THE DUTCH BOY PAINTER

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F-12-31

THE STORY *of* WHITE-LEAD

A DESCRIPTION OF THE PROCESS BY WHICH LEAD ORE IS PREPARED FOR PAINT, BY THE MANUFACTURERS OF DUTCH BOY PRODUCTS

NATIONAL LEAD COMPANY

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Buffalo, 116 Oak St. — Chicago, 900 West 18th St.
Cincinnati, 659 Freeman Ave. — Cleveland, 820 W. Superior Ave.
St. Louis, 722 Chestnut St. — San Francisco, 2240 24th St.
Pittsburgh, National Lead & Oil Co. of Pa., 316 Fourth Ave.
Philadelphia, John T. Lewis & Bros. Co., Widener Bldg.

The Story of White-Lead

The illustrations show the consecutive manufacturing processes in their proper order. The position of the picture on the page also shows how the operation progresses from floor to floor in the factory. For example, on page 10 the position of the picture at the top of the page illustrates operations on the top floor; page 11 shows them on the floor below and page 12 the ground floor.

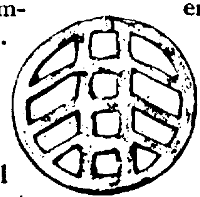
LEAD is one of the metals which apparently have been known to man from the earliest days. It is mentioned in the Bible and other ancient writings.

Tho not suitable for money or jewelry, and therefore never classed as one of the so-called precious metals, lead has certain characteristics which make it invaluable in many of the modern arts and industries.

Uses of Metal Lead

Metal lead is used chiefly for the better grades of plumbing, for roofs, for lining vats and rooms exposed to acids, for making bearing metals, solder, sash weights, shot and bullets, lead cames (the strips separating the panes in art glass windows), and for various other purposes where a soft, heavy, durable metal is required.

The chemical derivatives of lead are quite as important as the metal itself. Such beautiful paint pigments as chrome yellow and American vermillion are secured by chemically combining chromic acid with lead. The brilliant orange pigment seen so frequently on steel bridges and the skeletons of skyscrapers is lead oxide (red-lead). Fine cut glass is 40 per cent or more lead. The glaze on fine china and pottery is lead. Finally, passing by many other uses of this remarkable metal, there remains white-lead, the most important derivative of all.



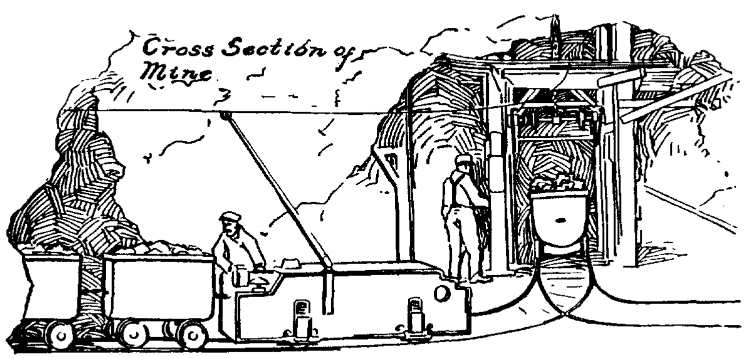
White-lead is used in numerous ways, but its widest use by far is as paint. It needs only to be mixed with linseed oil and it becomes a perfect white paint—a fact which does not hold true of any other known substance. The addition of tinting material gives any desirable color.

We speak of white-lead as a pigment. All paints, properly so-called, are mixtures of solid particles or pigment and a liquid or vehicle.

White-lead is nature's true paint pigment because when mixed with linseed oil (the only liquid that satisfactorily answers the purpose of a vehicle) it yields a perfect paint.

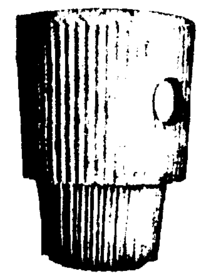
As a paint pigment, white-lead has been used since the Christian era. The Romans called it "ceruse." From descriptions of its manufacture found in ancient writings, and from the fact that the white-lead of the Romans contained acetate of lead, we know that the old-time method of manufacture was not different in principle from that of to-day. Progress has been in the direction of higher purity, greater fineness, and safer working conditions.

The Dutch are credited with being the originators of the process by which most white-lead is made—the Old Dutch Process. Indications are that the Dutch, thru intimate trade relations, obtained this process from the Venetians, who, with the Genoese, dominated the seas during part of the middle ages and whose trade reached to every part of the world then known.



The Chemistry of White-Lead

White-lead is a white, exceedingly fine powder known as basic lead carbonate. It is a chemical compound analyzing, when carefully manufactured, about 69 per cent carbonate of lead and 31 per cent hydrate of lead.

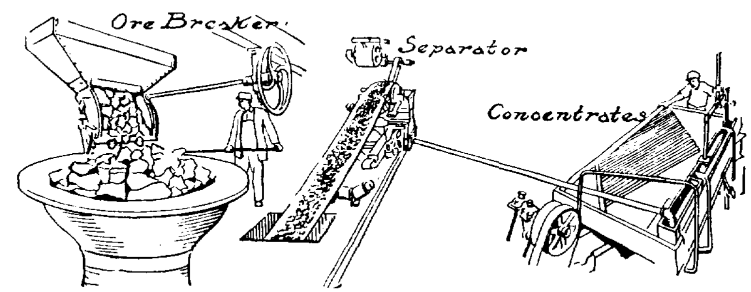


The chemical symbol for white-lead is $2PbCO_3 \cdot Pb(OH)_2$, which means that two molecules of lead carbonate ($PbCO_3$) and one molecule of lead hydrate ($Pb(OH)_2$) combine to produce a molecule of basic lead carbonate. Explaining still further the chemical composition, the formula shows that there are in a molecule of white-lead the following elements: Lead (Pb, which stands for the Latin name, plumbum), Carbon (C), Oxygen (O), and Hydrogen (H).

A Long Road to Travel

It sounds simple and prosy enough to say that white-lead is made by subjecting lead, such as that seen in a piece of lead pipe or the nose of a cartridge, to the fumes of acetic acid (vinegar), in the presence of a carbonic acid gas, then thoroly pulverizing by grinding, washing, and sifting, and finally mixing into a thick paste with a little linseed oil. The actual process, however, is far from simple and is most interesting. Not only must the lead first be mined and refined, but when it starts in its refined form on its way toward the paint film on the side of a house, it has a long road to travel, with many bumps and turns.

Lead occurs in nature as an ore, generally in combination with sulphur as lead sulphite or galena, which is usually associated with other minerals.



Some ore-bearing rock is found near the surface, but most of it is found at a depth of five to six hundred feet. It has to be blasted loose.

After mining, the ore-bearing rock goes to crushers of various sizes which gradually break it into smaller and smaller pieces. The biggest crushers are powerful enough to take into their huge jaws chunks of rock measuring as much as four or five feet each way and chew them up into small bits.

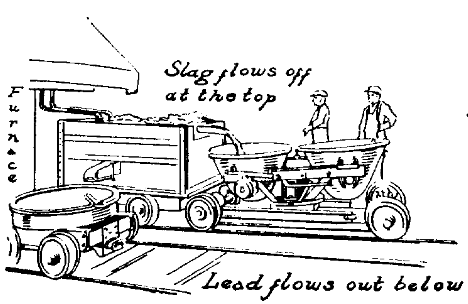
From the smallest crusher, the rock which is now as fine as coarse sand is conveyed in water to "concentrating" tables. Here the lead ore is separated from the associated earth and other waste or "gangue." The table is on a slant and the separation is accomplished by a jerking back and forth which causes the heavy pieces of rock containing lead to go one way and the lighter waste to go the other way.

Thus partially cleaned, the lead ore, or "concentrates" as it is now called, goes to the smelter, where it is carefully roasted and smelted in blast furnaces. This treatment drives off the sulphur, and crude lead is obtained.

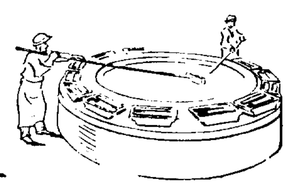
The crude lead is refined to remove the copper, silver, and other impurities. For even silver, though a precious metal, is here an undesirable citizen and must be ejected. This is done by a curious process, depending partly upon an attraction which silver has for zinc. Pieces of zinc thrown into the molten lead quickly melt, and by stirring the liquid mass the silver and zinc particles soon become attached to each other. When the stirring stops, the zinc and silver compound, being lighter than lead, soon floats to the top, where it is easily skimmed off and poured into the bullion molds seen on the edge of the big kettle. How this bullion is later heated to such a degree that the zinc is volatilized leaving the silver free is another story.

From Pigs to Paint

The refining done, the lead is siphoned into moulds, set in the



Desilvering Kettle and Bullion Molds



rim of a huge horizontal wheel, which cast it into lead pigs. A lead pig measures about four inches by five inches by twenty-two inches and weighs about ninety pounds.

In the form of pigs, the metal goes to the white-lead factory. The first operation there is melting the pigs and recasting the lead into metal discs which are called "buckles," because of their fancied resemblance to the shoe buckles of Colonial times. These discs are about five inches in diameter and one-fourth of an inch thick with perforated centers.

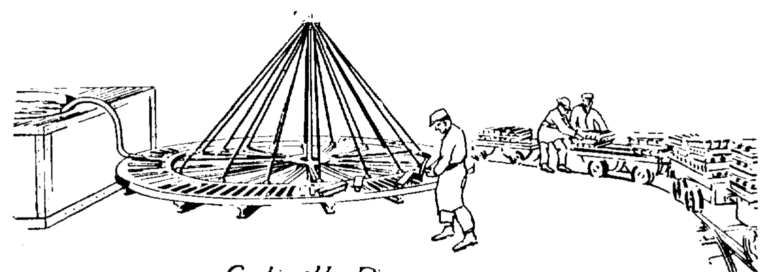
The recasting is done in molds which are linked together into an endless chain or belt that travels on two pulleys. Near one of the pulleys the chain moves along under the spouts of a kettle from which the melted lead runs just fast enough to fill each buckle mould as it passes. By the time each mold in its turn reaches the pulley on the other end, the lead has hardened, and as the chain makes the turn the buckle, knocked loose by an automatic hammer, drops into a little car.

In this car, which is suspended from a monorail track, the buckles are carried to the stack house or corroding shed. Here workmen place them in earthenware corroding pots.

A corroding pot is somewhat like a flower-pot, but so shaped that the buckles, which are piled flat, rest upon a shoulder some two inches from the base of the pot. From ten to fourteen buckles are put in each pot and in its cup-like bottom is poured about one-half pint of weak acetic acid (practically vinegar).

Laying the Stack

The stack house gets its name from the fact that white-lead is corroded in stacks. Each stack consists of alternate layers or tiers of spent tanbark (oak bark that has been used in tanneries) about twenty inches thick and filled corroding pots, each layer separated from the one above by a



Casting the Pigs

floor of loose boards. An ordinary stack will measure twenty-two feet long, twenty feet wide, and thirty feet high.

What Happens in the Stack

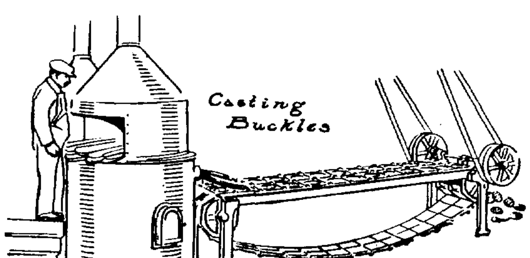
The first thing to happen in this huge pile of lead buckles, shredded bark, and acetic acid is the slow decomposition of the bark. It ferments and creates a heat strong enough to warm the acetic acid until vapor is given off. Slowly the fumes steam up thru the perforations in the buckles, which gradually turn white with a coating of lead acetate. At the same time the fermenting tanbark is generating carbonic acid gas (carbon dioxide). As fast as the acetic acid fumes turn the metal lead to lead acetate, the carbon dioxide turns the lead acetate to basic lead carbonate. This two-change process begins on all exposed portions of the metal buckle and progresses continuously inward until the conversion into basic lead carbonate is practically complete.

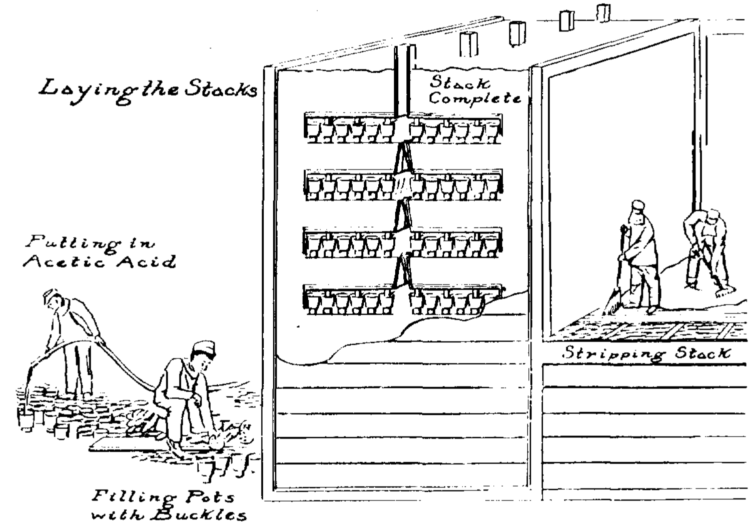
The heat in the stack reaches a temperature of 185 degrees Fahrenheit. If an egg is let down into one of the small wooden ventilating flues, which are left here and there when the stack is built, it is readily cooked.

The process of corrosion usually takes from ninety to one hundred and thirty days. By that time probably eighty per cent of the metal has become lead carbonate. The stacks are then torn down; as the workmen say, they are "drawn" or "stripped." The acetic acid has evaporated, the buckles are found in their original shape, only so brittle that they may be crumbled in the fingers. But instead of being bluish gray they are now snow-white; for it is the nature of lead to turn white when it corrodes, just as iron turns red and copper turns green when they corrode.

Safety First

The contents of the corroding pots are emptied into large covered boxes to which is attached a pipe with an in-draft to absorb all dust





which might otherwise fill the air. This dust collector is the invention of National Lead Company's engineers and is a very important contribution to the "Safety First" movement.

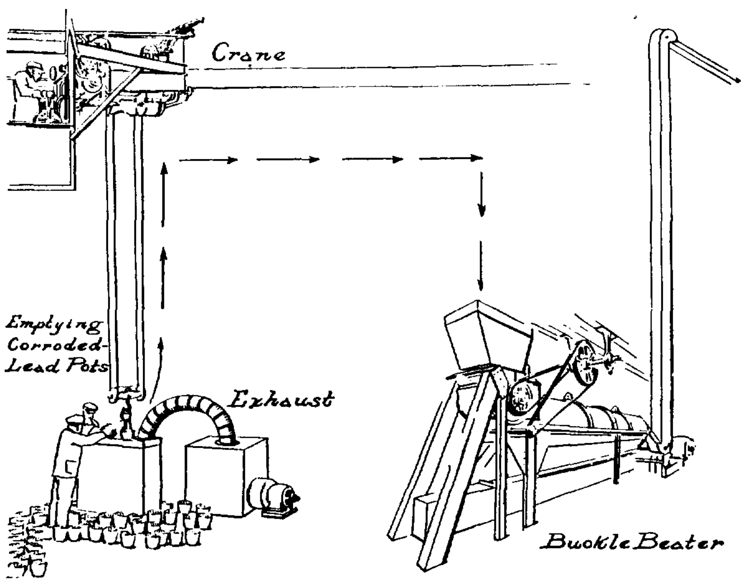
Next comes the pulverizing process, which goes on in machinery so enclosed that here, too, the workman is protected from possibly harmful dust.

A customary arrangement is to discharge the corroded buckles into a huge cylindrical screen where the material is thoroly shaken up and the larger pieces of uncorroded lead are worked out.

The mass is then dropped into a hopper and passed thru a set of corrugated rollers. These pulverize the brittle, corroded parts and simply flatten out the uncorroded metal parts. In some plants there are two of these rollers with a screen between them.

From the pulverizing rollers the grist is passed to a series of cylindrical screens which revolve almost horizontally, but with just enough tip or slant to carry the ground material, which is fed in at the higher end, gradually along toward the lower end. The first of these screens has rather coarse meshes or slots and most of the pulverized carbonate sifts thru while the scraps of metal tumble out at the open and lower end of cylinder No. I.

The white-lead that sifts thru the meshes is conveyed to cylinder No. II, where the same process as in cylinder No. I is repeated. The



only difference is that the meshes of the screen are finer, and small particles of uncorroded lead which sifted thru cylinder No. I are here worked out. In all the cylinders, whatever their number, the same process is repeated, except that each cylinder is finer meshed than the one before it.

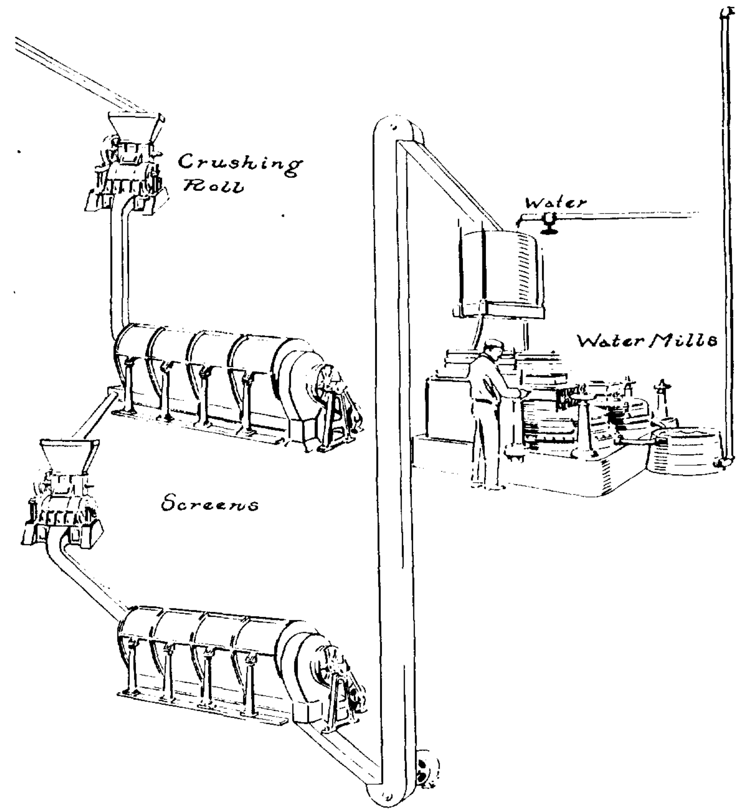
The purpose at every step is to let the pulverized white-lead thru and screen the metal lead out. All the sifting is in dust-tight enclosures.

The scrap metal which rolls out of the ends of the cylinders, one after the other, is dropped thru a chute into a bin, from which it is finally taken and remelted with a new lot of pig lead.

By the time the carbonate gets thru the series of screens, it is fairly clean and pretty well pulverized. It looks like fine, white cornmeal, but it is not nearly fine enough for use in paint.

The Water Mills

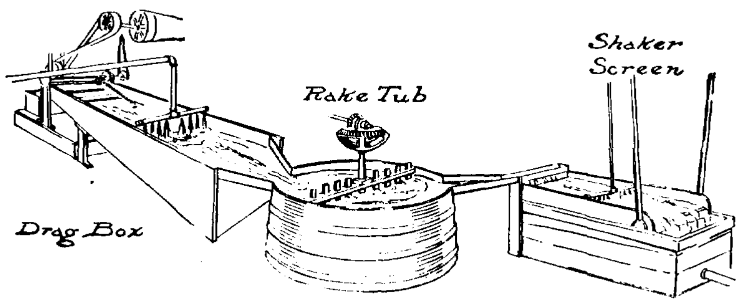
Water-grinding is the next step. It is done between huge millstones placed horizontally one above the other. The stones measure from four and a half to five feet in diameter. In some mills the lower stone is stationary and the upper stone revolves, resting its full weight upon the lower stone. In other mills the upper stone is fixed and the lower stone



revolves, being pressed against the upper stone by powerful, adjustable screws.

As the sifted white-lead comes to the water mills from the screens it is delivered into mixing tubs, where water is added. The resultant milky mixture is then fed slowly to the mills thru the "eye," a six-inch hole in the center of the upper stone, and is continually ground until it finally oozes out from between the stones at their outer edges.

From the water-mills, the mixture of white-lead and water runs into the "drag box." This is a water-tight box, measuring twenty-five feet long and five feet wide, whose bottom is so inclined that the depth is nothing at one end and five feet at the other end. When



the mills are in operation, the drag box is always full to overflowing and the box is so set that the overflow is from the top edge at the deep end.

Some Particles Fine Enough to Float

The finest particles of white-lead are most likely to float and naturally are the first to overflow. The coarser particles, being heavier, settle. A heavy sediment would soon form in the bottom of the drag box were it not for the "drags," a device which consists of two endless chains running lengthwise, one chain on each side of the box. They travel close to the bottom over revolving pulleys and are fitted with brass cross-bars at intervals of about four feet. The motion is such that the bars keep dragging the lead-and-water mixture up the inclined bottom toward the shallow end, away from the overflow. In fact, each bar pulls a little of the heavy pulp up over the shallow end of the box. This heavy, coarser pulp is carried back to the water-mills for another grinding.

Observe that thruout the process of manufacture the machinery is designed to reject all along the line the material which is not of suitable fineness.

The milk-like liquid which has washed over the end of the drag box flows into and thru a series of "rake" tubs, so named because they are equipped with slowly revolving arms of wood which keep the lead and water stirred up, causing the finer white-lead to float on top of the water. The coarser particles settle. Here, too, the white-lead is washed of all traces of acid and other impurities.

The Last Test for Fineness

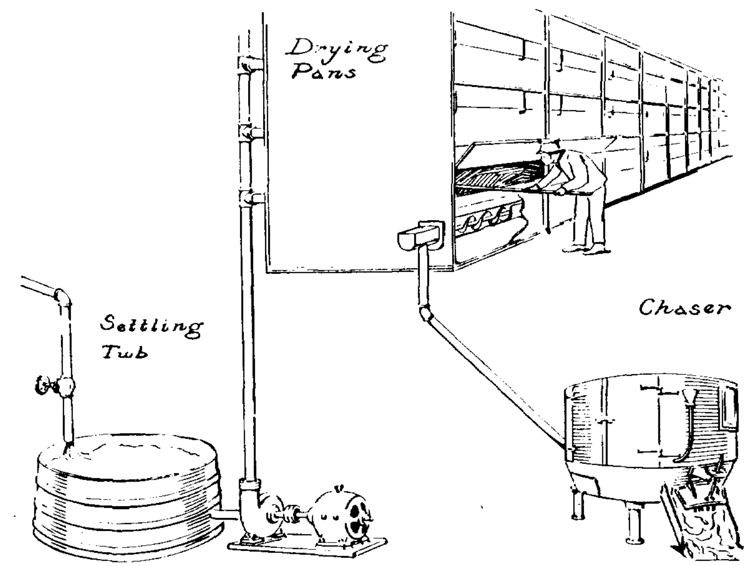
From the rake tubs the white-lead floats upon a screen of silk bolting cloth with meshes so minute that there are 27,000 or more of them to the square inch. This shaker screen, as it is called, stands

on wobbly legs and is jiggled mechanically with a quick, jerky motion to keep the meshes from becoming clogged.

Particles which will not pass thru the microscopic openings in this silk screen are rejected as too coarse for Dutch Boy white-lead, and are returned to the mills to be reground. That which passes thru the screen is pumped into steam-jacketed pans to be dried.

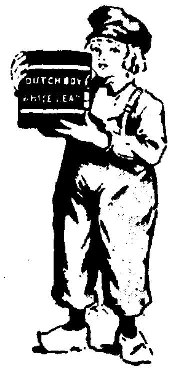
A Dustproof Drying Apparatus

In National Lead Company's improved system, a drying battery consists of four pans, one above the other, each having a double bottom thru which the steam passes. A forced circulation of warm air over the surface of the pans readily absorbs the moisture from the drying lead. The whole apparatus is enclosed in a dustproof structure.



The system of air circulation, controlled by a suction fan, is such that when a door in front of one of the pans is opened there is a strong in-current of air. Thus the workman may safely stand in front of the door and rake the dried lead toward the front of the pan, where it drops to a screw conveyer.

The engineers of National Lead Company designed this safe system of drying white-lead and offer it freely to all competitors who care to use it.



The screw conveyor carries the dry white-lead to the storage hopper and the weighing apparatus, which also are dust-tight. When the scales indicate that as much white-lead has run into the hopper as is to be mixed at one time, the feed is cut off. Another screw conveyor then carries the contents of the hopper to an enclosed "chaser" to be mixed with the proper amount of pure linseed oil.

The Linseed Oil is Finally Ground In

In the chaser is a mill-stone, weighing a ton and a half, which travels around and around in an upright position. By this process the thoro incorporation and machine-mixing of the linseed oil with the white-lead are assured, thus simplifying the later addition of linseed oil, turpentine or drier by the painter.

Thru a small gate in the bottom of each chaser the white-lead paste drops to a set of mills where it receives a final grinding and emerges in dough-like chunks as the white-lead of commerce. All that remains to be done is to pack it in steel kegs, every one of them filled by weight, and ship them off to market.

Nearly all paste white-lead is packed in 12½, 25, 50, or 100 pound steel kegs, though cans of one and five pounds are sold for the convenience of small consumers. The steel kegs made by National Lead Company are pressed out of single sheets of steel and are therefore seamless.