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METALS AND
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Prepared by the staff of the
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N49787

India.—Production of kyanite in 1961 was 29,933 short tons, a 35-percent increase over that of 1960. Sillimanite production was 8,943 tons, 2 percent less than that of 1960.[5]

Korea, Republic of.—Production of andalusite in Korea was 270 short tons in 1960 and 562 tons in 1961.[6]

South Africa, Republic of.—Production of andalusite and sillimanite was 79,367 short tons, a decrease of 22 percent from that of 1961. Local sales totaled 5,864 tons valued at $98,000, and exports were 50,989 tons valued at $2.4 million.[7]

South-West Africa.—Kyanite production was 1,667 short tons, 44 percent less than that of 1961. Exports totaled 2,177 tons valued at $62,600.[8]

TECHNOLOGY

The Pella corundum-sillimanite deposits in Namaqualand, Republic of South Africa, were described. Exploitation is difficult because of the extreme hardness and toughness of the ore, illustrated by the fact that in several tests the average penetration by diamond-drill bits was only 3 inches. Oxygen lancing was tried with some success, but percussion drilling with tungsten-carbide-tipped steel bits was found to be the most efficient method of preparing the material for blasting.[9]

Research on mullite-forming mixtures containing various quantities of the impurities, titanium dioxide, ferric oxide, and alkalis, and tests on sintered mullite shapes made from siliceous bauxite were reported. Satisfactory mullite was prepared from mixtures containing up to a total of 5 percent impurity oxides. Shapes made with mullite prepared from siliceous bauxite were equivalent to those made from imported kyanite.[10]

A monograph was published on the properties, structure, formation, and significance of mullite. Coverage of Russian research on mullite was included.[11]

Research results were presented which indicated that there is a complete isomorphous series between sillimanite (Al_2O_3-SiO_2) and 3/2 mullite ($3Al_2O_3$-$2SiO_2$).[12]

Significant revisions of the Al_2O_3-SiO_2 equilibrium diagram were made, based on 190 tests in sealed noble-metal containers at temperatures up to 1,850° C. Differences in equilibrium data obtained in past research may have resulted to a considerable extent from the conditions under which the experimental data were obtained, particularly with regard to the amount of evaporation of SiO_2 from the liquid phase.[13]

[5] U.S. Embassy, New Delhi, India. State Department Dispatch 892, Apr. 27, 1962, p. 2.
[6] U.S. Embassy, Seoul, Republic of Korea. State Department Dispatches 455, Apr. 4, 1961, encl. 1, p. 1 and 413, Apr. 27, 1962, encl. 1, p. 1.
[7] U.S. Consulate, Johannesburg, Republic of South Africa. State Department Airgram A-362, Mar. 28, 1963, p. 1.
[8] U.S. Consulate, Johannesburg, Republic of South Africa. State Department Airgram A-334, Mar. 13, 1963, p. 2.
[9] Weldner, P. J. Pella Corundum-Sillimanite. Mine & Quarry Eng. (London), v. 28, No. 11, November 1962, pp. 494–498.
[10] Tyrrell, M. E. Effects of Impurities on Sintered Mullite. BuMines Rept. of Inv. 5957, 1962, 15 pp.
[11] Grofcsik, Janos. Mullite, Its Structure, Formation, and Significance. Akademiai Kiado (Publishing House of the Hungarian Academy of Sciences), 1961, 163 pp. Abs. in J. Am. Ceram. Soc., v. 45, No. 10, October 1962, p. 252.
[12] Durovic, Slavomil. Isomorphism Between Sillimanite and Mullite. J. Am. Ceram. Soc., v. 45, No. 4, April 1962, pp. 157–161.
[13] Aramaki, Shigeo, and Rustum Roy. Revised Phase Diagram for the System Al_2O_3-SiO_2. J. Am. Ceram. Soc., v. 45, No. 5, May 1962, pp. 229–242.

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By Richard N. Spencer,[1] Edith E. den

Conte

MINE OUTPUT of recoverab
237,000 tons, production of pri
at primary refineries decrease
production of secondary lead decreas
sumption of lead in battery uses incr
line antiknock additives decreased
other classifications varied, most
decreased slightly to moderately.
during 1962 but some countries fell sl
Deliveries to the supplemental stock
barter contracts negotiated by the
(CCC) with two foreign producers.
plemental stockpile were 84,300 tons.
(New York market) declined on Ja
cents; on February 1 declined to 9.
further to 9.50 cents; and then on No

LEGISLATION AND GOV

Import quotas established in Octo
U.S. Tariff Commission submitted
October 25, in accordance with Exec
escape clause procedure, recommend
the domestic industry had not chang
protective import restrictions on le
investigation was required.

No barter contracts for lead for G
tiated during 1962, but 83,513 tons of
Broken Hill Associated Smelter an
ing Co. to satisfy the remainder of
1961. No acquisitions for Governm

[1] Commodity specialist, Division of Minerals.
[2] Statistical assistant, Division of Minerals.
[3] Figures on imports and exports compiled by Mae
Activities, Bureau of Mines, from records of the U.S. D

Public Law 87–347, to subsidize small lead-zinc mines was implemented by approval of funds. Participation in the program, by eligible producers, was retroactive for production from January 1, 1962. Participation in the program was less than that expected; only $654,140 was disbursed to producers from the $4.5 million appropriated by Congress. The program was to continue 3 more years but at a diminishing scale.

The Office of Minerals Exploration (OME) continued its assistance for approved exploration projects for lead-zinc through June 30, at which time lead, zinc, and copper were removed from the list of minerals eligible under the OME program. Government participation by OME in these projects was limited to 50 percent of approved costs with $250,000 the maximum for any one contract. Two applications for assistance were received, and one new contract was executed and two contracts were amended to increase contract amounts authorizing total new expenditures of $220,230 of which Government participation was $110,115. One contract from OME for lead and zinc was terminated.

The International Lead-Zinc Study Group met in Geneva, Switzerland in plenary session March 15 to 21 at which time it was suspended to reconvene May 28 to 31, and October 24 to 26. Efforts were continued to evaluate means of bringing lead and zinc production and consumption into better balance, and the working group adopted measures to improve the quality of Study Group World Statistics for lead and zinc.

TABLE 1.—Salient lead statistics

	1953–57 (average)	1958	1959	1960	1961	1962
United States:						
Production:						
Domestic ores, recoverable lead content...short tons	339,426	267,377	255,586	240,660	261,921	236,956
Value.....thousands	$97,437	$62,566	$58,785	$57,722	$53,956	$43,602
Primary lead (refined):						
From domestic ores and base bullion short tons	333,655	269,082	225,270	228,809	288,078	245,645
From foreign ores and base bullion short tons	168,265	201,074	115,661	153,537	161,487	130,418
Antimonial lead (primary lead content)...short tons	16,399	16,446	12,402	2,385	24,966	27,383
Secondary lead (lead content) short tons	493,139	401,787	451,387	460,903	452,792	444,202
Imports, general:						
Lead in ores and matte short tons	178,914	201,599	138,834	145,692	147,186	138,900
Lead in base bullion...do	205	460	80	293	422	4,599
Lead in pigs, bars, and old... short tons	314,813	375,022	271,695	213,671	261,794	259,522
Exports of refined pig lead..do	2,153	1,360	2,756	1,967	2,133	2,108
Stocks December 31 (lead content):						
At primary smelters and refineries.....short tons	120,834	231,290	171,079	250,142	262,102	190,661
At consumer plants...do	121,833	122,900	126,496	97,268	99,140	93,496
Consumption of metal, primary and secondary.....short tons	1,171,390	986,387	1,091,149	1,021,172	1,027,216	1,109,635
Price: New York, common lead, average, cents per pound	14.67	12.11	12.21	11.95	10.87	9.63
World:						
Production:						
Mine	2,430,000	2,590,000	2,560,000	2,615,000	2,625,000	2,765,000
Smelter	2,295,000	2,495,000	2,410,000	2,560,000	2,665,000	2,665,000
Price: London, common lead, average, cents per pound	12.46	9.13	8.88	9.04	8.03	7.06

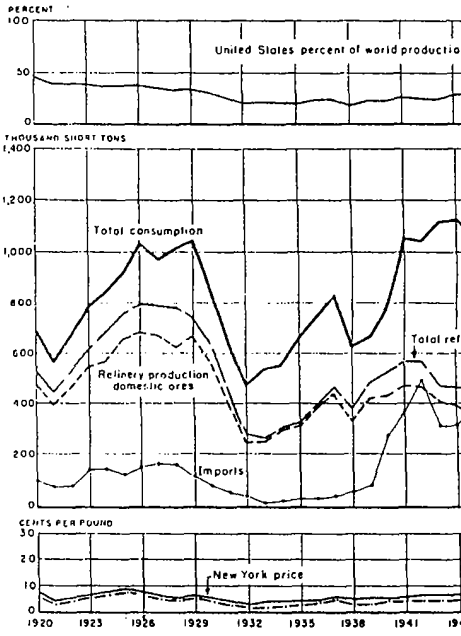

FIGURE 1.—Trends in the lead industry in the U
tion includes primary refined, antimonial,
pigments made directly from ore. Imports
of the lead content of ores, mattes, and con
bars, base bullion, and scrap.

DOMESTIC PRODU

MINE PRODUCT

Mines in the United States produced 23
25,000 tons less than that produced in 1
that produced in 1900; it was also the
Production was normal for recent years
strike closed all Missouri mines. The st
St. Joseph Lead Co. lasted the remainde
1963, resulting in zero output from that
strike. Missouri had long been the pr
but this prolonged strike caused it to dro

The four largest lead producing Sta
Missouri, 61,000 tons; Utah, 38,200 ton
Mines from these four States produced
the total U.S. output. The remaining 1
having a combined production of 36,300

TABLE 2.—Mine production of recoverable lead in the United States, by States

(Short tons)

State	1953-57 (average)	1958	1959	1960	1961	1962
Arizona	10,414	11,890	9,999	8,495	5,937	6,966
Arkansas			38			
California	6,471	140	227	440	103	455
Colorado	19,248	14,112	12,907	18,080	17,755	17,411
Idaho	68,807	53,603	62,395	42,907	71,476	84,058
Illinois	3,594	1,610	2,570	3,000	3,430	3,610
Kansas	4,954	1,209	481	781	1,449	970
Kentucky	154	516	400	558	656	743
Missouri	125,337	113,123	105,165	111,948	98,785	60,982
Montana	16,748	8,434	7,672	4,879	2,643	6,121
Nevada	4,613	4,150	1,357	987	1,791	771
New Mexico	3,692	1,117	820	1,990	2,332	1,134
New York	1,387	579	481	775	879	1,063
North Carolina	5			424	318	219
Oklahoma	11,433	3,692	601	936	980	2,710
Utah	46,194	40,355	36,630	39,398	40,894	38,199
Virginia	3,256	2,934	2,770	2,152	3,733	4,059
Washington	11,147	9,020	10,310	7,725	8,053	6,033
Wisconsin	1,957	800	745	1,165	680	1,394
Other States	15	3		23	27	58
Total	339,426	267,377	255,580	246,609	261,921	236,950

Major mines in these less productive States, with a combined total of 29,500 tons that represented 12 percent of the total output, were located in Washington, Arizona, Virginia, Illinois, Montana, and Oklahoma. Mines in New Mexico, New York, Wisconsin, Kansas, and Nevada produced 5,300 tons or 2 percent of the total, and 1 percent came from the 6 remaining States.

By area, the Western States supplied 68 percent of the total production, the West Central States 27 percent, and the States east of the Mississippi, 5 percent.

The 25 leading lead-producing mines accounted for 91 percent of total domestic mine output; the 10 leading mines yielded 74 percent, and the 4 largest mines 46 percent.

Southeast Missouri continued to be favored by more lead exploration activity than any other mineral area in the United States. Most of the major U.S. mining companies were actively engaged in leasing and exploring in Missouri. Exploration results were encouraging, but no plans for new Missouri mine production were announced. A unitized development contract was signed between the St. Joseph Lead Co. and the U.S. Department of the Interior for integrating mining development on 14,173 acres comprised of 6,000 acres of federally owned and 8,173 acres of privately owned land. Two Kennecott Copper Corp. subsidiaries started exercising their options on land containing a lead deposit in Reynolds and Shannon Counties in Missouri. No developments or production plans were announced.

Lead production from mines in Idaho was 18 percent higher than that in 1961. This higher production, uninterrupted by strikes, contrasted with the prolonged closure of mines in Missouri, enabled Idaho to become first in lead production. Most mines in the Coeur d'Alene district contributed to this record production, exceeded only once (in 1950) since 1942. Day Mines, Inc., closed the Dayrock lead-silver mine in September after 40 years of continuous operation.

TABLE 3.—Ores yielding lead and zinc in the United States in 1962

(Short tons)

State	Lead ore			Zinc ore			Lead-zinc ore			Copper-lead, copper-zinc, and copper-lead-zinc ores			All other sources [1]			Total		
	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc
Arizona	2,281	119	14	19,435	49	2,515	290,733	6,756	18,997	174,666	41	11,071	24,556,740	1	291	25,043,855	6,966	32,888
Arkansas				8,000		211							8,000			8,000		211
California	210	76	1				1,770	369	78				39,483	10	243	41,463	455	322
Colorado	2,983	42	13				441,255	8,074	31,115	1427,734	9,295	12,223	(1)			871,082	17,411	43,351
Idaho	213,739	23,083	2,013	77,631	712	1,915	882,250	56,318	54,163				412,613	3,945	4,774	1,586,133	84,058	62,865
Illinois				312,751	202	10,194	258,407		6,872				399,742	2,773	10,347	970,900	3,610	27,413
Kansas				51,931	174	2,107	72,602	796	1,836							124,533	970	3,943
Kentucky													85,669	743	1,172	85,669	743	1,172
Missouri	2,991,463	60,982	2,792	940,000	4,808	30,487		52	9				126,352	1,106	7,149	2,991,463	60,982	2,792
Montana	2,223	355	33				147									2,223	6,121	37,678

TABLE 4.—Mine production of recoverable lead in the United States, by months

(Short tons)

Month	1961	1962	Month	1961	1962
January	23,305	22,720	August	23,011	16,641
February	20,948	21,994	September	20,822	13,932
March	24,681	23,675	October	21,327	15,092
April	22,098	23,943	November	20,405	14,284
May	22,867	24,984	December	19,792	14,551
June	23,070	23,955			
July	19,595	21,179	Total	201,921	236,956

TABLE 5.—Twenty-five leading lead-producing mines in the United States in 1962, in order of output

Rank	Mine	District or region	State	Operator	Source of lead
1	Bunker Hill	Coeur d'Alene	Idaho	The Bunker Hill Co.	Lead-zinc ore.
2	United States & Lark.	West Mountain (Bingham).	Utah	United States Smelting, Refining and Mining Co.	Lead-zinc, gold-silver ore.
3	Federal	Southeastern Missouri.	Missouri	St. Joseph Lead Co.	Lead ore.
4	Lucky Friday	Coeur d'Alene	Idaho	Lucky Friday Silver-Lead Mines Co.	Do.
5	Viburnum	Southeastern Missouri.	Missouri	St. Joseph Lead Co.	Do.
6	Star and Morning Unit.	Coeur d'Alene	Idaho	The Bunker Hill Co. and Hecla Mining Co.	Lead-zinc ore.
7	Leadwood	Southeastern Missouri.	Missouri	St. Joseph Lead Co.	Lead ore.
8	Idarado	Upper San Miguel.	Colorado	Idarado Mining Co.	Copper-lead-zinc ore.
9	Indian Creek	Southeastern Missouri.	Missouri	St. Joseph Lead Co.	Lead ore.
10	Page	Coeur d'Alene	Idaho	American Smelting and Refining Company.	Lead-zinc ore.
11	Iron King	Big Bug	Arizona	Shattuck Denn Mining Corp.	Do.
12	United Park City	Blue Ledge	Utah	United Park City Mines Co.	Do.
13	Pend Oreille	Metaline	Washington	Pend Oreille Mines and Metals Co.	Do.
14	Badger State	Summit Valley	Montana	The Anaconda Company.	Zinc ore.
15	Austinville and Ivanhoe Mines.	Austinville	Virginia	The New Jersey Zinc Co.	Zinc-lead ore.
16	Eagle	Red Cliff (Battle Mountain).	Colorado	do	Lead-zinc, copper ore.
17	Ophir Unit	Ophir	Utah	United States Smelting, Refining and Mining Co.	Lead-zinc ore.
18	Sunshine	Coeur d'Alene	Idaho	Sunshine Mining Co.	Silver ore.
19	Emperius	Creede	Colorado	Emperius Mining Co.	Lead-zinc ore.
20	Deardorff Group	Upper Mississippi Valley.	Illinois	Ozark-Mahoning Co.	Fluorspar-lead-zinc ore.
21	Balmat	St. Lawrence County.	New York	St. Joseph Lead Company.	Zinc-lead ore.
22	Fairview-Blue Diggings.	Upper Mississippi Valley.	Illinois	Aluminum Company of America (Alcoa).	Fluorspar-lead-zinc ore.
23	Flux	Harshaw	Arizona	Nash & McFarland	Lead-zinc ore.
24	Camp Bird	Sneffels	Colorado	Camp Bird Colorado, Inc.	Do.
25	Blue Goose No. 1	Picher-Cardin	Oklahoma	The Eagle-Picher Co.	Zinc-lead ore.

Lead production of Utah was slightly less than in 1961 even though production continued uninterrupted. United States Smelting, Refining and Mining Co. started to reopen the Butterfield mine of Kennecott Copper Corp. Mine access was through the United States and Lark mine; it was expected that the ore body area would be reached during 1963. A new 400-ton-per-day differential flotation mill was

built to treat ore from the Mayfl
Mining Co. and operated by Hecl
begin soon from Burgin mine, Tinti
where exploration proved 1.5 milli
output in Utah was about 7 percen

Output of lead from mines in
development program for the Welli
being built and production was expe
Co. announced that its mine at Cr
nitely at yearend. Principal lead
The Eagle mine of The New Jersey
Mining Co., and Creede mine of th
of Rico Argentine Mining Co., an
Bird Colorado, Inc.

Production from lead-producing
to come mainly from the Metaline
Oreille Mines and Metals Co. and A
Co. There was some exploration ar
County and on the Spokane In
Uranium Co. took action to boos
Gladstone Mountain. Washington
percent.

The principal lead-producing mi
Iron King of Shattuck Denn Mini

Montana mine production of lead
This increase was due largely to cop
and stockpiles of The Anaconda C

New Mexico lead production dec
burg mine and the Hanover mine
indefinitely late in 1962.

SMELTER AND REFI

Refined lead was produced at pri
foreign source ore and base bullion,
small quantities of scrap. Primary
nial lead. The principal product
nial lead, and the major source of
scrap. Refined pig lead, and antim
alloys, accounted for 27 and 73 perc
lead recovery.

Three smelters, five combinatio
fineries comprised the domestic pri
list of major secondary smelting fi
Mines was published in the Lead c
book. All domestic primary smelte

Smelters:

American Smelting and Refining Co
East Helena, Mont.
El Paso, Tex.
International Smelting & Refining C

Smelter-refineries:
American Smelting and Refining Company
Selby, Calif.
Perth Amboy, New Jersey
The Bunker Hill Co., Kellogg, Idaho
St. Joseph Lead Co., Herculaneum, Mo.
The Eagle-Picher Co., Galena, Kansas
Refineries:
United States Smelting Lead Refinery, Inc., East Chicago, Ind.
American Smelting and Refining Company, Omaha, Nebr.
Schuylkill Products Co., Baton Rouge, La.

Refined Lead—Primary and Secondary.—Domestic primary lead smelters and refiners produced 377,900 tons of refined lead and 31,100 tons of lead in antimonial lead. The lead content of primary raw materials consumed for this production was 429,800 tons, and that of scrap material was 6,400 tons.

Domestic ores yielded 65 percent of the refined lead produced from primary sources compared with 64 percent in 1961. Foreign ores and bullion were the sources of the remainder.

Primary lead smelters also produced 1,842 tons of refined lead from scrap, but secondary smelters produced 91,600 tons. Refined lead, plus remelt lead produced from all sources, totaled 118,500 tons.

Antimonial Lead—Primary and Secondary.—Total antimonial lead production at both primary and secondary smelters was 273,100 tons with a lead content of 256,800 tons; 33,300 tons from primary smelters and 239,800 tons from secondary smelters. Scrap was the source of 11 percent of the primary smelter output; domestic ores furnished 49 percent and foreign ores, 40 percent. Battery scrap accounted for 65 percent of the total lead-base scrap melted. The major product from smelting scrap was antimonial lead.

TABLE 6.—Refined lead produced at primary refineries in the United States, by source material

(Short tons)

	1953-57 (average)	1958	1959	1960	1961	1962
Refined lead:						
From primary sources:						
Domestic ores and base bullion	333,655	269,082	225,270	228,899	288,078	245,645
Foreign ores and base bullion	168,265	201,074	115,661	153,537	101,487	130,418
Total	501,920	470,156	340,931	382,436	449,565	376,063
From secondary sources	4,138	2,338	1,194	4,776	1,569	1,842
Grand total	506,058	472,494	342,125	387,212	451,134	377,905
Average sales price per pound	$0.143	$0.117	$0.115	$0.117	$0.103	$0.093
Calculated value of primary refined lead (thousands)[1]	$143,649	$110,017	$78,414	$89,490	$92,610	$69,948

[1] Excludes value of refined lead produced from scrap at primary refineries.

Other Secondary Lead.—Lead-base, copper-base and tin-base scrap were source materials from which 444,200 tons of secondary lead was recovered. Secondary production decreased 2 percent. Secondary lead smelters recovered 92 percent of the total in 220 plants; primary smelters, 1 percent in 5 plants; and manufacturers, foundries, and secondary copper smelters, 7 percent.

TABLE 7.—Antimonial lead produced at prim States

Year	Production (short tons)	Antimony conten	
		Short tons	Percen
1953-57 (average)	64,180	3,605	5.
1958	50,246	2,803	5.
1959	37,487	1,924	5.
1960	30,230	1,575	5.
1961	35,080	1,804	5.
1962	33,325	2,249	6.

TABLE 8.—Stocks and consumption of new States in 1962

(Short tons, gross we

Class of consumers and type of scrap	Stocks Jan. 1[1]	Receip
Smelters and refiners:		
Soft lead	2,645	48,1
Hard lead	1,344	16,4
Cable lead	1,903	24,8
Battery-lead plates	16,118	384,5
Mixed common babbitt	375	3,1
Solder and tinny lead	230	8,4
Type metals	1,297	25,0
Drosses and residues	16,193	63,1
Total	40,105	573,7
Foundries and other manufacturers:		
Soft lead	100	3
Hard lead	203	1
Cable lead	102	
Battery-lead plates	166	3
Mixed common babbitt	279	8,7
Solder and tinny lead	3	2
Type metals		
Drosses and residues	281	
Total	1,140	9,9
Grand total:		
Soft lead	2,751	48,5
Hard lead	1,547	16,5
Cable lead	2,005	24,8
Battery-lead plates	16,284	384,9
Mixed common babbitt	654	11,8
Solder and tinny lead	233	8,7
Type metals	1,297	25,0
Drosses and residues	16,474	63,1
Total	41,245	583,7

[1] Revised figures.

TABLE 9.—Secondary metal recovered[1] from lead and tin scrap in the United States in 1962, by type of products

(Short tons, gross weight)

	Lead	Tin	Antimony	Other	Total
Refined pig lead	93,406				93,406
Remelt lead	25,062				25,062
Total	118,468				118,468
Refined pig tin		2,991			2,991
Remelt tin		343			343
Total		3,334			3,334
Lead and tin alloys:					
Antimonial lead	229,392	385	13,706	140	243,623
Common babbitt	17,074	905	1,620	74	19,573
Genuine babbitt	80	293	26	10	409
Solder	23,508	5,336	314	18	29,176
Type metals	30,055	1,742	3,610	10	35,417
Cable lead	16,295	6	165	3	16,469
Miscellaneous alloys	1,479	704	21	93	2,297
Total	317,883	9,371	19,362	348	346,964
Composition foil					
Tin content of chemical products		972			972
Grand total	436,351	13,677	19,362	348	469,738

[1] Most of the figures herein represent actual reported recovery of metal from scrap.

TABLE 10.—Secondary lead recovered in the United States

(Short tons)

	1953–57 (average)	1958	1959	1960	1961	1962
As refined metal:						
At primary plants	4,133	2,338	1,194	4,776	1,569	1,842
At other plants	122,835	113,719	124,185	143,443	139,100	116,626
Total	126,973	116,057	125,379	148,219	140,669	118,468
In antimonial lead:						
At primary plants	44,176	30,097	23,161	26,270	8,220	3,693
At other plants	198,990	151,956	181,185	179,217	197,349	225,699
Total	243,166	182,053	204,346	205,487	205,569	229,392
In other alloys	123,000	102,777	121,662	116,197	106,554	96,342
Grand total:						
Quantity	493,139	401,787	451,387	469,903	452,792	444,202
Value (thousands)	$141,590	$94,018	$103,819	$109,957	$93,275	$82,622

TABLE 11.—Lead recovered from scrap proc
of scrap and form

(Short tons

Kind of scrap	1961	1962	
New scrap:			As
Lead-base	56,808	44,803	
Copper-base	4,981	5,586	
Tin-base	465	529	
Total	62,254	50,918	
Old scrap:			In
Battery-lead plates	240,896	252,593	In
All other lead-base	132,405	124,277	In
Copper-base	17,142	16,409	In
Tin-base	5	5	
Total	390,538	393,284	
Grand total	452,792	444,202	

[1] Includes 8,220 tons of lead recovered in antimonial lead and 3,693 tons in 1962.

CONSUMPTION

Lead metal production at primary 113,000 tons, about 8,000 tons less t tion in 1961, the second quarter dro quarter to 96,000 tons, and the fourth q

Secondary lead production was at 1961 amounting to 444,200 tons. Pri totaled 847,600 tons compared with 9 stocks decreased moderately in the fir and fourth quarters these stocks d to 196,700 tons from the record high tons in 1961. Consumer stocks al moderately. At yearend, producer (refined, in antimonial and other al tons from 303,400 tons on January during 1962, reaching a low of 9.50 to 10.00 cents November 1 after con for several months. Consumption i classifications of Bureau of Mines st creased in two of the three largest us in red lead and litharge, 6 percent; gasoline antiknock additives.

Soft lead, primary and secondary, total consumed, 27 percent was lead was in alloys, 1.3 percent was in cop in scrap that went directly into an en recovered from ore in producing lea ments. Consumption ranged from a 79,600 tons to a high of 105,100 tons sumption trend was downward for it increased sharply and continued at of 1962 as battery and antiknock de was more than for any year since 195

Of the lead consumed during 1962, 72 percent was used in metal products; the major item was storage batteries which accounted for 38 percent of all lead consumed. Gasoline antiknock additives, 98 percent of the general classification chemicals, accounted for 15 percent of the total lead consumption. Lead pigments used 9 percent of the total lead, and 74 percent of that was for the manufacture of red lead and litharge. Two items of consumption related to the automobile industry, batteries and gasoline antiknock additives, represented 53 percent of total lead consumption.

The Association of Battery Manufacturers, Inc., reported the shipment of 30.5 million replacement battery units and total battery shipments of 38.9 million units, an increase of 8 percent and 11 percent, respectively. Battery shipments were at a record high.

Nine States accounted for 73 percent of the total lead consumed (excluding scrap) as follows: New Jersey, 14 percent; Louisiana and Texas together, 12 percent; Illinois, 11 percent; California, 10 percent; Indiana, 10 percent; Pennsylvania, 7 percent; New York, 5 percent; and Missouri, 4 percent.

TABLE 12.—Lead consumption in the United States, by products

(Short tons)

Product	1961	1962	Product	1961	1962
Metal products:			Pigments—Continued		
Ammunition	45,837	47,779	Pigment colors	11,273	11,660
Bearing metals	17,757	16,472	Other [1]	[2] 4,383	3,802
Brass and bronze	20,114	20,607	Total	[2] 95,293	102,968
Cable covering	57,458	56,676	Chemicals:		
Calking lead	67,379	72,648	Gasoline antiknock additives	169,802	168,026
Casting metals	6,873	7,355	Miscellaneous chemicals	[2] 2,119	2,715
Collapsible tubes	11,220	11,972	Total	[2] 171,921	171,641
Foil	2,968	3,720	Miscellaneous uses:		
Pipes, traps, and bends	19,098	19,819	Annealing	5,066	5,306
Sheet lead	28,102	28,540	Galvanizing	1,444	1,146
Solder	54,838	66,873	Lead plating	243	230
Storage batteries:			Weights and ballast	8,890	10,330
Antimonial lead	186,028	217,525	Total	15,643	17,018
Lead oxides	181,970	202,381	Other, unclassified uses	17,050	17,479
Terne metal	965	1,402	Grand total [3]	1,027,216	1,109,635
Type metal	26,693	26,760			
Total	727,300	800,529			
Pigments:					
White lead	7,615	11,031			
Red lead and litharge	72,022	76,325			

[1] Includes lead content of leaded zinc oxide and other pigments and chemicals.
[2] Revised figures.
[3] Includes lead which went directly from scrap to fabricated products.

TABLE 13.—Lead consumption in the United States, by months

(Short tons)

Month	1961	1962	Month	1961	1962
January	83,570	93,828	August	91,150	96,393
February	79,586	88,415	September	89,735	91,122
March	83,266	91,040	October	93,504	105,145
April	78,201	86,659	November	90,020	96,293
May	89,679	94,635	December	89,664	91,500
June	86,520	89,988			
July	72,312	79,567	Total [1]	1,027,216	1,109,635

[1] Includes lead content of leaded zinc oxide and other pigments and lead which went directly from scrap to fabricated products.

TABLE 14.—Lead consumption in the Uni and types of

(Short t

Product	Soft lead
Metal products	211,315
Storage batteries	211,128
Pigments	99,184
Chemicals	171,641
Miscellaneous	9,931
Unclassified	11,890
Total	715,080

[1] Excludes 35,797 tons of lead that went directly fron contained in leaded zinc oxide and other pigments and

TABLE 15.—Lead consump

(Short t

State	Refined soft lead
California	77,207
Colorado	1,879
Connecticut	12,928
District of Columbia	100
Florida	1,858
Illinois	72,488
Indiana	61,030
Kansas	8,358
Kentucky	42
Maryland	5,983
Massachusetts	5,802
Michigan	15,329
Missouri	39,134
Nebraska	4,927
New Jersey	119,271
New York	36,574
Ohio	13,496
Pennsylvania	45,500
Rhode Island	2,767
Tennessee	177
Virginia	2,387
Washington	7,809
West Virginia	16,332
Wisconsin	698
Alabama,[2] Georgia, Mississippi	33,296
Arkansas and Oklahoma	3,631
Hawaii and Oregon	686
Iowa and Minnesota	1,718
Louisiana and Texas	107,773
Montana and Idaho	11,140
New Hampshire, Maine, Delaware	3,681
North and South Carolina	646
Utah, Nevada, Arizona	113
Undistributed	328
Total	715,080

[1] Excludes 35,797 tons of lead which went directly lead contained in leaded zinc oxide and other nonspeci
[2] These and following States are grouped to avoid di

LEAD PIGMENTS [4]

Production of lead pigments increased slightly. Activity of industries consuming the largest amount of lead pigments varied as follows: Automobile and truck manufacture increased 24 percent, the value of public and private construction increased 6 percent, paint sales increased 5 percent, use in the production of natural and synthetic rubber increased 11 percent, and lead battery production rose 14 percent.

Production.—Lead consumed by manufacturers to produce lead pigments was 287,000 tons, compared with 270,300 tons in 1961.

All the white lead, red lead, and litharge pigments, as well as 161,000 tons of black oxide (battery oxides) were made from refined lead and represented 99 percent of the lead used for pigment purposes. The remaining 1 percent was consumed as lead ore to produce leaded zinc oxide. Production data for basic lead sulfate is withheld to avoid disclosing individual company confidential data. Lead silicate, a derivative of litharge, is included with litharge.

Consumption and Uses—*White Lead.*—Shipments of white lead decreased less than 1 percent. The paint industry used 74 percent of the white lead, and the ceramic industry used 1 percent. A substantial part of the remaining 25 percent also was used in the paint industry, and other uses for white lead included chemicals, greases, plasticizers, and stabilizers for plastics.

Basic Lead Sulfate.—Most lead sulfate was used in making leaded zinc oxide, but production figures were withheld to avoid disclosing individual company confidential data.

Red Lead.—Fifty-four percent of the red lead was consumed by the paint industry compared with 56 percent in 1961. Other use categories were colors, lubricants, petroleum, rubber, and miscellaneous small uses.

Orange Mineral.—No consumption was reported.

Litharge.—To avoid disclosing company confidential data, a large percentage of litharge shipped to industry was included in the group classification "Other." Within other uses, battery makers were the largest consuming group; chemicals, chrome pigments, driers, floor covering, friction material, ink, insecticides, and miscellaneous uses accounted for the remainder. Battery makers produced 161,000 tons of leaded litharge, known to the battery trade as black oxide or grey suboxide; this material was the basic ingredient of the lead paste filling of lead-acid battery plates.

Prices.—The quoted price of white lead was 16.5 cents per pound ($330 per ton) in carlots throughout 1962. The average value of shipments of dry white lead was $400 per ton; white lead in oil averaged $476 per ton. The quoted price of red lead ranged from 13.25 cents per pound to 14.00 cents, or $265 per ton to $280 per ton, in less than carlots; the average value of red lead shipments decreased $7 to $285 per ton. The quoted price of litharge ranged from 12.75 cents to 13.25 cents per pound, or $255 to $265 per ton, in less than carlots; averaged value of shipments decreased $10 to $231 per ton.

[4] Prepared by Richard N. Spencer, commodity specialist, and Esther B. Miller, statistical assistant, Division of Minerals.

TABLE 16.—Production and shipments of lead p
States

Pigment	1961			
	Production (short tons)	Shipments		
		Short tons	Value [2]	
			Total	Aver age p ton
White lead:				
Dry	10,354	10,523	$4,407,280	$41
In oil [3]	5,892	5,700	2,679,785	47
Total	16,246	16,223	7,087,065	
Red lead	22,708	22,856	6,675,990	29
Litharge	98,817	98,950	23,841,808	24
Black oxide	147,136			

[1] Except for basic lead sulfate, figures withheld to avoid disc
[2] At plant, exclusive of container.
[3] Weight of white lead only, but value of paste.

TABLE 17.—Lead content of lead and zinc pig
by domestic manufacturer

(Short tons)

Pigment	1961			Total lead i pigmen
	Lead in pigments produced from—			
	Ore		Pig lead	
	Domestic	Foreign		
White lead			12,997	12,99
Red lead			20,664	20,66
Litharge			91,900	91,90
Black oxide			140,973	140,97
Leaded zinc oxide	2,717	1,071		3,78
Total	2,717	1,071	266,534	270,32

[1] Excludes lead in basic lead sulfate; figures withheld to av
tial data.

TABLE 18.—Distribution of white lead (dry an

(Short tons)

Industry	1953–57 (average)	1958	1
Paints	20,205	15,288	
Ceramics	611	268	
Other	4,451	[2] 2,804	
Total	25,327	18,360	

[1] Excludes basic lead sulfate; figures withheld to avoid disc
[2] Figures for plasticizers and stabilizers withheld to avoid dis

TABLE 19.—Distribution of red lead shipments, by industries

(Short tons)

Industry	1953-57 (average)	1958	1959	1960	1961	1962
Paints	14,364	13,726	12,008	12,003	12,895	13,716
Storage batteries	(1)	(1)	(1)	(1)	(1)	(1)
Ceramics	(1)	(1)	(1)	328	(1)	637
Other	14,194	8,266	9,897	9,400	9,961	11,164
Total	28,548	21,992	21,905	22,631	22,856	25,517

[1] Included with "Other."

TABLE 20.—Distribution of litharge shipments, by industries

(Short tons)

Industry	1953-57 (average)	1958	1959	1960	1961	1962
Ceramics	20,018	(1)	15,340	15,763	14,393	17,762
Chrome pigments	5,339	3,731	4,082	(1)	(1)	(1)
Floor covering	(1)	(1)	(1)	(1)	(1)	(1)
Insecticides	(1)	(1)	(1)	(1)	(1)	(1)
Oil refining	3,771	2,598	3,096	2,371	2,147	2,494
Rubber	1,902	1,247	1,808	1,373	1,243	1,792
Storage batteries	(1)	(1)	(1)	(1)	(1)	(1)
Varnish	4,016	3,223	4,725	3,471	3,394	4,083
Other	101,198	81,306	76,362	75,672	77,773	77,366
Total	136,244	92,165	106,013	98,640	98,950	103,397

[1] Included with "Other."

Foreign Trade.—Imports of lead pigments and salts decreased 13 percent in value but increased 5 percent in quantity over imports during 1961. White lead imports increased 26 percent, red lead imports increased 21 percent, litharge imports increased 1 percent, and imports of other lead compounds increased 1 percent.

Exports of lead pigments decreased 22 percent in value and 17 percent in quantity, and exports of lead arsenate increased 36 percent in value and 53 percent in quantity.

TABLE 21.—U.S. imports for consumption of lead pigments and compounds

Kind	1961		1962	
	Short tons	Value (thousands)	Short tons	Value (thousands)
White lead	1,872	$535	2,361	$578
Red lead	457	88	555	83
Litharge	15,390	2,701	15,597	2,229
Other lead pigments			31	13
Other lead compounds	436	84	439	124
Total	18,155	3,408	18,986	3,027

Source: Bureau of the Census.

TABLE 22.—U.S. exports of lead pig

Kind	Sho
Lead pigments [1]	
Lead arsenate	
Total	

[1] Includes white lead, red lead, and litharge.

Source: Bureau of the Census.

STOCKS

Stocks of refined lead at primary throughout 1962, but from August 1 tons for an average monthly rate of 9, refined and antimonial lead decreased a end inventory of 142,500 tons. Total physical inventories at primary plants not including material in process or compared with 262,100 tons at the close c

Stocks reported by the American Bur an additional 17,700 tons of bullion was refineries, and about 18,600 tons of or making a total of 233,000 tons of prim these plants, 75,100 tons less than at year

Consumer and secondary smelter st January 1, 104,300 tons March 31, 106 September 30, and 93,500 tons Decem were 6 percent less than at the close of 19

On December 31 the total lead inven piles was 1,386,000 tons, comprised of (strategic) stockpile, and 336,000 ton Administration (DPA), CCC, and Sup ment lead stockpile inventories on De over maximum stockpile objectives.

TABLE 23.—Stocks of lead at primary sme States, Dec.

(Short tons)

Stocks	1953-57 (average)	1958
Refined pig lead	54,053	176,008
Lead in antimonial lead	11,714	11,811
Lead in base bullion	12,812	9,485
Lead in ore and matte	42,255	36,896
Total	120,834	234,290

Papers described the processing and coating,[10] annealing,[11] automatic gage control,[12] and automatic classification [13] of steel strips.

The physical properties and applications of columbium-tin superconducting alloys were studied.[14]

Additions of tin in cast iron for engine blocks resulted in more uniform hardness and better machinability.[15]

Tin had little effect on the hot workability, yield, strength, or tensile strength of three stainless steels.[16]

Sheets of glass, without scratches with high transparency, and free from distortions, were made by moulding the glass on molten tin.[17]

[10] McArthur, D. A. Strip Processing. Iron and Steel Eng., v. 39, No. 2, February 1962, pp. 111–134.
[11] Bishop, Tom. British Study New Method for Annealing Strip. Metal Prog., v. 82, No. 2, August 1962, pp. 93–94.
[12] Bryan, Thomas E., and Paul L. McMath. Automatic Gauge Control for Thin Tin. Blast Furnace and Steel Plant, v. 50, No. 10, October 1962, pp. 970–974, 976.
[13] Metal Industry (London). Automatic Classification of Tinplate. V. 101, No. 23, Dec. 6, 1962, pp. 422–423.
[14] American Metal Market. G.E. Claims Computer Device With Cryogenic Circuit. V. 69, No. 53, Mar. 19, 1962. pp. 1, 14.
Jones, William H., Frederick J. Milford, and Sherwood L. Fawcett. Status of Superconductivity. Battelle Tech. Rev., v. 11, No. 9, September 1962, pp. 2–11.
The following articles appeared in the IBM Journal of Research and Development, v. 6, No. 1, January 1962:
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Goodman, B. B. The Magnetic Behavior of Superconductors of Negative Surface Energy. Pp. 63–67.
Mapother, D. E. Thermodynamic Consistency of Magnetic and Calorimetric Measurements on Superconductors. Pp. 77–81.
Meissner, Hans. Surface Energy at the Boundary Between a Superconductor and a Normal Conductor. Pp. 71–74.
Morse, R. W. Ultrasonic Attenuation in Superconductors. Pp. 58–62.
Seraphim, D. P., and P. M Marcus. First-And-Second-Order Stress Effects on the Superconducting Transitions of Tantalum and Tin. Pp. 94–111.
Swenson, C. A. The Temperature and Pressure Dependence of Critical Field Curves. Pp. 82–88.
[15] Chemical and Engineering News. Chrysler Switches to Tin for Alloying. V. 40, No. 35, Aug. 27, 1962, pp. 44, 46, 47.
[16] Mitchell, J. R., M. E. Potter, and E. C. Rudolphy. The Effect of Tin on the Properties of Three Stainless Steels. Trans. AIME, v. 224 (Met. Soc.), 1962, pp. 686–693.
[17] Tin and Its Uses. Molten Tin Is the Mould for Float Glass. No. 56, 1962, pp. 1–4.

Titanium

By John W. Stamper

CONSUMPTION of 7,100 short tons of was about the same as in 1961. Howeve metal resulted in an 11 percent increas ingot to 10,400 tons. Mill product output wa in the 16-year history of the titanium metal ind

Ilmenite production of 808,000 tons was 3 1961, and rutile output increased 10 percent to dioxide pigment production, which utilized n a near-record, 4 percent higher than in 1961. were 5 percent higher than in 1961.

World production of 2.3 million tons of ilm used chiefly for making titanium pigment b the United States and foreign countries, was s high of 1961. World output of rutile rose 17 most of which was used in welding-rod coati tanium metal. New plants under constructio for production of titanium pigment from rutil were expected to require about 100,000 tons o operating at capacity.

LEGISLATION AND GOVERNMEN

Barter agreements for titanium sponge n Department of Agriculture, Commodity Cred and Japanese producers expired in January of sponge metal from Japan during the ye under the contracts. Deliveries under the pro Toho Titanium Industry Co., Ltd. (Japan), the total and Nippon Soda Co., Ltd. (Japan), 3

[1] Commodity specialist, Division of Minerals.

TABLE 1.—Salient titanium statistics

	1953–57 (average)	1958	1959	1960	1961	1962
United States:						
Ilmenite concentrate: [1]						
Mine shipments_short tons	627,125	565,164	637,283	[2] 789,237	782,629	809,037
Value_thousands	$12,173	$11,155	$12,106	$14,655	[2] $13,312	$13,974
Imports [3]_short tons	346,927	348,144	371,687	205,615	[2] 207,151	166,434
Consumption_do	762,872	731,424	917,747	808,080	929,147	944,707
Titanium slag: Consumption_do	117,641	117,581	143,329	120,402	130,184	138,205
Rutile concentrate:						
Mine shipments_do	9,134	1,803	8,648	9,433	7,661	8,033
Value_thousands	$1,197	$210	$877	$879	$778	$933
Imports_short tons	[4] 36,866	36,563	23,228	29,235	27,407	35,066
Consumption_do	33,968	21,077	23,741	24,229	29,548	31,740
Sponge metal:						
Production_do	9,371	4,585	3,808	5,311	6,727	6,730
Imports for consumption_do	1,275	2,073	1,563	2,231	2,490	925
Consumption_do	[5] 6,409	4,147	3,953	5,487	6,991	7,136
Price: Grade A-1, Dec. 31 per pound	$3.60	$1.82	$1.60	$1.60	$1.60	$1.60
World production:						
Ilmenite concentrate_short tons	1,500,500	[5] 1,710,200	[5] 1,937,900	[5] 2,235,500	[5] 2,326,900	2,295,100
Rutile concentrate_do	92,300	103,200	106,400	114,200	128,600	150,900
Sponge metal_do	12,071	7,700	7,900	9,200	9,800	8,600

[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite.
[2] Revised figure.
[3] Includes titanium slag.
[4] Excludes 36 tons rutile content of zirconium ore as reported to the Bureau of Mines by importers.
[5] 1954–57 only. Data for previous years not available.

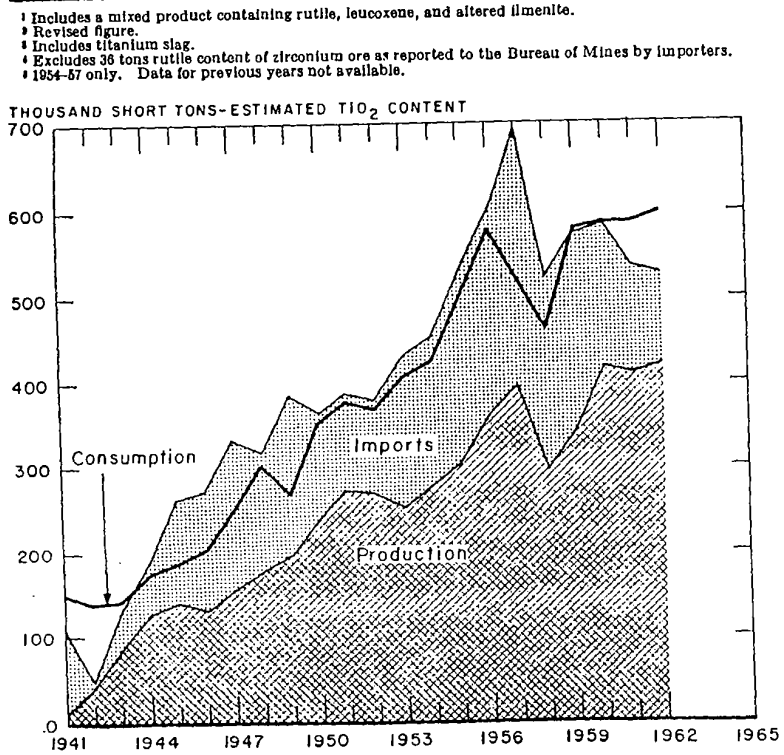

FIGURE 1.—Domestic production, imports, and consumption of ilmenite (includes titanium slags and mixed product), 1941–62.

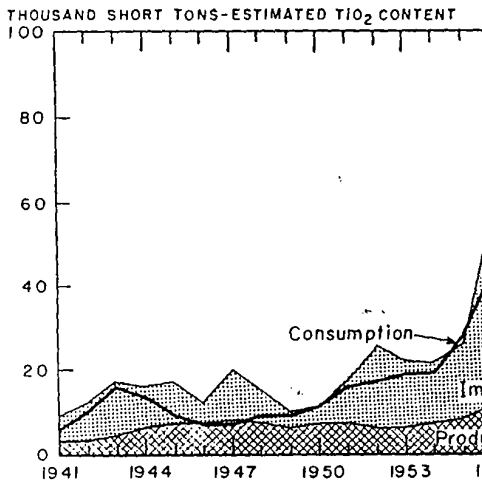

FIGURE 2.—Domestic production, imports, and cons
tion (1962) for making TiO2 pigments)

DOMESTIC PRODUC

Concentrates.—A record 808,000 tons of
New York, Florida, and Virginia. Rutile
Virginia of 10,000 tons was the highest sinc
opened a new ilmenite mine at Lakehurst, N.

Ilmenite production was reported by
Piney River, Va.; E. I. du Pont de Nemou
Lawtey, Fla.; M & T Chemicals, Inc., Hano
Lead Co., Tahawus, N.Y.; The Glidden C
nium Alloy Manufacturing Division, Nat
Fla.; and The Florida Minerals Co., Vero
Co., and Porter Brothers Corp. shipped il
Boise and Lowman, Idaho.

Rutile producers were as follows: M &
Dam, Va.; Titanium Alloy Manufacturing
Co., Skinner, Fla.; and The Florida Minera

Metal.—Production and consumption of t
about the same as in 1961, but increased uti
metal resulted in a high output of titanium i

National Distillers & Chemical Corp. bec
nium production, melting, and fabricating
Inc., at Ashtabula and Niles, Ohio. The sp
at Ashtabula were under U.S. Industrial C
the melting and fabricating plant at Nile
ment of Bridgeport Brass Co. (Reactive
Divisions of National Distillers. Bridge
a $1.2 million modernization program for th

TABLE 2.—Production and mine shipments of titanium concentrates from domestic ores in the United States

Year	Production, short tons (gross weight)	Shipments		
		Short tons (gross weight)	Short tons TiO_2 content	Value (thousands)
ILMENITE [1]				
1953–57 (average)	617,317	627,125	324,080	$12,173
1958	563,338	565,164	297,021	11,155
1959	634,886	637,263	342,746	12,106
1960	786,372	789,237	417,202	14,655
1961	782,412	782,620	[2] 410,191	[2] 13,312
1962	807,725	809,037	429,606	13,974
RUTILE				
1953–57 (average)	9,090	9,134	8,571	1,197
1958	7,406	1,863	1,804	210
1959	9,466	8,648	8,148	877
1960	8,808	9,433	9,065	879
1961	9,045	7,664	7,251	778
1962	9,981	8,033	7,617	933

[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite.
[2] Revised figure.

Harvey Aluminum, Inc., expected to put into production a new titanium bar and rod rolling mill early in the year. The new mill was to be installed in a separate building at the main plant at Torrance, Calif., and was to be capable of turning out titanium rod ⅜ inch to 6 inches in diameter and all intermediate sizes.

Titanium Metals Corp. of America (TMCA), completed a $2 million expansion at its Toronto, Ohio, plant, enabling the company to produce seamless titanium tubing and welded and redrawn tubing in diameters up to 3 inches and lengths up to 30 feet. The company also began construction, at the same site, of a new $14 million mill, that would produce titanium sheet and strip in widths up to 48 inches and thicknesses down to 0.01 inch on a continuous basis.

TMCA also reported development of a casting technique using permanent metal molds and indicated that up to 100 pours per mold could be made with good surfaces and section sizes as thin as ⅛ inch. The process lent itself to the casting of complex shapes where disposable cores were not required.

Commercial producers of titanium sponge were as follows: E. I. du Pont de Nemours & Co., Inc., Newport, Del.; USI, Ashtabula, Ohio; and TMCA, Henderson, Nev. Du Pont and TMCA used magnesium to reduce titanium tetrachloride to titanium; USI used sodium.

Titanium melters were Harvey Aluminum, Inc., Torrance, Calif.; Bridgeport Brass Co. (Reactive Metals Products), Niles, Ohio; Oregon Metallurgical Corp., Albany, Oreg.; Crucible Steel Company of America, Midland, Pa.; Republic Steel Corp., Massillon and Canton, Ohio; and TMCA, Henderson, Nev.

Oregon Metallurgical Corp. produced ingots and castings. The other companies produced and processed ingots into mill products

TABLE 3.—Titanium-metal

(Short tons)

	1958	1959
Sponge metal:		
Production	4,585	3,89
Imports for consumption	2,078	1,56
Industry stocks	1,000	1,10
Government stocks (DPA inventories)	22,463	22,47
Consumption	4,147	3,95
Scrap-metal consumption	1,336	1,69
Ingot: [2]		
Production	5,408	6,01
Consumption	4,971	5,96
Mill shape production [3]	2,594	3,21

[1] Revised figure.
[2] Includes alloy constituents.
[3] Bureau of the Census and Business and Defense Services Admi
Series BDSA F-263 (63).
[4] Net shipments derived by subtracting the sum of producers' re
ry's gross shipments of that shape. Data not comparable with pr

such as sheet, strip, plate, forging billets, a
num, Inc., produced titanium castings ir
products. Ladish Co., Cudahy, Wis., pro
products.

The Babcock & Wilcox Co., Beaver Fall
Tube Division of Calumet & Hecla, Inc., Al
titanium pipe, tubing, and extrusions.

Pigments.—On a gross-weight basis, produ
pigments increased 4 percent and shipments
the levels of 1961. Data on domestic pro
table 4 are based on TiO_2 content.

Titanium pigments were produced by t
American Cyanamid Co., Piney River, V
The Glidden Co., Baltimore, Md.; E. I. du
Inc., Edge Moor, Del., Baltimore, Md., and
National Lead Co., St. Louis, Mo., and S
New Jersey Zinc Co., Gloucester City, N.

Cabot Corp., Boston, Mass., and Ruber
formed a new titanium pigment company t
Corp. Cabot Titania, of which two-thir
and one-third by Ruberoid, planned to comp
ities for producing 20,000 tons of titanium
bula, Ohio, by mid-1963. Additional ex
year was also planned. A chloride process
de Produits Chimiques de Thann et de Mu
was to be used. Cabot reportedly reache
50,000 tons of rutile with an Australian
Mining Co. Pty., Ltd., and purchased facil
rutile at Ashtabula, Ohio, from National Di

Du Pont announced that construction had
per-year titanium dioxide plant at Antioch
tion was expected in the fall of 1963. The
used. Du Pont had agreements with Rutil
Castle), Ltd., an Australian producer, for 5

TABLE 4.—Titanium pigment data (TiO_2 content)

Year	Production (short tons)	Shipments [1]	
		Quantity (short tons)	Value, f.o.b. (thousands)
1953–57 (average)	407,525	393,819	$195,481
1958	403,867	425,765	231,888
1959	506,334	481,930	269,944
1960	455,583	468,228	252,835
1961	502,879	491,122	262,255
1962	523,201	(2)	(2)

[1] Includes interplant transfers.
[2] Data not available.

Source: Facts for Industry and Current Industrial Reports series, M19A and M28A, Inorganic Chemicals, published jointly by the Bureau of the Census and Business and Defense Services Administration, U.S. Department of Commerce.

Welding-Rod Coatings.—A total of 231,000 tons of welding rods, containing titaniferous materials in their coatings, was produced. Of the total output, 43 percent contained rutile; 17 percent, ilmenite; 15 percent, a mixture of rutile and manufactured titanium dioxide; 14 percent, manufactured titanium dioxide; 8 percent, slag; and 3 percent, miscellaneous mixtures.

CONSUMPTION AND USES

Concentrates.—Consumption of ilmenite, which is used principally for making titanium dioxide pigments, increased 2 percent to 945,000 tons. Titanium slag consumption, also used chiefly for pigment production, rose 6 percent above that of 1961. Rutile consumption, exclusive of that used for making pigment and other uses not reported in table 5, was 7 percent more than that in 1961.

Metal.—The consumption of 7,100 tons of titanium sponge metal was about the same as in 1961. However, increased use of titanium scrap resulted in production of a near-record 10,400 tons of titanium ingot. Use of titanium mill products, as gaged by shipments, was at the highest level in the 16-year history of the titanium metal industry.

As in past years, approximately 60 percent of the mill products went into manned military aircraft, according to one large producer. About 25 percent went into missiles and spacecraft, 10 percent went into commercial aircraft, and the remaining 5 percent was used in the chemical processing industry. The following estimated distribution of titanium mill product consumption in 1961 also was reported:[2]

Application	Consumption, Percent
Military jet engines	55
Military airframes	13
Missiles and spacecraft	16
Commercial aircraft	13
Chemical processing equipment	3
Total	100

[2] Finlay, Walter L. Titanium in American Ordnance. Weapons Technology, American Ordnance Association. October 1962, pp. 15–24.

TABLE 5.—Consumption of titanium concentrates
(Short tons)

Year and product	Ilmenite [1]		Tit
	Gross weight	Estimated TiO_2 content	Gross weigh
1953–57 (average)	762,872	401,370	117,
1958	731,424	379,765	117,
1959	914,747	476,660	143,
1960	868,080	464,614	120,
1961:			
Pigments	[3] 926,241	495,745	129,
Titanium metal	(4)	(4)	
Welding-rod coatings	842	320	
Alloys and carbide	2,302	1,410	(4)
Ceramics	59	37	
Fiber glass			
Miscellaneous [5]	3	2	
Total	929,147	497,514	130,
1962:			
Pigments	[3] 941,954	499,471	137,
Titanium metal	(4)	(4)	
Welding-rod coatings	503	298	
Alloys and carbide	2,282	1,391	(4)
Ceramics	50	31	
Fiber glass			
Miscellaneous [5]	8	5	
Total	944,797	501,196	138,

[1] Includes a mixed product containing rutile, leucoxene, and a
metal.
[3] Includes ilmenite that was upgraded to a product containing
pigments and the losses of ilmenite incurred in upgrading the il
[3] Figure withheld to avoid disclosing individual company c
[4] Included with "Pigments" to avoid disclosing individual co
[5] Included with "Miscellaneous" to avoid disclosing individu
[5] Includes consumption for chemicals and experimental purpo

The performance of the A3J Vigilant
airplane, was reportedly increased by inst
titanium for directing air at 750° F over t
use of titanium instead of stainless steel
and was said to make construction simp
elasticity of titanium permitted its use w
aluminum substructure.

A new helicopter blade-retention syst
titanium straps to achieve a compact, ligh

Titanium alloys, on a strength-to-weigh
steel or glass as potential materials for
motor cases, according to a Defense
study.[4]

An 8-foot-diameter, 24-foot-long titani
drogen was built as part of an Air Forc
tested successfully with 7,000 gallons of
pressure.[5]

[3] Materials In Design Engineering. Titanium S
V. 56, No. 7, December 1962, pp. 132–133.
[4] Achbach, W. P., and R. J. Runck. An Evalua
Cases based on Minimum Weight Concepts. Battel
147, March 1962, 30 pp.
[5] American Metal Market. Large Titanium Alloy T
Light. V. 69, No. 153, Aug. 9, 1962, p. 11.

The use of titanium in the chemical and electrochemical processing industries was reviewed.[6] About 50 percent of the titanium tubing employed in the process industries was for cooling wet chlorine. Other uses included anodizing racks, chlorine dioxide mixers, and pulp and paper processing equipment. Titanium was used in solutions of sodium hypochlorite, chlorate, nitric acid, sulfuric acid, and brine. Total annual use of titanium in these industries was expected to grow from an estimated 200 tons in 1962 to 3,000 tons by 1973.

A total of 36 titanium heat exchangers (plate-type, 83 inches long by 18 inches wide) was used to heat solutions of sodium perchlorate and ammonium chloride in the production of ammonium perchlorate.[7]

A 120-foot-high titanium-lined stack exposed to fumes of hydrochloric acid and ferric and cupric chlorides at 180° to 1,000° F replaced an unlined stack that had failed in 8 months. The titanium-lined stack cost $36,000 compared with $17,000 for the unlined stack.[8]

Titanium wire plated with copper, nickel, solder, or gold became commercially available.[9] It was said to be possible to manufacture fine thread screws from it by the economical method of thread rolling, because of the good drawing characteristics of the copper-plated wire.

Soviet engineers reportedly tested steam-turbine blades of titanium for use in a 1.5-million-kilowatt generator.[10]

TABLE 6.—Distribution of titanium-pigment shipments, by industries[1]

(Percent)

Industry	1953–57 (average)	1958	1959	1960	1961	1962
Distribution by gross weight:						
Paints, varnishes, and lacquers	65.4	65.8	64.8	65.1	63.4	61.9
Paper	10.2	11.5	11.7	11.3	12.5	13.0
Floor coverings (linoleum and felt base)	4.4	5.0	4.9	4.8	4.5	4.7
Rubber	3.4	3.9	4.2	4.0	4.1	4.2
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.)	2.6	2.9	3.1	2.8	3.3	3.3
Printing ink	1.3	1.5	1.7	1.3	1.6	1.7
Other	12.7	9.4	9.6	10.7	10.6	11.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Distribution by titanium dioxide content:						
Paints, varnishes, and lacquers	57.7	59.1	58.2	58.5	57.0	55.3
Paper	13.9	15.2	15.1	14.6	15.7	16.2
Floor coverings (linoleum and felt base)	5.1	6.4	6.3	6.2	5.6	5.8
Rubber	4.4	5.1	5.4	4.9	5.1	5.2
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.)	3.4	3.7	3.9	3.5	4.1	4.0
Printing ink	1.7	1.9	2.2	1.7	2.0	2.1
Other	13.8	8.6	8.9	10.6	10.5	11.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

[1] Data based on figures supplied to the Bureau of Mines by producers.

[6] Chemical Week. Titanium. V. 91, No. 15, Oct. 13, 1962, pp. 123–130.
[7] Titanium Metals Corporation of America, Technical Service Department. Titanium Data for Chemical Process Industry: How Titanium Plate Heat Exchangers Succeed Where Other Metals Fail in Perchlorate Process. New York, 1962, 4 pp.
[8] Steel. Titanium Lining Extends Life of Steel Stack. V. 151, No. 16, Oct. 15, 1962, p. 98.
[9] American Metal Market. Orbit Electric Displays Plated Titanium Wire at Metal Show in New York. V. 69, No. 210, Oct. 31, 1962, p. 14.
[10] Metalworking News. Titanium Blade Soviet Turbine Undergoes Tests. V. 3, Whole No. 91, July 2, 1962, p. 16.

Pigments.—Consumption of titaniu
weight and using shipments as a gage,
Consumption of pigments not separate
use in plastic, roofing granules, weldi
ceramics.

STOCKS

Industry stocks of rutile decreased
about 2.5 years' supply at the 1962 c
stocks of rutile on December 31 total
tons was in the national (strategic) st
Production Act (DPA) inventories;
mental stockpile. Ilmenite stocks al
inventories increased.

Yearend stocks of titanium sponge
semifabricators totaled 1,300 tons, com
at the end of 1961. In addition, the
in DPA inventories and 9,021 tons
for a total of 31,477 tons.

Titantium metal scrap held by m
yearend was 3,300 tons, the same as at th

TABLE 7.—Stocks of titanium concentrates

(Short tons)

Year and stock	Ilmenite		
	Gross weight	TiO_2 content, estimated	
1961:			
Mine	[1] 30,483	[1] 14,381	
Distributor	303	177	
Consumer	675,052	[1] 377,046	
Total	[1] 705,788	[1] 391,604	
1962:			
Mine	29,121	14,387	
Distributor	254	149	
Consumer	572,071	313,504	
Total	601,446	328,040	

[1] Revised figure.

PRICES

Concentrates.—The price quoted for
Mineral Markets remained unchanged
percent TiO_2, f.o.b. Atlantic seaboard).

The quoted price of rutile (94 pe
board) increased from $80 per short t
short ton at the end of 1962.

Manufactured Titanium Dioxide.—Th
grades of manufactured titanium diox
base titanium pigments were unchang

price was given to purchasers of large lots. The following prices were quoted in the Oil, Paint and Drug Reporter at yearend:

	Price per pound
Anatase, chalk-resistant, regular and ceramic, carlots, delivered	$0.255
Less than carlots, delivered	.265
Rutile, nonchalking, bags, carlots, delivered East	.275
Less than carlots, delivered East	.285
Titanium pigment, calcium-rutile base, 30 percent TiO_2, bags, carlots, delivered	.09375
Less than carlots, delivered	.09875

Metal.—Prices per pound for various grades of titanium sponge metal at the beginning of 1962 ranged from $1.34 to $1.85 and at the end of the year from $1.32 to $1.60.

Quoted prices of most titanium mill shapes declined during the year. Prices per pound of mill shapes (f.o.b. mill, commercially pure grades, in lots of 10,000 pounds) were quoted in January and December as follows:

	Jan. 1, 1962	Dec. 31, 1962
Sheet	$7.25–$8.00	$4.90–$5.10
Strip	6.75– 7.50	4.90– 5.10
Plate	5.25– 6.00	3.80– 4.00
Wire	5.55– 6.05	3.50– 3.80
Forging billets	[1] 3.00– 3.30	2.40– 2.55
Hot-rolled bars	[1] 3.15– 3.35	3.15– 3.35

[1] Revised figure.

Ferrotitanium.—Nominal prices at yearend for various grades of ferrotitanium were quoted in E&MJ Metal and Mineral Markets as follows:

	Price
Low-carbon: [1]	
Titanium, 40 percent; carbon, 0.10 percent maximum	$1.35
Titanium, 25 percent; carbon, 0.10 percent maximum	1.50
Medium-carbon: [2]	
Titanium, 17 to 21 percent; carbon, 3 to 5 percent	375
High-carbon: [2]	
Titanium, 15 to 19 percent; carbon, 6 to 8 percent	310

[1] Price per pound contained titanium in 1-ton lots or more, lump (½-inch, plus) packed; f.o.b. destination Northeastern United States.
[2] Price per short ton, carload lots, lump, packed; f.o.b. destination Northeastern United States.

FOREIGN TRADE [11]

Imports.—Imports of ilmenite and titanium slag decreased for the third successive year. Slag containing 70 percent titanium dioxide was imported from Canada. Rutile imports rose 31 percent.

Imports of titanium metal were only 925 tons, 63 percent below 1961, as a result of the cessation of barter contracts with Japanese producers. Titanium imports included 270 tons from Japan brought in free for the Government under the CCC barter agreements. About 11 tons of metal was imported from the United Kingdom and Canada and classified free under certain public laws. The remainder was dutiable.

During the first 6 months of the year, 5,979 tons, classified as "titanium potassium oxylate and all compounds and mixtures containing

[11] Figures on imports and exports compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign Activities, Bureau of Mines, from records of the U.S. Department of Commerce, Bureau of the Census.

titanium," was imported. Beginning
pigments and compounds were classifi
titanium pigments," and "titanium con
classified)." In the last 6 months of th
classification totaled 10,678 tons of titan
143 tons of titanium compounds, n.e.c.

TABLE 8.—U.S. imports for consumption of ti

(Short tons)

Country	1953–57 (average)	1958	
Ilmenite:			
Australia	50	22,736	
Canada [2]	165,567	112,874	
India	175,066	212,479	
Malaya, Federation of	6,229		
Other countries	15	55	
Total: Short tons	346,927	348,144	
Value	[3] $7,400,535	$6,766,391	$7,
Rutile:			
Australia	[3] 36,835	36,507	
South Africa, Republic of [7]			
Other countries	31	56	
Total: Short tons	[3] 36,866	36,563	
Value	$4,818,046	$4,512,937	$2,

[1] Classified as "ore" by the Bureau of the Census.
[2] Chiefly titanium slag averaging about 70 percent TiO_2.
[3] Revised figure.
[4] Bureau of the Census shows less than 1 pound, valued at
of Mines.
[5] Data known to be not comparable with other years.
[6] Excludes 36 tons rutile content of zirconium ore as reporte
table 8, 1961 Minerals Yearbook should read excludes 67 ton
[7] Effective Jan. 1, 1962; formerly Union of South Africa.

Source: Bureau of the Census.

Finland, France, and Japan were th
materials. Other suppliers were Canad
dom, the Netherlands, Belgium-Lu
Switzerland, Spain, and Italy.

Exports.—Titanium dioxide and pign
sixth successive year. Canada, as in p
of most of the pigments, receiving 12,8
received 1,000 tons or more were as follo
1,900; the Netherlands, 1,700; France,
gium-Luxembourg, 1,200.

Exports of 1,224 tons of ores and con
Canada, 165 tons to Hong Kong, 115 to
Iran. Small quantities were sent to C
many, the United Kingdom, Belgium-L
and the Philippines.

Titanium sponge and scrap exports
818 tons exported, 583 tons were sent to
to West Germany; 60 tons to France; a
Peru, Sweden, the Netherlands, Be
Switzerland, Italy, and India.

TABLE 9.—U.S. exports of titanium products, by classes

Year	Ores and concentrates		Metal and alloys in crude form and scrap [1]		Primary forms n.e.c.[2]		Ferroalloys		Dioxide and pigments	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1953-57 (average)	1,406	$195,657	29	$258,683	315	$4,661,171	267	$80,441	55,140	$10,635,040
1958	1,246	172,481	97	172,285	336	5,227,932	323	138,431	37,016	11,346,651
1959	4,656	280,507	496	543,104	499	5,161,074	321	145,621	36,282	10,558,287
1960	1,200	166,685	879	868,846	426	3,237,949	245	157,419	33,655	10,000,884
1961	1,436	190,480	886	920,783	384	2,702,322	212	93,389	31,104	9,215,839
1962	1,224	166,987	818	925,495	561	4,102,113	130	96,265	29,095	8,636,350

[1] Beginning Jan. 1, 1956, classified as sponge and scrap.
[2] Beginning Jan. 1, 1956, classified as intermediate mill shapes and mill products, n.e.c. (not elsewhere classified).

Source: Bureau of the Census.

Exports of primary forms of titanium metal products increased 46 percent to 561 tons. Of this total 441 tons went to Canada, 64 tons to France, and most of the remainder to Italy and West Germany. Of the 130 tons of ferroalloys exported Canada received 116 tons, Italy received 7 tons, and most of the remainder went to Belgium-Luxembourg, Australia, and Liberia.

WORLD REVIEW [12]

The United States continued to be the free world's principal source and consumer of ilmenite, and the chief market for rutile. As in previous years, Australia was the leading rutile producer, accounting for 88 percent of the world total. In addition to the announcements of titanium dioxide pigment plants to be built in the United States (see Domestic Production), plans for expansion of capacity also were reported in Canada, Argentina, Italy, Norway, and Japan. New titanium dioxide plants began operating in the Netherlands and the Republic of South Africa.

NORTH AMERICA

Canada.—The Department of Mines and Technical Surveys published a review of the titanium industry in 1961.[13] Data in table 11 on the 1959 consumption of titanium pigments were included in the report.

Quebec Iron & Titanium Corp. (QIT) continued to smelt ilmenite-hematite ore, but output of titanium slag decreased markedly owing to a strike which shut down the plant for 3 months in the latter half of the year.

Capacity of the Canadian Titanium Pigments, Ltd., titanium pigment plant was expanded from 16,000 to 25,000 tons per year in

[12] Values in this section are U.S. dollars based on the average rate of exchange by the Federal Reserve Board unless otherwise specified.
[13] Schneider, V. B. Titanium. Canada. Dept. of Mines and Tech. Surveys, 1961, 9 pp.

TABLE 10.—World production of titanium co
countries [1]
(Short tons)

Country [1]	1953-57 (average)	1958
Ilmenite:		
Australia (shipments)	17,121	78,34
Canada [2]	186,100	161,31
Ceylon		
Finland	76,582	117,38
Gambia	[4] 4,128	31,85
India	299,792	346,26
Japan (titanium slag)	5,913	3,93
Malagasy Republic (Madagascar)		1,15
Malaya (exports)	75,958	83,80
Mexico	[6] 4	16
Mozambique		
Norway	184,208	233,58
Portugal	648	50
Senegal	21,510	36,90
South Africa, Republic of	1,380	29,61
Spain	5,225	18,16
Thailand	[6] 1,200	92
United Arab Republic (Egypt Region)	3,336	[7] 3,00
United States [8]	617,317	563,33
World total ilmenite (estimate) [1 3]	1,500,500	1,710,20
Rutile:		
Australia	82,440	93,32
Brazil	181	26
Cameroon, Federal Republic of	76	
India	308	50
Norway	12	
Senegal	179	1,15
South Africa, Republic of	[10] 82	55
United Arab Republic (Egypt)		
United States	9,000	7,40
World total rutile (estimate) [1 3]	92,300	103,20

[1] Titanium concentrates are produced in Brazil and the
no estimates are included in the total.
[3] This table incorporates some revisions. Data do not a
where estimated figures are included in the detail.
[4] Represents titanium slag containing approximately 70
ore".
[4] Average annual production 1954-57.
[5] Exports.
[6] Average annual production 1955-57.
[7] Estimate.
[8] Average annual production 1956-57.
[9] Includes a mixed product containing ilmenite, leucoxen
[10] 1 year only, as 1957 was the first year of commercial pr

Compiled by Pearl J. Thompson, Division of Foreign A

TABLE 11.—Consumption of titanium dio
pigments in Cana

Refined titanium dioxide (TiO_2):	
Paints	
Polishes and dressings	
Pulp and paper	
Linoleum and oilcloth	
Rubber goods	
Miscellaneous nonmetallic minerals	
Total	
Extended titanium dioxide pigments: Paints	

[1] Estimated TiO_2 content 4,800 tons.

TABLE 12.—Quebec Iron & Titanium Corp. smelting operations

(Short tons)

	1953–57 (average)	1958	1959	1960	1961	1962
Ore smelted	416,605	420,032	626,310	607,373	1,165,977	745,753
Titanium slag produced	181,024	161,312	243,700	380,639	403,361	301,448
Estimated TiO_2 content	120,713	110,150	175,464	278,380	333,620	217,048
Value of slag produced	$5,933,912	$6,575,077	$8,509,149	$14,257,292	(1)	(1)
Desulfurized iron produced	133,230	117,878	163,509	248,578	310,300	207,190

[1] Data not available.

1961. Its operations were described.[14] A new pigment plant at Ville-de-Tracy, Quebec, with a 22,000-ton capacity was scheduled to be completed in 1962 by British Titan Products (Canada), Ltd.

SOUTH AMERICA

Argentina.—American Cyanamid Co., a titanium pigment producer in the United States, reportedly reached an agreement with Hafen S.A. to build a titanium pigment plant near Buenos Aires. The plant was expected to cost $11 million and produce 10,000 tons per year.[15]

EUROPE

Finland.—Automatic continuous analysis of magnetite and titanium dioxide in ilmenite concentrate produced at the titanium mine at Otanmaki was described.[16] The concentration of Otanmaki ore was by wet magnetic separation of magnetite, flotation of pyrite, and finally flotation of ilmenite. The automatic analyzer system was installed to permit improved control of the process.

Italy.—An 8,000- to 12,000-ton-per-year titanium dioxide plant at Gallipoli Lecce in Apulia was planned by the Societa Metalchimica Merodionale Finanziaria Breda, a new company formed by the Societa Finanziaria Ernesto Breda S.p.A. of Milan and S.p.A. Solbar of Milan.[17] Completion of the plant was expected in 1964.

Netherlands.—Titaandioxydefabriek N.V. opened its 12,000-ton-a-year titanium pigment plant near Rotterdam.[18] The plant, reportedly built at a cost of $11.2 million, used a process licensed from Glidden International. Annual consumption of titanium dioxide was reported at 18,000 tons. The company was owned by N.V. Billiton Maatschappij (55 percent), Koninklijke Nederlandse Zoutindustries (22.5 percent), and Cyprus Mines Corp. (22.5 percent).

Norway.—Titan Co. A/S, planned to build a 15,000-ton-per-year titanium pigment plant at Fredrikstad.[19] Titan A/S and Titania

[14] Levine, Sidney. Canadian Titanium Pigments Expands for Rapidly Growing Markets. Nonmetallic Minerals Processing, v. 3, No. 2, February 1962, pp. 21–23.
[15] Chemical Week. Titanium Dioxide/Argentina. V. 90, No. 26, June 30, 1962, p. 23. Chemical Trade Journal and Chemical Engineer (London). V. 151, No. 3942, Dec. 21, 1962, p. 1279.
[16] Mining Journal (London). Continuous Assaying of Magnetite and Ilmenite Pulps. V. 259, No. 6639, Nov. 9, 1962, p. 435.
[17] Chemical Trade Journal and Chemical Engineer (London). Third Titania Plant for Italy. V. 151, No. 3942, Dec. 21, 1962, p. 1279.
[18] Oil, Paint and Drug Reporter. Titanium Dioxide Installation Officially Opened in Holland. V. 182, No. 20, Nov. 12, 1962, p. 56.
[19] Engineering and Mining Journal. National Lead Will Build Titanium Plant in Norway. V. 163, No. 10, October 1962, p. 112.
Chemical Week, Titanium Pigment/Norway. V. 91, No. 14, Oct. 6, 1962, p. 77.

A/S, both owned by National Lead (from deposits at Tellnes and Sokndal

ASIA

Ceylon.—Ceylon Mineral Sands Co ilmenite to Japan.[20] Ilmenite produ opened in 1961, was expected to be ab mate capacity was expected to be 6 were reported sufficient to last 40 yea

India.—Travancore Minerals, Ltd., Quilon, Kerala, and one in southwes a rate equivalent to 80 percent of th of the rutile totals for the year. F. duced the remainder.[22]

Japan.—Sumitomo Light Metals Inc Ltd., and Furukawa Electric Co., Lt grades of titanium mill products, 80 form.[23] Annual capacity on a one-sh commercially pure titanium mill pr reported as follows:

Kobe Steel Works, Ltd	
Sumitomo Light Metals Industries, Ltd	
Furukawa Electric Co., Ltd	

The output of 70,000 tons of titaniu high. The completion of expanded fa ide plants and the expansion plans Industry expansion was expected to tons by 1965 and to 140,000 tons by 19 to reach 45,000 tons in 1963, 55,000 1970.[24]

TABLE 13.—Japan: Titanium meta

(Short ton

	1958
Titanium metal:	
Production	1,812
Exports	1,962
Stock, Dec. 31	677
Titanium dioxide:	
Production	33,285
Exports	15,223
Stocks, Dec. 31	2,754

[20] Foreign Trade (Ottawa, Canada). Ilmenit
[21] Mining Journal (London). Shipments Fro Sept. 21, 1962, p. 273.
[22] U.S. Consulate General, New Delhi, India. July 31, 1962.
[23] U.S. Consulate General, Tokyo, Japan. St 1962.
[24] Oil, Paint and Drug Reporter. TiO_2 and Ja V. 183, No. 2, Jan. 14, 1963, p. 7.

AFRICA

South Africa, Republic of.—South African Titan Products (Pty.), Ltd., began producing titanium dioxide in its new 10,000-ton-per-year plant at Umbogintwini.[25]

OCEANIA

Australia.—Associated Minerals Consolidated, Ltd., entered into an agreement with American Potash & Chemical Corp. (U.S.A.) for 110,000 tons of rutile and an option to purchase an additional 100,000 tons. Deliveries were planned over a 10-year period to begin in 1963.[26]

Cable, Ltd. at Bunbury, Western Titanium, N.L. at Capel, and Western Oil, Ltd. at Yoganup produced ilmenite concentrate in West Australia. A fourth producer, Western Mineral Sands (Pty.) was scheduled to start production in 1964 from a mine at Capel. Estimated capacity of the four producers was expected to be 370,000 tons per year.[27]

TABLE 14.—Australia: Exports of ilmenite concentrates by countries
(Short tons)

Destination	1958	1959	1960	1961	1962 [1]
Belgium-Luxembourg	3,228	3			
France	5,730	6,274	2,011	4,503	
Japan	10,848	9,969	25,500	31,799	
Netherlands	3,305	34	698	12,533	(2)
United Kingdom	13,693	354	35,159	76,813	
United States	22,738	60,108	20,377	35,334	
Other countries	3,360	145	612	248	
Total	62,992	76,887	84,357	161,290	[1] 70,890

[1] January through June, inclusive.
[2] Countries of destination not available for 1962.

Compiled from Customs Returns of Australia by Virginia G. Huguley and Corra A. Barry, Division o Foreign Activities.

TABLE 15.—Australia: Exports of rutile concentrates by countries[1]
(Short tons)

Destination	1958	1959	1960	1961	1962 [2]
Belgium	2,532	1,390	1,314	2,846	(3)
France	5,459	7,482	9,075	8,084	(3)
Germany, West	4,114	10,037	10,546	9,855	(3)
Italy	3,293	3,519	4,536	6,030	(3)
Japan	2,920	7,967	9,042	13,705	(3)
Netherlands	10,579	12,243	11,091	13,590	10,247
Sweden	3,687	2,824	3,771	4,013	(3)
United Kingdom	13,026	9,600	14,243	15,989	7,087
United States	29,365	25,241	29,360	26,357	9,687
Other countries	9,714	10,258	11,372	11,081	31,922
Total	84,689	90,661	104,950	111,610	[2] 58,943

[1] This table incorporates some revisions.
[2] January through June, inclusive.
[3] Data not separately recorded.

Compiled from Customs Returns of Australia by Virginia G. Huguley and Corra A. Barry, Division of Foreign Activities.

[25] Sulphur. South Africa's First Titanium Dioxide Plant. No. 40, June 1962, p. 30.
[26] Steel and Coal (London). Australian Rutile for U.S. Company. V. 185, No. 4920, Nov. 2, 1962, p. 854.
[27] Chemical Trade Journal and Chemical Engineer (London). W. Australian Ilmenite. V. 151, No. 3940, Dec. 7, 1962, p. 1157.

The formation and physiographic
deposits in Queensland were describe
in the area were estimated as follows:

Rutile
Ilmenite
Zircon
Monazite

Over three-fourths of these resou
grade deposits on North Stradbroke Is

At the annual conference of the Au
Metallurgy, 15 papers on the techni
mineral sands industry in Eastern Au

TECHNOL

The development of a process for ma
from titanium tetrachloride ($TiCl_4$) c
but little information on the practic
lished. The method consisted of c
material (usually rutile) with carbo
acted as a vapor with oxygen to yield
generated in the reaction is recycled

A patent was granted for a proces
ride and oxygen in a vertical reacto
dioxide was formed substantially
surfaces.[31]

The Bureau of Mines investigated
ium slags prepared from ilmenite con
County, Idaho; Trail Ridge, Fla.; A
A slag made from titaniferous magn
also was evaluated. The tests were r
4 inches and 36 inches in diameter.
a 40-millimeter bench-type unit. Th
South Carolina ilmenites were chlori
70 to 80 percent of the titanium in th
tetrachloride. In a given chlorinator
$TiCl_4$ was made from slags as fro
Wyoming slags, that contained
nesium and calcium oxides, were n
chlorinators.[32]

Finely divided titania (1 to 50 mi
percent efficiency.[33] Dust losses of o

[28] Mining Journal (London). The Beach Sa
6640, Nov. 23, 1962, pp. 488–489, 491.
[29] Paterson, O. D. The Search for Deposits
Eastern Australia—Paper No. 1, The Australia
21 pp.
[30] Chemical Engineering. TiO_2 Technology Ke
July 23, 1962, pp. 62–64.
[31] Nelson, Earl W. (assigned to American C
Titanium Tetrachloride With Oxygen. U.S. Pat.
[32] Perkins, E. C., H. Dolezal, H. Leitch, and
Slags: A Study of the Moving Bed Technique.
[33] Cole, S. S., and L. W. Rowe. Flash Chlorina
Trans. AIME (Met. Soc.) V. 224, No. 1, February

by conducting the reaction in a fluidized restraining bed of coarse-grained rutile.

A report described the method used at a West German titanium plant for recovering sulfuric acid and ferrous oxide from byproduct copperas ($FeSO_4 \cdot 7H_2O$).[34] The copperas was converted to the monohydrate ($FeSO_4 \cdot H_2O$) in a fluidized bed furnace at about 800° C. Dissociation of the monohydrate was conducted by burning sulfur at 1,000° to 1,100° C. and passing the resulting sulfur dioxide through the monohydrate in a hearth-type furnace. The sulfur dioxide produced by burning the sulfur and dissociating the monohydrate was then used conventionally to make sulfuric acid for the pigment plant. A fluidized bed furnace for carrying out the dissociation step at 1,100° to 1,200° C. was expected to be on stream in 1962.

M & T Chemicals, Inc. rutile and aplite mine in Hanover County, Va. was described.[35] Raw ore was crushed wet in a swing hammer mill, ground to 20 mesh in a closed-circuit rod mill, and deslimed in cyclones. Gravity separation was in three stages—two stages of spirals followed by tabling. The aplite was separated in the first-stage spirals and processed for use as a source of alumina in glass and other industrial products. Concentrate from the tables was dried and treated by hightension and magnetic separators, yielding a granular rutile of approximately 97 percent titanium dioxide and an ilmenite concentrate. Some of the rutile was sold in the granular form, but most of it was ground to approximately 325 mesh in a continuous dry ball mill for use in ceramics. Ilmenite produced at the plant was marketed principally for titanium-alloy production. Separation techniques and possible commercial applications for titanite, which also occurs in the deposit, were under development.

The equilibrium relationship between titanium dichlorides and sodium dissolved in molten sodium chloride was determined from measurements of the potential difference between a titanium electrode and a reference electrode in molten sodium chloride containing the lower chloride of titanium or sodium.[36]

Dry chlorine gas will rapidly attack titanium; however, the presence of a trace of water (about 0.1 percent) is normally adequate to inhibit corrosion by stabilizing the resistant surface oxide film. In a preliminary investigation of the cause of unexpected corrosion of titanium in wet chlorine gas in a production installation, Crucible Steel Company of America concluded that titanium had a tendency to corrode in wet chlorine in deep crevices. Slow dehydration below the critical moisture level was believed to occur in stagnant crevices having a large metal-area to gas-volume ratio.[37]

A two-stage process for reducing titanium tetrachloride with sodium was patented.[38] The process, developed by the Bureau of Mines,

[34] Sulphur. Sulphuric Acid From Ferrous Sulphate. No. 40, June 1962, pp. 27–28.
[35] Doud, D. E., and W. W. Coffeen. Unique Mining Operation Yields Rutile and Aplite. Min. Eng., v. 14, No. 10, October 1962, pp. 59–62.
[36] Boozenny, Alex. Na^o–$TiCl_2$–$TiCl_3$ Equilibrium in NaCl Melts. Trans. AIME, Met. Soc., v. 224, No. 5, October 1962, pp. 950–956.
[37] Crucible Steel Company of America. Titanium Review. V. 10, No. 1, August 1962, pp. 1–5.
[38] Baker, Don H., Jr., and Vernon E. Homme (assigned to the U.S. Department of the Interior). Production of High Purity Titanium by Metallic Sodium Reduction of Titanic Halide. U.S. Pat. 3,069,255, Dec. 18, 1962.

involved a partial reduction of titanium t
form lower valent chlorides which were
a separate compartment. Titanium with
as low as 49 was produced by the process.

The titanium-iridium alloy system was
and 2,400° C.[39] The phase diagram of
100 atomic percent titanium was construct
tion of two intermetallic compounds, Ti_3
mediate solid solution centered about th
composition. The alloys containing eith
pounds were extremely brittle, but alloys
percent iridium were less brittle and som
neutron cross section and melting point o
temperature applications.

The physical properties and homogen
alloys in ingot and sheet form were ev
variations in the melting and casting pr
trode melting was used, arc current and f
varied, and ingots were formed both by n
cooled copper mold and by skull melting
graphite mold. Alloying metal additio
(1) 8 percent manganese, (2) 6 percen
vanadium, (3) 6 percent molybdenum a
(4) 16 percent vanadium and 2.8 percent

Physical and mechanical properties of
titanium nitride were evaluated.[41] Th
magnetism, corrosion and abrasion resis
dendritic weld structure of titanium nitr
alloys indicated a possible use of wrou
tanium nitride-base alloys in nonmagneti
as hard tools.

The Bureau of Mines described a sp
determining 19 impurity elements in
titanium oxides, and titanium halides.[42]
to titanium dioxide before analysis. Det
studied in the concentration range of 0 t
different determination limits were fou
The procedure was quantitative for 18 e
for beryllium.

[39] Croeni, J. G., C. E. Armantrout, and H. Kato
BuMines Rept. of Inv. 6079, 1962, 15 pp.
[40] Calvert, E. D., P. C. Magnusson, M. D. Carver
Mechanical Properties of Selected Cold-Mold and S
Rept. of Inv. 6014, 1962. 26 pp.
[41] Buehler, W. J., and R. C. Wiley. TiNi-Ductile I
v. 55. 1962, pp. 269–276.
[42] Wells, J. Robert, and Lloyd Carpenter. Spec
Titanium. BuMines Rept. of Inv. 6105, 1962, 23 pp.

ZINC PIGMENTS AND SALTS

Production of zinc pigments and salts increased 3 percent over 1961 production. The output of natural and synthetic rubber, a major zinc-pigment-consuming product, increased 11 percent; paint, varnish, and lacquer industries, also using large quantities of zinc pigments, increased 5 percent in value of shipments.

Production.—Output of lead-free zinc oxide increased 8 percent, but production of leaded zinc oxide declined to 14,400 tons. Zinc chloride (50° Baumé) and zinc sulfate production increased 2 and 4 percent, respectively.

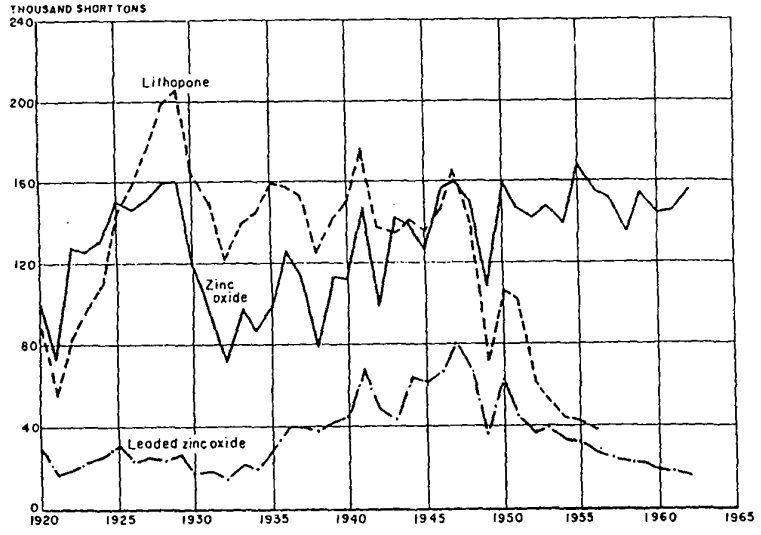

FIGURE 2.—Trends in shipments of zinc pigments, 1920–62.

Pigments and salts were made from various zinc-bearing materials, including ore, slab zinc, scrap, and residues. Zinc contained in pigments and salts made directly from ore, both domestic and foreign, exceeded 89,000 tons; zinc in zinc oxide and zinc chloride from slab zinc exceeded 18,000 tons; and the zinc derived from secondary materials in zinc pigments and salts exceeded 39,000 tons.

Lead-free zinc oxide was made by several processes; 66 percent was made from ores and residues by the American process, 19 percent from metal by the French process, and 15 percent from scrap residues and secondary materials by other processes. Leaded zinc oxide was made from ores; zinc chloride was made from slab zinc and secondary zinc materials; and zinc sulfate was made from ores and secondary materials.

Four grades of leaded zinc oxide, classified according to lead content, were produced. Only a very small quantity of 5 percent or less

TABLE 20.—Production and shipments of zinc pigme
United States

Pigment or salt	1961				
	Production (short tons)	Shipments			Produc tion (short tons)
		Short tons	Value [2]		
			Total	Average per ton	
Zinc oxide [1]	147,555	145,208	$33,219,370	$299	158,844
Leaded zinc oxide [1]	20,335	18,007	4,204,066	233	14,377
Zinc chloride, 50° B [4]	52,479	53,099	(5)	(5)	53,733
Zinc sulfate	29,269	28,891	(5)	(5)	30,539

[1] Excludes lithopone; figure withheld to avoid disclosing individual com
[2] Value at plant, exclusive of container.
[3] Zinc oxide containing 5 percent or more lead is classed as leaded zinc o
[4] Includes zinc chloride equivalent of zinc ammonium chloride and chro
[5] Figure withheld to avoid disclosing individual company confidential d

leaded zinc oxide was produced; the more than
constituted most of the production. Small qu
than 35 through 50 percent and over 50 percent g

Lithopone, a coprecipitate of zinc sulfide and
produced, but figures are withheld to avoid
company confidential data.

TABLE 21.—Zinc content of zinc pigments [1] and salt
manufacturers, by sources

(Short tons)

Pigment or salt	1961					Zinc i p
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts	Or
	Ore		Slab zinc	Secondary material		Domestic
	Domestic	Foreign				
Zinc oxide	63,872	10,305	17,930	25,639	117,752	63,565
Leaded zinc oxide	7,665	4,752	-------	-------	12,417	5,232
Total pigments	71,537	15,057	17,936	25,639	130,169	68,797
Zinc chloride [2]	-------	-------	(3)	11,410	11,410	-------
Zinc sulfate	(3)	(3)	-------	(3)	10,667	(3)

[1] Excludes zinc sulfide and lithopone; figures withheld to avoid disclosing i
data.
[2] Includes zinc content of zinc ammonium chloride and chromated zinc c
[3] Figure withheld to avoid disclosing individual company confidential d

Consumption and Uses.—Shipments of lead-fre
percent greater than in 1961. The quantity con
paint, and ceramic industries increased, and th
counted for 79 percent of the total 154,800 tons shi

The paint industry accounted for 95 percent of
shipped.

TABLE 22.—Distribution of zinc oxide shipments, by industries

(Short tons)

Industry	1953-57 (average)	1958	1959	1960	1961	1962
Rubber	79,675	68,176	79,505	75,120	71,534	80,247
Paints	32,420	33,335	33,708	31,610	30,405	31,381
Ceramics	9,418	9,095	10,486	9,840	10,058	11,092
Coated fabrics and textiles [1]	7,674	2,327	2,125	1,331	1,185	202
Floor coverings	1,790	971	1,207	1,316	1,174	457
Other	21,758	22,087	27,203	25,561	30,852	31,470
Total	152,735	135,991	154,234	144,778	145,208	154,840

[1] Includes the following tonnages for rayon: 1957—2,838; 1958—1,140. Figures for 1959, 1960, 1961, and 1962 withheld to avoid disclosing individual company confidential data.

TABLE 23.—Distribution of leaded zinc oxide shipments, by industries

(Short tons)

Industry	1953-57 (average)	1958	1959	1960	1961	1962
Paints	31,174	23,021	20,748	17,616	16,533	14,959
Rubber }	368	267	1,878	1,662	1,474	735
Other }						
Total	31,542	23,288	22,626	19,278	18,007	15,694

Lithopone was used in paint, varnish, and lacquer, coated fabrics and textiles, rubber, and floor covering.

The principal uses of zinc chloride were for battery making, galvanizing, vulcanizing fiber, preserving wood, and refining oil, as well as for fungicides, solder, and tinning fluxes.

The chief uses of zinc sulfate were in rayon and agriculture. Other uses were in glue manufacture, flotation reagents, rubber, and medicine.

TABLE 24.—Distribution of zinc sulfate shipments, by industries

(Short tons)

Year	Rayon		Agriculture		Other		Total	
	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
1953-57 (average)	13,468	11,900	7,779	6,735	4,939	3,912	26,186	22,547
1958	19,796	17,747	11,525	9,810	2,416	2,191	33,737	29,757
1959	26,062	23,354	5,262	4,696	9,346	7,428	40,670	35,478
1960	15,727	14,077	4,320	3,848	8,749	7,882	28,796	25,827
1961	12,284	11,007	5,673	5,086	10,934	9,926	28,891	26,019
1962	(1)	(1)	8,544	7,313	22,687	20,359	31,231	27,672

[1] Figure withheld to avoid disclosing individual company confidential data, included with "Other."

Prices.—American-process zinc oxide was quoted at 13.00 cents per pound in carlots throughout 1962. Leaded zinc oxide of the 35 percent grade was quoted at 13.875 cents per pound for carlots throughout 1962.

Quotations for Red-seal, Green-seal, and White zinc oxide in carlots remained unchanged at 14 14.75 cents, and 15.00 cents, respectively.

Zinc chloride (50° Baumé) was quoted at 5. throughout 1962. Zinc sulfate (Monohydrate, 36 carlots was quoted at 9.00 cents per pound but in in May and remained at this level.

Foreign Trade.—Imports of zinc pigments and s cent in quantity but only 16 percent in value ov ports of zinc oxide increased to 12,900 tons and t chloride.

TABLE 25.—U.S. imports for consumption of zinc pi

Kind	1961	
	Short tons	Va (thou
Zinc oxide	10,222	$
Zinc sulfide	363	
Lithopone	74	
Zinc arsenate		
Zinc chloride	800	
Zinc sulfate	1,159	
Total	12,608	

[1] Revised figure.
[2] Less than $1,000.

Source: Bureau of the Census.

Exports of zinc oxide were 2,100 tons valued a pone exports were 350 tons valued at $68,000.

TABLE 26.—U.S. exports of zinc pigm

Kind	1961	
	Short tons	Va (thou
Zinc oxide	2,183	
Lithopone	608	
Total	2,791	

Source: Bureau of the Census.

STOCKS

National Stockpile.—There was 1,257,000 tons o (strategic) stockpile and 324,000 tons in the sup at the end of the year; a total of 1,581,000 tons at y

Producer Stocks.—Smelter stocks of slab zinc the beginning of 1962. By the end of March, inv to 139,000 tons, but thereafter they gradually tons by the end of September. At the yearend 144,700 tons.