298	85,32
1.964	85.410	93.740	91,11
1.965	118.868	124.642	95,36
1.966	122.903	127.071	96,71
1.967	105.656	109.253	96,70
1.968	132.392	137.820	96,06
1.969	230.046 (1)	n. a.	-
1.970	n. a.	n. a.	-

- **Units:** Metric tons.
- **Source:** Anuario Estatistico do Brasil

(1) Production figures for 1.969 from MAGNESITA S.A. and COMINAG.

TABLE Nº Mg-2

EXPORTS OF DEAD-BURNED MAGNESITE (1 963-1.970)

YEARS	(a)	(b)		
		Total	To Europe	To Argentine
1.963	584	n. a.	n. a.	n. a.
1.964	1.966	n. a.	n. a.	n. a.
1.965	12.361	12.000	11.100	900
1.966	4.653	4.500	3.750	750
1.967	4.700	4.600	3.560	1.040
1.968	4.578	3.800	2.110	1.690
1.969	10.945	10.000	5.765	4.235
1.970	n. a.	18.500	12.000	6.500

- Units: Metric tons.
- Sources: (a) Anuario Statístico do Brasil
  (b) Magnesita, S.A.

TABLE Nº Mg-3

ESTIMATED DOMESTIC DEMAND OF BASIC REFRACTORIES AND DEAD BURNED MAGNESITE

(1.970 - 1.975)

YEARS	Steel Demand t (x 1.000)	b. refract. demand (Kg)	D.b. magnesite demand (Kg) (steel)	D.b. magnesite demand (Kg) (total) (1)
1.970	5.097	25.485	38.227	54.600
1.971	5.616	28.080	42.120	60.200
1.972	6.159	30.795	46.192	66.000
1.973	6.808	34.040	51.060	73.000
1.974	7.457	37.285	55.927	80.000
1.975	8.226	41.130	61.695	88.100

- Sources: National Steel Plan of Brazil (1.969). Magnesite S A. - Own estimations
(1) Rounded figures

B-197

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7 OF 7

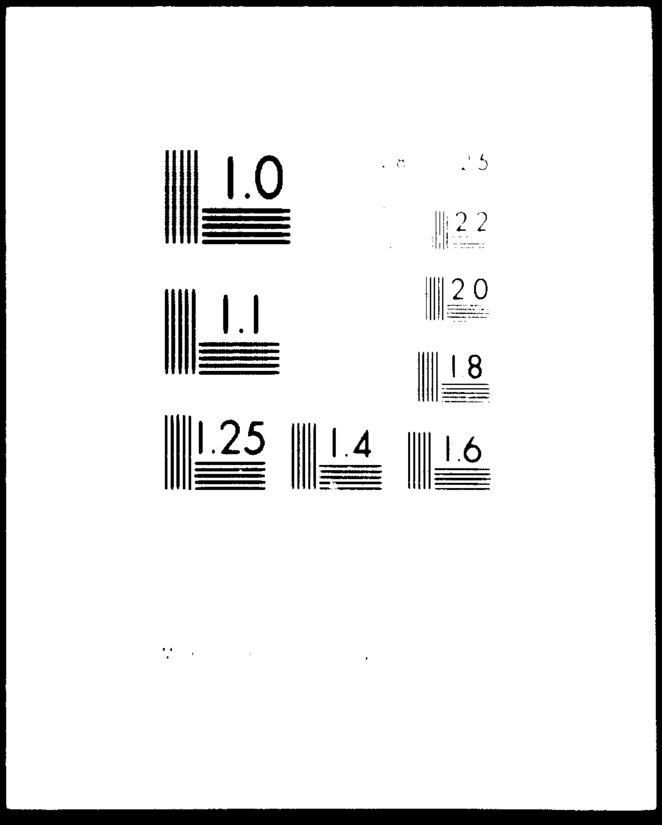

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TABLE Nº Mg-4

BALANCE BETWEEN ESTIMATED DEMAND AND PRODUCTION OF DEAD-BURNED MAGNESITE

YEARS	Estimated Production			Estimated Demand (c)	Balance
	(a)	(b)	Total		
1.970	96.000	10.000	106.000	54.600	+51.400
1.971	96.000	10.000	106.000	60.200	+45.800
1.972	96.000	10.000	106.000	66.000	+40.000
1.973	96.000	48.000	144.000	73.000	+71.000
1.974	112.000	48.000	160.000	80.000	+80.000
1.975	112.000	48.000	160.000	88.100	+71.900

- Units: Metric tons.
- Source: Own estimations based on Magnesita S. A. and Cominag data.
  - (a) - Magnesita S. A.
  - (b) - Cominag

TABLE Nº Mg-5

IMPORTS OF METAL MAGNESIUM

YEARS	METRIC TONS
1.961	92
1.962	611
1.963	1.807
1.964	1.501
1.965	1.330
1.966	2.816
1.967	1.984
1.968	3.069
1.969	5.211
1.970	7.500 (1)

SOURCE: Anuario Estatistico do Brasil

(1) - Own estimation.

TABLE Nº A1-1

PRODUCTION OF BAUXITE

YEARS	A. BAHIA	A: BRAZIL	A/B (%)
1.954	-	27.618	-
1.955	-	45.071	-
1.956	-	69.755	-
1.957	-	63.550	-
1.958	-	69.583	-
1.959	-	96.998	-
1.960	-	120.763	-
1.961	-	111.394	-
1.962	-	190.708	-
1.963	-	169.636	-
1.964	-	131.650	-
1.965	-	187.964	-
1.966	-	249.931	-
1.967	-	302.853	-
1.968	-	313.748	-
1.969	-	n.a.	-
1.970	-	n.a.	-

UNITS: Metric tons
SOURCE: Anuário Estatistico do Brasil

TABLE Nº A1-2

FOREIGN COMMERCE OF BAUXITE

YEARS	BRAZIL		
	Export	Import	Balance
1.954	-	6.793	-6.793
1.955	-	2.916	-2.916
1.956	-	-	-
1.957	-	-	-
1.958	-	-	-
1.959	-	-	-
1.960	-	-	-
1.961	-	-	-
1.962	-	-	-
1.963	26	1.076	-1.050
1.964	32	507	-475
1.965	403	1.433	-1.030
1.966	-	755	-755
1.967	-	702	-702
1.968	-	1.109	-1.109
1.969	-	788	-788
1.970	n.a.	n.a.	-

- Units: Metric tons.
- Source: Anuario Estatistico do Brasil

TABLE Nº A1-3

APPARENT CONSUMPTION OF BAUXITE

YEARS	BRAZIL
1.954	34.411
1.955	47.987
1.956	69.755
1.957	63.550
1.958	69.583
1.959	96.998
1.960	120.763
1.961	111.394
1.962	190.708
1.963	170.686
1.964	132.125
1.965	188.994
1.966	250.686
1.967	303.555
1.968	314.857
1.969	-
1.970	-

- Units: Metric tons.
- Source: Own estimations.

TABLE Nº Al-4

HISTORICAL EVOLUTION OF PRIMARY ALUMINIUM PRODUCTION

Years	Production		Increment (percent) on last year
	Brasil	Bahia	
1.959	15.749	-	+71,37
1.960	16.573	-	+5,23
1.961	18.467	-	+11,42
1.962	21.700	-	+17,50
1.963	22.000	-	+1,38
1.964	26.500	-	+20,45
1.965	29.450	-	+11,13
1.966	32.967	-	+11,94
1.967	37.516	-	+13,79
1.968	41.091	-	+9,52
1.969	42.445	-	+3,28
1.970	n.a.	-	-
Cummulative annual rate: 1.959/69			10,4%
" " " 1.964/69			10,0%

- Units: Metric tons.
- Source: Banco Nacional do Desenvolvimento Economico

TABLE Nº Al-5

APPARENT CONSUMPTION OF PRIMARY ALUMINIUM

YEARS	Export	Import	Production (a)	Apparent consumption (b)	a/b %
1. 959	-	9. 312	15. 749	25. 061	62, 8
1. 960	-	15. 015	16. 573	31 588	52, 5
1. 961	-	18. 476	18. 467	36. 943	50, 0
1. 962	-	19. 700	21. 700	41. 400	52, 4
1. 963	-	25. 815	22. 000	47. 815	46, 0
1. 964	4	18. 549	26. 500	45. 045	58, 8
1. 965	697	21. 844	29. 450	50 597	58, 2
1. 966	842	39. 540	32. 967	71. 665	46, 0
1. 967	184	28. 014	37. 516	65. 346	57, 4
1. 968	349	31. 246	41. 091	71. 988	57, 1
1. 969	160	49. 271	42. 445	91. 556	46, 4
1. 970	n. a.	n. a.	-	-	-

- Units: Metric tons.
- Source: Banco Nacional do Desenvolvimento Econômico. Cited by I. B. G. E.

TABLE Nº A1-6

ALUMINIUM IMPORTS ACCORDING TO TYPES OF PRODUCTS

Years	Ingots	Bars and rounds	Band and - sheet (cut, stamped, etc)	Scale, pe- llets and - powders	Hollow bars and tubes	Other	Total
1.954	15.195	58	367	-	-	311	15.931
1.955	6.450	52	95	-	-	107	6.704
1.956	12.749	302	52	136	-	7	13.246
1.957	12.692	277	95	154	-	42	13.260
1.958	14.107	31	40	62	-	127	14.407
1.959	8.926	-	-	20	-	21	9.312
1.960	14.808	34	-	-	-	173	15.015
1.961	18.334	50	-	-	-	92	18.476
1.962	19.507	52	-	-	-	231	19.790
1.963	25.815	84	94	-	131	148	26.272
1.964	18.549	38	100	-	54	62	18.803
1.965	21.844	50	116	-	79	148	22.237
1.966	39.540	702	243	179	192	48	40.904
1.967	28.014	140	207	430	147	163	29.101
1.968	31.246	218	238	656	150	334	32.842
1.969	49.271	848	338	1.252	352	2.139	54.200
1.970	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.

- Units: Metric tons.
- Source: Anuario Estatistico do Brasil

TABLE Nº Al-7

PROJECTIONS ON PRIMARY ALUMINIUM PRODUCTION

YEARS	PROJECTION I	PROJECTION II
1.971	94.000	79.000
1.972	104.000	102.000
1.973	114.000	114.000
1.974	124.000	134.000
1.975	129.000	145.000

- Units: Metric tons.
- Legend: Projection I . - Plano Decenal de Desenvolvimento Econômico e Social
  Projection II. - Based on ALCAN data (1.971)

TABLE Nº Al-8

DISTRIBUTION OF PROJECTED PRIMARY ALUMINIUM PRODUCTION (1.970-1.975)

COMPANY	1.970	1.971	1.972	1.973	1.974	1.975
- Aluminas (ALCAN)(MG)	25.130	27.000	29.000	29.000	29.000	30.000
- Alumordeste (ALCAN) (Ba)	-	-	10.000	10.000	15.000	25.000
- C.B.A. (S.P.)	23.120	30.000	35.000	40.000	40.000	40.000
- Alcominas (ALCOA) (MG)	7.900	22.000	28.000	35.000	50.000	50.000
- TOTAL	56.150	79.000	102.000	114.000	134.000	145.000

- Units: Metric tons.
- Source: ALCAN

TABLE Nº A1-9

BALANCE BETWEEN PROJECTED PRODUCTION AND DEMAND (1.971/1.975)

Years	Production (a)	Demand (b)	Balance (c) = (b) - (a)
1.971	79.000	100.000	21.000
1.972	102.000	106.500	4.500
1.973	114.000	113.500	-
1.974	134.000	121.000	-
1.975	145.000	129.000	-

- Source: Own estimations.
- Units: Metric tons.

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B-197

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