Gold

By J. M. West [1]

Free market gold prices rose sharply in 1972 as a result of monetary uncertainties, higher world industrial consumption, reduced supplies, and increased speculative buying of gold. The average price rose about $17 per troy ounce; the price change from the first of the year to the yearend was nearly $21 per ounce. On August 2, gold reached a record price, slightly over $70. The official price increased $3 per ounce to $38, effective May 8, 1972. U.S. official gold reserves declined 15.6 million ounces during 1972, owing mainly to transactions with the International Monetary Fund (IMF).

During 1972, domestic gold production declined to 1.45 million ounces, a drop of 3% from 1971 output. About 76% of the newly mined gold came from four producers: Homestake Mining Co., Kennecott Copper Corp., Carlin Gold Mining Co., and Cortez Gold Mines. Domestic consumption of gold rose 5% to 7.3 million ounces, with jewelry and arts accounting for 60% of the total consumed. Net imports declined 21% and industry stocks rose approximately 1% during the year.

World gold production declined in 1972, chiefly because of a continuing drop in the Republic of South Africa production. The Republic of South Africa supplied 65% of the world's newly mined production; the

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Table 1.—Salient gold statistics

	1968	1969	1970	1971	1972
United States:					
Mine production.....thousand troy ounces..	1,478	1,733	1,743	1,495	1,450
Value.....thousands..	$58,038	$71,944	$63,439	$61,673	$84,967
Ore (dry and siliceous) produced:					
Gold ore.....thousand short tons..	2,780	3,393	3,692	3,472	3,320
Gold-silver ore.....do....	199	208	W	166	169
Silver ore.....do....	655	655	673	574	344
Percentage derived from:					
Dry and siliceous ores.....	63	59	60	60	58
Base-metal ores.....	34	40	38	39	41
Placers.....	3	1	2	1	1
Refinery production [1]..thousand troy ounces..	1,539	1,717	NA	NA	NA
Exports [2].....do....	23,962	338	1,074	1,339	1,472
Imports, general [2].....do....	5,944	5,861	6,652	7,201	6,126
Stocks Dec. 31:					
Monetary [3].....millions..	$10,892	$11,859	$11,072	$10,206	$10,487
Industrial.....thousand troy ounces..	3,617	4,158	3,984	4,375	4,407
Consumption in industry and the arts..do....	6,604	7,109	5,973	6,933	7,285
Price:[4] Average per troy ounce.....	$39.26	$41.51	$36.41	$41.25	$58.60
World:					
Production.....thousand troy ounces..	46,165	46,612	47,522	46,491	44,711
Official reserves [5].....millions..	$40,905	$41,010	$41,275	r [6] $44,742	[6] $45,000

r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included in gold and silver ores.
[1] From domestic ores—U.S. Bureau of the Mint.
[2] Excludes coinage.
[3] Includes gold in Exchange Stabilization Fund.
[4] U.S. Treasury price through March 15, 1968, and Engelhard selling quotations March 20, 1968, through 1972.
[5] Held by free-world central banks and governments.
[6] Value based at $38 per troy ounce.

Table 2.—Salient statistics on gold, 1939–1972

(Thousand troy ounces unless otherwise noted)

Year	United States							World production			
	Production			Trade [1]		Net consumption [2]	Treasury stocks, value yearend [3] (million)	Total	Principal sources, other than U.S.		
	Total	From placers	From dry and siliceous gold and silver ores	Exports	Imports (general)				Canada	Republic of South Africa	U.S.S.R.
1939	4,673	1,334	2,794	15	101,968	213	$17,644	39,658	5,115	12,822	5,200
1940	4,870	1,511	2,706	32	126,464	380	21,995	37,104	5,333	14,097	5,100
1941	4,751	1,488	2,583	2	28,023	1,057	22,736	34,743	5,366	14,408	4,300
1942	3,457	1,014	1,730	3	9,012	1,351	22,726	36,038	4,857	14,127	3,300
1943	1,364	158	523	689	2,907	2,467	21,938	28,801	3,670	12,804	3,200
1944	998	123	298	27,402	2,872	2,780	20,619	26,145	2,938	12,280	3,200
1945	955	185	285	5,665	2,676	3,113	20,065	26,287	2,708	12,295	3,200
1946	1,575	591	622	6,323	10,917	4,391	20,529	27,651	2,833	11,927	3,300
1947	2,109	679	812	5,406	55,414	1,397	22,754	28,947	3,081	11,200	3,400
1948	2,014	601	795	5,343	55,259	1,285	24,244	29,958	3,530	11,585	3,600
1949	1,992	533	892	2,172	22,040	3,110	24,427	30,980	4,124	11,705	3,600
1950	2,394	611	1,032	14,634	4,652	2,796	22,706	32,661	4,441	11,664	3,600
1951	1,981	491	770	17,549	2,323	1,985	22,695	34,274	4,393	11,516	3,600
1952	1,893	426	748	784	21,140	2,753	23,186	33,814	4,472	11,819	3,600
1953	1,958	409	791	854	1,344	2,143	22,030	33,276	4,056	11,941	3,500
1954	1,837	420	787	494	1,083	1,270	21,713	34,632	4,366	13,237	3,500
1955	1,880	410	777	162	2,930	1,300	21,690	35,941	4,542	14,602	3,500
1956	1,827	349	779	734	3,730	1,400	21,949	37,957	4,384	15,897	3,500
1957	1,794	343	777	4,806	7,701	1,450	22,857	39,144	4,434	17,031	3,500
1958	1,739	371	806	886	8,120	1,833	20,582	40,077	4,571	17,656	3,600
1959	1,603	359	801	50	8,485	2,522	19,507	42,304	4,483	20,066	3,900
1960	1,667	264	792	47	9,322	3,000	17,804	37,312	4,629	21,383	4,100
1961	1,548	203	741	22,146	1,615	2,775	16,947	39,297	4,474	22,942	4,400
1962	1,543	265	728	10,884	4,312	3,576	16,057	41,182	4,178	25,492	4,080
1963	1,454	185	748	5,820	1,281	2,920	15,596	43,147	4,003	27,432	4,370
1964	1,456	125	796	12,078	1,169	4,801	15,471	44,841	3,835	29,112	4,650
1965	1,705	99	928	36,717	2,905	5,276	13,806	46,225	3,606	30,554	5,030
1966	1,803	92	1,038	13,067	1,200	6,062	13,235	46,580	3,319	30,880	5,370
1967	1,584	65	1,086	28,720	930	6,294	12,065	45,737	2,962	30,535	5,700
1968	1,478	37	934	23,962	5,944	6,604	10,892	46,165	2,688	31,169	5,900
1969	1,733	25	1,034	338	5,861	7,109	11,859	46,612	2,545	31,276	6,250
1970	1,743	39	1,049	1,074	6,652	5,973	11,072	47,522	2,409	32,164	6,500
1971	1,495	16	891	1,339	7,201	6,933	10,206	46,491	2,243	31,389	6,700
1972	1,450	13	841	1,472	6,126	7,285	10,487	44,711	2,079	29,245	6,900

[1] Includes monetary gold. Trade data converted from reported values at $35 per ounce, 1939–51.
[2] U.S. Department of the Treasury.
[3] U.S. Department of the Treasury. Convertible to ounces at official price of $35 per ounce through 1971 and $38 per ounce in 1972.

U.S.S.R. ranked second to the Republic of South Africa, with an estimated 6.9 million ounces produced in 1972. Third and fourth were Canada and the United States, both with declining outputs.

David Lloyd-Jacob, Manager, Consolidated Gold Fields Ltd., told a conference in London in October 1972 that he estimated the total newly mined world supply of gold coming to markets in 1972, including that from the Republic of South Africa and Russian sales, would decline 5.1 million ounces to 38.6 million ounces. Of the total, it was estimated that 16.1 million ounces would go to jewelry manufacturers in advanced countries, 11.9 million ounces-sharply lower than in 1971 to jewelry manufacturers in less developed countries, and the balance into other fabrication including coins. Substantial net dishoarding of gold was anticipated to supply rising industrial demands in 1972–73. Russian sales of gold on world markets have been estimated at 8 million ounces in 1972 and were expected to drop to 4.8 million ounces in 1973. R. C. J. Goode, President, Chamber of Mines of South Africa, predicted in an address at the same London conference that even with an immediate increase in the official gold price to $70 per ounce the Republic of South Africa production would probably decline to 26.3 million ounces by 1982. If the price was to go to $100, a 1982 output of 27.2 million ounces was predicted. Estimates took into account various factors, such as working costs, pay limits, ore reserves, etc.

Legislation and Government Programs.—Following the December 18, 1971, accord of finance ministers from 10 leading industrial nations at the Smithsonian Institution, Washington, D.C., the U.S. Congress passed a bill which was signed into law March 31, 1972, (Public Law 92–268) to devalue the dollar to the equivalent of $38 per troy ounce of gold. In early May, $1.6 billion was appropriated to adjust U.S. balances in international financial institutions to accomodate the devaluation, and on May 8, 1972, the Act became effective, changing the par value of the dollar to one thirty-eighth of an ounce of gold. A number of bills were introduced in the Congress to permit American citizens to hold gold but none of the bills reached a vote.

In a report issued November 18, 1972, by the Subcommittee on International Exchange and Payments of the Joint Economic Committee, Congress of the United States (92d Congress, 2d Session), the following recommendations were made in respect to actions on gold for the purpose of deemphasizing gold as a reserve asset:

1. The March 1968 two-tier gold agreement should be modified to permit, at their own initiative and volition, sales of gold in the free market by the IMF and central banks. On the other hand, the prohibition against central bank purchases of gold in the free market or directly from the Republic of South Africa ought to be maintained.
2. Under a reformed international monetary regime, special drawing rights should be made acceptable in lieu of gold in all transactions between the IMF and its member countries.
3. As soon as the international monetary reform that is currently being negotiated is achieved, all prohibitions on the purchases, sale, and holding of gold by American citizens should be promptly abolished.
4. The current agreement committing the IMF to purchase gold from the Republic of South Africa under certain conditions ought not to be renewed. Instead it should be terminated in 2 years when it expires. Recommendations were also made toward strengthening the special drawing rights mechanism.

A Canadian exchange opened at Winnipeg in November for trading gold futures, and because of many questions, the Treasury Gold Regulations permitting persons and firms licensed by the Treasury Department to buy and hold gold for commercial, industrial, and artistic purposes "in amounts necessary to conduct their business operations" were clarified, as follows: Under the Regulations, the purchase of gold in futures markets is treated in the same manner as other gold purchases:

1) Treasury's Gold Regulations provide that Americans may not acquire any interest in gold, at home or abroad, unless authorized by a Treasury license. This prohibition is applicable to U.S. citizens wherever residing, to noncitizens residing in the United States and to U.S. companies and their foreign subsidiaries.
2) U.S. firms and individuals authorized by a Treasury license to buy or hold gold for commercial, industrial, and

artistic purposes may engage in gold futures transactions only to an extent consistent with their licenses. Specifically, purchases of gold futures are limited in amount to the specific inventory restrictions contained in their licenses and the transactions must serve the legitimate and customary purposes of their businesses. Speculative activities by gold licensees not related to current business operations could result in the revocation of their gold licenses and subject them to the civil and criminal provisions prescribed by law.

Gold purchased for future delivery will be included in the authorized inventory of the gold licensee. Gold licensees are required to set forth their net futures position in their regular reports to the Treasury Department and their position is subject to inspection at all times.

3) U.S. firms and foreign subsidiaries of U.S. firms which are members of commodity exchanges abroad may engage in brokerage activities on such exchanges for Treasury gold licensees and for firms and individuals not subject to the jurisdiction of the United States. A Treasury gold license is not required for brokerage functions.

At the same time, brokerage firms may not acquire any interest in gold for their own account for present or future delivery. Brokerage firms engaging in brokerage activities must take reasonable measures to assure that the transactions on behalf of U.S. gold licensees serve legitimate business purposes and are consistent with the limitations contained in the gold license. They must also take reasonable measures to assure that non-U.S. citizens with whom they transact business are not acting on behalf of U.S. citizens.

The Office of Minerals Exploration (OME), U.S. Geological Survey continued its program of offering participatory loans for gold exploration up to 75% of approved costs. However, only a few relatively small loans or active contracts were approved or in effect.

DOMESTIC PRODUCTION

A decline in domestic gold production in 1972 was largely the result of a strike at the Homestake gold mine, Lead, S.D., which together with other production problems cut over 100,000 ounces from the Homestake's output. Outputs from copper mining States of Nevada, Arizona, New Mexico, and Montana, were generally higher in 1972, offsetting part of the South Dakota drop; Colorado production increased owing to greater base-and-precious-metal mine activity. A decline in Utah output was signalled by the yearend closure of the Mayflower mine, operated under lease by the Hecla Mining Co. In 1972 the Mayflower produced 46,863 ounces of gold in addition to other metals. Downtrends continued in most other States, although there was a widespread increase in prospecting and exploration activity because of higher gold prices. Golden Cycle Corp. announced a $6 million program to reactivate its mining operations in the Cripple Creek area of Colorado. Work was begun by a subsidiary, Cripple Creek Gold Corp., to rehabilitate the Carlton tunnel and rebuild mill facilities. Diamond drilling was planned in 1973 on the 3,111-foot level, reached from the Ajax shaft which was also rehabilitated. The Shenandoah mill of Standard Metals Corp., in the Silverton area, San Juan County, Colo., treated about 700 tons of ore daily from the Sunnyside mine.

In Alaska, a gold dredge which had been inactive for two seasons, was reactivated on the Solomon River, in the Nome area, and offshore gold deposits were under investigation for possible new oceangoing dredge operations at several locations. UV Industries, Inc. (formerly United States Smelting, Refining and Mining Co.) operated a gold dredge at Hogatza, in the Yukon River region. Other smaller scale placer mining was active in the Hot Springs, Fortymile, Ruby, and Iditarod districts of Alaska. In Montana, Judith Gold Corp. continued evaluation of its property in the Kendall district near Lewistown, Fergus County. Gold milling facilities were under construction in Nevada at Silver Peak, Esmeralda County; at a property near Manhattan, Nye County; and at a site near Tonopah, Esmeralda County.

Gold production dropped 21% to 407,397 ounces valued at $23.1 million in 1972 at the Homestake mine in South Dakota. Ore grade averaged 0.278 ounce of gold per ton treated compared with 0.285 ounce in 1971.

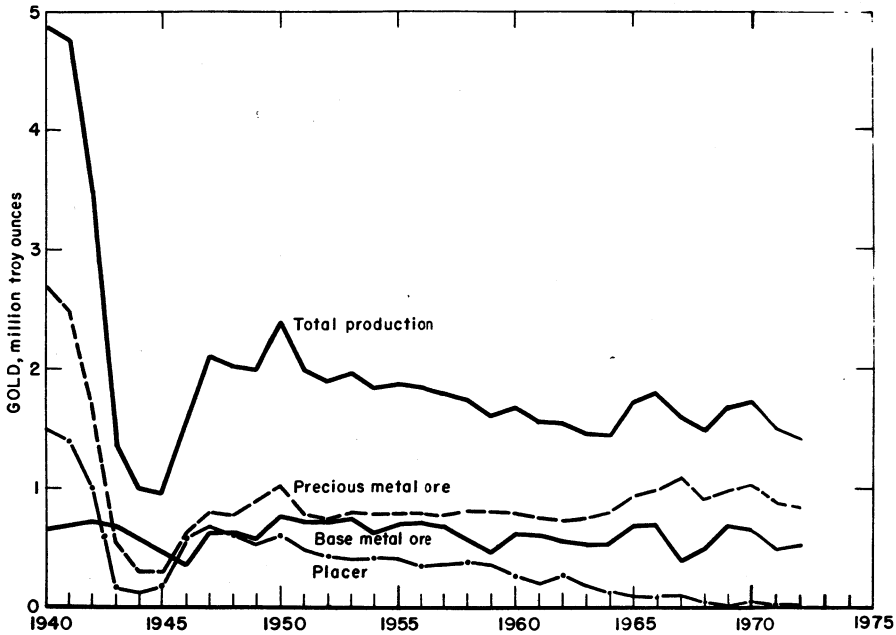

Figure 1.—Gold production in the United States.

A total of 1.47 milion tons of ore was milled. Construction of a new gold recovery unit using a "charcoal-in-pulp" process was nearly completed and was due to go into operation in early 1973. Lower gold losses were anticipated in 1973 as a result. Measured ore reserves at the Homestake mine were estimated at 7.3 million tons averaging 0.299 ounce per ton at the end of 1972. Deep level development reached the maximum project depth, shaft equipment was installed, and new working levels were driven in preparation for increased extraction rates.

At the Cortez mine, Lander County, Nev., mill throughput rose to 803,000 tons in 1972; however, the mine was due to close in early 1973 owing to ore depletion. Production increased 59% to 190,600 ounces compared with 120,251 ounces produced in 1971. The average grade milled was 0.214 ounce per ton and 88.9% was recovered. A large low-grade waste dump, containing 1.6 million tons of mine-run material, was constructed for cyanide "heap-leaching" and during the year 37,600 ounces was produced by this low cost method. Material in the waste dump was estimated to average only about 0.06 ounce per ton and ultimate extraction was expected to be 50% or higher. Cortez Gold Mines also conducted studies in the nearby Gold Acres area and planned to establish a heap-leach/activated carbon extraction operation there, trucking any quantities of milling grade ores found to the Cortez mill for treatment.

The Carlin mine, Eureka County, Nev., produced 194,000 ounces of gold compared with 199,000 ounces in 1971. Sales were valued at $11.7 million compared with $8.3 million in 1971. The average grade of ore milled was 0.238 ounce per ton, compared with 0.287 ounce per ton in 1971. Heap-leaching was credited with recovery of about 2% of the gold, with the balance from treating better grade oxidized and carbonaceous ores in the established milling circuits. Investigations and production planning continued at the Bootstrap deposit, which was expected to be partly a heap-leach operation, with the better ores hauled to the Carlin cyanide plant for processing. Another deposit nearby, the Blue Star, was also scheduled for development. Ore reserves at the main Carlin deposit were estimated at yearend to be 2.71 million tons averaging 0.317 ounce per ton.

This compared with 3.5 million tons averaging 0.297 ounce per ton at yearend 1971. Combined reserves at the Bootstrap and Blue Star deposits were estimated at 1.1 million tons of somewhat lower grade ore. Production was scheduled at the latter two deposits about yearend 1973. Carbon-column gold extraction units underwent testing at each major gold operation (Homestake, Cortez, and Carlin) and were expected to lead to more efficient production.

At Bingham, Utah, the Utah Copper Division, Kennecott Copper Corp., remained the principal byproduct gold producer, reported gold production, mostly from the Bingham pit totaling 350,080 ounces in 1972. The Knob Hill gold mine, operated in conjunction with the Gold Dollar property of Day Mines, Inc., in the Republic district of northeastern Washington, was a continuing source of gold; reserves reportedly were adequate for about 2 more years of operation. Day Mines' share of production from the Gold Dollar Lease was 15,281 tons of ore milled averaging 0.85 ounce of gold and 2.34 ounces of silver per ton. The firm's share in output from a joint operation with Knob Hill Mines, Inc., was 12,255 tons of ore averaging 0.43 ounce of gold and 2.5 ounces of silver per ton. An $80,000 diamond drilling program was scheduled in 1973 to develop further reserves.

Production from the Mayflower mine, located in the Park City district of Utah and leased from Newpark Resources, Inc. by Hecla Mining Co., included 46,863 ounces of gold. Accompanying the gold were 620,024 ounces of silver, 3,586 tons of lead, 2,163 tons of zinc, and 1,495 tons of copper. A total of 114,604 tons of ore was produced. At yearend, Hecla terminated its lease, owing to depleted ore reserves, and closed the mine.

All but a few thousand ounces of Colorado's gold production in 1972 came from the Sunnyside mine, operated by Standard Metals Corp.; the Idarado mine, operated by Idarado Mining Co.; and the Leadville mine, operated by American Smelting & Refining Co. The latter mines were operated primarily for base metals, with the gold as a byproduct.

Of total U.S. gold production, the leading four producers, Homestake Mining, Kennecott Copper, Carlin Gold Mining, and Cortez Gold Mines, contributed 76%; 98% of the total was accountable to 25 leading producers (table 6). Placer and byproduct gold production accounted for 1% and 4%, respectively, of total gold output. An estimated 2.1 million ounces of secondary gold was produced compared with 2.2 million ounces in 1971.

CONSUMPTION AND USES

Domestic consumption of gold, as reported by the Office of Domestic Gold and Silver Operations, U.S. Department of the Treasury, rose 5% to 7.3 million ounces in 1972. Consumption in 1972, as indicated by reports of fabricators of industrial and other products, was divided, as follows, in thousand ounces (with 1971 figures for comparison): Jewelry and arts, 4,344 (4,299); dental, 750 (750); and industrial, including space and defense 2,191 (1,884). Increases in most categories were the result of an upsurge in the U.S. economy and greater affluence.

Consumption was undeterred by sharply higher gold prices, although manufacturers noted increasing efforts to substitute other metals, use thinner plating, cover smaller areas of products, and lower the carat content of gold. Most users were reported "by choice or by lack of a suitable substitute, to be sticking with gold and the higher costs involved."[2] Increased costs were passed on to consumers of many products, notably jewelry purchasers, but for a variety of reasons some manufacturers had to absorb the increases themselves. Electronic products makers were particularly hard pressed because of intense competition and were reported investing in more spot-plating and selective plating equipment in 1972.[3] Palladium was used more in contact and connector points as a base for reducing the thickness of gold. Some increase in substitution of tin for gold was noted in the manufacture of printed circuit boards.

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2 Wall Street Journal. Guessing About Gold: Metal's Unsettled Price Confuses Firms; Some Hold Off Buying, Others Build Stocks. V. 180, No. 113, June 12, 1972, p. 34.

3 Snyderman, Nat. Price Pressures May Hit Gold Vendors to Electronics Firms. Am. Metal Market, v. 79, No. 156, Aug. 28, 1972, p. 61.

One firm offered a new customer's service to solve technical problems with contact bimetal materials.[4] Other firms sent technical representatives to plating plants to advise customers on ways to economize on use of gold. It was contended that gold plating operators lost from 10% to 60% of their gold because of inefficiencies.[5] A new form of gold salts to provide more uniform gold plating was said to have been developed.[6] A superior doped gold ribbon and wire product was developed,[7] and a gold-coated foil was used in an experimental telephone needing no metal contacts for dialing.[8] A substitute dental alloy using titanium or chrome base alloys instead of gold was marketed,[9] and gold-plated beryllium-copper radar waveguides were used in the new Hawk missile.[10]

STOCKS

Monetary.—Official U.S. gold stocks, including those in the Exchange Stabilization Fund, were valued at $10,487 million based on $38 per ounce gold at the end of 1972 compared with $10,206 million based on $35 per ounce gold at the end of 1971. The equivalent amounts of gold were 276.0 million ounces at the end of 1972 compared with 291.6 million ounces a year earlier for a net outflow of 15.6 million ounces. Virtually all of the outflow was the result of a resale of gold to the IMF in the early part of the year. Suspension of convertibility of dollars to gold, begun in August 1971, remained in effect at yearend 1972.

Federal Reserve Banks held $15,530 million (408.7 million ounces at $38 per ounce) worth of "earmarked" gold at the end of 1972 for foreign and international agency accounts. This compared with $13,815 million (394.7 million ounces at $35 per ounce) at the end of 1971. Total gold stocks of national monetary authorities and international institutions (excluding the U.S.S.R., other Eastern European countries, and the People's Republic of China) were valued at an estimated $45,000 million at the end of 1972 compared with $44,742 a year earlier. Stocks were equivalent to about 1,184 million troy ounces compared with 1,177 million ounces at yearend 1971, indicating an accumulation of nearly 7 million ounces.

World monetary gold stocks at the end of 1972 were distributed, as follows, in million ounces: United States (276.0); IMF (153.3); West Germany (117.3); France (100.6); Switzerland (83.1); Italy (82.3); the Netherlands (54.2); Belgium (43.1); Portugal (26.9); Canada (21.9); Japan (21.1); Republic of South Africa (17.9 compared with 10.8 at end of 1971); Spain (14.2); Venezuela (11.2); Bank for International Settlements (5.7); and others (155.2). The largest gain in stocks was with the IMF, which acquired about 18.2 million ounces, mainly from the United States, as a result of dollar devaluation. "Paper gold" Special Drawing Rights (SDR's) in the IMF totaled 9,431 million at the end of 1972 compared with 6,378 million at the end of 1971, an increase of 3,053 million. The SDR's, created to increase world money liquidity, were the official equivalent of 269.5 million ounces of gold (the unit of SDR by definition is equivalent to 0.888671 gram of fine gold). Thus, SDR's added to amounts in existence at yearend 1971 were equivalent to 87.2 million ounces of gold, over twice the free-world mine production of gold during 1972.

Industrial.—Inventories of gold at domestic refiners and fabricators rose approximately 1% during 1972, to 4.41 million ounces, according to data collected by the Office of Domestic Gold and Silver Operations.

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4 Belos, Rick. Engelhard Group Has Answers To Contact Bi-Metal Queries. Am. Metal Market, v. 79, No. 155, Aug. 25, 1972, p. 17.

5 American Metal Market. Technic Chief Warns Gold Users Rising Market Good Time To Stay on Toes. V. 79, No. 109, June 12, 1972, p. 10.

6 ———. Say New Form of Gold Salts Prolong Life of Plated Parts. V. 79, No. 155, Aug. 25, 1972, p. 8.

7 ———. Alloying & Precious Metals: Close Control or Doped Gold Claimed. V. 78, No. 237, Dec. 13, 1971, p. 14.

8 ———. Layer of Gold Plays Part in Bell Dialing Mechanism. V. 80, No. 25, Feb. 5, 1973, p. 27.

9 ———. Dentillium May Replace Some Dental Gold Uses. V. 79, No. 169, Sept. 15, 1972, p. 6.

10 ———. Hawk Missile Waveguides Use Gold Plated Beryllium Alloy. V. 79, No. 145, Aug. 7, 1972, p. 29.

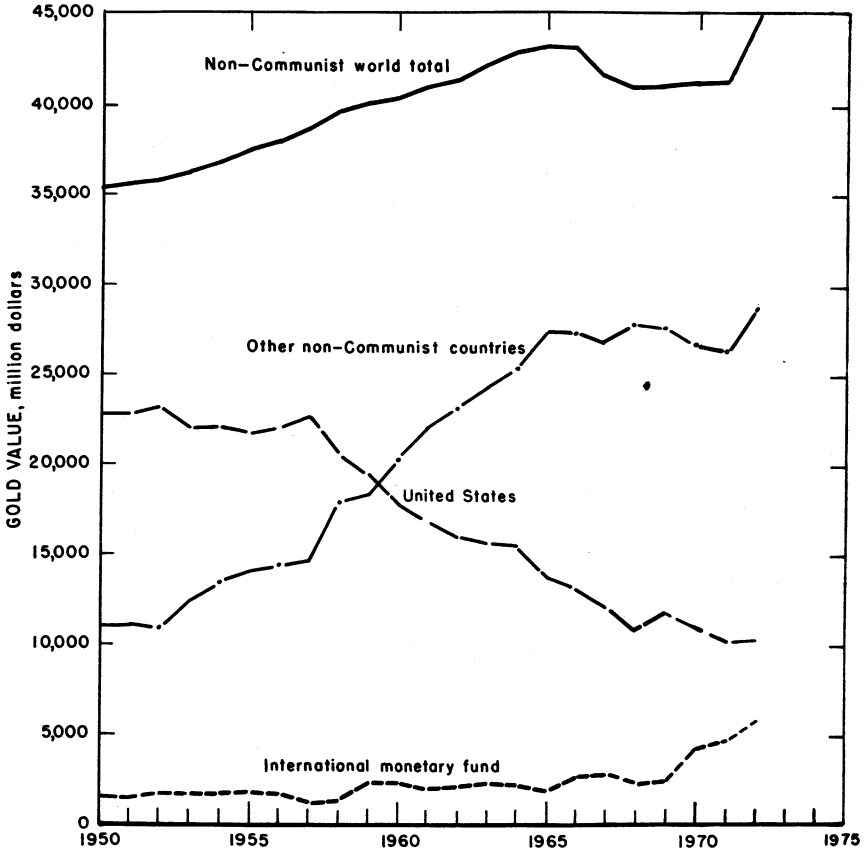

Figure 2.—Gold reserves of free world central banks and governments.

PRICES

Free market gold prices rose to new highs during the year, reaching $70.45 per troy ounce (Engelhard Industries selling price) on August 2. This contrasted sharply with the official U.S. price of gold which was formally increased from $35 to $38 per ounce on May 8, and continued through the balance of the year at that level. The lowest free market price of the year was on January 3, the first trading day when the selling price was $44.45 per ounce. The price on the last trading day, December 28, was $65.10, an increase of $20.65 or 46% for the year. The average price for the year, $58.60 per ounce, was 42% higher than in 1971. High prices generally were attributed to speculative demand due to unsettled monetary and trade problems, also a restricted supply of newly mined gold coming to market.

Table 3.—U.S. monthly gold selling prices, per ounce
(Engelhard Industries)

Month	1972		
	Average	Low	High
January	$46.20	$44.45	$47.80
February	48.70	47.45	49.70
March	48.78	48.50	48.90
April	49.46	48.75	50.20
May	55.09	50.80	59.90
June	62.54	59.65	65.30
July	66.15	65.30	68.75
August	67.49	65.60	70.45
September	65.85	61.70	67.70
October	65.32	64.55	65.95
November	63.36	60.80	64.60
December	64.31	63.35	65.85
Year total	58.60	44.45	70.45

FOREIGN TRADE

Exports of gold in 1972 went largely to Switzerland (40%), the Netherlands (25%), and Canada (16%), with the balance to eight other countries. Scrap comprised 18% of the exports, going to the United Kingdom (45%), Belgium-Luxembourg (40%), and four other countries. A small quantity of monetary gold was included in bullion exports.

Net imports of gold, mostly as bullion, showed a sharp rise (fig. 3) compared with those of 1971 and totaled 4.65 million ounces. The inflow of gold in ore, scrap, and base bullion was balanced by an equal outflow in the form of scrap. Total imports of 6.13 million ounces were valued at $357.7 million; total exports of 1.47 million ounces were valued at $63.1 million. The bulk of the imports came from Canada (49%), Switzerland (33%), and the U.S.S.R. (9%). The balance was from 23 other countries. Virtually all imported gold was destined for industrial use.

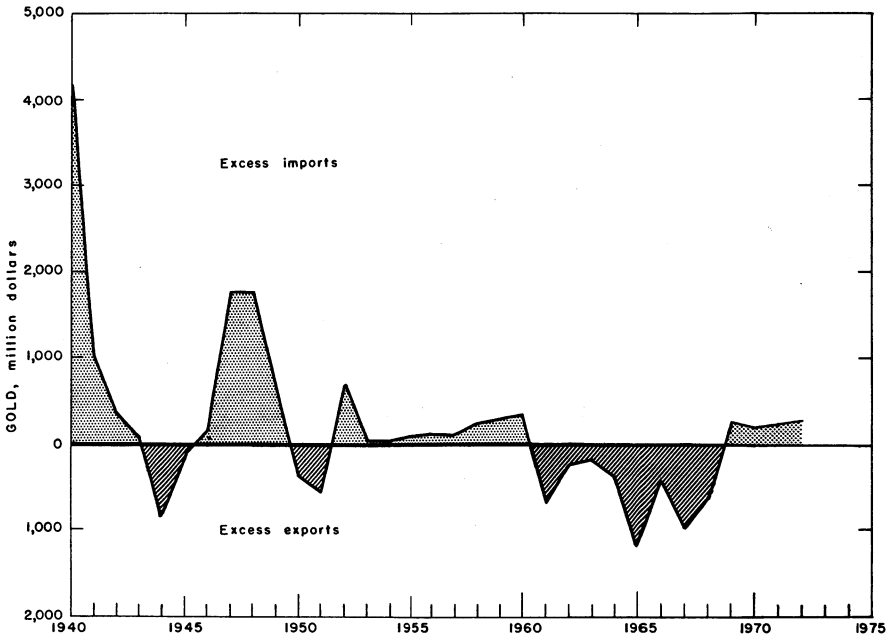

Figure 3.—Net exports or imports of gold.

WORLD REVIEW

World gold production declined again in 1972 to 44.7 million ounces, a drop of 4%. Outputs of most of the main producing countries were lower except in the U.S.S.R. where the Government heavily subsidized production. Policies of the Republic of South Africa limiting the sale of gold continued to exert a dominant influence on the gold markets, although releases of Soviet gold had significant effects in offsetting the shortfall in world supply. World monetary unrest and trade problems resulted in rising speculative demands for gold and higher world prices as supplies fluctuated. Shipments of gold from the Republic of South Africa to the United Kingdom were only about 55% of those in 1971 indicating a diversion to other markets, primarily Switzerland. United Kingdom shipments of gold to the Far East and Middle East were sharply lower showing resistance on the part of purchasers in

those areas to high world prices. World industrial consumption was estimated at 4 to 5% higher than in 1971, consonant with the expanding economies of major manufacturing nations.

Argentina.—Corporación Andina S.A., reported discovery of a placer gold deposit near the El Condor mine in Jujuy Province. The company sought assistance to develop the property under claim.

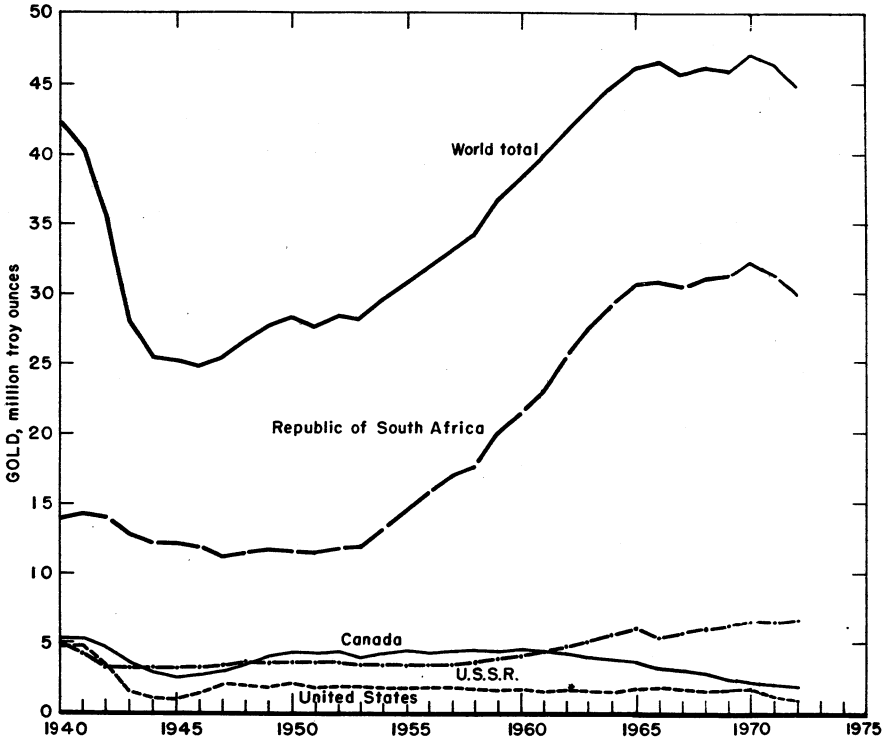

Figure 4.—World production of gold.

Australia.—Australian refinery production of gold from ores and concentrates consisted of 540,300 ounces from domestic and 112,220 ounces from foreign sources. Also, 20,800 ounces was produced from domestic scrap and 2,100 ounces from foreign scrap. Mine production was up 12% compared with that in 1971.

Federal subsidies under the Gold Mining Industry Assistance Act were increased 50% to A$12 maximum per ounce (A$1 = US$1.275); also, producers were allowed to keep 50% instead of 25% of the difference between the free market and official prices of gold. Most Australian and New Guinean gold was marketed. as before, through the 700-member Australian Gold Producers' Association, a cooperative organization of producers. As a result of higher gold prices, additional development work was planned at a number of mines, including the Lake View and Star mines, the largest remaining operations in the Kalgoorlie district of Western Australia. Exploration of a gold-bearing structure was continued near Bathurst, New South Wales, by Pacific Copper Mines Ltd. Gold was reported associated with vanadium in a deposit being explored by Ferrovanadium Corp. at Barambie, east of Geraldton, Western Australia.

Bolivia.—The Bolivian Government issued a Supreme Decree in June 1972 reducing royalties on gold production payable to the Government for the purpose of encouraging gold mining, especially of placer deposits north and northeast of La

Paz.[11] Then, in December the Government issued another Decree annulling the one in June.[12] The new Decree eliminated royalties altogether but applied a 2% tax on gross value of gold production to amortize debts owed by the Gold Cooperatives to the Banco Minero and Bolivian Development Corporation. South American Placers Inc., remained active in Bolivia, selling 11,310 ounces produced in unrefined form in the first half of 1972. Gaensel Gold Mines & Co. completed a shaft to explore placer material on the upper Tipuani River and arranged with Lipez Mining Co. to exploit a placer deposit near the village of Mojotoro. The firm also was expected to take over the placer operation of Condor Mining Co., which had been active since about 1967.

Brazil.—Lode gold production came from one group of mines operated by Mineração Morro Velho S.A. in the area of Nova Lima, Minas Gerais. Output was 5% more than in 1971 when 157,400 ounces was recovered together with silver and white arsenic from 529,218 short tons of ore. Battelle Memorial Institute was preparing plans to modernize the plant, expanding arsenic output and adding sulfur recovery equipment. Cia.Mina da Passagem operated two floating dragline gold washing plants near Mariana, Minas Gerais. About 6,400 ounces was produced in 1971 at this operation. Mineração Tejucana S.A. recovered 2,600 ounces (also 1971) during diamond dredging on the Rio Jequitinhonha, Minas Gerais. A small quantity of byproduct gold was recovered from lead refining at the Panelas smelter, Paraná. A number of small-scale hand and portable washing plant operations in various parts of Brazil supplied the balance of production.[13]

Canada.—Canadian gold production continued its long decline with a 7% drop in 1972. Ontario remained the largest gold producing Province, followed by Quebec, the Northwest Territories, and British Columbia. The greatest drops in production were in Quebec (17%), and Ontario (11%). Significant increases were noted in British Columbia (48%), the Prairie Provinces (49%) and the Atlantic Provinces (100%). Total output was divided approximately, as follows, in percent: Ontario (49); Quebec (27); Northwest Territories (14); British Columbia (6); Prairie Provinces (3); Atlantic Provinces (1); and the Yukon Territory (0.3). In Quebec five gold mines treated 2.4 million tons of ore and shipped products containing 359,469 ounces of gold valued at $13.3 million in 1972. The balance of production was from about 15 base metal mines reporting 12.25 million tons of ore treated and shipments of 181,631 ounces of gold valued at $6.7 million. It was announced about midyear that the Canadian Government would extend its Emergency Gold Mining Assistance Act another 3 years until June 30, 1976. Under the act, gold producers were assured a return of Can $48.27 per troy ounce on mine production.

During the year, Falconbridge Nickel Mines Ltd. announced plans to bring into production a section of its Ellis Lake Opemiska property in the Chibougamau area of Quebec where high copper-gold values were found. A 300-ton-per-day mill addition was planned for treatment, and ore reserves were estimated about 0.5 million tons. Teck Corp. continued the operation of its Lamaque mine in Quebec, which had been scheduled for closure. Also, because of rising gold prices, East Malartic Mines Ltd. was scheduled to remain in operation. Agnico-Eagle Mines Ltd. prepared to open its Eagle gold mine in the Joutel area of Quebec and scheduled startup of a $3.8 million 1,000-ton-per-day mill in 1973. Chibex Ltd. planned to develop a gold-copper property in Rohault Township, in the Southern Chibougamau area. In Ontario, Dickenson Mines Ltd. drifted into some rich gold ore in a section purchased from Robin Red Lake Mines Ltd. and expanded milling to 450 tons per day. Campbell Red Lake Mines Ltd. reported about the same rate of production in early 1972 as the year before with recovery of 0.65 ounce of gold per ton of ore milled. Earnings were sharply higher because of rising gold prices. The firm will spend $1 million to control emissions at its roaster plant in 1973. Pamour Porcupine Mines Ltd. was expanding capacity from 1,900 to 2,500 tons of ore per day in the Porcupine district of Ontario and in November 1972 acquired Aunor

11 U.S. Embassy, La Paz, Bolivia. State Department Airgram A-155, July 7, 1972, 7 pp.
12 ———. State Department Airgram A-308, Dec. 8, 1972, 3 pp.
13 U.S. Embassy, Rio de Janeiro, Brazil. State Department Airgram A-236, Oct. 10, 1972, pp. 19, 20.

Gold Mines Ltd. Pamour milled 346,700 tons of ore grading 0.152 ounce per ton in the first half of 1972. Kennco Explorations Ltd., owned by Kennecott Copper Corp., reported a gold-silver discovery in the Toodoggone River area north of Smithers, British Columbia and held about 600 claims. Other companies were also active in the area.

Colombia.—Pato Consolidated Gold Dredging Ltd., 67.5% owned by International Mining Corp., reported 1971 production of 60,910 fine ounces of gold from 17.8 million cubic yards of gravel. The firm operated four dredges, two of which were moved during the year to new locations. Reserves declined to about 242 million cubic yards averaging 13.1 cents per yard and an additional 167 million yards averaging 10.1 cents per yard (basis $38 per ounce).

Costa Rica.—Financing of a new gold and silver development project was considered by the U.S. Export-Import Bank. The Costa Rican Government continued to require that all gold production be sold to the Central Bank at the official monetary rate.

Dominican Republic.—New York & Honduras Rosario Mining Co. (name changed to Rosario Resources Corp. in 1973) and J. R. Simplot Co., in a joint venture, continued exploration at the Pueblo Viejo gold-silver mine and planned to go into production in late 1974, processing 6,000 tons of oxidized ores per day. At yearend reserves were estimated at about 20 million tons averaging 0.15 ounce of gold and 0.76 ounce of silver. In addition, an equally large underlying sulfide zone was reported to contain 2.19% zinc, 0.25% copper, 0.131 ounce per ton of gold and 1.12 ounces per ton of silver, and a pilot plant was planned for test processing of this ore.

Fiji.—Fiji's gold production, all from the Emperor Gold Mining Co. mine, was sold on the commercial market and in 1971 brought in $3.5 million in foreign exchange. Because of the mine's importance to the local economy, the Government decided to subsidize the operation to the extent of $750,000 for further exploration and development work.

India.—Bharat Gold Mines Ltd. was established to explore and develop the Ramgiri gold field in the Anantapur district of Andhra Pradesh. The Kolar mines in Mysore continued to provide the bulk of Indian gold production under severe problems of depth, heat, and difficult ground control. Most of the balance of production came from the Hutti mines, also in Mysore. Domestic commercial consumption of gold was probably slightly higher than the 48,000 ounces reported in 1971.

Japan.—Domestic consumption of gold during the fiscal year beginning April 1, 1972, was estimated at about 2.8 million ounces. A 13% increase was forecast for the 1973 fiscal year beginning April 1, 1973. Effective on that date, restrictions on importing gold into Japan were to be lifted as a move toward further import liberalization.

Mexico.—Industrias Peñoles, S.A. and affiliates accounted for about 70% of Mexican gold production in 1972. Mexican output was largely byproduct from base metal mining. During 1972, about 32,200 ounces came from gold-silver ores and concentrates; 42,800 ounces came from copper refining, with the balance from other sources, including a small quantity from placer operations. Mid-Continent Mining Corp. (U.S.) announced plans to develop a large gold placer operation in southern Mexico.

New Zealand.—South Westland Minerals Ltd. announced plans to operate two small gold dredges in the Gorge River area of the West Coast where the firm had a 63,000-acre claim. Output of about 12 ounces per day was expected.

Papua-New Guinea, Territory of.—New Guinea Goldfields, Ltd. reported gold bullion sales valued at $485,191 and gold premium receipts at $109,283 in 1971 and values were expected to be higher in 1972. Exploration began on gold leases in Wau under an agreement with C.R.A. Exploration Pty. Ltd. Byproduct gold production began from the copper operation of Bougainville Copper Pty. Ltd. on Bougainville Island. Highland Gold Development NL began construction of a 100-ton-per-day mill at its Kathnel gold deposit near Kainantu, New Guinea.

Peru.—Production included about 34,100 ounces in refined form. About 2,300 ounces of placer gold was produced in 1972. A commission was appointed by the Government of Peru to study and recommend measures to increase Peruvian gold production. Banco Minero reportedly discovered a

rich gold placer area on the Inambari River in the Department of Madre de Dios, and small scale production was started. Another gold deposit was under study in the Rioja area of northern Peru. Peru's gold consumption was reportedly about 200,000 ounces annually, more than twice the production.

Philippines.—Production decreased in 1972, mainly because of less byproduct gold output from copper operations. A complex subsidy system remained in effect.[14] Benguet Consolidated Inc. remained the only important lode-gold mining firm in the Philippines, contributing about one-fifth of total gold production.

Rhodesia, Southern.—Efforts were underway to expand gold production with the reactivation of the Shamva mine, once a significant producer. The Dalny mine remained the country's largest gold producer in 1972.

South Africa, Republic of.—Production declined for the second straight year, dropping 7% to 29.2 million ounces in 1972. During the first 9 months of 1972, mines in the Transvaal area produced 14.24 million ounces; 7.85 million ounces was produced in the Orange Free State area. The balance of production came from Cape Province (3,760 ounces) and Natal (965 ounces). The largest and richest gold producer in 1972, as before, was the West Driefontein mine with 2.42 million ounces and mill recovery of 0.96 ounce of gold per metric ton of ore treated. The second largest output was recorded by Vaal Reefs, with 2.12 million ounces produced and recovery grade of 0.40 ounce per ton. Ten other mines produced over 1 million ounces each in 1972.

Generally, during 1972 larger tonnages of lower grade ores were mined because higher gold prices permitted economical production at a lower cutoff grade. Such procedures tend to prolong the productive life of a mine and, in fact, are required by the Republic of South Africa law as a conservation practice. Output from the Rand Refinery Ltd. plant at Germiston, during the company's fiscal year, October 1, 1971, to September 30, 1972, was 30,140,490 fine ounces of gold and 3,295,170 fine ounces of silver. Most of this was from bullion received from the mines, but 98,925 ounces of gold and 473,837 ounces of silver were from scrap. Several mine fires during the year caused production losses and a variety of accidents brought the gold mining fatality rate to about one every 48 hours. Mining costs rose, partly as a result of basic wage increases and devaluation which made imported materials and machinery more expensive. Nearly one-fourth of all production in 1972 went into official reserves of the Republic of South Africa Reserve Bank and, thus, was not available to the free market. The Bank reported gold reserves equivalent to 11.54 million ounces in January, rising to 17.53 million ounces in October (converted at the rate of R28.30 per troy ounce), and accumulation continued through the yearend.

U.S.S.R.—Gold production was higher in 1972, with intensified activities in all producing areas but particularly in the desert areas of Kazakhstan and Uzbekistan, south of the Ural Mountains, and in the region of the Aral Sea. An important new discovery was reported in the Mugodzhar Mountains of western Kazakhstan, and large scale gold production was planned to begin about 1975. Development continued at the Muruntau gold field, on the south slope of the Muruntau Mountains in the central part of western Uzbekistan. A large cyanide/ion exchange extraction plant was in operation and open pit/underground mine development was in progress at Muruntau. Soviet gold sales on world markets rose sharply in 1972 as a result of the need for foreign exchange, principally to purchase wheat.

Venezuela.—Canadian firms, Fairway Explorations and Nor-Acme Gold Mines, sampled a placer gold area in the eastern part of the State of Bolívar and reported relatively high grade assay returns. More extensive sampling was planned in 1972–73. Ores containing disseminated submicroscopic gold from the Callao region of Venezuela were investigated by engineers of the Evaluation Center of the Ministry of Mines, and comparisons were made with Nevada (U.S.) deposits.

TECHNOLOGY

Research to apply cyanide heap-leaching and activated carbon recovery processes to

[14] U.S. Bureau of Mines. Gold: Philippines. Mineral Trade Notes, v. 69, No. 5, May 1972, pp. 11–13.

the treatment of low-grade or "slimy" gold ores has indicated that notable savings in plant investment and operating cost can be made as compared with conventional practice. Bureau of Mines metallurgists at the Salt Lake City Metallurgy Research Center continued work during the year to develop improved gold recovery techniques. Tests at a carbon-in-pulp pilot plant operated in cooperation with the Homestake Mining Co. at Lead, S.Dak., showed that 90% to 95% of the gold in a 0.15-ounce-per-ton slime feed could be cyanide leached and recovered on granular activated carbon. Based on the tests, construction of a full scale plant was started, and the company expected to complete by February 1973, a 2,350-ton-per-day carbon-in-pulp unit which will replace a more costly plate-and-frame filter-type slime-treatment plant. Continued development of a Bureau-invented pressure stripping process for recovering gold from loaded carbon showed that savings could be achieved in stripping time, labor, and reagents. Carbon-column gold extraction methods developed by the Bureau were utilized at the Carlin and Cortez gold operations in Nevada to treat wash solutions before discharge to tailings ponds. Operating data on 4-foot-diameter expanded-bed carbon columns with solutions assaying 0.008 ounce of gold per ton showed recoveries up to 75%, and further testing was in progress to improve on this yield.

Pilot plant studies were conducted at the Bureau of Mines Reno Metallurgy Research Center to improve gold recovery from carbonaceous gold ores using oxidation procedures based on use of chlorine and sodium hypochlorite.[15] Treatment with 20-pounds-per-ton sodium hypochlorite solution at 50° C for 4 hours followed by cyanidation resulted in 90% gold extraction. A chlorine pretreatment produced about the same results in longer time but at lower temperature. Electrolyzing a pulp prepared with a brine solution proved equally effective, with power consumption on the order of 60 kwhr per ton of ore. A patent was issued on the process developed from the work.[16] Also patented were gold extraction processes using malononitrile in place of cyanide for solution followed by collection on an anion-exchange resin[17] and using isopropyl alcohol to recover gold from a chlorinated brine solution followed by precipitation of gold with aqueous sulfur dioxide.[18] Phosphorus took part in a unique method devised to extract gold and other metals from dilute aqueous solutions.[19]

Seismic and other geophysical measurements revealed levels of stratification and boundaries of Tertiary channels containing gold in the Badger Hill area of Nevada County, Calif.[20] It was demonstrated that 30 percent of the drilling expenditures for exploring the deposits could have been saved by using geophysical methods initially. Geochemical surveys showed gold and silver anomalies in three areas of the Brooks Range, Alaska, to accompany base-metal anomalies.[21] One of the areas of interest was an unexplored zone in carbonate rocks north of the Wiseman and Chandalar districts. Placer gold and tin deposits were described in a text accompanying a map of the Teller area of the Seward Peninsula, Alaska.[22] Reworked glacial deposits from Alaska's Seward Peninsula were cited as the source of offshore gold in the northern Bering Sea.[23] Values in one area near Nome were reported as high as 920 ppb ($1.48 per cubic yard at $50 per ounce). Beach deposits on the east shore of Bristol Bay, Alaska, were examined for gold. Although auriferous deposits were occasionally as large as 1 acre in areal extent, they were seldom more than 6 inches thick.

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15 Scheiner B. J., R. E. Lindstrom, W. J. Guay, and D. G. Peterson. Extraction of Gold From Carbonaceous Ores: Pilot Plant Studies. BuMines RI 7597, 1972, 20 pp.

16. Scheiner, B. J., R. E. Lindstrom, and T. A. Henrie (assigned to U.S. Secretary of the Interior). Recovery of Gold From Carbonaceous Ores. U.S. Pat. 3,639,925, Feb. 8, 1972.

17 Scheiner, B. J. and R. E. Lindstrom (assigned to U.S. Secretary of the Interior). Recovery of Gold. U.S. Pat. 3,635,697, Jan. 18, 1972.

18 Hedrick, C. E., Jr. (assigned to U.S. Atomic Energy Commission). Recovery of Gold By Solvent Extraction. Canadian Pat. 905,683, July 25, 1972.

19 Matthews, D. M. Method and Collector for Extracting Metals From an Aqueous Solution. U.S. Pat. 3,664,829, May 23, 1972.

20 Tibbetts, Benton L., and James H. Scott. Geophysical Measurements of Gold-Bearing Gravels, Nevada County, Calif. BuMines RI 7584, 1972, 32 pp.

21 Brosgé, W. P., and H. N. Reiser. Geochemical Reconnaissance in the Wiseman and Chandalar Districts and Adjacent Region, Southern Brooks Range, Alaska. U.S. Geol. Survey Prof. Paper 709, 1972, 21 pp.

22 Sainsbury, C. L. Geologic Map of the Teller Quandrangle, Western Seward Peninsula, Alaska. U.S. Geol. Survey Map I–685, 1972.

23 Nelson, C. H., and D. M. Hopkins. Sedimentary Processes and Distribution of Particulate Gold in the northern Bering Sea. U.S. Geol. Survey Prof. Paper 689, 1972, 27 pp.

The maximum gold content found was 0.007 ounce per ton.[24]

The distribution of gold in altered bedrock was studied in the Empire Mining district of Colorado, and high positive correlations found with tellurium, tin, bismuth, and silver.[25] Conversely, a negative correlation was found with manganese in the altered material. Based on the study, it was concluded that tellurium was the best "pathfinder" element to use in any widespread reconnaissance exploration for gold. Neutron-activation analyses of a wide variety of igneous rocks and minerals showed that gold in suites of unaltered igneous rocks associated with gold deposits was present in essentially the same amount as in compositionally equivalent rocks from unmineralized regions.[26] Gold content generally was highest in mafic rocks, decreasing in silicic rocks. Gold above background amounts was invariably found only locally in altered rocks, supporting other evidence that concentrations were either the result of remobilization or of secondary introduction. Interestingly, unaltered rhyolitic rocks ranging widely in age, provenance, and petrochemistry were uniformly low in gold (0.1-1 ppb), whereas calc-alkaline rocks from western U.S. batholiths were relatively high (0.5–10 ppb).

Descriptions and references to information on placer gold deposits were published for Arizona [27] and New Mexico.[28] Techniques of scuba diving for placer gold were described in a California publication.[29] Maps were published showing the distribution of gold and silver in several areas of Sierra County, N. Mex.[30] and of gold and copper in the Golconda and Iron Point Quadrangles, Nevada.[31]

A new process was developed for solution mining of gold and silver by introducing into permeable zones containing these metals solutions of chloride brines, with "residual oxidation potentials" over 500 millivolts, recovering the solution, and precipitating the precious metals with hydrogen sulfide.[32] In Yakutsk, U.S.S.R., the Scientific Research Institute for Rare Metals (Irkutsk) conducted field experiments to prevent refreezing of soil, which delays gold mining operations during part of the year.[33] A foam mixture was spread over the soil surface in several layers and mixed with snow to form a porous cover 1.5 meters thick. At the Vaal Reefs gold mine near Klerksdorp, the Republic of South Africa, gold ore, finely ground, was pumped to the surface from a depth of 7,200 feet using a new hydraulic hoisting system. Pumping capacity was equivalent to 25,000 dry tons of ore per month.

The Chamber of Mines of South Africa continued to publish its quarterly series entitled, Gold Bulletin, containing articles on new uses for gold and abstracts on new technology.[34] The January issue reviewed the optical and heat reflecting properties of very thin gold films; the Republic of South Africa research in gold mining and metallurgy was described in the July issue.

Bureau of Mines researchers developed a process including incineration, caustic leaching, smelting, and electrolysis to economically recover precious metals and copper from low-grade, complex electronic scrape.[35] In processing sweated aluminum electronic scrap, researchers developed and

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24 Kimball, Arthur L. Reconnaissance of Ugashik Beach Sands, Bristol Bay, Alaska. BuMines Open-File Rept. 21–72, 1972, 28 pp.; available for consultation at the Bureau of Mines library in Juneau, Alaska, and at the Central Library, U.S. Department of the Interior, Washington, D.C.; and from the National Technical Information Service, Springfield, Va., PB 211 052.

25 Chaffee, M. A. Distribution and Abundance of Gold and Other Selected Elements in Altered Bedrock, Empire Mining District, Clear Creek County, Colo. U.S. Geol. Survey Bull. 1278C, 1972, 23 pp.

26 Gottfried, David, J. J. Rowe, and R. I. Telling. Distribution of Gold in Igneous Rocks. U.S. Geol. Survey Prof. Paper 727, 1972, 42 pp.

27 Johnson, Maureen G. Placer Gold Deposits of Arizona. U.S. Geol. Survey Bull. 1355, 1972, 103 pp.

28 ———. Placer Gold Deposits of New Mexico. U.S. Geol. Survey Bull. 1348, 1972, 46 pp.

29 Clark, William B. Diving for Gold in California. Calif. Geol., v. 25, No. 6, June 1972, pp. 123–130.

30 Alminas, H. V., K. C. Watts, and D. L. Siems. Maps Showing Silver and Gold Distribution in the Winston and Chise Quandrangles and in the West Part of the Priest Tank Quadrangle, Sierra County, N. Mex. U.S. Geol. Survey MF–400, 1972.

31 Erickson, R. L., and S. P. Marsh. Geochemical, Aeromagnetic, and Generalized Geologic Maps Showing Distribution and Abundance of Gold and Copper, Golconda and Iron Point Quandrangles, Humboldt County, Nev. U.S. Geol, Survey MF–314, 1971 (1972).

32 Stenger, V. A., and W. R. Kramer (assigned to The Dow Chemical Co.). Process for Solution Mining of Silver. U.S. Pat. 3,647,261, Mar. 7, 1972.

33 Engineering and Mining Journal. News Briefs. V. 173, No. 9, September 1972, p. 234.

34 Chamber of Mines of South Africa Research Organization (Johannesburg). Gold Bulletin, v. 5, Nos. 1–4, 1972 issues (quarterly publication).

35 Dannenberg, R. O., J. M. Maurice, and G. M. Potter. Recovery of Precious Metals From Electronic Scrap. BuMines RI 7683, 1972, 19 pp.

Table 4.—Mine production of recoverable gold in the United States, by State

(Troy ounces)

State	1968	1969	1970	1971	1972
Alaska	21,262	21,227	34,776	13,012	8,639
Arizona	95,999	110,878	109,853	94,038	102,996
California	15,682	7,904	4,999	2,966	3,974
Colorado	22,638	25,777	37,114	42,031	61,100
Idaho	3,227	3,403	3,128	3,596	2,884
Montana	13,385	24,189	22,456	15,613	23,725
Nevada	317,382	456,294	480,144	374,878	419,748
New Mexico	6,630	8,952	8,719	10,681	14,897
Oregon	23	875	256	244	(1)
South Dakota	593,052	593,146	578,716	513,427	407,430
Tennessee	140	126	124	192	176
Utah	334,419	433,385	408,029	368,996	362,413
Washington [1]	54,453	47,020	55,008	55,434	41,961
Total	1,478,292	1,733,176	1,743,322	1,495,108	1,449,943

[1] Production of Pennsylvania, Washington, and Wyoming (1969), North Carolina (1971), and Oregon (1972) combined to avoid disclosing individual company confidential data.

Table 5.—Mine production of recoverable gold in the United States, by month

(Troy ounces)

Month	1971	1972
January	133,085	117,605
February	120,977	131,733
March	136,566	139,489
April	127,545	131,660
May	132,514	146,182
June	137,552	131,544
July	84,046	106,504
August	130,127	89,035
September	124,533	107,000
October	122,979	123,382
November	126,218	114,031
December	118,966	111,778
Year total	1,495,108	1,449,943

tested molten-salt electrorefining processes.[36] High quality aluminum was recovered at 94% recovery rates and a copper-gold-silver anode product was treated, achieving recovery rates of 98% of the contained metals.

To develop a better understanding of cyanide reactions in electrodeposition, Bell Telephone Laboratories studied behaviors in various baths using cyclic voltrammentry and galvanostatic transients.[37]

Gold/copper characteristics were the subjects of several investigations, including diffusion of copper through thin gold electroplates,[38] annealing and cold-working properties of Cu_3Au,[39] and the advantages of gold electrodeposited at very low current onto a coarse-grained copper surface for use as a substrate for Permalloy films.[40]

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36 Sullivan, T. A., R. L. de Beauchamp, and E. L. Singleton. Recovery of Aluminum, Base, and Precious Metals from Electronic Scrap. BuMines RI 7617, 1972, 16 pp.

37 MacArthur, D. M. A Study of Gold Reduction and Oxidation in Aqueous Solutions. J. Electrochem. Sci. and Technol., v. 119, No. 6, June 1972, pp. 672–676.

38 Pinnel, M. R., and J. E. Bennett. Mass Diffusion in Polycrystalline Copper/Electroplated Gold Planar Couples. Metal. Trans., v. 3, No. 7, July 1972, pp. 1989–1997.

39 Ward, A. L., and D. E. Mikkola. A Diffraction Study of the Annealing of Cold-Worked Cu_3Au. Metall. Trans., v. 3, No. 6, June 1972, pp. 1479–1485.

40 Luborsky, F. E., M. W. Breiter, and B. J. Drummond. Characterization of a Gold-Copper Composite Surface for Plated Wire Memory. J. Electrochem. Soc., v. 119, No. 1, January 1972, pp. 92–96.

Table 6.—Twenty-five leading gold-producing mines in the United States in 1972, in order of output

Rank	Mine	County and State	Operator	Source of gold
1	Homestake	Lawrence, S. Dak	Homestake Mining Co	Gold ore.
2	Utah Copper	Salt Lake, Utah	Kennecott Copper Corp	Copper, gold-silver ores.
3	Carlin	Eureka, Nev	Carlin Gold Mining Co	Gold ore.
4	Cortez	Lander, Nev	Cortez Gold Mines	Do.
5	Mayflower	Wasatch, Utah	Hecla Mining Co	Copper-lead ore.
6	Gold Dollar	Ferry, Wash	Knob Hill Mines, Inc	Gold ore.
7	Sunnyside	San Juan, Colo	Standard Metals Corp	Lead-zinc ore.
8	Copper Queen-Lavender Pit	Cochise, Ariz	Phelps Dodge Corp	Copper ore.
9	San Manuel	Pinal, Ariz	Magma Copper Co	Do.
10	New Cornelia	Pima, Ariz	Phelps Dodge Corp	Copper, gold-silver ores.
11	Idarado	Ouray and San Miguel, Colo	Idarado Mining Co	Copper-lead-zinc ore.
12	Ruth Pit	White Pine, Nev	Kennecott Copper Corp	Copper ore.
13	Berkeley Pit	Silver Bow, Mont	The Anaconda Company	Do.
14	Copper Canyon	Lander, Nev	Duval Corp	Do.
15	Morenci	Greenlee, Ariz	Phelps Dodge Corp	Do.
16	Leadville	Lake, Colo	American Smelting & Refining Co	Lead-zinc ore.
17	Magma	Pinal, Ariz	Magma Copper Co	Copper ore.
18	Continental	Grant, N. Mex	UV Industries, Inc	Do.
19	Christmas	Gila, Ariz	Inspiration Consolidated Copper Co	Do.
20	Hogatza River	Yukon River Region, Alaska	UV Industries, Inc	Placer.
21	Tyrone	Grant, N. Mex	Phelps Dodge Corp	Copper ore.
22	Bonney-Misers Chest	Hidalgo, N. Mex	Federal Resources Corp	Do.
23	Center & Penn	Grant, N. Mex	Mt. Royal Mining & Exploration Co	Gold ore.
24	Center	do	The Old Ontario Mining Co	Do.
25	Ruby Claims	Yukon River Region, Alaska	Ruby Mining Co	Placer.

Table 7.—Production of gold in the United States in 1972, by State, type of mine, and class of ore, yielding gold, in terms of recoverable metal

State	Placer (troy ounces of gold)	Lode: Gold ore: Short tons	Lode: Gold ore: Troy ounces of gold	Lode: Gold-silver ore: Short tons	Lode: Gold-silver ore: Troy ounces of gold	Lode: Silver ore: Short tons	Lode: Silver ore: Troy ounces of gold
Alaska	8,639	--	--	--	--	--	--
Arizona	6	--	--	[1] 19,579	[1] 44	W	W
California	2,822	[1] 4,755	[1] 951	W	W	--	--
Colorado	1,345	--	--	--	--	W	W
Idaho	5	--	--	--	--	331,046	1,047
Montana	46	W	W	[1] 6,273	[1] 668	12,480	270
Nevada	24	1,736,568	384,934	--	--	159	19
New Mexico	--	[1] 45,296	[1] 3,379	--	--	W	W
South Dakota	--	1,466,767	407,430	--	--	--	--
Utah	--	--	--	[1] 143,522	[1] 758	W	W
Other States [2]	35	66,461	41,925	--	--	--	--
Total	12,922	3,319,847	838,619	169,374	1,470	343,685	1,336
Percent of total gold	1	--	58	--	(3)	--	(3)

State	Lode: Copper ore: Short tons	Lode: Copper ore: Troy ounces of gold	Lode: Lead ore: Short tons	Lode: Lead ore: Troy ounces of gold	Lode: Zinc ore: Short tons	Lode: Zinc ore: Troy ounces of gold
Alaska	--	--	--	--	--	--
Arizona	138,906,469	102,236	--	--	--	--
California	--	--	--	--	W	W
Colorado	3,730	205	--	--	249,098	600
Idaho	2,375	66	256,605	1,319	--	--
Montana	17,126,668	22,335	119	40	--	--
Nevada	8,511,860	34,771	--	--	--	--
New Mexico	18,767,261	11,351	--	--	--	--
South Dakota	--	--	--	--	--	--
Utah	W	W	--	--	--	--
Other States [2]	--	--	--	--	--	--
Total	183,318,363	170,964	256,724	1,359	249,098	600
Percent of total gold	--	12	--	(3)	--	(3)

State	Lode: Copper-lead, lead-zinc, copper-zinc, and copper-lead-zinc ores: Short tons	Lode: Copper-lead, lead-zinc, copper-zinc, and copper-lead-zinc ores: Troy ounces of gold	Lode: Old tailings, etc.: Short tons	Lode: Old tailings, etc.: Troy ounces of gold	Lode: Total: Short tons	Lode: Total: Troy ounces of gold
Alaska	--	--	--	--	--	8,639
Arizona	96,211	290	83,867	420	139,106,126	102,996
California	[4] 13,187	[4] 75	--	[5] 126	17,942	3,974
Colorado	[6] 922,180	[6] 58,708	7,538	[5] 242	1,182,546	61,100
Idaho	659,886	447	--	--	1,249,912	2,884
Montana	--	--	55,186	366	17,200,726	23,725
Nevada	--	--	--	--	10,248,587	419,748
New Mexico	138,273	167	--	--	18,950,830	14,897
South Dakota	--	--	--	--	1,466,767	407,430
Utah	[4] 35,257,423	[4] 361,655	--	--	35,400,945	362,413
Other States [2]	1,762,000	176	12	1	1,828,473	42,137
Total	38,849,160	421,518	146,603	1,155	226,652,854	1,449,943
Percent of total gold	--	29	--	(3)	--	100

W Withheld to avoid disclosing individual company confidential data.
[1] Combined with other dry and siliceous ores to avoid disclosing individual company confidential data.
[2] Includes Oregon, Tennessee, Washington.
[3] Less than ½ unit.
[4] Combined with other base-metal ores to avoid disclosing individual company confidential data.
[5] Includes byproduct gold recovered from tungsten ore in California and North Carolina and from fluorspar ore in Colorado.
[6] Silver combined with copper-lead-zinc ores to avoid disclosing individual company confidential data.

Table 8.—Gold produced in the United States from ore, old tailings, etc., in 1972, by State and method of recovery, in terms of recoverable metal

State	Total ore, old tailings, etc., treated [1 2] (thousand short tons)	Ore and old tailings to mills					Crude ore, old tailings, etc., to smelters [1]	
		Thousand short tons [1 2]	Recoverable in bullion		Concentrates smelted and recoverable metal			
			Amalgamation (troy ounces)	Cyanidation (troy ounces)	Concentrates (short tons)	Troy ounces	Thousand short tons	Troy ounces
Arizona	166,029	165,578	--	--	3,296,309	100,386	451	2,604
California	18	15	210	--	5,056	928	3	14
Colorado	1,277	1,269	3,789	--	191,127	55,733	8	233
Idaho	1,394	1,392	--	--	170,319	2,838	2	41
Montana	17,201	17,099	--	--	366,990	22,305	102	1,374
Nevada	[3] 21,336	[3] 21,282	--	384,934	350,804	34,398	54	392
New Mexico	20,236	20,127	--	--	702,000	11,518	109	3,379
South Dakota	1,467	1,467	--	407,430	--	--	--	--
Utah	36,006	35,846	--	--	852,052	361,655	160	758
Other States [4]	5,568	5,568	--	--	278,708	41,917	([5])	185
Total	270,532	269,643	3,999	792,364	6,213,365	631,678	889	8,980

[1] Includes some nongold-bearing ores not separable.
[2] Excludes tonnages of fluorspar and tungsten ores from which gold was recovered as a byproduct.
[3] Includes tonnages from which gold is heap leached.
[4] Includes Oregon, Tennessee, Washington.
[5] Less than ½ unit.

Table 9.—Gold produced at amalgamation and cyanidation mills in the United States and percentage of gold recoverable from all sources

Year	Bullion and precipitates recoverable (troy ounces)		Gold recoverable from all sources (percent)			
	Amalgamation	Cyanidation	Amalgamation	Cyanidation	Smelting [1]	Placers
1968	394,051	482,616	26.7	32.6	38.2	2.5
1969	397,869	580,694	23.0	33.5	42.0	1.5
1970	353,957	638,966	20.3	36.7	40.8	2.2
1971	3,071	832,463	.2	55.7	43.0	1.1
1972	3,999	792,364	.3	54.6	44.2	.9

[1] Crude ores and concentrates.

Table 10.—Gold production at placer mines in the United States, by method of recovery

Method and year	Mines producing	Washing plants	Material washed (thousand cubic yards)	Gold recoverable: Thousand troy ounces	Gold recoverable: Value (thousands)	Gold recoverable: Average value per cubic yard
Bucketline dredging:						
1970	1	1	709	29	$1,055	$1.488
1971	2	3	[1] 740	[2] 7	301	[r 3] .407
1972	2	2	[1] 558	[2] 4	237	.425
Dragline dredging:						
1970	1	3	[1] 2	[2] (4)	20	[3] 10.000
1971	--	--	--	--	--	--
1972	1	1	(1)	1	27	(3)
Hydraulicking:						
1970	8	4	17	1	20	1.176
1971	5	5	32	1	30	.938
1972	16	16	230	3	180	.783
Nonfloating washing plants:						
1970	19	37	[1] 275	[2] 8	291	[3] 1.058
1971	21	38	[1] 289	[2] 8	[r] 334	[r 3] 1.156
1972	35	35	[1] 123	[2] 5	281	[r 3] 2.285
Underground placer, small-scale mechanical and hand methods, and suction dredge:						
1970	9	2	[1] 4	[2] 1	23	[3] 5.750
1971	12	[r] 2	6	[r] (4)	10	1.667
1972	14	4	2	(4)	6	3.000
Total placers:						
1970	38	47	[1] 1,007	[2] 39	1,409	[3] 1.399
1971	40	[r] 48	[1] 1,067	[2] 16	[r] 675	[r 3] .632
1972	68	58	[1] 913	[2] 13	731	[3] .801

[r] Revised.
[1] Excludes tonnage of material treated at commercial sand and gravel operations recovering byproduct gold.
[2] Includes gold recovered at commercial sand and gravel operations recovering byproduct gold.
[3] Gold recovered as a byproduct at sand and gravel operations not used in calculating average value per cubic yard.
[4] Less than ½ unit.

Table 11.—U.S. gold consumption in industry and the arts [e]

(Thousand troy ounces)

Industry group	1968	1969	1970	1971	1972
Jewelry and arts	3,908	3,839	3,340	4,299	4,344
Dental	771	710	658	750	750
Industrial, including space and defense	1,925	2,560	1,975	1,884	2,191
Total	6,604	7,109	5,973	6,933	7,285

[e] Estimated by Office of Domestic Gold and Silver Operations, U.S. Treasury Department.

Table 12.—U.S. exports of gold in 1972, by country

Destination	Ore, base bullion and scrap: Troy ounces	Ore, base bullion and scrap: Value (thousands)	Refined bullion: Troy ounces	Refined bullion: Value (thousands)
Belgium-Luxembourg	107,602	$5,969	--	--
Brazil	--	--	322	$14
Canada	1,034	60	232,744	13,314
Germany, West	33,743	2,017	--	--
Japan	2,847	132	--	--
Mexico	--	--	274	17
Netherlands	--	--	372,647	14,161
New Zealand	13	1	--	--
Switzerland	--	--	594,337	20,802
United Kingdom	120,544	6,352	--	--
Venezuela	--	--	6,062	214
Total	265,783	14,531	1,206,386	48,522

Table 13.—U.S. imports (general) of gold in 1972, by country

Country	Ore and base bullion		Refined bullion	
	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Australia	38,945	$2,229	--	--
Austria	--	--	24	$1
Canada	22,938	1,239	3,002,858	174,949
Chile	4,440	277	--	--
Colombia	450	27	--	--
France	16	(1)	154,499	8,696
Germany, West	--	--	8	(1)
Honduras	2,017	66	--	--
Jamaica	--	--	99	4
Japan	--	--	7,260	305
Kenya	235	15	--	--
Lebanon	--	--	2,646	114
Mexico	7,743	378	609	26
Nicaragua	19,008	804	--	--
Norway	462	16	--	--
Panama	47	2	--	--
Peru	31,771	1,699	--	--
Philippines	132,600	7,139	--	--
Portugal	64	2	31	2
Singapore	464	16	--	--
South Africa, Republic of	1,507	53	44,914	1,843
Switzerland	--	--	2,033,951	119,132
Taiwan	72	3	--	--
U.S.S.R.	64	2	533,962	34,690
United Kingdom	--	--	79,492	3,885
Venezuela	2,610	56	396	19
Total	265,453	14,023	5,860,749	343,666

[1] Less than ½ unit.

Table 14.—Value of gold imported into and exported from the United States

(Thousand dollars)

Year	Exports	Imports
1970	37,790	237,464
1971	51,249	283,947
1972	63,053	357,689

Table 15.—Gold: World production [1] by country

(Troy ounces)

Country [2]	1970	1971	1972 p
North America:			
Canada	2,408,574	2,243,000	2,079,000
Costa Rica e	500	500	500
El Salvador	2,301	3,503	2,861
Haiti e	3,000	3,000	3,000
Honduras	3,333	3,503	2,021
Mexico	198,241	150,915	146,061
Nicaragua	115,173	121,134	e 120,000
United States	1,743,322	1,495,108	1,449,943
South America:			
Bolivia	30,603	21,541	19,640
Brazil [3]	r 171,331	157,378	165,531
Chile	r 52,177	64,417	75,946
Colombia	r 201,519	188,847	186,816
Ecuador	r 8,521	11,028	e 11,000
French Guiana	2,347	2,315	e 2,300
Guyana	4,433	1,400	4,026
Peru	r 107,673	65,000	82,885
Surinam	1,137	643	e 600
Venezuela	r 22,320	18,567	e 18,834
Europe:			
Finland	20,319	17,489	17,619
France	r 63,112	65,620	e 66,000
Germany, West e	1,000	1,700	1,700
Portugal	11,992	13,696	13,601
Romania e	60,000	60,000	60,000
Sweden	r 44,207	54,528	e 50,000
U.S.S.R. e	6,500,000	6,700,000	6,900,000
Yugoslavia	97,384	123,780	135,033
Africa:			
Angola	--	32	e 30
Cameroon	r 154	88	e 100
Congo (Brazzaville)	r 2,669	2,958	e 3,100
Ethiopia	r 27,295	24,499	20,784
Gabon	16,108	13,728	13,182
Ghana	r 707,900	697,517	724,051
Guinea e	4,000	4,000	4,000
Kenya	--	--	34
Liberia [4]	r 669	2,546	1,324
Mali e	30	30	30
Malagasy Republic	514	412	190
Mozambique	35	19	e 20
Niger	235	119	--
Nigeria	123	40	12
Rhodesia, Southern	500,000	501,551	e 502,000
South Africa, Republic of	32,164,107	31,388,631	29,245,273
Sudan	--	--	95
Tanzania	r 8,263	167	213
Zaire	r 180,590	171,685	81,566
Zambia [5]	e r 10,700	9,866	e 11,400
Asia:			
China, People's Republic of e	50,000	50,000	50,000
India	104,200	118,569	105,773
Indonesia	7,608	10,600	10,899
Japan [6]	r 255,189	255,255	243,027
Khmer, Republic of e	4,000	4,000	4,000
Korea, North e	160,000	160,000	160,000
Korea, Republic of	r 51,345	28,807	17,072
Malaysia:			
Malaya	3,912	4,491	4,788
Sarawak	1,265	1,180	e 1,047
Philippines	602,715	637,048	606,730
Taiwan	22,602	19,496	17,882
Oceania:			
Australia	r 619,922	672,106	754,932
British Solomon Islands Protectorate	291	444	e 400
Fiji	r 106,301	89,129	e 90,000
New Zealand	11,283	9,418	13,511
Papua-New Guinea	[7] 23,798	24,071	409,125
Total	r 47,522,342	46,491,114	44,711,507

e Estimate. p Preliminary. r Revised.

[1] Unless otherwise indicated, production is on the basis of mine output.

[2] Gold is also produced in Bulgaria, Czechoslovakia, Spain, and small quantities probably in Argentina, Burma, East Germany, Hungary, Thailand, and several other countries. Data for these countries are not available. Data are also lacking on clandestine activities.

[3] Bullion only; excludes gold from placer operations for which no data are available.

[4] Purchased by Bank of Monrovia.

[5] Contained in blister copper, refinery muds, and electrolytic copper.

[6] Refinery production for Japan was as follows: 1970—709,338 ounces; 1971—772,652 ounces; 1972—845,628 ounces.

[7] New Guinea only.