NOTES ON LEAD ORES: THEIR DISTRIBUTION AND PROPERTIES

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649431984

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Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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BY

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LONDON
SCOTT, GREENWOOD & CO.
19 LUDGATE HILL, E.C.
1901

THE following Notes were contributed to a high-class technical journal some years ago by the late James Fairie, F.G.S., a painstaking and practical geologist. The literature of this subject is limited, and it is thought that, gathered in this booklet, they will be useful to those handling Lead Ores.

NOTES ON LEAD ORES

CHAPTER I

DEFINITIONS—PROPERTIES—OCCURRENCE

THE word "lead"—like many others—recalls very dissimilar ideas of the substance it represents to the minds of those who use it. The miner, who speaks of having found "lead," uses the word for the ores of that metal; the smelter, for both the ores and their metallic product in the form of "pigs" of lead; the plumber, for the metal itself, whether in pigs or the milled or rolled sheets so extensively employed in the plumbing trade; the painter, generally for the white carbonate of lead which, mixed with oil and various metallic oxides, constitute the pigments used by him in his handicraft or art; the house or ship-chandler, the colourman, and the drysalter, for the varied products of the oxides, largely sold by them as white, yellow, orange, and red lead; the glass manufacturer, for the purified sesqui-oxide or red lead—in the native form known as *minium*—which is largely employed

in the manufacture of flint glass; and the potter uses the word alike for the white carbonate and the red sesqui-oxide of the metal, ground and purified, both of which are extensively employed for lead glazes in the manufacture of earthenware.

Lead, in its metallic form, is a well-known and probably the most anciently known of all the metals, and familiar to everyone, chiefly as used by plumbers in house-building, and for gas and water pipes and various other household appliances, or in the form of bullets and shot. Its ores are of such universal occurrence as to be found in almost every country of the globe, as, next to iron, lead is the most abundantly diffused of all the metals. In colour lead is bluish grey. It is very, and proverbially, heavy (*vide* Ex. xv. 10), its specific gravity being 11·4, or nearly 11½ times that of water. It is the softest of all the durable metals —its hardness being only 1·5—so that it is easily marked by the nail and cut by a knife. It is flexible, but inelastic, and therefore not sonorous; its want of elasticity makes it useful for special purposes, as for deadening a shock or for preventing a rebound; ductile and extremely maleable, so that it can be hammered into very thin sheets, which, however, from insufficient tenacity, are easily torn or split, and, what is remarkable, it does not, like other metals, acquire increase of density by hammering or rolling; indeed, it is asserted that its specific gravity is even lessened by hammering. Its tenacity is small, a wire of it one-tenth of

an inch in diameter breaking with a weight of less than 30 lbs., and it cannot be drawn into wire smaller than one-twelfth of an inch in diameter, and even to that size with difficulty—such a wire breaking with a weight of about 18 lbs. As to fusibility, it is very easily melted, more so than any other metal, except tin, its fusing point being so low as 594° Fahr.: some authorities put it at 612°, and others at 617°, however, and it may vary according to its purity. When melting and exposed to the air it shows a bright metallic lustre resembling that of mercury, but, owing to its strong affinity for oxygen, it absorbs it rapidly, and immediately tarnishes on surface, and is in a short time covered with a spongy oxide or dross; when removed from the fire it quickly solidifies again, and on this dross being scraped off, the metal acquires a slight, new coating of sub-oxide which is permanent and prevents further oxidation. If slowly cooled, it may be obtained in octahedral crystals. It is not volatile, at least in closed vessels, in which it can be heated to whiteness without subliming. At common temperatures and in dry air it tarnishes slowly, but in moist air or in water it soon becomes coated with a grey film — a hydrated sub-oxide — which, once formed, prevents further oxidation (as just mentioned), and thereby it is rendered durable when exposed to the atmosphere, and also safe for water-supply pipes and cisterns. When these are new, and before this coating of sub-oxide is formed on the surface of the lead, there is much risk of lead-

poisoning by the use of water from them, and the purer the water the greater is the danger. Spring waters, which generally contain varying percentages of carbonates, sulphates, and other salts, do not corrode lead as pure water does. Lead has little taste, but when rubbed it yields a perceptible smell. While it does not soil the fingers, it makes a faint bluish black streak on paper.

Lead is found native, but is of rare occurrence and chiefly in lava and other volcanic rocks, in which it occurs as a product of fusion. It is prized merely as a mineral curiosity for the cabinets of mineralogists, and is of no practical value whatever. Commercially, lead is wholly obtained from its ores, which are numerous, and while varying much in appearance are all easily reduced; these occur in both igneous and sedimentary rocks and formations of all ages. In the British Isles, they occur sometimes in irregular deposits or pockets, but generally in veins in mica schist, clay-slate, gneiss, granite, and limestones—chiefly of the carboniferous formation. The most abundant and best known of its ores, and from which indeed nearly the whole of the metal is obtained, is *galena*, the protosulphide of lead, which is the representative of the lead-glance family. Of lead salts there are no less than twenty-seven species, which, however, are of comparatively little importance commercially, but are of great mineralogical interest and often occur associated with varieties of lead-glance in more or less definite crystallised forms. Of the various ores,

besides *galena*, but a few are worked — viz. the carbonate, phosphate, sulphate, arseniate, chromate, molybdate, of lead, and its oxides, of which there are four, viz. the sub-oxide, known as *litharge*; the protoxide, called *massicot*; the sesqui-oxide *minium*, or red lead ore; and the peroxide, occurring as an insoluble brown powder. With the exception of *galena*, a few of these ores are found in sufficient quantity to be smelted alone for the lead they contain.

Lead is speedily oxidised when melted in open vessels, and passes into a grey powder, the *litharge*, which, by further exposure to heat and air, becomes yellow, and is then *massicot*, or yellow protoxide of lead. By heating this and stirring it to prevent fusion, it gradually absorbs further oxygen, and acquiring a red colour, becomes red lead — the sesqui-oxide occurring native as *minium*. This red lead heated in nitric acid is partly converted into the brown insoluble powder which is the peroxide of lead. By treating these oxides with carbonic or acetate acid, white lead, the carbonate of lead, is obtained, and also acetate of lead, commonly called "sugar of lead," both of which are extensively used in manufactures and in the arts, and also in pharmacy.

Of the ores of lead—which are all very heavy, and are white, green, brown, yellow, or blue in colour—*galena* (from the Greek word *galeos*, to shine) is, as has been already stated, the most abundant; in fact it may, commercially speaking, be called *the* ore of lead, as it is the one from which