BAUXITE AT OUSE

Introduction

The proposed inauguration of aluminium production in Australia has directed renewed attention to the nation's bauxite resources, and in Tasmania, investigations have been centred on the Ouse district where the only deposits known to occur in the State are situated.

The probable occurrence of bauxite at Ouse was first recognised only a few months ago, when Mr. James Brock traced to their source some erratic boulders, which he had noticed mixed with gravel being used in the district for road maintenance purposes. Mr. Brock sought the advice of the Director of Mines who ordered an investigation, the preliminary work of which was commenced on 22nd July.

By road, Ouse is distant 55 miles in a north-westerly direction from Hobart. The principal bauxite occurrences are about two miles north westerly and about one mile westerly respectively from the township, while the Langloh coal mile is six miles south-easterly. The Hydro Electric Commission's main transmission line from Tarraleah passes between the bauxite areas.

A survey has been completed of outcrops representing some 2,000,000 tons of ferruginous bauxite under low overburden, and although the material is not of high grade, it is probably comparable with the avarage ore available from other Australian Deposits. The district offers considerable scope for prospecting and it is likely that further outcrops will be located, and that buried extensions of those already known will be proved.

Favoured by the proximity of a satisfactory source of coal, an abundance of good water, and easily accessible cheap electric power, Ouse is almost ideally equipped as a site for a beneficiation plant.

General Geology of the Deposits

The field work carried out to date has been devoted almost entirely to compiling data for the preparation of close-contoured plans of the outcrops, and of their surroundings in so far as they concern probable extensions of the ore. The geological structure is known only from observations incidental to this work and the background that would be provided by reconnaissance in the surrounding district is, at present, lacking. For this reason, the following statement is limited to details of the formations concerned.

The oldest rocks encountered in the area, of Trias-Jura series, which is represented by one isolated outcrop of indurated sandstone apparently overlying diabase, and underlying Tertiary clays and sands in the north-eastern corner of the area. Although prominently developed in the district, rocks of this series are unimportant in the immediate vicinity of the bauxite.

The Trias-Jura sandstones were intruded by massive diabases (dolerites) which substantially form the bedrock of the bauxite deposits. The diabase in this locality is rather fine-grained and exhibits a range of structures from close, platey jointing to bold, rounded outcrops. The rock may be observed in all stages of decomposition, but over most of the area it is hard and of very fresh appearance. In the more advanced stages, decomposition products from the diabase may superficially resemble the more earthy types of bauxite, but the several samples assayed have all shown a silica content in the vicinity of 50 per cent., indicating a normal process of weathering as contrasted with the lateritization undergone by the bauxite.

The next stratigraphic unit is the bauxite itself which occurs in the two principal belts, each striking a little to the west of north. The two belts are separated by the valley of the Kenmere Rivulet near its confluence with the Ouse River. On their eastern flank the deposits are truncated by the lower reaches of the Ouse valley, while to the west outcropping diabase usually provides a definite boundary.

The bauxite appears in the form of a fossil deposit exposed by virtue of the erosion of basalt and of Tertiary sediments of the Derwent Valley series. It is uniformly rich in iron and carries combined water in excess of 20 per cent. The silica content is generally low and in parts the physical characteristics are suggestive of a fragmental origin. It is considered that the deposits are of the laterite type and that they have been derived from igneous material, probably of the general nature of volcanic tuff. No evidence has been found to definitely disprove the theory that the bauxite represents some special alterational phase of the diabase, and although this view is not favoured, it must, nevertheless, be regarded as a reasonable one.

In appearance, the bauxite varies greatly both as regards colour and texture. The upper parts are usually pisolitic to a marked degree, and comprise hard ore which passes in a few feet to a variety more earthy in texture and varying in colour from reddish-brown to yellow or nearly white. There is commonly a hard capping impregnated with hematite and limonite, and with occasional cavity linings of psilomelane.

Concentrations of iron oxides occur in various parts of the deposits, and in mining it may prove desirable to discard material obviously very rich in iron. Segregations of iron are also distributed profusely throughout the clay and soil of the shallow overburden in the form of buckshot gravel. In places, the dip of the bauxite carries it under Tertiary clays and sands, the latter frequently carrying massive limonitic concentrations.

In most cases, the deposits may be seen to directly overlie diabase, both having a general easterly dip which varies from place to place, and probably results from tilting due to pre-basaltic faulting, combined with an initial dip towards the Ouse-Derwent basin. What appears to be a fault escarpment in diabase terminates Area No. 2 on its western boundary, and forms a steep drop to the Kenmere Rivulet.

The material from which the bauxite has developed was apparently deposited over a surface largely composed of diabase, and, therefore, generated after considerable erosion of the Trias-Jura sandstones. The formation of the bauxite indicates a period of climatic conditions favourable to lateritization and it is probable that this occurred in middle Tertiary time.

The deposits were overlain in some places by a coarse wash composed largely of rounded boulders of diabase and indurated sandstone, but containing also quartz, chert, conglomerate, and isolated blocks of bauxite which are waterworn to a slight degree only, indicating that they have undergone little transportation as compared with the rest of the material.

The boulder wash marks the commencement of a Tertiary sedimentary cycle, and is succeeded by white clays with bands of white sand. Over much of the area, the clays rested directly on the bauxite, and isolated remnants are preserved filling depressions and scours in the surface of deposition. There has also been some infiltration producing thin clay seams in the otherwise solid ore.

Considerable areas of clays and sands have been preserved, and are important in that they may have protected substantial quantities of bauxite from erosion. As indicated later, when considering the outcrops in detail, several of these areas should certainly be prospected.

The sands and clays were capped by basalt flows, portions of which still occupy much of the high land surrounding the river valleys. Since the basaltic surfaces are sensibly level the tilting of the underlying rocks apparently took place before the final extrusion of basalt.

During Tertiary time the bauxite has undergone two periodssof dissection, the first of which provided material for inclusion in the boulder wash, and the second of which has resulted in the development of the present mature river valleys. In predicting extensions of the deposits under overburden, allowance must, therefore, be made for the probable effects of two erosional phases separated by a period during which faulting took place. Consideration must also be given to the possibility that the bauxite has originated from water-sorted material deposited in a series of discontinuous basins.

An isolated outcrop of bauxite in the Derwent River cliffs, near Dunrobin Bridge and nearly four miles from the surveyed areas, indicates that a considerable extent of country merits careful prospecting. There is also an unexplored occurrence on the property of Mr. R.F.K. Pitt, to the west of the Kenmere Rivulet, and on the down-throw side of the probable fault escarpment. A surface sample from this locality gave very satisfactory results, but as the outcrop may be merely part of a large erratic, it is not at present being considered in the light of an addition to the ore reserves.

Details of the Outcrops

The following are notes on the various outcrops. Boundaries and general surface features, including gradients, are shown on the accompanying plans. Assay results and details of testing as to depth are summarised in the succeeding sections.

Area No. 1: This outcrop is on the property of Mr. R.B.K. Pitt and is crossed by the metalled road from Ouse to Lane's Tier. The adopted area is 48,000 square yards, but the northern and eastern boundaries are so ill-defined that this figure must be regarded as approximate. There may be some extension of the bauxite under the sands abutting on its eastern edge. These sands, in common with others in the vicinity, carry concentrations of limonite suggesting the probability of underlying ferruginous material, but since hard sandstone outcrops 900 feet east of the adopted boundary, there is a limit to any likely increase of area.

Solid boulders of bauxite outcropping in the gully along the southern boundary convey an encouraging impression as to the depth of the deposit, but generally the area is not attractive. There is a wide variation in the character of the ore which, in places, is highly ferruginous, pisolitic capping material being represented by sample No. S22, while S23 is average ore from the surface to 5'6" in shaft No. 12, where there is no overburden. Bore No. 3 penetrated 19 feet of purple and white clay with iron concretions, and indicates the presence of a clay pocket, probably arising from a scour in the bauxite.

Area No. 2: This is the largest and most important outcrop. The adopted area is 220,000 square yards, the greater part of which lies on the property of Mr. J. Triffett. The northern extremity extends into Mr. Pitt's land towards Area No. 1, from which it is separated by a shallow gully.

Area No. 2 has been tested by shafts Nos. 1,2,3, and 4, and by samples Nos. S2, S3, S4, S9, S21, C1, C2, C3 and C5. Of these samples Nos. C1, C2 and C3 were channelled from the sides of shafts and gave uniformly better results than the surface samples. Shaft No. 3, when last inspected, was showing 12'6" of solid ore, the lower part of which was tested by Sample No. C5. The shaft has since been reported to have entered a band of clay under about 16 feet of bauxite.

Substantial extensions of this area may occur in an easterly direction, where the bauxite is lost against an expanse of clays and sands with limonitic concretions. If practicable, prospecting work will be carried out in this part of the area. In other directions the proximity of massive diabase precludes the possibility of any great variation from the boundaries shown.

Area No. 3: A small patch from which surface sample No. S6 gave quite good results. The boundaries are ill-defined except on the eastern side. The area is adopted as 7,500 square yards and there is no useful evidence as to the depth of the bauxite.

Area No. 4: This area also has indefinite boundaries and may extend under the sands in a south-easterly direction. The area within the adopted boundaries is 17,400 square yards. Sample No. S1 was broken from surface boulders and gave a reasonable return.

Area No. 5: The last area on Mr. Triffett's property; this is a small but solid-looking patch of 1900 square yards. In a northerly direction it merges into soil with buckshot gravel, and a small exposure 150 feet from the adopted boundary may indicate a continuation of the bauxite under the soil, or may be an isolated remnant of a once continuous sheet.

The outcrop is bounded on its other sides by diabase, which continues on in a southerly direction forming a steep cliff along the western boundary of the river flats. Further traces of bauxite are to be found along the cliff both as rounded boulders in the diabase-sandstone wash, and as massive blocks slumped from the cliff on to the flood plain below.

The evidence in this section indicates that the material from which the bauxite was formed had already undergone lateritization, and was exposed at the surface in something resembling its present condition at the time

Tertiary sedimentation commenced with the laying down of the boulder wash. It is also evident that a more or less continuous sheet of bauxite once extended in a southerly direction from Area No. 1 to beyond area No. 5 and in all probability connected up with the outcrops in the southern section.

Area No. 6: This is the most northerly patch of the southern section and occurs on Mr. L. Seal's property. Its adopted area of 20,600 square yards may be increased to some degree by an extension under the heavy soil to the north. Sample No. S15 was a poor one due, no doubt , to surface concentration of iron. Shaft No. 5 was started in a clay pocket but at 3'6" struck the capping of the bauxite which was penetrated for a further 3'6". In this case the clay pocket proved to be a surface depression and does not indicate any diminution in the t thickness of the ore.

Area No. 7: A small patch of 1,550 square yards emerging from the sands on the eastern side of the gully. This is an interesting exposure in that it indicates the definite possibility of additional areas of bauxite lying under the extensive sands and clays to the east of the main belt of outcrops. Here the surface slope, although opposed to the dip, is very gentle and if the existence of underlying bauxite were proved, considerable areas could be worked before the depth of overburden became prohibitive.

Area No. 8: There is 27,800 square yards within the adopted boundaries and prospecting in an easterly direction would possibly permit of some increase in this area. Shaft No. 6 has proved 10 feet of solid bauxite and shaft No. 7 near the western end encountered a clay pocket and has been temporarily abandoned. Surface sample No. S11 showed a very high iron content and in No. S14, the silica was abnormally high. Sample No. S20, from 5 feet in Shaft No. 6 gave a very good return indicating, once again, that improved ore is to be expected below the surface. Sample No. C4 has since been channelled from 4'6" to 10'6" the ore being of attractive appearance and solid in the bottom of the shaft.

Area No. 9: There is a good outcrop of solid boulders in the central part of this patch. The adopted area of 16,500 square yards is not likely to be increased greatly by any buried extensions of the bauxite, although the boundaries are very poorly defined. Sample No. S10 showed a very ghigh silica content, but was a pilot sample and is not to be regarded as being in any way representative.

Area No. 10: This area is the first on the property of Mrs. G. Nicholas and is the outcrop of a deposit dipping under the clays and sands. The 2,100 square yards within the boundaries of the outcrop cannot be considered as a reasonable area to apply to any volume estimation. Shaft No. 9 is 84 feet from the outcrop and, on the evidence of an intermediate hole, should reach the bauxite at about 23 feet, the dip being in the vicinity of 13°. A sand-clay contact intersected in the shaft showed a computed dip of 19° at N. 65°E. This is not necessarily the dip of the bauxite although it is in a like direction. Outcrop measurements indicate a thickness of about 10 feet on the assumed dip. Sample No. S13, which indicates a satisfactory grade, is representative of the outcropping surface material.

There are two small but solid looking outcrops of bauxite in the gully between Areas Nos. 9 and 10. These may represent slumped remnants of a sheet once continuous at a higher level. Shaft No. 8, put down to test the possibility of a continuation of Area No. 10 in this direction, has passed through 8 feet of soil and clay without encountering bauxite.

Area No. 11: This area, of 6,750 square yards, also has a probable extension under the sands and clays in an easterly direction. It appears to have once been continuous with Area No. 10, the present configuration of the outcrop being an erosional feature. Sample No. S8 gave a satisfactory result from surface material.

Area No. 12: The area of this outcrop is given as 11,800 square yards, but this figure is of little importance as there is definite evidence that the bauxite extends under the sands and clays of Thistle Hill. Shaft sinking and boring are being carried out to establish the general dip of the formation, which will control the amount of ore that can be extracted without resorting to underground mining. The opposing surface slope is steep along the southerly part of the outcrop, but in the central section, it is favourable over a considerable area. Outcrop measurements indicate dips ranging between 6° and 12° at about N.60°E, and suggest probable thicknesses of from 10 feet to 18 feet. The existence of surface undulations in the deposits, and the difficulty of establishing definite boundaries to the outcrops render these measurements unreliable.

The south-eastern extremity of Area No. 12 has probably been effected to some extent by slumping of the overlying sedimentaries and basalt. A small isolated patch marks the southerly extension of the outcrop, as may be seen on the plan. Erratic boulders in the soil between Areas Nos. 11 and 12 suggest the continuity of the deposit along the side of Thistle Hill.

Surface samples Nos. S7 and S12 were gathered from Area No. 12, but it has not as yet been practicable to obtain samples at depth.

Areas Nos. 1 to 12 inclusive are all on freehold land, the mining rights at present being under the control of Mr. James Brock, who holds "Permits to Enter upon Private Land" under Section 70 of the Mining Act, 1929.

Grade of the Ore

The accompanying table sets out all relevant assay results that are at present available. Most of the samples were gathered at the surface, each one representing average portions of six or eight boulders distributed across the outcrops as indicated on the plans. Other samples were channelled vertically down the sides of shafts and a few were taken from at or near the bottoms of shafts. The average weight of sample in all cases was about five pounds.

Samples Nos. S7, S8, S10, S11, S17 and S18 were pilot samples of extreme types of material selected in an endeavour to find a method of predicting the grade of the ore from its appearance. The experiment was unsuccessful except, perhaps, with regard to iron. On appearance only, it is usually possible to determine whether the iron content is very high, but it is not easy to differentiate between samples of normal iron content, that is between 20% and 30% Fe_2O_3. As regards silica, the only guide is as to whether or not the material is free from clay and surface sand. Low specific gravity does not necessarily indicate a high alumina content, but seems more often to be due to a high degree of porosity.

On fact that emerges clearly is the improved grade of material below the surface as compared with that at the surface. Five samples from shafts (Nos. S20, S21, C1, C2, and C3), two of which were spot samples and three of which were channelled, shown as an average 44.66% Al_2O_3, 25.04% Fe_2O_3, and 3.90% SiO_2. The silica percentage should be a little lower than indicated because sample No. C2 obviously contained some clay. Sample No. C1 (48.47% Al_2O_3, 21.26% Fe_2O_3, and 2.50% SiO_2) is the best yet obtained and was channelled from 2'6" to 10'9" in shaft No. 3. Sample No. C5 has since been taken from 10'6" to 14'6" in the same shaft, and as other faces become available for deep sampling a better conception of the average grade will be obtained.

In actual production excessive concentrations of iron oxides would be discarded while clay and sand would be removed by washing, and under these conditions the present evidence inidicates that a grade approximating to 45% Al_2O_3, 25% Fe_2O_3, 3% to 4% SiO_2 and 2% TiO_2 should be obtainable. It is worthy of note that the titania contents of all samples analysed have averaged less than 2.2%.

The method "B" and method "C" determinations show that a very satisfactory recovery of alumina may be obtained from both acid and alkaline attack. These determinations were made as follows:-

Method B. "Available".

Being compounds soluble in dilute sulphuric acid (Sp.Gr. 1.38 ± 0.01) digested at a gentle boil for one hour. Twenty-two cubic cms. of solution were utilized for 5 grams of sample.

Method C. "Frees".

Being compounds soluble in 10% caustic soda solution digested at a gentle boil for three hours. One hundred cubic cms. of solution were utilized for one gram of sample. A spun iron crucible was used for digestion to allow of the estimation of "free" silica.

Field No.	Lab. No.	METHOD "A"					Soluble H_2SO_4, 1.38 S.G. METHOD "B"			Soluble 10% NaOH Solution METHOD "C"		Locality, Remarks.
		Al_2O_3	Fe_2O_3	SiO_2	TiO_2	Ign. Loss	Al_2O_3	Fe_2O_3	TiO_2	Al_2O_3	SiO_2	
S 1	960	38.29	31.47	3.80	2.12	23.92	36.86	31.04	0.5	37.92	2.52	Mixed surface material Area No. 4.
S 2	961	42.07	29.30	3.04	2.07	23.66	40.08	29.02	0.7	41.4	2.0	Mixed surface material Area No. 2.
S 3	962	41.17	25.87	6.32	2.22	23.48	38.52	24.42	0.74	40.2	4.12	Mixed surface material Area No. 2.
S 4	963	40.86	26.73	7.76	2.57	22.70	39.32	26.44	0.8	40.4	4.8	Mixed surface material Area No. 2.
S 6	965	41.05	27.73	4.72	2.22	24.12	39.42	27.3	0.6	40.6	3.2	Mixed surface material Area No. 3.
S 7	1084	32.51	39.78	4.92	3.01	18.63	32.45	39.65	0.63	31.92	4.2	Pilot sample; high iron pisolitic. Area No. 12.
S 8	1085	39.66	31.42	3.36	2.08	22.18	39.52	30.84	0.40	38.68	3.12	Pilot sample; yellow, sub-pisolitic, Area No. 11.
S 9	1086	39.84	32.54	2.58	2.12	22.17	39.00	31.25	0.50	39.6	2.32	From hole 5 feet South - West of Shaft No. 3. Area No. 2.
S10	1087	35.21	27.50	15.30	2.20	18.75	34.81	27.50	0.31	28.2	6.64	Pilot sample, pale pink, gritty; Area No. 9.
S11	1088	28.98	42.95	5.92	2.63	18.43	28.47	41.64	0.50	27.8	4.28	Pilot sample, high iron, pisolitic. Area No. 8.
S12	1119	41.96	28.18	4.37	2.17	23.15	40.92	27.60	0.40	39.8	3.2	Surface material, high iron pisolitic. Area No. 12.
S13	1120	42.30	27.66	4.22	2.19	22.92	40.91	27.08	0.42	39.72	3.0	Mixed surface material Area No. 10.
S14	1121	41.15	25.22	9.90	2.19	21.58	39.09	24.50	0.57	38.0	6.16	Mixed surface material Area No. 8.
S15	1122	28.42	44.89	7.96	1.65	16.38	27.52	44.43	0.49	24.32	5.2	Surface material, dark pisolitic. Area No. 6.
S17	1117	39.89	27.74	4.95	1.82	22.39						Dark Pisolitic (Pilot sample (from outcrop (in river
S18	1118	32.71	37.34	4.90	1.96	20.85						Yellow Earthy (cliff near (Dunrobin (Bridge, 4 (miles south (east of surv (eyed areas
S19	1218	46.75	20.95	6.40	1.8	24.36				41.68	3.76	From outcrop of ? large erratic on R.F.K. Pitt's property, west of Area No.2

S 7	1084	32.51	39.78	4.92	3.01	18.63	32.45	39.65	0.63	31.92	4.2	Pilot sample; high iron pisolitic. Area No. 12.
S 8	1085	39.66	31.42	3.36	2.08	22.18	39.52	30.84	0.40	38.68	3.12	Pilot sample; yellow, sub-pisolitic, Area No. 11.
S 9	1086	39.84	32.54	2.58	2.12	22.17	39.00	31.25	0.50	39.6	2.32	From hole 5 feet South - West of Shaft No. 3. Area No. 2.
S10	1087	35.21	27.50	15.30	2.20	18.75	34.81	27.50	0.31	28.2	6.64	Pilot sample, pale pink, gritty; Area No. 9.
S11	1088	28.98	42.95	5.92	2.63	18.43	28.47	41.64	0.50	27.8	4.28	Pilot sample, high iron, pisolitic. Area No. 8.
S12	1119	41.96	28.18	4.37	2.17	23.15	40.92	27.60	0.40	39.8	3.2	Surface material, high iron pisolitic. Area No. 12.
S13	1120	42.30	27.66	4.22	2.19	22.92	40.91	27.08	0.42	39.72	3.0	Mixed surface material Area No. 10.
S14	1121	41.15	25.22	9.90	2.19	21.58	39.09	24.50	0.57	38.0	6.16	Mixed surface material Area No. 8.
S15	1122	28.42	44.89	7.96	1.65	16.38	27.52	44.43	0.49	24.32	5.2	Surface material, dark pisolitic. Area No. 6.
S17	1117	39.89	27.74	4.95	1.82	22.39						Dark Pisolitic (Pilot sample (from outcrop (in river
S18	1118	32.71	37.34	4.90	1.96	20.85						Yellow Earthy (cliff near (Dunrobin (Bridge, 4 (miles south (east of surv (eyed areas
S19	1218	46.75	20.95	6.40	1.8	24.36				41.68	3.76	From outcrop of ? large erratic on R.F.K. Pitt's property, west of Area No.2
S20	1219	46.48	22.20	5.42	1.88	23.86				44.28	3.56	From Shaft No. 6, Area No. 8. Taken from wall of shaft at 5'0".
S21	1220	42.37	29.48	2.31	2.05	23.96				41.00	2.08	From Shaft No. 3, Area No. 2. Taken from bottom of shaft at 12'0".
C 1	1221	48.47	21.26	2.5	2.34	25.6				47.12	1.92	From Shaft No. 3, Area No. 2, Channelled from 2'6" to 10'9".
C 2	1222	42.53	24.50	7.16	2.04	24.00				39.68	3.82	From Shaft No. 4, Area No. 2, Channelled from 1'0" 5'0". contained some clay
C 3	1223	43.44	27.75	2.14	2.10	24.77				42.20	1.96	From Shaft No. 2, Area No. 2. Channelled from 2'0" to 6'6"

Estimation of Tonnage

Quantity determinations are entirely dependent on the depth factor and, at present, there is insufficient data available to permit of any mathematical estimation of average depths. A calculated figure could be arrived at only after considerable shaft sinking coupled with sampling to determine the persistence, or otherwise, of values with depth. In view of these limitations, an arbitrarily chosen figure of 10 feet has been adopted for estimation purposes, the basis of selection being that all available evidence, both from shafts and from outcrop measurements, suggests that this is a minimum figure.

In the matter of area, the position is better defined and a reasonable estimate is practicable as regards the section of the deposits under low overburden. The aggregate area within the adopted boundaries of the twelve outcrops is 381,900 square yards, which is considered to represent a good average figure for those deposits in which the surface slope approximately coincides with the easterly dip of the bauxite. This condition applies generally except as regards areas Nos. 7, 10, 11, and 12, in which the surface slope is opposed to the dip. The surveyed areas of these outcrops have been loaded to include the immediately adjacent material occurring under low overburden. This addition brings the total area to approximately 400,000 square yards.

Field tests by displacement methods indicate a specific gravity of 2.1 for average material in situ. On this basis, the conversion from colume to weight is made in the ratio of 1.6 long tons per cubic yard, giving a total of 2,133,000 tons of ore under low overburden.

The available quantity of useful ore represented in this estimate may be affected by:-

(a) Variations of the adopted boundaries.
(b) Variation of the depth factor.
(c) Presence of clay pockets.
(d) Rejection of unfavourable ore, including heavy iron concretions of clay seams.
(e) Mechanically held moisture.

Many of the boundaries are ill-defined, but where doubt existed, an endeavour was always made to adopt a mean position, so that any correction in area is just as likely to be positive as negative. As already stated, the depth factor used is definitely conservative and corrections due to alteration in this should be positive. Clay pockets constitute an indeterminate negative correction but are probably not of great aggregate importance, particularly in view of the fact that where the clay is occupying a surface depression, as distinct from a scour, no diminution of available tonnage is necessarily implied.

A percentage rejection of unfavourable ore must be expected, whether it be achieved by omitting sections from the mining operations; by the hand-picking and washing-out of impurities; or by other similar processes. The depreciation of available tonnage on this account can be determined only by actual production experience. The amount of mechanically held moisture will not be unduly high as the ore is fairly compact and most of the ground is well drained. Seasonal variations may be expected and there will also be a zonal variation with depth in the individual deposits. Field tests on available material indicate that the average figure should be in the vicinity of 12 per cent.

While the above considerations detract to some extent from the productive tonnage, they constitute a factor which must be applied on a like scale to almost any similar deposit. In this particular case, they are offset by the fact that no allowance has been made for ore under heavy overburden or for probable extensions of the deposits under thin coverings of Tertiary sediments. In all the circumstances, it is considered that a round figure estimate of 2,000,000 tons is a fair interpretation of the available information. The following are details of shafts and bore holes :-

Shaft No. 1	Western end, Area No. 2.	0' - 6'0"	Soil and clay with boulders of bauxite, white clay in bottom.
Shaft No. 2	Central, Area No. s	0' - 2'0"	Soil and bauxite boulders. Bauxite with iron concretions. Sample No. C3 channelled from 2'0" to 6'6". Solid bauxite in bottom.
Shaft No. 3	Central, Area No. 2	0' - 2'6"	Soil with gravel & boulders (removed by quarrying).
		2'6" -15'0"	Bauxite, pisolitic passing to earthy. Sample No. S21 from 12'0", C1 channelled from 2'6" to 10'9", C5 channelled from 10'6" to 14'6".
		15'0" -18'0"	Reported to be in bauxite.
		18'0" -20'0"	Reported to be in clay. Shaft being continued.
Shaft No. 4	Southern end, Area No. 2	0' - 1'0" 1'0" - 5'0"	Soil with boulders Bauxite, pisolitic passing to earthy sample No. C4 channelled from 1'0" to 5'0". Solid bauxite in bottom.
Shaft No. 5	Western end, Area No. 6	0' - 3'6" 3'6" - 7'0"	Clayey soil. Hard pisolitic bauxite. Bauxite in bottom.
Shaft No. 6	Eastern end, Area No. 8	0' - 1'0" 1'0" -11'0"	Soil with boulders. Bauxite, pisolitic passing to earthy. Sample S20 from 5'0", C4 channelled from 4'6". Solid bauxite in bottom.

Shaft No. 7	Western end, Area No. 8	0' - 6'0"	Clayey soil with boulders of bauxite.
Shaft No. 8	North-west from Area No. 10	0' - 1'0" 1'0" - 8'0"	Soil. White clay.
Shaft No. 9	East of Area No. 10 and 84' from outcrop.	0' - 3'0" 3'0" - 3'9" 3'9" - 7'3" 7'3" - 8'9"	Clay. Sandy clay. Clay. Fine, white to iron stained sand current bedded. Dip 19° N. 65° E.
		8'9" -20'0"	Fine white clay - some Fe stains.
Shaft No.10	Northern end, Area No. 12, 100' feet east of outcrop.	0' -	Shaft just started. Intermediate hole 55' from outcrop reached bauxite at 6'9".
Shaft No.11	Central, Area No. 12. 75' north-east of outcrop.	1'0" - 8'0"	Soil and white clay.
Bore No. 1	Central, Area No. 12. 125' north-east of outcrop.	0' -20'0" 20'0" - ?	Soil and clay. Bauxite.
Bore No. 2	Central, Area No. 12, 220' north-east of outcrop.	0' -32'0"	Mostly clay.
Bore No. 3	Southern edge, Area No. 1	0' -19'0"	Clay with iron concretions.

Mining and Transport

The bauxite deposits at Ouse, in common with other known occurrences of commercial size in Australia, are essential of low grade material. As such, their economic value depends on the degree to which cheap production costs can be made to offset the deficiencies of the ore. Comparative production costs of alumina extracted from ores of similar grade and amenability to treatment would be influenced largely by:-

(a) mining costs,
(b) beneficiation costs,
(c) transport costs.

As regards mining costs, the greater part of the Ouse deposits are almost ideally situated. Area No. 2, which is estimated to contain more than a million tons of ore, has a natural surface gradient of about 6 degrees and could be worked up the grade with any length of face desired. The overburden probably averages about 3 feet and the vegetation is so scanty that it presents no serious difficulties.

It is not practicable to suggest a useful mining scheme without some definite knowledge of the output required, but on the assumption that this will be of the order of two to five thousand tons per month, the following method is outlined to give some idea of the exceptionally cheap handling that could be established.

An assumed face averaging 10 to 15 feet of ore and 3 feet of overburden could be worked by a one cubic yard electric shovel on a caterpillar base. The ore, after being loosened by low-power explosive, could be loaded into six wheeled 10-ton motor trucks for transport to the crushing and drying plant, a distance of perhaps half a mile. Drilling would be best carried out with electric rotary drills and it would probably be preferable to put the holes in from the horizontal rather than from the vertical.

The overburden could be economically handled by bulldozer tractors, the general method being to push it over cleared sections of the face so that the power shovel, when not required for digging ore, could distribute it over the worked surface about 50 feet from the face. Where the overburden is very rich in buckshot gravel, it is in demand for roadmaking purposes, and would be saleable in considerable quantities at a figure in excess of handling costs.

Areas Nos. 1, 2, 3, 4, 5, 6, 7, 8 and 9 are all favourably situated with regard to extremely low cost handling, and would provide many years ore supply before consideration need be given to working material under appreciable amounts of overburden.

Preliminary beneficiation of the ore would probably take the form of:-

(1) Rejection of high-iron segregations.
(2) Coarse grinding with gyratory crushers.
(3) Washing (if desirable).
(4) Low temperature calcining in rotary kilns.

These processes could also be carried out at minimum cost because coal, water and electricity can be made available very cheaply. It is probable that only part of the ore would require washing as much of it would be substantially free from clay and sand.

As regards mining and beneficiation costs, the Ouse deposits appear to lose nothing by comparison with any in Australia, of which details have been published. In the matter of transport, the position may not be so favourable, and every effort should be made to provide a satisfactory solution to this problem.

The suggestion has been advanced that a plant for the preparation of purified alumina could suitably be established at Ouse. This would have undoubted advantages with respect to transport, as the total ton-mile haulage would be greatly reduced, and the inward loading of caustic soda and general stores could be made to balance the outward loading of alumina and surplus coal. The soundness of such a scheme would depend on whether the local deposits of coal and bauxite could maintain a continuous and satisfactory output of raw materials during the economic life of the plant. Until sufficient data becomes available to permit of reasonable certainty in this matter, it must be conceded that Hobart, as a deep water port within easy range of the deposits, has many factors in its favour to offset transport costs on coal and bauxite. There would also be considerable advantages attaching to the unit installation of purification and smelting works.

On the assumption that a beneficiation plant only is to be established at Ouse, the transport problem is made more difficult by the predominant one-way loading. There are two practicable solutions. One is the utilization of road facilities between Ouse, and the rail head at Macquarie Plains, and the other is the provision of railway or tramway connection to the most accessible point on the Derwent Valley railway.

The road distance to Macquarie Plains is about 26 miles by a State Highway. Loading restrictions set the maximum haulage capacity of a four-wheeled truck at five tons, while a six-wheeled truck may carry six tons and a truck with a four-wheeled trailer, nine tons, the trailer loading being four tons. The speed limit, which varies according to the unladen weight of the vehicle is 25 miles per hour for trucks of between 1½ tons and 3 tons, 35 miles per hour for lighter vehicles and 20 miles per hour for vehicles of greater weight than 3 tons.

If mass road haulage of ore and coal is to be undertaken over a period of years, representations should be made for a variation of the above, restrictions to permit of heavier loading and higher speed. Strict adherance to the present regulations would involve an expenditure on the 26 miles of road transport approximately equal to the combined costs of mining and of rail freight over the distance of 36 miles from Macquarie Plains to Hobart. This is a heavy burden to place on an ore which has to compete with deposits favoured by direct rail communication.

The construction of a railway to Ouse has been under consideration on several occasions and three different routes have been surveyed; one leaving the Derwent Valley line at Macquarie Plains; one at Glenora; and one at Westerway. The matter has recently been discussed with railway officials who are of the opinion that the provision of such a railway is quite practicable, and that apart from the transport of coal and ore, the line would gather considerable livestock and incidental freight.

The necessary length of railway would vary with the route chosen, but it is likely that, including sidings to the Langloh coal mine, and the bauxite drying plant, about 25 miles of track would be required. It is considered that construction costs would range from £8,000 to £10,000 per mile.

The suggestion is advanced that if finance could be provided to meet the capital cost of the railway, it would be practicable to recover the outlay by placing a loading, in the form of a toll, on the first million tons of freight hauled. Assuming that this freight consisted largely of bauxite and coal a surchage over standard rates could be met without seriously penalizing the economic value of the product.

Railway freight schedules are in course of revision, but the present rate of 9s. 7d. per ton that would be applicable to the cartage of bauxite 61 miles from Ouse to Hobart is not likely to be increased, as it represents profitable traffic. A toll loading of 4s. per ton would bring the figure to 13s. 7d., a substantial and perhaps vital economy as compared with combined road and rail transport. A lower freight charge is levied on coal, and the shorter haul from the Langloh mine to Hobart, as compared with the distance from the East Coast mines, would enable the coal also to pay a penalty rate without being unduly handicapped.

Failing Government assistance in the provision of a standard railway, consideration could be given to the construction of a narrow gauge ore tramway, which, with a guaranteed continuity of loading, should show a substantial ultimate economy as compared with road transport under the existing regulations. It cannot be too strongly urged, however, that if the Government railway system were extended to Ouse, both the coal and bauxite deposits would appreciate in economic importance to such an extent that large scale exploitation would be almost assured.

(Shd.) D. R. Dickinson.

EXTENSION OFFICER.

Department of Mines,
H O B A R T.

23rd October, 1941.

COPY.

6th November, 1941.

MEMORANDUM :

BAUXITE AT OUSE.

The following details of recent developments are supplementary to my report of the 23rd October.

A new discovery of bauxite has been made in an area about five miles north-westerly from the nearest of the surveyed deposits. The outcrop comprises some two acres of massive boulders, samples of which have been taken for assay. The bauxite is exposed along the side of a flat gully in timbered country, and passes under sands and clays which carry the usual ferruginous concretions, and are, in turn, overlain by basalt. Diabase occurs in the immediate neighbourhood.

In the intervening country, between this and the other bauxite areas, there are very extensive exposures of sands and clays, frequently with basalt cappings. Although a cursory inspection did not reveal any further outcrops of bauxite, traces were noted in the soil at one place, and parts of the area merit intensive prospecting, particularly where the outcropping formations are close to the base of the sub-basaltic sediments.

A further discovery has also been made on the south easterly extension of the deposits, where boulders of bauxite have been ploughed up in a cultivated paddock on Lachlan Vale, a property owned by Mrs. G. Nicholas.

These additional outcrops are important in that they confirm the north-westerly trend of the deposits over a tract of country not less than eleven miles in length. They also provide a valuable guide to the prospecting of intervening areas, where further occurrences may exist under a mask of younger formations, or of deep soil. The positions of all outcrops known at present are shown on the attached county plan.

At the surveyed deposits, shaft No. 3 passed through a 6 inch clay seam under 15 feet of solid bauxite. Bedrock was not reached in a further 6 feet of sinking, but since the ore was of a doubtful character, work was suspended pending assay results. Shaft No. 12 has been deepened to 9 feet, all in solid bauxite, the lower parts of which are of improved appearance. Work on the deposits is temporarily held up owing to shortage of labour, but it is expected that shaft sinking will be resumed on Monday next, the 10th November.

(Sgd.) D.R. Dickinson,

EXTENSION OFFICER.

The Director of Mines,
H O B A R T.