

# Cadmium

By Burton E. Ashley <sup>1</sup>

Strengthening interest in cadmium was presaged by rising producers' prices that increased from \$1.50 early in the year, to \$3.00 per pound at yearend. Domestic production of cadmium metal, at 8.3 million pounds, gained 5% over the 1971 level, and value of producer shipments increased by 93% to \$19 million. Apparent consumption rose 16% to 12.6 million pounds. Seven companies operating eight plants accounted for all domestic output.

Export trade in cadmium increased considerably from the 1971 quantity of 66,000 pounds to slightly over 1 million pounds; imports for the year declined by 31% to 2.4 million pounds.

**Legislation and Government Programs.**—Sales from the national stockpile amounted to 959,100 pounds; such sales were authorized by Public Law 91-314 of July 10, 1970. At yearend a total of 9,213,358 pounds of cadmium remained in the stockpile, of which 3,213,358 pounds was available for disposal. The stockpile objective remained at 6.0 million pounds.

On January 10, General Services Administration (GSA) announced that 600,000 pounds of cadmium ingot and slab would be available for sale at \$1.58 per pound, f.o.b. storage location, in lots of 2,000 pounds or more, and at \$1.63 per pound in lots of less than 2,000 pounds. Sticks in lots of more, or less, than 2,000 pounds were priced at \$1.70 and \$1.75 per pound, respectively. This offering was disposed of by February 1.

On April 3 an additional 600,000 pounds

was put on sale; sticks were priced at \$2.55 per pound in lots of 2,000 pounds or more and at \$2.60 per pound in lots of less than 2,000 pounds. Slabs and ingots brought \$2.43 per pound in lots of less than 2,000 pounds. Disposals in the second quarter amounted to 260,100 pounds. On July 6, GSA announced the availability from the stockpile of 600,000 pounds of cadmium in stick form at \$2.55 per pound in lots of 2,000 pounds or more and at \$2.60 per pound in lots of less than 2,000 pounds. No cadmium was sold at this offering. For the last quarter of the year cadmium sticks from the stockpile were priced at \$2.95 and \$3.00 per pound in quantities of 2,000 pounds and more and for lots of less than 2,000 pounds, respectively. Disposals amounted to 99,000 pounds, of which 10,000 pounds was bartered.

At midyear the U.S. Department of the Treasury announced that cadmium from Japan had been imported at less than fair value and that an industry had been injured. As a consequence, special dumping duties were to be assessed on the subject merchandise imported at less than fair value after March 24, 1971. Duties were to be assessed on a case-by-case basis and any sales made at fair value would not be subject to dumping duties.

The Office of Minerals Exploration, U.S. Geological Survey, provides up to 50% of allowable costs of exploration for cadmium to eligible participants. Cadmium producers were granted a depletion allowance of 22% on domestic production and 14% on foreign production.

## DOMESTIC PRODUCTION

Domestic production of cadmium metal was fairly uniform at slightly more than 2 million pounds for each quarter of the year, except for the third quarter when output was 1.9 million pounds. Total pro-

duction for 1972, at 8.3 million pounds, gained 5% over the 1971 level. Value of

<sup>1</sup> Physical scientist, Division of Nonferrous Metals.

producer shipments increased over the 1971 total by 93% to \$19 million.

Imports of flue dust from Mexico contained 741,000 pounds of cadmium for domestic recovery and refining. Other sources of cadmium for U.S. producers were provided by imports of zinc ore and small amounts of waste and scrap.

The cadmium content of sulfide com-

pounds produced (including cadmium sulfoselenide and lithopone) gained 21% over the 1971 level, to 2.7 million pounds.

Cadmium oxide was produced by American Smelting and Refining Company and Blackwell Zinc Co.

Table 1 shows comparative salient statistics for cadmium for 1968-72; table 2 refers to cadmium sulfide output for the same period.

**Table 1.—Salient cadmium statistics**

	(Thousand pounds)				
	1968	1969	1970	1971	1972
<b>United States:</b>					
Production <sup>1</sup> .....	10,651	12,646	9,465	7,930	8,290
Shipments by producers <sup>2</sup> .....	11,244	12,978	6,848	7,774	10,480
Value..... thousands..	\$28,409	\$40,636	\$24,163	\$9,823	\$18,965
Exports.....	530	1,085	373	66	1,017
Imports for consumption, metal.....	1,927	1,078	2,492	3,499	2,422
Apparent consumption.....	13,328	15,062	9,063	10,873	12,614
Price: Average <sup>3</sup> per pound.....	\$2.65	\$3.27	\$3.57	\$1.92	\$2.56
<b>World: Production.....</b>	<b>33,105</b>	<b>38,784</b>	<b>36,454</b>	<b>34,241</b>	<b>36,599</b>

<sup>r</sup> Revised.

<sup>1</sup> Primary and secondary cadmium metal. Includes equivalent metal content of cadmium sponge used directly in production of compounds.

<sup>2</sup> Includes metal consumed at producer plants.

<sup>3</sup> Average quoted price for cadmium sticks and balls in lots of 1 to 5 tons.

**Table 2.—Cadmium sulfide <sup>1</sup> produced in the United States**

(Thousand pounds)	
Year	Sulfide <sup>2</sup> (cadmium content)
1968.....	2,457
1969.....	2,439
1970.....	2,137
1971.....	2,235
1972.....	2,714

<sup>1</sup> Cadmium oxide withheld to avoid disclosing individual company confidential data.

<sup>2</sup> Includes cadmium lithopone and cadmium sulfoselenide.

## CONSUMPTION AND USES

Apparent consumption of cadmium (see table 3) amounted to 12.6 million pounds, a 16% gain over apparent consumption in 1971. Government sales increased considerably from 1,000 pounds in 1971 to 959,100 pounds in 1972.

The plating industry probably accounted for not less than one-half of cadmium consumption in the United States. Cadmium plating affords an attractive thin finish and under marine conditions is particularly resistant to corrosion. Its plating uses included parts for vehicles and boats, small household appliances, hardware, and fas-

teners, such as nuts, bolts, screws, and other accessories.

Cadmium compounds were used as colorants in plastics, paint, and printing ink; they were also used as stabilizing agents in the manufacture of plastics.

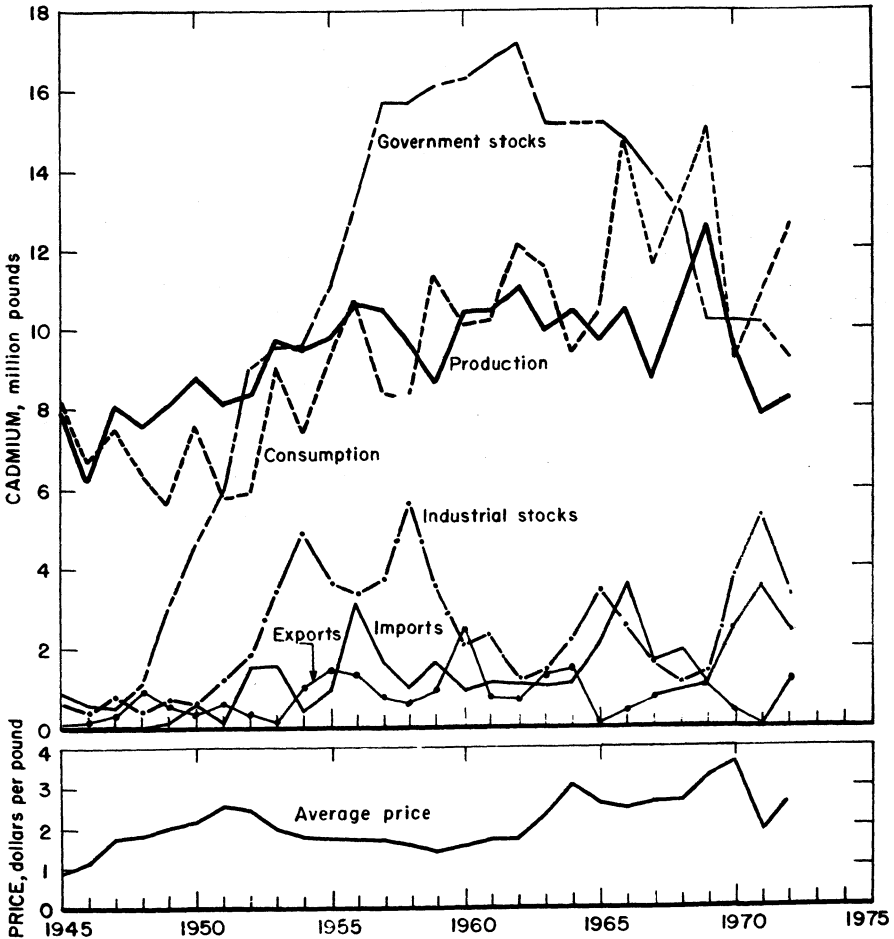
Cadmium was also used as a component of sealed and vented batteries. Such batteries were used to power hand tools and communication equipment, and as independent power sources for internal operational needs in vehicles. Cadmium was used as an alloy for hardening copper, in fusible alloys, and in electrical contacts in switches and relays.

**Table 3.—Apparent consumption of cadmium**  
(Thousand pounds)

	1971	1972
Stocks—beginning .....	4,781	5,272
Production .....	7,930	8,290
Imports, metal .....	3,499	2,422
Government sales .....	1	959
<b>Total (supply) .....</b>	<b>16,211</b>	<b>16,943</b>
Exports .....	66	1,017
Stocks—end .....	5,272 <sup>1</sup>	3,312
<b>Apparent consumption<sup>1</sup> .....</b>	<b>10,873</b>	<b>12,614</b>

<sup>1</sup> Revised.

<sup>1</sup> Total supply minus exports and yearend stocks.



**Figure 1.—Trends in production, consumption, yearend stocks, exports, imports, and average price of cadmium metal in the United States.**

## STOCKS

Yearend 1972 industry stocks of cadmium metal and cadmium content of compounds held in stocks totaled 3.3 million pounds, a decline of 37% from stocks held at year-

end 1971. Table 4 lists the details of industry stocks as of December 31, 1971, and December 31, 1972.

**Table 4.—Industry stocks, December 31**  
(Thousand pounds)

	1971		1972	
	Cadmium metal	Cadmium in compounds	Cadmium metal	Cadmium in compounds
Metal producers.....	3,502	W	1,663	W
Compound manufacturers.....	492	935	451	932
Distributors.....	r 303	40	223	38
Total.....	r 4,297	975	2,342	970

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Compound manufacturers."

## PRICES

The cadmium price of \$1.50 per pound in 1-ton lots held for the first 2 days of 1972 when it was raised to \$1.75 per pound on January 3. There were three more price rises during the year, as shown in table 5. Price for the year averaged out at \$2.56 per pound. Trade sources indicated that toward yearend cadmium was being traded at \$2.85 to \$2.95 per pound. In December the situation changed because balls were in short supply; it was then reported that sticks were trading at \$2.95 per

pound and balls had advanced to the premium position of \$3.15 per pound.

**Table 5.—Cadmium prices 1972**  
(Dollars per pound)

Date	Producer to consumer	
	1-ton lots	Less than 1-ton lots
Jan. 1.....	1.50	1.55
Jan. 3 to Jan. 31.....	1.75	1.80
Feb. 1 to Mar. 8.....	2.25	2.30
Mar. 9 to Oct. 31.....	2.60	2.65
Nov. 1 to Dec. 31.....	3.00	3.05

## FOREIGN TRADE

Exports of cadmium metal increased from 66,000 pounds in 1971 to over 1 million pounds in 1972. Chief destinations for 1972 exports were as follows, in percent: Netherlands, 30; Germany, West, 21; France, 21; United Kingdom, 16; and others, 12.

The preponderance of exports to the Netherlands was accounted for by shipments consigned to Rotterdam; most of the cadmium thus shipped was forwarded to other destinations which would not be listed in the U.S. statistics.

Imports of cadmium metal, waste and scrap, totaled 2.4 million pounds, a decline of 31% from the 1971 level; the imports of cadmium-containing flue dust, all from Mexico, also registered a substantial decline of 33%. Canada was the chief source

of cadmium metal having furnished 44% of total imports, followed by Australia, 17%; Peru, 12%; and Belgium-Luxembourg, 9%. The remaining 18% came from nine different countries. Value of metal imports declined 22% and that of flue dust 39%.

The duty on imported cadmium metal from countries enjoying most-favored-nation status was discontinued in 1971. Cadmium metal imported from Communist-bloc countries, Yugoslavia excepted, was subject to the statutory duty of 15 cents per pound. Imported cadmium-containing flue dust was duty free.

Table 6 shows U.S. exports of cadmium for 1971 and 1972. U.S. imports of cadmium, by country, are shown in table 7.

Table 6.—U.S. exports of cadmium metal and cadmium in alloys, dross, flue dust, residues, and scrap

(Thousand pounds and thousand dollars)

Year	Quantity	Value
1970.....	373	997
1971.....	66	172
1972.....	1,017	2,363

Table 7.—U.S. imports for consumption<sup>1</sup> of cadmium metal and cadmium flue dust, by country

(Thousand pounds and thousand dollars)

Country	1971		1972	
	Quantity	Value	Quantity	Value
<b>Cadmium metal:</b>				
Argentina.....	—	—	9	21
Australia.....	514	950	406	821
Belgium-Luxembourg.....	457	730	218	467
Canada.....	375	639	1,068	2,322
Finland.....	33	55	—	—
France.....	17	29	17	25
Germany, West.....	207	323	73	120
Italy.....	90	161	—	—
Japan.....	938	1,797	128	177
Mexico.....	220	312	136	196
Netherlands.....	81	134	36	64
Peru.....	332	630	297	600
South Africa, Republic of.....	67	134	33	70
Spain.....	22	27	1	3
Switzerland.....	7	11	—	—
U.S.S.R.....	—	—	( <sup>2</sup> )	( <sup>2</sup> )
United Kingdom.....	134	220	—	—
Yugoslavia.....	5	7	—	—
Total.....	3,499	6,264	2,422	4,886
Flue dust (cadmium content): Mexico.....	1,112	1,118	741	685
Grand total.....	4,611	7,382	3,163	5,571

<sup>1</sup> In 1971 general imports were 3,470,323 pounds (\$6,208,146); 1972 general imports and imports for consumption were the same.

<sup>2</sup> Less than ½ unit.

## WORLD REVIEW

World smelter production of cadmium increased by 7% over the preceding year to a total of 36,599,000 pounds. The United States held its place as the world's largest producer with 23% of the total; Japan followed with 18%; U.S.S.R., 15%; Belgium, 7%; Germany, West, 6%, and

Canada, 5%. The remaining 26% was produced by 22 other countries.

Apparent consumption in the United States was equivalent to about 35% of world production. Table 8 shows preliminary figures of world cadmium production in 1972, by country.

Table 8.—Cadmium: World smelter production by country<sup>1</sup>  
(Thousand pounds)

Country	1970	1971	1972 <sup>2</sup>
<b>North America:</b>			
Canada	1,845	1,569	* 1,940
United States <sup>2</sup>	9,465	7,930	8,290
<b>Latin America:</b>			
Mexico	591	423	* 440
Peru	410	377	* 385
<b>Europe:</b>			
Austria	r 47	56	* 55
Belgium	r 2,407	2,088	* 2,500
Bulgaria <sup>e</sup>	440	440	440
Finland	196	265	* 375
France	r 1,164	1,276	* 1,280
Germany, East <sup>e</sup>	33	r 33	33
Germany, West	2,282	2,163	* 2,180
Italy	937	772	* 904
Netherlands <sup>e</sup>	r 245	271	265
Norway	216	203	* 200
Poland	990	1,100	1,200
Romania <sup>e</sup>	180	180	180
Spain	245	225	* 220
U.S.S.R. <sup>e</sup>	5,200	5,300	5,400
United Kingdom	701	578	530
Yugoslavia	331	309	* 310
<b>Africa:</b>			
South-West Africa Territory of <sup>3</sup>	511	432	* 420
Zaire	699	575	* 575
Zambia	26	22	* 26
<b>Asia:</b>			
China, People's Republic of <sup>e</sup>	220	220	220
India	75	64	* 73
Japan	r 5,403	5,898	6,678
Korea, North <sup>e</sup>	240	240	240
<b>Oceania: Australia</b>			
	r 1,355	1,232	* 1,240
<b>Total</b>	<b>r 36,454</b>	<b>34,241</b>	<b>36,599</b>

<sup>e</sup> Estimate. <sup>2</sup> Preliminary. <sup>r</sup> Revised.

<sup>1</sup> Table gives unwrought metal production from ores, concentrates, flue dusts and other materials of both domestic and imported origin. Sources generally do not indicate if secondary metal (recovery from scrap) is included or not; where known, this has been indicated by footnote. Data derived in part from World Metal Statistics (published by World Bureau of Metal Statistics, London) and from Metal Statistics (published by Metallgesellschaft Aktiengesellschaft, Frankfurt am Main). Cadmium is produced in ores, concentrates and flue dusts in a number of other countries, but these materials are exported for treatment elsewhere to recover cadmium metal, therefore output is not recorded in this table to avoid double counting.

<sup>2</sup> Includes secondary.

<sup>3</sup> Output of Tsumeb Corp. Ltd. for year ending June 30 of that stated.

## TECHNOLOGY

An instrument was developed by Pye Unicam of Cambridge, England, which could detect 1 part of cadmium (and lead and zinc) in 1 billion parts of liquid in 20 seconds. It can be used to measure levels of the three metals in the bloodstream.<sup>2</sup>

Yuasa Battery Co., Ltd., of Japan reportedly developed an automatic system for removing harmful heavy metal from industrial effluent; the system will reduce cadmium content in effluents to less than 0.1 part per million. A thin synthetic resin membrane is used as the filtration element. Capacity of the various models ranges from 260 to 7,900 gallons per hour.<sup>3</sup>

A simple electrochemical method of preparing cadmium telluride was described; such compounds are useful for windows in infrared lasers, infrared modulators and as nuclear radiation detectors.<sup>4</sup>

U.S. Patent 3,699,207 was granted for a wet metallurgical process for resin extraction of cadmium from flue dusts or zinc liquor cementations.

**Environmental Developments.**—The Marine Protection Research and Sanctuaries Act of 1972 (P.L. 92-532) was signed into law in October. The law bans the dumping of certain hazardous materials into the ocean and subjects other materials to regulation through a new permit system. The following month 91 nations reached an agreement which regulates controls for the ocean dumping of toxic and dangerous

<sup>2</sup> Mining Journal (London). V. 278, No. 7123, Feb. 25, 1972, p. 159.

<sup>3</sup> News from Ionics. Ionics Inc., Press release, June 1972, 1 p.

<sup>4</sup> Miles, M. H., and W. S. McEwan. Electrochemical Preparation of Cadmium and Mercury Tellurides. J. Electrochem. Soc., v. 119, No. 9, September 1972, pp. 1188-1190.

wastes. As a toxic material, cadmium is one of the metals included in the disposal ban.

The relationship between cadmium pollution and human health received continuing attention. A materials balance was published showing the societal flow of cadmium in the United States for 1968.<sup>5</sup> The flowsheet illustrated the movement of cadmium from mine to environment. Studies have revealed that the daily average human intake of cadmium in the United States is between 0.02 and 0.1 part per million. There was some evidence that a continuous intake of 0.1 part per million may reduce the life span.

Zinc is an essential nutrient for man, but its mineralogical association with cadmium constitutes a hazard to good health. An abstract concerning the relationship of the two metals was published.<sup>6</sup>

The cadmium contamination of soils at a site in British Columbia was evaluated from a standpoint of possible accumulation in man.<sup>7</sup>

H.R. 12958 was introduced to amend the Federal Food, Drug, and Cosmetic Act in February. The Act would regulate the amounts of lead and cadmium which may be released from glazed ceramic or enamel dinnerware. Shortly before H.R. 12958 was introduced it was found that about 100,000 soup bowls had been distributed which contained traces of lead and cadmium. It was thought that the use of the bowls would create no hazard under ordinary circumstances but if they were used to store acid-producing foods, lead and cadmium

salts could be released in harmful quantities.

A study of cadmium-related fatal accidents led to determination of quantitative values for cadmium in air. The lethal amount for man of thermally generated cadmium fumes is not over 2,900 minute-milligrams per cubic meter, or an average concentration of 50 milligrams of cadmium per cubic meter of air during a period of 1 hour. Ingestion of 30 milligrams of soluble cadmium salts produced severe toxic symptoms.<sup>8</sup>

Representatives of the Masters Electroplating Association (MEPA) in New York presented the city Environmental Protection Administrator with an agreement to remove toxic metals (including cadmium) from waste discharged into surrounding waters. Some 200 electroplating firms were involved. Cost of the collective program was estimated at about \$10 million with individual costs reaching as much as \$350,000. Equipment will be installed to bring discharges into compliance with the city's sewer regulations.<sup>9</sup>

<sup>5</sup> Environmental Quality. Third Annual Report of the Council on Environmental Quality. August 1972, figure 5.

<sup>6</sup> Sanstead, H., M.D. Implications of Zinc-Cadmium Interactions for Health. Abs. With Programs of the 1972 Ann. Meetings of the Geol. Soc. of America, v. 4, No. 7, October 1972, p. 653.

<sup>7</sup> John, M. K., H. H. Chuah, and C. J. Van Laerhoven. Cadmium Contamination of Soil and Its Uptake by Oats. *Environmental Sci. and Technol.*, v. 6, No. 6, June 1972, pp. 555-557.

<sup>8</sup> Reynolds, J. M. Safety Advice—Cadmium. *Capital Chemist*, May 1972, p. 71.

<sup>9</sup> *American Metal Market*. V. 79, No. 145, Aug. 7, 1972, p. 4.

