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TASMANIA

MINES DEPARTMENT CIRCULAR

No. 1

BAUXITE: A SOURCE OF
ALUMINIUM

INFORMATION FOR PROSPECTORS AND OTHERS

BY

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Issued under the authority of
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FOREWORD.

IN view of the exceptional facilities for the reduction of aluminium from its ore offered by the Government hydro-electric installation, the Mines Department issues the accompanying information on the subject of bauxite, in the hope that it may be of use to prospectors and others, and stimulate the search for the deposits of this ore in Tasmania.

W. H. WALLACE,
Secretary for Mines

Hobart, 23rd August, 1917.



BAUXITE FROM ALABAMA.

Bauxite : A Source of Aluminium.

ALUMINIUM.

The bright and light metal known as aluminium has in recent years been subject to an increasing demand in the markets of the world. It is familiar to householders in the form of kitchen utensils. It is now extensively used in the bodies and engines of motor-cars, aeroplanes, and in the construction of electric long-distance transmission lines. It has been employed in making rifle and shell cartridges, though its use for this purpose is said to have fallen off, and its dust is being used in the manufacture of certain explosives. It has a high metallurgical value in welding iron, and it forms part of important alloys with zinc, copper, nickel, and tin; some of these alloys are greatly esteemed in the manufacture of machinery.

The world's production of the metal is estimated to be nearly 90,000 tons annually. Its market price in the United States, which produces more than half the total output, in 1915 was 1s. 4d. per lb., but by the end of the year this had risen to 2s. 6d. per lb., and at present is still higher. The price of bauxite ore at the American mines has for several years been about 20s. per ton.

UTILISATION OF BAUXITE IN THE PRODUCTION OF ALUMINIUM.

Aluminium does not occur as a native metal, but exists in the earth's crust in combination with oxygen, potash, soda, fluorine, phosphorus, beryllium, silica, and sulphur, some of which combinations form aluminium ores. Turquoise and chrysoberyl are gems; corundum is an abrasive. Bauxite and cryolite are ores from which aluminium may be reduced. Of these, bauxite, a hydrated oxide of aluminium, is now the most important source of the metal. It is first purified by calcining, and then treated with carbon in an electric furnace, when crystallised alumina is produced. This is charged into the electric aluminium reduction furnace, in the bottom of which the melted aluminium collects. It is stated that 6 tons of bauxite are used to make 1 ton of aluminium.⁽¹⁾

The metallurgy of aluminium dictates the elimination from the bauxite of metals which would contaminate the product. These are got rid of, as indicated above, in the first treatment stages, and then the difficultly-reducible

(¹) Mineral Industry during 1912; Vol. XXI, p. 92.

aluminium is separated from its oxide in the electric furnace. Consequently cheap hydro-electric current is a most important desideratum. This is now obtainable in Tasmania by means of the Government hydro-electric installation. How important a factor cheap electric current is in the production of aluminium may be judged from the fact that bauxite ores were, previous to the war, exported from Europe to Canada, to be treated at the extensive works at Shawenegan Falls, Quebec. Bauxite melts at a temperature of $1820^{\circ}\text{C. (+ 3308}^{\circ}\text{F.)}$.

Cryolite, a fluoride of sodium and aluminium, is also used in the manufacture of aluminium. It is not known to occur in Tasmania; and the only recorded occurrence of the mineral in commercial quantities is in Greenland.

The production of aluminium is the chief use to which bauxite is put, but there are other applications. It is employed for the manufacture of alum and other aluminium salts, and for refractory furnace bricks. At Niagara Falls in America calcined bauxite is smelted in the electric furnace and converted into "alundum," or artificial corundum, which is used for crucibles and other refractory laboratory articles, and as an abrasive for polishing metals.

BAUXITE: ITS COMPOSITION AND PHYSICAL CHARACTERS.

The exact composition of the ore is indefinite, being determined by the proportions of the impurities present; but the mineral itself is a combination of alumina (oxide of aluminium) and water, the alumina forming 74 per cent. and water 26 per cent. of the total (= 39 per cent. aluminium). The principal impurities are iron oxide and silica and oxide of titanium. Published analyses of good grades of bauxite ore are as follow:—⁽²⁾

	From Baux.	From Ireland.	From Georgia.	From Alabama.	From Arkansas.	From Georgia.
Alumina	57·60	61·89	59·22	61·00	62·05	62·46
Ferric Oxide	25·30	1·96	3·16	2·20	1·66	·81
Silica	2·80	6·01	3·30	2·10	2·00	4·72
Lime Carbonate	·40	..	..	..	..	..
Titanic Acid	3·10	..	3·62	..	..	·23
Water	10·80	27·82	28·80	31·58	30·31	31·03
Moisture .. .. .	..	..	1·90	3·12	3·50	..

⁽²⁾ Economic Geology : H. Ries, p. 517.

Ores with 40 per cent. of alumina and upwards are mined.

The contrast between this composition and that of ordinary clay and kaolin is easily realised when it is borne in mind that clays contain from 40 to 70 per cent. silica, and only from 10 to 40 per cent. alumina.

In appearance bauxite is decidedly clay-like or earthy-looking, generally with light-yellow, brown, or red colours. Sometimes its texture is compact, kaolinic, or even flinty, but often, and characteristically, oolitic or pisolitic; that is to say, with a structure showing concretionary concentric grains or spherules ranging from the size of a pea to that of a nut. Occasionally, when formed by the decomposition of syenite in place, it has a granitic texture.

Briefly, bauxite may be regarded as a disintegration product consisting of hydroxide of aluminium, and accompanied mostly by a little silica and sesquioxide of iron. For its correct identification an analysis is necessary. Prospectors and others desirous of information respecting their samples are invited to apply to the Government Assayer, Geological Survey Laboratory, Launceston. A determinative assay will be made, if wished, for the sum of one shilling.

BAUXITE: HOW IT OCCURS; COUNTRIES IN WHICH IT IS FOUND.

Bauxite owes its name to its occurrence in the district of Les Baux in Southern France, where it was first discovered. It exists there in limestone. In central France and the north of Ireland it is associated with basaltic rocks. In the Georgia-Alabama belt in the United States it is in pockets or lenses in residual clay derived from underlying dolomite. In Arkansas, beds of bauxite rest on and pass down into kaolinised nepheline syenite, and finally into the unaltered syenite. Where the mineral has been derived from igneous rocks, the decomposition of the latter supplied the aluminium silicate, which later was replaced by the oxide. It has been assumed widely that alkaline or acidic solutions have altered rocks and clays to deposits of bauxite, but the data on which the assumption is based are uncertain. It seems possible that ordinary weathering or lateritic processes in tropical or subtropical climates have in most cases been responsible for the alteration of the original rock by the abstraction of the lime and alkalis and the formation of bauxite. The bauxitic laterites or

ferruginous clays of India, which cover large areas of basaltic rock, are considered to have originated in this way.

The occurrence of bauxite in cold temperate climates is exceptional.

THE MOST LIKELY LOCALITIES FOR ITS DISCOVERY IN
TASMANIA: SUGGESTIONS TO PROSPECTORS.

The prospector will, of course, remember that he is not searching for a metallic mineral, but for one which assumes the guise of an ochreous or clay-like substance. Its modes of occurrence, as mentioned under the preceding heading, must be borne in mind. First, its association with igneous rocks must be followed up. If present, it will be found overlying these and filling the surface hollows and passing gradually into the fresh rock below. Then, again, it may occur as beds overlying the surface of limestone or forming pockets in the decomposed portions of the latter. Here it is obviously the result of weathering, but where it forms masses in the rock thermal or chemical action has been postulated.

In any case prospectors would do well to examine carefully the superficial covering of clay associated with limestone country. The limestone which offers the best chances in Tasmania is that of Silurian age, as it is not very siliceous; the Permo-Carboniferous limestones and calcareous mudstones contain more silica. Limestones which may be examined are those in the Chudleigh and Mole Creek districts, Railton, Gunn's Plains, Lorinna, Moina, Zeehan, Beaconsfield, Winkleigh, Ida Bay, Blyth River, and Gordon River. Notice should be taken as to whether the surface clay is the result of the weathering of the limestone or has been transported from a distance.

Beds of clay in the large Tertiary basins of the island may be here and there bauxitic; *e.g.*, those of the Longford plain or the basins of the Derwent and Tamar Rivers.

The igneous rocks of the island also offer a wide scope for prospecting. The clays and ochres which result from the weathering of the diabase (otherwise known as blue-stone, greenstone, trap) all over the island should be examined. These occur on the flanks, or even on the summits, of hills of diabase rock. The great Central Plateau offers examples of residual clay deposits, and, in fact, these may be found wherever diabase-crowned mountains

and ridges occur. Whether these are in any places bauxitic or not remains to be ascertained. The ordinary decomposed rock will still contain from 20 to 30 per cent. silica, and the desilication of clay takes place under some conditions not well understood. It is a characteristic phenomenon of tropical, subtropical, or warm temperate climates.

Judging from the analogy of the occurrences connected with the nepheline syenite of Arkansas, the clays in the Port Cygnet and Kettering and Woodbridge districts should not be neglected by prospectors. The mudstone clays of these districts, however, would be unlikely containers of bauxite. The favourable beds would be the clays directly derived from the decomposition of the alkali porphyries.

The extensive sheets of basalt in Tasmania are possible originators of bauxite deposits. The deep soil which is derived from the decay of this rock may well contain lenses of the mineral.

Finally, the kaolinic clays of the granite areas are worthy of examination. These are found in the tin districts throughout the island. Kaolin itself has a silica content of from 50 to 70 per cent., being among the most siliceous of clays, and though aluminous, cannot be used for the production of aluminium. Some less siliceous forms, however, may possibly be found, especially where the quartz-free modification of granite known as syenite exists as the parent rock.

If the prospector finds that his material is gritty with particles of quartz, he may reject it without further examination. On the other hand, pipe-clay, which is a fine-grained plastic clay, must not be confused with bauxite, which has an earthy feel. Pipe-clay is siliceous, despite its smoothness. The colours of bauxite are of little value as criteria, having a wide range from white through grey, yellow, buff, and brown to deep red.

If concretionary nodular and centric structure is present in the sample, the ore deserves careful examination. The texture may vary from a loose aggregate to that of a dense clay.

If present, bauxite will be found either at the surface or at shallow depths, horizontally bedded. Bauxite mining is generally carried on in open cuts, and the ore won with pick and shovel. It is washed, when necessary, to eliminate clay, and then dried in rotary kilns. A selection

is made of the least siliceous material for the aluminium furnace. Ores 40 per cent. and upwards are treated, the quality being controlled by daily assays.

From this circular it will be seen that the bauxite prospector has a wide field open to him. It is a mineral of which the deposits are associated with nearly every description of rock. They occur in connection with syenite, basalt lavas, beds of limestone, and lake sediments; and the substance exhibits many varieties of texture and structure. As said above, a reliable determination of the mineral can be made only by assay.

It may be mentioned here that specimens of bauxite are exhibited in the Geological Survey mineral collections in the Victoria Museum, Launceston.

If prospectors can discover deposits, there is in the State hydro-electric undertaking a means of treating the ore readily and cheaply.

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