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METALLIC LEAD PRODUCTS DIVISION

January 22, 1954

M.L.P. BULLETIN NO. 61

SUBJECT: SHEET METAL WORKERS' JOURNAL

To Members of the Metallic Lead Products Division:

We are pleased to attach a reprint of an article on lead that appeared in the November, 1953, issue of the "Sheet Metal Workers' Journal," official publication of the Sheet Metal Workers' International Association and distributed to all members of that organization.

Much of the text was developed from information supplied the author by the L.I.A., as were all but two of the photographs used to illustrate the article.

Sincerely yours,

Secretary

N 3024

LEAD

By Robert R. Kennedy
Written especially for the Journal
Fifth of a Series on Metals

ONE sure test of a counterfeit coin is to give it a healthy bite, and see if you can nick it or bend it with your teeth. If you can, you assume the money is phoney. While that may be the test for a good American coin today, it wasn't true of the first metal coins made by man. Back 2000 years before the birth of Christ, the Chinese made coins out of pure lead. Although they were soft, yet the Chinese valued their ease of casting and their resistance to corrosion.

Metal Is Ancient

Lead was known throughout the early world, and we have records of its being used in almost every ancient civilization. The Egyptians used the metal for solder, for water pipes, and as a glazing material for pottery. Lead is mentioned four times in the Bible, in words which showed the high esteem in which it was held. Typical is this quotation from Ezekiel (XXVII, 12).

> Tarshish trafficked with you by reason of your great wealth of every kind: silver, iron, tin and lead they exchanged for your wares.

The Romans were great users of lead. They were fond of bathing, and every household desired running water, plus their great public baths. To supply them enough water, they built long stone aqueducts to carry the water into their cities, and then developed distributive systems to bring it where it was wanted. For this they used large quantities of lead, mined mostly in Britain. They cast it in large sheets, as long as 10 feet, and as much as one inch thick. They used these sheets to line their baths, and out of them they made water pipes. For this, they rolled the sheets around a rod, and used molten lead to seal the joint. Some of these pipes have been found when excavating old Roman cities, and after 2000 years, they are still in good condition. The Latin name for lead was "plumbum," and the men who worked with lead were called "plumbers." From this we get our present-day word "plumber," although the worker of today uses many materials besides lead.

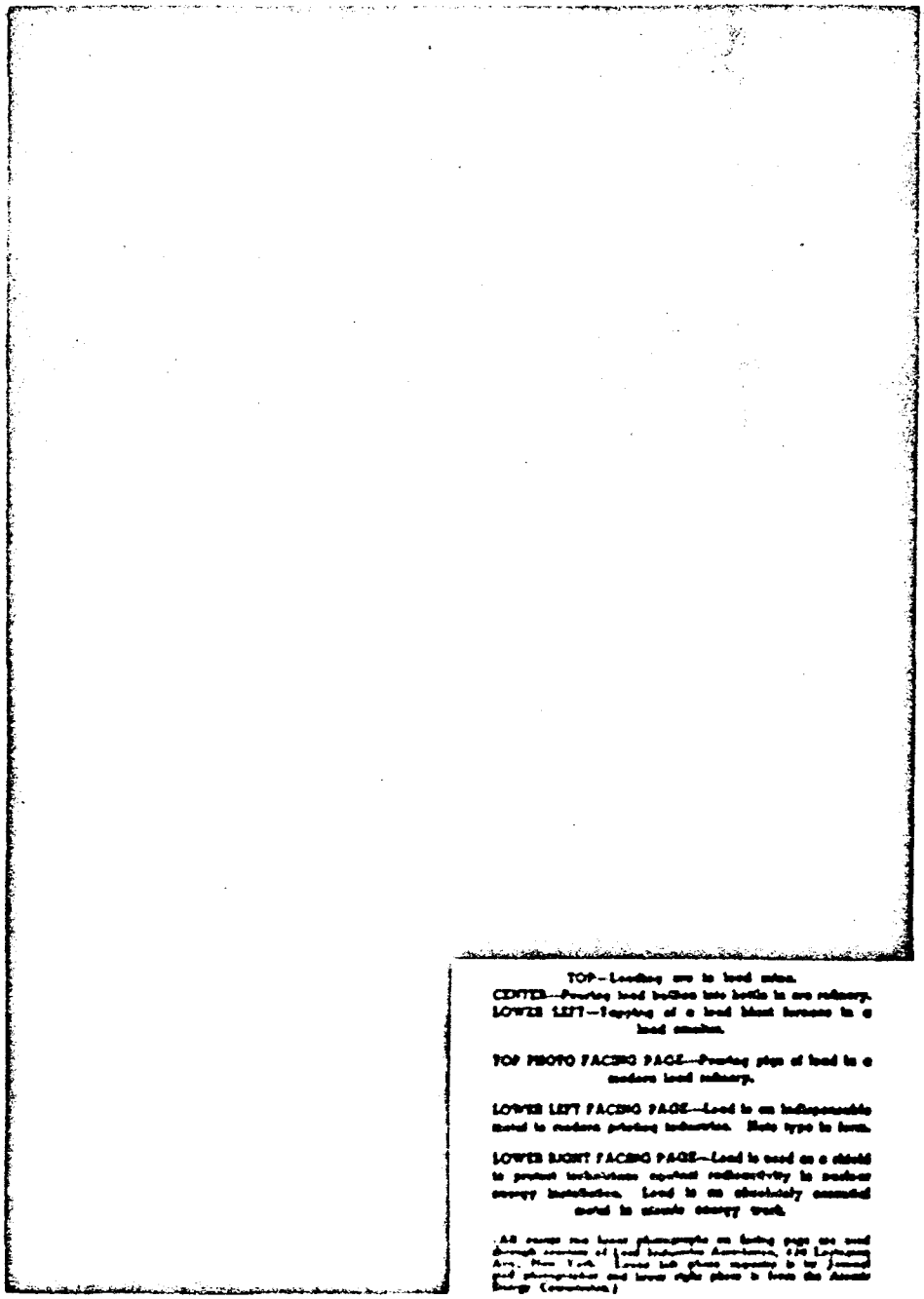
Heaviest Common Metal

Lead is the heaviest of the common metals, with a specific gravity of 11.11, making a cubic foot weigh somewhat over 700 pounds. Its heaviness has made it useful where sheer weight is called for. The fisherman uses lead weights, the surveyor has his plumb line, and even the housewife will sew lead shot into her drapes to keep them hanging straight. Its concentrated weight has made it useful in ammunition, where it contributes both stability in flight and increases impact upon striking.

Construction Uses

As a construction metal, lead has certain limitations. It is soft and weak. While pure lead can be strengthened by alloying it with various metals, even so it cannot compete with some of the lighter metals. The one important part of the construction industry where lead is useful is in roofing. It will resist corrosion, even in atmospheres polluted with sulphuric acid. Its softness makes it easy to cut and to form, so it will fit into complicated shapes of domes and cornices and parapets. Since water will not combine with lead, the runoff after rains carries no stain. Thus, lead can safely be used on white marble, or other structures of stone, without danger of that ugly staining which has marred so many otherwise-impressive buildings.

There are many examples of lead roofing throughout the world. It was used for this purpose very early in history. In Europe there are still roofs covered with the original lead that was installed in the 11th and 14th centuries. The famous church of St. Sophia, in Istanbul, has its many domes covered in lead. In this country, lead has often been used where permanent coverings for complicated



TOP—Loading ore in lead mine.
CENTER—Pouring lead bullion into bottle in ore refinery.
LOWER LEFT—Tapping of a lead blast furnace in a lead smelter.

TOP PHOTO FACING PAGE—Pouring pigs of lead in a modern lead refinery.

LOWER LEFT FACING PAGE—Lead is an indispensable metal in modern printing industries. Slugs type in form.

LOWER RIGHT FACING PAGE—Lead is used as a shield to protect technicians against radioactivity in modern energy installations. Lead is an absolutely essential metal in atomic energy work.

All except the lower photographs on facing page are used through courtesy of Lead Industries Association, 420 Lexington Ave., New York. Lower left photo appears to be Jouanel and photographer and lower right photo is from the Atomic Energy Commission.

shapes were desired. At Rahway, N. J., the 24-foot dome on the State Reformatory, the third largest dome in the world when it was built, is covered with lead, as is the dome of the Pennsylvania State Capitol, at Harrisburg. The famous baths at Saratoga Springs, N. Y., are roofed in lead, and many other buildings have used this roofing material for permanent protection.

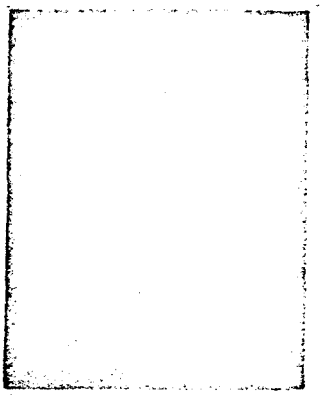
Protective Properties

Lead helps protect frame buildings and other wooden parts when it is used as a constituent of paint. One of the best outdoor paints uses white lead, which is a carbonate of lead. Familiar to all is the bright orange color characteristic of red lead, which is an oxide of the metal. Almost all steel work, whether for skyscrapers, ships, or bridges, is given a first coat with this paint.

Lead ore is found in many parts of the world. Today the United States is the leading producer of the raw metal, with about 20 per cent of total production. We pushed Spain out of first place in the late 1800's, and have held it ever since. Australia has recently replaced Mexico in second place, and other deposits are found in such scattered countries as Canada, Peru, Yugoslavia, Germany, French Morocco, Italy and Southwest Africa. In the United States, the major lead-producing area is the southeastern corner of Missouri, followed by Idaho and about twelve other states in which lesser deposits have been found.

The most important ore is galena, which is a lead sulphide, although some ores are of lead carbonate or lead sulphate. Galena is rarely found on the earth's surface, and has to be extracted in deep-mining operations. Occasionally the ore is rich enough so that it can be smelted directly, but more often there is so much waste material in what is dug up that there has to be a preliminary milling treatment, to increase the percentage of the metal-bearing ore.

In the early days of lead mining, the ore would be separated out by mechanical means that relied on the greater weight of the galena. A vibrating table would tend to move the lighter earth in one direction, the lead-bearing compound in another. While these methods are still in use,



Forming lead sheet (above) down to the inside to the sheet metal shop on the ground floor before hoisting sheets to roof on a construction job.

they have been largely supplanted by what is known as the flotation process. In this method, the ore is finely crushed, until it is made up of fairly small particles. It is then mixed with water, in the ratio of about four parts of water to one of ore. To this thin muddy mixture is added about a fraction of one per cent of pine oil, plus small amounts of other chemicals. When this mixture is agitated violently, the oil forms a froth that rises to the top. These suds carry with them the metal-bearing particles, leaving the waste to settle to the bottom of the tank. The froth, along with the ore, is drawn off for further processing.

Flotation Origin

This interesting method, in which the heavier particles float rather than sink, was discovered in a small lead-mining village. One day some idle character was watching a hard-working housewife washing her husband's overalls in a tub of sudsy water. He noticed that the soapsuds were gray instead of white. Upon closer examination, he found that the color was due to the small particles of galena, washed off the overalls, and floating in the suds. This was the initial idea that gave rise to the flotation process. This is a lovely little story, and probably has not a grain of truth in it. At least nobody has been able to identify the village in which it happened. If you are told the story by an American, it probably happened in Missouri; a British miner will insist, with equal assurance, that it all took place in Derbyshire.

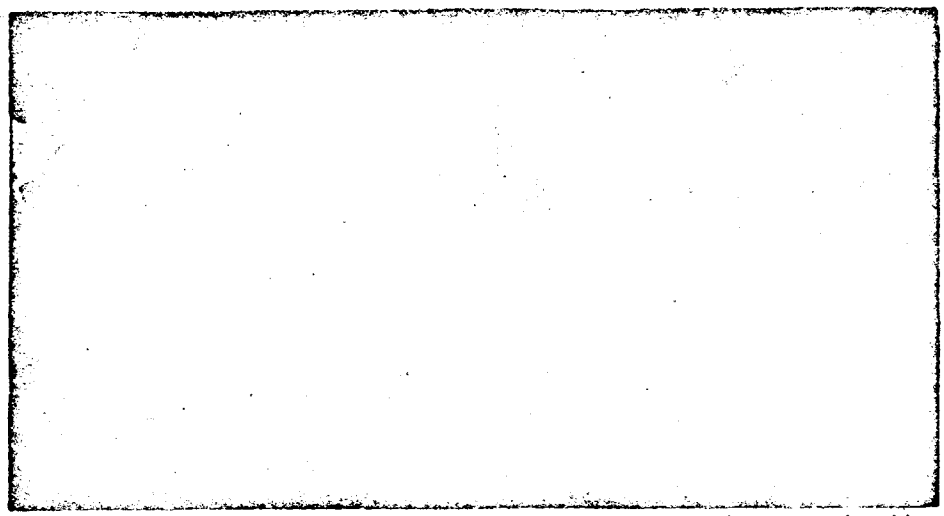
At any rate, the process was invented and developed, and today it is the most common method in concentrating the ore. It has made possible the use of ores that were too low in metal content to be handled economically by any of the other methods.

Chemical Processes

After the froth is dried, the residue is first roasted, to remove the sulphur. It is now called sinter, and is put in a blast furnace, which first forms oxides. These are then reduced to metals by the coke present, and the molten metal is drawn off. The result of this process is rarely pure lead, but can contain gold, silver, zinc, copper, antimony, arsenic, or bismuth. Lead of high purity is obtained by further refining the base bullion, the specific process used depending on the nature and amount of impurities present.

Although roofing and water pipe are important uses of finished lead, they do not rank in any of the first three places in quantities used. The leading consumer of lead is the storage battery, which uses about one-third of all lead used in this country. Fortunately, this use is one which does not use up the basic material. After a battery has been used for two or three years, it is no longer of much value as a battery, as many a car owner has discovered on a cold winter morning. The lead, however, is still inside the battery, even though it may have changed in position or in chemical composition. It can be reclaimed without much difficulty, and actually about 80 per cent of the lead in old batteries is put back into circulation, furnishing a substantial portion of our annual use of primary metal.

Following this use, comes the use of lead as sheathing for electric cables. This high resistance of lead to corrosion makes it a good cover to keep the corrosive elements of the soil from the more delicate rubber and copper of the cable. Its flexibility comes in handy here, too. The finished cable can be reeled on a large spool, can be threaded through underground conduits, and bent around corners, without danger of its cracking to expose the wires underneath.



LEAD DOME covers New Jersey Radiomarine unit at Belmar. R. L. Reed Lead recovers dome from top down to stage at base of dome.

The third largest user is the petroleum industry, which uses large quantities of lead in the anti-knocking compound tetra-ethyl-lead, and other similar products to improve the qualities of our gasolines.

Large Users

These three use about 58 per cent of our lead production. The rest is scattered throughout many industries. We have already mentioned roofing, plumbing, and paint. Lead, with its low melting point, is an important constituent of solder, so vital to the entire electronics industry. It starts to melt at 619° Fahrenheit, and is completely liquid at 630°, although its boiling point does not occur until it reaches 2700°. These characteristics make it easy to cast, as many a rifleman who casts his own bullets will testify. Toy soldiers from lead go far back in our history, although the cumulative poisoning effects of lead have eliminated it almost entirely from the toy market. But lead, alloyed with antimony and tin, is an important casting metal in the printing industry. Most type is made from this alloy, which is hard enough to stand up in the printing press. Pure lead would be much too soft, and even this alloy will not stand up when long runs are required. In this case, plates are made from the lead castings.

An important use of lead, even though small in total quantity, is for protection against X-rays and other radioactive phenomena. Because of its great density, lead presents the greatest resistance of any common material to the passage of such lethal radiation. Thus X-ray tubes may be enclosed in lead casings, which permit the rays to leave only in the desired directions. Operators are furnished with screens of lead sheeting, behind which they are safe. Lead is also used to furnish protection in the handling and shipping of radioactive materials, such as those which come out of the great nuclear reactors and play such an important part in many fields of modern research.

Seek Substitutes

Recently, many research teams have been trying to find substitutes for lead, egged on by a recent spurt in the cost of the metal. For the first 45 years of this century, the price of lead varied between 3½ cents a pound and 6½ cents, with the exception of the period of the first World War, when it hit a high of 9 cents. The low of 3½ cents came in 1932, and from there it crept up to 6½ cents in 1941. But by 1948, it leaped to a new peak of 18 cents, and has stayed within a few cents of that amount since. A pound of lead is about three cubic inches, or a block 1" x 1" x 3".

Important in Batteries

Substitutes, however, have been hard to find. For the largest single use of lead, the storage battery, there seems to be no feasible replacement. Plastics can be found to replace lead in cable sheathing, but it seems doubtful that there will be any great price savings. Copper is largely replacing lead in water systems, while lead is being reserved for those places which offer special problems of corrosion, such as the waste pipe in a chemical laboratory. Even in laboratories, chemicals are threatening the position of lead for lining sinks and tanks. The use of lead in solder and in bearings has resisted even the wartime search for substitutes.

This is the story of a base metal, weak and dull. It is a metal that has none of the romance of gold and silver. Yet perhaps it plays a more important part in our civilization than either of the two precious metals. Do you remember *The Merchant of Venice*? In that play, Shakespeare had the suitors of the lovely Portia choose one of three caskets. Gold and silver did not win the prize. It was only the lead casket that contained the prize. Shakespeare, many years ago, realized that this lowly metal had an important role to play. How important can be told by the long list of industries that use and depend upon lead.