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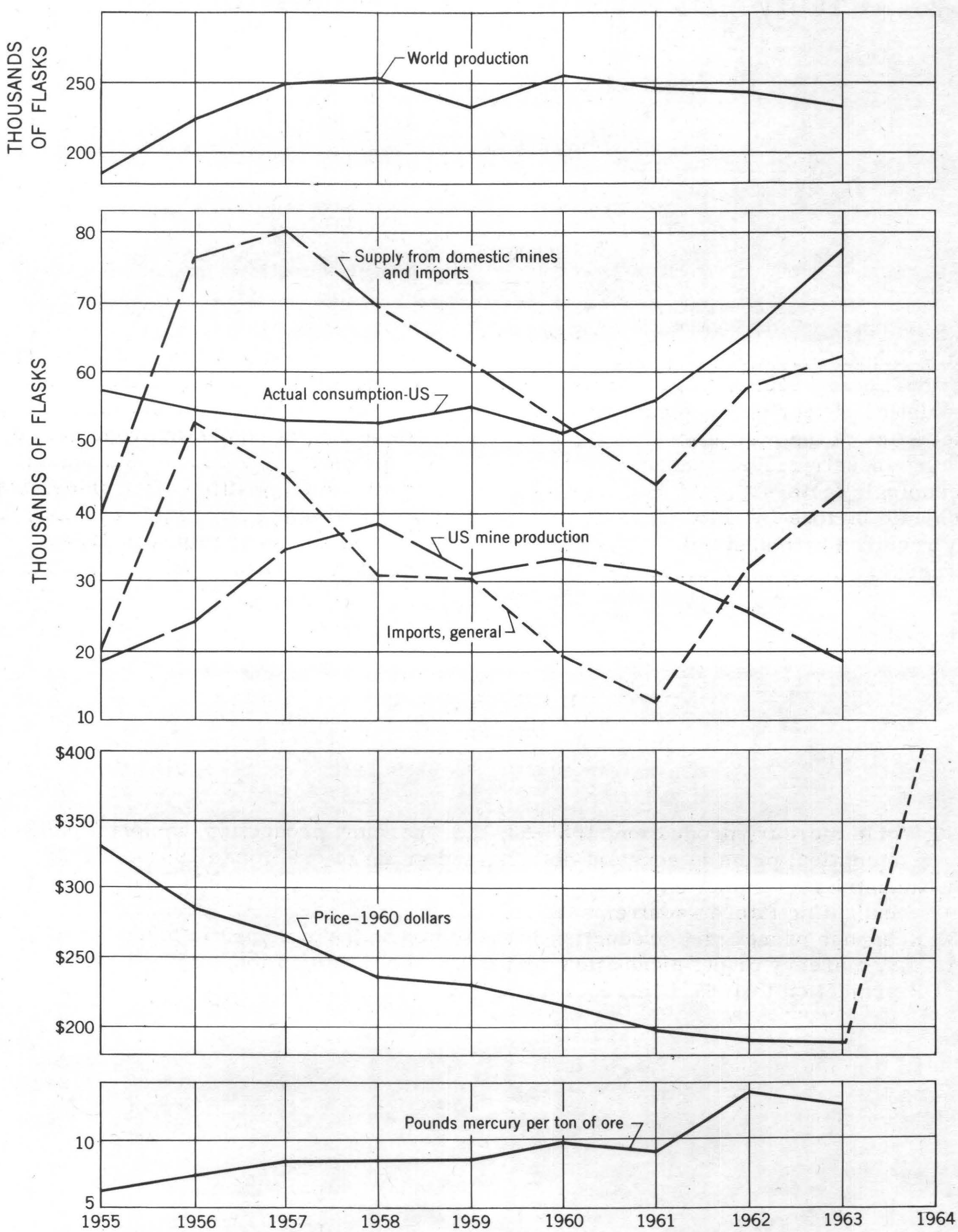

Figure 1.—World mercury production, 1955–63; U.S. mercury production, imports, consumption, price in constant dollars, and grade of o.e mined, 1955–63.

Mercury—Its Occurrence and Economic Trends

By Edgar H. Bailey and Roscoe M. Smith

ABSTRACT

In 1963 the domestic production of primary mercury was less than one-fourth of the domestic consumption, largely because a series of years of declining price led to the closing of most of the domestic mines. During 1963 and 1964 the U.S. price, which usually responds to world price, increased from $180 to about $500 a flask. Should the fluctuation in price and production conform to a previously established pattern, the response of the domestic industry to an increased price will be a predictable increase in production. If the price averages $300 a flask for 1 year or more, annual production may increase to a rate of 30,000–35,000 flasks in 1966 or 1967. If the price averages $400 a flask, production may increase to 45,000–50,000 flasks a year after a timelag of two or three years. New ore bodies would have to be found, however, to attain these rates of production, and the mining of lower grade ores would be needed to sustain them for more than a few years.

By 1966 the U.S. economy will require at least 67,000 flasks, and the domestic demand for mercury thereafter will continue to increase. The probability that domestic mines will continue to supply a fourth or more of the domestic consumption is dependent upon the price of mercury for the next few years. The outlook for the long-term supply is reassuring, but it is dependent, not only upon price, but upon continued progress in new techniques of discovery.

INTRODUCTION

In 1963 the consumption of mercury in the United States reached an alltime high of 77,936 flasks[1] while concurrently the domestic production declined to 19,104 flasks, the lowest level of the past 9 years, as is shown on figure 1. While the U.S. production was declining, the world production remained nearly constant, and increasing demand, both here and abroad, reduced available stocks to a minimal level. As a result of increased labor costs, Italian producers raised their price in late 1963, and subsequently prices increased throughout the world. The U.S. price of mercury, which is established by the world market, had been gradually declining since 1955 and was at a low of about $180 a flask, but in early 1964 it had risen to $275 a flask, and by December it had reached about $500 a flask. The purpose of this report is to analyze the present large gap between domestic production and consumption of mercury and to discuss the probable effect on domestic production of the recent increase in the price in the light of the unusual characteristics of mercury.

The statistical data in this report are compiled from records of the U.S. Bureau of Mines. The authors are pleased to acknowledge, also, the valuable comments of Mr. John E. Shelton, commodity specialist, U.S. Bureau of Mines, who reviewed the manuscript.

CHARACTERISTICS OF MERCURY DEPOSITS

All major mercury deposits are epithermal—deposited by rising warm solutions at comparatively shallow depths ranging from a few feet to a little more than 2,000 feet beneath the surface. Half of the domestic mines that have yielded a hundred or more flasks of mercury are less than 200 feet deep, and only six of the larger mines are more than 1,000 feet deep.

Because of their shallow character, mercury deposits, once formed, are generally quickly removed by erosion. The deposits available for mining in the United States are those so young that they have not yet been eroded; they are found in the western part of the United States in a region of recent volcanic and tectonic activity. For this reason, and other more subtle geologic considerations, it would be useless to look for epithermal mercury deposits in any of the major regions of the United States other than those in which mercury has already been found.

[1] The unit of marketing in the mercury industry is a steel flask containing 76 pounds of mercury.

A second geologic consequence of the shallow character of mercury deposits is the presence of near-surface products of hydrothermal alteration in addition to the mercury that has been introduced. The alteration often takes the form of the conversion of feldspar to clay with the result that many deposits are in "heavy ground"—that is, ground in which mine openings must be constantly repaired to keep them open. Although a significant number of the deposits in the California Coast Ranges are in a hard alteration of serpentine (silica-carbonate rock) in which stopes remain open for years, the surrounding rocks are usually mashed serpentine or altered sandstone, and the adits providing access to the stopes are quickly lost if the workings are not maintained.

Mercury ore bodies are generally smaller and more erratic in distribution than deposits of other minerals. Although the largest mines have the most continuous ore bodies, in only a few of these have reserves been blocked out a year in advance of mining, and in many smaller mercury mines the ores to be exploited a year later are largely in the "hoped-for" category. A continual search for new ore bodies is required for sustained production in many of the mines, and the ratio of exploration costs to production costs may be high.

All the domestic mercury mines and all the larger ones in the rest of the world are operated solely for the value of the mercury in their ores, and no byproducts are recovered. There are exceptions in some of the smaller mines, however, and mercury has been recovered as a byproduct of gold mining in Chile, iron mining in Czechoslovakia, and lead mining in Tunisia, Algeria, and elsewhere. Ores from Huitzuco, Mexico, yielded both antimony and mercury, and ores of the Red Devil mine in Alaska contained much more antimony than mercury, although none of the antimony was recovered. Nonetheless, because of the general isolation of mercury ores from other metals, neither the domestic nor world production of mercury is appreciably affected by gross change in the value of other metals.

Although thousands of small deposits have been exploited, only a few small areas yield the bulk of the world supply. Of the entire world production, one-third has come from 1 mine, one-half from 2, and three-fourths from only 6 mines or districts. The source of domestic production is strikingly similar; one-third has come from 1 mine, one-half from 2, and three-fourths from 7 mines or districts.

In only a few mines are deposits of less than ore grade sufficiently well known to estimate tonnage and grade, but low-grade deposits in other mines are suspected.

CHARACTERISTICS OF THE MERCURY-PRODUCING INDUSTRY

Several features of the technology of the recovery process and of the economics of the mercury-mining industry reflect the unique or unusual properties of the metal and the unusual characteristics of the deposits. The background factors that need to be considered in a realistic appraisal of the present status and probable future of the industry are summarized below.

TECHNOLOGIC FACTORS

Mercury is easily recovered from its common mercury sulfide ores by heating in either a retort or furnace; hence, 99.9 percent pure metal is generally recovered at the mine. The cost of constructing a recovery plant amounts to only about $1,000 per ton of daily capacity but varies from mine to mine as a result of differences in remoteness or inacessibility. Small retorts to treat a ton or so a day can be built by individual miners at comparable costs, or less if secondhand material and their own labor is used. The cost of furnacing the ore ranges from $2 to $10 per ton, varying according to size of the operation and access to fuel.

Mercury ore may be concentrated by tabling and flotation, but, because these processes require crushing or grinding, the concentrating cost generally exceeds that of direct furnace treatment. Leaching and recovery by chemical or electrolytic precipitation, followed by retorting, can be made an efficient method of recovery, but no large-scale application of this recovery process has met with economic success.

Generally 50–75 percent of the cost involved in the mining and treatment of normal ore is the cost of labor.

Mercury mining generally presents no special problems other than those due to the erratic distribution of the ore bodies and the "heavy ground" found in some of the mines. In a few mines explosive gas and excessive heat required special attention. Geologists are not employed at most mines, and geologic maps of workings are not maintained. Sampling and assaying procedures at many mines are crude or inadequate.

Secondary mercury, derived from scrap, has been of minor but increasing importance owing to the trend toward industrial uses in which the mercury is recoverable. In 1950, production of secondary mercury was 2,000 flasks, whereas in 1963 it was 5,920 flasks.

ECONOMIC FACTORS

Nearly all the world production of mercury is by seven countries, which in order of productivity in recent years are: Italy, Spain, United States, Russia, China, Mexico, and Yugoslavia. Much of the mercury produced in Russia and China remains behind the Iron Curtain, but mercury of Yugoslavia and the other nations is available to the Free World.

The largest and richest deposit is that of the great Almaden mine in Spain, which recently was processing ore containing 3.2 percent mercury as compared with 0.6 percent for U.S. deposits. Mine operation and marketing are controlled by the Spanish Government. Some of the furnacing and mining equipment has been modernized in recent years, and a new shaft has been sunk, partly to permit the hoisting of more ore and partly for exploration. Recent expansion of activity at other Spanish mines suggests that attempts to find and develop new ore bodies at Almaden did not come up to expectations, however, and increases in efficiency due to modernization may not have resulted in any appreciable reduction in overall costs because the Government feels obligated to provide a living for over 2,000 workers at Almaden. Nonetheless, there can be no doubt that mercury can be recovered at Almaden more cheaply than at any other mine, and there is no reason to believe this condition will not continue for many years to come.

The Italian deposits, which are in part privately owned and in part held by a Government-financed organization, are operating on ores comparable in grade to those mined in the United States. Several of their plants were recently modernized, and the mines seem to be operated efficiently. The recent rise in mercury prices began when the Monte Amiata Co., which operates several of the large mines, increased its selling price because of "increased labor costs and decreasing ore values." Because less rewarding parts of the mines had been taken out of production in 1961, in spite of the suspension of the Italian production tax in 1959, it seems likely that their move to raise the selling price was really necessary for sustained production.

The selling price of the big producers of mercury, Italy and Spain, determines the world price, and hence the U.S. price. Prior to World War II these two countries regulated prices and sales through a cartel; since 1950 they have operated independently. Both the U.S.S.R. and China are believed to be producing annually several tens of thousands of flasks of mercury, most of which is consumed behind the Iron Curtain. The U.S.S.R. is aggressively searching for deposits and developing mercury mines. With only a small increase in production or decrease in consumption, either the U.S.S.R. or China could upset the normal trade pattern by dumping a few tens of thousands of flasks on the world market. A few years ago the U.S.S.R. brought about a temporary break in the world price by dumping into Europe several thousand flasks obtained from Yugoslavia. Conversely, because of the small quantities involved, a single new major use could easily increase the demand enough to bring about a sustained increase in price.

The mercury mining industry is small, both as compared to other mining industries and as compared to the industries requiring some mercury in their processes or products. The worth of the entire U.S. production in 1963 was about $3.6 million if computed at the average New York price, but actually somewhat less was received by the producers in the Far West. In 1943, when the productive peak of 51,929 flasks was achieved, the value was a little more than $10 million. In most years fewer than 1,000 persons are directly involved in all phases of the production of primary mercury.

MERCURY REQUIRED BY INDUSTRIAL CONSUMERS

Mercury is utilized by the U.S. industry in many diverse ways, and new uses are being constantly discovered. The greatest single use in recent years has been in plants manufacturing chlorine and caustic soda, where several thousand flasks are required initially for each new installation and about 8,000 flasks were required in 1963 just to replace losses. The domestic demand for chlorine has increased in recent years because it is used in the manufacture of plastics and detergents. Electrical apparatus requires a large amount of mercury each year, as does also the manufacture of toxic compounds, such as bactericides, fungicides, and mildewproofing paint. Significant amounts are used in dental preparations, medicines, mercury batteries, thermometers, atomic plants, and so on through a list of about 3,000 distinct uses.

Because domestic production expands during periods of war and the price increases as a result of unavailability of imports, mercury is generally thought of as a war mineral. It is better regarded as an industrial mineral because what increase there is in wartime consumption is largely a result of an increased use in many applications brought about by the general acceleration of manufacturing rather than by large consumption of mercury in war goods, such as fulminate and pharmaceuticals. That it is truly an industrial mineral is shown by the fact that the industrial consumption in 1963 was larger than at any time during either World War. Thus, even though mercury may be regarded as a strategic mineral that is necessary in times of war, it is equally vital to the U.S. economy in times of peace.

A graph of the annual average consumption of mercury in the United States since 1920 and a projection indicating future requirements are shown in figure 2. The trend line of consumption based on 10-year averages shows a remarkably steady increase and indicates that by 1980 there will be an annual domestic demand for at least 90,000 flasks. The trend of domestic consumption in 1960–63 shows a much higher rate of increase, but this increase is believed to be a short-term cyclic fluctuation resulting from new uses in electrical products and new caustic soda plants, both of which reflect general industrial expansion. The increase in consumption from 1960–63 is at a rate of about 10 percent per year, whereas the long-term growth is at a rate of about 2 percent per year. The rate of increase in consumption was greater than the increase of industry-wide spending on new plants and equipment, which rose from $34 billion in 1960 to nearly $40 billion in 1963, but it is more nearly comparable to the rapid growth of the chemical and electrical industries. Figure 2 suggests that, even though the 1963 consumption of 78,000 flasks was abnormally high, still greater consumption will be normal within a decade. The 1960–63 trend perhaps will not last many years, but the long-term consumption trend surely will continue.

MERCURY REQUIRED BY THE U.S. GOVERNMENT

The U.S. Government since World War II has purchased, either directly or indirectly, large amounts of mercury for the strategic

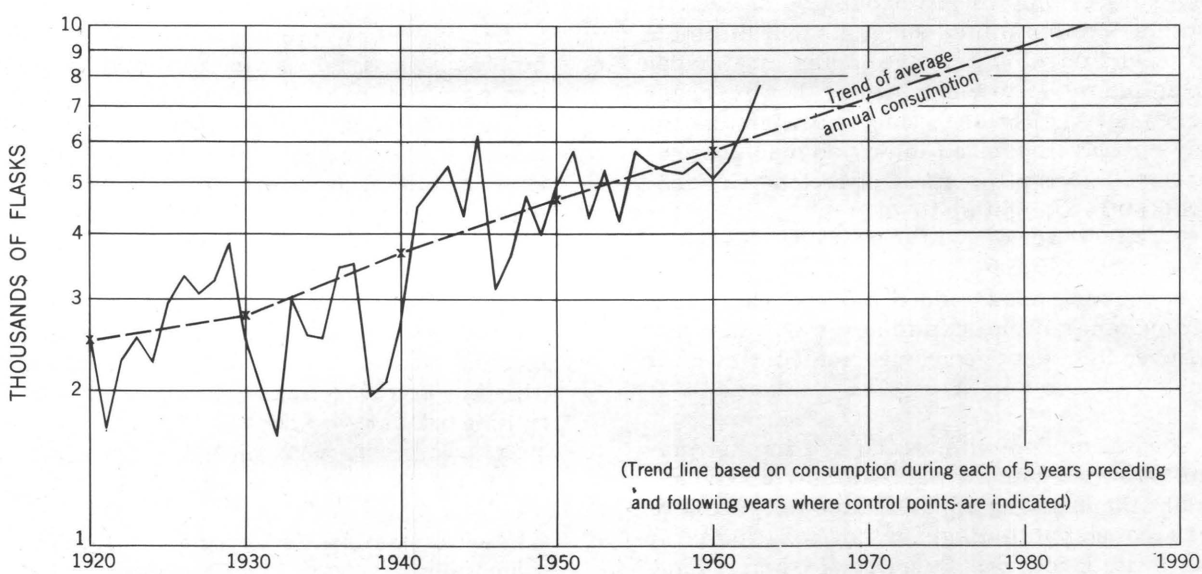

Figure 2.—Industrial consumption of mercury in the United States, 1920—63, and projection indicating future requirements.

or supplemental stockpile and for the AEC (Atomic Energy Commission). The stockpile objective was revised upward in mid-1963 by the Office of Emergency Planning to 200,000 flasks, and in 1964 the inventory was slightly above this figure owing to the transfer of 50,000 flasks from the AEC. The AEC also declared 65,736 additional flasks to be excess during 1964. One may conclude that the Government does not currently need additional mercury nor does it anticipate any expanded need in the future. Stockpile objectives have been re-evaluated several times, however, as industrial needs increased. The domestic mercury producers are well aware of the large quantity of mercury in Government hands and are keenly concerned about its release onto the open market. The release of even small amounts will depress the price. However, when the domestic consumption far exceeds production and the world demand remains at a high level, the sale of mercury by the Government at a limited rate, and only when the prevailing price is high, would protect both the consumer and the producer. The quantity that might be released without upsetting normal trade will vary inversely with domestic supply and should remain small enough to avoid any appreciable decrease in U.S. purchases from Italy or Spain, which is basically what determines the domestic price.

The domestic component of the mobilization base for mercury was set in 1956 at 7,500 flasks a year—a level that is adequate for mobilization purposes in view of the present stockpile inventory. Since 1956 the domestic mines have produced annually several times this amount, but if the 1961–63 production trend were to continue, it would fall below this rate by 1965. The latest declining trend in production is likely to be reversed before this low level is reached, owing to the latest surge of price.

ECONOMIC TRENDS

The present production cycle of mercury mining in the United States clearly began just before the World War II period and was at its peak in the early 1940's when the index price, relative to 1957–59 dollars, was in the range $350–$400 and annual production exceeded 50,000 flasks. During this period almost every mercury mine that had once been a substantial producer was opened, explored, and, if possible, brought into production; prospects were developed into mines; and a diligent search was made for undiscovered deposits. The intensified activity was supported by various forms of Government aid, both direct and indirect. With the withdrawal of Government aid in 1944 and worldwide oversupply, the price fell abruptly and continued downward until 1950. Prior to the decline in price, a few of the mines had exhausted the apparent ore and closed, but even when the price became so low that mining was unrewarding, an attempt was made at many of the larger mines to keep in production as long as possible in hopes of a reversal in the downward price trend. Nonetheless, by December 1950 the Sonoma mine was the only major producer still operating, though several other major mines were being maintained so they could be promptly reactivated.

Following the outbreak of the Korean war (June 1950), the price rose abruptly to a peak early in 1951, and many of the deposits held in readiness again began production. From 1955 until 1963 the price steadily declined, but production continued to rise until 1958. The continued high rate of production during the declining market from 1955–58 resulted from (1) operating inertia of going mines and (2) the establishment in July 1954 of a price-support program promising a stable floor price for a period of $3\frac{1}{2}$ years (later extended 1 more year). The support program, which set a floor about $50 below the market price at that time, was of considerable stimulus to the industry, as for the first time domestic producers were relieved of the fear of an abrupt drastic price drop being imposed by foreign producers. Because the floor price remained below the market price for most of the period, the U.S. Government had to purchase mercury only near the end of the support period, and then only to the extent of 30,165 flasks costing about $6.8 million. The mercury so obtained was transferred to the AEC.

Since 1958, with ever-declining prices, the mines have one by one gone out of production. Prospecting for new ore bodies, either in old mines or new areas, has been much reduced. The Government programs for assistance in exploration have been helpful, but, even with this aid, there has been little interest in looking for mercury in the past few years. Prior to mid-1958, 41 exploration contracts were written by the Defense Minerals Exploration Administration, but since 1958 only 10 have been written by the Office of Minerals Exploration, though the revised contract limitations are not greatly different. By the end of 1961 only 4 of the mines aided by these exploration programs were operating, and by the end of 1963 only 1 was obtaining some of its supply from ore found under OME exploration.

RESPONSE OF DOMESTIC PRODUCTION TO PRICE

Since 1911, the United States has not obtained from domestic mines the quantity of mercury required by its economy, except for brief periods during the World Wars and the 1931 depression. Throughout these 50 years, however, always a few domestic mines were in operation, and other unworked deposits with marginal ore were available. When the price reached a sufficiently high level, operating mines increased their production by processing larger amounts of lower grade ores, closed mines were reopened, and new mines were started. The result has been an increase in production that is closely related to price, but lags behind the price increase because of the time required to get into production. This relation is shown in the following table and in graphic form in figure 3.

The table indicates clearly the lag of production in response to price, and it is significant that this lag is becoming increasingly large as it becomes more difficult to find mercury ore, to install larger plants and more complicated mining equipment, and to bring major mines into production. Similarly, the mines today, once in operation, have greater momentum and are closed with greater reluctance than formerly, resulting in a longer lag in the depression of production following the lowering of price. The

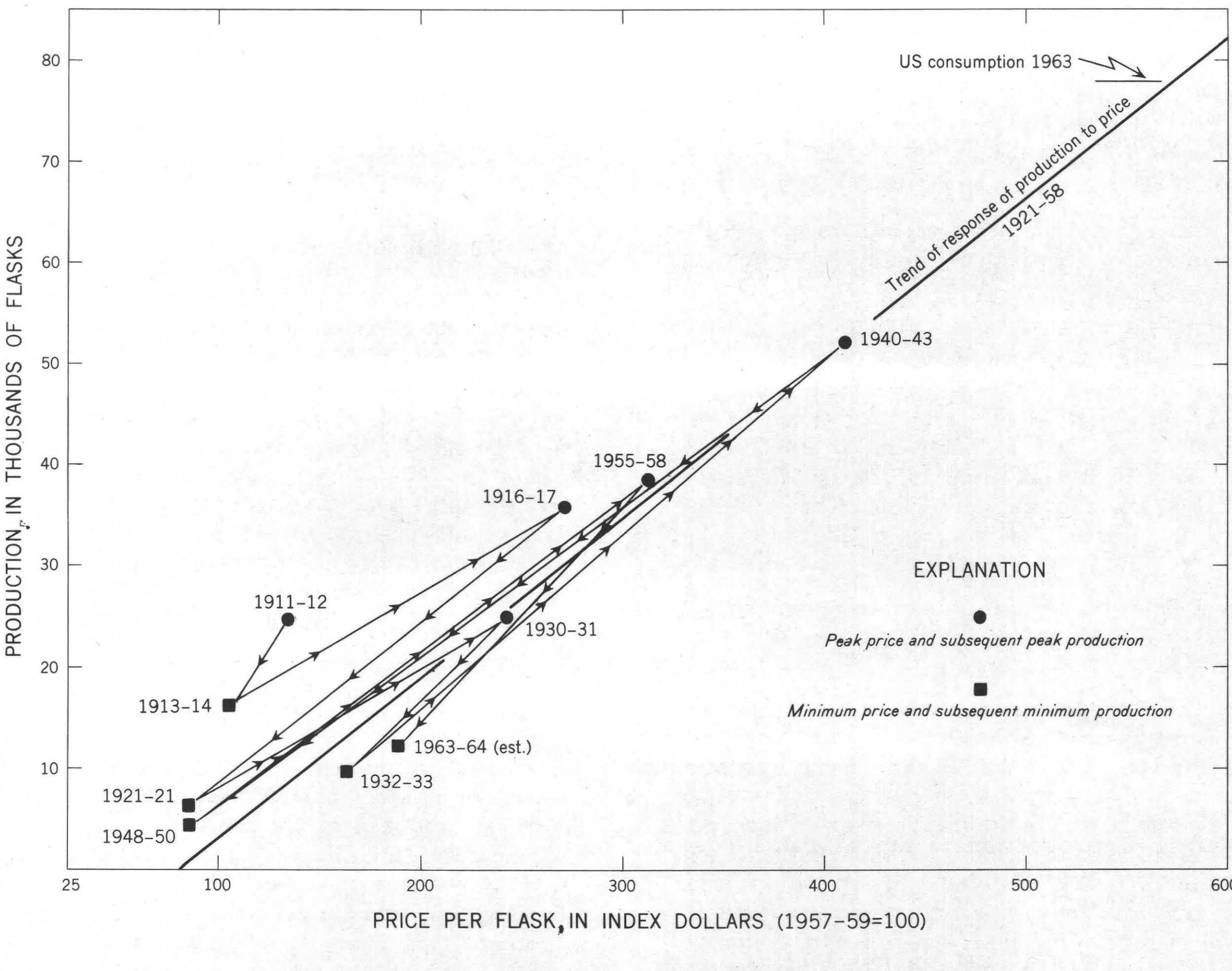

Figure 3.—Response of mercury production in the United States to the domestic price, 1911—63.

Time relation between maximum and minimum price and production of mercury, 1911–63

Peak		Lowest		Production lag in years	
Price	Production	Price	Production	From peak price	From lowest price
1911	1912	-----	--------	1	------
-----	--------	1913	1914	------	1
1916	1917	-----	--------	1	------
-----	--------	1921	1921–22	------	0
1930	1931	-----	--------	1	------
-----	--------	1932	1933	------	1
1940	1943	-----	--------	$2\frac{1}{2}$	------
-----	--------	1948	1950	------	2
1955	1958	-----	--------	3	------
-----	--------	1963	1964–65 (est)	------	1 or 2 (est)

normal lag in the response of production to a price increase was 2 years for the last production peak (1948–50), and the lag in response to a price decrease was 3 years (1955–58). The low in production related to the 1963 low in price may be yet to come; hence this low, as plotted on figure 3, is an estimate.

When the price production data are plotted in terms of constant dollars as in figure 3, it becomes apparent that the response of peak and minimum production to price over the entire 1911–58 period has been fairly uniform and since 1921 has been nearly linear—that is, a particular price has yielded nearly the same production throughout the entire period, in spite of changing economic and technologic conditions. In detail, however, the response of production to price increase was progressively less in three of the four upswings that have taken place since 1914, suggesting that it has become progressively more difficult or costly to find new reserves. The exception to this trend was the 1955–58 upswing, which may have resulted from technologic advances in both mine and mill.

In spite of these slight departures from a linear response, the general "trend of response of production to price" can be used with some confidence to predict future production at various price levels. The 1963 average price was $189, and the recorded production was 19,104 flasks—the response line of the graph would predict a production of 17,500 flasks if no time lag is considered and a production of 18,900 flasks if a lag reflecting the price 2 years earlier is introduced.

ANTICIPATED POSITION AFTER PRICE RISE

In 1963, when the average price was $189.45 a flask, the U.S. production consisted of 19,104 flasks of primary mercury and 6,500 flasks of secondary mercury, while the consumption was 77,965 flasks. The primary production in 1963 was less than one-fourth the consumption, and in the first quarter of 1964 the primary production was lower than in the corresponding period of 1963. In November 1963 the price rose to about $210, and then about $500 a flask in November 1964. The trend of price-production response shown in figure 3 suggests the U.S. production will increase in response to the higher price but will not respond fully until after a lag of about 2 years. As the consumption is also increasing rapidly, it is instructive to anticipate the production-consumption situation in 1966 after this lag has taken effect. The results of estimates based cn two different assumptions regarding consumption are shown in figure 4.

If we assume the price increase will average $300 for at least 1 year, which seems probable, the trend line in figure 3 indicates the domestic primary mercury production in 1966 will be 35,000 flasks, to which we might add 10,000 flasks from secondary mercury and Government sources to obtain a total of 45,000 flasks available for consumption. The consumption in 1966 indicated by the 25-year trend shown in figure 2 would be about 67,000 flasks, which with the indicated domestic production leaves a deficit of 22,000 flasks that must be offset by imports. If consumption were to rise at the 1961–63 rate, however, it would be 105,000 flasks in 1966, and there would be a supply deficit of 60,000 flasks. This extreme rate of increase is unlikely, as stated earlier, but it is included in figure 4 to illustrate that a net saving to the national economy will result from prices higher than those prevailing in 1963 owing to increased domestic production. If we assume an annual average price of $400 a flask, the expected production would be 45,000 to 50,000 flasks, but to bring out a domestic production equal to even our minimum

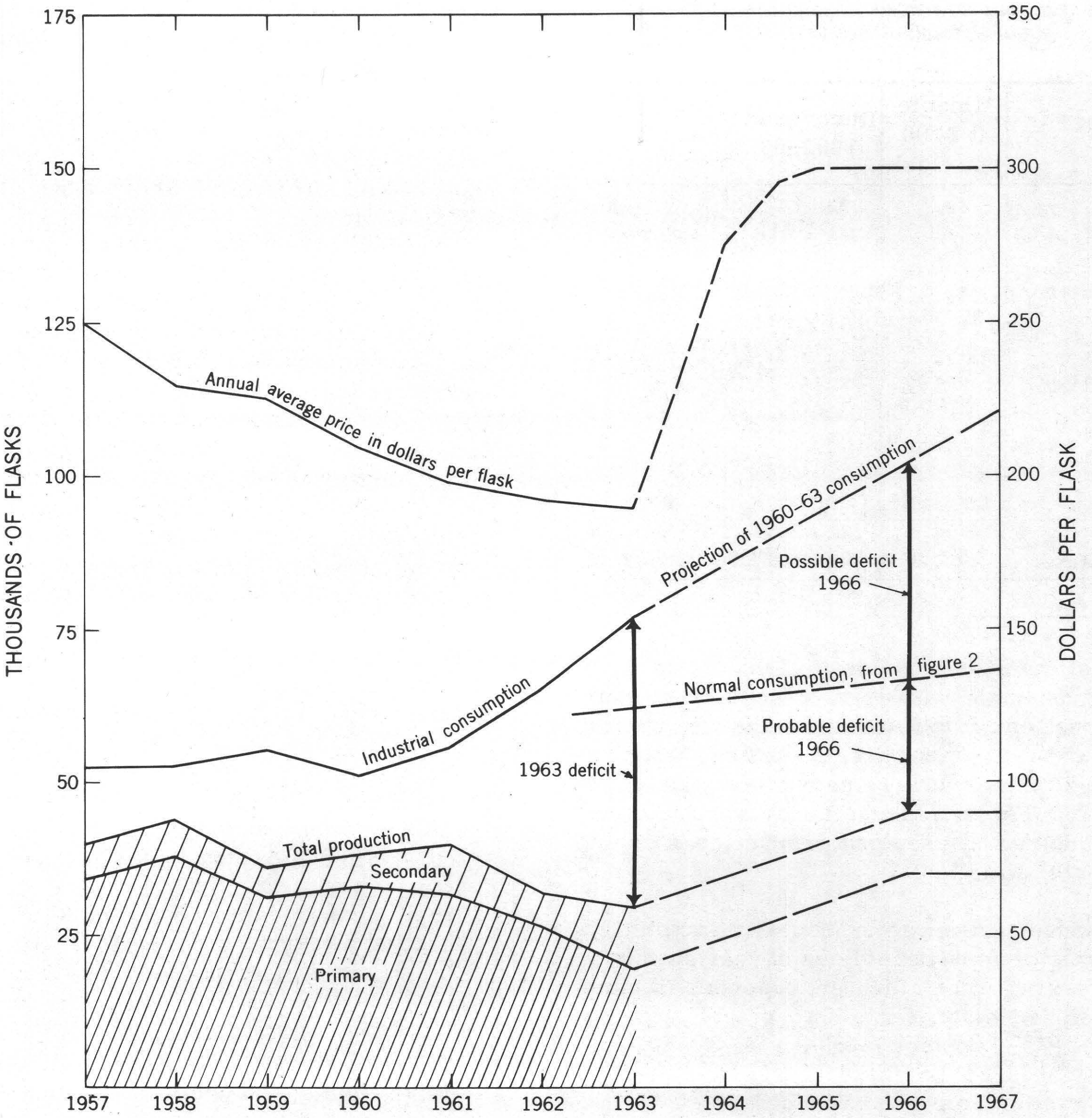

Figure 4.—U.S. mercury price, production, and industrial consumption, 1957—63, with projection to 1967.

estimate of consumption of 67,000 flasks would, according to figure 3, require a sustained price of at least $500 a flask.

ORE RESERVES

Mercury ore reserves of all classes, minable at $190 a flask, were estimated by E. H. Bailey in March 1962. As the average price until 1964 was very close to the $190 figure, it is instructive to compare the production with the estimate, as is done in the table on page 9.

Reserves of ore minable at $190 a flask are now believed to be somewhat less than the original estimate for Alaska, where ore has become inaccessible owing to the closing and flooding of the major mine, but reserves in California and Nevada are a little larger than estimated. About two-thirds of these reserves are now depleted. Reserves of all classes minable at $250 a flask were computed to be 228,500 flasks in 1962. These reserves are minable at 1964 prices, and the estimate minus subsequent production amounts to 183,219 flasks, of which about half is inferred.

Mercury reserves of the world in minable ores were estimated in 1962 to be about 3 million flasks. Only a small part of this has been mined, and there is no question but that the reserve is ample to supply the world

U.S. mercury reserves minable in 1962

[In flasks]

State	Minable at $190 per flask	Recovered 1962–63	Minable at $250 per flask
Alaska	12,000	4,119	25,000
Arizona	--------	(*)	3,000
Arkansas	--------	----------	1,000
California	52,000	29,543	149,000
Idaho	--------	(*)	20,000
Nevada	10,000	11,517	17,000
Oregon	2,000	(*)	7,500
Texas	--------	(*)	5,000
Utah and Washington	--------	----------	1,000
Total	76,000	45,179	228,500

*Not significant.

requirements for several years. However, some ores of lower grade than those included in the estimate will soon be needed to meet the expected consumption if the upward trend is maintained, a fact which suggests that the average price will remain above the 1962 level of $191 a flask. The 1962 estimate of all grades and subsequent production is given in the following table.

At Almaden, Spain, and Monte Amiata, Italy, the practice is to develop each year as much ore reserve as is mined, whereas in the United States few mines are able to do this because the deposits are smaller and more erratic. Hence, the absolute quantity of ore reserves at any particular time is not in itself an indication of the potential of the industry. A better indication is the historical response of production to price, and the effect of depletion upon the response.

World mercury reserves minable under 1962 economic conditions

[In thousands of flasks]

Country or area	Estimate March 1962	Recovered 1962–63
United States	75	45
Canada	------------	----------
Mexico	125	37
South America	20	8
Spain	1,000	106
Italy	700	109
Yugoslavia	400	32
Czechoslovakia	5	1
U.S.S.R.	300	70
Japan	60	9
China	400	52
Turkey	40	6
Philippines	35	5
Total	3,160	480

STATUS OF DOMESTIC MINES IN 1964

The debilitated condition of the domestic mercury mining industry is not fairly revealed by statements of the number of producing mines, which in 1963 was 47, or even the number of mines producing more than 100 flasks, which was 8 in 1963. The true condition is better revealed by the status of the few large mines that have in the past yielded nearly all the domestic production. In the following two tabulations are shown the current status of the 20 largest producers for

Status of the 20 largest domestic mercury producers, 1850—1962 [1]

[Production in flasks]

Mine	Production 1850–1962	Status 1964 [2]
New Almaden, Calif	1,083,773	-
New Idria, Calif	520,201	+
Oat Hill, Calif	153,210	0
Sulphur Bank, Calif	129,162	0
Knoxville, Calif	120,894	0
Guadalupe, Calif	116,609	-
Sonoma, Calif	105,186	0
Great Western, Calif	105,179	0
Chisos-Rainbow, Tex	92,097	0
Cordero, Nev	84,765	±
Aetna-Aetna Extension, Calif	65,806	0
Abbott, Calif	49,253	0
Mirabel, Calif	41,801	0
Oceanic, Calif	41,168	0
Bonanza, Oreg	39,488	0
Altoona, Calif	35,657	0
Mariposa, Tex	33,974	0
Red Devil, Alaska	31,718	0
Reed, Calif	27,749	0
Klau, Calif	25,903	0

[1] During 1964, 16 of the 20 largest producers were inactive, and only 2 were operated on a major scale; however, 12 of the 20 had significant production in World War II.
[2] Status symbols defined in paragraph following tables.

Status of the 13 largest domestic mercury producers, 1950–62 [1]

[Production, in flasks]

Mine	Production 1950–62	Status 1964[2]
New Idria, Calif	71,083	+
Cordero, Nev	61,359	±
Sonoma, Calif	31,603	0
Red Devil, Alaska	28,765	0
Abbott, Calif	15,525	0
Buena Vista, Calif	14,625	±
Idaho Almaden, Idaho	11,827	0
New Almaden, Calif	7,946	-
Bonanza, Oreg	7,697	0
Hermes, Idaho	4,938	0
Guadalupe, Calif	3,959	-
Bertz, Nev	3,699	0
Redwood City, Calif	2,720	0

[1] Of these 13 mines that have been the largest source of domestic mercury production in the past decade, only one has moderate production and developed reserves in 1964; two others are producing at a diminished rate and have little developed reserves; two are operated on a small scale by a few lessees who have almost no developed ore; and the rest are inoperative, though a few are known to contain ore of marginal quality.

[2] Status symbols defined in paragraph following table.

1850–1962, which account for all but 12 percent of the total U.S. production, and the status of the 13 largest producers for 1950–1962, which account for all but 10 percent of the production in this period. In the "status" column a plus (+) indicates the deposit is producing in 1964 at a scale commensurate with its past record, a plus-minus (±) indicates declining production, a minus (-) indicates small-scale operation such as might be conducted by a few lessees, and a zero (0) indicates the mine is either closed down or is supporting an insignificant cleanup operation.

OUTLOOK FOR FUTURE SUPPLY

The response of mercury production predicted by statistical methods may not be entirely valid because the statistical trend may in the near future be warped by factors that heretofore have not been so important. For example, exploration has been carried on at a reduced rate for so long that nearly all major mines are closed with the results that some known ore reserves are now (1964) inaccessible and new discoveries are increasingly difficult to make. Although reserves are adequate to permit the industry to reach a production of 35,000 flasks a year with few additional discoveries, they are inadequate to sustain production at this level; moreover prices below about $300 a flask are inadequate to offer the stimulus necessary to sustain this level of production. There are only one or two major mines operating in 1964 that might increase their production by mining a much larger amount of lower grade ore.

As mentioned earlier in this report, the geologic habit of mercury mineralization results in shallow ore bodies, which have two consequences that must inevitably influence future production. First, the areas favorable for the formation and preservation of mercury ore bodies, both in the United States and in the rest of the world, are quite limited, and within the past 50 years they have become well known. The discovery of entirely new districts containing major ore bodies cannot be expected except in the most remote, densely forested, or otherwise covered areas, but geologic techniques recently developed and being tested will facilitate their discovery in these more difficult terranes. Second, the shallow depositional environment of mercury results in the proportion of the total number of existing ore bodies exposed at the surface being much larger than is the case of ores of most other metals; and, in consequence, a larger proportion of those that exist have been found. These two factors together lead one to believe that the discovery of the new ore bodies required to maintain or increase production in the United States will become increasingly difficult and costly. Since the inception of World War I, 50 years ago, there have been three periods of intensive search for mercury deposits. During this time, only two major mercury deposits—Cordero, Nev., and Red Devil, Alaska—have been discovered; and, further, these are now seriously depleted, having yielded altogether only about 3 percent of the alltime U.S. production. The major production during this period came from the mining of previously known ore bodies or newly discovered extensions of known deposits. The history of mercury discoveries elsewhere in the Free World is comparable; only the Palawan mercury deposit in the Philippine jungle and some of the low-grade deposits on Hokkaido in Japan can be regarded as major deposits found since World War I.

The increasing cost of finding hidden ore bodies is partly offset by technological improvements permitting high-speed drilling of exploratory holes and the development of improved methods of geochemical prospecting. Other technologic advancements seem unlikely to be of great aid to the mercury mining industry, as the ore bodies are small and not adapted to the most modern large-bulk mining methods, and furnacing is such an efficient extractive method that it is not likely to be greatly improved.

We may conclude that changes in the mercury industry in the United States since 1911 are changes of degree rather than of basic characteristics. Price cycles may be expected to continue in response to erratic demand, but they may not reach the extreme low points of earlier cycles because of the trend toward increasingly diversified uses. The availability of mercury is dependent more upon price than upon the absolute quantity of ore reserves that are known at any given time. The majority of discoveries in the near future are almost certain to come from known districts, but there is a chance that exploration, utilizing new methods and knowledge, in generally favorable regions may uncover new districts as well. Although all major deposits are of the epithermal type, it is possible that other types of lower grade deposits of mercury may be found in other kinds of geologic environments, such as the occurrence of mercury with oil and gas in an oilfield in California. Such possibilities should be examined in future studies, for it seems to be apparent that the epithermal deposits of the world are of insufficient magnitude to support the longest term requirements.

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