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REPORT ON AN INITIAL ECONOMIC EVALUATION FOR LEAD, ZINC AND SILVER DEPOSITS IN AUSTRALIA

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ABSTRACT

Based on the informations provided by the first four diamond drill holes and an analysis of the market situation, the lead-zinc-silver deposit discovered in northwest Tasmania justifies further expenditures on exploration and possibly development. If sufficient ore can be located and a reasonably stable market for lead and zinc concentrates can be developed, then there is also a possibility for economic exploitation of the mentioned deposit.

With one exception, the growth in lead and zinc markets in the world has been steady, but not spectacular. The exception is Japan where growth is well above the rest of the world. Considering an operation in Tasmania, Japan has the further advantage of location, concentrates are preferred, and the Japanese companies tend to deal in long term contracts. However, Canada and Peru have been capitalizing on this market to date and the older Australian producers are gearing up for greater production not later than 1976. Thus it becomes critical to capitalize on this opportunity between now and 1975. A new mine after the date may arrive too late to catch the present trends. Investigation of the Japanese market should be begun immediately.

Although offering some promise, the Tasmanian discovery appears to have a lead-zinc content below other established Australian operations, and the reserves now indicated (perhaps 2 million tons) are well below the holdings of a typical Australian lead-zinc operation. Thus, it is essential that any mining method employed must be efficient, reasonably low cost, and cannot be on a small scale. Finally further field work must be able to assure the presence of at least 6 million tons of ore with indications that the ore body will ultimately yield an additional 6 million tons or more.

Because timing may be critical, a schedule is suggested for additional exploration and frequent review of the economics of the deposit. Evaluation of new geologic informations plus an engineering feasibility study are critical since the deposit as known to date falls in the marginal area. This initial evaluation has been based on average cost and price data. Future evaluations will have the benefit of additional information about the ore, of more specific information with regard to mining and milling methods, and consequently will result in more specific cost, revenue and profit estimates.

Outlook For Lead, Silver, and Zinc

The world outlook for zinc is for continued steady, but unspectacular, growth in production and consumption. Since secondary zinc is not a major factor in the market, world production and consumption grow at almost identical rates. With no significant technologic changes impending that might affect production, utilization, or consumer buying habits, there is no reason to expect that there should be any marked change in the approximately 5 percent per year growth rate that has been exhibited by zinc during the past decade.

Lead production grows at a slightly slower pace than consumption due to the secondary use of lead. In the immediate past, world lead production has been growing at 3 percent per year while consumption has been increasing at 3.5 percent. In both cases this is less than the growth in zinc. Two technologic changes threaten to modify the future lead market. First, present indications are that there may be a positive move within the next two to five years to reduce the tetraethyl lead content of U. S. automotive gasoline. Although tetraethyl lead use is not as great in other parts of the world, and it is not necessarily true that other nations would follow the U. S. lead, the U. S. consumption of lead in this form represents approximately 8 percent of world consumption. A second possible change would result from any change in storage battery use, either in type or materials. A shift to the electric car, for example, would not necessarily entail the use of lead batteries but could reduce the use of standard batteries in the conventional internal combustion automobile.

In neither zinc nor lead is there any immediate evidence of an existing or impending imbalance of an important magnitude between world productive capability and world consumption. Any surpluses or deficits are expected to be small and transient in nature. If there is any threat at all to market stability, it is found in the rapid expansion of Japanese smelting and refining capacity. The older hands in the International Lead and Zinc Study Group, based on past experience with instability in these commodities, find the aggressive expansion by Japan somewhat disquieting.

Silver as a monetary metal and as a by-product of other non-ferrous metal mining does not lend itself to making the usual supply/demand projections or the other customary approaches to commodity analysis. The major economic consideration concerning silver is not one of exploration, competition among producers, or markets, but rather price behavior. Silver will always be marketable at some place in the world. The key question is one of price stability and whether or not silver will hold at the higher levels reached in recent years. Since industrial use of silver continues to grow and consumption is still greater than production, there appears to be no threat of disastrous price declines in the near future. Although there is now greater interest in finding and producing silver, it still remains basically a captive of the effort to find and produce other metals. Thus it would be unwise to assume that silver prices will maintain the highest price achieved in the past few years, ($2.48/oz), but the somewhat lower current price level ($1.80/oz) does seem to be a reasonably conservative viewpoint.

Location of Potential Markets

There are a number of stages in the marketing of lead and zinc and there can be sale and export at any one of these points. Customarily the raw ore is beneficiated as part of the mining process. The resulting concentrates (which may have a metal content somewhere above 50 percent for both lead and zinc) can be sold to a smelter. The smelter in turn may sell crude metal to a refinery, which then produces a pure metal for sale to a metal fabricator or manufacturer. We will not attempt to analyze market trends at all of these stages, but it is at least useful to look at the areas of growing smelter production (which represents the concentrate market) and areas of growing metal consumption which would be the most likely markets for the metal itself.

In the past decade, Japan and the United Kingdom have exceeded the world trend in smelter production of lead while Germany has about been on a par with world growth. The UK growth is probably due to recent smelter capacity expansion coming into production rather than any surge reflecting basic economic growth. As a result the major center of growth in lead smelting (and consequently for concentrates) is found in Japan. The 1959-1968 Japanese growth rate is approximately 11 percent versus the world lead smelter growth rate of 3 percent.

The center of rapid growth in lead metal consumption is also found in Japan as Japanese industry takes the output of its smelters and refineries and converts it into finished goods for export. The export of crude lead metal from Japan is not large. U. S. and European consumption of lead metal, the two major markets in volume, are both growing at a very modest 2.5 percent per year. Although Japanese consumption of lead metal is growing extremely rapidly, in 1968 it was less than 10 percent of the world total consumption. Although it would be unrealistic to assume that the roughly 10 percent growth in Japanese lead consumption per year can continue for very long, growth faster than the world average seems quite feasible for at least another 10 years.

The dominance of Japan in the growth picture is even more apparent in zinc metal consumption. Japanese growth in zinc metal consumption in the past ten years was close to 14 percent per year compared to the world zinc metal consumption figure of near 5 percent. All other regions or major comsuming nations grew at or below the world rate, e.g., the U. S. growth in consumption was slightly under 5 percent per year. Unlike in lead, Japan does export some of her crude zinc metal production, about 15 percent in 1968. But the largest share is retained in Japan for domestic consumption or for export in semi-fabricated or fabricated form.

The present high level of Japanese zinc smelting and zinc consumption does raise some doubts as to how long this very fast pace can be maintained. If the present growth rate would continue, Japan would pass Europe and the U. S. in zinc consumption by 1980. Considering limitations in the size of the Japanese consuming population, in the Japanese labor supply, market availability, and other factors it does not seem reasonable to expect that Japan will become the largest single consumer of zinc in the world within ten years. Thus it seems prudent to expect that Japanese zinc smelting and consumption will have to begin to slow its rate of development between 1975 and 1980, falling back to something closer to the world rate of 5 percent per year. This would still involve a high level of per capita consumption, but it would be reasonable in light of Japanese exports and the heavy reliance in the Far East upon galvanized metal.

It would appear that Japan is the market for lead and zinc and will remain so for a number of years. It also appears that rapid growth may continue somewhat longer for lead than for zinc. However, it should be noted that the Japanese market has one peculiarity, it is dominated by import of concentrates for smelting and refining in Japan rather than importation of metal. This is not uncommon for zinc but it is unusual for lead. Zinc refining is more complex and is attractive if located near power, markets, and other industry. The greater share of zinc tends to move as concentrates to the smelter country. However, the simplicity of lead smelting and the advantages of shipping crude metal has led to most world trade being in lead metal. However, the Japanese in 1968 imported only 11,564 metric tons of pig lead while importing 114,157 tons of lead in ores and concentrates. (In contrast the U. S. imported over 300,000 tons of metallic lead and only 87,000 tons in ores and concentrates.) Furthermore, the Japanese displayed an inclination toward obtaining their non-ferrous concentrates on long term contract arrangements and in some cases with Japanese financial involvement in the mining ventures in the originating countries. For example, a consortium of three Japanese companies are investing in mines in Bolivia and Peru.

Lead and Zinc Sources

Free World mine production of lead is dominated by Australia, Canada, the United States, Mexico, Peru, and Yugoslavia. Japanese production, though growing, is relatively small compared to her consumption. All of these countries are expanding production at a rate equal to or above the world rate of 3 percent. However, the 7 percent growth in Canadian lead production is the outstanding trend among the lead mining countries. Although Canadian refining capacity has grown, it has not been as fast as mine production, leading to a sharper growth in Canadian lead concentrate exports than in pig lead. This tremendous surge of output has lead to a significant increase in Canadian exports to all over the world. Canada is a major supplier of lead to the United States, Europe, and her shipments to Japan are growing and expected to continue to do so on the basis of existing long term contracts.

Growth in Peru has not been spectacular but it has been steady. The United States with new lead mining operations being developed should also be capable of continued growth in mine output. Although exploration is being undertaken in many locations, there are no current indications that any new major source areas will appear in the world picture in the near future. New production will be primarily based upon the expansion of production in the established lead producing areas at or near old mines or in adjacent territories.

Japan as the prime market for lead relies for about three quarters of its imports on Canada, Peru, and Australia (in that order). However, the Australian shipments declined between 1965 and 1968 while Peruvian and Canadian shipments increased very rapidly.

In zinc mine production in the Free World, the major sources of ore are Canada, the United States, Australia, Peru, and Japan. Japan's domestic situation in zinc is more favorable than in lead and here mine production has been growing more rapidly than the world rate of 5 percent. But this still keeps her far short of her smelter requirements (a deficit of 340,000 metric tons of concentrate in 1968 had to be met by imports).

As in lead, the Canadian growth of 14 percent per year in mine output dominates the world trends and has led to large and growing movement of Canadian concentrates to the United States, Europe, and Japan. Peru also has been showing marked growth - 10 percent per year. But the United States has been lagging behind the rest of the world at about two percent per year. Australia has shown steady, but not very spectacular growth of slightly over 4 percent, below the world trend of 5 percent.

As of 1968, after a period of rapid growth, Peru was the major source of Japanese zinc concentrates imports - roughly 45 percent of the total. Canada has increased its shipments to Japan markedly and has moved into second place. Australia has also increased her shipments, but not as rapidly as Peru and Canada, and is the third most important shipper to Japan.

Not too surprisingly, the current and potential sources of zinc resemble in many respects the lead situation. Exploration continues in many parts of the world, but the greatest success is being realized in the established mining areas, such as Canada, Australia, and Peru. In the Pacific region, no major mining companies are known to be preparing to enter lead and zinc mining in the immediate future nor are there any new geographic regions of any significance about to be opened up. The older areas and the established mining firms in the area will continue to play the major role in the next ten years.

The established Australian lead and zinc mines have proved reserves of lead and zinc adequate to handle mining (at the present rate of growth) until 1977. In addition, the total reserves at these eatablished mines is probably several times greater than indicated in the attached table from the Quarterly Review of the Australian Mineral Industry of June 1969. This means that in general the Australian lead and zinc mining industry has a customary reserve of 20 years supply "proved" or "in sight". In addition there is to be considerable reworking of waste dumps which involve no additional exploration or mining development. Furthermore, there are some rather significant discoveries that have been made by established Australian lead and zonc operators which are not included in the reserves discussed above. For example, the McArthur River discovery has around 200 million tons of 4 percent Pb and 9 percent Zn but has metallurgical problems.

Information on planned expansions in Australia indicate that Roseberry's capacity will be doubled by 1971, and Mt. Isa when it brings its Northern leases into production in 1976 will have the world's largest mine. Anaconda and a combination of St. Joseph Lead and Phelps Dodge, plus a number of major oil companies, have been conducting exploration in Australia, New Guinea, and New Zealand but no actual mining development has resulted.

Price and Market Behavior

Generally speaking zinc is the more stable of the two commodities in recent years, both in price and market behavior. Although the individual mine or smelter may experience wider swings, the annual zinc production in individual countries only seems to vary about 15 percent. However, in the case of lead, production may vary as much as 25 percent from one year to the next.

An examination of Australian production and individual mine output seems to indicate a tendency toward somewhat wider swings in Australia in the last decade than in most other producing countries. An examination of year-by-year production of Australian lead and zinc mines shows that in some years production may be less than 50 percent of the amount produced in the immediately preceding years. The causes of these variations have not been investigated, but it is probably a combination of both labor difficulties and changing market conditions. Since Australia ia primarily an exporter nation in lead and zinc, it is likely that any variation in demand in the consuming nations will be magnified in Australia as the importers cut their imports and rely more heavily on local mines.

It would appear prudent in the engineering economic appraisal of any mine and mill design in Australia that the economics of the mine be tested against variations in output that may run as low as 75 percent of capacity for lead in specific years and 85 percent of capacity for zinc.

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TABLE 1. "PROVED" ORE RESERVES OF MAIN AUSTRALIAN PRODUCERS

Company	Location	Proved Reserves ('000 tons)	Assay Values				
			% Zinc	% Lead	oz/ton Silver	Zinc content ('000 tons)	Lead content ('000 tons)
North Broken Hill	Broken Hill, N.S.W.	4,463	10.7	13.0	7.4	477.5	580.2
Broken Hill South	Broken Hill, N.S.W.	770	11.0	11.6	6.5	84.7	89.3
Zinc Corporation	Broken Hill, N.S.W.	6,000	9.9	11.9	2.5	594.0	714.0
New B. H. Consolidated	Broken Hill, N.S.W.	6,000	13.8	9.9	2.6	828.0	594.0
Mt. Isa Mines	Mt. Isa, Qld.	32,000	5.6	7.2	5.2	1,792.0	2,304.0
E. Z. Industries Ltd.	Rosebery - Hercules, Tas.	8,650	18.6	5.6	5.1	1,608.9	484.4
E. Z. Industries Ltd.	Farrell, Tas.	60	7.3	12.8	14.1	4.4	7.7
E. Z. Industries Ltd.	Beltana, S. A.	730	37	2.9	---	270.1	2.1
E. Z. Industries Ltd.	Beltana, S. A.	97	24	12	---	23.3	11.6
				TOTAL		5,682.9	4,787.3

If the mine economics would be particularly sensitive to such fluctuations, then the mine might have troubles in bad years. However, if the mining can be based on long term contracts with Japanese smelters, this could bring in an element of stability in production.

Lead and zinc prices are subject to wide swings in all world markets - London, Germany, U. S., Japan, or Australia. A review of Australian lead and zinc quotations for the period January 1962 through December 1969 reveals a 29 percent variation in lead prices and a 14 percent variation in zinc prices. Zinc prices outside of the United States have been subject to some effort at producer control but this has not eliminated the swings. The Lead and Zinc Study Group under UN auspices has yet to arrive at any plan for world stabilization.

Lead and zinc prices, as shown on the attached graphs, are at a high for the past decade but not for the post-World War II period. Use of the current price levels for evaluation of a project does not seem overly optimistic but operations should be sufficiently strong to survive periods of depressed prices for both lead and zinc, with lead being the more unstable of the two.

The Establishment

Much of the world lead and zinc industry shows the typically strong organizational ties between smelters and refiners and between home country and present or former colonies. Thus we find U. S. smelting concerns financially involved in Latin American mining and we can note the ties that explain the volume of metal trade between Australian mines and England. Consequently, any new Australian lead and zinc mining venture must recognize that it will probably have to contend with operating outside of the existing establishment in Australia. This is particularly true if the mining operations of the Australian companies tend to stay in balance with the capacity of the smelters and refineries of the same organization. This appears to be the situation at present and for the near future. The following excerpt from the September 1969 Quarterly Review of the Australian Mineral Industry reveals some of this situation.

> However, a number of factors are involved in any expansion of processing. Australia continues to be the largest producer of lead and the third largest producer of zinc in the western world; our refinery capacity for both metals is normally fully utilized and production is far in excess of domestic demand; thus the emphasis has always fallen on the export market. The degree of vertical integration which has developed between Australian lead/zinc enterprises and associated industries in the U.K. has set a pattern of Australian concentrates feeding to U.K. smelters particularly in terms of zinc. Although this practice has retarded processing in Australia to some degree, it has carried the advantage of reliable outlets for significant portions of our large production of these two metals in which marketing has always been a matter of concern. The delicate balance existing most times between supply and demand of these metals has bred caution in increasing production; additional refining in Australia would normally increase world production of metal because overseas smelters would seek to replace Australian concentrates by those from other sources to continue the supply of metal to their customers. Tariff protection of the lead/zinc industry in the U. S. has imposed another restraint on

Australian marketing and, in recent years, the growth of refining capacity in Japan, largely based on import of ores and concentrates has provided another major world buyer for concentrates rather than for metal. The marketing of by-product sulphuric acid is a factor to be considered in the installation of smelters or refineries, although in Australia this is likely to govern location rather than feasibility, and power costs are very important in the electrolytic refining of zinc.

Some of the corporate ties that exist in Australia are described briefly below:

Rio Tinto Zinc of London owns 85 percent of Conzinc Riotinto of Australia and it owns Imperial Smelting Corporation.

Conzinc Riotinto of Australia in turn owns all of Zinc Corporation, Ltd., 32 percent of New Broken Hill, 50 percent of Broken Hill Assoc. Smelters, and 75 percent of Sulphide, Corporation. It is also involved in Cobar Mines.

Broken Hill Associated Smelters processes the ores of the Zinc Corp., North Broken Hill, and South Broken Hill. Broken Hill South owns 20 percent, North Broken Hill owns 30 percent, and Conzinc Riotinto owns 50 percent.

Electrolytic Zinc which has the Rosebery-Hercules operation is owned by E. Z. Industries. They ship their lead concentrates and process their zinc concentrates at Risdon. Risdon usually operates on mostly Rosebery and some Broken Hill concentrates.

Mount Isa owns the Britannia Lead Company in the United Kingdom which processes its lead/silver bullion. A. S. and R. owns 52.9 percent of the Mount Isa Stock.

There is not too much involvement by outside interests in the Japanese and German smelting and refining operations, although there are some ties between European processors and African mining ventures. Cominco Ltd. does have an interest along with Mitsubishi in one Japanese lead plant.

There is quite a bit of outside capital involved in Peruvian developments. For example, A. S. and R. owns Northern Peru Mining Company.

It would seem indicated that any new mining operation should not rely on a market for its ores in local Australian smelters. This means that the mine will have to seek a market for concentrates outside of Australia. Since much of international trade in lead is in metal, with the exception of the Japanese case, there is some question as to the ready marketability of lead concentrates as opposed to lead metal in most of the world's markets.

With regard to control of transportation, the existing railroad service in Tasmania is owned by E. Z. Industries, a possible competitor. Although it is not believed that this will place any limitation on transport, it is a situation that must be considered.

Political Features

Available information does not reveal any political circumstances in either the producing area or the market areas that would discourage development. Although there is some popular concern for the amount of outside capital coming into Australia and the magnitude of the nation's mineral reserves that are being shipped to other countries, this has not reached a point where it would lead to national policies to restrict mining developments or exports.

Quite naturally the Australian government would prefer as much of the processing to take place in Australia as possible and hopes that Australians will be involved in financing, managing, and providing the work force. However, this is an inclination rather than a positive policy. It is probable that projects which meet with official Australian approval can expect support and assistance in their development from the government. There have been no governmental road blocks, tariffs, taxes, or similar governmental restraints identified with respect to operations in Tasmania.

Outside of Australia itself, there are a number of conditions that should be recognized as having an impact on world lead and zinc. In the United States there is the presence of over a million tons each of lead and zinc in stockpiles. These stockpiles are managed in a fashion which tends to stabilize lead and zinc prices rather than upset them. Also, the United States has a tariff on both metals and has relied on quotas to protect the domestic industry. These things do tend to make the U. S. market less attractive for Australian production.

In Japan, the industrial and governmental desire to encourage processing in Japan rather than in the mining country is of importance. Further, the reliance on long term contracts and the inclination to be financially involved in the mining venture are important considerations.

Finally, there is the International Lead and Zinc Study Group, which does not officially control the international situation, but it does have some influence on world affairs.

Conclusions on Outlook

The most attractive market in terms of growth and proximity for both lead and zinc concentrates is Japan. Not only is there rapid growth in Japan itself, which appears capable of continuing for a number of years for zinc and perhaps for a decade or more for lead, Japan will probably remain a production center for the Far East and Oceania for quite some time. The type of growth that must occur initially in the other emerging nations of this part of the world will not make them markets for concentrates or raw metals until they get out of the "export-raw materials, import-manufactures" stage.

Europe and the United States are the other two centers of lead and zinc utilization. However, Europe is a distant and scattered market with established flow lines. The United States has a protected lead-zinc economy and may find its lead demands reduced by anti-pollution programs. There is the further consideration that European and U. S. markets tend toward lead metal rather than concentrates.

Any one initiating lead and zinc mining operations in Australia should recognize that both production and price of these metals experience wide swings. Thus lead operations should be prepared for price declines of as much as 28 percent and variations in production of 25 percent. Australian zinc prices in recent years have varied as much as 14 percent and production by 15 percent.

Another consideration for lead and zinc operators in Australia is that there is a well established mining establishment already in existence with ties between mining concerns, linkages between mines and smelters, and established marketing patterns. The old line Australian lead and zinc companies still possess adequate reserves of high grade materials and are developing new reserves or new sources to come on stream in the '70's.

The Australian and Tasmanian political environment seems favorable. However, recent labor difficulties and some question about the actual supply of available labor does represent one possible handicap for development.

Although there is no information available that indicates that there are new regions or new companies about to enter the Far Eastern lead and zinc scene, the known plans and developments of existing Australian producers and the strong growth of Canada and Peru represents considerable competition.

It is indicated that one key issue is whether or not a long term contract tie-in can be made for lead and zinc concentrates to be shipped to an existing or planned Japanese smelter. The second major consideration is whether or not a new lead and zinc operation can come into production before a new period of rapid growth on Australian production appears in the last half of the 1970's.

APPRAISAL OF THE DISCOVERY

So far in this report, we have concentrated on a thorough study of production, consumption, markets, price behaviour and general outlook for lead, zinc and silver. Now we will be more specific and make an economic initial evaluation of a particular project involving the same commodities studied so far.

Any organization entering the field of mineral exploration should approach it as just another type of business venture for profit. To accomplish this the following should be considered:

- The minimum acceptable return on invested capital; and the minimum acceptable contribution to earnings;
- The minimum feasible life of the property to be exploited;
- The minimum required annual expenditures for a given exploration program.

For an estimation of profitability we need estimation of revenue, estimation of operating costs and estimation of capital costs. The level of accuracy used in estimating all these costs is consistent with the accuracy of this entire study. Considering that a detailed engineering study should have an overall estimate within plus or minus 5% accuracy, the accuracy of our estimates fall safely within plus or minus 15% or better, due to a combination of accurate data, "best estimate" data and breakdown into component costs for variation calculations wherever possible.

To clarify how the numbers used in generating the curves on the attached graph have been obtained, and hopefully avoid confusion, the following pages present the basic assumptions made for the calculations and some selected calculations which have been used in this initial evaluation.

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Basic Assumptions

The deposit is considered a vein type deposit which will have to be mined by underground mining methods using partial ground support.

The chemistry and physics of the minerals involved have been considered as ordinary and hence unusual beneficiation and/or metallurgical problems have not been considered. (All $ Figures in U.S.$)

Price of Metals

	U.S. Market	Australian	Japanese
Pb	$ .16/lb.	¢14.5/lb.	¢15.8/lb.
Zn	.15/lb.	¢14.8/lb.	¢14.9/lb.
Ag	$1.80/oz.	$1.80/oz.	$1.80/oz.

Australian $ = U.S.$1.123; Japanese Yen = U.S.$0.0028

	Pb	Zn	Ag
Grade of Ore (Av. from 4 D.D.H.)	4.7% (94 lb/s.t.)	1.5% (30 lb/s.t.)	3.3 oz/ton
Recovery	90%	75%	85%

Return Per Ton of Ore	U.S. Price	Australian	Japanese
	$22.00	$20.58	$21.62

Cost Per Ton of Ore

Mining	$10.00
Milling	$ 3.00
Smelting	$ 1.50
Misc. & Overhead	$ 2.50
Trucking of ore	$ 0.50

$17.50/ton for a 340,000 t.p.y. operation

Profit Per Ton	U.S.	Australian	Japanese
	$4.50	$3.08	$4.12

Increase in Profit with
increase in size of operation

	U.S.	Australian
340,000 t.p.y.	$4.50	$3.08
510,000 t.p.y.	$5.47	$4.05
680,000 t.p.y.	$6.08	$4.66

Capital Cost of Mill: $2,000,000 for a 340,000 t.p.y. operation it varies as the 0.7 power of capacity.

Capital Cost Mine: $500,000 for a 340,000 t.p.y. operation and it varies as the 0.8 power of capacity.

Working Capital: Taken as 25% of operating cost.

Depletion Allowance: Take 14% of gross sales up to a maximum of 50% of profit before tax.

U. S. Tax has been taken as 48% of the U.S. taxable income. Because of the above mentioned depletion allowance, the U.S. taxable income in this report has been always 50% of profit before tax.

Australian Tax. The Australian Government has an agreement with U.S. for the avoidance of double taxation. Thus the tax paid in Australia by an American firm is credited towards the U.S. federal tax which that company will have to pay. Since the Australian tax appears to be less than the U.S. federal tax, only the U. S. tax has been considered.

Selected Calculations

6,000,000 tons deposit; 1000 t.p.d.; 340 d.p.y.; $3.08/ton profit

Tons per year: 1000 x 340 = 340,000

Life: $\frac{6,000,000}{340,000}$ = 17.6 years

Profit per year: 340,000 x $3.08 = $1,047,200

Profit for Life: 6,000,000 x $3.08 = $18,480,000

Present Value of $795,900 Annuity for 17.6 years at 20% interest and 8% redemption of capital:

U.S. Fed. Tax = 340,000 x $0.74 = $251,300

Profit after tax = $1,047,200 - $251,300 = $795,900

P.V. = $\frac{\$795,900 \times 17.6}{4.00928}$ = $3.5 million

Capital Cost Mill Plant

From previous experience and published data it is assumed that the cost of the mill will vary as the 0.7 power of the annual capacity.

Also from previous experience and published engineering estimates the milling plant cost for a 340,000 tons per year capacity is taken as $2,000,000.

Then capital cost milling plant = $hX^{0.7}$

where h - proportionality factor = $\frac{2,000,000}{(340,000)^{0.7}}$

$(340,000)^{0.7}$ = 0.7 log 340,000

log 340,000 = 5.53148   5.53148 x 0.7 = 3.872036

antilog of 3.872036 = 7448

h = $\frac{2,000,000}{7448}$ = 268.5 take 269

∴ Capital Cost of Milling Plant = $269X^{0.7}$

where X is annual capacity of mill

Capital Cost for Mining Equipment

As under capital cost for milling plant for a 340,000 tons per year production a $500,000 estimate is taken, and that it varies as the 0.8 power of annual production.

Then Capital Cost Mining: $jX^{0.8}$

At 340,000 tpy $j = \text{proportionality factor} = \frac{2,000,000}{(340,000)^{0.8}} = 18.8$

$\therefore$ Capital Cost Mine = $18.8X^{0.8}$

where X is annual production of mine

Variation in Cost of Mining and Milling

Based on industry information and on previous experience, the following costs are assumed:

Mining	\$10.00/ton
Milling	\$ 3.00/ton

It is also estimated that of the mining cost 70% is labor while 30% materials and supplies. From other companies data it is assumed that the annual cost of labor varies as the 0.7 power of the tons produced, while the materials and supplies cost varies directly proportional to the annual tonnage produced. Thus, a formula can be developed as follows:

Mining Cost = $fX^{0.7} + gX$

where f = proportionality constant (see calculations below)
x = tons mined per year
g = proportional factor

tons per year at 1000 tpy production

$$f = \frac{(70\% \text{ of } \$10)(340,000)}{(340,000)^{0.7}} = \frac{(7 \times 340,000)}{7448} = \frac{2,380,000}{7448} = 319.5$$

$$g = \frac{(30\% \text{ of } \$10)(340,000)}{(340,000)} = 3$$

Mining Cost = $320\ X^{0.7} + 3X$ when cost of mining @ 1000 tpd capacity is \$10/ton and 70% of it is labor while 30% is materials and supplies.

The cost of Milling varies as follows:

It is estimated that 50% of milling cost is labor cost and 50% is materials and supplies. Then:

Milling Cost = $dX^{0.7} + eX$; and similarly as for the mining cost proportionaltiy factors, we find:

$$d = \frac{(50\% \text{ of } \$3)(340,000)}{(340,000)^{0.7}} = \frac{(1.5 \times 340,000)}{7448} = 68.47 \text{ take } 68.5$$

$$e = \frac{(1.5)(340,000)}{340,000} = 1.5$$

$\therefore$ Milling Cost = $68.5X^{0.7} + 1.5X$

Example: Mining and Milling Cost for a 680,000 t.p.y. operation

Mining Cost = $(320 \times 680,000^{0.7}) + (3 \times 680,000)$ = \$5,915,840/year

$$\therefore \text{Mining Cost} = \frac{5,915,840}{680,000} = \$8.70/\text{ton}$$

Milling Cost = $(68.5 \times 680,000^{0.7}) + (1.5 \times 680,000)$ = \$1,848,850

$$\therefore \text{Milling Cost} = \frac{1,848,850}{680,000} = \$2.72/\text{ton}$$

Then total mining and milling cost for an operation of 680,000 t.p.y. is \$11.42/ton as compared to \$13.00/ton for a 340,000 t.p.y. operation.

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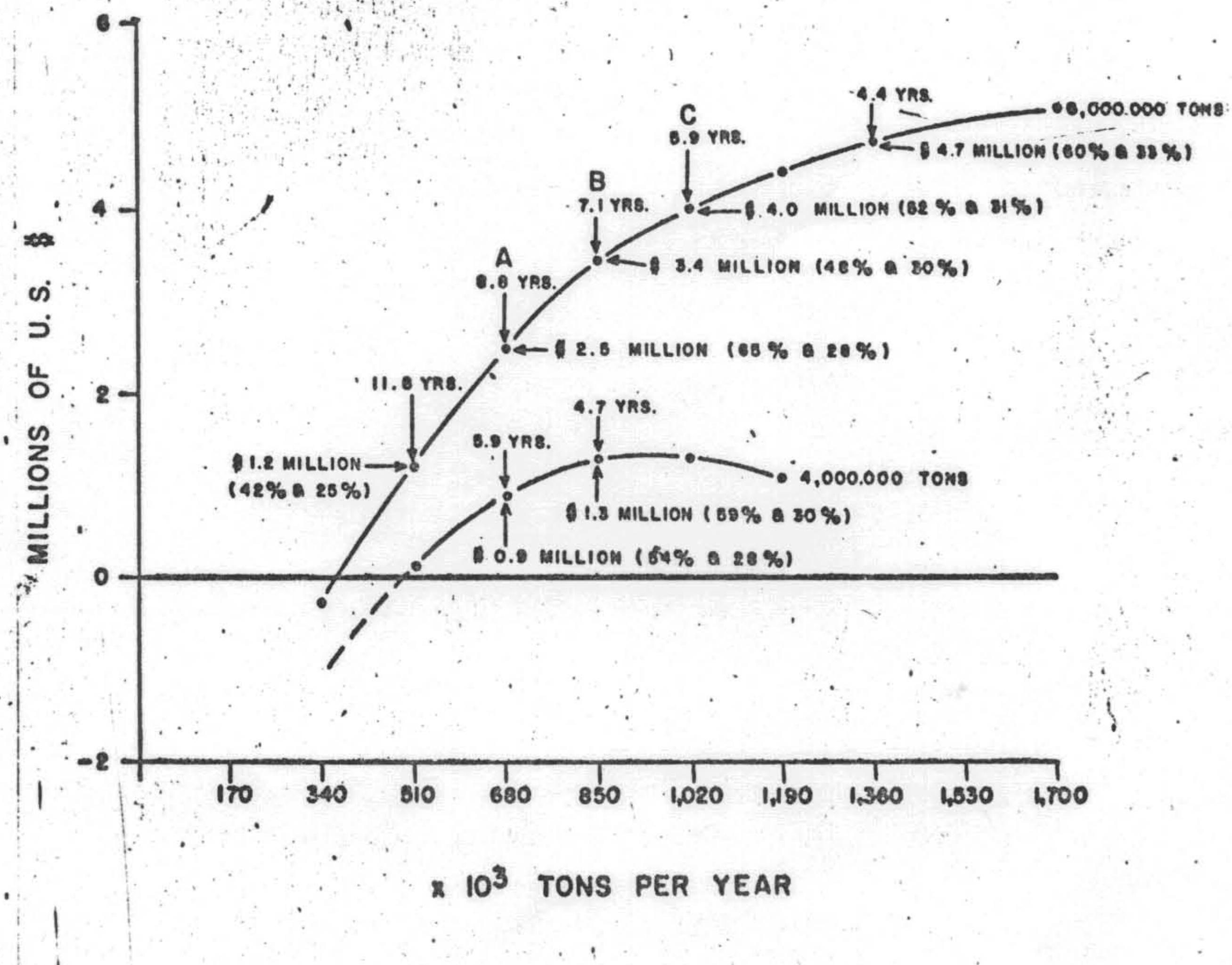
VALUE OF DEPOSIT VS. ANNUAL PRODUCTION

BASED ON: U. S. METAL PRICES
U. S. TAXES
NO ROYALTY
REDEMPTION ANNUITY OF:

20 % RETURN ON INVESTMENT
8 % SINKING FUND FOR CAPITAL INVESTMENT REDEMPTION.

IN BRACKETS $\left(\frac{PBT}{ASSETTS}\right.$ AND $\left.\frac{PBT}{GROSS\ SALES}\right)$

A, B, C (See details in Appendix B)

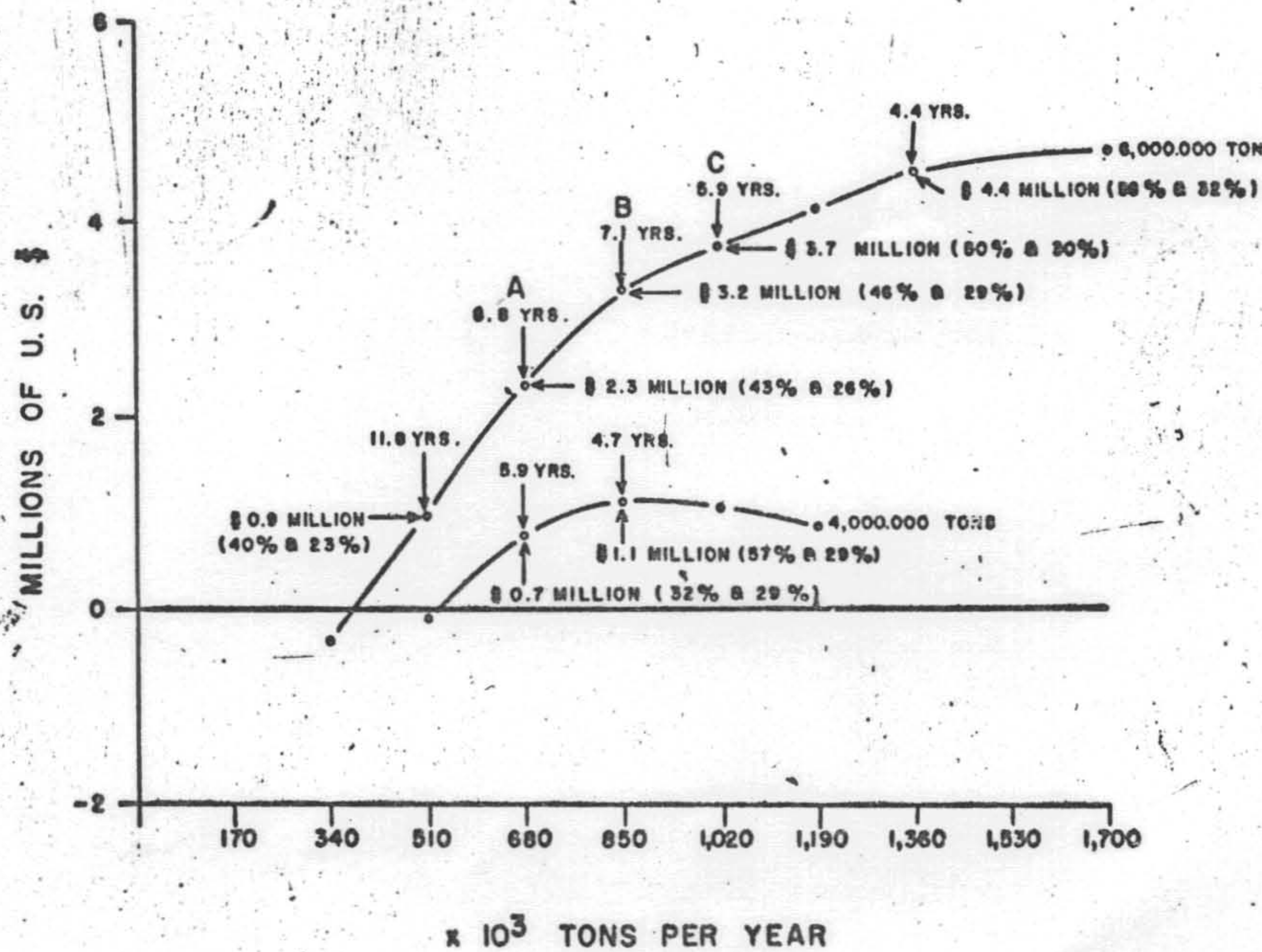


VALUE OF DEPOSIT VS. ANNUAL PRODUCTION

BASED ON: JAPAN METAL PRICES
U. S. TAXES
NO ROYALTY
REDEMPTION ANNUITY OF:
20 % RETURN ON INVESTMENT
8 % SINKING FUND FOR CAPITAL INVESTMENT REDEMPTION.

IN BRACKETS $\left(\frac{PBT}{ASSETTS} \text{ AND } \frac{PBT}{GROSS\ SALES} \right)$.

A, B, C (See details in Appendix B)



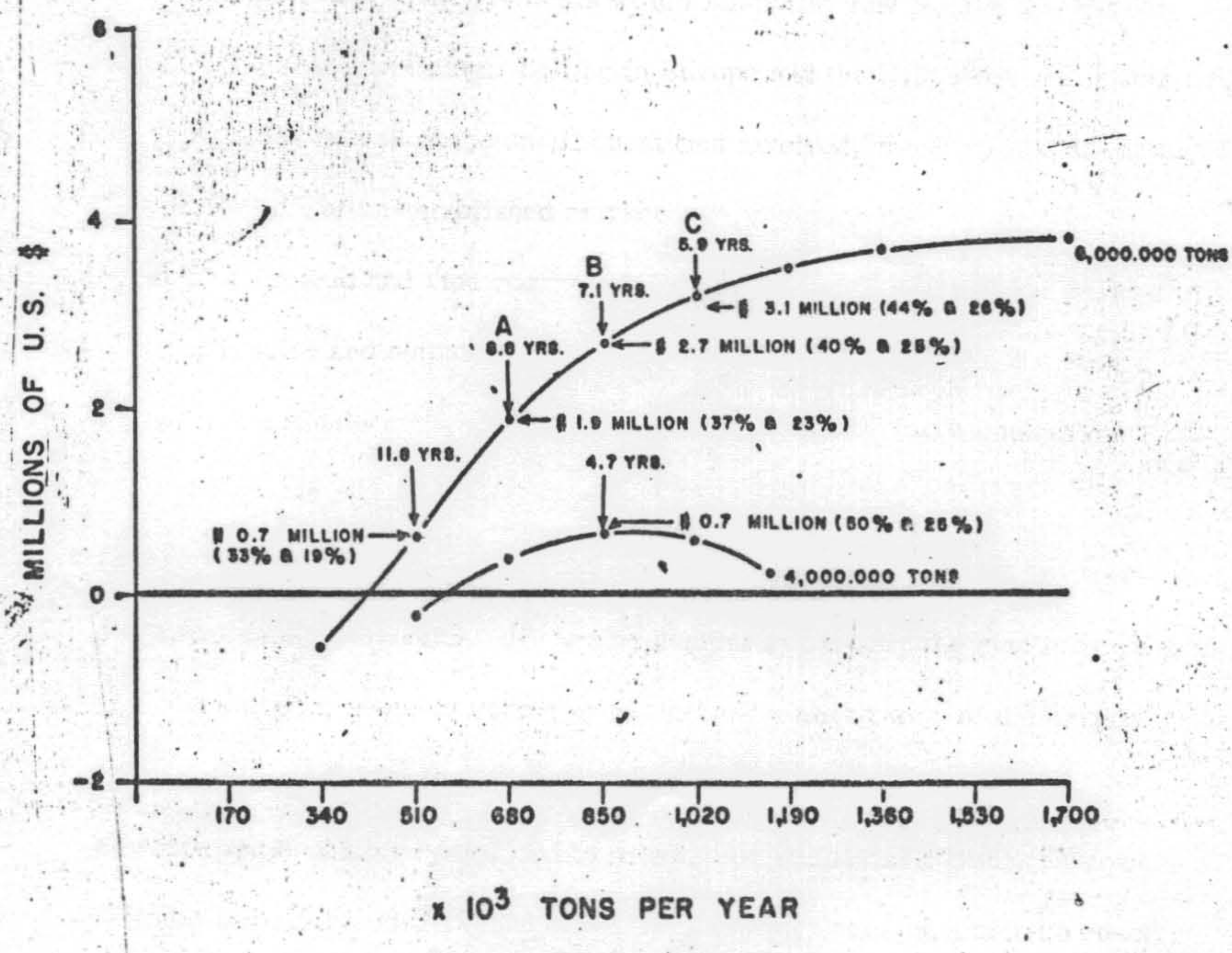
VALUE OF DEPOSIT VS. ANNUAL PRODUCTION

BASED ON: AUSTRALIAN METAL PRICES
U. S. TAXES
NO ROYALTY
REDEMPTION ANNUITY OF:

20 % RETURN ON INVESTMENT
8 % SINKING FUND FOR CAPITAL INVESTMENT REDEMPTION.

IN BRACKETS $\left(\frac{PBT}{ASSETTS} \text{ AND } \frac{PBT}{GROSS\ SALES} \right)$

A, B, C (See details in Appendix B)



Threshold Requirements And Deposit Limitations

1. The best market and most attractive arrangement for the development of a Tasmanian lead-zinc operation appears to be a long term contract with a Japanese lead and zinc smelter. Considering the rapid growth of Canadian and Peruvian shipments to Japan, initial investigation of this possibility should be undertaken as soon as possible. An additional attraction could be a financial contribution from the Japanese interests.
2. Sales on a custom smelter basis within Australia may be possible but the outlook is not promising. Selling in Europe and the U.S. does not appear promising because of the small quantities involved, the distance to market, and the lack of an established marketing organization.
3. Australian lead and zinc operations appear subject to fairly frequent swings in both price and output. Therefore any feasibility studies of a mining operation should include tests for sensitivity to these two elements over a broad enough range.
4. The reserve and capacity requirements stipulated below are based on the assumption that despite the low zinc content in the ore, the zinc is recoverable.
5. To achieve an adequate return on capital and amortization of the original investment, to allow for an anticipated variation in the margin between price and operating costs, and to provide for additional capital costs yet to be incurred (additional exploration, feasibility studies, start-up costs, working capital, etc.) a 6 million ton reserve of assured or "proved" ore

is the minimum requirement at the grade found in the test holes to date. (Average: 4.7% Pb; 1.5% Zn, 3.3 ozs/ton Ag.) Based on current information, it is assumed that there will be no royalty payments to either Australia or Tasmania.

6. If additional exploration, development and property acquiral costs exceed the amounts specified, then higher operating levels or greater reserves or better grade will be required to meet the specified rates of return.

7. The optimum rates for operation result in too short a lifetime (under 6 years) so lower operating rates are assumed. This, however, reduces the total capital that can be expended while still achieving the assumed rates of return.

8. It is recommended that sufficient additional exploration and test drilling be undertaken to determine if geologic evidence is sufficient to prove the presence of 6 million tons of ore.

9. A total reserve of 12 million tons (6 million tons proved and 6 million tons inferred) should be indicated geologically. This is minimal for an annual output that must fall between 680,000 and 1,020,000 tons. It should be noted that this amount of ore is less than the reserves held by most Australian mining operations and the ore is markedly lower in combined lead-zinc content.

10. Total capital requirements may vary from 8.7 to 12.5 million dollars depending upon the annual capacity desired. This includes the cost of the

mine and mill plus all capitalized exploration and development costs that may be incurred between now and the beginning of actual mining.

11. Only limited information is available on the labor supply. However, there appear to be possible limitations due to:

   a. Supply readily available

   b. The skills and quality of the men available

   c. The union-management environment in light of recent prolonged strikes in some lead-zinc operations

12. The information available on power indicates that the supply and cost of local power is acceptable. Some past difficulties were encountered due to drought.

13. The high annual precipitation in Tasmania indicates that water supplies for the mine and mill should be obtainable. However, the effect of this rainfall on the mining operations is not known.

14. Tasmania is somewhat isolated and not heavily populated so it can be expected that supplies and services may be somewhat limited. However, it is not believed that this represents a problem.

15. In view of the size and grade of the deposit indicated by present data, it is unlikely that time and capital expenditures needed for construction of any extensive special transportation facilities can be justified. Therefore, existing roads, railroads, and port facilities should be utilized wherever possible. Their availability should be determined at an early date.

16. Some advantages on marketing flexibility would be gained if the lead could be processed to the metallic form at an integrated smelter. This could be important if a Japanese arrangement is not feasible. However, this would require a 20 year reserve to be adequate for smelter amortization, more ore than has been discovered to date, and would involve additional capital outlays of the magnitude of 10 million dollars.

17. Another alternative to the Japanese market might be found within T.I. If T.I.'s activities involve the use of lead and zinc, then T.I. could become a stable outlet.

18. There is evidence that by 1975-1976 an upsurge of lead-zinc production will start in Australia. Mount Isa Mines have announced that they will bring into production by 1976 their new deposit (Northern leases) at approximately 5.0 million tons per year rate. Based on analyses of past production-consumption-price data the projected trends are interpreted to suggest that a lead-zinc mine should come into production not later than 1974. With this in mind, the following tentative work-expenditure schedule is suggested for a 6,000,000 tons deposit which is to be exploited as a 1,020,000 tons per year operation. On the next page the following timetable is proposed:

Tentative Expenditure Schedule

	Period Budget	Type of Work	Cumulative Budget	Remarks
To July 1970	$135,000	15-500 ft. D.D.Hs; assaying; geol. & geophys. work eval.	$300,000	
		PRELIMINARY EVALUATION		
August 1970 to December 1970	$300,000	More diamond drilling; geologic work, assaying. Also preliminary	$600,000	Evaluation Review
January 1970 to June 1971	$400,000	beneficiation and metallurgical tests. Re-evaluation	$1,000,000	
		RE-EVALUATION		
July 1971 to December 1971	$600,000	Definition D. drilling; underground bulk sampling and ground	$1,600,000	Evaluation Review
January 1972 to June 1972	$600,000	Testing; assaying; beneficiation, metal-lurgical	$2,200,000	Evaluation Review
July 1972 to December 1972	$800,000	Other necessary test. Evaluation reviews & feasibility study	$3,000,000	
		ENGINEERING FEASIBILITY STUDY COMPLETED*		
January 1973 to December 1973	$5,500,000	Design and construction of mine and mill for 1,020,000 t.p.y. operation	$8,500,000	
1974	$4,000,000	Production	$12,500,000	This is maximum capital investment

* If Feasibility Study is GO, with information available now (March 1970) the next step should not be taken unless a long term sale contract has been arranged.

Respectfully submitted,

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John J. Schanz, Jr.
Consultant

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APPENDIX A

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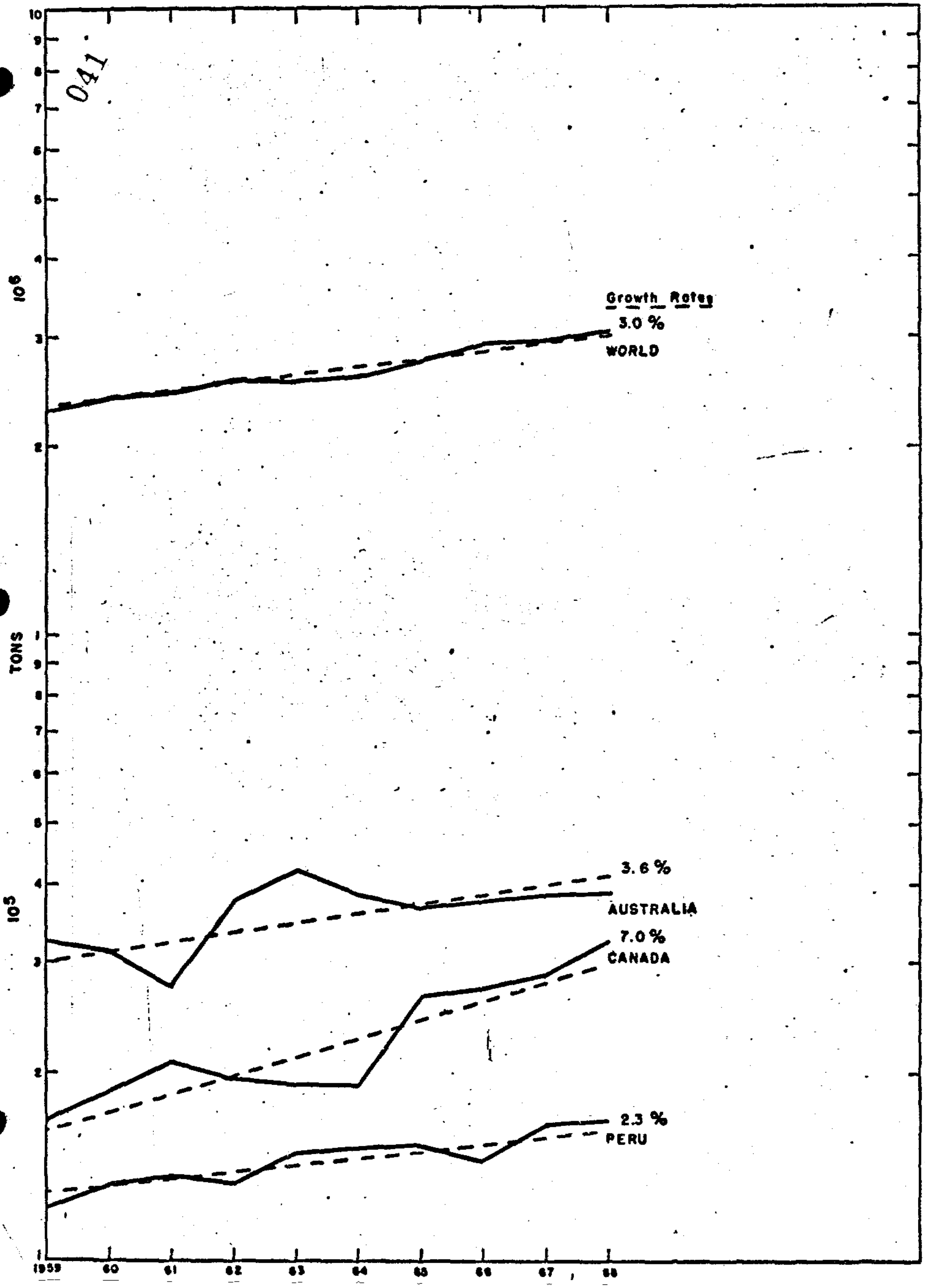
MINE PRODUCTION OF LEAD



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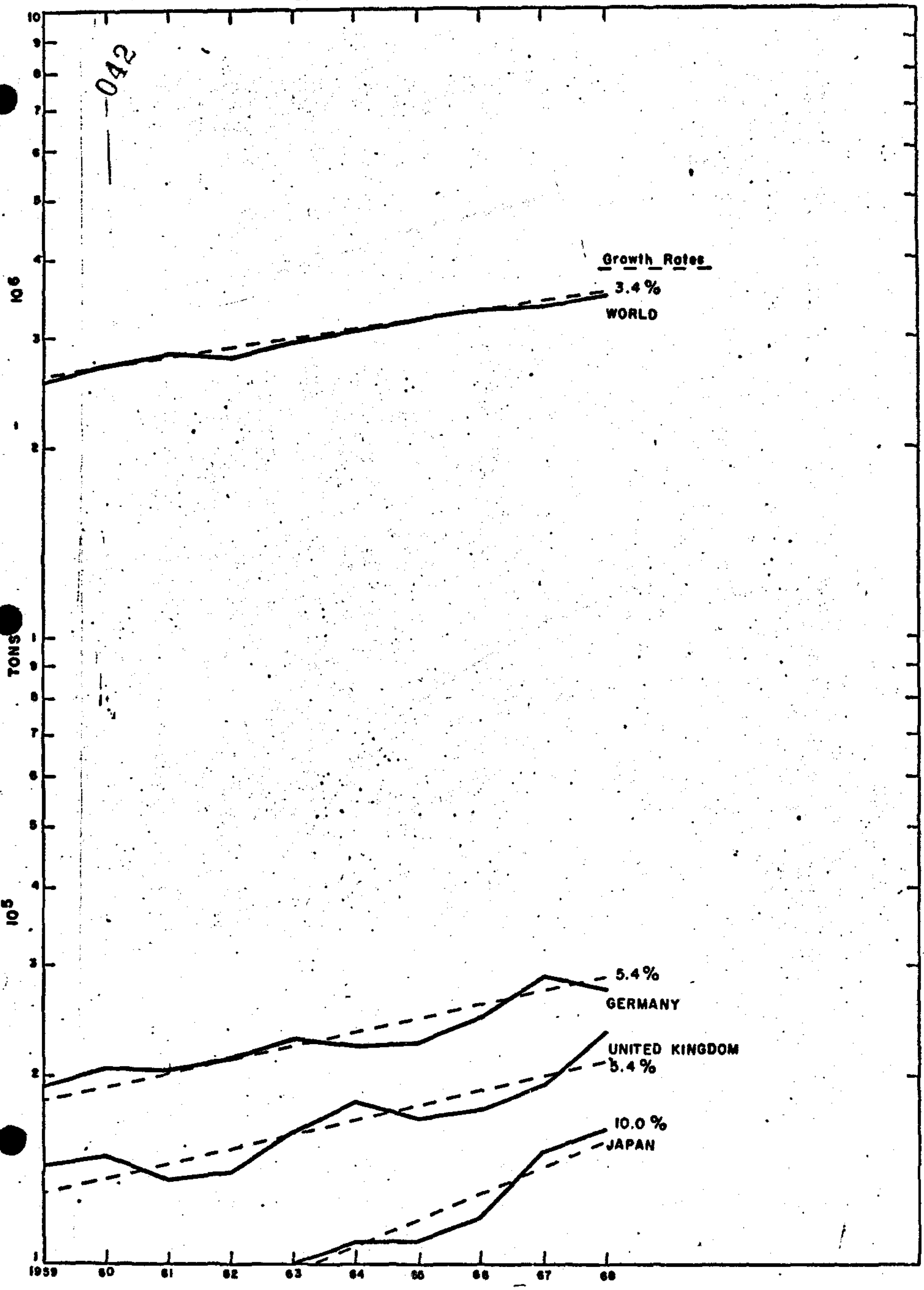
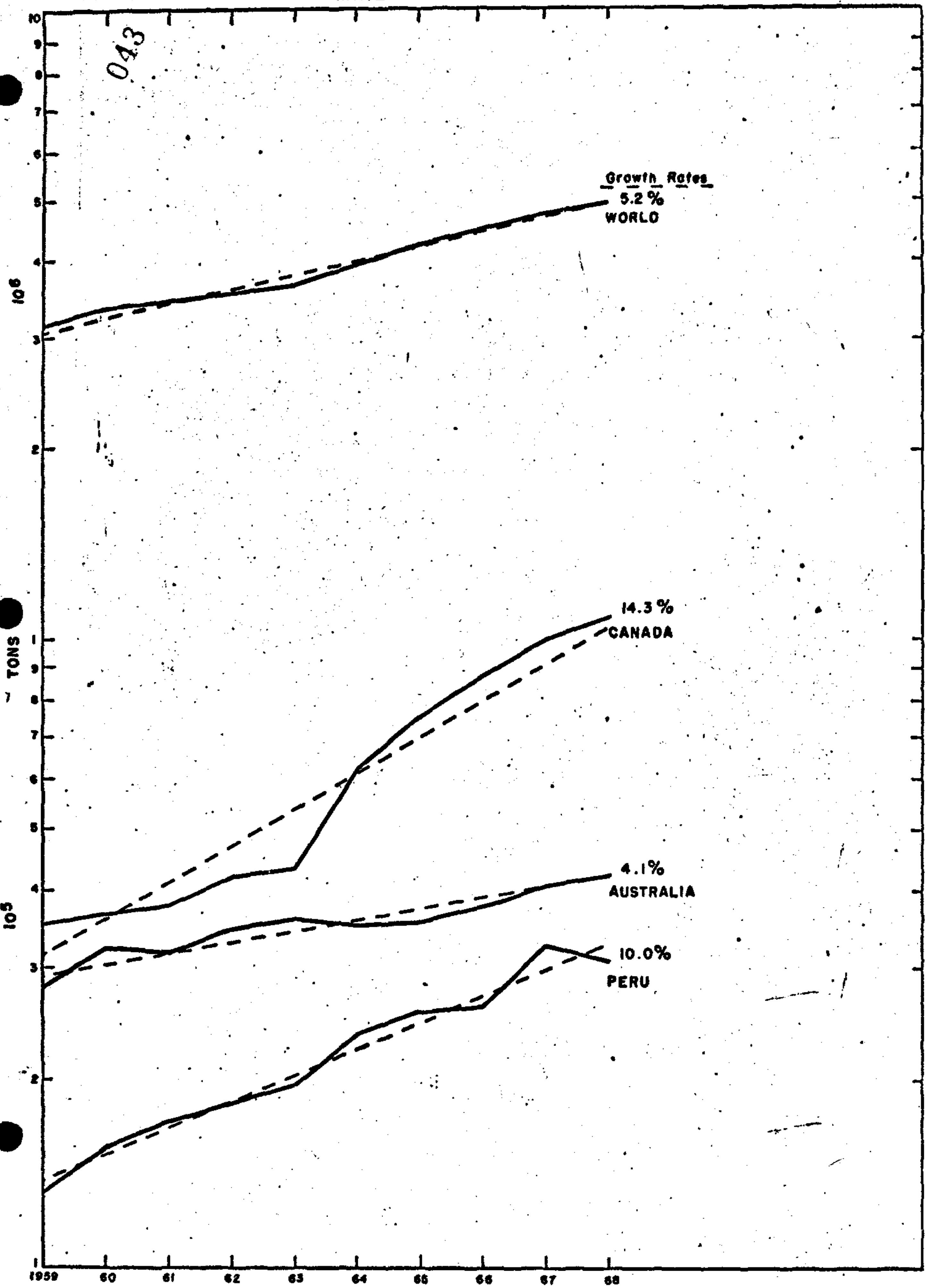
SMELTER PRODUCTION OF LEAD



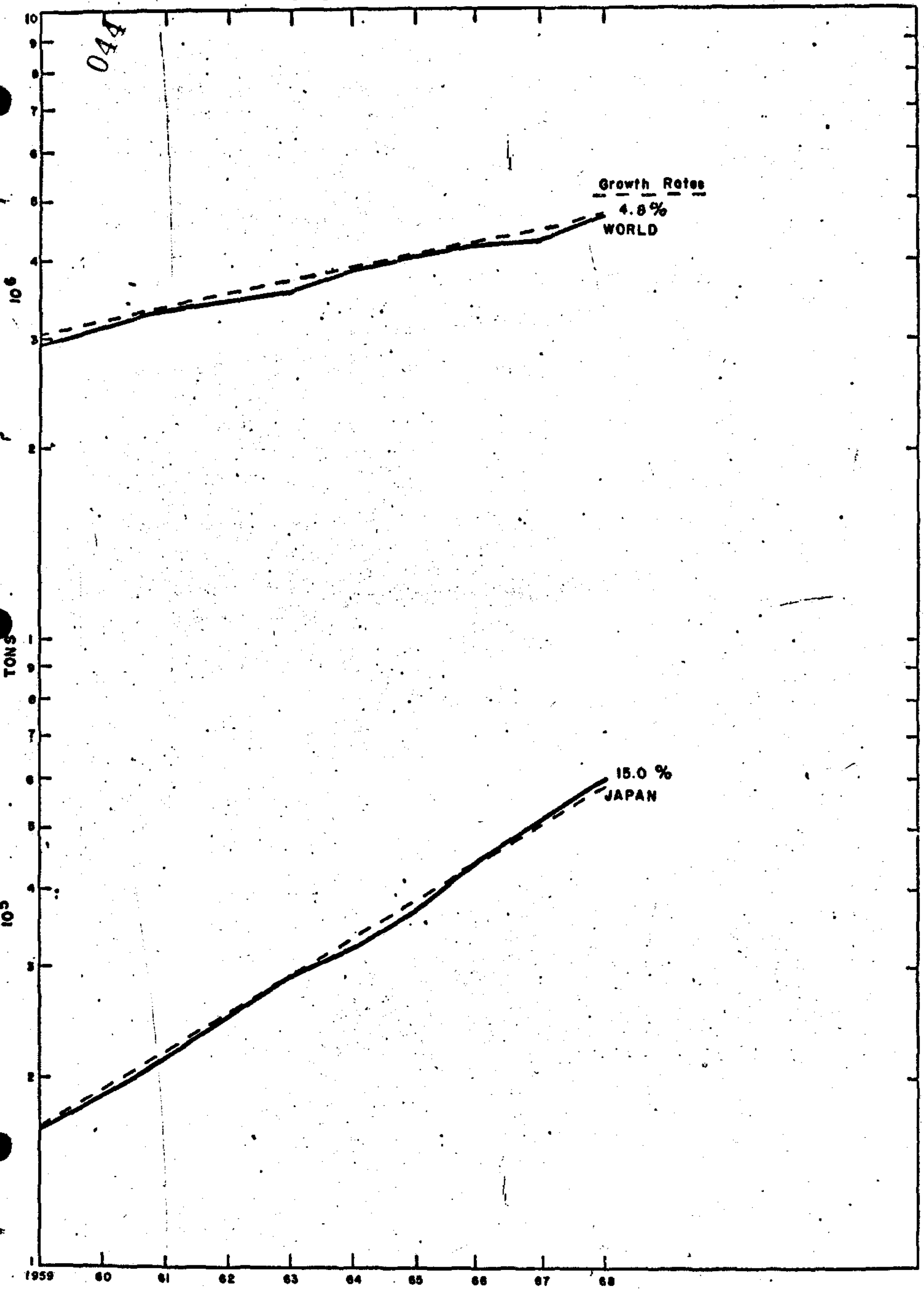
A-1

043

MINE PRODUCTION OF ZINC

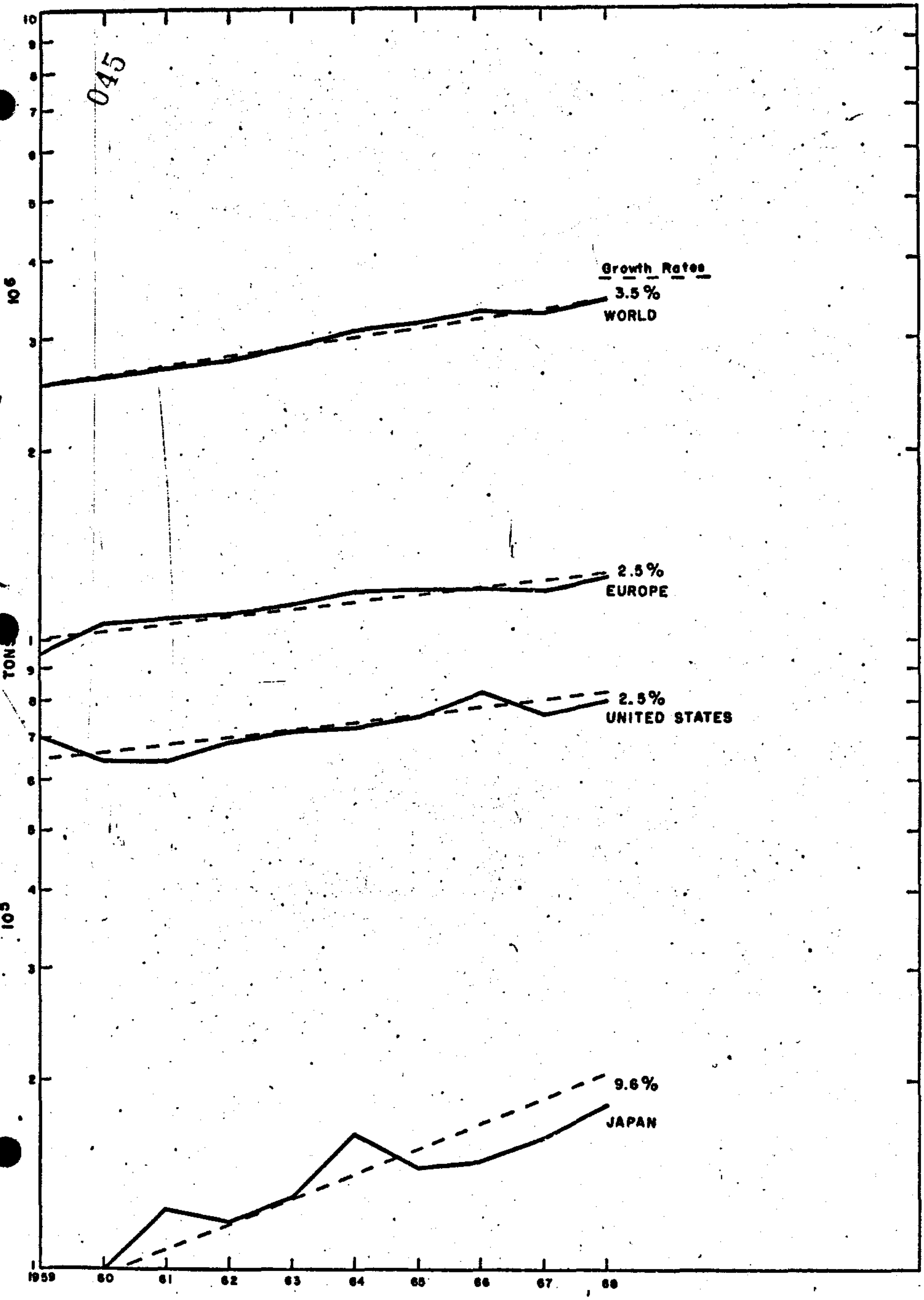


SMELTER PRODUCTION OF ZINC

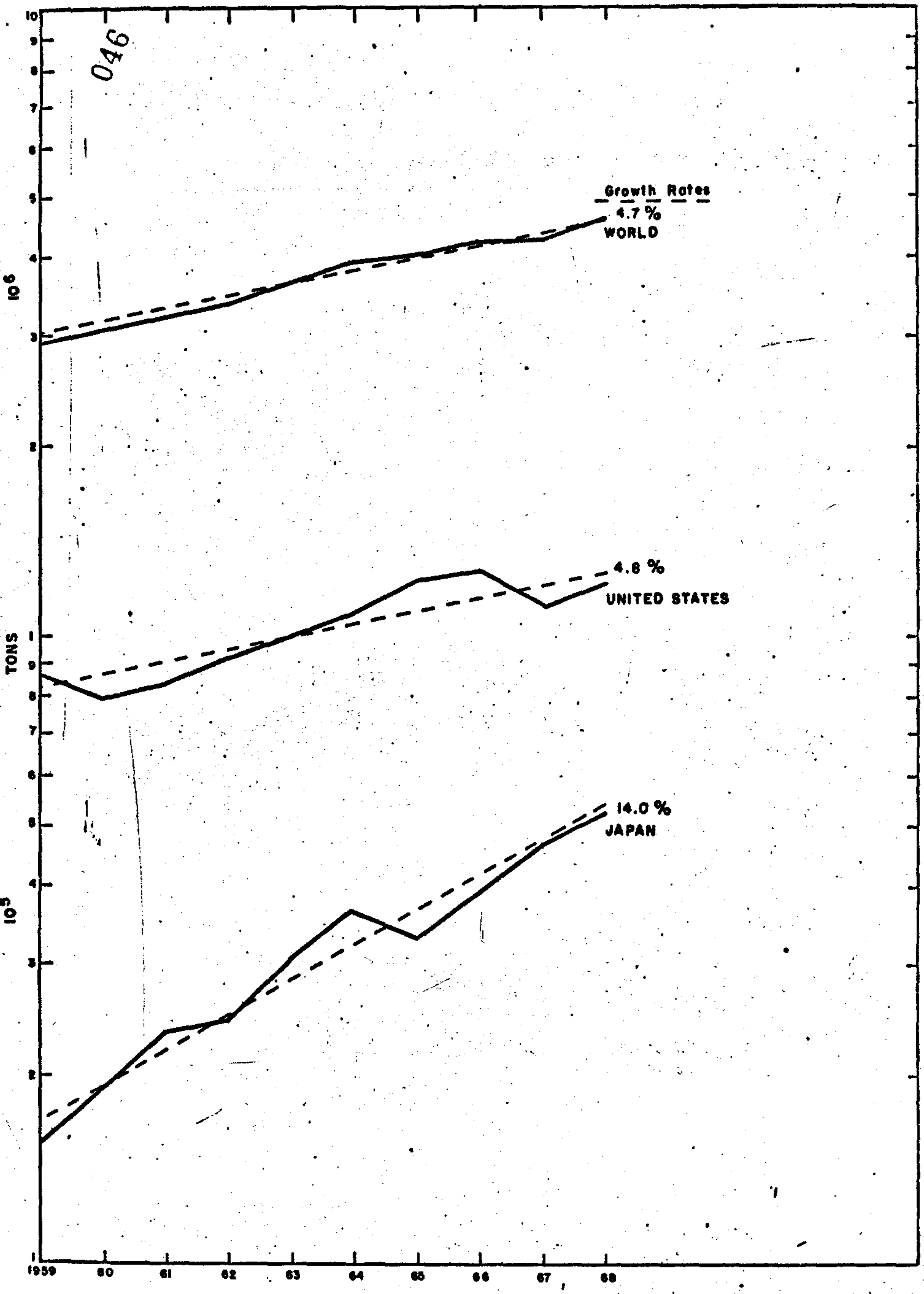


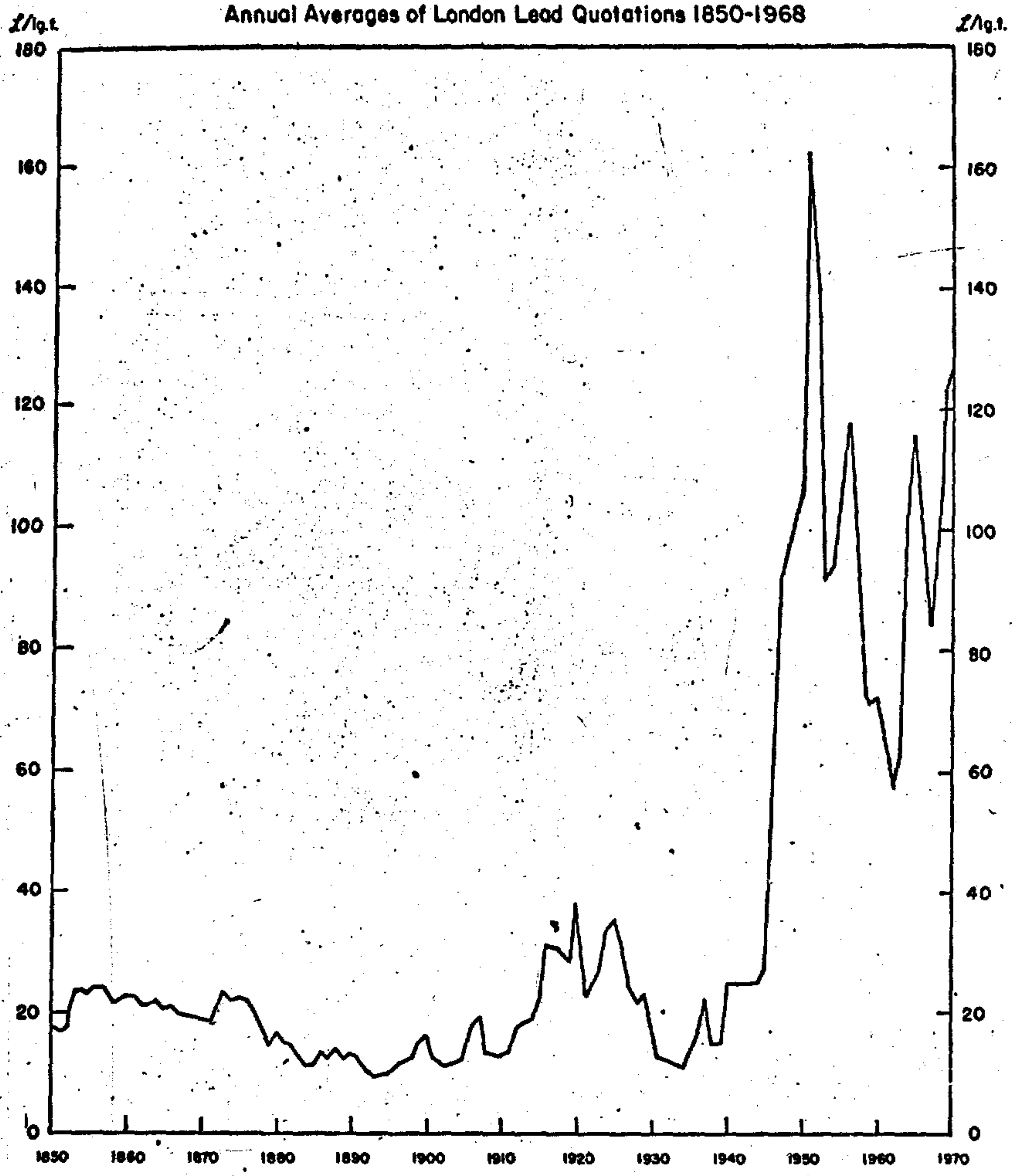
020046

CONSUMPTION OF REFINED LEAD



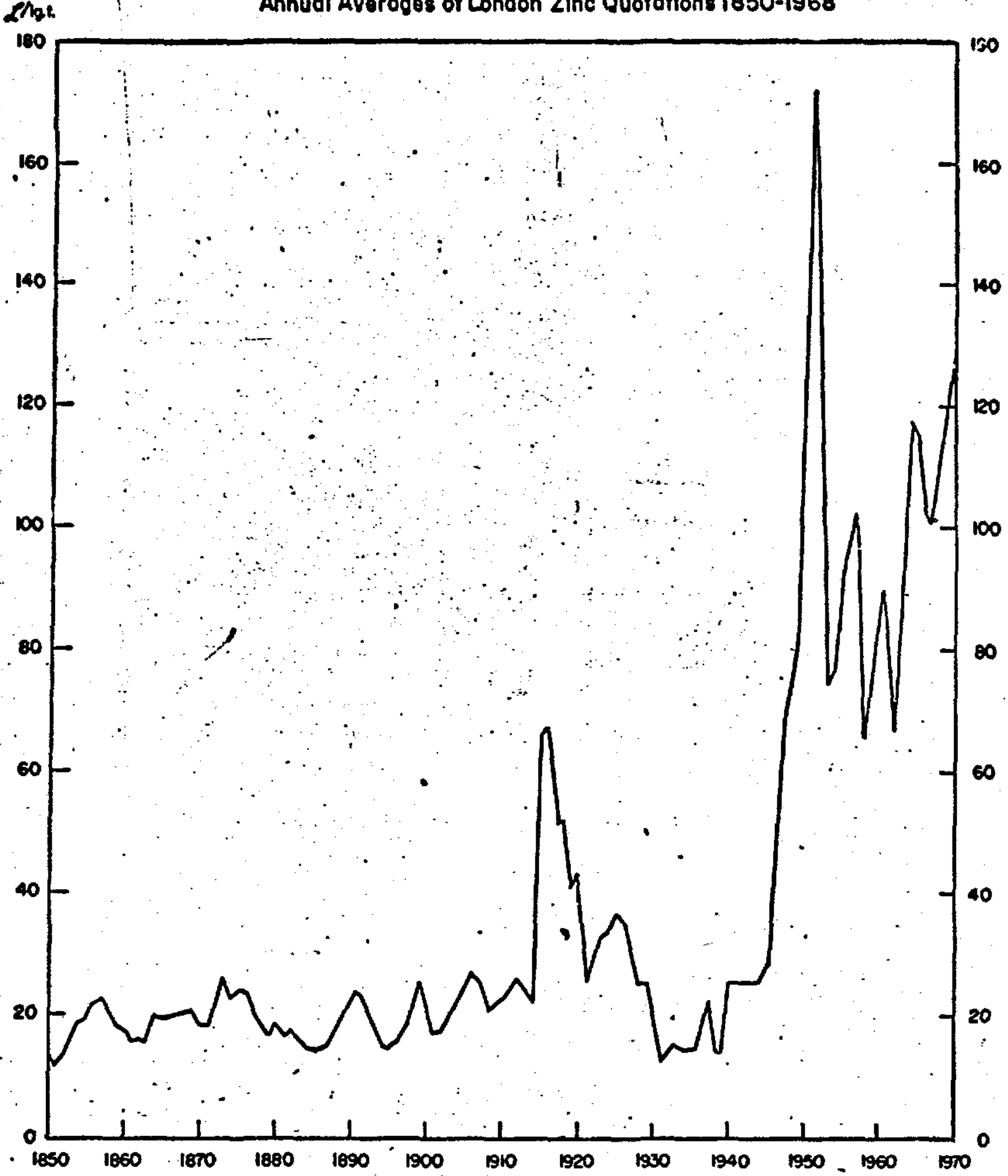
CONSUMPTION OF ZINC





Annual Averages of London Lead Quotations 1850-1968
£/lg.t.
£/lg.t.
0
20
40
60
80
100
120
140
160
180
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970

Annual Averages of London Zinc Quotations 1850-1968



APPENDIX B

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FINANCIAL DETAIL FIGURES

U. S. METAL PRICES

For A 6,000,000 Tons Deposit

	CASE*		
	A (8.8 yrs) 680,000 Tpy	B (7.1 yrs) 850,000 Tpy	C (5.9 yrs) 1,020,000 Tpy
Gross Sales/year	$14.9	$18.9	$22.4
Operating Cost/year	$10.7	$13.1	$15.4
Profit Before Tax/year	$ 4.2	$ 5.6	$ 7.0
Depletion Allowance/year	$ 2.1	$ 2.8	$ 3.5
U. S. Taxable Income/year	$ 2.1	$ 2.8	$ 3.5
U. S. Federal Tax/year	$ 1.0	$ 1.3	$ 1.7
Profit After Tax/year	$ 3.2	$ 4.3	$ 5.3
Present Value of Annuity	$ 9.3	$11.6	$13.3
Production Capital Investment	$ 6.8	$ 8.1	$ 9.4
Value of Deposit	$ 2.5	$ 3.5	$ 3.9
Maximum Capital Investment	$ 9.3	$11.6	$13.3
Return on Assets	45.2%	48.3%	52.6%
Operating Profit	28.1%	29.6%	31.3%

* All $ Figures rounded and in U.S.$.

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FINANCIAL DETAIL FIGURES

JAPANESE METAL PRICES

For A 6,000,000 Tons Deposit

	CASE*		
	A (8.8 yrs)	B (7.1 yrs)	C (5.9 yrs)
	680,000 Tpy	850,000 Tpy	1,020,000 Tpy
Gross Sales/year	$14.7	$18.4	$22.0
Operating Cost/year	$10.8	$13.1	$15.4
Profit Before Tax/year	$ 3.9	$ 5.3	$ 6.6
Depletion Allowance/year	$ 1.95	$ 2.65	$ 3.3
U. S. Taxable Income/year	$ 1.95	$ 2.65	$ 3.3
U. S. Federal Tax/year	$ 0.94	$ 1.27	$ 1.6
Profit After Tax/year	$ 2.9	$ 4.0	$ 5.0
Present Value of Annuity	$ 9.1	$11.4	$13.1
Production Capital Investment	$ 6.8	$ 8.1	$ 9.4
Value of Deposit	$ 2.3	$ 3.3	$ 3.7
Maximum Capital Investment	$ 9.1	$11.4	$13.1
Return on Assets	43.0%	46.5%	50.3%
Operating Profit	26.6%	29.0%	30.0%

* All $ Figures rounded and in U.S.$

052

FINANCIAL DETAIL FIGURES

AUSTRALIAN METAL PRICES

For A 6,000,000 Tons Deposit

	CASE*		
	A (8.8 yrs) 680,000 Tpy	B (7.1 yrs) 850,000 Tpy	C (5.9 yrs) 1,020,000 Tpy
Gross Sales/year	$14.0	$17.5	$21.0
Operating Cost/year	$10.8	$13.1	$15.4
Profit Before Tax/year	$ 3.2	$ 4.4	$ 5.6
Depletion Allowance/year	$ 1.6	$ 2.2	$ 2.8
U. S. Taxable Income/year	$ 1.6	$ 2.2	$ 2.8
U. S. Federal Tax/year	$ 0.8	$ 1.0	$ 1.4
Profit After Tax/year	$ 2.4	$ 3.4	$ 4.2
Present Value of Annuity	$ 8.7	$10.8	$12.5
Production Capital Investment	$ 6.8	$ 8.1	$ 9.4
Value of Deposit	$ 2.3	$ 2.7	$ 3.1
Maximum Capital Investment	$ 8.7	$10.8	$12.5
Return on Assets	36.8%	40.7%	44.8%
Operating Profit	22.8%	25.7%	26.6%

* All $ Figures rounded and in U.S.$