



U.S. Department of the Interior • Bureau of Mines

MINERAL INDUSTRY SURVEYS

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PLATINUM-GROUP METALS IN THE FIRST & SECOND QUARTERS 1991

In the first half of 1991, refinery production of platinum and palladium recovered from the low level of the preceeding half-year, according to the Bureau of Mines, U.S. Department of the Interior. As indicated by the accompanying data, some domestic refining capacity had been shut down temporarily in the second half of 1990.

The Stillwater Mining Co. (SMC), owned by Chevron Corp. and Manville Corp., postponed expansion plans that would have doubled ore production to 2,000 short tons per day. The Stillwater Mine in Montana was the only producer of platinum and palladium in the United States.

The Bureau's Reno Research Center investigated the use of bacteria to oxidize flotation concentrate from the Stillwater Mine. After bacterial pretreatment, tests were conducted to determine if the PGM could be extracted from the biooxidized residue using cyanide. In the most successful test, 34% of the platinum, 75% of the palladium, 94% of the rhodium, and 97% of the gold was removed from the biooxidized concentrate. Copies of the report, RI 9371, may be obtained from the Bureau's Pittsburgh office by telephoning 412-892-4338.

Impala Platinum Ltd., in the Republic of South Africa, announced plans to increase its PGM production, principally through its subsidiary, Messina Ltd. Impala's PGM output is expected to increase 27% between 1991 and 1995.

In January, the International Precious Metals Institute (IPMI) sponsored a seminar on PGM in Las Vegas, NV. Papers were presented on the supply and demand for PGM, autocatalyst recovery, diesel exhaust control, environmental technology, fuel cells, and rhodium catalysts.

The proceedings of the meeting were published and are available for purchase from IPMI, 4905 Tilghman St., Suite 160, Allentown, PA 18104.

In June, IPMI hosted its 15th Annual Meeting in Naples, FL. Two of the papers presented at the meeting concerned the Basel Convention for the transboundary shipment of hazardous materials and how, if adopted, it may affect the recycling of precious metals. The proposed procedures in the Convention require prior written consent by all parties, i.e., the generating country, the receiving country, and the transit countries. The precious metals industry is concerned about the lack of distinction in the Convention between hazardous waste and materials meant for recycling. Another concern is for the additional costs involved in complying with the Convention.

A less severe alternative to the Basel Convention is the OECD approach, which establishes three levels of control for shipping materials. The "green light list" would include metals with no controls and consequently no transport restrictions. The "amber light" would include some hazardous materials and the "red light list" would include hazardous waste and fall

under full Basel regulation. "Amber light" materials would be sent only to licensed facilities, and written contracts between the sending and receiving parties would be required. A company exporting material would be required to notify the receiving country in writing and the receiving country would have limited right of refusal to accept the material. Most precious metals waste would be in this class.

In May, Nissan Motors announced that it had developed a palladium-only catalytic converter. News of the announcement caused

an immediate reaction in markets in New York, causing platinum prices to drop and palladium prices to rise. Nissan's converter must still undergo testing to determine its reliability in both the U.S. and Japanese car markets. In June, Isuzu Motors announced that it had developed a palladium catalytic converter for use on its 1994 model 3-ton trucks for the United States market. The Isuzu announcement further depressed platinum prices. In a similar incident 3 years ago, an announcement by Ford Motor Company that it was testing a platinum-free catalytic converter had a large, but temporary, effect on the prices of platinum and palladium.

Table 1. - Platinum-group metals 1/ refined in the United States 2/
(Kilograms)

Period	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1990 (Final):							
Nontoll-refined:							
First quarter----	r/395	r/973	1	--	r/40	6	r/1,415
Second quarter---	r/616	r/909	2	--	r/25	--	r/1,552
Third quarter ---	r/452	r/700	2	--	r/63	24	r/1,241
Fourth quarter --	r/452	r/1,151	2	--	r/47	4	r/1,656
Total 3/ -----	r/1,915	r/3,733	7	--	r/175	34	r/5,864
Toll-refined:							
First quarter----	r/10,392	r/6,338	32	--	r/768	r/109	r/17,639
Second quarter---	r/9,326	r/5,786	32	--	r/772	108	r/16,024
Third quarter ---	r/3,915	r/2,227	(4/)	--	r/330	r/4	r/6,476
Fourth quarter --	r/3,915	r/2,057	r/1	--	r/330	r/4	r/6,307
Total 3/ -----	r/27,548	r/16,408	65	--	r/2,200	r/225	r/46,447
1991 p/:							
Nontoll-refined:							
First quarter---	433	512	2	--	28	3	978
Second quarter--	663	716	2	--	86	--	1,468
Toll-refined:							
First quarter---	9,635	6,167	32	6	768	235	16,843
Second quarter--	9,719	6,419	32	6	773	236	17,185

p/Preliminary. r/Revised.

1/Typically, nearly all of the platinum and palladium are secondary metal; the other metals are entirely secondary.

2/Data may include estimates.

3/Data may not add to totals shown because of independent rounding.

4/Revised to zero.

Platinum & Palladium Production Toll-Refined Plus Nontoll-Refined

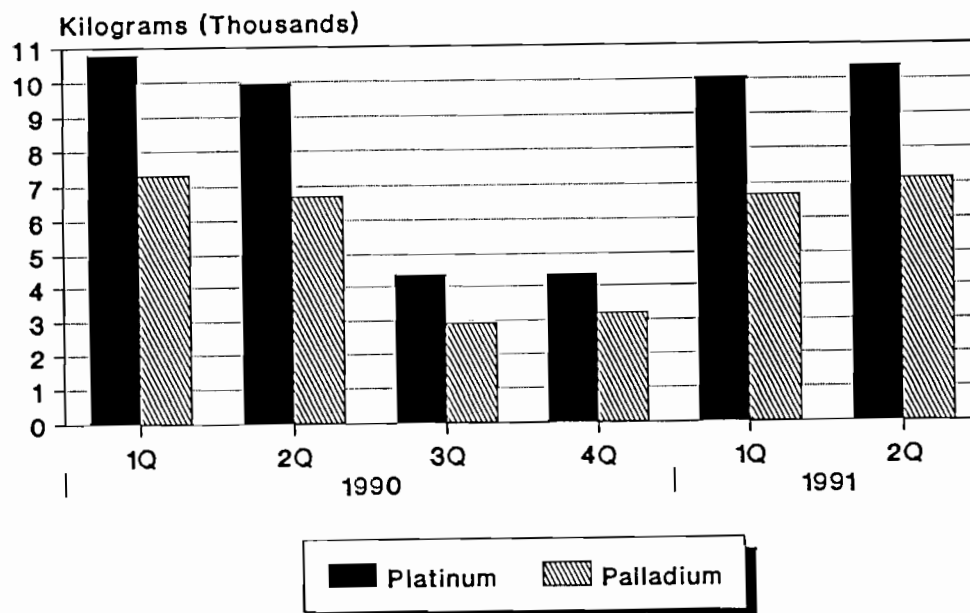


Table 2.--Platinum-group metals refined in the United States^{1/}

(Kilograms)

	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
PRIMARY METAL ^{2/}							
Nontoll-refined:							
1986-----	19	116	--	--	--	--	135
1987-----	32	158	--	--	--	--	191
1988-----	46	248	2	--	(3/)	--	297
1989-----	47	289	2	--	--	2	339
1990-----	2	62	--	--	--	--	64
SECONDARY METAL							
Nontoll-refined:							
1986-----	2,204	8,627	9	--	134	41	r/11,015
1987-----	1,180	3,743	4	19	123	49	r/5,118
1988-----	1,133	3,545	4	--	104	2	r/4,788
1989-----	r/1,134	r/2,664	6	--	94	35	r/3,933
1990-----	1,913	3,671	7	--	175	34	5,800
Toll-refined:							
1986-----	20,977	12,388	111	44	1,792	613	35,924
1987-----	22,580	19,169	102	25	1,895	1,164	44,935
1988-----	22,884	20,923	252	19	1,826	499	46,403
1989-----	24,058	20,037	219	1	1,565	373	46,253
1990-----	27,548	16,408	65	--	2,200	225	46,447
1989 TOTALS							
Total primary-----	47	289	2	--	--	2	339
Total secondary---	r/25,192	r/22,701	225	1	1,659	408	r/50,186
Total refined metal-----							
	r/25,239	r/22,990	227	1	1,659	410	r/50,525
1990 TOTALS							
Total primary-----	2	62	--	--	--	--	64
Total secondary---	29,461	20,079	72	--	2,375	259	52,247
Total refined metal-----							
	29,463	20,141	72	--	2,375	259	52,311

r/Revised.

^{1/}Data may not add to totals shown because of independent rounding.^{2/}"Toll-refined" data was not reported for years 1986-90.^{3/}Less than 1/2 unit.

Table 3. - Stocks of platinum-group metals held by refiners, importers,
and dealers in the United States 1/
(Kilograms)

Period	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total 2/
1990:							
Mar. 31-----	r/13,266	10,750	521	40	974	936	r/26,487
June 30-----	13,173	11,855	521	44	959	921	27,473
Sept. 30-----	r/12,634	r/11,708	521	41	972	926	r/26,802
Dec. 31-----	12,966	10,770	522	46	968	915	26,188
Yearend 3/----	13,421	14,425	483	55	1,089	851	30,324
=====							
1991:							
Mar. 31-----	10,305	10,668	482	46	1,015	846	23,362
June 30-----	10,421	10,021	482	46	1,015	846	22,831

r/Revised.

1/Includes metals in depositories of the New York Mercantile Exchange; on June 30, 1991, this comprised 3,585 kilograms of platinum and 2,535 kilograms of palladium.

2/Data may not add to totals shown because of independent rounding.

3/Includes data from companies reporting annually; quarterly figures not adjusted.

Table 4.- Platinum-group metals sold to consuming industries in the United States 1/
(Kilograms)

Period and industry	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1990:							
Automotive 2/-----	20,967	2,995	--	--	2,995	--	26,957
Chemical-----	2,080	2,369	22	--	169	16	4,654
Dental and medical-----	687	6,133	104	40	2	7	6,974
Electrical-----	3,907	17,997	111	--	274	1,406	23,698
Glass-----	431	346	1	--	31	1	810
Jewelry and decorative-----	431	177	11	--	195	8	818
Petroleum-----	3,274	1,488	--	--	--	--	4,762
Miscellaneous-----	4,280	3,612	199	1	520	202	8,814
Year-----	36,055	35,116	448	40	4,187	1,641	77,487
Apparent consumption 3/	49,860	51,463	649	56	12,311	1,903	116,242
1991:							
First quarter :							
Automotive 2/-----	4,127	591	--	--	591	--	5,309
Chemical-----	274	421	9	--	48	4	755
Dental and medical-----	153	983	30	20	--	4	1,188
Electrical-----	995	3,487	33	--	18	359	4,892
Glass-----	50	--	--	--	2	1	53
Jewelry and decorative-----	121	27	1	--	48	1	198
Petroleum-----	993	40	--	--	--	--	1,033
Miscellaneous-----	779	865	10	--	165	16	1,835
Total-----	7,491	6,414	82	20	873	384	15,264
Apparent consumption 3/	9,820	14,301	112	30	1,511	1,011	26,785
Second quarter:							
Automotive 2/-----	5,082	728	--	--	728	--	6,538
Chemical-----	217	363	8	--	46	2	636
Dental and medical-----	152	1,331	30	20	--	4	1,536
Electrical-----	988	3,255	33	--	18	359	4,652
Glass-----	28	--	--	--	1	1	30
Jewelry and decorative-----	124	32	1	--	48	1	206
Petroleum-----	714	35	--	--	--	--	749
Miscellaneous-----	784	852	9	--	166	15	1,827
Total-----	8,089	6,595	81	20	1,007	381	16,173
Apparent consumption 3/	6,425	9,369	48	12	1,078	360	17,292

1/Data may not add to totals shown because of independent rounding.

2/Platinum, palladium, and rhodium sales to the automotive industry are estimated based on the U.S. light truck sales and U.S. automobile production.

3/Defined as mine production + non-toll production + imports - exports + beginning stocks - ending stocks.
Iridium and osmium exports included with ruthenium.

Platinum & Palladium Consumption Sales to Industry

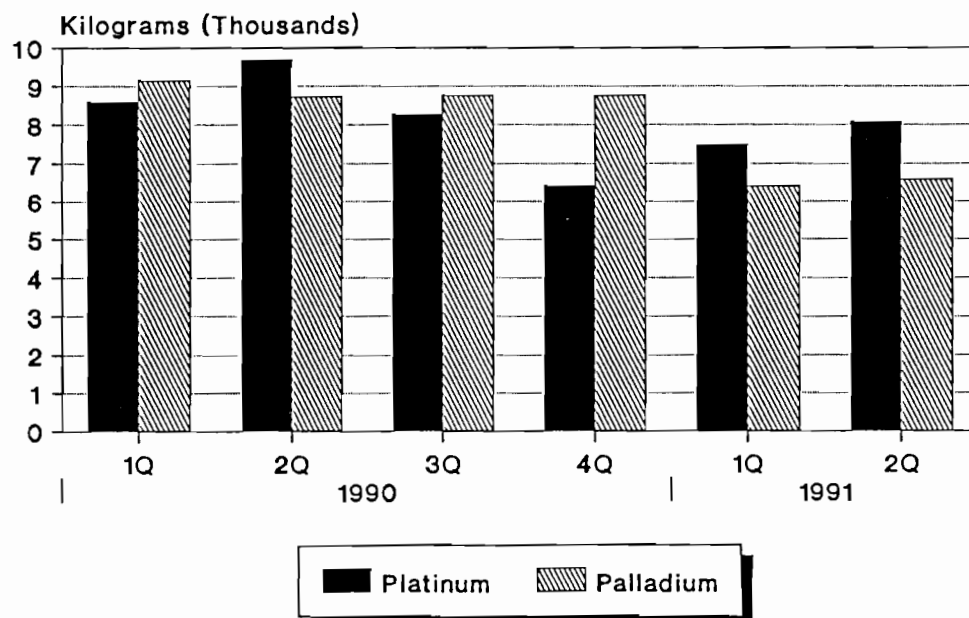


Table 5. --Platinum-group metals^{1/} sold to consuming industries in the United States^{2/}

(Kilograms)

Year and industry	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1986:							
Reported-----	30,513	27,681	382	21	2,906	3,203	64,705
Apparent consumption ^{3/}	51,304	45,796	940	247	5,695	5,998	109,980
1987:							
Reported-----	25,471	30,956	250	29	2,692	882	60,280
Apparent consumption ^{3/}	34,703	49,967	569	184	7,205	2,830	95,458
1988:							
Reported-----	31,125	34,241	495	23	3,292	1,821	70,998
Apparent consumption ^{3/}	39,208	52,342	721	76	7,294	3,661	103,302
1989:							
Automotive ^{4/} -----	18,774	4,886	--	--	1,982	--	25,643
Chemical-----	2,424	1,923	95	--	r/177	26	r/4,645
Dental and medical-----	632	8,424	105	57	1	15	9,233
Electrical-----	3,894	17,352	112	--	r/177	r/1,929	r/23,464
Glass-----	1,130	181	--	--	177	1	1,489
Jewelry and decorative-----	418	179	7	--	205	6	814
Petroleum-----	2,859	2,543	--	--	27	--	5,429
Miscellaneous-----	3,566	3,786	81	--	273	61	7,766
Total-----	33,698	39,273	400	57	r/3,019	r/2,037	r/78,483
Apparent consumption ^{3/}	47,035	45,299	604	30	6,112	2,129	101,209
1990:							
Automotive ^{4/} -----	20,967	2,995	--	--	2,995	--	26,957
Chemical-----	2,080	2,369	22	--	169	16	4,654
Dental and medical-----	687	6,133	104	40	2	7	6,974
Electrical-----	3,907	17,997	111	--	274	1,406	23,698
Glass-----	431	346	1	--	31	1	810
Jewelry and decorative-----	431	177	11	--	195	8	818
Petroleum-----	3,274	1,488	--	--	--	--	4,762
Miscellaneous-----	4,280	3,612	199	1	520	202	8,814
Total-----	36,055	35,116	448	40	4,187	1,641	77,487
Apparent consumption ^{3/}	49,860	51,463	649	56	12,311	1,903	116,242

r/Revised.

1/Comprises primary and nontoll-refined secondary metals.

2/Data may not add to totals shown because of independent rounding.

3/Defined as mine production + non-toll production + imports - exports + beginning stocks - ending stocks.

Between 1986 and 1988, unspecified PGM imports and exports were divided evenly between platinum and palladium.

Iridium and osmium exports included with ruthenium, in 1989 and 1990.

4/1986-90 platinum, palladium, and rhodium sales to the automotive industry are estimated based on U.S. light truck sales and U.S. automobile production.

Table 6.--Average producer and dealer prices^{1/} of platinum-group metals

(Dollars per troy ounce)

	Platinum		Palladium		Rhodium		Iridium	Ruthenium	Osmium
	Pro- ducer	Dealer	Pro- ducer	Dealer	Pro- ducer	Dealer	Dealer	Dealer	Dealer
1990:									
January----	600	492	150	134	1,275	2,031	315	63	505
February---	600	516	150	135	1,275	2,098	310	61	444
March-----	600	494	150	130	1,275	2,058	310	61	425
April-----	600	475	150	127	1,275	2,108	310	61	421
May-----	600	484	150	118	1,275	2,308	305	61	400
June-----	600	479	150	115	1,275	2,960	305	61	400
July-----	600	475	150	116	1,275	5,040	305	61	400
August-----	600	486	150	115	1,275	5,014	305	61	400
September--	600	319	150	103	1,275	5,271	305	61	400
October----	600	415	150	94	1,275	4,720	305	59	400
November---	600	416	150	93	1,275	4,405	304	60	400
December---	600	414	150	87	1,275	4,769	309	61	400
Average--	600	455	150	114	1,275	3,565	307	61	416
1991:									
January----	600	400	150	84	1,275	5,348	300	59	400
February---	600	379	150	83	1,275	5,329	293	58	400
March-----	600	393	150	84	1,275	5,223	288	58	400
April-----	600	394	150	94	1,275	5,086	285	56	400
May-----	600	384	150	94	1,275	4,099	285	59	400
June-----	600	372	150	96	1,275	3,688	285	54	400
July-----	600	372	150	95	1,275	3,693	284	55	400
Average--	600	385	150	90	1,275	4,638	289	57	400

^{1/}Average prices calculated at the low end of the range and rounded to the nearest dollar.

Source: Metals Week.

Table 7.--U.S. imports for consumption of platinum-group metals
(Kilograms and thousand dollars)

Period and country									Total 1/	
	Platinum	Palladium	Rhodium	Ruthenium	Iridium	Osmium	Waste and scrap	Ores	Quantity	Value (thousands)
1990:										
First quarter-----	13,059	11,727	2,932	683	64	54	348	31	28,896	\$350,881
Second quarter-----	13,802	15,016	3,818	740	193	5	2,643	47	36,263	450,316
Third quarter-----	10,959	9,948	3,591	559	177	10	854	--	26,097	471,237
Fourth quarter-----	14,460	15,301	2,757	604	169	6	769	32	34,098	687,397
Total 1/-----	52,277	51,992	13,098	2,586	603	75	4,614	109	125,354	1,905,830
1991:										
First quarter:										
Australia-----	253	--	--	--	--	--	--	--	253	3,858
Belgium-----	389	2,097	25	--	--	--	--	--	2,511	14,125
Canada-----	59	348	1	--	--	--	195	--	603	3,700
France-----	6	9	3	--	--	--	--	--	18	631
Germany, Federal Republic of-----	703	159	97	6	--	--	106	--	1,071	27,890
Hong Kong-----	3	--	--	--	--	--	57	--	60	1,055
Japan-----	67	766	--	--	--	--	7	--	840	1,918
Mexico-----	--	--	--	--	--	--	70	--	70	122
Norway-----	101	341	--	--	--	--	--	--	442	293,001
South Africa, Republic of-----	9,634	5,041	885	1,087	96	21	--	--	16,764	3,445
Switzerland-----	182	18	--	--	3	--	49	--	252	1,416
Taiwan-----	--	--	--	--	--	--	94	--	94	50,834
U.S.S.R.-----	83	4,517	223	--	--	--	--	--	4,823	89,778
United Kingdom-----	1,003	2,143	360	107	6	--	257	--	3,876	4,347
Other-----	52	2	3	4	--	--	107	31	198	1,369
Total 1/-----	2/12,534	15,441	1,598	1,201	110	21	941	31	2/31,877	497,488
Second quarter:										
Australia-----	198	--	--	--	--	--	100	--	298	4,872
Belgium-----	135	1,926	46	--	--	--	40	--	2,147	15,358
Canada-----	62	559	--	--	--	--	118	--	740	4,441
Germany, Federal Republic of-----	723	--	131	2	1	--	--	--	857	36,028
Hong Kong-----	1	--	1	--	--	--	49	--	51	787
Japan-----	44	560	--	--	--	--	--	--	604	3,547
Mexico-----	--	2	--	--	--	--	50	--	52	809
Netherlands-----	--	1	--	--	--	--	119	--	120	4,828
Norway-----	82	230	5	--	--	--	8	--	325	2,679
South Africa, Republic of-----	8,861	6,283	1,056	356	114	12	43	--	16,725	292,062
Switzerland-----	40	17	3	--	--	--	162	--	222	3,232
U.S.S.R.-----	26	3,401	180	--	--	--	--	--	3,608	39,223
United Kingdom-----	1,087	1,744	223	64	--	--	444	--	3,562	60,434
Other-----	26	--	17	--	--	--	43	--	85	4,156
Total 1/-----	3/11,286	14,723	1,661	422	115	12	1,177	--	3/29,396	472,455

1/ Data may not add to totals shown because of independent rounding.

2/ Of this amount, 303 kilograms was in the form of platinum coins.

3/ Of this amount, 289 kilograms was in the form of platinum coins.

Source: Bureau of the Census.

Table 8.--U.S. imports for consumption of platinum-group metals, by year and country

(Kilograms)

Year and country	Platinum	Palladium	Rhodium	Ruthenium	Iridium	Osmium	Waste and scrap	Ores	Total	
									Quantity	Value (thousands)
1989-----	49,238	51,135	7,105	2,883	688	58	2,159	12	113,278	\$1,381,693
1990:										
Belgium-----	1,465	5,329	164	--	--	--	9	--	6,967	53,837
Canada-----	98	1,035	25	8	2	--	652	76	1,896	16,396
France-----	437	6	307	--	--	--	--	--	750	10,737
Germany, Federal Republic of-----	3,457	745	331	37	25	11	95	--	4,701	100,074
Hong Kong-----	4	--	11	--	--	--	601	--	616	8,340
Italy-----	22	--	--	--	--	--	--	--	22	297
Japan-----	632	1,846	--	--	--	--	43	--	2,521	25,557
Mexico-----	3	--	--	--	--	--	578	--	581	1,470
Netherlands-----	30	240	536	--	--	--	6	--	812	14,339
Norway-----	672	988	11	--	--	--	14	--	1,685	13,532
South Africa, Republic of-----	38,926	19,782	5,494	2,328	512	64	--	1	67,107	1,021,710
Switzerland-----	482	350	131	2	--	--	--	--	965	17,337
Taiwan-----	4	529	--	--	--	--	--	--	533	2,480
U.S.S.R-----	455	12,023	3,073	15	--	--	--	--	15,566	335,697
United Kingdom-----	5,030	9,015	2,717	184	55	--	2,161	--	19,162	269,578
Other-----	560	104	298	12	9	--	455	32	1,470	14,449
Total-----	52,277	51,992	13,098	2,586	603	75	4,614	109	125,354	1,905,830

Source: Bureau of the Census.

Table 9.--U.S. exports of platinum-group metals
(Kilograms and thousand dollars)

Period and country	Platinum	Palladium	Rhodium	Iridium, Osmium, Ruthenium	Ores and Concentrates	Waste and scrap	Total 1/	
							Quantity	Value (thousands)
1990:								
First quarter -----	1,646	3,262	324	251	111	5,431	10,914	\$106,914
Second quarter -----	1,426	2,725	260	255	131	4,534	9,200	89,395
Third quarter -----	1,742	2,004	244	54	90	4,009	8,053	112,749
Fourth quarter -----	2,697	2,898	142	226	77	20,513	26,545	106,547
Total 1/-----	7,510	10,887	969	782	409	34,487	55,044	415,605
=====								
1991:								
First quarter:								
Belgium-----	324	558	--	--	2/814	666	2,362	17,455
Canada-----	204	172	7	9	--	60	452	5,327
China-----	18	39	--	1	--	--	58	384
France-----	249	131	--	1	--	21	402	3,698
Germany, Federal Republic of----	716	523	--	3	--	402	1,644	16,704
India-----	248	47	--	--	--	695	990	3,212
Italy-----	139	56	--	--	9	235	439	7,470
Japan-----	2/2,337	551	93	32	--	--	3,013	53,287
Korea, Republic of-----	99	32	19	--	--	--	150	4,742
Netherlands-----	--	302	--	--	--	--	302	1,446
Sweden-----	2	34	--	--	--	77	113	330
Switzerland-----	570	102	7	--	--	138	817	12,047
Taiwan-----	114	388	--	1	--	--	503	4,259
United Kingdom-----	106	191	--	137	--	771	1,205	17,422
Other-----	71	159	2	11	--	6	265	2,878
Total 1/-----	5,211	3,291	127	195	823	3,072	12,719	150,667
=====								
Second quarter:								
Belgium-----	725	1,755	--	--	27	1,177	3,683	29,509
Canada-----	162	273	6	1	1	147	588	7,303
Germany, Federal Republic of----	15	177	1	3	--	491	687	7,307
Italy-----	98	53	--	--	--	371	522	5,339
Japan-----	389	587	114	3	--	191	1,284	28,480
Korea, Republic of-----	191	54	31	6	2	--	284	7,524
Netherlands-----	--	190	--	--	--	--	190	684
Switzerland-----	74	156	--	--	--	22	253	3,777
Taiwan-----	--	324	--	--	--	--	325	1,505
United Kingdom-----	247	124	2	2	--	597	972	12,126
Other-----	69	107	43	5	--	61	287	7,741
Total 1/-----	1,971	3,802	197	21	31	3,056	9,077	111,294

1/Data may not add to totals shown because of independent rounding.

2/Data being questioned.

Source: Bureau of the Census.

Table 10.--U.S. exports of platinum-group metals, by year and country

(Kilograms)

Year and country	Platinum	Palladium	Rhodium	Iridium, osmium, ruthenium	Ores and concentrates	Waste and scrap	Total	
							Quantity	Value (thousands)
1989-----	8,414	13,005	1,156	507	173	15,046	r/38,301	r/\$398,760
1990:								
Australia-----	102	63	--	31	--	--	196	1,640
Austria-----	14	57	--	--	--	--	71	341
Belgium-----	559	749	151	5	--	2,643	4,107	52,417
Brazil-----	12	22	8	--	--	--	42	297
Canada-----	728	824	326	14	300	290	2,482	31,307
China-----	--	1,303	--	1	--	--	1,304	5,434
France-----	1	63	--	1	--	71	136	656
Germany, Federal Republic of-----	800	644	1	84	59	3,052	4,640	54,269
Hong Kong-----	143	11	--	3	--	--	157	1,583
Italy-----	68	157	7	--	--	2,484	2,716	41,669
Japan-----	2,899	3,007	287	204	--	18,430	24,827	85,194
Korea, Republic of-----	495	141	106	9	--	3	754	19,792
Netherlands-----	2	1,496	--	--	--	--	1,498	6,919
Singapore-----	8	156	--	1	--	--	165	1,261
Sweden-----	10	31	--	175	--	191	407	1,586
Switzerland-----	196	309	35	--	22	--	562	6,450
Taiwan-----	631	356	--	16	27	--	1,030	10,666
U.S.S.R.-----	--	--	--	60	--	--	60	613
United Kingdom-----	733	1,127	46	54	--	7,322	9,282	90,119
Other-----	109	371	2	124	1	1	608	3,392
Total-----	7,510	10,887	969	782	409	34,487	55,044	415,605

r/Revised.

Source: Bureau of the Census.