LEAD STORAGE BATTERIES -- YEAR 1963

by

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Before we talk about 1963, perhaps we should briefly review what happened in 1962, and reminisce by reversing the last two digits and compare 1926 with today. Here is how the salient statistics might be compared:

	1926	1962
Primary stocks at beginning	11373 tons	211522 tons
Production	831211 "	413297 "
Imports, refined Pb	10017 "	257155 " **
" , antimonial Pb	3496 "	7418 "
Total Supply	856097 "	889392 "
Less --		
Exports	71935 "	5943 "
Stocks at end	28693 "	154990 "
Domestic deliveries	755469 "	728459 "

** Includes about 53000 tons of bartered lead to U.S. Stockpile.

Use of lead in the U.S.:		
Storage Batteries	190,000 tons (21.0%)	400,000 tons (37%)
Cable Covering	185,000 " (20.5%)	55,000 " (5.1%)
White Lead	120,000 " (13.3%)	7,000 " (.65%)
Tetra-ethyl Lead	?	170,000 " (15.6%)
	900,900 tons (100%)	1080,700 tons (100%)

Prices would compare:		
Average New York common	8.417¢	9.631¢ (+14.4%)
Wholesale commodity price index for other than food & farm products	100.	178.5

In 36 years, the complexion of the industry has changed considerably. We carry 9 times the average stocks to produce half as much lead domestically. We import 20 times as much and export only 1/12 what we did in 1926. We consume only 20% more than we did in 1926 at a price only 14.4% higher, when the price of all commodities other than food and farm products increased 78.5%. The shift in classification of major uses is quite obvious from the above comparison.

In retrospect, the lead industry in 1962 had its good and bad features. The storage battery industry had its highest lead usage in history with over 400 thousand tons which was 37% of the total consumption. Total consumption (preliminary - 1080 thousand tons) was 2.5% higher than the preceding 5-year average consumption. The metal stocks of primary smelters and refiners dropped 56532 tons, but a large part of this (40000 tons) was indirectly due to the fact that our largest lead mining company lost 5 months of production in 1962 because of a strike.

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Price was something else again. It reached a low of 9.5¢ officially and was subject to a host of discounts which produced an unstable market. To equal that we must go back 16 years to 1946 when we were just recovering from war and the average price was 8.109¢. But why should this be? Here are some interesting statistics:

	Sales Tons x 1000	Consumption Tons x 1000	Ratio S/C	N.Y. Price
1962	641.0	1080	59.35%	9.63¢
1961	614.4	1027	59.82%	10.87¢
1960	519.9	1021	50.92%	11.95¢
1959	645.8	1091	59.19%	12.21¢
1958	662.8	986.4	67.19	12.11¢
1957	781.8	1138.1	68.69	14.66¢
1956	797.1	1210.0	65.88	16.01¢
1955	859.9	1212.6	70.91	15.14¢

Any comment is conjectural. Import quotas were imposed in October 1958. The sales ratio dropped almost 10%. In my opinion, the secondary smelters who normally have first call on the market assumed an increasing role in feeding the soft lead market by decreasing their antimonial lead production. The primary producers' stocks rose alarmingly and the price war began in the battle to liquidate inventories. But did that sell more lead? Obviously, no. Please observe that the same volume of sales in earlier years supported prices of 11¢ and 12¢. A continuation of such a condition can only mean liquidation of the small producer or support by governmental subsidy, and decreased exploratory development by large producers because there are better profits or returns elsewhere.

Registrations - Total and New

According to preceding formulas the author should now bring the statistics on registration, new vehicle registration and original equipment sales up to date. Associate these figures with vehicle storage batteries for replacement of worn-out batteries, those required for new vehicle production, and those expected to be exported. Then, as if by magic, he guessed the total number of units to be shipped, multiplied by the average pounds of lead per unit and, presto, there was the tonnage used by the industry. If the guess was close, the author bragged about it; otherwise everyone proceeded to forget about it. In 1955, your present author guessed a 400,000 ton year which was expected to be a record -- something was wrong because total battery lead usage was 380,000 tons.

This year we are going to continue using those same facts and figures; guess at the batteries that will be built and the tons of lead required; but introduce an additional study on <u>trends</u>. The latter might furnish a clue to a better forecasting in the future.

You will recall the enigma that existed when we plotted registrations which were steadily rising, storage battery shipments which were rising at a much slower rate, but lead usage actually dropping off most of the years. We blamed that on building better quality batteries that averaged longer life and the advent of compact cars with smaller engines and lower cranking requirements. But this couldn't go on ad infinitum. Back in 1958 this author expressed the thought that technological progress would not continue at its earlier rate and that the replacement battery curve would again bend upward, better to match the growth rate of

vehicle registrations. Perhaps we have seen that turning point in 1961 and this is what has lent encouragement to the introduction of trend lines.

The first appended page lists the related statistical data referred to earlier in this paper. Study it if you like, but please let us skip over 1963 for the time being.

Now turn to the second appendage. On semi-logarithmic paper are plotted (A) total vehicle registrations, (B) total automotive battery shipments, (c) replacement battery shipments and (D) lead consumption by the battery industry. The spread between (B) and (C) reflects largely the original equipment sales plus relatively small exports of 6V and 12V batteries. Lines (A) and (C) have a close relationship as do lines (B) and (D). Semi-log paper permits us to plot curves of widely varying values on the same sheet plus the added convenience of observing relative growth rates (the same slope represents equal percentage changes of growth or decline). The graphs begin with the year 1935 and continue to date. The trend study begins in 1948 for reasons explained below.

It is timely to introduce some historical references. World War II began in 1939 but we became involved late in 1941. Promptly, we shut off production of vehicles for four years but continued replacement battery production under close control. This is reflected in curves (B) & (C). War activity ceased in 1945 and a few vehicles were built the latter part of 1945. The real rush began in 1947 when the combined demand for replacement and original equipment batteries could not be met by the battery manufacturers.

Battery dealers and distributors were not going to be caught short in supply two years in a row so they ordered heavily for the second half of 1948. Sales were "borrowed" from the future and when the pipeline was refilled, it resulted in a big drop in shipments for 1949. Therefore 1947 is a poor choice to begin a study in trends. The oversupply in 1948 was counter-balanced by stock carryover and shorter demand in 1949. This is the reason my trend study begins in 1948.

In a logarithmic scale, the length of each division shortens as you approach 10 or a multiple thereof. Consequently, the shape of curve (A) seems to bend downward. This is an optical illusion. To avoid it we shall deal with each curve separately by replotting it on a linear scale.

Trend of Total Vehicle Registrations

Look at the third attached sheet showing total registrations alone. Note that by visual inspection it is apparent that the average trend line is a straight line. Problem is to find the slope of that trend line and write a formula for it.

Having assumed a straight line trend, the formula will be:

$$(1) \quad Y = a + b X$$

The principle of least squares aids in determining the line that best describes the trend of the data, and it is a line whose sum of the squares of the deviations from actual values will be a minimum. Only one line will qualify.

The formula must be summed up for all points. This results in

$$(2)\ \Sigma(Y) = \Sigma a + b\,\Sigma(X)$$

in which Σa is the number of points (years in this case) times the constant or $\Sigma a = Na$,
or rewriting $(2)\ \Sigma(Y) = Na + b\,\Sigma(X)$

The coefficient of the second unknown (b) is X. Multiplying equation (1) by X we obtain

$$XY = a\,X + b\,X^2$$

This sums up to

$$(3)\ \Sigma(XY) = a\,\Sigma(X) + b\,\Sigma(X^2)$$

We must now determine the values of a and b in the above equations by substituting the various known values obtained from existing data.

	Years From Start (X)	Vehicle Registrations (millions) (Y)	(XY)	(X^2)	Trend Curve (Y)	
1948	0	40.556	0.	0	42.618	1948
1949	1	44.140	44.140	1	45.279	1949
1950	2	48.872	97.744	4	47.941	1950
1951	3	51.586	154.758	9	50.603	1951
1952	4	53.110	212.440	16	53.264	1952
1953	5	56.280	281.400	25	55.926	1953
1954	6	58.765	352.590	36	58.587	1954
1955	7	62.780	439.460	49	61.249	1955
1956	8	65.270	522.160	64	63.911	1956
1957	9	67.470	607.230	81	66.572	1957
1958	10	68.740	687.400	100	69.234	1958
1959	11	71.668	788.348	121	71.895	1959
1960	12	73.947	887.364	144	74.557	1960
1961	13	76.350	992.550	169	77.219	1961
1962	14	79.200	1108.800	196	79.880	1962
					82.542	1963
N=15	$\Sigma(X)$ =	$\Sigma(Y)$ =	$\Sigma(XY)$ =	$\Sigma(X^2)$ =	85.203	1964
	105	918.734	7176.384	1015	87.865	1965
					90.527	1966
	(2)	= 918.734	= 15a +	105b	93.188	1967
	(3)	= 7176.384	= 105a +	1015b	95.850	1968
	(2) X 7 = (4)	= 6431.138	= 105a +	735b	98.511	1969
	(3) - (4)	= 745.246	=	280b	101.173	1970
			b = 2.661593			
	(2)	= 918.734	= 15a + 279.4673			
			15a = 639.2667			
			a = 42.6178			

Formula for trend curve beginning in 1948 is

$$Y = 42.6178 + 2.6616\,X$$

where units are in millions.

The trend values for various values of X (years) are computed in the right-hand column. Assuming the continuation of the same trend, we can compute the values for succeeding years which has been done in the right-hand column.

Trend of Replacement Battery Shipments

Please refer to the last attached sheet. Here we have replotted replacement battery shipments to a linear scale and observe that by visual inspection the trend is not a straight line but actually bends upward. This is good. It means that the rate of increase is approaching the registration trend, in fact, in the last two years it has increased at a higher rate. But the formula for such a bending line is the reciprocal of a straight line and would be written:

$$(1)\quad Y = \frac{1}{a + bX} \quad \text{or} \quad \frac{1}{Y} = (Y') = a + bX$$

Now we can treat this formula the same as we did before.

$$(2)\quad \Sigma(Y') = Na + b\,\Sigma(X)$$

$$(3)\quad \Sigma(XY') = a\,\Sigma(X) + b\,\Sigma(X^2)$$

and a table like this one below develops the known values.

	Years from start (X)	Replacement Batteries (millions) (Y)	Reciprocal of Y = (Y')	(XY')	(X^2)	Trend Curve Y	
1948	0	25.075	.03988	0	0	21.785	1948
1949	1	19.383	.05159	.05159	1	22.165	1949
1950	2	24.442	.04091	.08182	4	22.560	1950
1951	3	22.219	.04501	.13503	9	22.970	1951
1952	4	22.453	.04454	.17816	16	23.395	1952
1953	5	23.614	.04235	.21175	25	23.835	1953
1954	6	23.771	.04207	.25242	36	24.295	1954
1955	7	25.828	.03872	.27104	49	24.770	1955
1956	8	25.014	.03998	.31984	64	25.260	1956
1957	9	25.943	.03855	.34695	81	25.775	1957
1958	10	25.270	.03957	.39570	100	26.310	1958
1959	11	27.495	.03637	.40007	121	26.870	1959
1960	12	26.329	.03798	.45576	144	27.450	1960
1961	13	28.311	.03532	.45916	169	28.060	1961
1962	14	30.486	.03280	.45920	196	28.695	1962
						29.360	1963
N=15	$\Sigma(X)$ = 105	$\Sigma(Y)$ = 375.633	$\Sigma(Y')$ = .60564	$\Sigma(XY')$ = 4.01849	$\Sigma(X^2)$ = 1015	30.055	1964
						30.785	1965

$$(2) = .60564 = 15a + 105b$$
$$(2) \times 7 = (4) = 4.23948 = 105a + 735b$$
$$(3) = 4.01849 = 105a + 1015b$$
$$(4) - (3) = .22099 = -280b$$
$$b = -.000789$$

$$(2)\quad .60564 = 15a - .08287$$
$$15a = .68851$$
$$a = .0459$$

Trend curve is $Y = \dfrac{1}{.0459 - .000789\,X}$

for replacement battery shipments in which the values are expressed in millions. The right-hand column shows the computation of Y for various values of X.

The Trend of Lead Consumption by Storage Battery Industry

Let us not burden this section with more tables and formulas, except to say that by similar derivation, the trend line beginning in 1948 may be expressed as:

$$Y = 352.9623 + 1.2355\ X$$

in which the units are thousands of tons of lead. This is not a very encouraging rate of increase and might be expressed as only 1235.5 tons a year.

Total lead used by the battery industry is divided between that portion used for automotive types and that portion used for industrial types. Let us hope that there will be no more "skinning" of lead content in automotive batteries and that we can later prove our trend curve for lead consumption in succeeding years actually bends upward like that for replacement batteries.

1963 Forecast

Now let us return to the first attached sheet showing statistics. Original equipment sales values are the reflection of several public utterances by the "experts" in the automotive field discounted to some extent by the expected public optimism of a sales manager.

Replacement battery shipments represent the largest usage of lead. Look again at the trend curve. Remember that last year's cold weather extended until March of 1963. Many of the "weaklings" were knocked out by the cold weather sooner than they might have failed normally. As of this writing, replacement sales are pretty sour but given a normal weather return, I would expect this year's replacement volume to return to the trend line or slightly below. That is why I chose the figure 29,000,000 units for 1963.

A word of caution against too close an association of replacement battery sales with total vehicle registrations. Two years ago I made a study of storage battery volume as used to crank marine outboard motors. Here is a market which has grown rapidly since 1955 and as of Jan. 1960, it was estimated that there were over 600,000 automotive batteries used in marine service. Practically all of these were bought through automotive battery dealers. Due to winter storage and probable lack of care, the average life is estimated to be only about 18 months. So don't make the mistake of matching replacement volume directly with car registrations without making due allowance for perhaps 300,000 units going into marine service. The same is true for any computations on average life.

Some minor adjustments were made to the estimates of lead used to manufacture industrial batteries in earlier years. To repeat a remark made a number of times in the past -- "you will not be far amiss if you estimate 10% to 12% of total battery industry consumption as going to the production of industrial batteries."

In years prior to 1963, we use the industry consumption figure given us by the Bureau of Mines, subtract the estimate of tonnage for industrial batteries, and the remainder is divided by the total unit shipments to get an average lead weight per battery. In the case of 1963, I have assumed the same average lead weight per battery as occurred in 1962 and the same industrial battery tonnage to arrive at the total estimated requirement of 390,000 tons which is 3½% below what I expect the final 1962 consumption figure will be.

4/17/63.

U.S. AUTO VEHICLE & STORAGE BATTERY STATISTICS

Compiled For Lead Industries Assoc., Inc., April 1963

(Units x 1000)		1963*	1962	1961	1960	1959	1958	1957	1956	1955	1954
VEHICLES											
1. Registrations, Total U.S., Jan. 1	(a)	79200	76350	73947	71668	68740	67470	65270	62780	58765	56280
2. Registrations, New - 12 Mo.	(b)	7900	8008	6773	7520	6981	5381	6840	6850	8127	6365
3. Scrappage, Estimated	(c)	5000	5000*	5000*	4927	5211	4179	4264	4948	4392	4353
4. Registrations, Total U.S., Dec. 31	(a)	82000	79200	76350	73947	71668	68740	67470	65270	62780	58765
ORIGINAL EQUIPMENT SALES:											
Passenger Car -											
5. U.S. Factory Sales	(d)	6850	6933	5543	6675	5591	4258	6113	5816	7920	5559
6. Imports	(e)	385	384	289	471	697	444	264	109	58	35
7. Total Passenger Car		7235	7317	5832	7146	6288	4702	6377	5925	7978	5594
Truck & Bus -											
8. U.S. Factory Sales	(d)	1185	1260	1134	1194	1137	877	1107	1104	1249	1042
9. Imports	(e)	15	12	9	24	22	15	8	3	1.3	.5
10. Total Truck & Bus		1200	1252	1143	1218	1159	892	1115	1107	1250	1042
Total Original Equipment											
11. U.S. Factory Sales	(d)	8035	8173	6677	7869	6729	5135	7221	6921	9169	6601
12. Imports	(e)	400	396	298	495	719	459	273	112	60	36
13. Total O.E. Sales		8435	8569	6975	8364	7448	5594	7494	7033	9229	6637
AUTO. STORAGE BATTERY MARKET:											
5. O.E. - Passenger Car		6850	6933	5543	6675	5591	4258	6113	5816	7920	5559
8. O.E. - Truck & Bus		1185	1240	1134	1194	1137	877	1107	1104	1249	1042
14. O.E. - Tractor	(f)	230	222	202	187	289	268	274	277	377	285
15. O.E. - Total		8265	8395	6879	8056	7017	5403	7494	7197	9546	6886
16. Replacement	(g)	29000	30486	28311	26329	27495	25270	25943	25014	25828	23771
17. Exports - 6V & 12V	(e)	235	254	239	180	217	219	271	361	429	409
18. TOTAL AUTO BATTERIES		37500	39135	35429	34565	34729	30892	33708	32572	35803	31066
TONS OF LEAD USED IN BATTERY MANUFACTURING:											
19. As Metal (Grids, posts)	(h)	202	210	186	175	187	160	186	192	196	174
20. As Oxides	(h)	188	195	182	178	193	153	175	179	184	163
21. Total for all batteries		390	405*	368	353	381	313	361	371	380	337
22. Less Industrial batteries	(*)	47	47	40	41	39	30	40	42	40	32
23. Lead used Auto. Types		343	358	328	312	342	283	321	329	340	305
24. Average Pounds per Auto. Battery		18.3#	18.3#	18.5#	18.1#	19.7#	18.3#	19.0#	20.2#	19.0#	19.6#

References - (a) Automotive Industries Count (d) Auto. Mfgr. Assoc. (g) A.A.B.M.
(b) R. L. Polk & Co. (e) Dept. of Commerce (h) Bur. of Mines
(c) Auto. Mfgr. Assoc. to 1960 (f) Bur. of Census (*) Est. by K.W.Green

Note - Alaska & Hawaii Registrations included beginning 1959.