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THE PRESENT STATE OF LEAD AND ZINC INDUSTRY IN DEVELOPING COUNTRIES

by

UNIDO Secretariat

id.69-1105

The Present State of Lead and Zinc Industry in Developing Countries

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1. During the years of the First Development Decade, sponsored by the United Nations to accelerate the industrial growth of the developing countries, their share in the world lead and zinc apparent consumption has grown from about 6% to 9%.

The ingot metal production in developing countries has also been rising and in 1968 reached approximately 530,000 tons of lead and 420,000 tons of zinc. In addition about 230,000 tons of lead and 520,000 tons of zinc were exported to the developed countries, as ores or concentrates.

2. These general figures may be used to describe the role of the developing countries in the world lead and zinc industry and also for the general analysis of the lead and zinc industry in the developing countries as a whole. However, they do not show how this industry is distributed in the developing countries and what problems are existing with production and consumption of the metals in individual countries.

3. At present only a few developing countries consume and produce lead and zinc in considerable quantities. Most of the developing countries are not producing lead or zinc in any form and their annual consumption of these metals is not more than several hundred kilogrammes. At the same time, for some of the developing countries lead and zinc are an important part of their economy and they are interested in improving home production of the metals for export or internal needs.

4. Identification of the specific trends and problems existing in the lead and zinc industry of the developing countries cannot be made on the basis of general figures covering consumption and production of the metals in the whole developing world or in the developing regions. This can be made only after classification of the developing countries into groups.

5. The volumes of consumption or production of lead and zinc seem to be the most suitable criteria for a classification. The application of both the factors, consumption and production, is necessary because some of the developing countries are only producing lead and zinc without any significant consumption, whilst others are consuming the metals without any considerable production.

6. Such factors as per capita consumption or production, cannot be used for the classification of the developing countries to analyse their metallurgical industries. As a rule large scale of production at modern plants and diversified consumption of metals are existing in the developing countries with large populations and per capita figures might be less there than in small countries with primitive level of production and small consumption.

According to the volumes of lead and zinc consumption and production, all the developing countries could be divided into four groups.

7. The first group consists of the developing countries which are main consumers of lead and zinc in the developing world and have an apparent consumption of more than 10,000 tons a year. Production of the metals is, as a rule, also rather high but in many countries installed capacities or resources cannot meet all the local demand and lead and zinc are imported.

The volume of consumption, more than 10,000 tons for each metal, means nowadays that application of the metals is not restricted to one or two industries and they are used for internal needs in different forms.

8. Pattern of lead and zinc consumption in the first group of the developing countries is almost the same as in the developed countries (see Tables I and II), but may not be always in the same proportion. Lead is used mainly to produce batteries for motor vehicles, anti-knock compounds for petrol, sheeted and coated cables, pipes and sheets for construction and pigments, at the same time zinc is used in galvanizing processes, die casting and brass manufacturing.

9. The second group of countries are exporters of ingot metal. Their own consumption of lead and zinc is very small in comparison to their production (less than 10%) and the industries have been developed mainly to export.

Production of one or both of the metals in the second group is above 10,000 tons annually and so the contribution of lead and zinc industry into the whole economy of a country is significant.

10. The countries of the third group are not smelting lead and zinc. They are mining ores or making concentrates for export and their mining capacities are able to excavate more than 10,000 tons of the metals a year.

11. The fourth group of the developing countries is the most numerous. It consists of the countries which are consuming or producing lead and zinc in small quantities and these metals do not seriously influence their economic development at the moment.

First Group

12. At the beginning of the First Development Decade, only five countries in the developing world, Argentina, Brazil, Mexico, China (mainland) and India, had more than 10,000 tons annual consumption of lead and zinc. Just recently, because of the intensification of the industrial production lead and zinc consumption has reached the level of the first group (see Table III) in Pakistan, Philippines, China (Taiwan), Thailand, North and South Korea.

13. The end-use pattern of lead and zinc in the developing countries reflects, to a great extent, levels of industrialization. There is no surprise, therefore, that all the countries of the first group are also among the main consumers of steel and the other non-ferrous metals in the developing world.

On the basis of the economic growth which has taken place, it is possible to express a supposition that during the Second Development Decade the number of the developing countries in the first group would be increased to at least fifteen members.

14. As was mentioned above, the production of lead and zinc is not on the same level for all countries of the first group. Only Mexico and North Korea are producing much more than their home needs, the others are importing the metals to bridge the gap between local production and demand. It is one of the reasons why Mexico has been permanently increasing its consumption in spite of the fact that volumes of its lead and zinc production jump up and down because of the world market situation but always above the volumes of consumption. (See graph I).

15. In some other countries of the first group the consumption of metals is not growing so smoothly as in Mexico. This is due to the foreign currency

shortage which does not allow to import lead and zinc in necessary quantities from year to year.

16. In order to reduce the import of lead and zinc the countries of the first group are doing their best for the establishment of their own smelting installations to produce the metals for home industry.

Argentina, China (mainland), South Korea and partly Brazil are smelting several thousand tons of lead and zinc a year but their production is still lower than local demand.

India, Pakistan, the Philippines, China (Taiwan) and Thailand only produce a few per cent of their needs and for them the problem of local lead and zinc production is very acute.

India has already started operations at two new plants. One of them in Kerela was built with Canadian assistance and has a 20,000 ton annual capacity of zinc. The other plant is in Udaipor and has a capacity for an annual production of 25,000 tons of zinc and 10,000 tons of lead. A feasibility study is being carried out with the assistance of Polish specialists, to build a plant in Vishakhapatnam.

17. It is understood that for all of the first group countries, excluding Mexico, and North Korea, the increase of home production, based on a modern technological achievement, is a task for the Second Development Decade.

18. Appendix I contains a list of companies and plants (taken from "Non-Ferrous Works of the World", Incorporating World's Non-Ferrous Smelters and Refiners, 1967, First Edition, Published by "Metal Bulletin Books Limited") smelting lead and zinc in the first group of developing countries. This shows that not only output but also technology of production differ from country to country. Horizontal retorts, vertical retorts, shaft furnaces, Imperial Smelting Furnaces (I.S.F.) as well as electrothermic and electrolytic processes are used to produce lead and zinc. This variety of processes is due of course to the various minerals used as raw materials and time when the plants were built. No doubt that for new plants which will be erected in the developing countries only the most productive methods should be recommended after proper feasibility studies.

19. Expansion of the smelting capacities should be backed by new sources of raw materials and especially by increasing of the mine production. In the first group of the countries some efforts have been made already in this direction. In Argentina, for example, the St. Joseph Lead Company of U.S.A. through its holding in Cia Minera Aguilar, is to develop the company's annual output of concentrates to 38,000 tons of lead and 63,000 tons of zinc.

20. Summarizing the present situation for lead and zinc industries in the first group of the developing countries the following aspects look important for the future development of these industries.

(a) Find new sources of raw material supply for smelting plants to produce lead and zinc in necessary quantities.

(b) Establish new and expand existing capacities for lead and zinc production applying the latest technological achievements to reach the world standards of productivity.

(c) Rationalize use of lead and zinc in consumer industries to increase degree of their utilization.

(d) Use widely the materials which could be easily produced under local conditions to replace lead and zinc in some instances.

Second Group

21. The Second Group of the developing countries consists of Peru, Zambia, Burma, Morocco, Tunizia and Congo (Kinshasa). These countries have a low consumption and a high production of lead and zinc and are exporters of these metals and concentrates.

22. Peru and Zambia smelt both metals and their output is increasing. In 1968 lead production in Peru was about 85,000 tons and in Zambia about 20,000. For zinc production the corresponding figures were 65,000 tons and 45,000 tons respectively. For their internal needs Peru and Zambia consume not more than 5,000 tons of each metal annually and the rest of their production is exported.

23. Burma, Tunisia and Morocco mainly smelt and export lead. Zinc ores are mined there also, especially in Morocco, but export of zinc exists only in the form of concentrates. During the First Development Decade production and export of lead metal in these three countries changed from year to year. The highest figures of lead production were at the beginning of the sixties.

In 1962 Morocco produced 24,000 tons of lead, in 1965 their output dropped to 17,200 tons but in 1968 it was again above 24,000. The maximum lead production in Tunisia was also in 1962 when it reached 15,900 tons then in 1964 it was only 11,000 tons and during the last four years it has been between 14-15 thousand. The highest output of smelted lead was in Burma in 1963 (17,700 tons) and since that time it has declined to 12,000.

24. Congo (Kinshasa) unlike the above three is producing and exporting zinc metal and concentrates of zinc ores without smelting lead. Last year its mine production of zinc was more than 114,000 tons and its output of zinc slabs about 62,000 tons.

25. In all the second group countries production of lead and zinc metal has been developed as an export branch of industry and volumes of output have depended on the world market situation and demand of main world importers. The consumption of the metals inside the second group countries is not to make goods for the internal market but mainly for the lead and zinc industry itself or for other export industries.

26. The problems facing the lead and zinc industry in the second group of developing countries for the Second Development Decade appears as follows:

(a) Expand the lead and zinc production in the country using modern technology to smelt ores and concentrates which are now exported.

(b) Reduce the cost of production at the existing plants by application of new technology and more modern management techniques.

(c) Increase and diversify lead and zinc application for the internal use.

(d) Improve trade of the metals by signing long-term agreements covering export volumes and prices.

27. A list of the plants for lead and zinc production in the second group countries is given in Appendix No. II.

Third Group

28. The third group of countries are exporters of lead and zinc concentrates and ores. Nowadays only Algeria, Iran, Bolivia and Honduras are exporting lead and zinc ores and concentrates without smelting. The volumes of the excavated metals changed from year to year and the difference between the highest and lowest levels of production was sometimes considerable.

29. For example, Algeria mined in 1965 38,700 tons of zinc and 10,400 tons of lead but last year these figures were almost half. In Iran, Bolivia and Honduras however fluctuations were smaller and their mine production has a tendency to increase. In Iran, last year production of zinc ore was 38,000 tons of metal equivalent and lead 6,000 tons. In Bolivia these figures were 16,000 tons and 20,000 tons and for Honduras 13,000 and 12,000.

There is no information about building up smelting plants in the third group, only production of the concentrates is planned to be increased. The Matilda mine in Bolivia is scheduled to be expanded up to 100,000 tons of lead a year and Iran is going to develop the Batq mine for a production of 50,000 tons.

30. The problem facing the third group of countries during the Second Development Decade is the establishment of their own smelting plants. This appears to be a most important task for the near future and any assistance in this respect would be very useful.

Fourth Group

31. It might be expected that, during the Second Development Decade, one or two new producers of lead and zinc will join the second or third groups of the developing countries. For example, Turkey is planning now to develop its zinc deposits in Kayseri and mine in 1970 30,000 tons of metal. Towards the end of the seventies they hope to produce about 300,000 tons of zinc in concentrates and 100,000 tons of slabs. The smelting capacities of 40,000 tons a year are to be put into operation in 1975.

32. On the other hand a number of the countries in the first group will increase faster. The economic development in Singapore, Hong Kong, UAR, Chile, Colombia, Venezuela, Nigeria and Malasia, are showing signs of possibly coming into the

group of consumers during the next ten years and some preliminary work should be done to meet the lead and zinc demand in these countries before it becomes a burden on their balance of payments.

This work includes evaluation of the available raw materials and choosing of the most suitable way of their utilization. Studying carefully growth of industries which are main consumers of lead and zinc, these countries of the fourth group have to calculate when, and in which form, their own lead and zinc production should be established.

33. The main object of technical assistance for these countries is to provide accurate and up-to-date information on lead and zinc to ensure that both metals would be used efficiently and would not be replaced by unsuitable substitutes. This information would be also very useful for the developing countries to realize their needs in respect of the most productive methods of smelting, requirements for manpower, water and electricity supply, transport facilities and buildings.

34. Partly the work of such kind is made now by the national Lead and Zinc Associations and the International Lead and Zinc Study Group which was set up in 1960. The Monthly Bulletin of the Group on Lead and Zinc Statistics is the most reliable source of data about lead and zinc in the world. Many figures used in the paper were quoted from this document.

35. Besides issuing the Bulletin the International Lead and Zinc Study Group, through its Special Working Groups, initiated a number of studies on production, consumption, international economic policies, scrap and secondary metal estimates of mine and metal production and consumption, pricing mechanisms in major markets. Some of them have been completed and published.

Conclusions

36. The present state of the lead and zinc industry in the developing world is characterized by the availability of the four groups of the countries which have a different attitude to the subject.

The First Group is formed by the country-consumers, where lead and zinc apparent consumption is more than 10,000 tons a year. The majority of the group

has not developed the metal production to meet the whole local demand and so is importing the metals for internal needs.

The Second Group contains exporters of the metals and concentrates who are smelting lead and zinc without considerable home consumption, and their industry depends mainly on the world market situation.

The Third Group is exporting only the ores and concentrates. The production of the smelted metals is the task for future development.

The Fourth Group includes all the developing countries which were not put into the first three groups. It means that the consumption or production of the metals in these countries is lower than 10,000 tons a year and consequently the influence of lead and zinc on their economy is not strong.

37. Each group of the developing countries have their specific problems and of course these are different for consumers and exporters of the metals.

Analysis of the groups shows that the number of developing countries where the local demand on lead and zinc is higher than home production, is more than the number of the country-suppliers.

38. Only six countries of the second group, plus Mexico and North Korea, possess at present surplus capacities for smelting lead and zinc. Some of them are smelting only one of these metals but eventually all of them as well as four countries of the third group, could smelt both.

Hundred thousand tons of ingots, concentrates and ores exported by these twelve to the world market gave the impression that developing countries are lead and zinc suppliers. Up until now the quantity of metals consumed by the developing countries is less than the volume of their mine and ingot production, but it is not expected that the number of developing countries exporting lead and zinc would be increased greatly during the seventies. Only Turkey has a firm intention to join them soon.

39. At the same time there are already nine of the developing countries with a lead and zinc consumption of more than 10,000 tons a year, without adequate home production and about ten where apparent consumption of the metals is several thousand tons. During the Second Development Decade this group of the

developing countries would grow up from year to year increasing general lead and zinc consumption of the developing world and if the rate of ingot metals production is the same as it was during the sixties the developing countries would be net importers not only for zinc but for lead metal as well.

40. It is understood that problems dealing with smelting lead and zinc in the developing countries are more important than any others in this respect. Practically all of the developing countries have to think about new smelting installations. They need them for home utilisation of the ores and concentrates which are now exported or for production of metals to meet local demand, which cannot be covered only by import.

41. Because of this, technical assistance submitted to the developing countries should be aimed first of all at a decision of the techno-economical questions for lead and zinc production under specific conditions in different countries to find the most suitable way of meeting the existing requirements.

Some projects have been implemented already by the United Nations through its bodies in this field. In 1966 the "Survey of Lead and Zinc Mining and Smelting in Burma" was finished, which helped the country in planning some measures to develop resources for lead and zinc production.

The example of our meeting presents another form of assistance to the developing countries. It is aimed at a collection of experience and technological achievements in the lead and zinc industry of the developed countries, to consider possible ways of their application under specific conditions in the developing world.

There is a hope that after discussion of the submitted reports some recommendations and proposals would be given on the most useful forms of technical assistance, technological processes and other aspects of lead and zinc industry of the developing countries for its successful growth during the future.

Table I

Summary of the Applications of Lead in Europe (Federal Republic of Germany, France, UK, Italy, Austria and Switzerland) in 1967

	0,000 metric tons	%
Consumer applications: •		
Electric cables	269	24.5
Batteries	293	26.6
Chemical uses	192	17.5
Alloys	80	7.3
Sheet, strip, foil, pipes, shot, etc.	222	20.2
Miscellaneous	43	3.9
Total	1099	100

Table II

Summary of the Applications of Zinc in Europe (Federal Republic of Germany, France, UK, Italy, Austria and Switzerland) in 1967

	0,000 metric tons	%
Consumer applications: •		
Strip, sheet, wire, rod, tube, etc.	192	15.1
In brass and other alloys	350	27.5
Zinc castings	208	16.3
Galvanising	370	29.1
Chemical uses	125	9.7
Miscellaneous	29	2.3
Total	1273	100

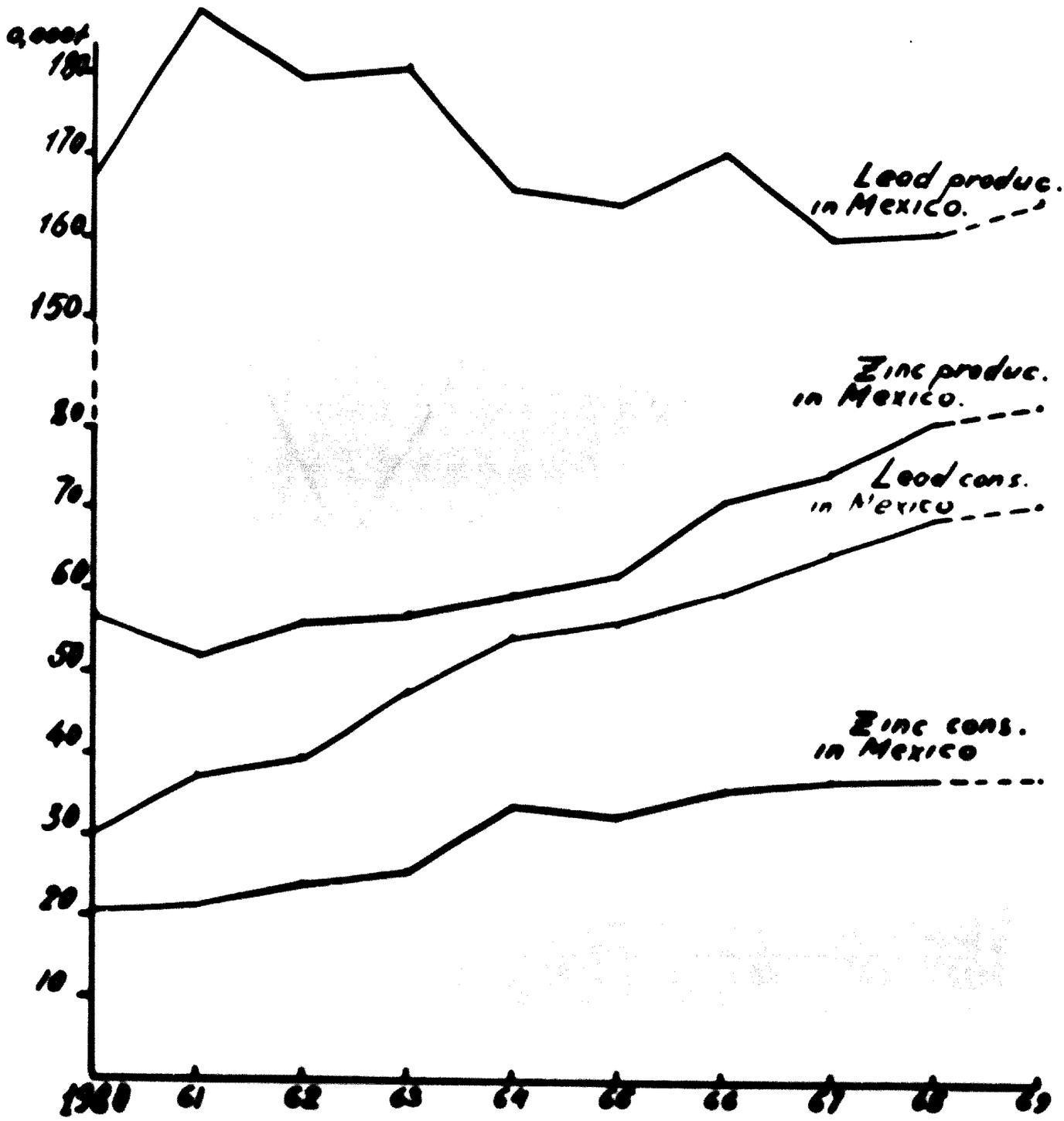
• Statistics quoted by Organisation de Cooperation et de Developpement Economique.

Table III

Consumption of Lead and Zinc in the countries of the First Group in 1968 *

	Lead 0,000 metric tons	Zinc 0,000 metric tons
Pakistan	6	18
Philippines	8	24
China (Taiwan)	4	12
Thailand	2	18
North Korea	11	20
South Korea	4	15

* Statistics taken from the Monthly Bulletin of the International Lead and Zinc Study Group, Vol. IX No. 1.


Lead produc. in Mexico.
Zinc produc. in Mexico.
Lead cons. in Mexico
Zinc cons. in Mexico
180
170
160
150
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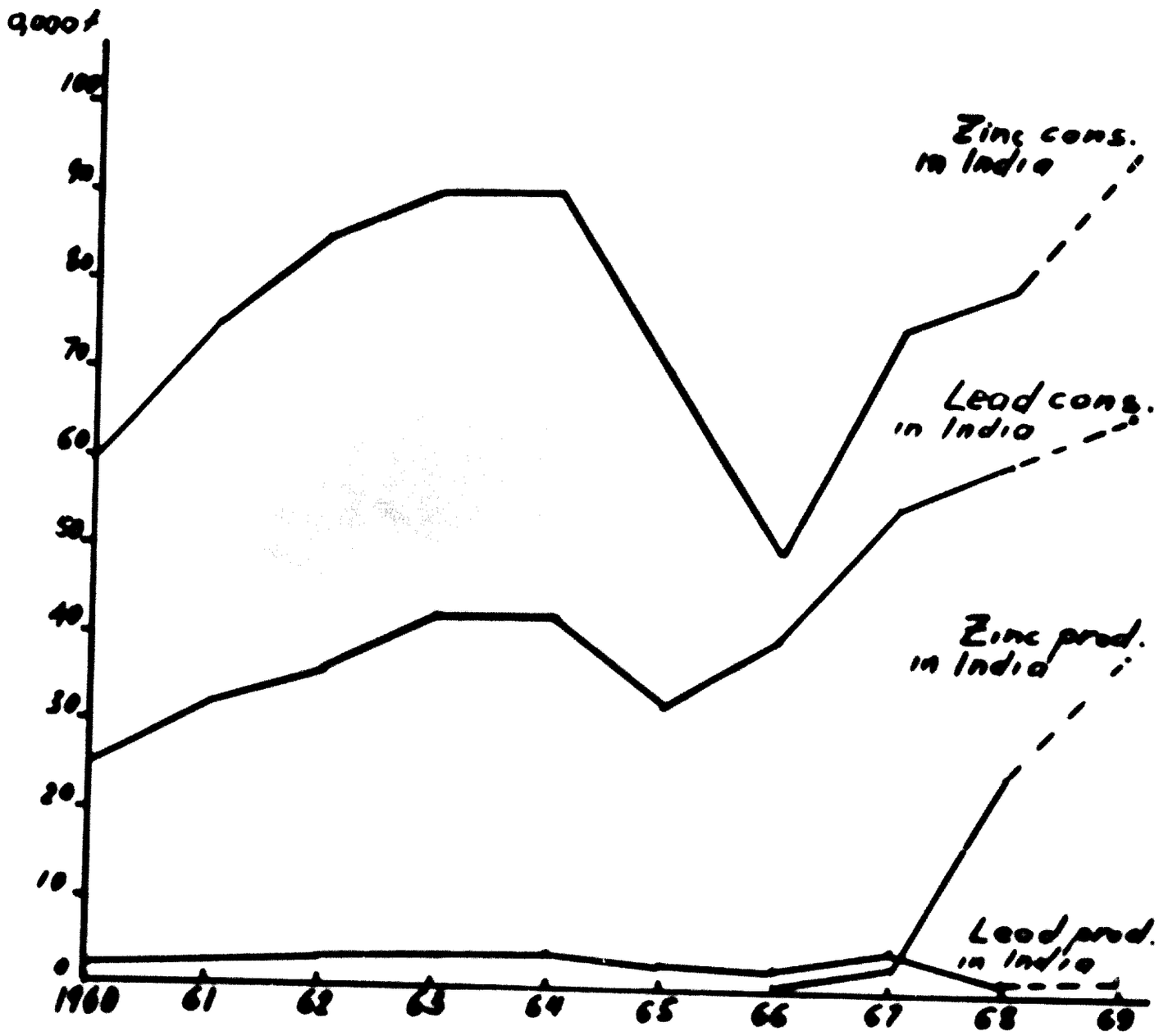
Graph No. 1. (1)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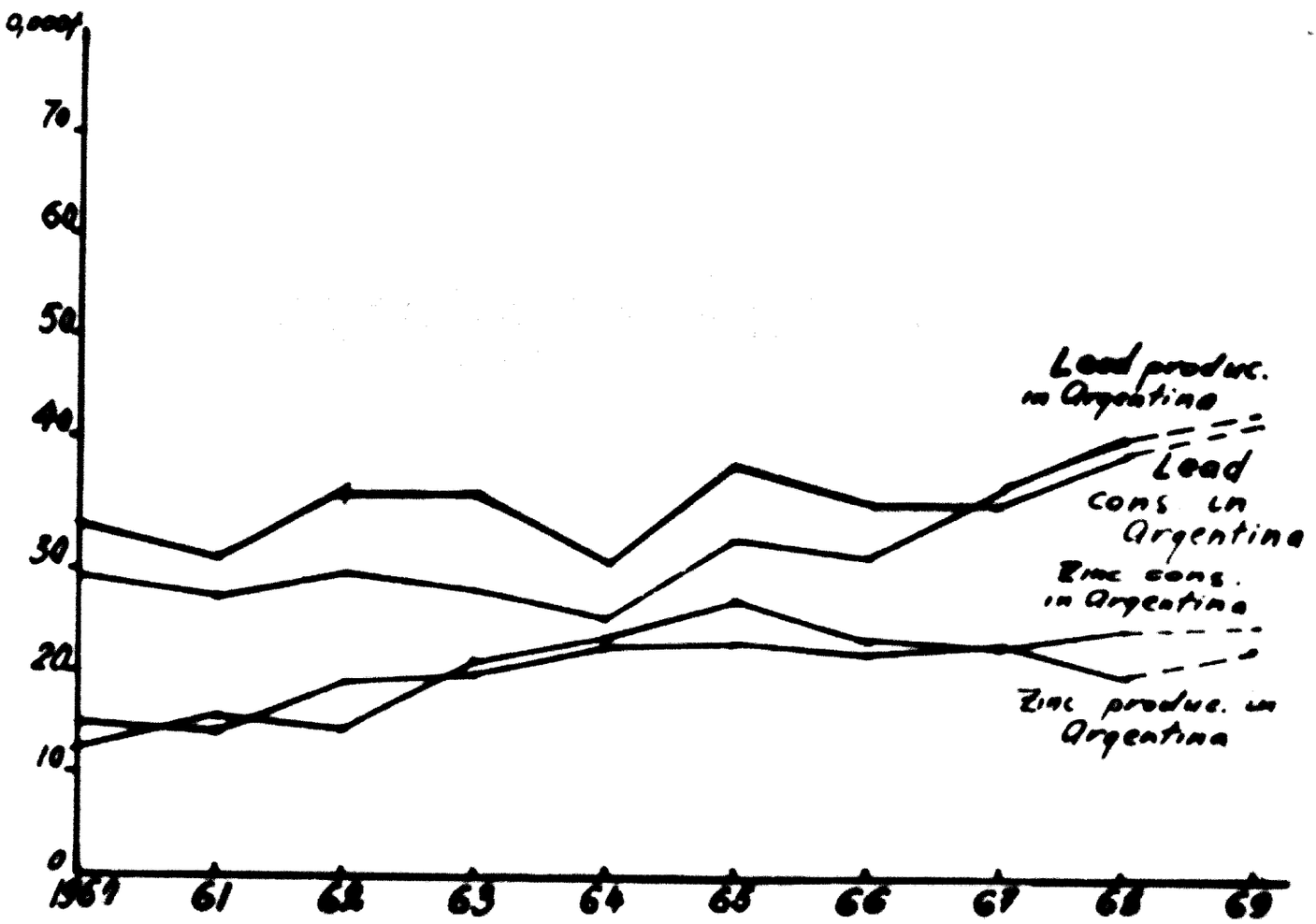
Zinc cons. in India
Lead cons. in India
Zinc prod. in India
Lead prod. in India

Graph No. 1(8)


Lead produc. in Argentina
Lead cons in Argentina
Zinc cons. in Argentina
Zinc produc. in Argentina
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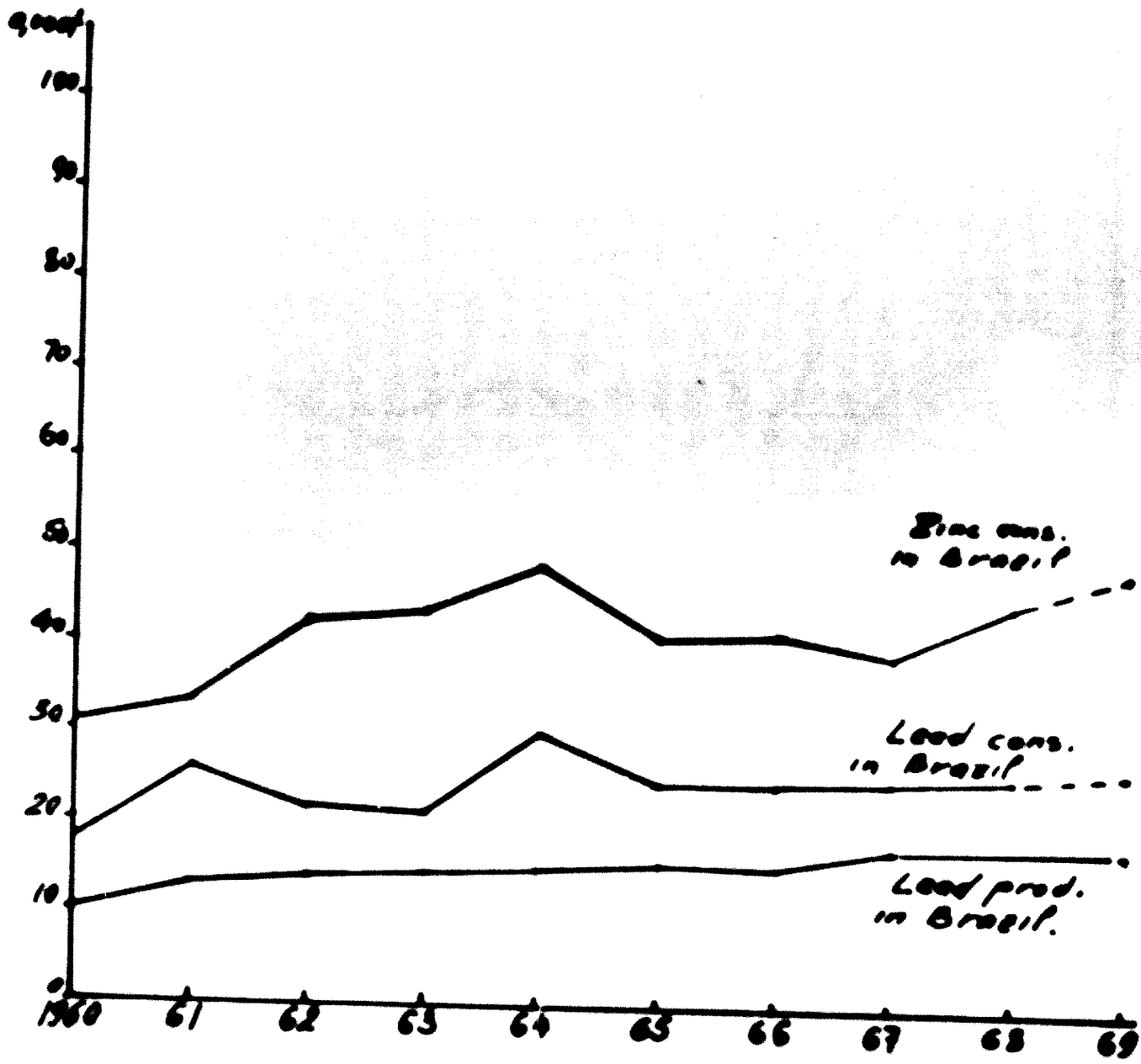
Graph No. 1 (3)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1960
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69
Zinc cons. in Brazil
Lead cons. in Brazil
Lead prod. in Brazil

Graph No. 1(a)

APPENDIX I

The Lead and Zinc Plants in the Countries of the First Group

Mexico

1. Compañia Minera de Peñoles S.A.

Head Office: 416 Matamoros Oriente, Apartado Postal 251, Monterrey, N.L.

Directors: R. Bailleres (president), B. Rohe (director general), J. Campillo, M.G. Escobedo, J.A. Garcia, A.D. Garza, E. Madero, Sr., H. de Neufville, E.T. Rose, R.G. Sada, M. Senderos, C. Trouvet, C. Sanchez Mejorada (secretary), J.R. McGrath (treasurer).

Associated Company: American Metal Climax, Inc. Subsidiary Company: Compañia Metalurgica Peñoles.

Plant: Lead-zinc mines at Avalos, Zacatecas; Etzatlan, Jalisco; and Topia, Durango. At Torreon, Coahuila, smelter (capacity 350,000 tons of material), for the treatment of lead ores and concentrates which also contain silver and gold. At Monterrey, Nuevo Leon, lead refinery (capacity 130,000 short tons). Sintered custom ores and concentrates are smelted in blast furnaces to produce lead bullion and copper speiss. Lead bullion is refined by continuous softening and desilverising process.

Products:	Output Year 1965 (short tons)	Annual capacity (short tons)
Refined lead	98,345	100,000
Antimonial lead		2,000
Bismuth		100
Silver		700
Gold		6
Bearing metals		60
Solder		60
Typemetals		300
Litharge		

Brands: C.M.P.y A.M-Corroding Lead. PEÑOLES-Antimonial Lead.

2. Metalurgica de Plomo, S.A. de C.V.

Head Office: Paseo de la Reforma 35-90. Piso, México 1, D.F.

Telegraphic address: Zinc. Telephone No: 35-13-25.

Capital: US$113,352.96. Established: 1954.

Metalurgica de Plomo, S.A. de C.V. (continued)

Directors: José T. Mata (general manager and lic.), Manual Muñiz A. (manager).

Plant: Located at Fraccionamiento Industrial Xalostoc, Colonia Viveros, Ecatepec de Morelos, Estudo de México.

Raw Materials used: Storage batteries and lead scrap.

Products: Refined lead, antimonial lead.

3. Zinc Industrial, S.A.

Head Office: Paseo de la Reforma 35-90. Piso, México 1, D.F.

Telegraphic address: Zinc. **Telephone No:** 35-13-25.

Capital: US$760,000. **Established:** 1959.

Directors: José T. Mata (manager). Héctor Cortés C. (assistant manager).

Associated Company: American Smelting and Refining Company, New York, U.S.A.

Plant: At Tlalnepantla, Edo. de México. Vertical fractional distillation column process is utilised for special high grade zinc production. In addition to their own output, the company also buys special high grade zinc for the production of die-casting alloy.

Raw materials used: Zinc Prime Western, special high grade zinc, aluminium, magnesium and copper.

Products:

	Output Year 1964 (metric tons)	Annual capacity (metric tons)
Special high grade zinc	6,600	9,000
Zamaks (zinc alloys)	2,600	2,900

Brands: "ZINSA"

Expansion Plans (at time of compilation): It is proposed to expand capacity by 100%.

4. Zincomex S.A.

Head Office: Saltillo.

Parent Company: State controlled.

Plant: At head office address.

Raw materials used: Concentrates from privately-owned mines.

Products:

	Annual capacity (metric tons)
Slab zinc	40,000
Cadmium	240

Overseas sales representation: Worldwide (through Continental Ore Corp.)

Argentina

1. Compañia Metalurgica Austral Argentina S.A.C.I. y F.

Head Office: Lavalle 1430, 6° piso, Buenos Aires.

Telegraphic address: Ausmetal. Telephone No: 40-4088.

Capital: m$n 120,000,000. Established: 1951.

Directors: Eduardo Bidau (president), Ismael R. Gandulfo (vice-president), Juan B. Iribarne, Rodolfo E. López Barreiro, Alberto T. López, Manual A. Portela Ramírez, Luis Sanmarco, Antonio Vaquer, Guillermo S. Castellanos (síndico). General Manager: Daniel A. Brunella.

Parent Company: Cia. Minera Aguilar (St. Joseph Lead Company).

Plant: At Comodoro Rivadavia. Dwight Lloyd sintering machine and two electro-thermic zinc furnaces. Zinc oxide ore is processed according to St. Joseph Lead Co. patents.

Raw materials used: See above.

Products:	Output Year 1964 (metric tons)	Annual capacity (metric tons)
High grade zinc	10,000	12,000

Brands and analyses: "TRES CRUCES". Zn between 98.5 and 99.5%.

Expansion plans (at time of compilation): Early in 1966 the company planned to increase production to 14,000 tons per year.

2. "Meteor" Establecimentos Metalurgicos S.A.I. y C.

Head Office: Zarate.

Plant: At Zarate. Electrolytic zinc refinery.

Products:	Annual capacity (metric tons)
Electrolytic zinc	7,000

3. National Lead Co. S.A.

Head Office: Avenida R. Saens Pena 567, Buenos Aires.

Parent Company: National Lead Co. Subsidiary Companies: Metalmina S.A. Industrias Deriplom S.R.L. Cia. Minera Castaño Viejo S.A.

Plant: At Barranqueras, Provincia del Chaco. Lead smelter (scotch hearth plant). At Buenos Aires. Lead semifabricating plant with melting, casting, rolling, extrusion etc. facilities.

National Lead Co. S.A. (continued)

Products:	Annual capacity (short tons)
Refined lead	30,000

Anitomonial lead, refined silver, copper matte. Lead pipe, sheet, etc. Solder, antifriction metal, etc.

Brands and analyses: Lead: Stella 99.97% Pb. Lead products etc: Dutch Boy and Nalco.

4. Compañía Sudamericana de Industria y Comercio S.A. "INSUD"

Head Office: 25 de Mayo 460, Buenos Aires.

Telegraphic address: Insud. Telephone No: 32 - 3661. Telex: 012-1644 and 012-1465.

Capital: m$n200,000,000. Established: 1945.

Directors: Dr. José Heriberto Martinez (president), Pablo Hirsh (vice-president). Board of Directors: Dr. Miguel J. de Anchorena, Martin Heineberg, Fernando Lira Ossa, Dr. Luis Mayer, Dr. Enrique Mendelsohn, Dr. Juan Mosciaro, Héctor L. Fernández. Syndic: Dr. Julio Delmonte, Dr. R.E. Delmonte.

Parent Companies: Mauricio Hochschild S.A.I.C., Santiago, Chile. Mauricio Hochschild and Cia. Ltd. S.A., Lima, Peru. "BRASIMET" Comercio e Industria S.A., Sao Paulo, Brazil.

Plant: At San Justo, Province of Buenos Aires. Non-ferrous metal smelter.

Raw materials used: Ores and residues of lead and antimony, tin, copper, aluminium, etc.

Products:	Output Year 1964 (metric tons)	Annual capacity (metric tons)
Lead and antimonial lead	6,700	12,000
Lead-antimony-tin alloys	800	
Copper alloys	900	1,500
Zinc die casting	400	1,500
Aluminium alloys	400	1,500
Silver	15	25

Brands: INSUD.

Overseas sales representation: In U.S.A., Belgium, England, Germany.

5. **Sulfacid S.A.**

Parent Company: Cia. Minera Aguilar (St. Joseph Lead Company).

Plant: At Borghi near Rosario. Electrolytic zinc refinery.

Raw materials used: Zinc concentrates from Aguilar.

Products:

	Annual capacity (metric tons)
Electrolytic zinc	12,500

Brazil

1. **Comércio e Indústria de Metais "ARPA" S/A**

Head Office: Rua da Assembléia, 19-13° andar, Rio de Janeiro-GB

Telegraphic address: Arpametal. **Telephone No:** 31-0859, 31-0689.

Capital: Cr$200,000,000. **Established:** 1947.

Directors: F. Eric Wulff, Hermann B. Kaufmann.

Plant: At Bonsucesso-GB.

Raw materials used: Antimony ores, lead ores, tin ores, metallic residues, scrap.

Products: Antimony ingots, lead ingots, alloys, type metals, solder, bismuth alloys, remelted copper, bronze ingots, brass ingots.

2. Cia. Brasileira de Chumbo "Cobrac"

Head Office: Casa Republica 270,2°, São Paulo.

Capital: 400 m. Brazilian cruzeiros. **Established:** 1960.

Parent Companies: Cia. des Acumuladores Prest-O-Lite, Peñarroya and Adriano Seabra group. **Associated Companies:** Plumbum S.A. Cia. Mineiros Ferros y Metais. Companhia Bahiana de Chumbo.

Plant: At Panelas, São Paulo. Lead smelter treating ore from the company's own mines in the Plumbum region.

At Santo Amaro, Bahia. Lead smelter treating ore from the company's own mines at Boquira, Bahia.

Raw materials used: See Plant.

Products:

	Output Year 1965	Annual capacity (metric tons)
Pig lead	*	14,000

* **Curtailed due to local market weakness**

3. Cia. Mercantil e Industrial Inga

Plant: At Itaguai, Rio de Janeiro. Electrolytic zinc refinery treating silicate ore by the Hugo Radino process.

Products:

	Annual capacity (metric tons)
Electrolytic zinc	7,200

General information: This works started commercial operation at the end of 1965 after several years pilot plant study of the process.

Expansion plans (at time of compilation): Expansion of capacity to 24,000 tons a year as soon as electricity supplies are available.

4. Cia Mineira de Metais

Parent Company: Votorantim group.

Plant: At Tres Marias, Minas Gerais. Electrolytic zinc refinery treating zinc ore from the Vazante region by the Italian process.

Products:

	Annual capacity (metric tons)
Electrolytic zinc	10,000

Expansion plans (at time of compilation): Expansion of capacity to 30,000 tons a year.

General information: Production was scheduled to start at this works in 1966, but it is not certain if it has yet done so.

5. Plumbum S/A, Indústria Brasileira de Mineração

Address: Praça da República No. 270 - 2°, São Paulo 2, S.P.

Telegraphic address: Plumbum. Capital: Cr$1,533,000,000. Established: 1937.

Directors: Adriano Seabra da Fonseca (presidente), Carlos Pacheco Fernandes (vice-presidente), George Boehringer, Antonio Lartigau Seabra, Claus Dalins, João Guaraldo.

Associated companies: Mineração Lageado Lda. Cobrac - Companhia Brasileira de Chumbo S/A. Mineração Boquira S/A.

Plant: At Municipio de Adrianópolis, Paraná State. Melting plant and ore dressing plant, mine and fully-equipped workshop.

Products:

	Output Year 1964 (metric tons)	Annual capacity (metric tons)
Lead	5,586	7,000
Silver	11	12

Analyses: Lead - 99.90% Pb. Silver - electrolytic.

China (mainland)

1. Szechwan Copper and Zinc Refinery

This is said to be located near the rich copper and lead-zinc ore deposits in the Huili district. The plant was originally established during the Japanese war. The programme at that time was to produce about 2,000 tons a

year of 99.9 per cent copper and 800 tons of 99.75 per cent grade of copper and some 1,000 tons of zinc. Output is probably now considerably higher.

2. Changsha Lead Smelter (Hunan Province)

Treats lead concentrates from important lead-zinc-silver ore deposits at Shuikowshan in Hunan.

3. Sungpai Zinc Smelter (Hunan Province)

This plant which consists of a concentrating mill and smelter treats ore from the Shuikowshan lead-zinc-silver deposits, 30 miles south of Hengyan.

4. Anshan Lead Smelter

This works was built at Anshan (Manchukuo) by the Japanese during the war years and was styled by them Mandchou Enko Kabushiki Kaisha. There is no information as to its present capacity.

5. Dairen Lead-Zinc Plant

Before the War this works treated some 2,100 tons of local ore daily.

6. Chinchow Zinc Smelter

There was a zinc smelter some years ago at Chinchow in Manchuria (now known as North East Region) but we have no details regarding its present condition.

India

1. Cominco Binani Zinc Limited

Head Office: Binani Buildings, 38 Strand Road, Calcutta-1.

Telegraphic address: Combizinc. Telephone No: 22-1346 (4 lines), 22-0875.

Capital: Authorised: Rs. 3,00,00,000.00. Paid-up: Rs. 1,68,00,000.00.
Employed: Rs. 5,00,00,000.00. Established: 1962.

Directors: Ghanshyamdas Binani, W.S. Kirkpatrick, A.O. Wolff, H.T. Fargey, D.D. Morris, Charat Ram, S.C. Gladstone, M. Abdussalam, Dr. D.P. Antia, Ramanlal Parikh, R.K. Bagri.

Plant: Edayar Industrial Area, near Cochin in Kerala State. Situated on 103 acres it comprises: electrolytic zinc plant with by-product recovery units for cadmium, sulphuric acid, etc.

Raw materials used: Zinc concentrates.

Products:	Annual capacity (metric tons)
Slab zinc	20,000
Sulphuric acid	45,000
Cadmium metal	40

(Note: Plant was expected to commence production during second half of 1966.)

Brands and analyses: Zinc - "CBZ" Brand. Electrolytic quality 99.99% minimum.

Cominco Binani Zinc Limited

Expansion plans (at time of compilation): It is planned to expand the existing capacity of zinc from 20,000 to 60,000 metric tons in two stages, with corresponding increases in the quantities of sulphuric acid and cadmium. There is also a proposal to set up a plant for the production of zinc dust.

2. Hindustan Zinc Limited (A Government of India Undertaking)

(Note: The Government of India took over the undertaking of the Metal Corporation of India by Act 44 of 1965 and established a new Company in the name and style of Hindustan Zinc Limited under the India Companies Act, 1956).

Head Office: 11/221 Hospital Road, Udaipur, Rajasthan.

Telegraphic address: Hindszinc. **Telephone No:** 221.

Capital: Authorised: Rs. 10 crores. Established: 1966.

Directors: M.C. Shrivastava (chairman), Nagendra Bahadur (managing director), K.S. Bhandari, M.N. Vasudeva, S.S. Kumar, T.N. Chaturvedi, A.G. Jhingran, B.S. Mehta.

Plant: There are three productive units, viz. (i) Zawar Mines, Udaipur; (ii) Zinc Smelter, Udaipur and (iii) Lead Smelter at Tundoo, near Dhanbad, Bihar:-
Zawar Mines: Various non-ferrous mining and milling (in processing galena phalerite ores into lead and ore concentrates).
Zinc Smelter: Various plants for processing (under electrolysis process) zinc concentrates into refined zinc and cadmium and for manufacturing sulphuric acid and superphosphate, imported under French Collaboration Agreement, are in course of erection.
Lead Smelter at Tundoo, near Dhanbad: Various plants and machinery for refining lead by smelting, and also for obtaining silver as by-product.

Products:

	Output Year 1964 (metric tons)
Refined lead	3,565
Silver	6,055 Kg.
Refined Zinc (zinc concentrates exported and equivalent metal content in concentrates being imported under toll basis)	5,899

Expansion plans (at time of compilation): It was stated in the middle of 1966 that when completed, the zinc smelter would produce the following: Refined zinc (18,000 tons per annum), Cadmium (70 tons), single superphosphate (75,000 tons), sulphuric acids (10,500 tons). The Zawar mines will produce 2,000 tons of ore per day when the expansion programme is completed.

Malaysia

1. Eastern Smelting Company Limited

Head Office: "Birch House", 73 Dato Kramat Road, Penang.

Telegraphic address: Smelter Penang. **Telephone No.** Penang 63702 (3 lines). Penang 63705 (Tin Market).

Capital:

	Authorised	Issued and converted into Stock
"A" Ordinary Shares of M$1 each	M$3,000,000	M$2,500,000
Ordinary Shares of M$1 each	M$9,000,000	M$,500,000

Established: 1911.

Directors: D.R. Mitchell, B.Sc., A.R.S.M., M.I.M.M. (chairman); F.J. Steggall, O.B.E. (managing director); Clifford Waite, C.M.G.; Woo Ka Lim, J.M.N., J.P. (Malaysian); Dato Kurnia Jasa Haji Osman bin Talib, S.M.B., S.M.B., D.P.M.P., D.P.M.Ps. (Malaysian); E.R.E. Carter; A.R.Andrew, F.C.A.

Parent Company: Consolidated Tin Smelters Limited. **Associated Companies:** Williams, Harvey and Co. Limited, Liverpool, England. Makeri Smelting Company Limited, Jos, Nigeria. **Subsidiary Company:** Eastern Development Company Limited.

Plant: The company operates a tin smelting plant on Penang Island. Tin concentrates are smelted in reverberatory furnaces, with an annual plant capacity of 60,000 long tons of Straits Refined Tin.
A small secondary lead smelting and refining plant was established towards the end of 1965, treating locally arising scrap and producing refined soft lead, antimonial lead and typemetals, principally for Malaysian consumption.

Raw Materials used: See above.

Products:	Output Year 1964 (long tons)	Annual capacity (long tons)
Refined tin	38,640	60,000
Lead and lead alloys	-	2,000

Brands and analyses: **MECOY Brand** - Straits Refined Tin. **Typical Analyses:** Sn 99.890%, Sb 0.003%, As 0.027%, Pb 0.037%, Bi 0.004%, Cu 0.023%, Fe 0.005%, Ag trace, S 0.001%, Co-, Ni 0.002%.

Philippines

1. C.C. Unsen Company, Inc.

Head Office: 1262 Espeña, Manila.

Telegraphic address: Unsenco Manila. Telephone No: 3-04-35/37/38.

Capital: 2,000,000 pesos. Established: 1949.

Directors: C.C. Unsen, L.V. Magnaye, A.Q. Tablante, C.J. Unsen, Jr., Mrs. F.V. Tablante.

Associated Companies: Philippine Lead Corporation. Industrial Fabricators.

Plant: At Novaliches, Quezon City. The works covers 20,000 sq.m. Smelting, casting and battery manufacturing operations.

Raw materials used: Pure lead, pure antimony, pure tin, battery scrap, scrap iron, soda ash, charcoal.

Products:	Output Year 1964 (metric tons)	Annual capacity (metric tons)
Storage batteries (basis - automotive)	62,442 units	84,000 units
Solder, type and babbitt metals	25	60

Brands and analyses: FILOLITE - Solder: 50% Sn 50% Pb, 40% Sn 60% Pb, - 22% Sn 75% Pb Sb. Linotype, Stereotype and Monotype - standard. Babbitt - for high speed. MOTOLITE, SUPERLITE, AMERICAN, ACE - Batteries.

APPENDIX II

The Lead and Zinc Plants in the Countries of the Second Group

Peru

1. Cerro de Pasco Corporation

Head Office: 300 Park Avenue, New York, N.Y. 10022, U.S.A.

Cable address: Cerroperu New York. **Telephone No:** (212) Murray Hill 8-8822. Telex: ITT-420753. RCA - 223110.

Capital: Authorised: 150,000 shares 6¼% cumulative convertible Preferred Stock Par Value $100), all issued. 900,000 shares Common Stock (Par Value $5) - issued 500,000 shares. **Established:** Incorporated 1956 as Cerro de Pasco (incorporated in Delaware). Name changed 18 April, 1957.

Directors: Frank F. Russell (chairman of the Board), Robert P. Koenig (president), Edward W. Bourne, Leslie M. Cassidy, Aurelio Garcia Sayán, L.C. Gratem, Charles B. Harding, Richard H. Lewin, Adrian M. Massie, Don G. Mitchell, H. Danforth Starr (vice-president, finance), John B. Stone.

Parent Company: Cerro Corporation, New York, U.S.A. (100%). **Associated Companies:** Minority stock interests in: Compania de Minas Buenaventura, S.A. Explosivos, S.A. Industrias de Cobre, S.A. Minas de Venturosa, S.A. Refractorios Peruanos, S.A.

Plant: Copper-lead-zinc-silver mining properties in the Departments of Pasco, Junin and Lima. Mines at Cerro de Pasco, Morococha, Casapalca, Yauricocha, San Cristobal, Cobrisia and Antamina (the last having ore reserves of more than 100,000,000 tons averaging approximately 1.5% copper). Selective flotation concentrators at: Cerro de Pasco Paragsha Mill), lead-zinc ore; Morococha, copper-lead-zinc ore; Casapalca, copper-lead-zinc and silver ores; and San Cristobal (Mahr Mill), copper-lead-zinc-tungsten ores. Customs ores now concentrated at the Mahr Mill are smelted and refined at La Oroya.

At La Oroya: A lead smelter and refinery, a copper smelter and refinery, an electrolytic zinc plant and several by-product plants to recover bismuth, silver/gold, sulphuric acid, etc.

La Oroya has three principal circuits, for copper, lead and zinc, also a Cottrell system for the recovery of metallurgical fume and dust.

Ores, concentrates and fluxes for the copper circuit are received by rail and mixed. The copper smelter comprises roasters, reverberatory furnaces, converters and anode casting equipment. Blister copper anodes are transported by rail to the electrolytic refinery at Huayumanta about two miles to the west, or sent directly to market. Slimes from the copper circuit are treated for the recovery of silver, gold, tellurium and selenium.

Cerro de Pasco Corporation (continued)

The lead circuit employs material handling facilities similar to those of the copper circuit. It includes a sinter plant, blast furnaces, dross furnace and anode casting equipment for the production of lead bullion, and an electrolytic lead refinery employing the modified Betts process. Slimes are also treated for the recovery of silver, gold, bismuth, antimony, tellurium and selenium.

The zinc circuit consists of concentrate handling equipment separate from that mentioned above, pelletising and drying lines, fluid bed roasters, hearth roasters, leach tanks, filters, a solution purification section, electrolytic tankhouse, and melting and casting facilities. It treats part of the Corporation's own concentrates output (the rest going direct to market) and custom ores.

The Cottrell installation is one of the largest in existence. It processes furnace gases from the copper, lead and zinc circuits and precipitates daily an average of 150 tons of metal-bearing dust, the metal content of which is recovered in the lead and zinc circuits.

The anode slimes treatment plant includes reverberatory furnaces, converters and cupels in addition to electrolytic refining equipment.

The smelters at Oroya also handle custom ores from several independent producers. Power is provided by hydro-electric plants located at Oroya, Paucartambo, Pachachaca, Malpaso, Sunca, Siria and Bellavista and a waste heat generator at Oroya.

Raw materials used: See above.

Products:

	Annual capacity (short tons)
Antimony	1,000
Bismuth (high grade)	900
Cadmium	250
Blister copper	50,000
Electrolytic copper (cathode, ingot, bar, wirebar)	45,000
Gold	60,000 oz.
Refined lead	100,000
Selenium	10
Silver	22,000,000 oz.
Tellurium	25
Special High Grade zinc	85,000
Bismuth base alloys	
Copper sulphate	
Indium	

Brands: C de P Peru

Overseas sales representation: In most countries of the world.

Zambia

1. The Zambia Broken Hill Development Company Limited

Head Office: Permanent House, Cairo Road, P.O. Box 1986, Lusaka.

Telegraphic address: Anmercosa Lusaka. **Telephone No:** 73023 Lusaka.
Telex: Anmercosa, Lusaka.

Capital: Authorised: £4,000,000 in 16,000,000 shares of 5s. each. Issued: £3,250,000 in 13,000,000 shares of 5s. each. Established: 1910.

Directors: H.F. Oppenheimer (chairman), Sir Keith Acutt, K.B.E. (deputy chairman), G.W.H. Relly (deputy chairman), D.O. Beckingham, P.H.A. Brownrigg, C.M.G., D.S.O., O.B.E., H.M. Forrest, H.H. Taylor, W.D. Wilson.
Alternates: I.M. Cowan, M.B. Hofmeyr, N.K. Kinkead-Weekes, J.M.F. Phillimore, M.W. Rushton, O.B.E.

Parent Company: Zambian Anglo American Limited.

Plant: Lead, zinc, cadmium and silver are produced at Broken Hill. Lead production is obtained from the Imperial Smelting furnace and Neumann hearths; zinc from the I.S.F. and by the electrolytic process. Other metallurgical installations include washing plant, heavy medium separation plant, flotation plant, zinc roaster, zinc leach plant, zinc electrolytic and melting plant, sulphuric acid plant, lead refinery and rolling mill. Electric power is provided from nearby hydro-electric stations at Mulungushi and Lunsemfwa.

Products:

	Output Year 1965 (long tons)	Annual capacity (long tons)
Refined lead ingots	21,090	25,000
Electrolytic zinc slabs	23,252	30,000
G.O.B. zinc slabs	23,420	25,000
Refined cadmium pencils	40,000 lb.	40,000 lb.
Silver doré	1,000 troy oz.Ag	

Brands and analyses: Sable Brand -99.99+ Lead; 99.95+ Zinc; 98.5+ Zinc; Refined Cadmium. Lead, electrolytic zinc and G.O.B. zinc to appropriate B.S. Specification.

Overseas sales representation: In South Africa. For all other countries the company is represented by Anmercosa Sales Limited, London, England.

Burma

1. Peoples' Enterprise Industry

Head Office: 104 Strand Road, P.O. Box 801, Rangoon.

Telegraphic address: Enterun Rangoon. **Telephone No:** Rangoon 14711, 14251, 14254.

Established: 1965. State owned enterprise, formerly Burma Corporation (1951) Limited.

Peoples' Bawdwin Industry (continued)

Directors: Thakin Chan Tun (chairman), Lt. Col. J. Smyth, Lt. Col. Saw Ohn, Major Kyaw Za, U Kyaw Zaw, U Saw Aleric.

Plant: At Namtu, Northern Shan State. Mill for treatment of complex silver, lead and zinc minerals (Bawdwin ore) - average grade 8 oz./ton silver, 12% lead and 6% zinc (annual capacity 160,000 long tons). Combined gravity and froth flotation techniques are used, recovering 85% total lead in smelter products and 60% zinc in zinc concentrates. Smelter producing hard lead (annual capacity 33,[illegible]96 tons) and crude antimonial lead (18,03[illegible] tons). Lead refining plant - improving, de-copperising, softening, de-silverising (Parkes process), vacuum de-zincing and fire refining. Silver refining plant - retorting, de-golding, cupellation, refining.

Raw materials used: See above.

Products:

	Output Year ended 30 Sept 1964 (long tons)	Annual capacity (long tons)
Zinc concentrates	14,125	15,000
"B.M. Refined" lead (99.99% Pb)	16,525	44,000*
Refined antimonial lead (18-20% Sb)	580	1,100
De-Golded silver (999.0 fineness)	1,343,663 (fine oz.)	5,100,000 (fine oz.)
Doré silver	51,521 (fine oz.)	2,550,000 (fine oz.)
Gold (in doré silver)	269 (fine oz.)	13,300 (fine oz.)
Copper matte (38-45% Cu)	323	670
Nickel speiss (20-26% Ni, 2-5% Co)	179	350

* With vacuum de-zincing (60,000 tons without vacuum de-zincing).

Brands and analyses: "B.M. Refined" pig lead - 99.99%. "Burma Mines" refined silver - 99.9%. Zinc concentrates analyses: 8.0 oz./ton Ag, 5.16% Pb, 53.50% Zn, 0.094% Cu, 4.34% Fe, 0.12% Sb, 0.46% As, 0.27% Cd and 4.39% Insol.

Morocco

1. **Société des Fonderies Penarroya-Zellidja**

Head Office: Oued el Heimer.

Telegraphic address: Pesed Oujda. Telephone No: Inter 9 Oujda. Telex: 61029 Oujda

Capital: [illegible],500,000 dirhams. Established: 1946.

Directors: Giuseppe Chiappella

Parent Company: Société Minière and Métallurgique de Penarroya, Paris, France.

Products:

	Annual capacity (metric tons)
Lead	21,000
Silver	22,000 kilogrammes

Tunisia

1. Société Minière et Métallurgique de Peñarroya

Head Office: 12 Place Vendome, Paris (1er).

Telegraphic address: Pollux-81-Paris. Telephone No: 742.24-04.
Telex: 21613.

Capital: 155,793,500 francs.

Directors: Baron Guy de Rothschild (president-director general), Pierre Cotton, René Fillon (vice president), Henry Pagesy (honorary president). Executive Directors: Rolland Ritter, Bernard de Villemejane (director general), Pierre Mayer.

Associated companies: Companies in the Rothschild group and others, namely Sociedad Minera y Metalurgica de Peñarroya S.A., Minerais et Métaux, Société Francaise des Métaux et Alliages Blancs, Affineries de Nanterre, Société Chimique et Metallurgique de Bondy, Société Le Nickel, Compagnie Francaise des Minerais D'Uranium, Società Mineraria and Metallurgica di Pertusola, Compagnie Francaise des Mines du Laurium, Peñarroya-Maroc, Compania Minera Disputada de las Condes, Participaciones Mineras y Financieras.

Plant: Mégrine. This is a lead-silver smelter, and uses local ore from the company's own mines.

Raw Materials: See above.

Products:	Output Year 1965 (metric tons)	Annual capacity (metric tons)
Lead	14,871	15,000

Brand: "Penarroya Tunisie"

Overseas sales representation: Throughout the world.

Congo (Kinshasa)

1. Société Métallurgique Katangaise (Metalkat)

Head Office: Kolwezi, Province of Lualaba. Administrative Offices (parent company): 7 rue de la Chancellerie, Brussels, Belgium.

Telegraphic address: Metalkat Brussels. Telephone No: Brussels 13.60.90.
Telex: 02-21551.

Capital: 600,000,000 francs. Established: 1948.

Directors: M. Van Weyenbergh (chairman), J. Verdussen (managing director), J. Ysebrant de Lendonck (administration).

Société Métallurgique Katangaise (metalkat) (continued)

Parent Companies: (Through Société Métallurgique de Katanga (Metalkat), Brussels, Belgium) Union Minière du Haut-Katanga. Société des Mines et Fonderies de Zinc de la Vieille-Montagne, Compagnie des Métaux d'Overpelt-Lommel et de Corphalie. Société de Prayon. République Democratique du Congo. Métallurgie Hoboken.

Plant: At Kolwezi, Province of Lualaba. Electrolytic zinc plant, processing zinc concentrates bought from Union Minière du Haut-Katanga; also an electrolytic cadmium plant and a small copper foundry.

Products:

	Annual capacity (metric tons)
Electrolytic zinc (special high grade and high grade)	60,000
Electrolytic cadmium	400

Brands and analyses: Electrolytic zinc "Métalkat" - Special High Grade 99.995+%, High Grade 99.99+%. Electrolytic cadmium "Katanga" - over 99.99% Cd.

General information: The company's products are sold by the Société Générale des Minerais, Brussels, Belgium.

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