RECORD COPY

A SURVEY OF THE WORLD ANTIMONY SITUATION

Unclassified

F-9

RESTRICTED

COMPILATION OF DATA REGARDING

THE WORLD ANTIMONY SITUATION

Note: This paper is merely a factual summary of information received from a variety of sources, without any attempt at interpretation of the data. Dissemination in this form is made for the benefit of contributors and other agencies of the government having a legitimate interest in facts concerning the world antimony situation.

by
Office of Reports and Estimates
Central Intelligence Agency

RESTRICTED

COMPILATION OF DATA REGARDING
THE WORLD ANTIMONY SITUATION

RESTRICTED

TABLE OF CONTENTS

Acknowledgments and references 1

Summary 2

World reserves 8

Smelting Industry 10

Technology 10

Uses 12

Substitutes 14

Position of the United States . . . . . .

- Domestic Consumption 14
- Deposits in the United States 18
- Secondary Antimony 19
- Foreign trade 20
- Tariff 20
- Prices 22
- Present Situation and Future Outlook 24
- Emergency Supply and Demand 24

Major World Producers . . . . . .

- China 28
- Bolivia 37
- Mexico 46

Minor World Producers . . . . . .

- Peru 55
- Argentina 56

RESTRICTED

Declassified and Approved For Release 2013/09/12 : CIA-RDP78-01617A005700010009-9

Honduras 56
Canada 57
Union of South Africa 57
Australia 58
Yugoslavia 59
Czechoslovakia 59
Italy 60
Austria 60
France 60
Algeria 61
Spain 61
Turkey 61
Japan 62
USSR 62

TABLES

1 - World production of antimony, 1939-48, by countries 6
2 - Estimated antimony reserves of the principal producing countries as of 1944 9
3 - Statistical review of antimony in the United States 1938-48 15
4 - Industrial consumption of primary antimony, 1938-48 16
5 - Antimony reserves in the United States, as of 1944 19
6 - Antimony imported into the United States, 1938-48, by countries 21
7 - United States preliminary statistics for 1948 25
8 - Estimated US antimony requirements and supply under Emergency conditions 26

9 - Estimated reserves of antimony in China by deposits 34

10 - Bolivia - Exports of antimony concentrates by countries, 1938-48 42

11 - Reserves of the Antimonio district, Sonora 47

12 - Reserves of the Los Tejocotes mines, Oaxaca 47

MAPS

1 - China - Antimony deposits 35

Index 36

2 - Bolivia - Antimony deposits 43

Index 44

3 - Mexico - Antimony deposits 52

Index 53

ACKNOWLEDGMENTS AND REFERENCES

Special acknowledgment is made here to the Bureau of Mines for many helpful suggestions in the preparation of this report.

Information was gathered from the Minerals yearbooks, annual editions of Metal Statistics, issues of London Mining Journal, African World, Engineering and Mining Journal, Mining and Metallurgy, South African Mining Journal and Mineral Trade Notes, 1940 - 1947.

Data were also obtained from files of the Foreign Minerals Division U. S. Bureau of Mines; U. S. Geological Survey; Reports of Supreme Command Allies in the Pacific; Consular reports of the Department of State; and reports of the Foreign Economic Administration.

SUMMARY

There are only three major producers of antimony ore: China, Bolivia and Mexico, with China having the bulk of the world's reserves. The large consumers of antimony are the industrialized nations, namely the US, USSR, UK, France, Belgium, Japan, Italy, and, formerly, Germany. All of the consuming countries have smelting industries. Control of the smelters and the deposits is held by nationals of the respective countries, except in Mexico where the National Lead Company controls the industry.

World production has varied considerably during the last 50 years. Maximum output was in 1916 when more than 80,000 tons were produced under the impetus of a shrapnel war. New highs since 1916 were registered during World War II with the peak year 1943 when about 53,200 tons were produced. The world output fell to 25,400 tons in 1946, the lowest tonnage since the early thirties. The decrease in production was due to rising costs, labor difficulties and a fear of overproduction. The great drop in consumption, expected when the war ended, did not take place, supplies became short, and the New York price rose until it reached an all-time peak of 41.67 cents (New York December 1948 price) compared to a fixed price of 15.84 cents in 1944-45 and 12 cents in 1939.

NOTE: The term "ton" in this report refers to a metric ton of 2204.6 pounds. World production figures are reported in terms of recoverable antimony content (92 percent of total content) in accordance with US Bureau of Mines procedure.

Periodically, the National Lead Company has raised its price, thereby effecting an increase in the world market price. In December 1948 Chinese antimony was quoted at 38.50 cents, duty paid New York, which was about three cents per pound less than National Lead Company's price in New York. Imports of metal from China decreased in 1948. However, as a result of increased imports of ores and concentrates from Peru, Bolivia and Mexico, both Government and industry stocks increased in 1948 with supplies beginning to exceed demand.

China dominated the world's antimony industry before the Japanese invasion in 1937 by supplying about two-thirds of the world's requirements. The industry was ravaged by war, and the lack of economic stability coupled with a shortage of operating equipment are hindering operations. It will be some time before production can reach prewar levels.

With China cut off as a source of antimony, Bolivia and Mexico have become the principal sources of supply. Bolivia was the principal producer until 1944 when cancellation of the United States over-all purchase agreement caused a significant decrease in production. In 1946 Bolivia regained European markets, thereby replacing Mexico as the principal producer. Peru is producing antimony in increasing quantities. The building of the Laredo, Texas, smelter and the US tariff on antimony metal are the factors responsible for Mexico's position as the chief US supplier. Subsidiaries of the National Lead Company control Mexico's present production.

The US is an important producer in the Western Hemisphere. The output comes mainly from the Yellow Pine mine in Idaho where antimony was found asscciated with gold and tungsten. Reserves are not large and self-sufficiency is far from possible under any conditions. In 1946 domestic mine production accounted for 14 percent of the primary antimony consumed, in 1947 for about 32 percent, and in 1948 for 42 percent.

Yugoslavia, Czechoslovakia, and Hungary shipped substantial tonnages of antimony to Germany during the war. Production figures for the USSR have not been reported but several deposits are in production and self-sufficiencyis possible, and may already have been attained. The Union of South Africa annually produces more than 2,000 tons of antimony contained in concentrates recovered from gold ores of the Murchison Range. All but a few tons are exported to the UK. US supplies of primary antimony have been short despite a price more than double that of war years but increased supplies from Mexico, Peru, Bolivia and the US are enabling the US to meet requirements. Most of Mexico's production is imported into the US.

During 1948 the UK took a substantial portion of Bolivia's production, however, the US received the major share (3,003 metric tons of contained antimony) with smaller portions going to other European countries. Approximately 6,100 tons (antimony content) were mined in the US and 7,900 tons imported from Mexico, thus, supplies will begin to exceed US demand in 1949 unless the stock-pile program is revised. About 20,000 tons of available secondary antimony will meet all secondary requirements.

The USSR received shipments of at least 1,000 tons of antimony and tungsten from China in 1948, and probably will receive additional shipments during 1949. It is believed that production of antimony in the USSR is possibly sufficient for present requirements but could not meet a sudden increase in demand. Therefore, the USSR may have a definite stockpile program for antimony, such as they appear to have initiated with tungsten, as a strategic reserve in an emergency. The capacity of Hungary, Yugoslavia, and Czechoslovakia is estimated at about 11,000 metric tons annually. Important quantities of antimonial lead scrap have been shipped to the USSR from Germany and the Satellite countries.

In the event of a future emergency, about 46,000 tons annually would be required to meet US consumption. Approximately 23,500 tons could be produced domestically from secondary antimony, domestic mines, and as a by-product of lead ores. About 22,500 tons would need to be imported, of which Mexico could supply 8,000 to 10,000 tons; Bolivia, 12,000 tons; and Peru, under very favorable conditions, 1,500 tons. As a protection against labor and transport difficulties, at least a year's supply of primary antimony (27,000 tons) should be stockpiled to maintain a constant flow to consumers. If an acute shortage should develop, exports of Bolivia could be increased quickly by a slight chage in specifications.

Table 1 - World Production of Antimony, 1939-48, by Countries 1/
(Compiled by B. B. Mitchell, Bureau of Mines)

(In metric tons)

Country	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
North America										
Canada	550 2/	1,083	1,329	1,269	465	809	696	286	480	124
Honduras	-	3/	23	103	110	65	11	8	-	5
Mexico 4/	7,243	11,286	10,241	10,759	12,585	10,056	8,053	6,046	6,371	6,790
United States	328	412	1,013	2,457	4,638	3,952	1,611	2,091	4,437	5,416
South America										
Argentina	97	91	123	41	100	71	13	-	-	-
Bolivia (exports)	9,255	10,813	13,680	16,231	16,536	6,852	5,093	6,407	9,989	11,280
Peru	775	809	1,440	1,457	2,472	932	2,041	969	1,140	1,770
Europe										
Czechoslovakia	1,012 2/	1,104 2/	1,645	3,130 2/	3/	3/	1,115	2,156	1,434	1,593
France	-	-	-	128	153	116	153	202	200	3/
Austria	102	184	26	391	571	658	132	15	82	247
Italy	674	630	819	667	522	403	348	330	450	430
Portugal	174	247	46	135	115 2/	39 2/	6	5	23	3/
Spain	22	3	101	210	176	128	108	96	84	270 5/
Yugoslavia	3,759	5,791	3/	3/	3/	3/	3/	3/	3/	3/
Hungary 2/	750	3,100	3,000	2,200	1,500	1,160 6/7/	-	-	-	3/
Asia										
Pakistan	-	-	3/	3/	3/	3/	3/	3/	3/	3/
Burma 2/	163	305	400	843	843	843	3/	3/	66	3/
China	12,017 8/	8,469 8/	7,989 8/	3,510 8/	505 8/	203 8/	-	426	1,909	3,251
Indochina	22	10	4	1	11	25	3/	-	-	-
Iran 9/	3/	1	19	3/	18	2	-	-	3/	3/
Turkey (Asia Minor) 10/	460	240	80	40	8	58	33	36	103	520
Japan	125	180	250	350	600	450	210	49	100	124
Siam	3/	3/	-	-	22 2/	54 2/	41 2/	3/	104 2/	85

See footnotes bottom of next page.

Table 1 - World Production of Antimony, 1939-48, by Countries 1/ - Continued
(Compiled by B. B. Mitchell, Bureau of Mines)

(In metric tons)

Country	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Africa										
Algeria	216	270	397	304	902	170	423	-	110	217
Morocco										
French	460	469	184	322	409	166	353	260	390	411
Spanish	54	67	85	144	153	72	52	103	128	5/
Southern Rhodesia	50	101	83	169	164	116	29	15	38	10
Union of South Africa	6	126	445	990	1,560	2,570	2,250	2,330	3,020	3,700
Oceania										
Australia	419	404	1,052	1,042	532	454	172	460	162	39 11/
New Zealand	-	1	8	-	-	-	-	-	-	3/
Total 12/	38,800	46,300	49,000	51,400	53,200	36,400	26,900	25,400	34,800	41,300

1/ Approximate recoverable metal content of ore produced, exclusive of antimonial lead ores; 92 percent of reported gross content is used as basis for calculations in nearly every instance. USSR produces antimony but data on production are not available.
2/ Estimate.
3/ Data not available; estimate included in total.
4/ Includes antimony content of antimonial lead.
5/ Includes Spanish Morocco.
6/ January to June, inclusive.
7/ Data represent Trianon Hungary subsequent to October 1944.
8/ Data represent area designated as Free China during the period of Japanese occupation.
9/ Fiscal year ended March 20 of year following that stated.
10/ Revised data; previously shipments were listed in some cases in lieu of production data.
11/ Including New South Wales; data not available.
12/ Estimated by the author.

WORLD RESERVES

The geological process of deposition of antimony minerals, in general, is to form small and irregular ore bodies, thus, an appraisal of antimony ore reserves is difficult and highly speculative unless the deposits are thoroughly explored. The large scale production possible with other ores is usually precluded where antimony is concerned because of insufficient tonnage, and most of the world's output is mined by hand. Due to the irregularity and small size of most antimony deposits the cost of advance development to "block out" ore reserves is not economically possible for it often would exceed the cost of mining. Therefore, little development is carried out in advance of the actual mining, the ore bodies being mined immediately on discovery. For this reason reserve figures on individual properties are rare and estimates on total reserves are available only in the case of China and the US where the projects were financed by government funds.

Besides the output of straight antimony ores, important quantities are mined from deposits of lead and gold ores. In these deposits it is economically possible to "block out" reserves and figures are available, but the tonnage is relatively unimportant except in the case of the Yellow Pine mine in the US and the properties of Consolidated Murchison in the Union of South Africa where antimony is associated with gold.

An appraisal of the world's reserves is necessary to predict the future sources of supply in the event of an emergency and to convey some idea as to the tonnage available from these sources. Since the only estimates

available are those of the US and China, determined by agencies of the respective governments, the writer has compiled a table reporting his estimates of the reserves of other countries as a means of indicating the order of magnitude of the supply that might be mined in the future. The industry usually is highly competitive and, since only high grade ore can be mined at a profit in normal years, some mines often are closed down and reported to be exhausted although large quantities of ore remain that can be mined profitably at present prices.

TABLE 2 - ESTIMATED ANTIMONY RESERVES OF THE PRINCIPAL PRODUCING COUNTRIES AS OF 1944

In metric tons of metal content

Country	Metric tons
Major Producers	
China	3,802,870 1/
Bolivia	700,000
Mexico	700,000
Minor Producers	
United States	103,500 2/
Peru	70,000
Yugoslavia	100,000
Czechoslovakia	50,000
Union of South Africa	80,000
Australia	60,000
USSR	150,000

1/ Geological Survey of China

2/ US Bureau of Mines and Geological Survey estimate of antimony reserves (measured, indicated and inferred) which could be mined at prices as high as $1.50 per pound).

SMELTING INDUSTRY

China had the world's largest smelting industry until 1944 when the Japanese captured Changsha, the city in which most of the plants were located, and demolished many of the plants. The Chinese government is earnestly trying to rebuild the smelters to rehabilitate that country's antimony industry. The US now has the largest smelter capacity in the production of antimony metal and antimony oxide, but UK, Belgium, France, Yugoslavia, Germany, Italy, Japan, Australia and the USSR have smelting capacities sufficient to meet domestic requirements. Belgium and the UK import largely Bolivian ore and export most of their production of metal in normal years. At this time there is not sufficient information available on the present status of the industry in foreign countries to compile a table covering smelter production and capacities of individual plants. In general, they are small, many having a capacity of only a ton or so a day, with makeshift equipment. Plant capacity in the US is sufficient to meet the requirements for antimony metal or compounds, provided that the ore is available.

TECHNOLOGY

Most antimony ores are deposited at low temperatures and shallow depths as narrow fissure fillings and erratic replacement deposits. The ore minerals of straight antimony ores are stibnite, the tri-sulfide of antimony, and its oxidation products, occurring in small irregular ore bodies in quartz veins. Generally the ores range from three to twelve per cent antimony with ores from several Chinese and Bolivian deposits exceeding this tenor.

Due to the small size and irregularity of most of the deposits, they are selectively mined and the ore is hand-sorted, very little equipment being used. In some instances ores and rejects of hand-sorting are concentrated in jigs but losses are high. Antimony in some localities occurs associated with lead, copper, silver or gold ores and is recovered in the milling or in the smelting of these ores. Significant quantities of antimony also are recovered from flue dust at lead smelters.

Lower grade antimony ores are usually improved by roasting, thereby yielding a volatile oxide which may be condensed and sold as such or smelted to metal. Ore and concentrates containing over 50 per cent sulfide usually are liquated for the production of crude. Stibnite has a low melting point which enables it to be drained off from the gangue when it is fused to a melt, producing liquated antimony sulfide (antimony matte, needle or crude). Liquation and roasting are relatively easy and more modern methods of beneficiation have been little used by the industry.

Antimony metal (regulus) is produced by smelting the oxide, the liquated sulfide (crude) or ore in blast furnaces, reverberatory furnaces or crucibles. Ores averaging 30-35 per cent metal, such as those from Mexico, are best for direct smelting as they are too high in grade for best work in roasting and too low for very successful results in liquation. Liquated sulfide is usually smelted with oxides or reduced to metal by fusion with scrap iron in crucibles, yielding antimony metal and a residue of iron sulfide. Oxide and electrolytic antimony are recovered from Idaho lead ores by use of the Lee Muir process which separates the components of tetrahedrite. Often impurities exceed the one per cent maximum and the metal must be refined to remove them. This is done in a reverberatory furnace or crucible by fusing the metal with an oxidizing slag.

Many buyers demand "starred" ingots because they believe that indicates high purity, though this is not always true. "Starring" is produced by cooling the metal slowly under a specially prepared slag at a melting point lower than that of antimony. Special brands of regulus (antimony metal) exceed 99.6 per cent antimony and command a higher price than ordinary brands of 99 per cent plus.

Metal produced domestically is cast in ingots 10 by 10 by $2\frac{1}{2}$ inches, weighing about 56 pounds, packed 4 to the box (224 lbs.) for small consumers, 10 boxes to the long ton (2240 lbs.).

USES

The chief use of antimony is to impart hardness and mechanical strength to lead. It is a "cheap metal" that is frequently substituted for more expensive metals such as tin. In its pure state the uses of antimony are limited to castings of a decorative character and as a metal powder to give a steel-like finish to pottery.

More than half of the antimony consumed during the war and about three-fourths of peacetime consumption is used in the metallic state as an alloy, most often with lead. The strength and hardness imparted to lead by the addition of 4 to 12 per cent antimony permit the lead to be used for many purposes not possible in its normally soft state, such as in bullet cores and shrapnel. The most important uses are in storage battery plates, sheet and pipe, where resistance to sulfuric acid is required. It is also used in cable covering and bearing metals where from 3 to 20 per cent of antimony is alloyed with varying amounts of tin, copper, lead and other metals. Although the tonnage used in type metal is small compared to other applications, it is extremely important, for antimony imparts to the melt

the property of expanding on cooling, thus producing a very sharp, clear type. Many other alloys contain appreciable amounts of antimony such as solder, pewter (lead-tin-antimony), Brittania metal (lead-antimony-copper), sterline (copper-antimony-zinc-iron) and Queen's metal (tin-antimony-copper-zinc).

The principal compounds of antimony are the oxides and the sulfides. The chief use for the oxide during a war, although small in peacetime, is the treatment of canvas and other textiles against fire and rotting, and in fire-retardant paints. The oxides also are used in the manufacture of enamels, as a pigment for porcelain and glazed earthernware, and as a water-resisting paint.

The oxide and the sulfide often are blended to obtain yellowish-red and dark-brown pigments. The sulfides are used in vulcanization, but cheaper methods have largely replaced them in rubber coloring. Another use is in lining lead chambers for making sulfuric acid. The heads of safety matches are about three per cent antimony tri-sulfide and the striking surface eight per cent.

Compounds of antimony are used in dyes, antiseptics, tartar emetic, furniture polishes, and in fireproofing wood.

In time of war there are several uses which are of direct military value besides the industrial uses such as storage batteries, cable coverings and bearing metals which also serve military requirements. Shrapnel and range-finding shells in which the bursting charge produces dense white smoke contain antimony sulfide and the shrapnel itself is hardened by six to ten per cent antimony, as are bullet cores. More than 6,500 metric tons of antimony a year, during some war years, was used for flameproofing canvas and textiles for military purposes.

There are a limited number of substitutes which could be used in an emergency but they are much more expensive and difficult to obtain at such a time. Small percentages of calcium can be used in place of antimony in hard lead alloys for cable coverings, bearing metals and bullet cores. Smaller quantities of antimony can be used in storage battery plates by using calcium and bismuth to replace some of the antimony. Cadmium has replaced antimony to a considerable extent in bearing metals. Tin oxide can be used instead of antimony oxide in ceramic enamels while cadmium and titanium compounds can be used in some pigments. Substitution can be made also in most other chemical uses.

The difficulty in employing substitutes is that antimony is much the cheaper in normal times while in time of war many of the substitutes are also in short supply. Important amounts of antimony can be saved by using calcium to harden lead but the greater part of antimony used for this purpose is recovered from scrap and requires the addition of comparatively small amounts of primary antimony each year to sweeten the alloy. Much greater substitution was expected with the rise in price but this has not resulted to any great extent.

POSITION OF THE US

Domestic Consumption

Almost half of the antimony consumed in the US has come from scrap while most of the primary metal is from foreign ores. The US mined only six per cent of the primary antimony consumed in 1938 but domestic mine output reached 5,040 tons in 1943 accounting for 28 per cent of primary consumption. US consumption of antimony in 1938 was equal to nearly a third

of world production, in 1946 it exceeded two-thirds of the world output, while in 1947 consumption was approximately one-half of world production excluding production from USSR.

Prior to 1938 the Bureau of Mines did not differentiate consumption by product but reported the supply available for consumption. Apparent consumption in 1938 was 18,195 tons while by 1941 this figure increased to a peak of 46,831 tons. Antimony was still being consumed at the wartime rate during 1946, 1947 and 1948, but with a different use pattern. These changes in consumption by product are reported in table 4. A complete review of the antimony industry in the US is reported in table 3.

Deposits in the US

From 1940 to 1948 an average of about 16 per cent of the primary antimony consumed in the US was from domestic antimony ores and concentrates. Most of the domestic output was mined at the Bradley Mining Company's Yellow Pine mine at Stibnite, Valley County, Idaho. This property is a moderately large low grade gold-antimony deposit from which substantial quantities of tungsten ores (scheelite) were mined during the war, but the scheelite ore body was exhausted and mining and milling operations were changed entirely to gold and antimony in 1946.

The Bureau of Mines and Geological Survey carried out prospecting and exploration work on antimony deposits during the war in attempts to evaluate production potential and to alleviate the dependency on foreign ores. There has only been one important mine discovered in the last fifty years (the Yellow Pine) and the possibilities of any important deposits being discovered in the future are reported to be remote. Antimony reserves of the US are shown in the following table. About 50 per cent of the total reserves occur in the Yellow Pine mine. The 1943 peak production of 5,040 metric tons

Table 3 - Statistical Review of Antimony in the United States, 1938-1948

(In metric tons and cents per pound)

	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Antimony contained in ore and concentrates	590	357	448	1,101	2,671	5,040	4,295	1,751	2,272	4,823	5,887
Antimony content of antimonial lead produced from domestic and foreign ores	1,887	1,005	1,884	2,683	2,964	1,891	2,592	1,807	1,322	1,842	N.A.
Secondary Antimony produced	7,711	8,899	10,361	19,621	16,511	14,046	14,411	15,556	17,341	20,851	19,788
Imports for consumption:											
Antimony in ore	7,550	8,571	14,273	17,587	19,002	26,086	15,495	20,541	15,355	8,420	12,276
Needle or liquated antimony	82	207	103	579	474	1	-	-	-	15	484
Metal	745	948	190	6,776	115	845	266	569	2,352	5,333	2,881
Oxide and other compounds	376	157	5	2	1/	1/	-	-	-	-	-
Exports of antimony ore, metal, and compounds	645	53	250	64	209	448	1,197	302	419	733	295
Consumption of primary antimony	10,484 2/	10,531 2/	16,288 2/	27,210 2/	21,638 2/	17,697	21,551	23,370	15,889	15,102	14,021
Average US price in cents per pound	12.35	12.36	14.00	14.00	15.55	15.92	15.84	15.84	17.31	33.45	36.67
World production of primary antimony	33,900	38,800	46,300	49,000	51,400	53,200	36,400	26,900	25,400	34,800	41,300

1/ Less than 1 ton.
2/ Primary antimony available for consumption; data not strictly comparable with figures for subsequent years.

Source: US Bureau of Mines.

Table 4 - Industrial Consumption of Primary Antimony, 1938-1948

(In metric tons of metal content)

Product	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Metal products:											
Antimonial lead						2,621	4,796	5,371	4,379	5,599	5,465
Bearing metal and bearings		Statistics do not				1,418	2,392	2,563	2,618	1,865	1,636
Battery metal and battery parts						2,177	2,124	1,155	983	1/	1/
Type metal and type		differentiate consumption by				777	763	1,128	1,726	1,103	924
Cable covering						406	383	249	72	55	56
Sheet and pipe						160	296	334	198	204	177
Castings		product during these				180	104	242	211	117	73
Collapsible tubes and foil						120	103	184	110	70	28
Ammunition						353	84	97	27	22	19
Solder		years.				117	64	113	255	120	132
Total metal products						8,327	11,110	11,436	10,580	9,155	8,510

See footnotes bottom of next page.

Table 4 - Industrial Consumption of Primary Antimony, 1938-1948 - Continued

Product	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Nonmetal products:											
Flame proofed textiles						6,307	6,407	6,963	88	186	352
Paints and lacquers	Statistics do not					1,686	2,259	2,778	1,508	1,201	1,169
Frits and ceramic enamels						255	454	849	1,646	1,591	1,416
Glass and pottery	differentiate consumption by					487	373	276	318	382	319
Sodium antimonate						43	335	464	1,232	2/	2/
Antimony trichloride						139	262	188	96	2/	2/
Ammunition primers	product during these					88	39	60	14	15	5
Matches						16	9	16	23	21	34
Other	years.					349	302	340	386	2,551	2,215
Total nonmetal products						9,370	10,441	11,934	5,310	5,947	5,510
Grand total primary	10,484 3/	10,531 3/	16,288 3/	27,210 3/	21,638 3/	17,697	21,551	23,370	15,889	15,102	14,020
Secondary	7,711	8,899	10,361	19,621	16,511	14,046	14,411	15,556	17,341	20,851	19,788
Total US consumption	18,195	19,430	26,649	46,831	38,149	31,743	35,962	38,926	33,230	35,953	33,808

1/ Included with antimonial lead.
2/ Included with other.
3/ Primary antimony available for consumption; data not strictly comparable with figures for subsequent years.

Source: Department of Commerce.

metal content was exceeded in 1948 with a high of 5,887 tons, and if the present high price continues the Bureau of Mines believes the 1949 production from domestic ores will exceed the 1948 peak.

Table 5 - Antimony Reserves in the US as of 1944 1/

(In metric tons)

	Measured and Indicated		Inferred		Total
	Tons of ore	Antimony Content	Tons of ore	Antimony Content	Antimony Contained
Price of antimony at 16¢ per pound					
From antimony ore	9,000	890	4,500	470	1,400
From by-product ore	3,901,000	38,000	816,000	10,000	48,000
Total	3,910,000	38,900	821,000	10,500	49,400
Antimony at 17¢ to $1.50					
From antimony ore	454,000	4,400 2/	680,000	13,600	18,000
From by-product ore	7,802,000	20,900	2,450,000	5,400	26,300
Total	8,256,000	25,300	3,130,000	19,000	44,300
Grand total	12,166,000	64,200	3,951,000	29,500	93,700

1/ Rounded figures.

2/ Nearly all indicated.

Secondary Antimony

About half of the annual antimony consumption in normal years is recovered from scrap while in war years this percentage decreases with large increases in antimony consumption. A maximum of 19,621 tons of antimony were produced from scrap in 1941, but this tonnage fell to a World War II low of 14,046 tons in 1943, and 14,411 tons in 1944. This significant decrease was due partly to the lower per cent of antimony in battery scrap. In 1942 limits were temporarily set at 7.5 per cent antimony in battery grids. These limits were discontinued and by 1946 secondary

production of antimony had increased to 17,341 tons, in 1947 reached 20,851 tons, and in 1948 was approximately 19,800 tons.

The antimony used in antimonial lead and other alloys is susceptible to secondary recovery. The main sources of scrap are the plates, grids and sludge from discarded storage batteries of which about 75 per cent are recovered as scrap. During 1947 and 1948, as a result of high lead prices and a shortage of lead, there was separation of considerable lead scrap into antimony and lead metal. However, this is not normally done, all antimony recovered ordinarily remaining in the alloyed state.

Foreign Trade

The US was an importer of regulus before the building of the Laredo smelter. Afterwards, the dependency on foreign metal changed to a dependency on foreign ores for most of the supply of primary antimony. The peak year of imports was 1943 when 27,021 tons of antimony contained in ores arrived in this country. This tonnage amounted to more than two-thirds of the world production of primary antimony for that year. Mexico was our chief supplier before World War II but was surpassed by Bolivia in 1943 and 1945. To supplement meagre supplies in the US, large amounts of regulus were imported from China in 1941 but Japanese offensives prevented further shipments until the end of the war. Imports of only 7,709 tons during 1946 were at the lowest level since 1935; however, imports reached 13,776 tons in 1947, and 15,375 tons in 1948.

Tariff

Antimony ores enter the US duty free, whereas antimony metal and the oxide are dutiable at one cent per pound, and needle (liquated) antimony at one-fourth cent per pound. The import duty on sulphides is one-half cent plus twelve and one-half per cent ad valorem; tartar emetic (potassium-antimony

Table 6 - Antimony Imported into the US, 1938-1948, by Countries 1/

(In metric tons of metal content)

Country	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	649	198	28	-	-	-	-	-	-	-	-
Belgium	23	173	6	20	98	-	-	-	-	51	191
Bolivia	1,028	2,226	5,032	6,436	6,778	12,549	4,037	10,295	688	2,209	3,003
Chile 2/	704	-	-	-	733	5	440	1,419	35	316	236
China	639	600	176	6,455	-	-	-	518	1,560	5,275	2,709
Honduras	-	-	5	10	84	131	96	15	7	-	5
Mexico	4,864	5,870	8,659	10,879	11,279	12,080	10,257	7,532	4,564	5,568	7,918
Peru	367	390	544	531	311	2,195	749	1,360	44	141	963
Others	20	62	12	31	396	61	-	55	811 3/	216	350
Totals	8,294	9,519	14,462	24,362	19,581	27,021	15,580	21,194	7,709	13,776	15,375

1/ Figures include antimony imported for consumption plus material entering under bond.
2/ Imports shown from Chile probably mined in Bolivia or Peru and shipped from a port in Chile.
3/ Imports from Japan amounted to 792 tons.

Source: US Bureau of Mines.

tartrate) six cents; and other salts and compounds, not specifically provided for, are dutiable at one cent plus 25 per cent ad valorem. There has been no change in tariff rates since 1930 except in the case of metal and oxide which prior to 1948 were dutiable at two cents per pound, and sulphides at one cent plus 25 per cent ad valorem.

Prices

Antimony prices are characterized by wide and frequent fluctuations. This is especially true of prices in the New York market. The New York price is the base price with the quotations on a duty-paid basis for imported regulus (metal) which controls the price of domestic metal in normal years. Concentrates are purchased either at a given price per short ton unit (20 pounds of contained antimony) or at a given price per pound of antimony content, which is usually more than half the market price of refined antimony at New York.

The highest monthly average price for antimony was in 1917 when it reached 44.71 cents a pound, New York price, compared to a low of 4.32 cents reached in the postwar depression of 1921-22. Prices again increased annually reaching an average yearly price of 17.5 cents in 1925. In the subsequent years the price fell gradually, averaging only 5.62 cents for the year 1932, but by 1937 it again had exceeded 15 cents.

During 1939 the price averaged 12.36 cents increasing to 14 cents in 1941 and was held at that figure by the Office of Price Administration. On 13 April 1942, the price was raised to 16.049 cents a pound in case lots, 10,000 pounds and over, but a reduction in freight charges from Laredo, Texas, to New York City was passed on to the buyers beginning 3 June 1943, and the New York price was quoted at 15.839 cents from that

time until the removal of price control on 9 November 1946. The price then rose to 29.625 cents by 17 December. In 1947 the price for carlots standard brands reached a high of 34.53 cents per pound, and on 31 December 1948 the price was 40.17 cents.

The price fluctuations are attributable to peculiarities both of supply and of demand for antimony. In wartime, owing to certain physical characteristics rendering the metal highly desirable for military purposes, demand for the metal increases sharply. On the other hand, in a general depression, demand for antimony drops sharply because its peacetime uses are for the most part restricted to inflexible price industries.

The volume of supplies brought to the market also shows wide fluctuations. The market has always depended heavily upon Chinese production; shipments from China are quite irregular and the time of arrival is not generally known beforehand. Coupled with the fact that only small stocks of antimony are generally held in the principal consuming countries, the arrival of a shipment of concentrates from China usually causes a sharp drop in the market price of the metal.

As will be seen in subsequent sections of this report, the price behavior of antimony has resulted (except in wartime) in the working of only the high grade pockets in producing areas outside China. Producers in these areas, e.g., Bolivia and Mexico, have been reluctant to reopen low grade workings under the stimulus of a rise in market price which experience has taught them may be short-lived.

In the light of price and production history and of heavy US dependence, in time of emergency, upon non-Chinese production, adequate supplies cannot be assured unless profitable prices are guaranteed to the miners (not the smelters) in the Western Hemisphere. Belated efforts of the US

to secure stockpiles of antimony after the opening of hostilities in Europe effected a shortage in World War II which could be prevented in the event of a future emergency.

Present Situation and Future Outlook

The US supply of antimony was in approximate balance with industrial demand during 1947 and 1948. When the needs of the stockpiling program are taken into account, however, the total demand is above new supply. As a result of transfers to the stockpile, and withdrawals for industrial use during the past two years, total Government and industrial working stocks, exclusive of the stockpile, dropped from 16,664 metric tons at the end of 1946 to 14,481 tons as of 31 December 1948.

Present indications are that new supply of antimony in 1949 will be about 41,000 metric tons or nearly the same as in 1948. Reduced scrap recovery is expected to be offset by a slight increase in domestic mine production and in imports from Mexico, Bolivia and Peru. Imports of antimony from China could be also reasonably increased during 1949. China has by far the largest reserves of antimony in the world and is important to the US not only as a direct source of supply, but also in that it could satisfy the antimony requirements of other nations and thus make more antimony available to the US from Mexico, Bolivia and Peru. Any significant change in the present pattern of consumption is not expected in the near future and all demands will probably be met in full.

Emergency Supply and Demand

In the event of a national emergency about 22,500 tons would be required annually from foreign sources to augment domestic supplies in fulfilling US requirements. Large quantities would have to be obtained from

Table 1 - United States Preliminary Statistics for 1948 RESTRICTED

(Metric tons of contained antimony)

Consumption and Exports		
Metallic products		28,298
Primary	8,510	
Secondary	19,788	
Flame-proofed textiles		352
Paints and lacquers		1,169
Glass and pottery		320
Frits		1,414
Miscellaneous		2,255
Processing loss		1,503
Total domestic consumption		35,311
Exports and re-exports		761
Total demand		36,072
New Supply		
Domestic ore		6,072
Foreign ore		12,288
Foreign metal		3,004
Needle		326
Total primary		21,690
Scrap		20,071
Total new supply		41,761
Stocks		
Government		
Ore		188
Metal		3,540
Total government stocks		3,728
Private		
Mine ore		863
Industrial ore		3,348
Metal		2,188
Sulfide		186
Oxide		1,960
Total primary		8,545
Scrap		2,208
Total private stocks		10,753
Total stocks, government and private		14,481
United States Imports		
Metal		
China		2,612
Yugoslavia		120
Italy		27
Canada		1
Siam		3
Belgium		192
Mexico		48
		3,003
Ores (Metal content)		
Mexico		7,869
Honduras		5
French Morocco		73
Peru		963
Yugoslavia		20
Bolivia		3,026
Portugal		15
Chile		236
Canada		28
Siam		50
		12,285
Needle		
China		327

Bolivia as well as Mexico. Mexico undoubtedly has sufficient reserves to supply US needs, but a considerable increase in the output of antimony ores, because of their geological occurrence, cannot be effected as quickly as with lead, zinc, copper and many other metals. To increase the output substantially, additional labor would be required. The supply of Mexican mine labor is limited and other strategic minerals would be competing for their services, therefore, it probably would be necessary to buy as much as possible from Bolivia. Peru could be depended on for at least 1,000 tons annually and up to 3,500 tons if necessary. Honduras, due to the inaccessibility of the deposits and their relatively small potential, would not be important; nor would Argentina, Colombia or Guatemala, who also have antimony deposits, for their reserves are not large. The following table shows our probable requirements, both immediate and after several years, under the accelerated conditions brought on by a sudden emergency.

Table 8 - Estimated US Antimony Requirements and Supply under Emergency Conditions

(In metric tons)

	First complete year	Third Year
Domestic production (antimony content ores and concentrates)	4,800	6,000
Antimony content of antimonial lead produced in US from domestic and some foreign lead ores	1,700	3,000
Secondary antimony, from domestic scrap	17,000	20,000
Total supply from domestic sources	23,500	29,000
Probable domestic requirements	46,000	58,000 1/
Deficiency which will have to be supplied from foreign sources (Antimony contained in ore and concentrates)	22,500	29,000 1/
Supplied by Mexico	8-10,000 2/	12,000
Supplied by Bolivia	10-12,000 2/	16,000 3/
Supplied by Peru	1,000 2/	3,500 2/

1/ Includes 3-4,000 tons for stockpiling in event of shipping shortages.
2/ Peru can supply at least 1,000 tons of any deficiency in supply from Mexico or Bolivia and up to 3,500 tons if necessary.
3/ Within three years Bolivia may be able to supply 16,000 tons annually. However, if there were transport difficulties it might be necessary to

RESTRICTED

increase production as much as possible from Mexico thereby reserving available shipping space for materials more urgently needed from Bolivia, such as tin and tungsten. In time of an emergency, the limited labor supply is the most difficult problem faced by the industry in both Mexico and Bolivia; other strategic minerals compete for the labor supply.

It would be necessary to have at least a year's supply of primary antimony stockpiled in the US, and more, if possible, to maintain a steady flow to consumers and as a protection against labor difficulties and a shipping shortage which might develop. However, it is doubtful if this stockpile could be built up after the emergency developed, therefore, the most logical plan would be to stockpile in advance.

In Mexico, Bolivia and Peru an increase in production could readily be attained by a contract which guaranteed purchase of the entire country's output such as the Bolivian over-all antimony agreement made by the United States Commercial Company during the war. The producing mines are hand-to-mouth operations, their capital is limited, and prompt payments on deliveries to the railhead or port would aid operations considerably. A slight relaxation of specifications in purchasing Bolivian concentrates also would cause a rise in production to meet an unexpected demand. Specifications for Bolivian concentrates have been too strict, calling for at least 60 per cent antimony and not more than 0.5 per cent lead and arsenic combined.

The aforementioned are the most important means of increasing foreign production and in all probability will be sufficient. However, in certain specific districts with important possibilities but not much production, technical assistance and small loans made directly to individual operators against monthly production would also contribute towards increasing the output of both these countries. By using all of these methods, Mexican and Bolivian production might be increased above the figures given in Table 8, provided other mining enterprises do not compete for the available labor supply.

In an emergency the UK and Canada may also have to be supplied with their antimony requirements. South African, Australian and Canadian production would not be able to fulfil the needs of these two countries. Canadian production is small and the supply lines from South Africa and Australia are difficult to maintain. Not only would it be necessary to ship to these countries Bolivian ore for part of their requirements, but any output in excess of our needs would be required for the UK and, therefore, it would be advantageous to increase Bolivian production as much as possible.

Consumption of primary antimony in the UK during 1947 totaled 5,302 tons, of which 683 tons were used in batteries; 697 tons in other antimonial lead; 595 tons in bearings; 2,804 tons in oxides and other compounds; and 523 tons in various other materials. Secondary antimony consumption amounted to 3,490 tons, of which 2,451 tons were used in antimonial lead and 1,039 tons for other purposes. Emergency requirements of the UK and Canada would total 8-11,000 tons of primary antimony annually.

MAJOR WORLD PRODUCERS

China

Prior to the Japanese invasion in 1937, China dominated the world's antimony industry, mining almost two-thirds of all the antimony produced in the period 1913-37. China's huge reserves of antimony, estimated in 1945 by the Chinese Geological Survey at 3,803,000 metric tons of contained metal, dwarf those of Mexico, Bolivia and the US into insignificance. The combination of high grade ores and cheap labor could make it possible for China to force other producers out of the market in normal years, but the policy of the Chinese government has been to maintain a fair price, at times withholding stocks from the market until the price advanced. China, in the ten year period from 1931-40 produced 116,674 metric tons of antimony metal, 14,914 tons of liquated sulfide and 7,177 tons of oxide.

RESTRICTED

With the Japanese occupation of eastern China, shipments of antimony could be made only with great difficulty, exports declined, stocks increased and production had to be curtailed. Whereas China's output totaled as much as 22,401 tons of metal in 1929 only 9,436 tons (recoverable metal content of ore) were mined in 1938. When the Burma road was cut by the Japanese in 1942, it effected a complete breakdown of the Chinese antimony industry and production virtually ceased. In June 1944 the Japanese captured Changsha, center of the Chinese antimony industry and capital of Hunan Province. Smelters were wrecked and the industry was paralyzed.

Because so many smelters were demolished and mining installations were so badly damaged, it will be some time before the mines can regain their former position as the world's leading producers. The industry is starting anew, rebuilding smelters and rehabilitating the mines. Another difficulty which has faced the industry is a lack of economic stability - - too wide a discrepancy in the official and black market rates of foreign exchange. The mines, with some aid from the government, resumed production late in 1946 and are now producing at a rate of about 3,000 to 4,000 tons annually. A drilling campaign is underway at Hsi-kuang-shan, the principal producing area. Meanwhile the severe shortage of Chinese antimony has been felt in world markets, and this is responsible for the considerable rise in the world price. Production of antimony during the year 1946 amounted to only 426 tons, for 1947 to 1,909 tons, and 1948 to 3,251 tons.

The antimony industry, because of its national importance, is under strict government surveillance and control. The National Antimony Administration was established in 1936 to regulate production and collect taxes. Through this organization the government is now attempting to restitute production to its former levels by loans and other aids for acquiring equipment,

while the National Resources Commission is operating a few mines, smelters and refineries. All antimony must be sold to the government.

Local consumption of antimony has been small, rarely exceeding more than 100 to 200 tons annually, used in the manufacture of matches, fire-crackers and enamels. After the Burma road was closed by the Japanese offensive, the Chinese government constructed a plant for manufacturing pigments in order to increase domestic antimony consumption. It is hoped that under an accelerated program consumption will increase to 1,000 tons of antimony annually within a few years.

In prewar years about 75 per cent of China's production was exported in the form of regulus, 19 per cent as crude and six per cent as oxide. Prior to the Japanese invasion the UK, Japan and Germany were the chief buyers of Chinese antimony. Exports to the US gradually decreased after the building of the Laredo, Texas, smelter in 1930.

Most of China's antimony deposits are in Hunan Province which usually accounts for 95 per cent of the country's production. The major district is Hsin-hua where two-thirds of the province's output is mined. The Chinese Geological Survey in 1945 reported Hunan reserves at 1,995,500 metric tons of contained metal. Normally the ore is rich, containing from 6 to 18 per cent antimony. There are 24 major deposits in the province with the Hsi-kuang-shan mines the most important of these. In 1939 Hsi-kuang-shan mined 10,291 tons (metal content) which was more than the entire output of Mexico and approximately that of Bolivia. These mines are about 20 miles northeast of Hsin-hua. At Hsi-Kuang-shan stibnite and cervantite occur in quartz veins along faults and bedding planes of Paleozoic strata, as replacement deposits in limestone, and in fractures in the brecciated crests of anticlines. The usual occurrence of antimony is in narrow, irregular veins; however, at Hsi-kuang-shan, and elsewhere in China, there are many exceptions to this

rule. One lode outcrops along the crest of an anticline for over a mile in length, and is honeycombed with the workings of more than 70 companies. Reserves of Hsi-kuang-shan in terms of metric tons of contained metal have been estimated at 970,000 tons. Two other important deposits in Hunan are the Wu-chi near Yuan-ling with reserves of 107,000 tons, and the Pan-chi near I-yang. At the Pan-chi there are two main veins, 2,000 feet and 1,600 feet in length and varying from 1 to 25 feet wide. Average grade of ore is about 16 per cent.

Although 95 per cent of China's output has come from Hunan several other provinces are potentially of major importance. In Kwangtung Province the Tien-tzu-ling deposit near Chu-chiang and Mai-hua-chieu near Ju-yuang each have estimated reserves of more than 500,000 tons. The Fan-ching-shan deposit near Chiang-k'ou in Kweichow Province is believed to contain over 400,000 tons of contained metal. Possibilities also exist in Kwangsi and Yunnan Provinces. Reserves of individual mines as published by the Chinese Geological Survey in 1945 are reported in Table 9. Their locations are shown in the accompanying map.

Mining of ore in China, as in other countries, is chiefly by small groups in scattered workings using primitive methods. In general little machinery and equipment is used, although many are equipped with electric pumps. Most of the work is done on a contract basis to the smallest unit with many hundreds of contractors and sub-contractors engaged in mining operations simultaneously. In normal years there are about 24,000 workmen, about 17,000 of whom work underground. Wages of common laborers were low in prewar years in comparison to wages paid in Bolivia and Mexico. Generally mining is carried out with hand drills and the ore is roughly sorted from the gangue after blasting and carried to the surface in small bamboo baskets. At the surface the ore is hand sorted again and sent to a mill for concentration

by gravity methods or concentrated by breaking the ore into fine fragments and then jigging to further separate the ore and gangue.

The concentrated ore assaying 45 to 60 per cent Sb_2S_3, is either sent to the smelter where it is liquated, forming crude fused sulfide or is made into tri-oxide or tetra-oxide by oxidizing the ore in a small reverberatory furnace. The recovery in liquating is between 85 and 90 per cent of the sulfide content, while 88 to 92 per cent is recovered by oxidation. The crude and oxides are sometimes sold as such, but most frequently they are refined to the metal in reverberatory or blast furnaces. In the former recovery is seldom above 88 per cent while in the latter recovery is as high as 95 to 98 per cent. The metal produced by these two methods is ordinarily further refined, usually in reverberatory furnaces to regulus over 99 per cent. China is the only large producer of antimony ore also possessing an important smelting and refining industry. There were more than 24 plants employing over 1,000 workmen smelting antimony in southern Hunan prior to the Japanese invasion. Most of these were centered about Chang-sha. Two of these were modern smelters with an annual output of 6,000 tons of regulus. Chinese regulus is sold in slabs weighing 30 to 40 pounds each, shipped in cases containing 224 pounds. Standard regulus is over 99 per cent antimony while special brands have a guaranteed purity of 99.6 - 99.8 per cent.

If economic conditions should become stabilized, smelters rebuilt, and mines rehabilitated, China could again be able to dominate the world's antimony industry. Under normal conditions production could be increased readily to 20,000 tons or more annually and any fluctuations in world demand could be met. Restitution of large scale production would tumble the world price to about 15 cents and would have an adverse effect mainly on Bolivian production, and, to a lesser extent, that of Mexico. However, the immediate

future of the antimony industry is not bright, for demands cannot be met unless internal difficulties and the exchange problem are solved, and the political situation is settled in a manner permitting normal trade.

China needs to recapture the European, as well as a substantial share of the American markets. In the event of a conflict, China could not be considered a major source of antimony to the US over any period of time. Protection of the artery of the Pacific Ocean and the Chinese rivers is a difficult problem and air transport space would be saved for tin and tungsten.

Table 9 - Estimated Reserves of Antimony in China by Deposits 1/

(In Metric Tons of Metal)

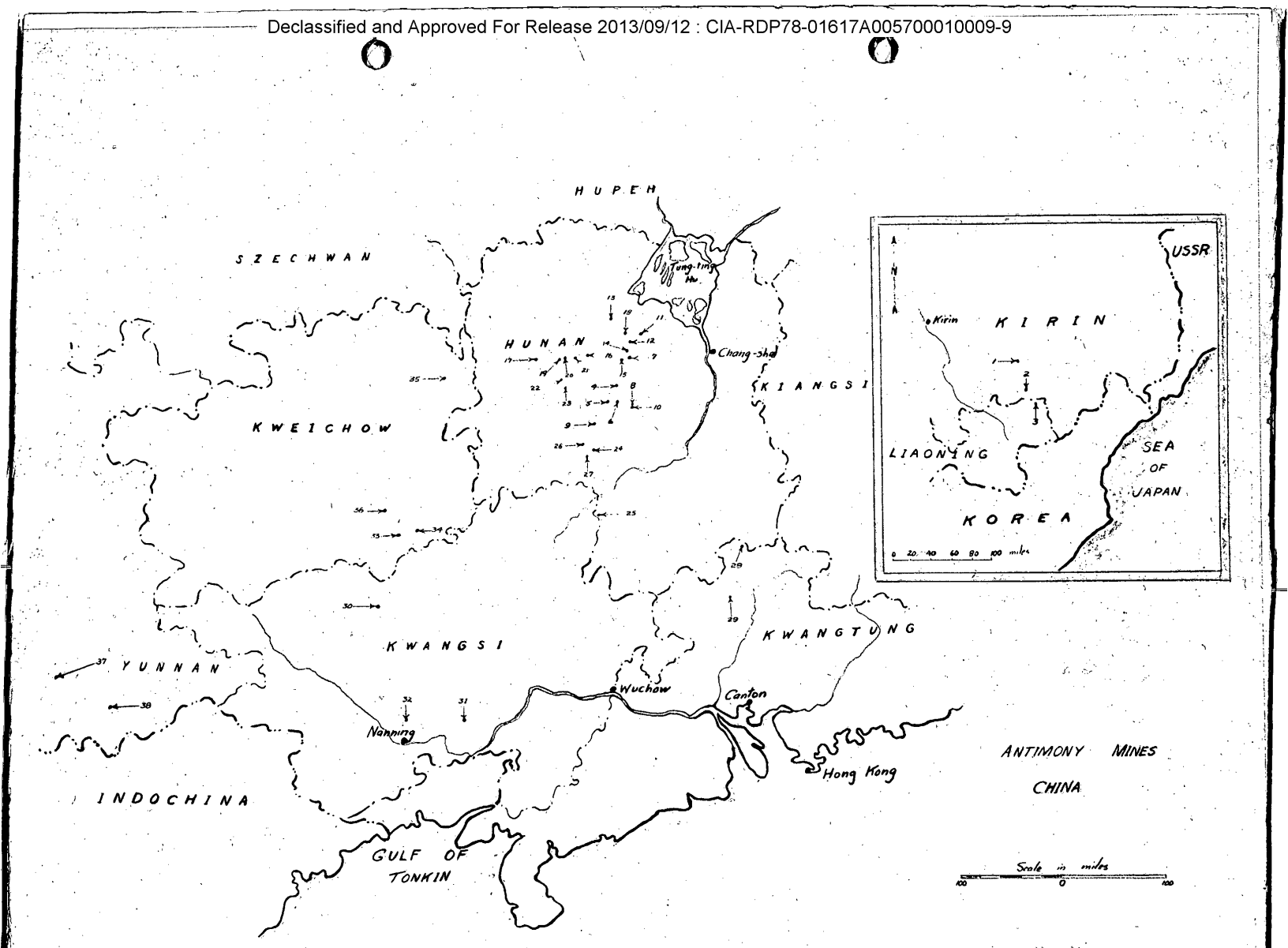
Province	Deposit	Locality	Reserves	Total for Provinces
Hunan	Hsi-kuang-shan	Hsin-hua	970,000	
	Wu-chi	Yuan-ling	107,000	
	Hou-tung-chun	Shao-yang	75,000	
	Lung-shan	do	63,000	
	Pan-chi	I-yang	56,000	
	Kan-tzu-yuan	An-hua	28,000	
	Hua-pan-chi	do	18,000	
	Lui-tou-tsi	Tung-an	17,000	
	Lung-kou	Hsing-ning	16,000	
	Chiang-kou	do	11,600	
	Lao-chia-ping	An-hua	10,000	
	Tseng-chia-chi	Hsu-pu	8,300	
	Chiang-chi-lung	do	7,200	
	Cha-tzu-kou	An-hua	7,000	
	Kuang-in-tang	Hsu-pu	6,400	
	Mou-tzu-ling	Hsin-hua	6,300	
	Wang-chia-chung	I-yang	6,000	
	Huang-chung	Tung-an	2,200	
	Hsi-chung	I-yang	500	
	Others		580,000	1,995,500
Kwangtung	Tien-tzu-ling	Chu-chiang	554,000	
	Mai-hua-chieu	Ju-yuang	629,000	1,183,000
Kwangsi	Sam-cha-ho	Ho-ch'ih and	5,300	
	Chien-chu-po	Nan-tan		
	Ping-tou-shan	Chung-shan	1,260	
	Others	Tung-lan		
		Tien-yang		
		Tien-tung	60,000	66,560
Kweichow	Ho-shao-tsai			
	Wu-feng-shan	San-ho	41,000	
	Mia-lung	do	17,000	
	Liu-chang, Kao-tung			
	Shia-pai-cheng		6,000	
	Pa-ming	Jong-chiang	12,500	
	Shia-shan	Hsing-jen	8,750	
	Pai-ti	Ts'e-Hene	8,640	

Table 9 - Estimated Reserves of Antimony in China
by Deposits (Cont'd)

(In Metric Tons of Metal)

Province	Deposit	Locality	Reserves	Total for Province
Kweichow (cont'd)	Fan-ching-shan	Chiang-K'ou	400,000	
	Pai-poh	Jung-chiang	2,900	
	Miao-ling	Tu-shan	3,000	
	Others		10,000	509,810
Yunnan	Yu-chia-tou-chang	Ping-I	28,000	
	Kai-yuan	Wen-shan		
	Hsi-tsu	Ping-Pien	20,000	48,000
		Total Reserves of China		3,802,870

1/ Pai, C.C., Geol. Survey China, Spec. Rept. 7, December 1945.



MAP 1 - CHINA--ANTIMONY DEPOSITS
INDEX

Map No.	Province	Name of Mine or of (Deposit)	Location	Latitude Deg.	Latitude Min.	Longitude Deg.	Longitude Min.
1	Kirin	Ta-huang-kou	Tun-hua	43	14	128	13
2		Wan-p'ao-ho-tzu	An-t'u	42	51	128	22
3	Liaoning	Man-pao	An-t'u	42	40 1/	128	30
4	Hunan	(Hsi-k'uang-shan)	Hsin-hua	27	46	111	30
5		(San-chien-feng)	do	27	33	111	24
6		(Mao-tzu-ling)	do	27	32	111	32
7		(Pei-ch'i)	do	28	09	111	45
8		(Lung-shan)	Shao-yang	27	30	111	46
9		(Hou-tung-ch'ung)	do	27	14 2/	111	28
10		(Chiang-ch'i)		27	30	111	45
11		(Pan-ch'i)	I-yang	28	39	111	56
12		(Wang-chia-ch'ung)	do	28	23	111	45
13		(Hsi-ch'ung)		28	35 2/	112	20
14		(Liao-chia-p'ing)	An-hua	28	08 2/	111	39
15		(Kan-tzu-yuan)	do	28	08 2/	111	39
16		(Hua-pan-ch'i)	do	28	12	111	05
17		(Cha-tzu-ch'i)	do	28	08 2/	111	39
18		(T'ien-chuang-wan)	do	28	30	111	40
19		(Ts'ung-ch'i)	do	28	08 2/	111	39
20		(Lin-chia-ch'ung)	do	28	08 2/	111	39
21		(Tseng-chia-ch'i)	Hsu-p'u	27	53 2/	110	40
22		(Kuan-yin-t'ang)	do	27	53 2/	110	40
23		(Chiang-ch'i-lung)	do	27	53 2/	110	40
24		(Niu-t'ou-chai and Hsien-chiang-ch'ung)	Tung-an	26	20 2/	111	14
25		(Heng-ch'ung)	do	26	20 2/	111	14
26		(Chiang-k'ou)	Hsin-ning	26	31 2/	110	48
27		(Lung-k'ou)	do	26	31 2/	110	48
28	Kwangtung	(Lo-chia-wan)	Lo-ch'ang	25	22	113	31
29		(T'ien-tzu-ling)	Ch'u-chiang	24	43	113	10
30	Kwangsi	(Fu-jung-ch'ang)	Ho-ch'ih	24	41	107	53
31		(Li-t'ang)	Pin-yang	23	07	109	10
32		(T'ien-ching-ling)	Wu-ming	23	07	108	19
33	Kweichow	(Huo-shao-chai)	Tu-chiang	25	42	108	11
34		(Pa-meng)	Jung-chiang	25	46	108	26
35		(Fan-ching-shan)	Chiang-k'ou	27	55	108	51
36		(Miao-lung-ch'ang)	San-tu	26	03	107	58
37	Yunnan	(Tu-pi) & (Kuo-hua)	K'ai-yuan	23	36	103	07
38		(Mao-shan)	Wen-shan	23	13	103	55

1/ Approximate location.
2/ Coordinates Hsien seat.

When China's production decreased due to the Japanese invasion, Bolivia and Mexico increased their outputs to make up China's deficiency. Bolivia became the world's principal producer in 1941 and held this position until 1944 when a decline of 58.6 per cent in production reduced Bolivia from first place to one subordinate to that of Mexico. The decline in 1944 and that of 1945 was due mainly to the termination of the overall sales contract between Bolivian antimony producers and the United States Commercial Company, and, to a lesser extent, restricted by a serious shortage of ships. Bolivia again became the leading world producer in 1946, when Bolivian mines became the chief source of supply for European countries. The peak year of Bolivian production and also for that of Mexico was 1943 when 16,536 metric tons recoverable antimony content of concentrates were mined compared to Mexico's 12,585 metric tons. There is no antimony smelter in Bolivia and the antimony is exported in the form of concentrates averaging about 60 per cent antimony. There is no consumption of antimony within the country.

The main difficulty of the producers in 1944 and 1945 was the lack of a stable market for Bolivian ore. When the US cancelled its purchasing agreement most of the mines were forced to shut down. Later purchases were resumed on a smaller scale. More rigid specifications (a minimum of 60 per cent antimony and 0.5 per cent combined lead and arsenic contents) were applied but could not be met by many of the small mines. Present difficulties are a high freight rate to the coast and the fear of fluctuating market prices similar to prewar years. In an apparent attempt to assist the industry the Bolivian government reduced export taxes by 50 per cent in 1947.

Before World War II, Belgium, the US, the UK, and Japan were the leading markets for Bolivian antimony concentrates. The chief buyer was

Belgium, where the ores were smelted and the metal re-exported to Germany. In 1940 and 1941 Japan received most of the ores, buying at prices above the London parity. During the war the US received the bulk of Bolivia's exports with minor amounts going to the UK and to Argentina where antimony concentrates are consumed in the manufacture of antimonial lead at the smelter of the National Lead Company. A complete review of Bolivia's exports is reported in the accompanying export table.

Antimony occurs in numerous and widely scattered deposits in a belt roughly corresponding to the tin belt, though there is no direct association with the tin deposits. This great mineral belt extends from Achacachi north of La Paz through Tupiza and into Argentina, and follows the general outline of a granite batholith that underlies the area and from which the mineral deposits originated. The most important districts are Tupiza, which produces more than half of the country's production and the richest ore, located in the Department of Potosi, and Challapata in the Department of Oruro (see Map 2) The ore is stibnite occurring in quartz veins which traverse narrow belts of fractured black slates often more than ten miles in length. (Nine major belts are shown on the attached map. Belts of minor importance also carrying antimony deposits are denoted by a +.) The veins are usually narrow and irregular, with ore masses occurring where veins intersect. Stibnite also occurs disseminated in quartz. There were 166 properties being worked in 1943. Usually the ore as mined averages about 10 per cent antimony and the concentrate produced about 60 per cent. The selling value of the concentrate often is reduced by penalties for high arsenic content. Gold is sometimes present in payable quantities. The antimony deposits in Bolivia, as in Mexico and practically all other countries except at Hsi-kuang-shan in China, are small in size and irregular with no considerable extension in depth or along the strike. Many hundreds of deposits occur, but in every

case there is little development ahead of mining.

Although the Bolivian antimony deposits are numerous, almost all of them are small in size and are worked by the most primitive methods, only the richer portions of the veins being mined. The ore bodies are first explored by surface cuts and trenches along the veins. The deposits usually are opened at depth by adits. The ore is hand sorted underground with much of the ore wasted in the attempt to produce a high grade concentrate. The high grade is sacked, the rest trammed to the surface, often by wheelbarrows where it is further sorted.

The second sorting is usually near the mouth of the lowest adit, where women cob waste from ore. Remaining poor ore is hand crushed, screened and jigged. The fines are concentrated in buddles. The fuel problem is a serious one on the Bolivian plateau and is the major reason why antimony and other mines are worked without much mechanical equipment. Some of the larger mines have concentration plants and ball mills but these are badly in need of replacement parts.

With the exception of a few mines, only about 30 to 60 workers are employed in each mine. Little technically trained help is employed in the entire industry. Since most of the mines are about 15,000 feet above sea level, local labor must be used, as workmen from lower altitudes are inefficient and find it difficult to become acclimated to the altitude. The local labor supply is often scarce, becoming the chief problem of the producers when antimony is in great demand.

Transport is still a major difficulty facing the Bolivian mining industry. Not only are freight rates high, but the transport to the railhead is often difficult and high cost. From the principal stations near the antimony mines, the concentrates are shipped to the ports of Antofagasta

and Arica in Chile and some to Santa Fe in Argentina. Shipments to the railroad and nearest highways in some instances are still made by means of llamas and burros. There are several inaccessible areas with important ore deposits which will not be productive until roads or railroads are built.

There are no antimony smelters in Bolivia due to the lack of fuel. During the war plans were proposed for a smelter in the Potosi District to utilize domestic crude oil but this apparently has been abandoned.

The Banco Minero de Bolivia, designated by law the official local buyer of minerals, usually buys the product of small mines at a fixed price at the nearest railroad station. The price varies with the quality of the concentrate and the London price for antimony. During the war, funds were advanced for supplies in order to increase production.

Bolivian producers are now supplying the European antimony markets and production has increased sharply, following the increase in world price. Usually production is stimulated after a price rise, gradually meeting all demands and producing a surplus. The price falls but production does not decrease until sometime after the drop in price when the higher cost producers are forced to suspend operations. Mexico is the least affected because its transportation cost to the Laredo smelter is much less than that of Bolivia. However, with China out of the market for sometime the industrial output probably will not fluctuate until the Chinese mines return to normal. When this happens, many problems will have to be solved in order that Bolivia can compete profitably. The Bolivian government now is more favorably inclined toward antimony producers. Taxes have been reduced 50 per cent and limited financial assistance was proffered prior to the price rise. Freight rates would have to be reduced, technical assistance would be required, and internal transport facilities would have to be improved before Bolivia could compete with China on a large scale.

In the event of a sudden emergency Bolivia again would be one of the two major sources of antimony supplying US requirements, and probably the major supplier. If this should happen an over-all purchase contract for the entire production, technical assistance and limited amounts of small machinery should be sent to the miners and a system initiated whereby loans for equipment and supplies could be made to individual producers against future purchases. A slight relaxation of specifications should effect an increase in production, inasmuch as meeting these often lowers the output per man shift.

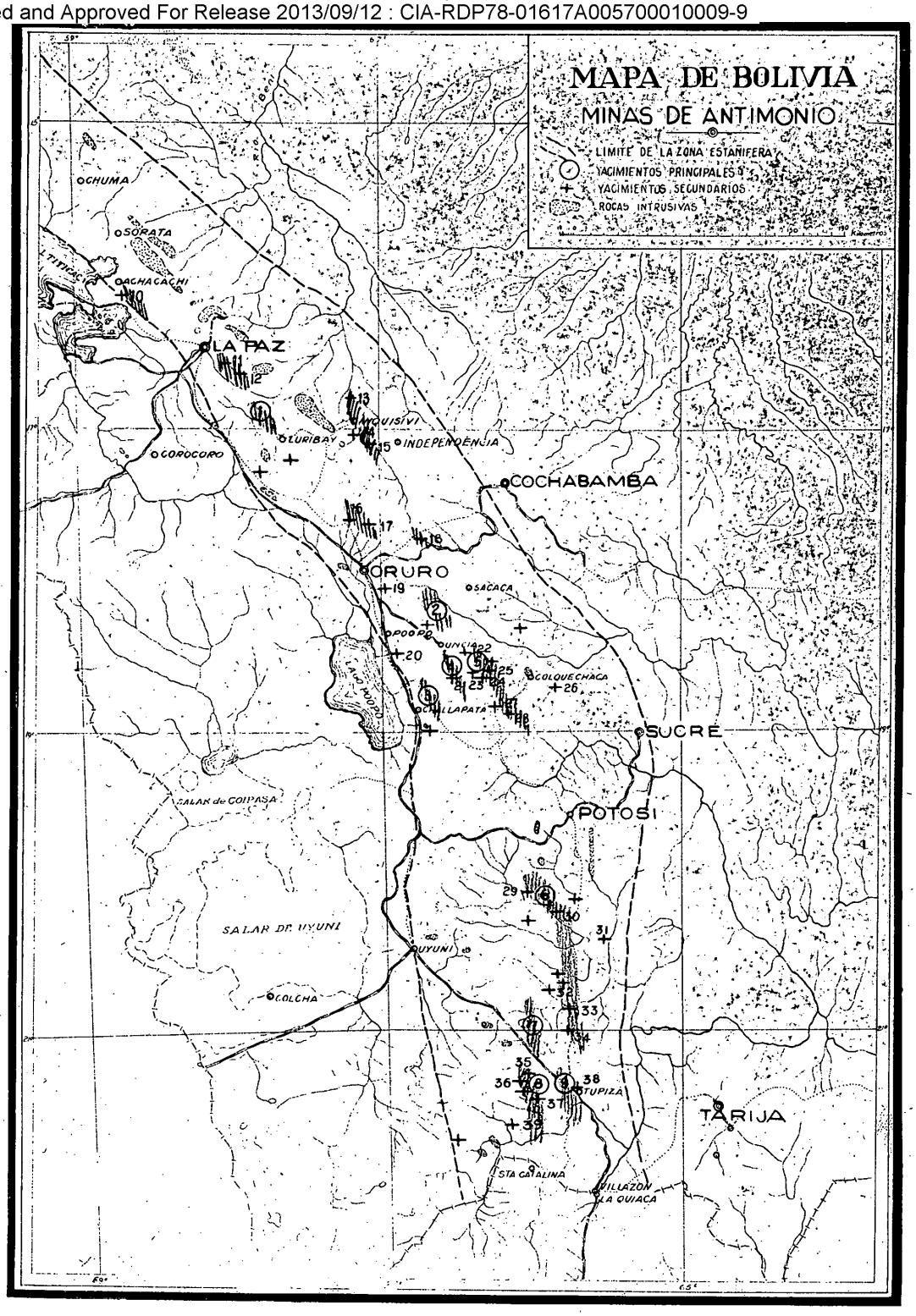
RESTRICTED

Table 10 - Bolivia - Exports of Antimony Concentrates by Countries, 1938-1948

(In Metric Tons of Contained Antimony)

	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	133	173	39	59	414	116	1/	319	2/	2/	2/
Belgium	7,051	4,761	579	-	-	-	-	-	2/	2/	2/
France	21	-	-	-	-	-	-	-	2/	2/	2/
Germany	72	-	-	-	-	-	-	-	-	-	-
Japan	603	1,426	621	879	-	-	-	-	-	-	-
Spain	15	-	-	-	-	-	-	-	2/	2/	2/
United Kingdom	529	1,310	261	90	15	180	1/	24	2/	2/	2/
United States	1,013	2,390	10,253	13,845	17,214	17,678	1/	5,193	2/	2/	2/
Total exports	9,437	10,060	11,753	14,873	17,643	17,974	7,448	5,536	7,676	10,857	12,260

1/ All but a few tons were shipped to the United States.
2/ Breakdown not reported but large quantities are known to have been shipped to Europe.



MAP 2 - BOLIVIA--ANTIMONY DEPOSITS
INDEX

- Limits of Mineral Zone
- Principal Deposits
- Secondary Deposits
- Intrusive Rocks
- Black Slate Belts

ANTIMONY MINES

Principal Mines Owners

1. Espiritu Santo (Vivda de Pringle)
2. Malliri (Empresa Jose Dominguez)
3. Challviri (Hochschild)
4. La India (Fadic)
5. Irpa Irpa (Manuel Solares)
6. Churata (Stevenson)
7. Churquini (Prish and Wright)
8. Cobija (Testamentaria Cruz)
9. Santiago (Patino)

Small Mines Owners

10. San Simon (Mendez)
11. Huancapampa
12. Aguila (Trepp)
13. S. Teresita (Franz)
14. Huarahuarani
15. Cavari
16. Tarumita (Trepp)
17. Chillcani (Ellis)
18. Challa (Emp. 4 Hermanos)
19. Antofagasta (Garcia)
20. El Condor (Herbas & C.)
21. Terremoto (Finingham)
22. Capacirca
23. Cebadillas
24. Chuquiuta
25. Francia (Koehler)
26. Guadalupe (Busolic)

MAP 2 - BOLIVIA--ANTIMONY DEPOSITS (Cont'd)

Small Mines Owners (Continued)

27. Hilluir (Busolic)
28. Churin (Etienne)
29. Puntuma (Rocabado)
30. Reforma (Rocabado)
31. Emp. M. Quesada
32. Rio Blanco
33. Huarojla (Gericke)
34. Tapi (Gericke)
35. Quillacas
36. Alianza
37. Candelaria (San Juan)
38. San Pedro (Gericke)
39. Sucre (Tramontini)

Mexico

In 1940, 1944, and 1945, Mexico was the world's largest producer of antimony ore. The peak year of production was 1943 when 12,585 tons recoverable antimony content of ore were mined. Mexico's output dropped in 1945 and 1946 because of increased costs, labor difficulties, and the curtailing of public purchasing by US Government agencies. The demand and, consequently, prices increased considerably in late 1946. The supply was short and production began to increase. Since Mexico was the chief US supplier just before the war, the demand for Mexican antimony has been more constant than for ores from other countries. Mexico's low cost for transporting ore to the Laredo, Texas, smelter, the major one in the US, and the US tariff on antimony metal make it possible for Mexico to supply most of the US' requirements during normal years.

In prewar years Mexico shipped between 70 and 80 per cent of its output to the US, about 20 per cent to England, and the remaining tonnage to Japan, France and Belgium. During the war years (1941-1945) the US received most of Mexico's output.

Antimony deposits occur in practically all the states in Mexico, and during World War II ore was mined in eleven states from many hundreds of workings. Except for a few properties the deposits are small. The ores vary considerably in richness, but many of them have a low antimony content. Generally high grade ores have come from Oaxaca and Sonora. Average grade of Mexican ores and concentrates shipped to the US is 35 per cent antimony compared to 60 per cent for those from Bolivia. The Bolivian ores are sulfides whereas in Mexico the oxides predominate. The smelter at Laredo treats these low grade ores successfully, smelting the oxide ores without roasting.

Table 11 - Reserves of the Antimonio District, Sonora

(In Metric Tons)

	Tons of Ore	Grade	Tons Sb
No measured ore	-	-	-
Indicated Ore			
High grade in veins and placers	1,000 - 3,000	45%	450 - 1,350
Mill ore in veins	40,000 - 60,000	5 - 10%	2,000 - 6,000
Dump ore	5,000 - 10,000	10 - 15%	500 - 1,500
Total indicated	46,000 - 73,000		2,950 - 8,850
Inferred Ore			
High grade in veins	25,000 - 50,000	45%	11,250 -22,500
High grade in placers	1,000 - 3,000	45%	450 - 1,350
Mill ore in veins	50,000 - 150,000	5 - 10%	2,500 -15,000
Total inferred	76,000 - 203,000		14,200 -38,850
Grand total	122,000 - 276,000		17,150 -47,700

Table 12 - Reserves of Los Tejocotes Mines, Oaxaca

(In Metric Tons)

	Tons of Ore	Grade	Tons Sb
No measured ore	-		
Indicated			
High grade	20,000 - 35,000	55%	11,000 - 19,000
Low grade	30,000	10 - 15%	3,000 - 4,500
Inferred	40,000 - 70,000	50%	20,000 - 35,000
Total	90,000 - 135,000		34,000 - 58,500

The size and irregularity characteristic of the deposits are such that any attempt to prove measurable ore would increase mining costs several times so the development of reserves is usually economically impractical. Thus exact data on reserves of the deposits are not available. The principal producing mines are San Jose near Wadley, Zacatecas; Tejocotes, 14 miles north of Chicahauxtla, Oaxaca; Santa Maria de Miera in the Soyatal District of Queretaro; and those of Roberto Moreno at Antimonio, Sonora. Many small deposits occur in one district so that the total output for the area proves considerable over a period of years. Several districts with an aggregate tonnage of importance are Chicahuaxtla, Oaxaca; Bernal, Queretaro; Charcas and Matehuala, San Luis Potosi; and the Pacheco District in Zacatecas.

Both the Los Tejocotes mines, Oaxaca and those of the Antimonio District, Sonora, are believed to have produced at only a fraction of their potential capacity even during the war years. The possibilities of these areas can be seen from Tables 11 and 12 obtained from the files of the Foreign Economic Administration. In both cases there was no measured ore, for development work needed to block out ore proved unprofitable.

Besides straight antimony ores, antimony is also produced as a by-product from lead ores smelted at Monterrey. Some antimony has been produced from livingstonite (a sulfide of mercury and antimony averaging 1 per cent mercury, 3 per cent antimony) in the Huitzuco mercury district of Guerrero. The ore was shipped to the smelter of Menardi Metals near Los Angeles, California.

Due to the small size and irregularity of the ore bodies, mining is principally by hand. In 1943 the Cia. Minera de Oaxaca tried large scale open pit mining with mechanical equipment at a mine near San Juan Mixtepec in an attempt to increase production. Not only did the output fail to increase substantially but large scale open pit mining proved too costly due

to the increased proportion of waste handled, and operations ceased after a few months. The buscon system used in Mexico is a contracting system similar to those used in Bolivia and China and is successful where ore bodies are very small and irregular and hand mining is involved to a great extent. It is often used in the exploitation of old mines after formal company operations have become unprofitable.

Concentration is mainly by hand-picking but several mines have jigs. The sulfide ore can be concentrated mechanically, but often the oxide is too porous for successful concentration. In the jigging operations losses are high. More than 2,000 workers are employed in the Mexican antimony industry.

When the Laredo, Texas, smelter was constructed in 1930, Mexico's smelter at Wadley, San Luis Potosi was closed down. A small smelter was built several years ago at Tlalnepantla, near Mexico City by the Cia. Metallurgica Mexicanna. Metallic antimony is also produced at the Monterrey smelter of American Smelting and Refining Company and antimonial lead produced at Penoles by the Cia. Metallurgica Penoles. About 300 to 400 tons of the metallic antimony produced is consumed locally. Annual production in recent years is reported below in metric tons.

Year	Refined
1941	840
1942	734
1943	1,338
1944	1,034
1945	1,060
1946	693
1947	865
1948	881

The main difficulties of the producers are the export and other taxes imposed on the mining industry by the Mexican government, labor troubles, and a lack of technical assistance in mining. Transport costs are high

but have had little effect on the Mexican antimony industry. Production has not increased as much as is possible due to the wide discrepancy between the market price of metal and the price paid for ore by the company controlling the industry.

The Mexican antimony deposits are most important strategically because of the great distances between the other producers and the US. Though the individual deposits are small, they are numerous and capable of a substantially increased output. In an emergency production could be increased most readily by guaranteeing a market for the entire production. Many mines have large stocks of low grade ore which could be shipped as a last resort in the event of an extreme shortage.

About three-fourths of Mexico's annual production has come from properties of the Cia. Minera y Refinadora Mexicana, S.A., and the Cia. Minera de Oaxaca, formerly affiliated companies of Texas Mining and Smelting Company, but now 100 per cent subsidiaries of the National Lead Company which acquired them in 1947 from the Cookson interests of England. (The Laredo, Texas, smelter was purchased by National Lead Company from the Cookson interests on 31 December 1946.) These companies operate three of the four major Mexican mines, and many small producers, and if buying from individuals is included the National Lead Company now controls up to 90 per cent of the industry. The ownership of these companies formerly consisted largely of British capital and some American, with a smaller share owned by Mexicans, mainly the Madera brothers of Mexico City. The British capital was Cookson and Company, Newcastle-on-Tyne, England, a firm which first initiated operations in the lead smelting industry in 1704 and started antimony smelting in England about 1825, using imported ores. Republican Mining and Metal Company, also an affiliate of Texas Mining and Smelting, leases its properties to the aforementioned companies whose operations are reported below.

Compania Minera y Refinadora Mexicana, S.A.

Bernal Unit - operates the Santa Maria de Miera mine located in the Toliman District, Queretaro.

Durango Unit - operates many small deposits near Somberete, Zacatecas and west of Torreon.

Maroma Unit - operates the Lagunita mine and several small properties near Matchuela, San Luie Potosi.

Pacheco Unit - operates a group of small mines near Pacheco and another group east of the city of Zacatecas.

Sonora Unit - operates small mines scattered in southeastern Sonora and western Chihuahua.

Wadley Unit - operates the San Jose mines in southern Catorce District of San Luis Potosi.

Compania Minera de Oaxaca, S.A. - A large share of this company is held by the Madera brothers of Mexico City.

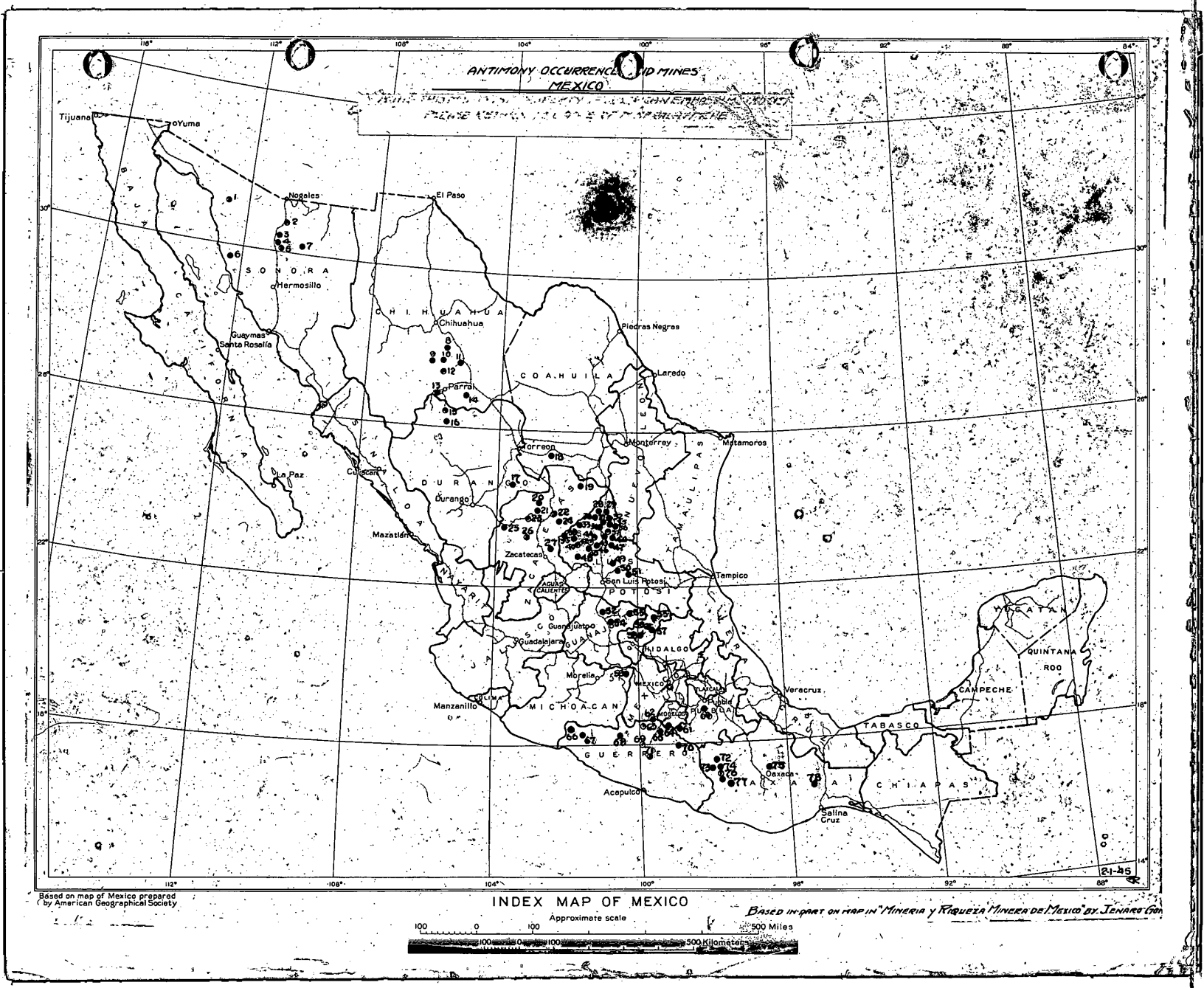
Tejocotes Mine - located 15 miles west of Tlaxiaco, Oaxaca. This and Refinadora's Santa Maria de Miera are Mexico's two largest producing mines.

Chicahuaxtla District - located 13 miles south of Tejocotes. The company has many properties in the district.

Yucunicoco District - located 6 miles southwest of Tejocotes, the company's properties have important reserves.

Cabrillas District - located 3 miles northwest of Tejocotes, the company owns several small deposits.

Compania Minera de Cerro Negro, S.A. - This company is affiliated with Cia. Refinadora and Cia. Oaxaca but the exact ties have not been reported. Properties near Tulancingo, Puebla, were leased by Cia. Cerro Negro in October 1938.



MAP 3 - MEXICO--ANTIMONY DEPOSITS
INDEX

No. on Map		No. on Map	
	CHIHUAHUA STATE		OAXACA STATE
14.	Adargas	78.	Guienagate
12.	Los Trenes	77.	Llano de San Vicente
10.	Naica	74.	Los Tejocctes
13.	Nuevo Vesuvius	75.	San Felipe del Agua
11.	Santa Rosalia	72.	Santos Reyes-Princesa
8.	Vallecillos	73.	Tucuyo-Estrella-Union
9.	Virginia	76.	Yucunicoco
	COAHUILA STATE		PUEBLA STATE
18.	Los Hornos	61.	Chetzalan
		80.	Tulcingo
	DURANGO STATE		QUERETARO STATE
16.	Inde		
17.	Quien Sabe-Perdida	58.	Bernal
15.	San Bernardo	57.	Cadereyta Dist.
		55.	Soyotal
	GUANAJUATO STATE	56.	Vizarron
54.	Pena Miller		SAN LUIS POTOSI STATE
52.	San Jose		
53.	Xichu	46.	Cabucoco
		29.	Catorce
	GUERRERO STATE	32.	Catorce Real
		30.	Cedral
67.	Buena Suerte	41.	Charcas
65.	El Negro	47.	Cuevas de Coronado
63.	El Palmarudo	51.	El Rayon
68.	Escalecava	49.	Guadalcanal
64.	Huitzuco	35.	Guadalupe
69.	Las Vinatas	45.	La Amarilla
66.	Maria-Sirena-Sta. Lucia	40.	La Cardioncita
62.	Pirichahuasco	42.	La Perla
71.	Tlacotepec	34.	Matanzas
70.	Zona de Tenantla	36.	Matehuala
		44.	Minas de Antimonio
	MICHOACAN STATE	48.	Penon Blanco
		50.	Pectillas
59.	Sierra de Tlalpujahua	31.	Potosi-Jacolera

MAP-3 - MEXICO--ANTIMONY DEPOSITS (Continued)

SAN LUIS POTOSI STATE (Cont'd)

28. San Antonio
43. San Felipe
37. San Jose-Custom-El Pastor
33. San Jose de los Godornices
38. Santo Domingo
39. Tierra Blanca

SONORA STATE

6. Antimonio
7. Arizpe
2. Cananea
1. Linena-Piedra Azul
4. Magdalena
3. Moreno Mines
5. Ruiz

ZACATECAS STATE

26. Fresnillo
21. Independencia
27. La Calderona
19. Mazapil
25. Noria
22. Pacheco
24. Refugio
23. sierra Azufre
20. Tanger

Peru

Antimony ores have been mined in Peru since 1915 with production during the last ten years averaging more than 1,000 tons of metal content annually. The peak year of production was 1943 when 2,472 tons, recoverable metal content of ores, were produced. Before the war the United States and UK were the principal buyers of Peruvian concentrates with the United States Commercial Company taking the entire output during the war. Peru is now shipping the major part of its production to these two countries. Antimony bars 78 per cent antimony and 15 per cent lead, and antimonial lead with 5 to 6 per cent antimony are produced at the La Oroya smelter.

Production has come from 70 small mines scattered through seven departments but mainly in the Department of Puno. Irregular ore shoots of stibnite occur in quartz veins traversing belts of slate and schist. The mines are worked by primitive methods without mechanical equipment and the deposits are generally lower grade than those of Bolivia. The Bueno Suerte mine of the Negaciacion Minera Bueno Suerte of Azagaro, 60 miles north of Juliaca, is believed to be the largest producer, but the individual ore bodies being mined are small.

Peruvian production could be doubled by guaranteeing a fair set price, by small loans to individual miners against monthly production, and by technical assistance. Transportation facilities are very poor and costs are high, precluding exploitation of several important prospects. The country's antimony mines are working at only a fraction of potential.

Although most of the concentrates are exported, an important part of production is smelted locally at La Oroya smelter of the Cerro de Pasco Corporation where a special recovery plant was completed in August, 1942. Peak year of smelter production was 1943 when 805 tons of antimony

bars averaging 95.3 per cent antimony and 63 tons of antimony in antimonial lead bars were produced.

Argentina

The yearly output of antimony from Argentine mines seldom exceeds more than 100 tons. Since annual consumption of antimony is more than 200 tons, antimony concentrates or metal must be imported to make up this deficiency. Exports reported from Argentina originate in the southern section of Bolivia's antimony belt. Argentine statistics do not differentiate as to origin. Before the war China, Belgium and the UK supplied regulus to Argentine consumers. The National Lead Company produces small quantities of antimony each year as a by-product of lead smelting. However, this company now purchases more than 100 tons of concentrates annually from Bolivia for the manufacture of antimonial lead. The largest producer of antimony ore in Argentina is the El Pabellon mine located in Cerros Grandos, Department of Rinconada, Province of Jujuy, owned by Jose Bach. There are several other properties in the area but the individual deposits are small. Argentina could supply its own requirements if necessary, but its potential is not important.

Honduras

Antimony mining in Honduras began in 1940, but production has never been important amounting to only 110 tons, recoverable metal content of ore, in 1943, the peak year. Most of the output has come from the El Quetzal mine, near San Augustin de Copan, owned by Manuel Bueso and Rudolfo Nater. The ore was mined by hand from open cuts, hand-picked and a stibnite concentrate averaging 58 to 62 per cent exported to the US by way of Guatemala. This concentrate had to be transported a considerable distance over mountains by burro. Due to the high cost of transport and inefficient mining methods the mine was reported to have shut down in 1946. The owners are planning to

exploit other less remote deposits and hope to install a plant for treating the ore in Honduras to alleviate the high cost of transport.

Some production has also been reported by the La Union mine, Department of Olancho, owned by Eleazon Vargas, and four other properties, as well as from the concentrates of the Agua Fria gold mine. There are many occurrences of stibnite in the country, but they are typically small and irregular. Poor transport hinders their development, but should this be remedied, the US still could not depend on Honduras for more than a very small part of its supply.

Canada

With the advent of World War II and the subsequent shortage of supply, attempts were made to increase domestic production. The peak year was 1941 when 1,329 tons were produced. The only producer of consequence was the Consolidated Mining and Smelting Company, extracting antimony from flue dust recovered at the company lead smelter at Trail, British Columbia. Production fluctuates considerably and in 1947 was about a third of Canada's estimated consumption of about 1,000 tons. To augment this supply Canada has imported antimony from China and the US.

There are many stibnite occurrences in Canada, but these are small and low grade requiring costly methods of mining and are, therefore, uneconomical. In the event of an extreme emergency Canada could supply its own requirements at high cost from deposits in New Brunswick, Quebec, Ontario and British Columbia.

Union of South Africa

The Union of South Africa is now the only important producer of antimony ore in Africa. Ore has been mined in the Murchison Range of Transvaal since 1913. The 1947 output totaled 5,813 metric tons of concentrates containing 3,020 tons of antimony, and the 1948 output increased to 3,700 tons of

contained antimony. The ores are principally worked for their gold content, the concentrates being exported to the UK and small amounts to Australia and the US for treatment. Local demand is very small, amounting to only a few tons. Most of the production is hand-cobbed ore and flotation concentrates containing up to 60 per cent antimony from the Monarch, Union Jack, and Weigel Mines of the Consolidated Murchison Goldfields and Development Company in the Petersburg District of Eastern Transvaal. These are principally gold mines and are well-equipped mechanically. In 1946 the company overhauled its machinery and modernized its concentrating plant in an attempt to increase its antimony output and at the same time began an extensive development program to block out its antimony reserves to maintain a constant mill feed, increasing production and taking advantage of the high price of antimony. In 1946 tons milled totaled 92,000, from which 11,708 ounces of gold and 2,330 tons of antimony were recovered.

Improvements in mining and milling have placed the South African mines in a favorable position even in the event of a highly competitive market.

Australia

Although production of antimony in Australia ranged as high as 1,052 tons in 1942, the entire output is consumed within the country. Most of the production comes from the Wiluna and the Moonlight mines in Western Australia where stibnite occurs in gold ores. Also varying amounts are mined in straight antimony ores scattered throughout the country and some antimony is recovered as a by-product of lead smelting. The stibnite ores are smelted at the plant of O. T. Lempiere & Company, Ltd., Sidney, N.S.W., and antimonial lead is produced by the Electrolytic Refining and Smelting Company, Port Kembla, N.S.W., from antimonial slag resulting from smelting

of lead ores. Although Australia has numerous antimony occurrences the isolated location of many of the deposits and the shortage of labor will prevent the country from being an important contender in the world market.

Yugoslavia

In 1940, Yugoslavia was the fourth largest producer of antimony in the world with a production of 4,800 tons, metal content, approximately 13 per cent of the world's output. During the war, Yugoslavia was the chief source of supply for Germany; but exact statistics for the war years are lacking. Yugoslavia is normally the chief supplier of antimony for the Balkans.

The main mines are confined to the Department of Drinska near Krupanj and Ivanjica. Almost three-fourths of the country's production prior to the war came from the Stolica mines, then owned by the Podrinje Mines, Ltd., and English company. The company owned a smelter at Krupanj which was completely modernized in 1938.

When the war started German interests acquired the Lisanki mine near Drinska and completed a smelter with an annual capacity of 900 tons of metal. This mine was reported to have large estimated reserves. About the same time the Zacaja mines near Krupanj were taken over by the German controlled "Montania A.G.". Explorations by the Germans indicated large tonnages of possible ore, so the company constructed a small smelter at Loznica. Three smelters were repaired in 1946 but recent data on the activities of the Yugoslav antimony industry are not available at this time.

Czechoslovakia

Normally domestic production of antimony is just sufficient to meet domestic requirements but the output was stepped up during the war to help

meet German demands. The Cucina mine in southern Slovakia was the largest producer before the war, accounting for two-thirds of the country's production which totalled 800 tons in 1938. The remainder, during that year, was a by-product from the lead-silver mine at Pribram. The ore from the Cucina mine was smelted at the company plant at Vajskova.

Italy

Until 1938 domestic mines fell far short of supplying domestic requirements estimated at 1,000 tons, but in that year production reached a peak of 851 tons of antimony. The Su Suergiu mine near Villasalto, Sardinia, owned by the S. A. Miniere e Fonderie di Antimonio, has been the major producer for nearly 40 years. The ore is hand-sorted to 16 per cent antimony and smelted in the company's plant. Two other producers are the Corti Rosas mine near Ballao, 12 miles north of the Su Suergiu, and the Santa Rosa mine near Valdarno, Tuscany. It is reported that these mines could supply all domestic demands, if necessary

Austria

The country's output comes from mines at Schilsining in Styria. Capacity is believed to be 750 tons of antimony content annually. The ore was shipped for processing to metal to the Herzog Julius Smelter at Goslar, Germany's only antimony smelter. This plant consumed 2,000 tons of sulfide ores, 40 per cent antimony, annually during the war. Most of this tonnage came from Austria with minor amounts from Hungary and Yugoslavia, both of which treat most of their own output.

France

The peak year of production during the war was 1943 when 153 tons, antimony content, were mined. This output comes from small deposits in

the Department of Mayenne in the northwestern part of France. The French deposits are becoming exhausted; the ore is low grade and production costs are high. The antimony ore produced is usually consumed in the manufacture of antimony oxide. Important quantities of antimony metal are being imported from Algeria and Morocco, as well as concentrates from Bolivia, to supply French demands.

Algeria

Algerian production reached a wartime peak in 1943 when 902 tons, recoverable metal content of ore, were mined. The principal deposits are situated northwest of Ain Beida in the Province of Constantine. The deposits have been worked for many years, the tonnage of high grade ores is believed to be limited, but substantial quantities of low grade ores remain that can be worked successfully at high prices. The ore is smelted locally and shipped to France to augment France's small supply.

Spain

Antimony ore is mined at Villarbacu in Lugo Province by Antimonios Espanoles, at Almuradiel in Ciudad Real by Metals de Espana, from numerous small mines in Cordoba, and from mines of the Cia. de Beni Mezala in Spanish Morocco. The total production is small but sufficient to fulfill Spanish requirements of 200 tons a year. The reserves are not believed to be large enough for extensive production. There are two smelters in Spain, one in Bilbao and another in Almuradiel, owned by Lipperheide y Guzman.

Turkey

Production of antimony ore reached a wartime peak of 600 tons (recoverable metal content of ore) in 1942 but has dropped considerably since that time due to the lack of a market and the accumulation of stocks amounting

to 700 tons of ore containing about 20 - 35 per cent antimony. The two principal deposits are near Turhal in north central Turkey. One of the properties is owned by the Eti Bank and the other by Ozdemir Antimuan, Ltd. The ore is stibnite occurring in veins and stringers cutting crystalline schists.

Japan

The production of antimony in Japan reached a wartime peak of 423 tons in the fiscal year ending March 31, 1945. Japan's wartime demands were supplied by small amounts from Burma, Indo-china, Korea, Manchuria, and by smuggling metal and ore from China. The Nakase mine of Nakase Mining Company in Hyogo Prefecture and the Ichinokowa mine of the Ichinokowa Mining Company in Ehime Prefecture on Shikoku Island have been consistent producers for many years.

It is reported that the Japanese often substituted tin, of which they had an oversupply, for several uses of antimony during the war.

USSR

Although antimony deposits have been reported in scattered localities in the USSR, specific information on the Soviet production of antimony, as well as many other metals, is lacking. The US Bureau of Mines does not include the USSR in its world production table because reliable estimates of production are not available, but it is likely that new properties brought into production by intensive prospecting and development work are supplying all of the domestic requirements. Imports in 1937 totaled 1,091 tons of which 860 tons came from China, 127 from Belgium and 103 from Czechoslovakia. Under a barter agreement with China the USSR received 5,950 tons of antimony metal during 1938, 2,534 tons in 1939, and 1,315 tons in 1940. This decline

in imports at a time when USSR was expanding industrially would appear to be evidence of an increasing production. At the same time consumption also must have been increasing, stimulated by growing industrial requirements and later by accelerated military needs. Annual peacetime consumption of antimony in the USSR is believed to be about 6,000 metric tons including secondary.

About 1,500 tons of antimony concentrates were produced annually from the Razdolninskoe deposit in the Krasnoyarsk district of Western Siberia before the war. This tonnage was treated in a local smelter. Substantial quantities of antimony ores are reported to have been mined at the Kadamdzaiskoe mine located along the Shakhimarden River south of Fergana on the northern side of the Alaiskiy Range in the Osh Oblast of Kirgiz. The ore averages 2 to 4 per cent antimony and the concentrates are smelted by the antimony-mercury combine of Im-Frunze in Kirgiz. Mining is believed to have started in 1934.

Antimony is mined at Turgai in Kazakhstan from a deposit containing livingstonite, an antimony-mercury sulfide, yielding both antimony and mercury. Only one other deposit of livingstonite has been exploited commercially, that is at Huitzuco, Guerrero, Mexico.

Other deposits of antimony ores have been reported at Aramasheveskoe in the Urals, and at Nalchik and Tyrny-Auz in the Caucasus, at Aldan Boguchanskoe, and Leninskoe in the Far East. Probably the widespread geological studies that the Soviet government has carried out in recent years have revealed other deposits in these areas as well as several new localities. Therefore, self-sufficiency probably can be attained even with increasing consumption, for it must be remembered that the Soviet government does not consider cost as a factor in mining and under such conditions uneconomical low grade deposits are often exploited to become independent of foreign

sources, not only wasting capital but also labor which could be directed to more constructive occupations.

Large quantities of antimonial lead scrap probably have been shipped into the USSR from the Satellite countries and Germany, which together with domestic secondary should be sufficient to meet the antimonial lead requirements of the USSR for storage batteries, cable and sheet. There may be a small surplus of primary or secondary antimony available for stockpiling, if domestic deposits are producing at wartime rate. Various estimates indicate the reserves of the deposits controlled by the Im-Frunze combine are sufficient to supply the entire country for more than fifteen years if necessary.

The Satellite countries, Hungary, Yugoslavia and Czechoslovakia have a combined capacity of about 11,000 metric tons of primary antimony a year. Present production of these countries is not known, but if the output of these countries is less than half of capacity, the USSR has available a surplus supply of antimony. Yet the USSR still is receiving shipments from China.

For several years antimony has been included with tungsten in the trade agreements between China and the USSR, and from 1938 to 1948, inclusive, about 13,000 metric tons were shipped. Agreements have been made whereby the USSR is to receive at least 1,000 tons annually from China until 1952. At the same time the US is also purchasing antimony in China. Whatever the USSR is receiving, reduces the US' supply by an equal amount. Antimony is also believed to be smuggled out of China to the USSR. In view of the USSR'S increase in production of secondary antimony from scrap, and the probability that domestic production, chiefly of the Im-Frunze Combine, has risen, the antimony from China, as well as some of the tonnage from the Satellites, appears to be for stockpile purposes.

Document No. 001
NO CHANGE in Class. ☐
☒ DECLASSIFIED
Class. CHANGED TO: TS S C
DDA Memo, 4 Apr 77
Auth: DDA REG. 77/1763
Date: 3/2/78 By: 023