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July 12, 1971

SUBJECT: ANNUAL REVIEW
LEAD - 1970

To LIA's Board of Directors
Industry Development Committee
Members

Please find attached LIA's latest publication "Annual Review" -- The U. S. Lead Industry - 1970. We sincerely hope you find the "Review" useful and informative. Extra copies are available upon request.

LIA is distributing roughly 4,200 copies to a mailing list that includes consumers, banks and brokerage firms, libraries, Universities and government agencies. We are also arranging for distribution of the "Review" to members of the American Association of Battery Manufacturers and the National Association of Secondary Materials Institute. A press release announcing its availability will also be sent out to the trade press.

If you have any other suggestions for further distribution or comments about the publication, we would appreciate hearing from you.

Sincerely,

LEAD INDUSTRIES ASSOCIATION, INC.

David M. Borcina
Secretary, Treasurer

DMB:rf
Att: "Annual Review"
Lead - 1970

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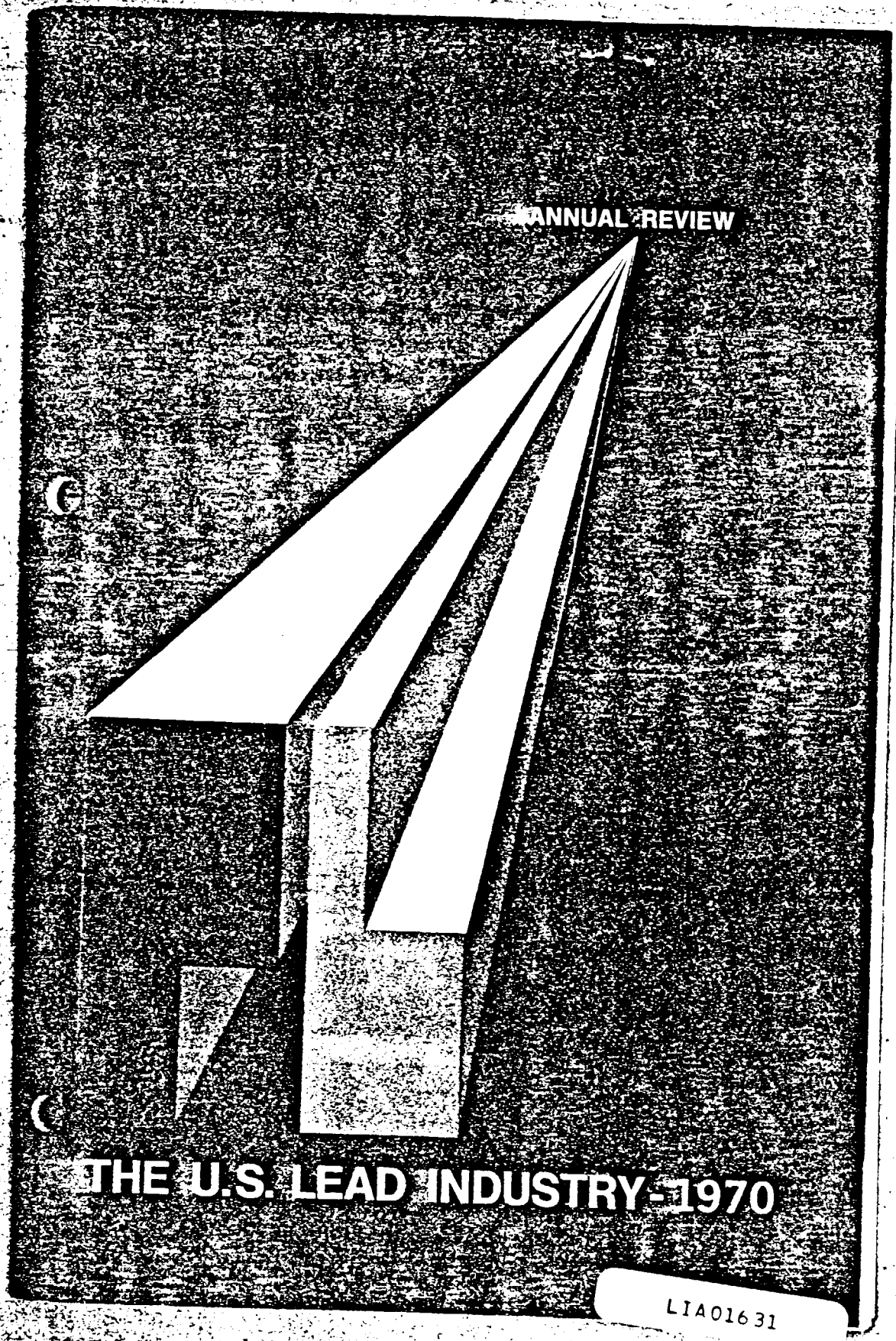

Summary of U.S. Lead Statistics*

(In thousands of short tons of lead content)

	Mine Production	Secondary Production	Imports			U.S. Stockpile Releases	Total Supply
			Ore, Matte, etc.	Pig, Bullion	Total		
1960	247	470	146	214	360	–	1,077
1	262	453	147	262	409	–	1,124
2	237	444	139	265	404	–	1,085
3	253	493	148	241	389	–	1,135
4	286	540	123	218	341	50	1,217
5	301	576	123	227	350	36	1,263
6	327	573	144	291	435	64	1,399
7	317	554	124	374	498	27	1,396
8	359	551	88	338	426	28	1,364
9	509	604	109	280	389	12	1,514
1970a	585	590	112	245	357	12	1,544

* Source: U.S. Bureau of Mines, Bureau of Census

a Estimated

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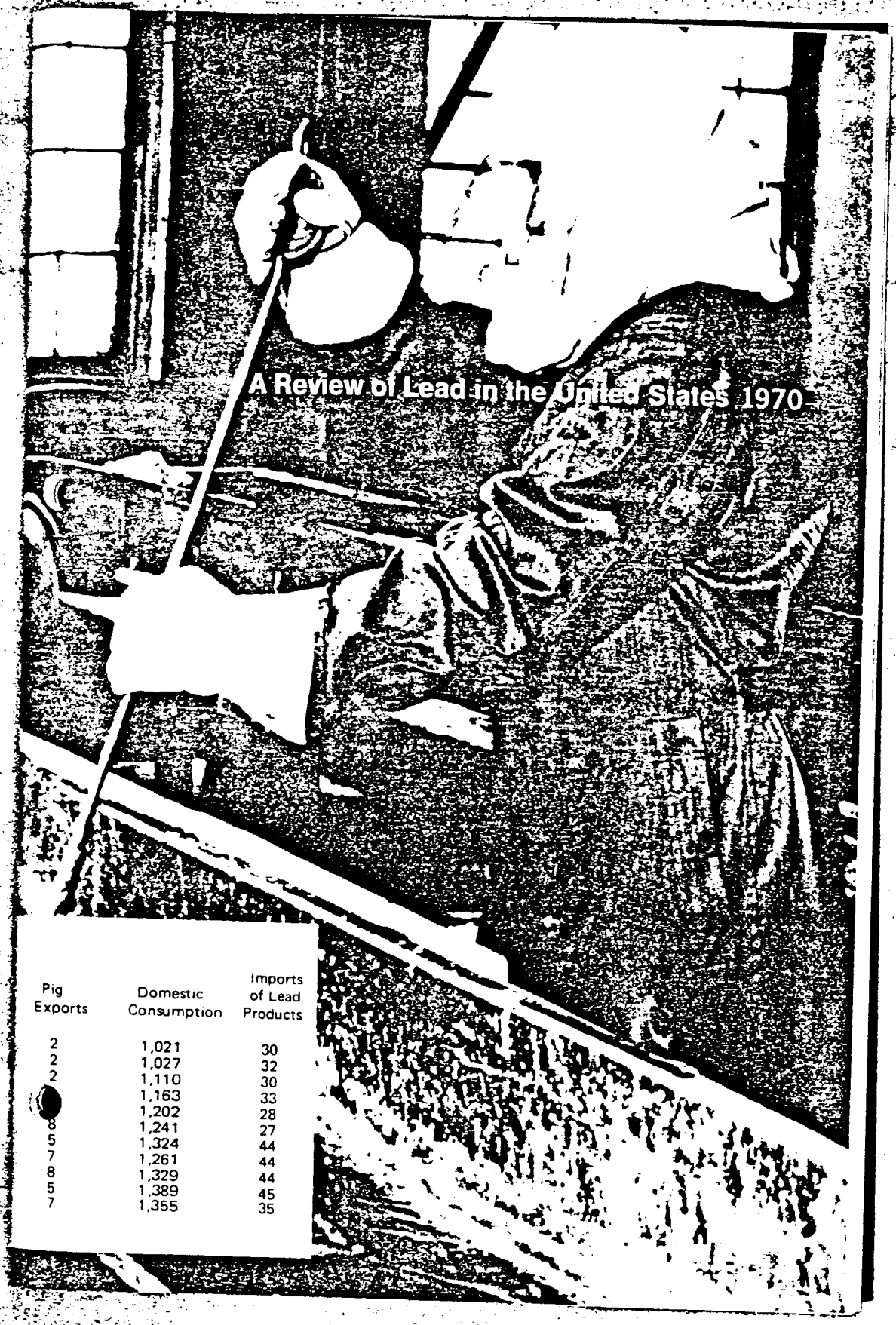

Pig Exports	Domestic Consumption	Imports of Lead Products
2	1,021	30
2	1,027	32
2	1,110	30
[illegible]	1,163	33
[illegible]	1,202	28
8	1,241	27
5	1,324	44
7	1,261	44
8	1,329	44
5	1,389	45
7	1,355	35

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General Summary:

The U.S. lead industry in 1970 continued to show remarkable growth in domestic primary and secondary production, reaching the unprecedented level of 1,175,000 tons. Imports of concentrates and pig declined to 357,000 tons and exports of these remained at the low level of 7,000 tons. U.S. Government stockpile sales were a little over 12,000 tons, mostly for government account. Nevertheless, the year was unsatisfactory because of declining prices – from 16½ to 13½ cents per pound in 4 moves during the last half of the year.

Consumption of lead in the United States during 1970 totaled 1,355,000 tons, a little less than 3 percent down from the record breaking year, 1969. Imports of lead products (not included in U.S. consumption figures) totaled 35,000 tons.

(See "Summary of U.S. Lead Statistics" inside front cover)

Stock in the hands of primary smelters and refiners were 276,000 tons at year's end up from 190,000 tons a year earlier, and the highest since 1961. Consumer and secondary stocks at year-end were 117,700 tons.

Supply

Domestic mining in 1970 (Table I) continued the growth pattern established in 1968 with 585,000 tons produced, 15 percent higher than 1969. The 1970 total is the highest since 1929. Missouri, as a result of the new properties that have recently come on stream, continues to be the dominant factor in U.S. mining, accounting for 78 percent of the total, vs. 70 percent in 1969. Idaho remains as the second major producing state accounting for 10 percent, followed closely by Utah with 8 percent of the total.

Secondary lead recovery (Table II) continued as a major source, contributing an estimated 590,000 tons in 1970, down about 2 percent from record breaking 1969.

The major sources of lead from scrap are, a) old battery plates which represented about 61 percent of the total scrap received with, b) drosses and residues accounting for 21 percent, and c) the remaining 18 percent from solder, babbitt, soft lead, antimonial lead, cable covering and type metal. Note: The various civic and governmental groups clamoring for environmental improvement through the recycling of bottles, cans, and general trash would be well advised to investigate how recycling is being successfully and profitably accomplished by the lead industry.

U.S. imports of lead in 1970 declined for the third straight year to 357,000 tons, (Table III) off about 8 percent from 1969. There was a 3,000 ton increase in imports of ore and matte while imports of bullion and pig lead, dropped substantially by about 35,000 tons from the previous year's level. Australia, France, West Germany, Mexico, Peru, United Kingdom and Yugoslavia shipped less, with Canada alone showing a sizable increase. South Africa's shipments remained about the same as in 1969.

TABLE I

U.S. Mine Production of Recoverable Lead *
(in short tons)

State	1966	1967	1968	1969	Estimated 1970
Arizona	5,211	4,771	1,704	217	400
California	1,976	1,735	4,001	2,518	1,900
Colorado	23,082	21,923	19,778	21,767	20,400
Idaho	72,334	61,387	54,790	65,597	60,300
Illinois	2,285	2,384	1,467	791	1,600
Kansas	1,109	1,031	1,227	395	300
Kentucky	484	845	-a	–	–
Missouri	132,255	152,649	212,611	355,452	436,000
Montana	4,409	898	1,870	1,753	1,700
Nevada	3,581	1,500	863	1,420	1,200
New Mexico	1,596	1,827	1,363	2,368	3,600
New York	1,097	1,653	1,396	1,686	1,200
Oklahoma	2,999	2,727	2,387	605	500
Utah	64,124	53,813	45,205	41,332	45,800
Virginia	3,078	3,430	3,573	3,358	3,300
Washington	5,859	2,762	5,655	8,649	6,000
Wisconsin	1,694	1,596	1,126	1,102	800
Other States	195	–	140	3	–
Total	327,368	316,931	359,156	509,013	585,000

* U.S. Bureau of Mines
a Incl. in "other states"

Sales of Pig Lead from the U.S. Government stockpile during 1970 amounted to 12,300 tons.

Stocks at primary smelters and refiners (Table IV) increased substantially during 1970, ending the year at 276,000 tons, up 86,000 tons from the end of 1969. The most significant part of this increase was 72,000 tons of Refined Pig Lead. The year-end holdings by the primary smelters and refiners was at the highest level since 1961.

Consumer and secondary stocks (Table IV) decreased slightly during 1970 based on a U.S.B.M. revised figure of 117,700 tons at year-end. Stock figures have been in error since September, 1968

TABLE II

Secondary Lead Recovered in the U.S. *
(in short tons)

	1966	1967	1968	1969	1970
As metal:					
At primary plants	9,004	2,538	2,259	4,966	a
At other plants	147,215	147,806	136,607	149,344	a
Total	156,219	150,344	138,866	154,310	a
In antimonial lead:					
At primary plants	10,758	7,808	6,862	6,409	a
At other plants	272,977	280,911	301,701	336,066	a
Total	283,735	288,719	308,563	342,475	a
In other alloys	132,880	114,709	103,450	107,120	a
Grand Total	572,834	553,772	550,879	603,905	590,000 est.

* U.S. Bureau of Mines
a Not yet available

TABLE III

U.S. Imports of Lead
(in short tons of lead content)

	1966	1967	1968	1969	1970
ORE, MATTE, ETC.:					
Australia	22,614	25,553	20,592	20,335	29,360
Bolivia	11,136	13,764	5,718	3,605	3,034
Canada	52,707	33,474	36,815	48,606	41,337
Chile	–	–	490	–	10
Colombia	445	561	–	345	464
Germany West	–	4,371	–	–	–
Guatemala	35	197	–	–	–
Honduras	11,132	6,513	9,272	12,988	15,054
Mexico	624	314	303	301	439
Peru	41,610	36,734	13,976	22,582	21,339
Philippines	164	37	–	–	–
South Africa, Republic of	1,394	359	608	365	–
Other countries	2,130	2,190	62	125	1,361
Total	143,991	124,067	87,836	109,252	112,398
BASE BULLION:					
Australia	1,283	–	–	1,979	–
Belgium – Luxembourg	–	442	–	–	–
Canada	62	23	14	–	–
France	–	55	–	–	–
Germany West	56	–	–	–	–
Mexico	547	95	101	–	–
Peru	64	66	–	–	–
United Kingdom	–	71	–	–	–
Other countries	–	–	35	14	300
Total	2,012	752	150	1,993	300
PIG AND BARS:					
Australia	44,187	53,156	46,919	60,791	51,705
Belgium – Luxembourg	2,535	23,281	18,649	1,315	680
Burma	5,532	2,548	–	150	341
Canada	34,283	37,238	60,161	44,457	63,753
Denmark	672	423	–	114	141
France	224	8,202	4,604	5,627	1,255
Germany West	15,499	49,077	20,711	1,289	703
Japan	1,719	–	–	–	–
Mexico	75,294	57,271	56,516	57,451	38,368
Morocco	–	2,413	–	–	–
Netherlands	5,137	878	205	–	–
New Zealand	–	–	–	–	–
Peru	51,593	70,377	75,105	57,249	52,471
South Africa, Republic of	11,986	6,989	8,298	12,558	12,986
Spain	–	–	–	–	–
Sweden	–	3,307	3,868	–	–
United Kingdom	3,101	17,680	22,919	8,664	2,929
Yugoslavia	31,322	30,478	19,775	27,862	18,765
Zambia	1,148	–	–	–	–
Other countries	1,157	280	390	853	525
Total	285,389	363,598	338,120	278,380	244,622
Grand Total	431,392	488,417	426,106	389,625	357,320

TABLE IV

Lead Stocks – United States
(in short tons)

SMELTERS AND REFINERS[a]

End of	In Ore and Matte and in Process	In Base Bullion: At Smelters & Refiners	In Base Bullion: In Transit to Refiners	In Base Bullion: In Process at Refiners	Refined Pig Lead	Antimonial Lead	Total Stocks
1965	77,839	10,880	437	17,613	18,726	7,736	133,231
1966	108,547	15,870	223	17,532	17,604	6,284	166,060
1967	124,600	17,764	42	17,878	18,660	5,127	184,071
1968	106,074	21,706	600	18,129	11,956	3,483	161,948
1969	120,373	22,385	809	21,067	21,378	4,411	190,423
1970	110,846	39,181	1,139	26,631	93,310	4,946	276,053

CONSUMER'S AND SECONDARY SMELTER'S[b]

End of	Refined Soft Lead	Antimonial	Lead in Alloys	Copper Base Scrap	Total
1965	59,237	34,245	8,757	914	103,153
1966	42,376	32,872	9,236	956	85,440
1967	56,980	34,688	8,007	1,031	100,706
1968	41,420	23,478r	8,287	590	73,774r
1969	64,318	47,969r	7,939	735	120,961r
1970	69,527	40,703	6,662	766	117,658

a American Bureau of Metal Statistics

b U.S. Bureau of Mines

r Revised

as noted in the January, 1971, Bureau of Mines publication "Lead Industry in January, 1971," which states: "Erroneous reporting of stocks of antimonial lead by one consumer was corrected in January, 1971. The error in reporting, which increased consumer stocks approximately 2,500 tons monthly during the September 1968-December, 1970 period, thus necessitated a revision in consumer stocks downward at the end of December, 1970 from 145,300 to 73,000 tons."

Total supplies for 1970, (Table V) taking into account changes in primary smelter and refiners stocks, were 1,452,000 tons, down less than 2 percent from the previous year.

TABLE V

United States Lead Supplies
(in short tons)

	1968	1969	Estimated 1970
Domestic Mine Production	359,200	509,000	585,000
Secondary Lead Recovered	550,900	603,900	590,000
Imports: Ore and Matte	87,800	109,200	112,400
Bullion	200	2,000	300
Pig Lead	338,100	278,400	244,600
Total Production	1,336,200	1,502,500	1,532,300
Change in Stocks at U.S. Smelters & Refiners	22,100 (decr.)	28,600 (incr.)	85,600 (incr.)
Stockpile Shipments	28,400	11,900	12,300
Adjusted Supplies giving effect to changes in Stocks	1,386,700	1,481,900	1,459,000
Exports; Pig Lead	8,300	5,000	7,000
Total Supplies	1,378,400	1,476,900	1,452,000

U.S. Stockpile: The total amount of lead in the U.S. stockpile at the end of 1970 amounted to 1,140,000 tons of which 610,000 tons are surplus over the 530,000 tons, the present stockpile objective. Included in the surplus are 78,100 tons unsold from 100,000 tons released in July, 1969 and 31,000 tons still authorized for specific Government uses from the 50,000 tons authorized by Congress in 1965. Interestingly enough, the only sales from the Government stockpile during 1970 were for Government account, at 12,300 tons.

Prices: The lead price at the beginning of 1970 was 16½ cents per lb. New York and at year-end had declined to 13½ cents. There were four price changes, all down – 1 cent on July 8, ½ cent on Aug. 7 and again on Sept. 1, and 1 cent on Dec. 21.

Consumption: The consumption of lead in the United States in 1970 (Table VI) is estimated at 1,355,100 tons, nearly 3 percent below last year's record breaking tonnage of 1,389,358 tons. Consumption during the year fell off in practically all of lead's uses with the exception of the two major markets – storage batteries, up 2 percent and gasoline antiknock additives, up slightly less than 3 percent. These two continued to break all records, reaching the combined level of 872,500 tons, more than 64 percent of the total consumption for the year.

TABLE VI

United States Consumption of Lead *
(In short tons)

	1966	1967	1968	1969	1970a
Ammunition	78,435	78,766	82,193	79,233	69,500
Bearing metals	21,588	19,561	18,441	17,406	16,000
Brass and bronze	25,447	20,467	21,021	21,512	19,000
Cable covering	66,491	63,037	53,456	54,203	50,500
Calking lead	63,250	48,789	49,718	44,857	34,500
Casting metals	6,671	10,083	8,693	9,918	8,500
Collapsible tubes	11,987	11,299	9,310	12,484	11,000
Foil	6,041	6,148	6,114	5,881	5,500
Pipe, traps and bends	19,984	20,184	21,098	19,407	18,000
Sheet lead	28,938	26,763	28,271	25,818	22,000
Solder	78,898	68,833	74,074	72,626	68,500
Storage batteries	472,492	466,665	513,703	582,546	594,000
Terne metal	1,966	1,620	1,427	1,583	1,000
Type metal	30,421	28,554	27,981	25,660	22,000
White lead	8,131	8,087	5,857	6,617	6,000
Red lead and litharge	89,500	76,589	86,480	79,898	77,000
Pigment colors	13,695	13,041	14,163	14,670	14,500
Other pigments	8,562	5,473	3,234	1,201	1,100
Gasoline antiknock additives	246,879	247,170	261,897	271,128	278,500
Misc. chemicals	614	609	629	602	600
Annealing	5,441	4,202	4,194	4,252	4,000
Galvanizing	1,639	1,854	1,755	1,797	2,000
Lead plating	428	532	389	406	400
Weights and ballast	18,090	15,794	16,768	17,366	16,500
Other uses unclassified	18,289	16,396	17,924	18,289	14,500
TOTAL	1,323,877	1,260,516	1,328,790	1,389,358	1,355,100

* U.S. Bureau of Mines

a Estimated by L.I.A.

As important as is the production of motor vehicles to the lead industry, their operation and use demands far greater tonnages than are required for original equipment. For example until the vehicles are sold and in service there is no use of gasoline antiknock additives, replacement battery requirements are almost four times original equipment needs. In 1970 the total of automotive type batteries shipped is estimated at almost 46,000,000 units. Of these, 37,500,100 were for replacement while 8,500,000 were for new cars, buses and trucks. According to the Battery Council International, "replacement battery shipments, in 1970 increased at a greater rate than did vehicle registrations." This is due largely to the fact that during the past two or three years, sharply increasing numbers of such batteries are being used in non-highway vehicles and equipment such as personnel carriers, golf cars, boats, snowmobiles.

Lead used in industrial battery manufacturing for 1970 constituted a bright spot in the market and showed a gain of more than 10%, increasing from over 57,000 tons in 1969 to more than 63,000 tons in 1970. A new organization of industrial battery manufacturers called The Industrial Battery Group was formed under the auspices of the National Electrical Manufacturers Association (NEMA), and this group forecasts a growth rate of about 8% per year for the next five years. The industry attributes this growth potential to the increasing interest in non-combustion type vehicles, with a contribution from an entirely new application in uninterruptible power systems for computer reliability.

Lead in Gasoline

Of vital importance to the future position of lead is resolution of the question of continued use of lead anti-knock additives in gasoline. The position of the lead industry – through the Lead Industries Association – is stated in the following paragraphs, updated from an L.I.A. "Position Statement" of April 1970.

"Get the lead out" of gasoline has become a slogan in recent months. Like most slogans it attempts to reduce a complex problem to simple terms. Unfortunately complex problems, such as those of automotive emissions, cannot be solved simply.

Automobile manufacturers, with greatest emphasis from General Motors, said in early 1970 that with unleaded gasoline, various catalytic devices to control emissions "could become technically feasible." In late summer 1970, General Motors announced one of their 1973 lines would carry such devices. However, in January 1971 Mr. Cole (Pres.) and Mr. Roche (Chairman) announced to the press that there would be no such devices on any 1973 model and that "they did not know when."

But we do know that systems have been demonstrated that will meet 1975 and approach 1980's originally proposed Federal goals for emissions using leaded gasolines. These systems include traps which can reduce lead to the atmosphere by 90% or more.

The estimates of cost for catalytic systems – originally low – have now been so increased that cost parity to the consumer would seem probable whether "catalytic" devices, or others of a type compatible with leaded gasoline, are broadly adopted.

Neither have we seen any evidence that lead emissions from

automobiles constitute a present threat to health or contribute to smog problems.

Why should the public have to use an inferior gasoline which will give an unsatisfactory performance until the alleged devices which can operate on unleaded gasoline *have been proved* and *have actually been installed on new cars?*

Unleaded gasoline has already been marketed in many parts of the country. Its price is commonly more than leaded regular and has in some cases been more than leaded premium. Thus, as now may develop the public may have to pay a penalty for an inferior product.

The April 8 issue of *The Wall Street Journal* listed other ramifications and consequences of a quick switch to unleaded gasoline:

1. The oil industry will have to make a major investment in new refining facilities, variously estimated from $6 billion to $10 billion, as well as an additional 6 to 8 percent draw down in petroleum reserves. This, we believe, is of vital importance.
2. Small petroleum refineries may have to shut down because they do not have the capital resources to make the new investment.
3. Asphalt, the backbone of road building, would be cultailed since this product is made largely by the small refineries.
4. The hundreds of thousands of retail outlets for gasoline would have to install new gasoline pumps and gasoline storage tanks. The availability of pumps is strictly limtied; the labor required to install them and the tanks will add to the inflation of construction costs.
5. Without lead in gasoline, oil companies would have to make greater use of benzene, toluene and xylene, thereby diminishing the supply of these materials to the petro-chemical industry, with sharp inflationary consequences.
6. Sellers of bromine and sodium would lose a major market since these are the elements used in combination with lead for gasoline additives.
7. The lead industry would lose 20 percent of its total market. A replacement market cannot be found overnight. The problem is complicated by the fact that many lead producers have recently made major capital outlays for plant expansions.

All these dislocations and difficulties might be justified *if* there had been demonstrated, beyond question, the availability of devices to deal with emissions from unleaded gasoline that would materially reduce air pollution. However, this has yet to be proven. In fact, a May 1970 Department of the Interior report states that greater air pollution might result from the use of unleaded gasoline, and there are others who are seriously concerned about the unknown health effects of replacements for lead additives. Such considerations have to be weighed against the fact that there is no existing or threatened health hazard to the public from lead additives.

The Lead Industries Association believes that *it is poor public policy to compel* the abandonment of an existing proved source of efficient automotive power until there has been a clear, accepted demonstration that the alternative represents an improvement.

Other Markets

For the second successive year lead for ammunition declined substantially, 12 percent, as did calking lead, down about 23 percent. The latter use is undoubtedly suffering as a result of the fewer building starts during 1970. Substitute type jointing materials for cast iron soil pipe are also contributing to this decline. Similarly affected, are sheet, cable, pipe, traps and bends. As serious as some of these declines may appear, it is notable that the 1970 demand for lead held up exceedingly well when compared to the other major non-ferrous metals.

The drop in use for ammunition deserves a special comment. Several possible factors have been cited, not surprisingly, the general slump in discretionary spending for sporting arms and ammunition has had its effect on lead. In addition, about 11,000 tons of lead were transferred during 1970 from Government Stockpile to the Dept. of the Army for manufacture of ammunition at the Federal arsenals, and unspecified quantities of that metal may not have been reported to the Bureau of Mines as lead consumed for ammunition. Finally, it is a fact that the 1968 Gun Control Act, which prohibits the sale of ammunition to minors and the sale of mail order guns, as well as requiring registration of rifle ammunition, has produced a noticeable drop in the use of sporting arms ammunition.

Report on Free World Lead Situation:

The International Lead Zinc Study Group representing essentially all of the lead producing countries of the world met in Geneva in November, 1970 and reported that: a) World mine production of lead (primary) in 1970 was estimated at 2,591,000 metric tons, an increase of 168,000 tons or about 7 percent over 1969. b) Lead metal production (primary plus secondary) was expected to reach 3,383,000 metric tons, an increase of 117,000 tons, about 3½ percent above 1969. c) World consumption (primary plus secondary) was expected to reach 3,171,000 metric tons, 15,000 tons more than in 1969, a small growth of about ½ percent. The study group also reported that the statistical picture for 1970 showed supplies exceeding demand by 198,000 metric tons.
(See tables pages 21 and 22)

Short Term Outlook:

Consumption in the U.S. for 1971 should remain at or near the levels attained in 1970. U.S. mine production in 1971 in all probability will not reach the 1970 levels as a result of production cutbacks announced during the last quarter of 1970. It would appear that secondary smelters are limiting intake of scrap judging from the announced increase, at least in the East, of higher smelting charges. Also bearing on the market are the 78,000 tons of lead unsold from the 100,000 tons U.S. Stockpile release of July, 1969 and 31,000 tons from the 50,000 tons released in 1965. The influences surrounding the present lead situation are so many and varied that the best that can be said of the short term outlook is "unsettled." A continued sturdy growth in the market for batteries seems assured. If – at worst – lead is phased out of gasoline, such will be gradual and not be significantly felt for more than three years.

Major efforts through research, development and promotion continue by the lead industry in developing new markets, while protecting and expanding present market areas. Included in the aggregate effort is a free world program (Zinc and Lead Information Service – ZALIS) that is aimed at expanding lead consumption in the developing areas of the world such as Latin America, South East Asia, South Africa, India and the Near East. In this connection three new lead information centers were opened in 1970 and are now functioning in Argentina, Brazil and Mexico.

Reports on Research and Other than U.S.:

The remaining portion of this review consist of tables of world statistics, statement on the research activities of the lead industry through the International Lead Zinc Research Organization, and reports from some other free world countries.

Lead Research – 1970

By Schrade F. Radtke Executive Vice President and Director of Research International Lead Zinc Research Organization, Inc.

International Lead Zinc Research Organization, Inc. (ILZRO), the cooperative research arm for the lead industry on a world wide basis, conducted approximately 33 research programs dealing with existing uses of lead as well as new product areas. The effort included architectural and wrought lead applications, cable sheathing, lead-coated steel, battery applications, chemicals, paints and pigments, ceramics, and basic research.

Considerable efforts was directed in 1970 to development of lightweight roofing systems, plumbing applications and wrought lead architectural components. Roofing research lead to development of composite lead-sheet roofing shingles which offer the appeal and performance of quality roofing systems at a cost competitive to all but the most economical paper roofing systems. Another program involved development of a reinforced lead sheet composite for roofing and other architectural applications. Continuous production techniques are being developed to make possible application of lead as roll roofing from which long coils also could be blanked into standard shingle configurations.

Efforts also were continued in related programs, including research to develop a quick method for providing a uniform and decorative patina on the surface of lead and lead alloy products used for architectural purposes. The program also involves study of the paintability of such products.

Research also was conducted in the area of lead-plastics composites for use in hermetic sealing and packaging, as well as for moisture and gas barriers in architectural and industrial use. Another program concerned with lead-plastics composites was aimed at developing an improved cable sheathing material. Such composites have exhibited tensile elongations of over 500%. This superplastic quality combined with the corrosion resistance, conductivity, impermeability, and other unique properties of lead are expected to have significance in many other application areas. A second ILZRO program in the cable sheathing area involved efforts to extrude a series of commonly used lead alloys into tubular form, employing a continuous screw extrusion machine and starting with particulate material made from the melt and supplied from a complementary ILZRO project in which rod extrusions were made from particulate lead.

Programs to improve the lead-acid battery included a study to

identify the effects of a range of variables encountered in commercially available battery oxides. Another program was directed to development of an optimum power system for vehicle propulsion. This is a successor to a study which demonstrated the technical and economic feasibility of battery power for multistop delivery vans.

Several ILZRO programs were concerned with development of new techniques for applying corrosion-resistant lead coatings satisfactorily and economically to steel. One such effort led in 1970 to development of a method for cladding steel through "explosive welding," whereby the lead is bonded to steel sheets up to 4 x 8 ft. by use of explosives. The research demonstrated that the process is a feasible and economic method of applying lead to steel.

Synthesis and application research of new organolead compounds was intended to establish new applications to augment the outstanding example of lead chemical utilization represented by tetraethyllead as a gasoline antiknock additive. Many of the compounds are showing technical and commercial potential in such diverse applications as antifouling paints, catalysts for polyurethane foams, fungicides, biocidal agents, corrosion inhibitors, preservatives for wood and cotton, rodent repellents, lubricant additives, stabilizers for polyvinyl chloride, molluscicides for the treatment of coccidiosis, and anthelmintics, among others.

Fellowship programs were directed to such diverse ceramics areas as photochemical properties of lead oxide, development of oriented high lead ferrites, and preparation of large-scale phase diagrams for lead-glass systems containing strontium and calcium. While some of these are essentially fundamental in scope, others are aimed at expanding lead use in various applications.

Additional major research areas included programs devoted to paints and pigments, including development of lead-pigmented water-based paints and electrophoretic paints. The environmental health program was pursued on an expanded basis, with many projects conducted jointly with other industries and government agencies.

Lead in the United Kingdom — 1970

R. L. Stubbs, Director-General, Lead Development Association, London, England

The consumption of Refined lead in the U.K. amounted to 261,700 m. tons in 1970, 5% less than in 1969. In addition, 88,500 m. tons of scrap and remelted lead were used, making a total consumption of 350,300 m. tons, which was about 5% below the 1969 total.

As with other metals, consumption of lead was affected by a general slackening of industrial activity particularly in the second half of the year. The only end-use categories which showed an increase compared with 1969 were anti-knock compounds (up by 2½%) and miscellaneous uses (up by 2%). Anti-knock compounds use only primary lead and the majority of the production is exported from Britain so it is likely that the increase was mainly due to increased consumption elsewhere.

No breakdown is published for the uses of primary lead and so the table shows only figures for total lead. The continuing fall in cable sheathing is attributed largely to a reduction in the installation of new medium voltage power cables, following the period of high activity at the beginning of the decade. The decline in lead sheet was

mainly due to a fall off in building work generally. A surprising feature of the year is the 4.8 per cent drop in the consumption of lead for batteries since the demand for batteries was in general quite well maintained. It seems that the higher price level for lead, particularly in the first half of the year, caused manufacturers to slow down advanced production and draw more heavily on stocks. Another factor was the loss of output sustained by one major manufacturer in a move to close down the factory in order to concentrate production at another works, and for a while demand greatly exceeded supply.

Production of refined lead in the United Kingdom amounted to 287,000 m. tons in 1970, an increase of 26,500 m. tons. Production of refined lead from imported Australian bullion rose by 22,000 m. tons to 140,300 m. tons and there was also a small increase in production from domestic scrap. Imports of refined lead, mainly from Australia and Canada, dropped from 106,000 m. tons to 96,900 m. tons. At the same time, exports to Germany of bullion produced as a by-product of the U.K. zinc industry rose from 32,300 m. tons to 39,700 m. tons. Exports of refined lead increased from 94,400 m. tons to 97,500 m. tons. The biggest export markets were mainland China and the Netherlands though China bought only 26,000 tons compared with 43,000 m. tons in 1969.

UNITED KINGDOM

Consumption of Lead in all forms by End Uses
(thousand metric tons)

End Use	1966	1967	1968	1969	1970
Batteries	85.1	87.2	96.2	99.3	94.7
Cable Sheathing	115.1	102.6	80.8	66.5	60.4
Sheet and Pipe	67.4	68.5	66.4	58.5	53.1
Other semi-manufactures (shot, collapsible tubes, foil, etc.)	12.8	11.0	11.3	10.9	10.7
Anti-knock compounds	35.2	36.9	40.4	39.5	40.4
Pigments and compounds	33.9	32.4	33.4	35.8	34.6
Solder and other alloys	39.3	34.6	34.5	35.2	34.3
Miscellaneous	21.1	21.8	21.1	21.5	22.1
Total Consumption	410.7	395.0	385.1	367,1	350.3

Refined Lead Supplies
(thousand metric tons)

Production					
from imported bullion	66.2	65.9	92.2	118.9	140.3
from secondary and scrap material	112.8	126.1	143.9	141.6	146.7
Imports	147.7	115.5	121.3	106.0	96.9
Exports and re-exports	19.5	39.9	60.2	94.4	97.5

Source: World Bureau of Metal Statistics

Lead in France – 1970

J. Chauvin, Secretary General, Centre D' Information Du Plomb, Paris, France

FRANCE

Consumption of Lead by Uses

(In Thousands of Metric Tons)

	1968	1969	1970
Cable Sheathing	46,7	42,–	37,7
Batteries	76,–	86,7	86,7
Plates	(38,–)	(43,3)	(43,3)
Oxide	(38,–)	(43,4)	(43,4)
Semi-Finished	44,4	44,4	43,6
Pipe	(15,8)	(14,–)	(12,4)
Tubes	(0,4)	(0,4)	(–)
Sheet & Strip	(14,–)	(14,–)	(14,1)
Ammunition	(9,2)	(10,–)	(10,–)
Wire	(0,6)	(1,–)	(0,5)
Collapsible Tubes	(4,4)	(5,–)	(6,6)
Alloys	18,8	19,1	15,7
Solder	(8,9)	(9,5)	(6,4)
Bearings	(0,6)	(0,6)	(0,5)
Printing	(7,3)	(7,–)	(6,8)
Misc.	(2,–)	(2,–)	(2,–)
Chemical Lead	35,1	36,3	42,3
Oxides other than for batteries	(22,1)	(22,8)	(30,5)
Tetraethyl	(13,–)	(13,5)	(11,8)
Others	4,5	5,7	6,–
Total	225,5	234,2	232,–

In 1970 the decrease in consumption in cable sheathing, at about 10%, followed the trend established in 1969. Batteries remained at the high level of the year before.

As concerned semi-finished products the total is essentially unchanged from year to year. Alloys of different type dropped sharply with solder accounting for the major change. On the contrary there is a major increase in consumption for chemical products primarily in oxides other than for batteries.

For 1971, the expected consumption will normally be about 3 percent in progress on the total. The progressing items will be particularly in sheets (building, sound attenuation), tetraethyl lead, lead for nuclear and chemical equipment and oxides other than for batteries (red lead and others).

A smaller raise can also be expected in batteries.

The pipes are expected to decline again, but slower and less than this year. The same trend for cable sheathing.

For the differences of 1970 compared to 1969 one must emphasize a change in the way of two estimates as follows:

For TEL, in 1969, figures were for lead pig deliveries to the manufacturer. In 1970, figures are only for the tonnage of lead used into the really manufactured TEL - So the tonnage appears lower.

For oxides, other than batteries in 1969, figures did not include the exported lead powder. In 1970, figures do include this exported powder, so the tonnage appears to be much bigger. In reality it is in progress of nearly 6 percent only, for lead oxides properly.

Lead in India – 1970

M. N. Parthasarathi
Indian Lead/Zinc Information Centre, New Delhi, India.

The total consumption of lead in India during 1970 is estimated to be between 38-42,000 tonnes. Of this, 32,000 tonnes were imported, 2,000 tonnes were produced indigenously, and the balance came from secondary sources. There was no significant change in the pattern of consumption; the most important use of lead – in batteries – continued to grow and accounted for about 35% of the total metal consumption. The lead-acid battery industry is poised for a big expansion and Indian battery manufacturers have embarked on an export promotion programme in a big way. An appreciable rise in the consumption of lead for batteries is, therefore, envisaged.

The cable sheathing industry was the second biggest user of lead and accounted for over 25% consumption. However, the future for lead in sheathing, particularly for power cables, does not seem to be very bright as the Government is contemplating to extend the ban on the use of lead sheathing for power cables up to and including 11KV cables in favour of plastics. Plastics are gaining importance even in telephone cables but lead will continue to be used for some time to come. However, the overall lead consumption in cables may not be affected much as there has been an increase in the activity of power cable manufacturers and a new telecommunications cable unit has been installed for the manufacture of telephone cables.

The other principal use of lead was in paints and pigments, accounting for about 20% of the total metal consumed. The application of lead sheet and pipe has also increased due to the establishment of a number of chemical industries and the spurt in building activities. These, together with lead-base alloys, used about 15% of the metal. The balance was utilized for various minor applications.

Lead in Italy – 1970

Elemer Varady, Director, Istituto Italiano del Piombo e dello Zinco, Milano, Italy

Italian production of lead from ore in 1970 amounted to 54,300 metric tons, a drop of 8,000 tons from 1969. Production of refined lead from by-products amounted to 25,000 metric tons, as against 17,700 tons in 1969, an increase of 7,300 tons. Imports reached a figure of 118,000 metric tons of metal as against 63,000 tons in 1969, with an increase of some 55,000 tons. Supplies increased by 12,000 tons and therefore the balance for the year closes with a consumption of 184,900 metric tons of lead ingots.

Lead consumption for final uses breaks down as follows for the last two years.

ITALY
Lead Consumption by Industry
(in metric tons)

	1969	1970
Unfinished products	50,000	50,000
Cables	24,000	25,400
Batteries	43,800	52,300
Alloys	5,000	5,700
Chemical uses	38,700	45,000
Miscellaneous	3,500	6,500
	165,000	184,900

Excluding the standstill in unfinished products, all other final uses of lead registered increases in consumption in Italy in 1970.

Among all the final uses, the battery field, which is especially tied to the automobile industry, merits particular mention: despite tumult and strikes in the sector that is the largest consumer of batteries, the fact stands out that there was an 8,500-ton increase in lead over the 1969 figure.

In unfinished products consumption for lead shot was below, albeit by only 100 tons, the 1969 level: the reason for this slowdown in the sector, which for Italy is rather important, is to be found in the poor hunting season and the new legal regulations for issuance of hunting licenses. The consumption of lead in this area amounted to 12,900 metric tons in 1970.

In the field of chemical uses, consumption for antiknock mixture (tetraethyl and tetramethyl) registered as increase, after the sluggishness of 1968 and 1969, of 2,500 tons (from 14,500 to 17,000 tons).

Consumption for alloys continues to remain stationary and consumption for cables exhibits only slight variations.

Lead in Australia—1970

Neil A. Hanley, General Mgr., Australian Lead Development Association, Melbourne, Australia

The total Australian primary lead consumption for 1970 was 39,831 long tons which is consistent with the average of 40,000 tons which has been maintained over the past decade. Although the total is down 4,885 tons on 1969 consumption, this was almost entirely due to a reduction of 4,391 tons in the lead used as cable sheathing. This reduction is the result of the continued trend to other sheathing materials, particularly in the communications field.

Some of the large variations in these figures compared with those for 1969 are mainly due to the more detailed classification which was adopted last year.

End Use	1966	1967	1968	1969	1970
Cable Covering	10,145	11,227	10,377	12,466	8,075
Batteries – Metal	6,349	8,353	7,391	7,764	7,336
Battery Oxides	4,952	4,710	4,767	7,549	10,171
Red Lead & Other Cmpds.	4,503	4,240	4,230	4,226	3,400
White Lead	942	1,169	734	490	357
Sheet & Pipe	2,817	2,939	2,402	3,596	3,802
Foils & Collapsible Tube	39	41	35	31	68
Solder	2,762	3,307	3,782	2,512	1,839
Casting Alloys	1,522	1,134	1,031	2,109	2,801
Other Rolled & Extruded	1,840	2,015	1,279	n.a.	n.a.
Caulking	n.a.	n.a.	n.a.	186	140
Brass, Bronze & Bearing Metal	n.a.	n.a.	n.a.	178	271
Galvanizing, Terne & Lead Plating	n.a.	n.a.	n.a.	139	138
Annealing	n.a.	n.a.	n.a.	145	305
Ammunition	n.a.	n.a.	n.a.	375	126
Unclassified	2,569	3,171	2,088	360	1,002
TOTAL	38,440	42,306	38,116	44,716	39,831

Lead in Japan — 1970

Sunao Tokanaga Director General Japan Lead Zinc Development Association

Lead sheet and pipe

In 1970, the consumption of lead for sheet and pipe was about 28,600t which occupied nearly 13% of the total. During the past ten years, some substitutes such as plastics and aluminum replaced lead as the materials for sheet and pipe.

For the break through, we have to persuade the sheet and pipe makers to reduce their production cost and to exert more efforts to develop the new fields of application.

We have been sponsoring a series of research works on sound attenuation with the use of lead sheet. The research result will be helpful for our campaign to develop the use of lead sheet sound barrier in buildings and housings.

Lead-acid Storage Batteries

In 1970, the amount of refined lead used for lead-acid batteries was 89,000t and its share of the total consumption was about 41%, and this is, of course, because of the remarkable expansion of the automobile industry in Japan.

There is a constant increase of the production and use of battery-driven industrial vehicles such as forklifts, and, as a results, the share of the units of electric forklifts of its total units approached 12%, and has been increasing steadily because of the clients' recognition of its sanitary and quiet operation. Some of the automobile manufacturers and storage battery makers have been endeavouring to develop battery-driven electric cars for commercial use, and some of them have already made their prototypes of battery-driven cars showing satisfactory performance. The performance of these electric cars is more than enough to run in the congested districts in the big cities.

Inorganic Chemicals

The consumption of lead for inorganic chemicals has been growing steadily, and its share of the total domestic consumption has also been increasing gradually.

In 1970 consumption of lead for inorganic chemicals was 54,600t, about 25% of the total lead consumption.

i) Red Lead

Use of red lead has been growing year by year. Major kinds of its use are paints, Braun tubes for TV, Vacuum tubes, fluorescent lamps, optical lenses, crystal glasses, glazings, pigments, etc. Lead consumption in this category in 1969 was about 14,000t.

ii) White lead

Major of the use of white lead is as the stabilizer of polyvinyl chloride, paints and glazings. The production of these commodities has been growing as the demand for white lead has been increasing appreciably and will continue to increase for some years to come. Its consumption in 1970 is estimated as 2,000-3,000t.

iii) Litharge

Litharge is used as the stabilizer of polyvinyl chloride, raw materials for lead arsenate, and the component of Braun tube, vacuum tube, optical lens, etc. In favour of the increasing demands for these commodities, it is estimated that the amount of the demand of litharge will grow up to nearly 45,000t in 1970.

Cable Sheathing

In 1960, consumption of refined lead for cable sheathing was 33,200t which was about 30% of the total lead consumption. However, in 1966, since the alternative such as alpeth and stalpeth began to replace lead for communication cable, lead producers in Japan lost the two-thirds of the demand of lead for cable sheathing. For that reason, the consumption of lead for cable sheathing in 1970 went down to only 20,000t, about 9% of the total lead consumption.

Other Uses

Lead is used as the raw material for solder, collapsible tube, printing type, hard lead castings, etc.

Two groups of the enterprisers in Japan has been planning to commence the production of tetraethyl lead. However, according to the hot arguments against the air pollution due to the exhaust gas from automobiles, they decided to give up the production of tetraethyl lead.

JAPAN

Lead Consumption in Various Uses (in metric tons)

Fiscal Year	1960	1969	1970 (Estimated)
Sheet and Pipe	19,400	25,700	28,600
Storage Batteries	28,600	79,900	89,000
Cable Sheathing	33,200	18,100	20,200
Inorganic Chemicals	17,900	49,100	54,600
Others	8,900	19,100	26,500
Total	108,000	191,900	218,900

Lead in the Developing Countries – 1970

The developing countries of the world – Latin America, Africa, the Middle East, India and other Asia (excluding Japan) – together took about 11 per cent of the total free world consumption of refined lead in 1970. In these countries as a whole consumption has been growing at a faster rate than in the rest of the world but there was little growth in 1970, reflecting the slowing down in the world economic expansion. Although statistics for consumption in the developing countries are improving, in many countries the figures still have to be based on estimates from unofficial sources. More information has become available following the establishment of ZALIS – the Zinc and Lead International Service – and the table gives a broad picture.

The use of lead in most developing countries is very largely for the manufacture of batteries for automobiles, but there is a wide range of outlets in some countries such as India, Mexico, Brazil and Argentina, where there is a traditional pattern of lead usage similar to that in Europe and the United States. It should be noted that about half the lead consumed in Mexico is for making litharge, mainly for export.

Peru and Mexico in Latin America, and Morocco, South-West Africa and Zambia in Africa, are important mine and metal producers who supply concentrates and/or metal to world markets as well as to other developing countries. There were only small increases in production in 1970 when the developing countries together provided about 27 per cent of the free world mine production and 13 per cent of refined lead production.

LEAD IN THE DEVELOPING COUNTRIES
Consumption of Refined Lead

1,000 m tons

	1966	1967	1968	1969	1970*
LATIN AMERICA					
Argentina	36	35	38	41	41
Brazil	24	25	28	26	26
Mexico	60	65	70	79	78
Others	30	28	28	28	28
AFRICA (Excluding South Africa)	16	20	21	18	18
MIDDLE EAST	24	28	32	–	–
Israel	–	–	–	6	6
Pakistan	–	–	–	6	6
Iran	–	–	–	4	4
Turkey	–	–	–	8	8
Egypt	–	–	–	10	10
Others	–	–	–	4	4
INDIA	40	55	38	47	60
OTHER ASIA (Excluding Japan)	19	24	–	–	–
Korea Rep. of	–	–	4	4	5
Malaysia	–	–	1	1	2
Philippines	–	–	8	7	7
Singapore	–	–	1	1	2
Taiwan	–	–	4	4	5
Thailand	–	–	2	4	6
Hong Kong	–	–	4	4	4
Others	–	–	2	2	2
Total developing areas	249	281	281	304	322

* Estimated
Source: International Lead and Zinc Study Group and ZALIS estimates

World Lead Mine Production *
(in thousands of short tons)

	America's	Europe	Africa	Asia	Australia	Total
1965	1,060	399	271	114	397	2,241
1966	1,113	470	241	120	399	2,343
1967	1,135	509	221	124	410	2,399
1968	1,204	517	209	127	417	2,474
1969	1,321	503	234	123	484	2,665
1970a	1,460	506	228	127	478	2,799

*Source: "Lead and Zinc Statistics" Published monthly by International Lead Zinc Study Group. Lead content by analysis of lead ores and concentrates plus the lead content of other ores and concentrates known to be intended for treatment for lead recovery.

a Estimate based on reported figures.

World Refined Lead Production*
(in thousands of short tons)

	America's	Europe	Africa	Asia	Australia	Total
1965	1,359	1,027	132	143	241	2,902
1966	1,393	1,064	141	151	243	2,992
1967	1,316	1,164	138	184	239	3,041
1968	1,456	1,203	129	201	224	3,213
1969	1,652	1,295	150	223	266	3,586
1970a	1,674	1,308	157	248	227	3,614

*Source: "Lead and Zinc Statistics" Published monthly by International Lead Zinc Study Group. Total production by smelters or refineries of refined pig lead, plus the lead content of antimonial lead – including production on toll in the reporting country – regardless of the type of source material, i.e. whether ores, concentrates, bullion, alloys, mattes, residues, slags or scraps. Remelted pig lead and antimonial lead are excluded.

a Estimate based on reported figures.

World Refinery Stock Figures*
(in short tons)

	Dec. 31, 1969	Dec. 31, 1970
United States	46,654	124,760
O.E.C.D. Countries	66,422	76,178
All other	71,889	102,580
Total	184,965a	303,518a

*Based on American Bureau of Metal Statistics – "Summary of Lead Refinery Statistics in U.S.A. and outside U.S.A."

a Represents approximately 85 percent of the Western World or 75 percent of the World Total.

World Refined Lead Consumption*
(in thousands of short tons)

	America's	Europe	Africa	Asia	Australia & New Zealand	Total
1965	1,309	1,315	36	217	70	2,947
1966	1,412	1,307	40	228	76	3,063
1967	1,367	1,293	36	282	79	3,057
1968	1,453	1,366	34	289	74	3,216
1969	1,531	1,463	42	321	77	3,434
1970a	1,478	1,540	43	355	72	3,488

* Source "Lead and Zinc Statistics" Published monthly by International Lead Zinc Study Group. Includes consumption of the types of lead reported under "World Refined Lead Production"

a Estimate based on reported figures

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The Lead Industries Association, Inc. was organized in 1928 and now includes sixty corporate members representing all segments of the lead industry.

LIA is a non-profit trade association for the lead industry of the United States with sister associations in major countries throughout the world. The association neither produces nor sells lead, but collects and distributes information relative to the uses of this metal. A booklet entitled "Publications and Films" is available upon request.

An extensive library of lead information is housed at the Association's New York headquarters and data pertaining to lead and lead products may be obtained by letter or telephone inquiry to the technical service department. The staff of the Lead Industries Association will cooperate without obligation in the solution of your lead problems.

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