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SUPPLY AND CONSUMPTION OF MERCURY IN THE SINO-SOVIET BLOC

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FOREWORD

The primary purpose of this report is to assess the adequacy of the supplies of mercury in the Sino-Soviet Bloc for consumption and for a stockpiling program.

A word of caution is necessary concerning the use of the data in this report, which contain unusually wide ranges of error. Because of a lack of specific data, the estimates established for production, trade, consumption, and stockpiling are in almost every instance based upon fragmentary evidence, general economic trends, and assumptions; they are not to be considered final or precise. These estimates, however, give the general order of magnitude of the various aspects of the mercury industry in the Sino-Soviet Bloc. They are believed to be adequate for the purposes of this report but should be used with extreme caution in establishing conclusions on any questions other than those herein considered.

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SUPPLY AND CONSUMPTION OF MERCURY IN THE SINO-SOVIET BLOC*

Summary

The production of mercury in the Sino-Soviet Bloc has risen sharply from an estimated 12,000 flasks** in 1948 to an estimated 41,000 flasks in 1954. This increase was largely the result of the reconstruction of the Nikitovka Combine in the Ukraine, the development and expansion of Combine No. 5 imeni Frunze in Central Asia, and the organization and expansion of the mercury industry in Communist China. Eighty percent of the 1954 total was produced by the USSR; 17 percent by China; and the remainder by Czechoslovakia and Rumania.

Sino-Soviet Bloc imports of mercury from Free World sources from 1948 to 1954 are estimated to have ranged from a high of 11,000 flasks in 1953 to a low of 7,000 flasks in 1954. Future imports by the Sino-Soviet Bloc probably will decline because of the imposition of an embargo by the Coordinating Committee on Export Control (COCOM) on 16 August 1954, a trend which appeared in the last quarter of 1954.

Consumption of mercury by the Sino-Soviet Bloc is estimated to have increased from 25,000 flasks in 1950 to about 35,000 flasks in 1954. The USSR and East Germany are the largest consuming countries. It is estimated that in 1954 the USSR consumed 15,000 flasks and East Germany 8,000 flasks, the latter using large quantities in its highly developed chemical industry. Although rumors of some new, highly strategic use requiring large quantities of mercury have appeared repeatedly in the US and foreign press, these rumors have not been confirmed, and

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 March 1955.

** One flask equals 34.5 kilograms, net. Flasks are the standard unit of measure for metallic mercury.

there is no evidence of any unusual interest in mercury in the Bloc. Barring new developments requiring large quantities of mercury, it is anticipated that Bloc consumption will continue to rise slowly as the over-all economy expands.

It is estimated that a stockpile of about 58,000 flasks has been accumulated -- all of it in the USSR. In addition, it is estimated that 10,000 to 15,000 flasks are in working inventories and in transit throughout the Bloc, creating a total reserve of 65,000 to 75,000 flasks, about 2 years' supply at estimated current rates of consumption.

Under present conditions, production of mercury in the Sino-Soviet Bloc is adequate to meet estimated consumption requirements; imports for the Bloc as a whole are not required. The bulk of the output, however, is concentrated within three areas: Central and South China, Central Asia, and the Ukraine. Two of these are long distances from the major consuming areas of the European USSR, East Germany, and Czechoslovakia. The European Satellites by themselves are particularly vulnerable, being largely dependent upon imports from the USSR and Communist China.

On the basis of ore reserves, it is estimated that the Sino-Soviet Bloc is capable of increasing mercury production by one-third to one-half over the next 10 years, especially in Communist China and to a lesser extent in Central Asia (Economic Region Xb).

On the basis of conventional uses, it is probable that mercury is not, on the whole, a good indicator of intentions. Mercury has many military applications, some of which are strategic, but it is consumed in relatively small quantities over a very wide range of uses, for most of which readily available substitutes are known. For example, lead azide could be substituted for mercury fulminate in detonators for explosives, as has been done in the US. Although some of the substitutes are less efficient and more costly, they are adequate to cover emergency uses.

I. Introduction.

In the Sino-Soviet Bloc, as elsewhere, the use of mercury is extremely diversified: its end uses, some of which are highly strategic, number more than 3,000. The more important uses of mercury include the following: pharmaceuticals; dental preparations; agricultural insecticides; pesticides and fungicides; fulminate (used as a detonator for explosives); vermillion; antifouling paint; catalyst in the manufacture of chlorine, caustic soda, and the like; gold and silver amalgamation; general laboratory uses; electrical equipment such as vapor lamps, rectifiers, and oscillators; switches and dry cell batteries for communications equipment; a wide variety of industrial and control instruments; mercury-vapor power plants; heat-exchanger equipment; and precision die casting.

In general, substitutes are known for most applications of mercury, but many are either less efficient or more costly. They are, however, adequate for emergency use. As adequate alternate materials have been developed over the past 30 years, the use pattern of mercury has shifted radically throughout the world and new uses have appeared, but there has been no downward consumption trend anywhere. Therefore, it is not likely that substitution of other materials for mercury will decrease total Bloc requirements in the future.

In the USSR the production of mercury is under the direction of the Ministry of Nonferrous Metallurgy, which was established by a decree of the Presidium of the Supreme Soviet of the USSR on 8 February 1954. 1/* At this time, Petr Fadeyevich Lomako was appointed Minister of Nonferrous Metallurgy. 2/ Previously, the ferrous and nonferrous metals industries had been combined under the Ministry of Metallurgical Industry. The mercury industry in the USSR is under the Chief Directorate of Rare Metals, which is subordinate

* For serially numbered source references, see Appendix D.

to the Ministry of Nonferrous Metallurgy. 3/ Two combines, Combine No. 5 imeni Frunze in Central Asia (Economic Region Xb) 4/ and the Nikitovka Mercury Combine in the Ukraine 5/ produce nearly all of the output.

In Communist China the primitive industry of the pre-Communist era has now been organized under government control and direction with the aid of studies made by Soviet experts 6/ and the use of Soviet technicians and equipment. 7/ The government control extends from the Ministry of Heavy Industry at Peking, through the Heavy Industry Department of Central and South China to the Metal Mining Bureaus of the respective provinces. 8/

In Czechoslovakia, mercury is chiefly a byproduct from mines producing iron and pyrites. The most important mercury producer is the Koterbachy (Rudney) Iron Ore Mine, 9/ under the Ministry of Metallurgical Industry and Ore Mines. 10/

The small Rumanian production is under the control of the Ministry of Metallurgical Industry. 11/

II. Supply.

A. Production.

The USSR is by far the most important producer of primary mercury in the Sino-Soviet Bloc, with 1954 production of mercury estimated to be about 80 percent of the Bloc total. In addition, China produces important quantities of mercury, and small quantities are produced in Czechoslovakia and Rumania.

1. USSR.

Nearly all of the Soviet output of primary mercury is produced by two combines: Combine No. 5 imeni Frunze, located at Khaydarkan, 39°57' N - 71°20' E in Central Asia, 12/ and the Nikitovka

Mercury Combine, located at Nikitovka, 48°20' N - 38°02' E, in the Ukraine. 13/ The rest of the primary output comes from a number of small scattered mines. The USSR also produces small quantities of secondary mercury.*

Combine No. 5 imeni Frunze, which processes very large quantities of low-grade antimony-mercury ores at 5 or 6 locations in Central Asia, 14/ is the most important producer of primary mercury in the USSR. On the basis of estimated 1954 production, about two-thirds of the Soviet production came from this combine.

The Nikitovka Combine, the only important producer of mercury in the USSR before World War II, was captured and destroyed by the German Army during the war. 15/ Restored after the war, the Nikitovka Combine is estimated to have accounted for one-third of the Soviet primary mercury production in 1954.

Additional production of primary mercury, attributed to a number of small scattered mines, is estimated to have been less than 2 percent of the Soviet primary production in 1954. Secondary mercury is estimated to have been less than 3 percent of the total Soviet production in 1954. (The consumption of mercury in small instruments and a wide variety of chemical compounds prohibits any large recovery of secondary metal.)

The estimated production of mercury in the USSR from 1948 through 1954 is given in Table 1.**

2. Communist China and the European Satellites.

After the USSR, Communist China is the most important producer of mercury in the Sino-Soviet Bloc. The Chinese Communist industry is based upon a large number of small deposits scattered widely over an area extending through Kweichow, Hunan, Szechwan, Yunnan, Chekiang Provinces, and Hainan Island. Over 150 specific locations have been identified. 16/ Important quantities of mercury

* Secondary mercury is mercury obtained from sources other than ores.

** Table 1 follows on p. 6.

Table 1

Estimated Production of Mercury in the USSR a/
1948-54

Flasks

Year	Primary Production: Combine No. 5 imeni Frunze	Primary Production: Nikitovka Mercury Combine b/	Secondary Production c/	Total d/
1948	9,000 e/	f/	f/	10,000
1949	10,000 g/	1,000	f/	12,000
1950	14,000 h/	2,000	1,000	18,000
1951	16,000 h/	4,000	1,000	22,000
1952	18,000 i/	10,000	1,000	30,000
1953	20,000 i/	10,000	1,000	32,000
1954	21,000 i/	10,000	1,000	32,000

a. The range of error is plus or minus 25 percent; all figures are rounded to the nearest 1,000 flasks.

b. Completely destroyed in World War II, Nikitovka resumed limited production in 1948. 17/ Allowing a reasonable time for full restoration, it is estimated that by 1952 this plant had achieved the 1940 rate of production (10,000 flasks per year based on 1937 output and the Third Five Year Plan -- 1937-42). 18/

c. Based upon the analogous statistical relationship of secondary mercury recovery to total consumption in the US.

d. Includes arbitrary estimate, less than the rounding error, to cover other small mines in the USSR producing mercury.

e. Based upon an average monthly output obtained from reported production figures for 4 scattered months. 19/

f. Estimated at less than 1,000 flasks. Actual production figures, where known, are listed in footnotes to all tables.

g. Based upon an estimated monthly output obtained from reported production in September and December raised by 5 percent on the basis of shipments to state reserves. 20/

Table 1

Estimated Production of Mercury in the USSR a/
1948-54
(Continued)

h. Assuming that quantities shipped or sequestered are approximately equal to quantities produced, the average of quantities shipped or sequestered for several months was used to estimate annual output. 21/ The large increase in 1950 over 1949 was the result, in part, of the development of the Chauvay mine; which began operating in 1948-49. 22/

i. Straight line projection reduced on the basis of constant production of antimony from the same ores by some of the same mines of this combine. 23/

have been produced for many years by an unorganized industry consisting largely of seasonal operations by farmer-miners working small mines and using very primitive techniques and equipment. 24/ The peak production in relatively recent years was 13,600 flasks in 1925. In the period from 1935 to 1939, production averaged 2,450 flasks a year. 25/ With the aid of Soviet experts 26/ and the introduction of Soviet equipment, 27/ the Chinese Communists have made rapid progress in organizing and developing their mercury industry. By 1954, Chinese production had increased to 24 times that of 1948, although total Sino-Soviet Bloc production in 1954 was only slightly more than 3 times 1948 Bloc production. Chinese Communist production, which in 1948 represented only about 2 percent of Bloc production, had risen to approximately 17 percent of total Sino-Soviet Bloc production in 1954.

The relative importance of Czechoslovak production has declined since the pre-World War II period. Czechoslovakia has produced mercury for many years from three mines: Mernik, Koterbachy, and Gelnice. In 1942, however, Mernik, the most important mine, was closed because of the exhaustion of the ore. 28/ As a result, Czechoslovak production decreased from an average of 2,465 flasks a

year for the period from 1935 to 1940 to an average of 823 flasks per year for the period from 1944 to 1948. 29/ Czechoslovakia is estimated to have produced only about 2 percent of the Bloc output of primary mercury in 1954.

The production of mercury in Rumania is insignificant in the total Bloc supply position. For a number of years, Rumania has been an irregular producer of small quantities of primary mercury from the Mina de Mercury Valea Dosului near Zlatna. 30/ In 1942 a smelter was built here with a capacity of about 500 flasks a year. 31/

The estimated production of primary mercury by Communist China and the European Satellites from 1948 through 1954 is given in Table 2.*

3. Sino-Soviet Bloc.

Estimated production of mercury in the Sino-Soviet Bloc from 1948 through 1954 is given in Table 3.** The estimates are computed from the estimated production of all metal by the USSR and primary metal plus an estimate of secondary metal by the European Satellites and Communist China.

B. Trade with the Free World.

Sino-Soviet Bloc trade in mercury with the Free World consists entirely of imports by the Bloc from the Free World. These imports*** declined from 45 percent of the total Sino-Soviet Bloc mercury supply in 1948 to less than 15 percent of Bloc supply in 1954. It is estimated that in 1954 imports were 4,000 flasks less than in 1953 -- attributable in part to the establishment of an embargo on sales of mercury to the Sino-Soviet Bloc on 16 August 1954 by the inclusion of mercury on COCOM International List I. 32/

* Table 2 follows on p. 9.
** Table 3 follows on p. 10.
*** See Table 5, p. 13, below.

Table 2

Estimated Production of Primary Mercury
in Communist China and the European Satellites a/
1948-54

Flasks

Year	China	Czechoslovakia	Rumania	Total
1948	b/	c/	d/	1,000
1949	d/	e/	f/	1,000
1950	1,000 g/	1,000 h/	d/	2,000
1951	2,000 i/	1,000 h/	j/	3,000
1952	3,000 k/	1,000 h/	d/	4,000
1953	5,000 k/	1,000 h/	d/	6,000
1954	7,000 k/	1,000 h/	d/	8,000

a. The range of error is plus or minus 25 percent. All figures are rounded to the nearest 1,000 flasks. The production of mercury by Satellites other than Czechoslovakia and Rumania is believed to be nonexistent.
b. In 1948, China produced 290 flasks. 33/
c. In 1948, Czechoslovakia produced 800 flasks. 34/
d. Less than 1,000 flasks.
e. In 1949, Czechoslovakia produced 800 flasks. 35/
f. In 1949, Rumania produced 135 flasks. 36/
g. Interpolated.
h. Projected on the basis of limited ore reserves and the byproduct nature of production. 37/
i. 38/
j. In 1951, Rumania produced 200 flasks. 39/
k. Projected on the basis of past production, adequacy of reserves, organization and development of industry with Soviet aid, and reported discoveries of new deposits.

Table 3

Estimated Production of Mercury in the Sino-Soviet Bloc a/
1948-54

Flasks

Year	USSR b/	European Satellites and Communist China c/	Total
1948	10,000	2,000	12,000
1949	12,000	2,000	14,000
1950	18,000	3,000	21,000
1951	22,000	3,000	25,000
1952	30,000	5,000	35,000
1953	32,000	7,000	39,000
1954	32,000	9,000	41,000

a. The range of error is plus or minus 25 percent. All figures are rounded to the nearest 1,000 flasks.

b. See Table 1, p. 6, above.

c. Primary production plus estimated secondary production is based on total estimated consumption by the European Satellites and Communist China (see Table 2, p. 9, above, and Table 9, p. 19, below) and an analogous relationship of secondary recovery to total consumption in the US. In most instances secondary production is less than the rounding error.

C. Supply Balance.

1. USSR.

The estimated available net supply of mercury in the USSR from 1948 through 1954 is given in Table 4.

Table 4

Estimated Available Net Supply of Mercury in the USSR a/
1948-54

Flasks

Year	Production b/	Imports	Exports	Net Total
1948	10,000	4,000 c/	5,000 d/	9,000
1949	12,000	4,000 e/	4,000 f/	12,000
1950	18,000	g/	4,000 f/	14,000
1951	22,000	g/	4,000 h/	18,000
1952	30,000	2,000 i/	7,000 j/	25,000
1953	32,000	3,000 k/	8,000 l/	27,000
1954	32,000	4,000 m/	6,000 n/	30,000

a. The range of error is plus or minus 25 percent. All figures are rounded to the nearest 1,000 flasks.
b. See Table 1, p. 5, above.
c. 4,350 flasks from Yugoslavia. 40/
d. 4,524 flasks exported to East Germany. 41/
e. 1,350 flasks from Yugoslavia, 42/ 2,175 from Italy. 43/
f. Based on figures for 1951.
g. Less than 1,000 flasks.
h. Estimated on the basis of known exports of 3,480 flasks to East Germany. 44/
i. From Communist China, based on estimated Chinese Communist production less consumption.

Table 4

Estimated Available Net Supply of Mercury in the USSR a/
1948-54
(Continued)

j. Based on 1951 and 1953 figures and on large exports to East Germany, which imported a total of 8,000 flasks in 1952. 45/

k. 1,160 flasks from Spain 46/; 2,000 from Communist China, based on estimated production in China less estimated consumption and exports to the European Satellites.

l. Based on a minimum of 6,238 flasks exported to East Germany. 47/

m. From Communist China, based on estimated production less consumption and estimated exports to the European Satellites.

n. Based on planned imports of 6,400 flasks by East Germany, the bulk of which will come from the USSR. 48/

2. Sino-Soviet Bloc.

Because the Sino-Soviet Bloc does not export mercury to the Free World, the supply of mercury in the Bloc consists of production plus imports. The estimated available net supply of mercury in the Sino-Soviet Bloc from 1948 through 1954 is given in Table 5.*

III. Consumption.

A. USSR.

1. Aggregate Consumption.

Evidence relating directly to the consumption of mercury in the USSR is extremely scarce. Certain factors, however, may be

* Table 5 follows on p. 13.

Table 5

Estimated Available Net Supply of Mercury
in the Sino-Soviet Bloc a/
1948-54

Flasks

Year	Production b/	Imports c/	Total
1948	12,000	10,000	22,000
1949	14,000	8,000	22,000
1950	21,000	8,000	29,000
1951	25,000	9,000	34,000
1952	35,000	10,000	45,000
1953	39,000	11,000	50,000
1954	41,000	7,000	48,000

a. The range of error is plus or minus 25 percent. All figures are rounded to the nearest 1,000 flasks.
b. See Table 3, p.10, above.
c. The figures have a range of error of plus or minus 20 percent. They are based on known imports to the Sino-Soviet Bloc from Free World sources, from agents of the Sino-Soviet Bloc, and from Free World traders and on shortages in Free World markets in 1954 (for a tabulation of imports of mercury by the Sino-Soviet Bloc from Free World sources, see Appendix A).

used to establish general trends in the rate of consumption, and tentative estimates may be made by applying these trends to the estimated pre-World War II rate.

In general, the trend of mercury consumption rose sharply from about 10,000 flasks in 1940 to about 17,000 or 18,000 flasks a year during World War II.* The rate of consumption from 1947 to 1954 is estimated to have risen steadily for the following reasons:

a. The supply of mercury available for consumption has risen sharply (see Table 4**).

b. Over-all industrial productivity in the USSR has increased, 49/ probably accompanied by a rise in mercury consumption.

c. It appears that use of mercury fungicides and pesticides is increasing in Soviet agriculture as it is in the US. 50/ In 1953 and 1954, requests for "Granazan," an ethyl-mercuric chloride used in seed treatment to increase the percentage of germination, have appeared. 51/

d. The general substitution of lead azide for mercury fulminate in detonators and blasting caps in the US apparently has not been paralleled in the USSR. 52/

e. Because of the widespread use of mercury in electrical equipment, mercury consumption in the electrical industry tends to follow closely changes in production levels. During the 1948-54 period, production by the electric equipment industry increased so that the 1954 production was approximately three times that of 1948. 53/

Estimated consumption of mercury in the USSR from 1948 through 1954 is given in Table 6.***

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* See Appendix B.

** P. 11, above.

*** Table 6 follows on p. 15.

Table 6

Estimated Consumption of Mercury
in the USSR a/
1948-54

Year	Flasks Quantity b/
1948	9,000
1949	10,000
1950	11,000
1951	13,000
1952	14,000
1953	15,000
1954	15,000

a. The range of error is plus or minus 40 percent.
b. Based on the probable trend resulting from increases in supply, increases in general productivity, and increases in several specific mercury-consuming industries applied to prewar and early postwar consumption (see Appendix B).

2. Use Pattern.

Because of the highly diversified nature of mercury consumption and because of the dearth of data regarding Soviet consumption, only speculative estimates can be made of quantities of mercury consumed in the various uses. Within a total estimated consumption of 15,000 flasks in 1954, however, some rough approximation based upon the following probabilities has been made:

a. The Soviet electrical equipment industry is about one-third the size of the US industry, 54/ and the input coefficient of mercury for this industry probably is the same.

b. Mercury products, especially fungicides, are becoming increasingly important in US agriculture, 55/ consuming about 7,000 flasks in 1953. 56/ The USSR uses mercury products in agriculture 57/ and, in view of Soviet pressure to increase agricultural output, may be consuming half as much as the US.

c. Soviet consumption of mercury fulminate in detonators and blasting caps will substantially exceed US consumption because of the substitution of lead azide in the US. Estimates of Soviet consumption are based upon rounds of ammunition produced, plus an arbitrary estimate to cover other explosives. 58/

d. The consumption of mercury in the production of caustic soda in the USSR is very small because of the limited use of the mercury cell. Of a total of 387,000 metric tons of caustic soda produced in 1953, only about 10,000 metric tons requiring a consumption of about 145 flasks of mercury came from mercury cells. 59/

The estimated use pattern of mercury in the USSR in 1954 is given in Table 7.*

B. European Satellites and Communist China.

1. East Germany.

Large quantities of mercury are consumed in East Germany by the chemical industry. East Germany is second only to the USSR in mercury consumption in the Sino-Soviet Bloc.

* Table 7 follows on p. 17.

Table 7

Estimated Use Pattern of Mercury
in the USSR a/
1954

Use	Flasks Quantity
Electrical equipment	3,000 b/
Agriculture	3,000 c/
Explosives	3,000 d/
Other	6,000 e/
Total	15,000

a. The range of error is plus or minus 50 percent.
b. Based on the comparative sizes of US and Soviet industries.
c. Based on US consumption and Soviet efforts to increase agricultural productivity.
d. Based on estimated consumption in ammunition plus an arbitrary estimate for other explosives.
e. The difference between consumption accounted for and estimated total consumption.

Estimates of consumption by use are based on allocations or on production of mercury-consuming products and appropriate East German mercury-consumption coefficients. 60/ The estimated use pattern of mercury in East Germany from 1952 through 1954 is given in Table 8.*

* Table 8 follows on p. 18.

Table 8

Estimated Use Pattern of Mercury
in East Germany a/ 61/
1952-54

Flasks

Use	1952	1953	1954
Caustic soda	2,700	2,900	3,400
Acetaldehyde	2,000	2,100	2,300
Explosives	900	1,100	1,100
Caustic potash	200	200	200
Electrical equipment	200	300	300
Miscellaneous	600	600	800
Total	7,000	7,000	8,000

a. The range of error (applying to totals) is plus or minus 15 percent. All detail figures are rounded to the nearest 100 flasks; all total figures are rounded to the nearest 1,000 flasks.

2. European Satellites and Communist China.

The aggregate consumption of mercury in the other European Satellites and Communist China is substantial. Estimates of consumption for each country for the period from 1950 through 1954 are made on the basis of apparent consumption -- that is, production plus imports. The estimated consumption of mercury by the European Satellites and Communist China from 1950 through 1954 is given in Table 9.*

* Table 9 follows on p. 19.

Table 9

Estimated Consumption of Mercury
by the European Satellites and Communist China a/
1950-54

Flasks

Country	1950	1951	1952	1953	1954
Bulgaria	200 b/	200 c/	200 b/	200 d/	200 b/
Communist China	1,000 e/	1,000 f/	1,500 g/	1,500 h/	2,000 i/
Czechoslovakia	3,500 j/	4,000 k/	4,000 k/	4,500 k/	4,500 l/
East Germany	5,000 m/	6,000 m/	7,000 m/	7,000 m/	8,000 m/
Hungary	1,400 n/	1,400 o/	1,500 p/	1,500 q/	1,500 g/
Poland	2,000 r/	2,500 s/	2,500 t/	3,000 u/	3,000 g/
Rumania	1,200 n/	1,200 v/	1,200 v/	1,300 v/	1,300 g/
Total	14,000	16,000	18,000	19,000	20,000

a. The range of error is plus or minus 25 percent. All country figures are rounded to the nearest 100 flasks and all total figures to the nearest 1,000 flasks. Albania has no known production or imports, and consumption is estimated to be negligible.
b. Based on 1951 and 1953 figures, assuming consumption to be constant.
c. Based on 1951 imports of 180 flasks from the USSR. 62/
d. Based on 1953 imports of 145 flasks from the USSR. 63/
e. Based on production (see Table 2, p. 9, above).
f. 1950 consumption is assumed to be constant.
g. 1953 consumption is assumed to be constant.

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Table 9

Estimated Consumption of Mercury
by the European Satellites and Communist China a/
1950-54
(Continued)

h. 64/
i. Projected on the basis of increased consumption from 1950 through 1953.
j. Based on planned 1949 consumption. 65/
k. Based on estimated cumulative 1950-53 imports of 11,500 flasks and estimated 1950-53 cumulative production of 4,000 flasks and -- assuming that annual consumption equals annual available supply -- distribution of the cumulative supply over the 3-year period, assuming increases in consumption over the 1949 planned level. 66/ Cumulative 1950-53 imports were as follows: 4,335 flasks from Italy, 67/ 6,298 from the UK, 68/ 43 from Trieste, 69/ and 400 from the USSR. 70/
l. 1953 consumption is assumed to be constant.
m. Derived from source 71/ and rounded to the nearest 1,000 flasks. The figures have a range of error of plus or minus 15 percent.
n. 1951 consumption assumed to be constant.
o. Based on 1951 imports of 377 flasks from Italy, 72/ 500 from Switzerland, 73/ 290 from Trieste, 74/ and 154 from Communist China. 75/
p. Based on 1952 imports of 56 flasks from the UK, 76/ 780 from Italy, 77/ 213 from Switzerland, 78/ 220 from Belgium, 79/ and 100 from West Germany. 80/
q. Based on 1953 imports of 865 flasks from the UK, 81/ 580 from Italy, 82/ and 10 from West Germany. 83/
r. Based on 1950 imports of 1,653 flasks from Italy. 84/
s. Based on 1951 imports of 2,176 flasks from Italy 85/ and 87 from the UK. 86/
t. Based on 1952 imports of (and assuming no decrease from 1952), 1,218 flasks from Italy 87/ and 551 from the UK. 88/

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Table 9

Estimated Consumption of Mercury
by the European Satellites and Communist China a/
1950-54
(Continued)

u. Based on 1953 imports of 2,862 flasks from Italy. 89/

v. Based on estimated cumulative 1951-53 imports of about 3,000 flasks and estimated cumulative 1951-53 production of 700 flasks and distribution of the cumulative supply over the period on the assumption of a rise in consumption levels. Cumulative 1951-53 imports were as follows: 1,829 flasks from Italy, 90/ 180 from the UK, 91/ and 917 from the USSR. 92/

C. Sino-Soviet Bloc.

The estimated total consumption of mercury in the Sino-Soviet Bloc from 1950 through 1954 is given in Table 10.

Table 10

Estimated Total Consumption of Mercury
in the Sino-Soviet Bloc a/
1950-54

Flasks

Year	Quantity
1950	25,000
1951	29,000
1952	32,000
1953	34,000
1954	35,000

a. Based on Table 6, p. 15, above, and Table 9, p. 19, above. The range of error is plus or minus 50 percent.

IV. Stockpiling.

A. USSR.

1. Direct Evidence.

There is available direct evidence to establish the following data concerning a Soviet stockpile of mercury:

a. A stockpile of mercury exists in the USSR under the Ministry of State Reserves. 93/

b. Mercury is stocked at a number of deposits dispersed throughout the country, including producing installations. This is established by specific shipments made by Combine No. 5 imeni Frunze and statements made by returning prisoners of war claiming to have seen flasks of mercury in various depots. 94/

c. One depot, at Voyennyi Gorodak, 50°15' N - 107°20' E, near Irkutsk, held a minimum of 8,400 flasks as of 1 November 1950. 95/

2. Deduced Data and Hypothetical Estimates of Quantity.

On the basis of the excess of supply over consumption during the war years,* it is estimated that by 1946 the USSR had accumulated a stockpile of about 10,000 flasks. It is known that quantities of mercury were being added in the 1949-51 period. 96/ The estimated stockpile of mercury in the USSR from 1947 through 1954 is given in Table 11.**

B. European Satellites and Communist China.

There is no evidence of a strategic stockpile of mercury in the European Satellites or Communist China. Where state reserves are maintained, as they are in East Germany, the purpose is to control distribution. 97/ Such stocks must be considered as working inventories. On the basis of general practice in the Free World, it is estimated that 10,000 to 15,000 flasks would be in working inventories and in transit throughout the Sino-Soviet Bloc. Adding this amount to the 58,000 flasks estimated in the Soviet stockpile yields a total reserve supply of 65,000 to 75,000 flasks.

* See Appendix B.

** Table 11 follows on p. 24.

Table 11

Estimated Stockpile of Mercury
in the USSR a/
1947-54

Flasks

Year	Quantity Added b/	Accrued Total
1947	N. A.	10,000
1948	N. A.	10,000
1949	2,000	12,000
1950	3,000	15,000
1951	5,000	20,000
1952	11,000	31,000
1953	12,000	43,000
1954	15,000	58,000

a. The range of error is plus or minus 50 percent.
b. Represents the difference between estimated supply (see Table 4, p. 11, above) and estimated consumption (see Table 6, p. 15, above).

VI. Consumption of Related Resources.

A. Ore.

1. USSR.

The ore mined by Combine No. 5 imeni Frunze averages about 0.25 percent metallic mercury 98/ and by the Nikitovka Combine about 0.4 percent, 99/ and the small quantities produced by other scattered mines are assumed to average about 0.4 percent. The bulk of the mercury ores mined in the

USSR contain antimony. In order to eliminate antimony from the metallic mercury end product, it is thus necessary to beneficiate the ores by flotation before smelting. In 1940, mercury metal losses in beneficiation were reported to be about 25 percent in the USSR. An additional 10 percent mercury metal was reported lost in the smelting process 100/ (only a few percent higher than in current US operations). US investigations indicate a maximum probable recovery of 85 percent in beneficiation. 101/ Therefore, it is not likely that any great reduction in beneficiation losses has been achieved by the USSR since 1940.

2. Communist China.

The ore reserves of Communist China average about 1 percent metal content. There is no problem of removing antimony or other associated minerals, and in general there is no ore dressing other than hand sorting. Traditionally the ores were smelted in primitive retorts with losses of metal averaging about 40 percent. 102/ Some modern Soviet equipment has been introduced and by 1953 over-all losses may be reduced to about 35 percent. Estimated mercury ore mined in the Sino-Soviet Bloc from 1948 through 1954 is given in Table 12.* The USSR and Communist China produced about 97 percent of the Sino-Soviet Bloc output of primary mercury in 1954. Production in Czechoslovakia is byproduct in nature, and probably the output in Rumania is also. The ore treated in these two countries is not considered.

B. Fuel, Power, and Labor.

Because fuel oil lends itself to better control of heat levels, it is generally used for smelting purposes by the major producers of mercury throughout the world. In view of the relative proximity of the Soviet mercury plants to oilfields, it is assumed that the bulk of the fuel used in Soviet production of mercury is also fuel oil. In Communist China, many of the facilities are very primitive, and the fuel consumed probably varies widely, with a high proportion being charcoal and wood. For the purpose of estimating quantities consumed, however, all figures

* Table 12 follows on p. 26.

Table 12

Estimated Mercury Ore Mined in the Sino-Soviet Bloc a/
1948-54

Thousand Metric Tons

Year	USSR				Communist China	Bloc Total
	Combine No. 5 imeni Frunze b/	Nikitovka Combine c/	Other c/	Total	Total d/	
1948	180	10	10	200	e/	200
1949	200	10	10	220	e/	220
1950	290	30	10	330	10	340
1951	330	50	10	390	10	400
1952	370	130	10	510	20	530
1953	410	130	10	550	30	580
1954	430	130	10	570	40	610

a. Communist China and the USSR produced about 97 percent of total Bloc production of primary mercury in 1954. All figures are rounded to the nearest 10,000 tons. The margin of error is plus or minus 35 percent.

b. Figures are based on estimated production of primary mercury, an average ore content of 0.25 percent, ore dressing recovery of 75 percent, and smelting recovery of 90 percent.

c. Figures are based on estimated production of primary mercury, an average ore content of 0.4 percent, ore dressing recovery of 75 percent, and smelting recovery of 90 percent.

d. Figures are based on estimated total production of mercury, an average ore content of 1 percent, a 1948-52 smelting recovery of 60 percent, and a 1953-54 smelting recovery of 65 percent.

e. Less than 5,000 tons.

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are given in terms of fuel oil. The consumption of fuel, power, and labor in mercury production in Czechoslovakia and Rumania is not considered, because of the byproduct nature of the output and the small quantities involved. Estimated major input requirements and related production figures for the mining and smelting of primary mercury in the USSR and Communist China from 1948 through 1954 are given in Table 13.*

VII. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

On the basis of ore reserves, the Sino-Soviet Bloc is capable of expanding the production of mercury over a 10-year period. The most promising area for increasing production is in Central and South China, where a great number of small deposits occur over an area about 420 miles long by 180 miles wide. 103/ Despite extremely primitive operations, Communist China has produced significant quantities of mercury in the past. The most pressing need is for modern equipment and technological competence, both of which are being supplied by the USSR.

The second promising area is in Central Asia of the USSR (Economic Region Xb), where Combine No. 5 imeni Frunze has increased production rapidly from 1940 to the present. Current operations are based upon 5 or 6 large, low-grade ore deposits. In addition to those deposits now being exploited, there are a large number of smaller deposits in the area, some of which may be commercially exploitable. 104/

The Nikitovka Combine in the Ukraine should be able to maintain current production for many years on the basis of ore reserves, estimated in 1940 to contain about 350,000 flasks of metal. 105/ Ore reserves in Czechoslovakia and Rumania are small and low in grade, and it will be difficult to maintain current output.

* Table 13 follows on p. 28.

Table 13

Estimated Major Input Requirements and Related Production Figures
for the Mining and Smelting of Primary Mercury in the USSR and Communist China a/
1948-54

	1948	1949	1950	1951	1952	1953	1954
USSR							
Production (flasks) b/	10,000	12,000	17,000	21,000	29,000	31,000	31,000
Ore treated (thousand metric tons) c/	200	220	330	390	510	550	570
Fuel oil (thousand gallons) d/	20	24	34	41	57	61	62
Electric power (thousand kwh) e/	7,000	7,700	11,600	13,700	17,900	19,300	20,000
Labor (man-years) f/	3,600	3,900	5,900	7,000	9,100	9,800	10,200
Communist China							
Production (flasks) g/	h/	h/	1,000	2,000	3,000	5,000	7,000
Ore treated (thousand metric tons) c/	i/	i/	i/	10	20	30	40
Fuel oil (thousand gallons) d/	10	20	50	70	140	210	280
Electric power (thousand kwh) e/	j/	j/	j/	100	200	300	400
Labor (man-years) f/	k/	k/	260	400	800	1,200	1,600

a. In 1954 the USSR and Communist China together produced over 97 percent of the total output of primary mercury in the Sino-Soviet Bloc.

b. Total production by Combine No. 5 imeni Frunze and the Nikitovka Mercury Combine (see Table 1, p. 6, above) plus an arbitrary estimate, less than the rounding error, to cover small mines in the USSR.

c. See Table 14, p. 33, below.

d. See Appendix B. All figures are calculated from unrounded data and rounded to the nearest 1,000 gallons.

e. See Appendix B. All figures are rounded to the nearest 100,000 kwh.

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Table 13

Estimated Major Input Requirements and Related Production Figures
for the Mining and Smelting of Primary Mercury in the USSR and Communist China a/
1948-54

f. See Appendix B. All figures are rounded to the nearest 100 man-years.
g. See Table 2, p. 9, above.
h. Less than 1,000 flasks.
i. Less than 10,000 tons.
j. Less than 100,000 kwh.
k. Less than 100 man-years.

Additional increases in productivity may be obtained through technological improvement. Metal losses in Communist China, estimated at about 35 percent in smelting, are excessive. Given modern equipment and competence, the recovery of metal may approach standards in the US, where recovery averages up to 95 percent. 106/ Less can be accomplished through technological advance in the USSR because of the beneficiation required by the presence of antimony. Recovery in ore dressing, however, may be raised to 80-85 percent, and some small increase could possibly be achieved in smelting.

B. Vulnerabilities.

Under present conditions the production of mercury in the Sino-Soviet Bloc is adequate to meet consumption requirements; imports for the Bloc as a whole are not required. The bulk of the output, however, is concentrated within 3 areas -- Central and South China, Central Asia, and the Ukraine -- 2 of which are remote from the major consuming areas of the European USSR, East Germany, and Czechoslovakia. The European Satellites by themselves are particularly vulnerable, being largely dependent on imports from the USSR and Communist China.

It is probable that Soviet requirements could be reduced substantially, if necessary, by the substitution of other materials -- for example, lead azide for mercury fulminate in explosives. In East Germany, however, it would be more difficult to reduce requirements. A major portion of the mercury consumed is used in the manufacture of chlorine and caustic soda, and a shift to processes not using mercury would require substantial capital investment in new equipment.

C. Intentions.

On the basis of conventional uses, mercury is not, on the whole, a good indicator of intentions because it is consumed in relatively small quantities in a very wide range of uses, both military

and civilian. Although mercury has many military applications, some of which are highly strategic, readily available substitutes in most uses are known. In many cases, however, the substitutes are less efficient of more costly, but they would be adequate in an emergency.

In the past the consumption of mercury fulminate in detonators has been a good indicator of military intentions. During World War II, however, the US substituted lead azide -- in some ways a product superior to mercury fulminate. Although the Sino-Soviet Bloc apparently has not made the shift to lead azide in quantity, the change could be made in a relatively short period of time.

Of interest is the recent flurry of press comment concerning the possibility of some new, highly strategic, and highly secret use of mercury requiring consumption of large quantities. To date, these rumors have not been confirmed, although the great activity in Free World mercury markets in 1954 may give some credence. Insofar as the Sino-Soviet Bloc is concerned, there is to date no evidence to support unusual interest in obtaining any exceptionally large quantity.

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APPENDIX A

FREE WORLD SOURCES OF MERCURY

Estimated imports of mercury by the Sino-Soviet Bloc from the Free World from 1947 through 1954 are given in Table 14.

Table 14

Estimated Imports of Mercury by the Sino-Soviet Bloc from the Free World a/*
1947-54

Flasks

Destination	1947	1948	1949	1950	1951	1952	1953	1954
USSR	2,900 b/	4,350 b/	3,480 b/				1,160 c/	
Albania								
Bulgaria							145 d/	
Communist China								
Czechoslovakia	2,987 e/	1,557 f/	754 g/	2,510 h/	1,838 i/	2,491 j/	3,837 k/	577 l/
East Germany		2,240 m/	580 n/	934 o/	1,740 p/	500 q/		
Hungary	667 b/	783 b/			1,167 r/	1,389 s/	1,455 t/	665 u/
Poland				1,653 q/	2,258 v/	1,769 w/	2,862 x/	1,824 y/
Rumania		290 b/			725 z/	1,005 aa/	280 bb/	
Total	6,554	9,220	4,814	5,097	7,728	7,154	9,739	3,066

* Footnotes for Table 14 follow on p. 34.

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Table 14

Estimated Imports of Mercury by the Sino-Soviet Bloc from the Free World a/
1947-54
(Continued)

a. The figures represent actual and probable shipments. They are based on fragmentary evidence and should be considered minimal.
b. From Yugoslavia. 107/
c. From Spain. 108/
d.
e. 1,508 flasks from Italy 110/ and 1,479 from Yugoslavia. 111/
f. ___/ and 957 from Yugoslavia. 113/
g. 580 flasks from Yugoslavia 114/ and 174 from Trieste. 115/
h. 1,015 flasks from Italy 116/ and ___
i.
j. 913 flasks from Italy. 119/ 120/ and 43 from Trieste. 121/
k. and 2,407 from Italy. 122/
l. 177 flasks from Italy 123/ and 400 from Rotterdam, origin unknown. 124/
m. 1,302 flasks from Yugoslavia and 938 from Italy. 125/
n. From Yugoslavia. 126/
o.
p. 1,160 flasks from Switzerland and
q. From Italy. 129/
r. 377 flasks from Italy, 130/ 500 from Switzerland, 131/ and 290 from Trieste. 132/
s. 133/ 780 from Italy, 134/ 213 from Switzerland, 135/ 220 from Belgium, 136/
and y. 137/
t. 138/ 580 from Italy, 139/ and 140/
u. 141/ and 350 from Italy. 142/
v. 143/ and 2,176 from Italy, 144/
w. 145/ and 1,218 from Italy. 146/

Table 14

Estimated Imports of Mercury by the Sino-Soviet Bloc from the Free World a/
1947-54
(Continued)

x. From Italy. 147/
y. ___ and 500 from Italy. 149/
z. From Italy. 150/
aa. 984 flasks from Italy, 151/
bb. 120 flasks from Italy 154/ an

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APPENDIX B

METHODOLOGY

1. Consumption.

Consumption estimates for the years 1940 and 1946 and the average during the World War II period are established on the basis of apparent consumption -- that is, the supply available for consumption.

a. 1940.

The supply available for consumption consisted of domestic production, imports and exports for the period 1937 to 1940 being negligible. Domestic production is estimated at 10,000 flasks in 1940, interpolated from a production of 8,700 flasks in 1937 and a planned production under the Third Five Year Plan (1938-42) of 11,300 flasks in 1942. 156/ Capacity to meet the Plan was available at Nikitovka. 157/

b. Average Consumption, 1941 to 1945.

The supply of mercury available for consumption for the period 1941 to 1945 averaged 20,000 flasks per year and consisted of imports from the wartime allies, including China, and some domestic production. 158/ For the following reasons it is estimated that 2,000 to 3,000 flasks of this supply went into reserves: (1) it was the policy of the Soviet government to obtain as much as possible of any given commodity under Lend-Lease terms; (2) a mercury stockpile was known to exist in the early postwar years 159/; (3) at least one Lend-Lease shipment of mercury is known to have gone directly into state reserves. 160/

c. 1946.

The supply of mercury in 1946 available for consumption consisted principally of domestic production which, on the basis of extrapolation backwards from the 1948 estimate given in Table 1,* would be 7,500 flasks. This estimate is supported by the implication that the widespread destruction of World War II would have reduced consumption below that of the 1937-40 period of 8,700 to 10,000 flasks a year.

2. Consumption of Other Resource Factors.

a. Estimates of Fuel Oil Consumption.

On the basis of standard practice in the US and elsewhere, about 7 gallons of fuel oil are required for 1 ton of feed in smelting. 161/ In the USSR the smelter feed consists of concentrates averaging about 15 percent metal. 162/ Metal losses in smelting are estimated at 10 percent. Therefore, the quantities of fuel oil used in the smelter are established by the following formula:

$$\text{Gallons of fuel oil} = \frac{7 \times \text{the tons of mercury produced}}{0.90 \times 0.15}$$

The figure derived from the above formula is multiplied by 1.10 in order to cover other miscellaneous uses.

Fuel consumption in China is estimated as equivalent to 8 gallons of fuel oil, allowing for the primitive nature of much of the equipment. The ore, averaging 1 percent metal content, is fed directly into the smelter, in which losses are estimated at 35 to 40 percent. 163/ No allowance is made for consumption in other miscellaneous uses, which is believed to be negligible.

* P. 6, above.

b. Estimates of Electric Power Consumption.

The consumption of electric power in mining varies widely according to the method of mining, the means of ore transport, the quantity of water pumped, and many other factors. In the US, where the mined ore is smelted directly, power consumption in 1939 averaged about 20 kwh per ton of ore mined and smelted. 164/ Electric power consumption in a modern furnace is about 10 kwh per ton of feed, indicating that the power consumption in US mining alone in 1939 was about 10 kwh per ton. An additional factor of 25 kwh per ton of ore treated is allowed for beneficiation, based upon general US flotation practices. 165/ Soviet plants have been built since 1940 and are presumed to be relatively modern and efficient installations, so that the above factors were applied directly to estimated quantities of (1) ore mined, (2) ore beneficiated, and (3) concentrates smelted.

A rough estimate of 10 kwh per ton of ore mined and smelted is used for the primitive operations and methods of China.

c. Estimate of Labor Requirements.

Information on labor requirements for production of mercury is sparse, but some information is available on antimony, frequently a coproduct in the USSR. For example, the Khaydarkan and Kadamdzhay operations of Combine No. 5 imeni Frunze produce both metals from the same ore. The ore yield per man-year in mining operations of the antimony industry for the period from 1948 to 1953 averaged 70 tons. 166/ The labor requirements for mining mercury ore were obtained by applying this factor to the estimated quantity of mercury ore mined (see Table 12*). The additional labor for milling and smelting is estimated by assuming that about 20 percent more is required for milling and 5 percent more for smelting.

* P. 26, above.

Chinese Communist labor requirements are derived by modifying the ore yield per man-year to 30 tons because of the large number of small operations and the primitive methods and equipment in use. Because the ore is not concentrated before smelting, it is estimated that an additional 20 percent of labor is required for smelting.

APPENDIX C

GAPS IN INTELLIGENCE

A minor metal such as mercury, produced in relatively small tonnages and consumed in small quantities in over 3,000 uses, is the subject of far less information than the more common materials produced, consumed, and traded by the Sino-Soviet Bloc in greater quantities. The major deficiencies of information are as follows:

1. Production.

The most difficult problem regarding production is establishing country totals. For the USSR there has not been reported a single total by country or by combine, either for any year during the post-World War II period or as a percentage change over a previous time period. For Communist China, with the exception of a possibly true figure for 1951, no total figures have been obtained during the period of the Communist occupation. There is a similar lack of data on Czechoslovakia and Rumania.

2. Trade.

Information on shipments between countries of the Sino-Soviet Bloc is fragmentary, consisting almost entirely of movements from the USSR to East Germany and, on occasion, to other European Satellites

More information is available on exports to the Sino-Soviet Bloc by the Free World. The officially reported exports to the Bloc by Free World countries, except Italy, are not complete, even though before 16 August 1954 no export controls were maintained on such trade. With the use of reasonable estimates of the order of magnitude have been established.

3. Consumption.

Reports of quantities of mercury consumed in any single pertinent category are not available except for East Germany. Derived estimates of mercury consumption on the basis of production of end products are very difficult because of lack of data on such production. The normal consumption of mercury is by small quantities in a very wide range of uses -- many highly specialized -- and the pattern of consumption varies widely from country to country. Therefore, analogous estimates on the basis of consumption in the US or other countries are weak.

4. Inputs.

Information on inputs is almost totally lacking. Therefore, any data on individual mines or plants would be of value. All estimates of such factors in this report were derived by indirect methods.