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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF SUPPLY AND DEVELOPMENT.

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

REPORT No. 1949/95
(Geol. Ser. No. 63)

BAUXITE RESOURCES OF THE INVERELL AREA, N.S.W.

by

H.B. Owen
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CANBERRA, A.C.T. May, 1949

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LIST OF PLATES.

1. Locality Plan
2. Plan No. 1 Area. Emmaville.
3. Sections - No. 1 Area Emmaville.
4. Plan of No. 2 Area Campbell.
5. Sections - No. 2 Area Campbell
6. Plan of No. 3 Area, Champagne
7. Sections of No. 3 Area, Champagne
8. Plan and Sections of No. 4 Area, "Lockwoods"
9. Plan of No. 5 Area, "Parish's"
10. Sections of No. 5 Area, "Parish's"
11. Geological plan of No. 5 Area, "Parish's"
12. Plan of No. 10 Area, "Wade's".

BAUXITE RESOURCES OF THE NEW ENGLAND DISTRICT. NEW SOUTH WALES.

I. SUMMARY.

The following tables set out the known reserves of bauxite in the vicinity of Emmaville, Inverell and Tingha in the New England district of northern New South Wales.

Table I shows the proved reserves of economic bauxite which are under the control of the Australian Aluminium Production Commission.

The second table refers to other similar deposits which are mostly alienated, and which previously had been examined and reported upon by the N.S.W. Department of Mines. Table III comprises a list of localities examined by the Commission with negative results or where the prospects were not sufficiently good to warrant acquisition of the deposits.

The term "bauxite" as used herein refers to laterite of a composition which it is believed would permit the extraction of alumina on an economic basis. Strictly, the material contained in the reserves should be regarded as normal laterite as the analyses quoted herein indicate. All laterites in the region are derived from basalt of Oligocene (?) age, and were formed, it is believed, during the Miocene epoch.

In Tables I, II and III, the deposits and localities are numbered in accordance with the numbers shown on the locality plan (Plate I).

TABLE I.

BAUXITE DEPOSITS HELD BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION.

No.	Locality.	Long Tons (dry ore)	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Avail Al_2O_3 %	Na_2O loss Cwt.
	EMMAVILLE							
1.	Strathbogie	1,480,000	3.3	40.8	31.1	3.9	34.7	0.88
	INVERELL							
2.	Nullamanna East.	650,000	2.9	39.4	29.3	4.4	36.1	0.77
3.	Champagne	740,000	3.6	38.8	29.5	5.0	34.0	1.04
4.	Lockwood's	140,000	3.1	38.5	29.1	5.8	34.9	0.80
5.	Parish's	4,755,000	3.2	38.6	30.1	5.0	33.7	1.00
	TOTAL	7,765,000 tons dry ore equivalent to about 8,800,000 tons moist ore in situ.						

TABLE II.

BAUXITE DEPOSITS ALIENATED TO OR EXAMINED BY INTERESTS OTHER THAN AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION.

No.	Locality	Long Tons (dry ore)	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av. Al_2O_3 %	Na_2O loss Cwt.
	EMMAVILLE.	(1), (2).	(2)	(2)	(2)	(2)	(2)	(2)
1.	Strathbogie	1,300,000	4.4	39.0	31.0	3.6	34.7	0.89
2.	Astley	2,280,000	4.0	39.2	-	-	-	-
7.	Lorne	1,420,000	5.2	40.3	-	-	-	-
8.	Scone	800,000	3.8	38.6	-		-	-
9.	E. Common	985,000	6.6	35.7	-		-	-
	INVERELL.	(2)	(2)		(2)	(2)	(2)	(2)
10.	Wade's	110,000	5.8	39.5	28.0		33.1	1.4
	TINGHA.	(3)						
11.	Ph. Herbert	140,000	10.1	43.1	-		-	-
12.	Ph. Clive	160,000	5.0	42.9	-		-	-
13.	Topper's Mtn.	200,000(2)	4.7	39.5	30.3		-	-
14.	Ph. Swinton (4)	60,000	5.5	40.0	-		-	-
	TOTAL	7,455,000						

(1) Not less than.

(2). Figures by Australian Aluminium Production Commission. All other figures from unpublished report by F. W. Booker and F. N. Hanlon, Department of Mines, Sydney, 1944 - "The Bauxite Deposits of the Tingha-Inverell-Emmaville District."

(3). Deposit II. Reserves of economic bauxite have been calculated to be not more than 65,000 tons containing 4.7 per cent. SiO_2, 42 per cent. Al_2O_3, 30 per cent. Fe_2O_3.

(4). Deposit 14. By rejection of high-silica material near the surface reserves become 50,000 tons containing 3.6 per cent SiO_2, 40.4 per cent Al_2O_3, 32.8 per cent. Fe_2O_3, 31.7 per cent Free Al_2O_3 soluble in NaOH.

TABLE III.

LOCALITIES EXAMINED BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION.

No.	Locality.	Tonnage and Remarks.
15.	Pindaroi	- About 25,000 tons capping a steep hill
16.	Wellingrove	- Very small, mostly residual boulders only.
17.	II Parran	- Very small.
18.	Swanbrook	- Very small.
19.	Wandera	- Low grade.
20.	Burgundy	- Small deposits, low grade.
21.	McIntyre Park	- Small deposits, low grade.
22.	McCoskers	- About 30,000 tons in separate deposits.
23.	Cherrytree Hill	- 160,000 tons, relatively inaccessible.
24.	Mt. Russell	- Small, scattered deposits. Grade too low.
25.	Little Plain	- Nil.
26.	Station 2 NZ	- Very small. Grade too low.
27.	Garley's etc.	- Small scattered deposits of low grade
28.	Bundarra Road	- Very low grade.

II. INTRODUCTION.

A. Accessibility.

(See locality plan herewith and refer to the 4-mile strategic series maps. Grafton H56/6 Zone 8 and Inverell H56.5, Zone 8).

The bauxite deposits of the New England district are easily accessible by road and all major deposits lie within less than 20 miles of a railway. The nearest sea port from which New England bauxite could be shipped is Newcastle which involves long rail haulages as shown below :-

Deposit No.	Locality.	Road haul to railway at		Rail haul to Newcastle
No. 1.	Emmaville	Deepwater	19 miles	349 miles.
2.	Campbell	Inverell	9 "	412 "
3.	Champagne	Byron	9 "	406 "
4.	Lockwood's	Byron	9 "	406 "
5.	Parish's	Byron	6-7 "	406 "

The long haulages involved constitute a serious handicap to the economic exploitation of the deposits.

B. Topography.

The whole of the area under discussion lies on the western slopes of the Great Dividing Range. The crest of the Divide crosses the south-east corner of the area covered by the locality plan (Plate I) where it attains elevations from 4,800 feet in the south to 3,600 feet in the east.

From the Waterloo Range the general level of the surface, which is one of considerable relief, falls from 4,000 feet to the valley of the MacIntyre River with an elevation of 1900 feet at Inverell.

West of the MacIntyre the surface has less relief but remnants of a basalt sheet form flat-topped hills rising about 150 to 200 feet.

The area is drained by the MacIntyre and Severn Rivers which join and flow north-westerly to the Dumaresq River.

C. Definitions.

Bauxite.

The term "bauxite" as used in this report signified lateritic material 5 feet or more in thickness which contains not less than 30 per cent alumina available to extraction by alkali without undue loss of alkali caused by the presence of combined silica or due to other causes. The maximum permissible loss of alkali rises with the available alumina content as follows ;-

Available Al_2O_3%	Maximum permissible alkali loss expressed as Cwt (112 lb) Na_2O per ton of available alumina.
30	1.20
32	1.41
34	1.56
36	1.70
38	1.83
40	1.95
42	2.05
44	2.15
46	2.24

3 AB

Available Alumina.- is the amount of alumina extracted by pressure digestion with caustic soda solution under conditions simulating those of the Bayer extraction process.

Na_2O Loss. The figures given under this heading express the loss of alkali, stated as Na_2O, in hundredweights (112 lb) per ton (2,240 lb.) of alumina extracted. This unrecoverable alkali remains in the insoluble matter ("red mud") left after digestion of the bauxite with caustic soda solution, and is a measure of combined and opaline silica present in the original ore.

III. GENERAL GEOLOGY.

The following succession is exposed within the area covered by the locality plan (Plate I).

Quaternary.		
Recent	:	Unconsolidated alluvium - gravel, sand, etc.
Pleistocene or Recent	:	Silt and Clay.
Tertiary.		
Pliocene (or younger)	:	Basalt.
Lower Pliocene	:	Clay, sand and loosely cemented conglomerate, lignite
		Basalt
		Recemented detrital laterite
Miocene (?)	:	Laterite
Miocene or Oligocene	:	Basalt.
Palaeozoic :		
Permian	:	Conglomerate and coarse grit
Permian Lower Coal Measures	:	Conglomerate sandstone, shale and coal
Lower Carboniferous (?)	:	Chert, tuff, quartzite, slate, etc.
Intrusive:		
Post-Lower Carboniferous (?) / Pre-Lower Coal Measures		Granite.

The greater part of the area under discussion is occupied at the surface by Lower Carboniferous (?) rocks and acid intrusives.

Permian formations occupy only minor portions of the area. At Arthur's Seat, 10 miles north-west from Bukkulla, the Lower Coal Measures unconformably overlie the Carboniferous bedrock, and are in turn overlain unconformably by a small outcrop of angular conglomerate and coarse grit believed to be also of Permian age. At Arrawatta, 4 miles east of Oakwood, the coal measures, including a coal seam 10 feet thick, outcrop in the bank of the McIntyre River and dip west at 60°.

Wide areas, particularly north of the Severn River and west of Waterloo Range are covered by Tertiary basalts. Generally the older basalt now remains as low hills capped with derived laterite, and the younger basalt occupies lower ground and caps the higher hills in the vicinity of Inverell and Oakwood.

The Oligocene basalt has covered an important deep-lead system at Emmaville and Tingha principally, where the leads have been very extensively mined for tin.

The laterite and bauxite occurs only on the older basalt as horizontal sheets with an average thickness of the order of 20 feet. The pisolitic capping characteristic of ferruginous laterites is present at Emmaville but absent from most other deposits in the region suggesting that the laterite surface was, in many places, subject to considerable erosion before the outpouring of the Pliocene basalts.

After the first period of vulcanicity in the Pliocene a small accumulation of paludal and fluviatile sediment including lignitic clay, sand and gravel formed at low levels on the surface of the lava field. These sediments, which are probably of Lower Pliocene age, were in turn covered by basalt in Upper Pliocene, or later, time.

IV. DESCRIPTION OF THE LATERITES.

The three zones recognisable in a complete laterite profile, viz. ferruginous, mottled and pallid, are not all easily distinguishable at the bauxite occurrences described herein.

A sharply defined ferruginous zone does not exist at Parish's and other deposits in proximity, but is represented at Emmaville and Tingha by pisolitic ore.

At Emmaville this consists of closely packed dark red pisolites, either loose or set in a ferruginous cement and attains a thickness exceeding 20 feet (see Part V of this report). Notwithstanding the deep colouration it usually contains only slightly higher iron content than the earthy bauxite at Parish's.

Chemical analyses indicate that the pisolitic ore consists essentially of a mixture of aluminium tri-hydrate and hematite or goethite with or without an appreciable amount of aluminium monohydrate. At Deposit C. Emmaville, the composition probably ranges between the following examples.

	Per cent.	Per cent.
Clay (kaolin)	4.5	5
$Al_2O_3\ 3H_2O$	45	61
$Al_2O_3\ H_2O$	13.5	v.small
$Fe_2O_3\ H_2O$ (goethite) }	33.5	{ 28.5
Fe_2O_3 (hematite) }		{ v.small
TiO_2	4.5	5

The earthy bauxite, typical of Parish's deposit, is mainly red and brown in colour, and except for a harder surface capping a few feet thick is soft and clay-like in appearance and crumbles on exposure to the weather.

The silica content declines with depth to the kaolinized zone where it rises steeply as the following analyses illustrate.

PARISH'S AREA. 400S/900W.

Depth Feet. From	to	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Ignition Loss. %
2	7	9.4	46.6	12.0	6.0	24.7
7	11	3.8	49.6	11.9	7.9	26.5
11	15	1.5	48.4	15.3	7.8	25.8
15	19	1.5	42.9	25.4	6.7	23.1
19	23	1.1	36.9	33.8	6.2	21.6
23	27	16.9	26.9	35.4	5.1	14.8
27	30	24.1	25.8	31.6	4.9	12.8

PARISH'S AREA. 2000S/3300W

1.5	6	5.1	39.1	24.7	3.7	22.1
6	10	3.8	36.6	23.4	4.6	22.3
10	14	2.1	34.7	28.2	5.0	21.5
14	18	2.1	34.3	31.9	6.2	21.4
18	22	6.4	28.9	41.0	5.0	16.6
22	25	30.9	28.2	31.4	4.3	13.9
25	27	28.6	26.6	26.6	4.9	12.4

It is evident from the foregoing analyses that very little alumina is present as monohydrate. Samples with low combined water content, however, have been obtained from bores in the south-east corner of Block H, Parish's area (see Plates 9 and 11), where monohydrate may constitute about 5 per cent of the ore.

The original texture of the parent basalt has been retained near the base of the bauxite with the result that the passage from bauxite to kaolinized basalt is not readily discerned by eye.

A suite of specimens from Parish's area, collected by the writer was submitted to the Council for Scientific and Industrial Research for mineragraphic investigation. The resulting report, No.395, appears as an appendix herewith.

Nodular bauxite which differs in character from either type mentioned above occurs in a small deposit (No.10) four miles west of Inverell.

This bauxite bears a resemblance to that of Malaya as it consists of aluminous nodules embedded in a soft earthy matrix. The nodules range in size up to about 3 inches diameter and contain about 70 per cent of aluminium trihydrate and 20 per cent of hydrated iron oxide. The proportion of nodules contained in the matrix varies over a wide range but probably averages less than 50 per cent.

IV. DESCRIPTION OF BAUXITE DEPOSITS HELD BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION.

1. Emmaville. - No. 1 Area: Strathbogie.

A. Summary.

A group of four laterite deposits occurs in Portions 514, 513, 512 and 516, Parish of Scone, and Portions 700, 699, 703, 704, 38, 29, 35, 694 and 702, Parish of Strathbogie, all in the County of Gough. (See Plates 2 and 3)

The Broken Hill Pty. Co. Ltd. holds mining leases over the greater part of the laterite lying in Portions 512 and 516, Scone, and Portion 38, Strathbogie, and the Australian Aluminium Production Commission has secured Authorities to Enter covering all significant parts of the remaining laterite areas.

The four deposits are marked "A", "B", "C" and "D" respectively on the accompanying plan which is to a scale of one inch equals two hundred feet. (Plate 2).

The whole of deposit A is enclosed by B.H.P. leases No.565, 3109 and 3114. Deposits B and C, except for the extreme northern end of the former, are held by the Aluminium Commission. Deposit D is small and has not been taken up.

Sub-surface prospecting was conducted by shaft-sinking and in all 24 shafts were sunk on the areas and 15 existing shafts were re-sampled. Of these shafts 4 were put down on B.H.P. ground and three old shafts within the Company's leases were re-sampled. Three new shafts and four old ones on ground outside the B.H.P. and Commission holdings were also sampled. All the remaining shafts were sunk on areas that had been taken up on behalf of the Commission.

The results of this prospecting are summarised in Table IV.

B. Situation and Access.

The deposits occur along the northern boundary of the Parish of Strathbogie, County of Gough, about 5 miles by road west-south-west from the village of Emmaville. The nearest railway station is Deepwater, 16 miles east from Emmaville by an indifferent gravel road. All roads in the locality are gravel surfaced and in poor condition, and traffic is subject to interruption during wet weather when low level bridges and fords may become impassable temporarily.

The road distance from the bauxite deposits to Inverell and to Parish's bauxite deposit are 42 and 52 miles respectively, but a shorter route between the two bauxite localities via Bukkulla could be put into use. (See Locality Plan, Plate I).

C. Description of Individual Deposits.

1. Deposit A.

As the mineral rights over this deposit are alienated, the description and statement of reserves will be found in Part V of this report.

ii. Deposit B. General. The greater part of this deposit lies in Portion 704, Parish of Strathbogie, with small extensions, northerly into Portion 512, Scone, and westerly and southerly into Portions 29, 35 and 702, Strathbogie. Except for the small area lying in Portion 512 and occupying a reserved road between Portion 512 and 704, the deposit is held by the Aluminium Commission under Authority to Enter.

The main part of the deposit occupies a narrow strip measuring 3,300 feet from north to south by a maximum width at the centre of about 900 feet. The total area of this body is about 44 acres of which 25 acres are underlain by economic bauxite. In addition to this area, two small areas together occupying about 5 acres, narrowly separated from the main area, and lying in Portion 29 are included in the reserves of Deposit B and are within the area taken up by the Aluminium Commission.

TABLE IV.

NO. 1 AREA BAUXITE DEPOSITS (EMMAVILLE).

Deposit	Approx. Area Acres	Number of shafts giving Positive Results	Bauxite: Tons (2240 lb)	Bauxite: SiO_2 %	Bauxite: Al_2O_3 %	Bauxite: Fe_2O_3 %	Bauxite: TiO_2 %	Bauxite: Av. Al_2O_3 %	Bauxite: Na2O loss Cwt.	Over-burden cubic yards
A	54	5	1,300,000	4.4	39.0	31.0	3.6	34.7	0.89	620,000
B	30	8	880,000	3.2	40.0	30.9	3.9	35.4	0.91	534,000
C	25	6	710,000	3.3	41.7	30.9	4.1	34.0	0.83	420,000
D	4	1	100,000	5.3	28.6	31.2	3.9	33.8	1.04	18,000
TOTAL			2,990,000	3.8	40.0	31.0	3.8	34.8	0.90	1,592,000
Reserves under control of Australian Aluminium Production Commission.										
B	25.5	8	770,000	3.3	40.0	31.2	3.8	35.3	0.93	490,000
C	25	6	710,000	3.3	41.7	30.9	4.1	34.0	0.83	420,000
TOTAL			1,480,000	3.3	40.8	31.1	3.9	34.7	0.88	910,000

Two shaft logs typical of sections encountered in deposit B are given :

Depth Feet From	To	Field Description	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Analysis. Available Al_2O_3 %
		Shaft No. 14 1600N/800W				
0	2	Soil	-	-	-	-
2	7	Pisolitic laterite	4.7	42.2	33.6	31.2
7	12	Pisolitic laterite	2.2	40.7	33.9	36.1
12	17	Nodular laterite	2.2	42.2	29.1	39.9
17	21	Nodular laterite	2.2	41.9	25.8	40.5
21	25	Lateritized basalt	14.8	36.6	23.6	24.3
		Shaft No. 10. 1200S/300E.			Ignition Loss %	
0	2	Soil	-	-	-	-
2	7	Pisolitic laterite	-	-	17.9	30.2
7	12	Pisolitic laterite	-	-	18.0	30.3
12	17	Pisolitic laterite	-	-	15.8	30.6
17	22	Pisolitic laterite	-	-	16.0	29.2
22	25	Nodular laterite becoming clayey	-	-	19.2	31.5
25	26	Lateritized basalt	-	-	-	-

Reserves and composition of Bauxite.

Reserves proved in the main part of deposit B amount to 720,000 tons under 444,000 cubic yards of over-burden, and the two small detached areas together contain 160,000 tons beneath 90,000 cubic yards of overburden.

The composition of the total tonnage of economic bauxite in the deposit, viz., 880,000 tons has been computed from the weighted averages of composite samples from 8 shafts given in the following Table V.

TABLE V.

GRADE OF BAUXITE. DEPOSIT B.

Shaft No.	Thickness Feet.	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 "	Av. Al_2O_3 "	Na_2O loss Cwt.
14 *	14	2.7	40.4	29.3	4.3	36.5	0.75
8	15	3.0	42.0	26.3	3.7	36.6	0.72
13	9	1.9	39.4	33.1	3.6	37.4	0.48
19	20	3.6	29.8	33.8	3.4	34.2	0.95
XIIa.	7	2.2	44.9	29.8	3.2	41.1	0.82
VIII	18	3.7	36.9	34.1	4.2	32.8	1.20
VII	24	3.8	39.2	31.2	4.5	34.5	0.81
VIIa	18	3.5	41.6	28.6	3.3	36.6	1.03
880,000 tons		3.2	40.0	30.9	3.9	35.4	0.91
Excluding Shaft 14 770,000 tons		3.3	40.0	31.2	3.8	35.3	0.93

* Shaft 14 is outside the area taken up by A.A.F.C.

Overburden. The overburden ranges in thickness from 22 feet at Shaft VIII to 2 feet at Shaft 14, and averages about 10 feet. The bulk of it consists of pisolitic or nodular and earthy bauxite of which no complete analysis is available. The following few determinations are a guide to the composition of this material:-

Shaft No.	Depth Feet From	To	Field Description	SiO_2 %	Ign. Loss %	Al_2O_3 %
8	3	8	Pisolites and clay	N.D.	17.4	
13	3	13	Pisolitic laterite	N.D.	17.5	
XIIa	5.5	11	Hard mottled red and purple laterite	N.D.	18.3	28.9(a)
6	1	11	Pisolitic laterite	5.0	19.1	39.6(b)

(a) Available Alumina

(b) Total Alumina

The total volume of overburden covering the bauxite in deposit B is estimated at 534,000 cubic yards, of which 490,000 cubic yards overlies the reserves in the area taken up by the Aluminium Commission.

iii. Deposit C. General.

This deposit consists of three separate bodies of bauxite lying almost wholly in Portions 700,699 and 703, Parish of Strathbogie, and about 100 feet west fromdeposit B.

All of the known deposit, except for insignificant extensions into Portion 513, Parish of Scone, and parts underlying reserved roads, is held by the Aluminium Commission. The northern boundary of the deposit has not been adequately defined and it is possible that somewhat larger reserves exist than has been computed, but the area taken up by the Commission is adequate to contain any northern extension which may exist.

The principal bauxite zone occupies an elliptical area of 17.5 acres, 1200 feet from north to south by 800 feet wide. The two small detached areas in Portion 700 total about 7 acres, but the north-western body may be larger than the area which has been used for purposes of calculation.

This deposit is characterised by the presence of a higher proportion of pisolitic laterite than either deposits A and B. Furthermore, much of the pisolitic material is sufficiently high in alumina and low in silica to come within the definition of economic bauxite.

Logs of four shafts are given :

Depth Feet From	To	Field Description	SiO_2 %	Al_2O_3 %	Ign. Loss %	Av. Al_2O_3 %	Na_2O loss Cwt.
		Shaft No. & co-ordinates IX/2250N/3175W.					
0	2.5	Timber (inaccessible)	-	-	-	-	-
2.5	7.5	Loosely cemented pisolitic laterite	10.1[x]	42.8[x]	21.9	32.2	1.98
7.5	12.5	Loosely cemented pisolitic laterite	10.2[x]	40.0[x]	20.3	35.1	1.37
12.5	17.5	Loosely cemented pisolitic laterite	6.0[x]	40.2[x]	17.2	33.7	0.90
17.5	22	Loosely cemented pisolitic laterite	5.0[x]	42.0[x]	3.7	34.4	0.38
22	---	Bottom of shaft					
7.5	22	Composite sample	3.7	42.5	20.6	34.0	0.94
x	Determinations marked x taken from Booker and Hanlon op. cit.						
		Shaft No. X - 2050N/2175W					
0	5.5	Timber	-	-	-	-	-
5.5	10	Dense ferruginous laterite	-	-	22.8	37.3	0.85
10	15	Ditto with interstitial red earthy matter	-	-	23.0	36.0	0.92
15	19.5	Ditto, becoming softer and less ferruginous					
19.5	----	Bottom of shaft					
5.5	19.5	Composite sample	2.5	41.0	23.2	36.8	0.83
		Shaft No. 21 - 1200N/2000W					
0	4	Soil and brown clay	-	-	-	-	-
4	8	Brown clayey laterite	-	-	14.4	-	-
8	10	Brown clayey laterite	-	-	16.2	16.6	-
10	14	Soft brown laterite	-	-	18.2	23.2	-
14	18	Brown Pisolitic laterite		-	17.3	31.0	1.88
18	22	" " "	-	-	18.3	34.5	0.76
22	26	" " "	-	-	17.9	31.6	0.47
26	30	" " "	-	-	16.5	31.9	0.56
30	34	" " "	-	-	16.6	32.9	0.60
34	38	" " "	-	-	18.3	32.1	0.60
38	42	" " "	-	-	23.1	39.8	0.50
18	42	Composite sample	2.5	42.7	18.4	33.7	0.60

Depth From	Feet To	Field Description	SiO_2 %	Al_2O_3 %	Ign. Loss %	Av. Al_2O_3 %	Na_2O loss cwt.
	Shaft No. XI.	- 480N/2050W.					
0	1	Loose pisolites)					
1	2	Red earth with few pisolites)	-	-	15.9	29.4	-
2	3	Loosely cemented pisolites)					
3	8	Ditto	-	-	17.2	32.8	1.05
8	13	Ditto	-	-	16.8	32.0	0.93
13	18	Cemented pisolites	-	-	16.1	31.5	1.00
18	21	Cemented pisolites)					
21	23	Loosely cemented pisolites)	-	-	16.2	33.9	0.45
23	---	Bottom of shaft					
3	23	Composite sample	3.4	44.6	17.0	32.1	0.86

Reserves and Composition of Bauxite.

From the results of sampling 6 shafts, it is computed that Deposit C contains not less than 710,000 tons of economic bauxite beneath 420,000 cubic yards of overburden.

It is probable that additional sub-surface sampling might show a limited extension of bauxite to the north of the indicated limits, and it should be noted that the old shafts which were re-sampled (No. IX, X and XI) finished in fairly high-grade bauxite and presumably did not penetrate the entire thickness of ore. It is felt, therefore, that the tonnage estimate mentioned is perhaps conservative.

Composition of the bauxite reserves has been computed from sampling results as shown in Table VI.

TABLE VI.

GRADE OF BAUXITE. DEPOSIT C.

Shaft No.	Thickness Feet	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Avail Al_2O_3 %	Na_2O loss cwt.
IX	14.5	3.7	42.5	29.2	3.6	34.0	0.94
X	14	2.5	41.0	27.8	4.7	36.8	0.83
21	24	2.5	42.7	31.6	3.6	33.7	0.60
15	30	4.0	38.7	32.8	4.9	34.0	0.90
XI	20	3.4	44.6	31.3	3.6	32.1	0.90
710,000 tons		3.3	41.7	30.9	4.1	34.0	0.83

Overburden.

Thickness of overburden at the points tested ranges from 3 feet to a maximum of 19 feet. Descriptions and partial analyses of the overburden are given in the shaft logs quoted above. The bulk of the overburden is pisolitic with some nodular and earthy, laterite, and the total volume amounts to 420,000 cubic yards.

IV. Deposit D. General.

This deposit forms a small elliptical hill in Portion 512, Scone, lying 1000 feet north of Deposit B. The deposit is not included in any of the areas taken up by the Aluminium Commission.

One shaft was sunk from the highest point of the hill and was continued until it entered apparently siliceous lateritized basalt below 40 feet.

Channel samples from this shaft (No. 17 at 2800N/1000W) yielded the following results on analysis :

Depth Feet From	To	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av. Al_2O_3 %	Na_2O loss %
3	8	6.7	40.8	30.0	3.6	30.3	2.04
8	13	8.8	38.0	28.4	3.3	31.2	2.57
13	18	3.6	41.1	30.2	3.1	38.3	0.82
18	23	12.6	38.0	25.8	3.4	27.2	3.93
23	28	1.8	38.7	32.9	4.5	37.9	0.43
28	33	1.5	37.9	35.5	4.6	37.4	0.21
33	38	2.0	35.9	36.4	4.8	34.0	0.46
38	40	3.9	35.1	36.8	4.3	30.9	1.14

Reserves contained in this deposit calculated with and without the low-grade material above 23 feet, are given below :

TABLE VII.

GRADE OF BAUXITE. DEPOSIT D.

Tons	Si_2O %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av: Al_2O_3 %	NeO_2 loss cwt.	Overburden cu. yds.
100,000	5.3	38.6	31.2	3.9	33.8	1.04	18,000
or 40,000	1.8	38.5	34.9	4.7	36.4	0.36	45,000

2. INVERELL - No. 2 Area "Nullamanna East".

A. Summary.

A lateritic deposit lying just within the northern boundary of the Parish of Campbell, County of Gough in Portions 215, 216 and 222.

Testing the occurrence by shaft-sinking and boring revealed bauxite with a maximum thickness of 27.5 feet.

The bauxite occurs in a narrow body more than 3000 feet long west to east with an irregular width ranging up to 1,000 feet and averaging about 300 feet.

Irregularities in the thickness and depth of laterite are ascribed to faulting.

An extensive sub-surface prospecting campaign showed reserves amounting to 650,000 tons of the following composition:

3.0%	SiO_2
40.0%	Al_2O_3
29.7%	Fe_2O_3
4.4%	TiO_2
36.0%	Available Al_2O_3

0.77 cwt. Na_2O loss

B. Situation and Access.

The Nullamanna East deposit lies 9 miles north from Inverell by road and about ½ mile east of the Inverell to Emmaville road some 2 miles south of the village of Nullamanna.

C. Description of Deposit.

The plan (Plate 4) and Sections (Plate 5) indicate the topographical features of the area and show that the main body of bauxite forms the crest of a hill which rises prominently to about 100 feet above the plains to the south, and is crowned by a nearly vertical scarp of irregular height.

The main laterite body is crossed from north-west to south-east by a narrow faulted trough which is approximately parellel to the scarp that bounds the deposit on the south.

The downthrow of the trough is about 20 feet and its width 200 feet. A small block of laterite which has been tilted to a south-westerly dip occurs towards the eastern extremity of the area, and is separated from the main body by a small gully eroded along a faulted zone.

In the trough the bauxite zone lies beneath from 10 to 23 feet of low-grade laterite, some of which may be re-cemented detritus, but elsewhere the overburden is thin.

There is no pisolitic zone in evidence; the laterite consists of brown, red and grey earthy and massive material with irregular bands and patches of hard limonite.

Three shaft logs with partial analyses are given to indicate the nature of the laterite.

Depth feet. From	To.	Field Description.	Ign. loss %	Av. Al_2O_3 %	Na_2O loss cwt.
		Shaft 00/900W			
0	5	Hard brown bauxite	23.0	34.8	0.94
5	10	Hard brown bauxite	24.5	40.0	0.78
10	15	Hard brown bauxite	23.7	40.7	0.42
15	20	Greyish brown friable bauxite	24.7	41.3	0.34
20	25	Ditto	22.4	33.9	1.60
25	27.5	Ditto	27.3	34.2	0.91
27.5	----	Passing to decomposed basalt	-	-	-
0	27.5	Composite Sample : 2.8% SiO_2; 41.0% Al_2O_3; 26.2% Fe_2O_3; 37.3% Av. Al_2O_3; 0.79 cwt. Na_2O loss.			
		Shaft 800S/00			
0	3	Soil and rubble	-	-	-
3	8	Brown nodular bauxite	23.6	33.9	0.71
8	13	Grey and brown nodular bauxite	24.3	35.0	0.56
13	18	Hard nodules in grey friable matrix	22.8	39.3	0.48
18	21	Ditto, passing to decomposed basalt	21.0	26.8	-
21	23	Decomposed basalt	Not Sampled		-
3	18	Composite sample : 3.0% SiO_2; 38.6% Al_2O_3; 30.8% Fe_2O_3; 36.4% Av. Al_2O_3; 0.59 cwt. Na_2O loss.			
		Shaft 1200S/1400E			
0	4	Dark red earth	12.8	-	-
4	8	Yellow earth with red nodules	21.1	27.6	-
8	12	Ditto	24.3	38.1	0.74
12	15	Dark red earth	23.8	37.2	0.65
15	21	Red earth with red nodules	23.3	36.9	0.58
21	27	Ditto	22.4	37.0	0.50
27	31	Ditto	23.4	36.7	0.60
31	33.5	Mottled red clay)	14.8	-	-
33.5	35	Mottled yellow clay)			
8	31	Composite sample : 2.0% SiO_2; 38.4% Al_2O_3; 31.6% Fe_2O_3, 36.4% Av. Al_2O_3, 0.54 cwt. Na_2O loss.			

The bauxite zone contained in the main body of laterite is divided by a low-grade zone near the western end. The reserves estimated to be in each ore-body are given in Table VIII in the following order :-

1. Western ore-body within main area.
2. Main body.
3. Detached eastern area.

TABLE VIII.

	No. of Shafts sampled.	Tons	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av. Al_2O_3 %	Na_2O loss cwt.
1.	2	55,000	2.9	40.0	26.8	4.5	36.8	0.79
2.	12	550,000	2.9	39.3	29.7	4.4	36.0	0.77
3.	2	45,000	2.8	39.6	28.1	4.7	36.2	0.77

Overburden.

It is estimated that the three ore-bodies listed above are overlain by the following volumes of overburden :

1.	2,500 cubic yards
2.	200,000 cubic yards
3.	6,000 cubic yards
TOTAL	208,500 cubic yards

A partial analysis of overburden material is given in the log of Shaft 1200S/1400E above.

3. INVERELL. No. 3 Area. Champagne.

A. Summary.

The Champagne laterite deposit lies north-east from the village of Oakwood in Portions 72, 73, 74 and 75 Parish of Champagne, County of Arrawatta. A smaller deposit in Portions 79 and 80 is not described in this report but is shown on Plate 6. Sections of the main body are given in Plate 7.

Testing by both shaft sinking and boring revealed bauxite ranging up to 21 feet in thickness and averaging 12 feet thick over areas of 22.5 and 2.5 acres. Overburden is shallow, ranging from zero to 12 feet and averaging 4.5 feet.

Testing at 27 points within the bauxite zone and at 7 marginal positions revealed reserves of bauxite amounting to 740,000 tons containing -

3.6%	SiO_2
38.8%	Al_2O_3
29.5%	Fe_2O_3
5.0%	TiO_2
34.0%	Available Al_2O_3
1.04	Cwt. Na_2O loss.

B. Situation and Access

The deposit is accessible in dry weather by about 1½ miles of road from Oakwood. The track is quite impassable when wet.

C. Description of Deposit.

The ore deposit consists of two bodies; the principal one is a rectangular area 1,500 feet long from east to west by an average width of 600 feet, the other forming a small extension to the south-east.

To the west and south, the bauxite outcrops on the slopes of a wide gully which has cut down through the laterite profile to the parent basalt. On the north and east the laterite thins and passes under basalt.

Three shaft logs with partial analyses showing the sudden passage from low silica bauxite to kaolinized basalt are given. The deceptive appearance of the bauxite is well exemplified by the last log which is quoted in the original terms applied by the foreman.

Depth Feet		Field Description	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Ign. Loss %	Avail. Al_2O_3 %	Na_2O loss cwt.
		Shaft 300N/500E						
0	3	Nodular laterite with grey earthy matrix	7.1	33.3	33.3	19.4		
3	6	Grey bauxite	5.7	39.6	26.9	22.6		
6	9	Grey bauxite	3.6	42.4	24.4	24.2		
9	12	Grey bauxite	3.2	44.6	21.1	25.1		
12	15	Red bauxite	2.9	45.0	20.9	24.7		
15	18	Granular grey bauxite	2.3	38.3	31.9	21.9		
18	21	Granular grey bauxite	2.1	37.5	31.9	22.1		
21	24.5	Soft earthy bauxite passing to clay	1.9	35.3	35.4	20.8		
24.5	---	Weathered basalt			Not sampled			
6	24.5	Composite sample :	2.6	40.1	26.9	--	35.7	0.76
		Shaft 00/300E						
0	3	Bauxite nodules in soil	9.1	37.5	26.8	21.4	31.1	
3	6	Hard red bauxite	5.6	39.9	27.4	22.2	35.2	
6	9	Soft red bauxite	4.9	38.3	29.1	21.7	34.4	
9	12	Soft red bauxite	5.1	36.3	30.1	21.2	32.3	
12	15	Soft red bauxite	3.1	38.5	28.3	22.9	37.6	
15	18	Light red bauxite	1.8	38.0	30.1	22.7	36.5	
18	20.5	Weathered basalt	-	-	-	13.0	-	
3	18	Composite Sample	4.3	38.4	29.1	22.0	32.8	1.28

Depth Feet From	To	Field Description	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Ign. Loss %	Avail. Al_2O_3 %	Na_2O Loss cwt.
Shaft		300N/700E						
0	3	Nodules of bauxite in red soil	6.9	36.0	39.0	22.5	30.8	
3	6	Soft grey clay	3.7	36.4	32.6	22.3	32.6	
6	9	Soft red clay	3.9	34.3	35.3	20.3	30.1	
9	12	Soft red clay	3.8	36.8	32.7	21.4	34.5	
12	15	Soft dark red clay	2.9	36.7	32.7	21.4	33.7	
15	18	Soft dark red clay	2.9	36.2	32.9	21.2	33.1	
18	20	Dark red clay with seams showing basaltic texture	-	-	-	16.7	-	
3.	18	Calculated average	3.4	36.1	33.2	21.4	32.8	

Proved reserves of economic bauxite are given in Table IX.

TABLE IX.

GRADE AND TONNAGE OF BAUXITE

Tons	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av. Al_2O_3 %	Na_2O loss Cwt.	Overburden Cu. yds.
740,000	3.6	38.8	39.5	5.0	34.0	1.04	180,000

D. Overburden.

The overburden consists wholly of sub-standard laterite with the exception of a few inches of red soil mixed with fragments of laterite. A number of analyses of overburden material shows approximately the following composition :

SiO_2	5.7 to 10.4%
Al_2O_3	31.8 to 40.0%
Fe_2O_3	24.6 to 36.0%
TiO_2	3.3 to 5.9%
Avail. Al_2O_3	17.6 to 34.6%.

4. INVERELL. No. 4 Area. Lockwood's.

A. Summary.

The deposit known as Lockwood's forms a relatively thin capping of laterite on a low hill in Portion 113, Ph. of Byron, County of Arrawatta.

The zone of economic bauxite within the deposit occupies a rectangular area measuring about 800 feet from north to south by 360 feet wide, by an average thickness of 9.5 feet.

This small area was thoroughly tested with eight shafts yielding positive results and 11 showing thin bauxite or uneconomic material round the margins.

Proved reserves of economic bauxite amount to 140,000 long tons containing :

3.1%	SiO_2
38.5%	Al_2O_3
29.1%	Fe_2O_3
5.8%	TiO_2
34.9%	Available Al_2O_3

B. Situation and Access.

Lockwood's deposit lies about $\frac{3}{4}$ mile north-west of Parish's and two miles east from the village of Oakwood. Access is provided by an indifferent road from Oakwood suitable for dry weather use only.

C. Description of Deposit.

The laterite caps a small hill truncated at the northern end by a scarp which falls steeply to 45 feet below the crest level. To the east and south the slopes are gentle, and on the west the hill is separated by a saddle from a smaller prominence which is capped with basalt and has a narrow outcrop of laterite along its northern flank.

No pisolitic laterite or bauxite occurs in the deposit, most of the material is dense red laterite containing up to 36% Fe_2O_3 or granular bauxite retaining rather indistinctly the texture of the parent basalt and containing from 2.9 to 5.3% SiO_2 and from 32.6 to 43.4% Al_2O_3.

Tonnage, composition and volume of overburden calculated from the results of channel sampling in 8 shafts are given in Table X. below :-

TABLE X.

Tons	Bauxite						Overburden
	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av. Al_2O_3 %	Na_2O loss Cwt.	cu. yds.
140,000	3.1	38.5	29.1	5.8	34.9	0.80	44,000

Overburden.

The overburden consists of a thin layer of soil and boulders averaging 2 feet thick above low-alumina laterite which ranges in thickness from zero to 9.5 feet.

Typical composition of the laterite which constitutes overburden is :

7.1%	SiO_2
33.2%	Al_2O_3
33.2%	Fe_2O_3
6.2%	TiO_2
19.6%	Ignition loss
26.2%	Available Al_2O_3

5. INVERELL. No. 5 Area. "Parish's"

A. Summary.

The deposit known as "Parish's" occupies an area of approximately 2,800 by 1,000 yards in Portions 114, 115, 79, 67, 86 and 52, Parish of Byron, County of Arrawatta, and constitutes the largest proved body of economic bauxite known in Australia.

Of the total area occupied by bauxite approximately one half has been covered by basalt of a thickness known to exceed 40 feet which was extruded during Pliocene time after the process of lateritization had reached the stage represented by the present bauxite-laterite bodies.

For the purpose of computing reserves, it has been deemed that the cover of basalt would prevent economic exploitation of the bauxite beneath, and consequently large tonnages of bauxite underlying basalt have been excluded from the reserves.

Very thorough testing by shaft-sinking and boring proved reserves amounting to 4,760,000 tons of dry ore of the following composition :

3.2%	SiO_2
38.6%	Al_2O_3
30.1%	Fe_2O_3
5.0%	TiO_2
33.7%	Available Al_2O_3
1.00 cwt.	Na_2O loss.

B. Situation and Access.

The south-western extremity of the deposit in Portion 79 lies on the northern side of the Inverell-Yetman road within two hundred yards of the 10th mile post from Inverell.

C. Description of Deposit.

The deposit forms a roughly rectangular mass measuring 2,800 yards from south-west to north-east by an average width of about 1,000 yards.

Except for a small outlier in Portion 67, the deposit is bounded on the south by the channel of Appletree Gully which has cut through the Pliocene basalt to reveal an older valley partially filled with recemented detrital bauxite.

The bauxite outcrops in the banks of Appletree Gully and of lateral watercourses which drain southward from the crest of the deposit.

To the north and north-west, the Bauxite passes under Pliocene basalt, and sub-surface prospecting was not continued in this direction.

Depressions in the surface of the laterite caused partly by erosion and partly by faulting have been filled with the younger basalt, and these areas have been partly explored by boring.

The parent basalt, believed to be of Oligocene age, is exposed over relatively small areas on the northern, eastern and southern margins of the deposit.

Hand specimens of the bauxite do not show great variation. The dominant colour of the ore is brown and brownish-red, and the hardness ranges from a friable earth to a moderately hard, tough rock which may be broken with a hammer without much difficulty.

The mineral composition is not apparent to the unaided eye. In the main, the ore consists of a dull earthy mass, which may show minute crystalline flakes of gibbsite, and close inspection may reveal narrow veinlets and cavity linings of gibbsite.

Some of the bauxite has a fragmental appearance due to irregular distribution of iron. Near the base the bauxite exhibits a granular texture derived from the parent basalt.

Numerous analyses indicate that the ore consists of a mixture of clay, gibbsite and ferric oxide, leucoxeneand ilmenite, with minor amounts of boehmite, and limonite. Usually combined water is present in sufficient amount only to satisfy the gibbsite molecule and it is evident that most of the iron is present as anhydrous ferric oxide.

At least some of the bauxite in Appletree Gully is recemented detritus. One shaft sunk in this material showed it to be below economic limits.

A total of 343 shafts and bores were sunk on the deposit including many sunk through the younger basalt into laterite or bauxite.

The grade and tonnage figures here given have been calculated from results obtained by sampling 177 shafts and bores which gave positive results.

The sub-surface prospecting showed the economic bauxite to have a maximum thickness of 30 feet and to average 13.9 feet thick over a total area of 151½ acres. It was found that much sub-standard laterite occurred round the margins of the outcrop, especially in the southern, eastern and northern quarters. A few small outlying outcrops of laterite were tested and also found to be below acceptable grade.

The factor for computing tonnage was determined by measuring the volume occupied by a weighed sample freshly cut from a shaft. Duplicate samples packed in air-tight jars were sent to the laboratory for determination of moisture and specific gravity. It was found that the moisture content showed a range from 9.4 to 17.0 per cent and averaged 13.5 per cent. Specific gravity of dry ore ranged between 2.23 and 3.3 Field determinations of density showed a similar range and averaged about 136 pounds of moist bauxite per cubic foot in situ.

This figure is equivalent to 1.6 tons per cubic yard and this factor has been used for computing the reserves of moist ore containing 13.5 per cent of free water. It is to be expected that the moisture content will show much variation from place to place within the deposit according to the drainage conditions, and that there will also be marked seasonal fluctuations. Any figure which is accepted for moisture content is at best an approximation; nevertheless the application of an allowance for moisture enhances the accuracy of the tonnage calculation.

For convenience in calculating results as the work progressed the whole outcrop area was divided into square blocks with sides measuring 1,200 feet inlength. Some of these squares were found to contain no economic bauxite, but a total of fifteen included reserves ranging from 18,000 to 611,000 tons of dry ore.

The total reserves for the whole of Parish's deposit are set out in Table XI in which the separate results of each block are given to provide an indication of the ranges of composition encountered.

Overburden.

The salient figures for overburden are given in Table XI from which it will be seen that the ratio of overburden to bauxite is about 1 to 2.5.

This overburden consists mainly of sub-standard laterite but also includes weathered basalt in the marginal areas.

Two samples of loose earthy overburden from immediately below the surface were submitted to analysis with the following results :

	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Ign. Loss %	P_2O_3 %	Avail Al_2O_3 %
1.	4.0	35.5	35.2	3.1	21.0	0.29	29.8
2.	9.3	31.3	34.1	4.4	19.1	0.35	21.0

TABLE XI.

RESERVES PARISH'S DEPOSIT.

Block	Tons.	Average Thickness Feet.	BAUXITE. Analysis		
			SiO_2 %	Al_2O_3	Fe_2O_3 %
A	200,000	19.7	3.0	38	29.1
B	374,000	10.0	3.7	37.3	31.0
C	194,000	13.7	3.1	38.3	29.9
D	256,000	12.8	3.8	39.7	27.9
E	520,000	18.0	3.1	38.9	29.0
F	437,000	12.0	3.4	38.8	28.8
H	538,000	16.6	3.7	37.6	30.1
J.	608,000	15.0	2.6	39.2	30.2
K	18,000	9.0	4.0	37.5	29.3
L	23,000	12.0	4.6	37.5	28.7
M	81,000	11.0	3.7	38.7	29.5
N	374,000	12.4	4.6	40.5	28.1
O	606,000	16.6	2.6	37.4	31.0
P	426,000	16.4	2.4	38.8	29.9
Q	100,000	12.0	2.6	37.4	32.6
	4,755,000	14.25	3.2	38.6	30.1

TABLE XI.

RESERVES - PARISH'S DEPOSIT.

BAUXITE.			OVERBURDEN.		
Analysis			Max. thickness feet.	Average thickness feet.	Cubic Yards.
TiO_2 %	Available Al_2O_3 %	Na_2O loss cwt.			
4.6	34.3	0.90	11	5.4	40,000
4.3	32.8	1.23	12	6.4	175,000
5.3	32.7	1.03	12	9.4	97,400
4.8	33.4	1.21	14	7.3	119,000
5.2	34.1	0.91	10	5.7	120,300
4.8	33.8	0.99	15	3.5	93,000
5.3	32.1	1.11	14	6.4	151,700
5.3	34.1	0.78	12	5.5	163,000
5.1	31.7	1.32	2.5	2.5	2,000
5.5	32.1	1.66*	0	0	----
4.8	33.2	1.10	5	4.0	23,700
4.8	32.9	1.42	13.5	7.7	148,000
5.2	33.5	0.84	14	5.7	150,400
5.1	34.1	0.79	13	4.1	77,600
5.6	32.9	0.90	10.5	8.2	48,500
5.0	33.7	1.00	15	5.75	1,409,600

* The figures for Block L are the result of analysis of single composite sample. The average calculated from analyses of the three samples from which the composite was made, is :-

SiO_2	4.5%.
Al_2O_3	38.4%.
Fe_2O_3	28.5%.
TiO_2	5.7%.
Ign. loss	22.5%.
Av. Al_2O_3	33.9%.
Na_2O loss	1.34 cwt.

V. BAUXITE DEPOSITS ALIENATED TO INTERESTS OTHER THAN AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION.

1. EMMAVILLE. No. 1 Area. Strathbogie.

A. Description of Deposit A.

Two leases numbered 565 and 3109 held by the Broken Hill Pty.Co.Ltd. enclose this deposit which straddles the boundary between the Parishes of Scone and Strathbogie.

The accompanying plan (Plate 2) gives salient information including topographical form, positions of shafts, leases, and Parish boundaries.

The surface of the deposit is covered by thin reddish-brown soil containing fragments of laterite immediately overlying pisolitic or hard nodular laterite.

The log of one shaft (No. 16 at 2000N/1800E) near the centre of the deposit is given :

Depth Feet		Field Description	Analysis			
From	To		SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Avail. Al_2O_3. %
0	3	Red soil	-	-	-	-
3	8	Pisolitic laterite	16.7	35.5	26.7	24.9
8	13	Pisolitic laterite	5.6	38.9	32.3	33.8
13	18	Brown nodular laterite	4.4	39.8	32.9	34.9
18	23	Brown nodular laterite	4.6	37.3	34.0	33.5
23	28	Hard brown laterite	4.0	34.3	37.8	32.1
28	31	Hard brown laterite	3.5	40.4	29.8	36.5
31	33	Lateritized basalt	12.1	34.4	32.8	21.8
8	31	Composite sample	5.1	36.9	33.3	32.2

All samples from this shaft between 8 feet and 31 feet were found to yield sufficient "available alumina" with low enough soda consumption to come by a narrow margin within the Commission's definition of economic bauxite and for the purposes of this report, all material of similar composition will be referred to as ferruginous bauxite or simply bauxite.

It will be noted from the sections on Plate 3 that the pisolitic zone does not extend to the southern margin of the deposit from whence it has been removed by erosion.

Reserves and Composition of Bauxite.

Experience of other laterite bodies with bauxitic zones within them has shown irregularities of form which preclude highly accurate computation of reserves in the absence of closely spaced controls. Perusal ofearlier parts of this report dealing with other more exhaustively tested areas and reference to the cross-sections on the accompanying plates will have made this point clear.

It will be apparent that the accuracy of the estimation of both volume and composition of the ore-body will be proportional to the number of points tested in any given area.

In this present instance, the testing has been more limited than that applied to other areas and consequently it is probable that further work would reveal the presence of larger reserves than the figure herein given, viz. 1,300,000 tons. For example, it has been assumed on the negative evidence provided by one shaft at 200N/2450E that deposit A does not extend easterly beyond 2400E, whereas it is possible that a narrow tongue of bauxite may extend at least as far as 3800E increasing the reserves by some 300,000 tons.

For the purpose of calculating the reserves it has been assumed that the bauxite zone is lenticular in section and has an average thickness of 10 feet. On this basis the volume of economic bauxite amounts to 880,000 cubic yards equivalent to 1,300,000 long tons.

The composition has been computed from weighed averages of composite samples from Shafts III, 16,7 and 5. These analytical results are set out below in Table XII.

TABLE XII.

GRADE OF BAUXITE. DEPOSIT A.

Shaft No.	Thickness Feet.	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	TiO_2 %	Av. Al_2O_3 %	Na_2O loss Cwt.
III	30	2.1	39.2	33.9	3.5	33.8	0.54
16	23	5.1	36.9	33.3	3.4	32.2	1.21
7	20	7.5	38.3	27.8	4.0	35.8	0.90
5	15	3.8	42.4	25.9	3.7	38.4	1.18
1,300,000 tons :		4.4	39.0	31.0	3.6	34.7	0.89

Overburden.

The overburden consists of thin soil and laterite which is below the economic limits and cannot be regarded as bauxite.

The soil, which consists of reddish-brown pulverulent material containing abundant fragments of laterite, does not exceed a thickness of 3 feet on the crest of the deposit but may be thicker on the slopes. No analyses of this material have been made.

The remainder of the overburden consists chiefly of pisolitic bauxite of which an analysis is given in the shaft log quoted above.

The overburden covering deposit A has a maximum thickness of about 15 feet, and average about 7 feet. The total volume of overburden above the bauxite is estimated at 620,000 cubic yards.

2. EMMAVILLE DISTRICT. Area No. 6 Astley.

This deposit consists of eight separate flat-topped hills capped with bauxite lying in Portions 1,2,5,6,11 and 31, Parish of Astley, County of Arrawatta. Deepwater 28 miles east from the deposits is the nearest point of rail, and the distance to Inverell by road is about 38 miles.

The Broken Hill Pty.Co. Limited holds mining leases in Portions 1,2, 11 and 31 which include the greater part of the deposits.

Reserves have been estimated by the Mines Department of New South Wales from the results from seven shafts sunk in five of the bauxite bodies.

Analyses of samples showed compositions ranging from -

1.66% SiO_2 to 45.4% Al_2O_3

17.1% SiO_2 30.2% $Al2O_3$

It is estimated that the total reserves amount to 1,780,000 tons containing :-

4% SiO_2 : 39.2% Al_2O_3 : 31% Fe_2O_3

in addition to 500,000 tons of unknown composition.

Using the rather meagre information available the writer considers that the whole deposit may contain a total of 1,060,000 tons of economic bauxite of which 640,000 tons is alienated.

3. EMMAVILLE DISTRICT. No. 7 Areas. Lorne.

This deposit lies in Portions 29, 31, 32, 37, 36 and 34, Parish of Lorne, and Portion 11, Parish of Lockerby, County of Arrawatta, in a relatively inaccessible locality 45 miles by road from Deepwater.

The bauxite-bearing areas are held under lease by the Broken Hill Pty.Co. Limited.

The deposit forms three flat-topped hills capped with tubular and pisolitic laterite.

Results from the sampling of five shafts enabled the Mines Department of New South Wales to estimate 1,420,000 tons of reserves containing material ranging in composition from -

20.6% SiO_2 and 30.8% Free Al_2O_3
to 5.36% SiO_2 and 45.1% Free Al_2O_3
and 0.70% SiO_2 and 39.3% Free Al_2O_3

and averaging about -

5.2% SiO_2 : 40.3% Free Al_2O_3 : 26.3% Fe_2O_3.

4. EMMAVILLE DISTRICT. No. 8 Area. Scone.

No. 8 Deposit lies about 2 miles south-westerly from Emmaville and about 1½ miles east from No. 1 Deposit in Portions 520 and 521 Parish of Scone, County of Arrawatta.

The deposit forms a rounded hill with a steep slope to the east a gentle slope extending as a low ridge to the west. The average width of the deposit is about 750 feet and total length about 2,400 feet.

Bauxite is unusually thick at the eastern end and a shaft sunk from near the crest of the hill penetrated 43 feet of bauxite and bottomed in material assaying 2.7% SiO_2, 33.3% Al_2O_3, 36.9% Fe_2O_3.

The eastern extremity of the deposit is partly covered by a mining tenement M.L. 18.

Positive results from four shafts enabled the Mines Department to compute reserves as 800,000 tons of the following composition :-

	%
Free Al_2O_3	33.2
Total Al_2O_3	38.6
SiO_2	3.8
Fe_2O_3	31.1
TiO_2	4.1
Loss of Ignition	23.1

5. EMMAVILLE DISTRICT. No. 9 Area. Emmaville Common.

Deposit No. 8 lies on Emmaville Common and the adjoining Portions 41, 42 and 47, Parish of Hamilton, and Portions 46,73 237, 278 and 279, Parish of Strathbogie Borth, County of Arrawatta about 1½ miles west from the village of Emmaville.

The deposit has been examined by the Broken Hill Pty. Co. Ltd., but, presumably on account of the low grade, the Company allowed its tenure to lapse.

The Mines Department has estimated the tonnage of bauxite in the deposit to be approximately 985,000 tons of which the average composition is estimated by the writer to be 6.6% SiO_2 and 35.7% Al_2O_3.

It is probable that the deposit contains no bauxite acceptable by the Aluminium Commission.

6. INVERELL DISTRICT. No. 10 Area. "Wade's".

Wade's Deposit lies in Portion 358, Parish of Byron, County of Arrawatta, on the north side of the Inverell-Wariulda road at 4 miles from Inverell. At various times the Broken Hill Pty.Co.,Ltd., and other interested parties, have secured mining rights over the deposit, but in all instances the rights have been allowed to lapse.

The deposit consists of two narrowly separated bodies lying on the southern slope of a low flat-topped ridge. The westernmost body which is the larger of the two has been quarried for road material . See Plate 12.

The area has been examined and reported upon by officers of the Geological Survey of N.S.W. (Booker, and Hanlon.

Testing by the Commission was confined to the western body and included deepening of one of the old shafts previously sampled by the State Mines Department and the sinking of six additional shafts.

These shafts were inspected and sampled by the writer during April, 1947.

Only one shaft outside the quarry encountered bauxite, the remaining shafts 200 ft. and 400 ft. north, and 200 ft. south of the quarry, respectively, entered kaolinized basalt below a thin mantle of soil and detritus.

The log of Shafts 63 and the two shafts 200 feet north and south of Shaft 63 respectively, are given in full:

Shaft No. 3. Co-ordinate. 200S/00.

From	To	Description	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Ign. loss %
0	6	Red soil & clay	-	Not sampled		-
6	9	Red clay	27.9	24.5	30.3	10.5
9	13	Light brown granular weathered basalt passing to clay	26.3	24.9	30.9	11.5
13	17	Light brown and grey mottled clay (weathered basalt)	26.7	25.7	29.7	11.9
17	20.5	Ditto	26.2	24.8	31.3	11.7
20.5	26	Finely mottled white & brown clay (basalt)	31.8	29.0	22.2	13.1
26	33	Ditto	-	-	-	-
33	38	Red & Purple clay (basalt)	28.9	26.8	26.9	12.3

Shaft No. 63 Co-ordinates. 00/00.

From	To	Description	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Avail. Al_2O_3 %
0	9	Red soil & clay few nodules of bauxite	-	Not sampled		-
0	10	Nodular bauxite	12.4	39.3	23.5	28.9
10	12	Do. Nodules embedded in red clayey material	8.4	41.1	24.2	34.3
12	16	Red clayey material				
16	22	Dark purplish clay with few nodules	5.7	38.4	30.2	33.5
22	28	Ditto	5.1	36.6	32.6	32.8
28	32.5	Dark red earthy friable hard ferruginous nodules	4.8	40.2	28.0	35.8
32.5	34	Clayey material with few ferruginous nodules	3.8	36.8	34.7	32.5

Shaft No. 2. 200N/00.

From	To	Description	Ign. Loss %
0	6	Red soil and clay	-
6	8	Do. with fragments of bauxite)	12.6
8	9	Do. merging with weathered basalt)	
9	15	Weather basalt (red and grey clay)	12.7
15	20	Ditto	12.8
20	23.5	Ditto	Not sampled.

Samples cut from the north face of the quarry near the line of section yielded the following results on analysis :

Vert. Depth below surface feet		Description	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Avail. Al_2O_3 %
0	2.5	Red Soil	-	Not sampled		-
2.5	5.5	Nodules of hard basaltic bauxite in red soil	3.5¤	45.7¤	20.6¤	41.8*
5.5	9.5	Nodular bauxite	-	37	-	30
9.5	13.5	Nodules in soft friable earthy red matrix	8.0	38.7	27.0	32.7
13.5	17.5	Ditto	6.7	40.2	28.2	32.6
17.5	19.5	Ditto	-	Not sampled		-

A shaft sunk below the floor of the quarry was sampled by the N.S.W. Geological Surveyor with the following results :-

20	29.5	3.5	41.3	24.8	39.9ø
29.5	35	4.0	40.5	26.6	40.3ø

The results obtained by the Commission necessitated a drastic revision of the reserves previously estimated.

¤ Nodules only. No soil included in sample
ø Al_2O_3 sol. in 48% H_2SO_4

Total proved reserves are now estimated at :

110,000 tons with average thickness 24 feet, of following grades:-

SiO_2	5.8%
Al_2O_3	39.5%
Fe_2O_3	28.0%
Av. Al_2O_3	33.1%
Na_2O loss	1.4 cwt.

This bauxite is covered by 40,000 tons of overburden about 8 feet thick, consisting of red soil and clay with nodules and fragments of bauxite.

By rejecting the upper 5 feet of the bauxite included in the reserves given above the figures are brought to :-

Bauxite Tons	SiO_2 %	Al_2O_3 %	Av. Al_2O_3 %	NA_2O loss %	Overburden (Av. thickness 13 feet.) Tons.
90,000	5.1	39.5	35.3	1.2	60,000

It is possible that deepening of the old shafts at about 00/300E and 00/600E might disclose a relatively small addition to reserves under about 20 feet of overburden.

Eastern Deposit.

It was determined by inspection that the eastern body was too small to be of economic significance. Had the results of testing the larger western body shown a high grade of bauxite some testing of the eastern deposit might have been justified.

Inspection of the surface indicated that the total quantity of bauxite contained in this body might amount to 10,000 tons.

Conclusion.

It is improbable that this deposit could be regarded as a useful source of bauxite. The advantage that it possesses through proximity to the railway is offset by the low grade of the material. The nodular bauxite would be amenable to beneficiation by washing, but the quantity available is probably too small to justify the installation of a treatment plant.

7. TINGHA DISTRICT. No. 11 Area.

An apparently large deposit of laterite occurs on Crown Land near the northern boundary of the Parish of Swinton extending northwards into the Parish of Herbert.

Sampling of old tin mining shafts by geologists of the N.S.W. Mines Department revealed that laterite containing 30 per cent. or more of alumina was confined to a small area at the southern end of the occurrence at a point 2⅛ miles north of the village of Tingha.

It was estimated from the sampling of one shaft that the deposit contained approximately 140,000 tons of laterite assaying -

10.1%	SiO_2
43.1%	Al_2O_3
25.2%	Fe_2O_3
2.3%	TiO_2
22.5%	Ignition Loss
26.8%	Free Al_2O_3

From a critical examination of the individual shaft records it appears that reserves of economic bauxite as defined by the Aluminium Commission would amount to not more than 65,000 tons containing

4.7%	SiO_2
42%	Al_2O_3
30%	Fe_2O_3.

8. TINGHA DISTRICT. No.12 Area.

Deposit No. 12 lies in the Parishes of Clive and Swinton across the boundary between the Counties of Gough and Hardinge about 10 miles south of Inverell on the Tingha road.

The occurrence contains much pisolitic laterite but towards the south-western margin it is reported that the laterite becomes less ferruginous and more siliceous.

Only two shafts of the six that were sampled by the N.S.W. Mines Department showed bauxitic material with greater thickness than 5 feet. Silica ranged from 1.6 to 9.5 per cent and total alumina from 37.8 to 44.6 per cent.

The Mines Department estimate of reserves is 160,000 tons containing

5%	SiO_2
42.9%	Al_2O_3
29.5%	Fe_2O_3
2.2%	TiO_2
21.0%	Ignition loss
35.2%	Free Al_2O_3

The writer has examined this area and is in substantial agreement with the tonnage estimate here given.

9. TINGHA DISTRICT. No.13 Area.

This deposit consists of four separate bodies at Topper's Mountain 4 miles north-east from Tingha and about 23 miles by road south-east from Inverell.

These separate bodies lie in Portions 419, 229, 173, and 434, Parish of Herbert, County of Gough.

The Broken Hill Pty. Co. Limited. prospected the deposits by shaft-sinking and then made the results available to the New South Wales Department of Mines. With this information the Mines Department was able to estimate reserves at approximately 500,000 tons.

Using the Broken Hill Pty. Co.'s figures and the State Mines Department plan the writer estimates reserves of economic bauxite in Portions 229, 419, and 434 a t not less than 200,000 tons containing 4.7% SiO_2, 30.3% Fe_2O_3 and 39.5% Al_2O_3 soluble in sulphuric acid.

10. TINGHA DISTRICT. NO.14 Area.

This deposit is a small one forming a rounded hill in Portion 209, Parish of Swinton, County of Hardinge, about 2 miles north from Tingha.

Total reserves have been computed by the State Mines Department to be 60,000 tons of the following composition :-

5.5%	SiO_2
40.0%	Al_2O_3
33.1%	Fe_2O_3
29.3%	Free Al_2O_3 (Sol. in NaOH).

By rejection of high-silica material near the surface, the probable reserves are reduced to about 50,000 tons and the grade raised to :

3.6% SiO_2
40.4% Al_2O_3
32.8% Fe_2O_3
31.7% Free Al_2O_3 (sol. in NaOH)

VI. LOCALITIES EXAMINED AND ABANDONED BY THE AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION.

1. No.15 Pindaroi.

Pindaroi Station homestead lies between Inverell and Emmaville on the main road connecting the two places, and is about 26 miles north-north-east from the former and 18 miles west from Emmaville.

The bauxite deposit, which was inspected by the writer on 1st January, 1947, consists of a capping of laterite on the summit of a small isolated flat-topped hill. It is situated about two miles east of the homestead in the north-east corner of the Parish of Pindaroi, County of Arrawatta.

The possible reserves are very small and are estimated at about 25,000 tons of laterite, which was not sampled. It was considered that the deposit is too small to justify the work necessary for sub-surface sampling.

2. No. 16 Wellingrove.

A local resident drew attention to deposits of laterite in Portions 79, 113 and 112, Parish of Gordon, County of Gough about 5 miles north of Wellingrove.

Examination of the area revealed these deposits to be small remnants with a maximum thickness of four or five feet.

3. No. 17 11 Parran.

A very small residual of laterite in the south-west corner of Portion 36, Parish of Waterloo, County of Gough, was examined together with a large surrounding area. No deposit of any economic significance was found.

4. No. 18 Swanbrook.

A small outcrop of laterite occurs on the south side of the Inverell-King's Plains road in Portion 161 (?), Parish of Campbell, County of Gough, about 10 miles north-east from Inverell.

The outcrop which is very small, measuring about 100 feet across forms a small shoulder on an otherwise relatively uniform slope to the west.

The laterite passes under very thick cover of basalt on the north-east and east, but to the south-east underlies Tertiary gravel. In other directions about the periphery of the outcrop the underlying parent basalt is exposed.

5. No. 19 Wandera.

An area of 333 acres on the northern boundary of the Parish of Wandera, County of Arrawatta, including Portions 112 and 123, and the southern part of Portion 14, Parish of Nullamanna, contains three fairly prominent outcrops of laterite which were tested by sinking widely spaced pits at the most favourable positions.

Altogether 23 pits were sunk and only one encountered economic bauxite of any appreciable thickness. The laterite in this area is characterized by an unusually high silica content, even when the available alumina is relatively high, e.g. one sample assayed -

15.6% SiO_2; 30.3% Available Al_2O_3; 21.5% Ignition loss.

Nearly all the pits reached recognisable weathered basalt at less than 10 feet below the surface, thus indicating that the deposits in the area are in a late stage of denudation and represent only a siliceous and incompletely lateritized zone. It is probable that some at least of the silica contained in this laterite is detrital quartz of later origin.

In view of the disappointing results the area was abandoned.

6. No.20 Burgundy.

A dissected sheet of laterite covers a large area in Portion 38 and adjoining Portions, Parish of Burgundy, County of Arrawatta, about 13 miles north of Inverell.

Sampling of eleven shafts in Portion 38 showed the laterite to be thin and siliceous except for a small area where two adjacent shafts penetrated economic bauxite with a maximum thickness of 19 feet.

The total economic bauxite contained in the area amounts to about 65,000 tons of the following average composition :-

2.8% SiO_2; 36.9% Al_2O_3; 30,8% Fe_2O_3; 5.1% TiO_2; 34.2% Available Al_2O_3; Average soda loss - 0.94 cwt. Na_2O.

7. No. 21 McIntyre Park.

Several small outcrops of laterite in Portions 27, 28 and 141, Parish of Burgundy, County of Arrawatta, at 16 miles north of Inverell, were examined and a limited amount of testing by pit-sinking carried out.

Only negative results were obtained at the points selected for testing and the area was abandoned.

8. No.22 McCosker's.

This area occupies the eastern halves of Portions 404 and 405, Parish of Byron, County of Arrawatta, and lies about 1 mile east from the village of Oakwood and ½ mile south of the Champagne deposit described in Part 1 of this report.

McCosker's was the first area in the New England district to be examined by the Aluminium Commission, and although it was realised at a preliminary inspection that erosion of the laterite sheet is well advanced, it was decided to conduct a limited amount of exploration by shaft-sinking.

This exploration showed that the laterite is thin, and for the most part siliceous, and that the area as a whole contains no worthwhile quantity of economic bauxite.

The area contains three small separated bodies of laterite, formerly a continuous sheet, and testing revealed that the southern body in Portion 404 contained about 15,000 tons of bauxite giving the following average analysis ; -

5.3% SiO_2; 39.6% Al_2O_3; 26.0% Fe_2O_3; 6.0% TiO_2;
35.8% Avail. Al_2O_3; 1.26 cwt. Na_2O loss.

The northern outcrop in Portion 405 contains a similar quantity of bauxite of about the same grade.

9. No. 23 Cherrytree Hill.

Two occurrences of laterite lying about 7 miles north of Oakwood and 19 miles by road north-west from Inverell were tested by sub-surface sampling.

These occurrences proved to be relatively small remnants of laterite which form two low hills in Portion 422, Parish of Bannockburn, County of Arrawatta. One of these hills in the south-east corner of the Portion extends north-easterly in Portion 424, and the second lies about 1,800 feet west-north-west from the first.

Each outcrop was tested by two shafts, at 00/00 and 00/700W on the former and at 1400N/1500W and 1400N/2300W on the latter. The last mentioned shaft was placed too far down the western slope of the hill to encounter bauxite or laterite in situ.

Shaft 00/700W intersected 6 feet of good bauxite resting on kaolinized basalt but the shaft at 00/00 yielded a negative result.

On the second outcrop shaft 1400N/1500W revealed 8.5 feet of fairly good bauxite.

These results indicate the following probable tonnages and grades of bauxite :

	1st Outcrop	2nd Outcrop	Total
Tons	20,000	140,000	160,000
SiO_2%	1.7	2.9	2.7
Al_2O_3%	40.7	39.9	40.0
Fe_2O_3%	29.5	28.9	29.0
TiO_2%	3.7	3.6	3.6
Aw.Al_2O_3%	37.6	36.2	36.4
Na_2O loss cwt	0.43	0.84	0.79

The deposits are considered to be of little importance on account of their relative inaccessibility from Parish's area, which lies two miles east from Oakwood.

10. No. 24 Mt. Russell.

Five small areas of outcropping laterite occur along the boundary between the Counties of Murchison and Arrawatta, extending south-easterly for about 1½ miles from Portion 175, Parish of Bannockburn, County of Arrawatta to the north-west corner of Portion 180, Parish of Little Plain, County of Murchison. For convenience these deposits are designated A,B,C D and E from south to north. Deposit E lies 2 miles by road south-east from Mt. Russell railway station and 15 miles by road west-north-west from Inverell.

The locations of these deposits from south to north are:-

A. Por. 180. Ph. Little Plain Co. Murchison and adjoining portions.

B. Por. 11. Ph. Little Plain. Co. Murchison and adjoining portions.

C. Por. 231 Ph. Bannockburn. Co. Arra watta.

D. Por. 184 Ph. Little Plain. Co. Murchison.

E. Por. 323 Ph. Bannockburn. Co. Arrawatta.

Descriptions of the individual deposits follow:

A. This occurrence forms a small round hill capped by a thin band of bauxite under dark red weathered laterite. The possible area that could be underlain by bauxite is so small that the deposit cannot be regarded as of any importance.

One shaft sunk from the crest of the hill revealed 2.5 feet of bauxite containing 32.7% Available alumina beneath 10 feet of weathered ferruginous laterite, and resting on lateritized basalt.

B. A small hill, similar to the above, is capped with ferruginous laterite mainly present as residual boulders embedded in red earth. A shaft sunk from the top of the hill passed through earthy laterite into kaolinized basalt at 11 feet from the surface. The area is of no importance.

C. Very similar to A. The capping of laterite has a maximim thickness of 17 feet and a probable area of 120,000 square feet. The alumina content is low. Two shafts were sunk but neither encountered economic bauxite.

D. Very similar to the preceding three examples. At the crest of the hill a thickness of 8.5 feet of bauxite containing 33.3 per cent available alumina was sampled, but apparently the silica is high as the soda loss figure was 2.25 cwt. Na_2O per ton of alumina.

High silica and very limited reserves render this deposit valueless.

E. This deposit differs from the others in the locality in that it covers a greater area of lower relief. Hard redlaterite outcrops over most of an area measuring about 1,000 feet long from north to south by 400 feet wide. The laterite is well exposed in a shallow quarry near the northern end of the deposit. Three shafts sunk to test the deposit entered basalt at depths ranging from 10 feet to 14 feet.

A slightly greater thickness of laterite might have been penetrated had the shafts been placed 200 feet east of the positions chosen, but it is very unlikely that any notable difference in results would have been achieved. Only two samples were tested for available alumina and these yielded 23.8 and 18.8 per cent.

The occurrence consists of a relatively thin capping of ferruginous laterite which passes into the parent basalt at about 14 feet below the surface.

Except as a source of road material the deposit has no economic value.

11. No. 25 Little Plain.

Laterite outcrops on the north side of the Inverell to Warialda road 10 miles west of Inverell and about 600 yards from the road. The deposit passes easterly from Portion 180, Parish of Little Plain, County of Murchison into Portion 141, Parish of Bannockburn, County of Arrawatta.

The deposit forms a low red hill rising steeply on the south side about 30 feet above the general level and sloping away gently to the north and west. Six shallow pits were sunk on the crest and flanks of the outcrop, and results showed that the deposit is in the final stage of denudation and consists of a thin remnant of ferruginous laterite capping kaolinized basalt. The body of laterite occupies an area about 400 feet in diameter and has a maximum thickness of 5.5 feet.

Only two samples, of a total of 22, lost more than 18.5% on ignition and these two assayed :

	Thickness	Ignition loss	Available Al_2O_3
1.	3 feet	19.0%	23.7%
2.	5.5 feet	20.8%	28.7%

An apparently somewhat larger deposit of similar appearance in Portions 139 and 140, Parish of Bannockburn, was not tested.

12. No.26. Station 2NZ

Laterite forms a small prominent hill on the south side of the Inverell to Warialda road at 11 miles west from Inverell. The hill which straddles the boundary between Portion 357, Parish of Bannockburn, County of Arrawatta, and Portion 27, Parish of Gum Flat, County of Murchison, is flat-topped and stands about 60 feet above the surrounding surface. The crest of the hill is about 800 feet long from north to south and about 300 feet wide. The southern end of the hill in the Parish of Gum Flat is occupied by the transmitter of broadcasting station 2NZ.

Two trial pits were sunk. The northern one revealed 4 feet of yellowish laterite containing 24.3 per cent. of Available alumina, and the other shaft 700 feet south, yielded 11.5 feet of siliceous ferruginous bauxite containing 30.5 per cent. Available alumina which was extracted with a loss of 2.29 cwt. Na_2O per ton. It is obvious from these results that the deposit is not of commercial value as a source of bauxite.

Pisolitic laterite also occurs to the north-east of Station 2NZ in Portions 357 and 356 and the Travelling Stock Route adjoining the Warialda road. A road quarry has been opened in the deposit; a shaft sunk in the floor of the quarry by Broken Hill Pty. Co.Ltd., showed a thickness of 10.5 feet of laterite of the following average composition:

11% SiO_2; 27%Fe_2O_3; 36% Al_2O_3 (sol. in H_2SO_4).

The southerly extension of the deposit was not tested in view of the unfavourable results obtained at Station 2NZ and on the northern side of the Warialda road in Portion 141 (Deposit 25.)

13. No.27 Garley's etc.

A discontinuous sheet of laterite in Portions 79,80, 82, 83, 109, 144 and 168, Parish of Auburn Vale, County of Hardinge occupying an area of approximately 600 acres was tested by groups of shafts at three points, without disclosing the presence of economic bauxite.

On Garley's property, portion 80, one shaft showed a total thickness of 17.5 feet of siliceous bauxite containing 8.1% SiO_2 and 32% Available Al_2O_3 extracted with a loss of alkali equivalent to 2.2 cwt. Na_2O per ton of Al_2O_3.

The best result obtained on Portion 144 (Humphries') was 11.9% SiO_2; 30.6% Available Al_2O_3 with soda loss equivalent to 3.67 cwt. Na_2O.

On Portion 83 (McDonald's) the least unsatisfactory result was 4 feet of bauxite containing 4.8% SiO_2; 33.4% Available Al_2O_3, with 1.46 cwt. Na_2O consumption, under 1 foot of soil and 7 feet of laterite containing 31.9% Available Al_2O_3 extractable with a loss of 1.47 cwt. Na_2O per ton of alumina.

14. No. 28. Bundarra Road.

Deposit No.28 is situated on Portions 38, 43,73, 276, 406 and 409, Parish of Clive, County of Gough about 10 miles south of Inverell on the road to Bundarra.

Fifty-two channel samples were taken by members of New South Wales Geological Survey from 20 old shafts and eight samples were taken of ferruginous pisolitic laterite exposed in shallow quarry faces.

The 60 samples taken were examined in the Mines Department laboratory for alumina soluble in caustic soda solution, and it was found that 25 samples contained less than 20 per cent, and only 4 samples contained more than 30 per cent "free" alumina.

In view of these results, it was considered that no examination of the deposit by the Aluminium Commission was necessary.

VII. ACKNOWLEDGMENTS.

As indicated at various places in this report much information and many of the tonnage and assay figures given in Table II and Part IV have been taken from an unpublished report (cited below) by Messrs. F.W. Booker & F.N. Hanlon of the Geological Survey of New South Wales. In addition the writer is indebted to Mr. Hanlom for helpful discussion regarding the laterite occurrences of the New England district.

It will be noted that a considerable discrepancy exists between the estimates made by the Mines Department for Wade's (No.10) deposit and the figures given herein. A similar difference, but of lesser magnitude, occurs in the respective estimates of the reserves at No. 1 Area, Emmaville. When considering such discrepancies it must be borne in mind that strict comparison between the results of the two investigations is not easy. Different methods of analysis of the samples were used and much material included in the Mines Department estimates failed to reach the minimum grade of economic bauxite as defined by the Aluminium Commission, and therefore was excluded.

The sinking of manyadditional shafts and bores by the Commission yielded a wealth of detail that was not available during the initial survey, and permitted a more accurate definition of the boundaries of deposits than had been possible previously.

Except where the contrary is evident from the text all chemical analyses herein are by R.A. Dunt, Chief Chemist, Australian Aluminium Production Commission.

H.B. OWEN.
Senior Geologist.

CANBERRA.
MAY 1949.

REFERENCE:

Booker F.W., and Hanlon F.N. : The Bauxite Deposits of the Tingha-Inverell-Emmaville District. Geological Survey of N.S.W.Department of Mines, Sydney. 1944. Unpublished.

EXPLANATORY NOTES TO ACCOMPANY

PLATES

Plate 2 — In this, as in following plates, except Plate 12, the word NIL at a shaft denotes the absence of economic bauxite and does not necessarily imply that the shaft is outside the body of laterite. The boundary of the laterite is not shown in Plate 2 but numerous points on the periphery of the body are shown by the sections in Plate 3.

Plates 3, 4, 5,7,8, & 10. — Economic bauxite as shown in the sections has been determined on chemical data. In some instances the economic bauxite shown in section is both too thin and too deep to be recovered economically. Such ore is not included in the "areas underlain by economic bauxite" shown on the corresponding plans.

Plate 12 — Shafts marked NIL entered kaolinized basalt beneath soil cover.

Topographic heights are based on an independent assumed datum at each area approximately related to sea level.

MINERAGRAPHIC INVESTIGATIONS,

OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

REPORT NO. 395.

UNIVERSITY OF MELBOURNE,
5th November, 1948.

Ferruginous Bauxite from Inverell, N.S.W.

A series of nine specimens from the ferruginous bauxite deposit on portion 114, Parish of Byron, County of Arrawatta, 10 miles NW. of Inverell, N.S.W. has been submitted by the Australian Aluminium Production Commission for examination with reference to their mineral composition.

The localities from which the specimens were taken are as follows:-

1. Typical outcropping bauxite, from approx. 500 N./1100 W.
2. Sample at 3 ft. depth, from shaft at 200 S./300 W., from near the contact of later basalt.
3. Sample of hard brown bauxite at 6.5 ft. depth, same shaft as No. 2.
4. Sample of softer brown bauxite at 8.5 ft., same shaft as No.2.
5. Sample of brown bauxite at 11 ft., same shaft as No.2.
6. Hard lumps from bore core, at depth of 10 to 12.5 ft., in bore at 2600 S./2300 W.
7. Hard lumps from same bore core, at depth of 12.5 to 15 ft.
8. Hard lumps from same bore core at depth of 15 to 17.5 ft.
9. Parent basalt from outcrop at 2200 S./1600 E.

Analyses of the bauxite specimens were provided by Mr. R. A. Dunt, Chief Chemist of the Australian Aluminium Production Commission, and are as follows:-

SiO_2	2.5	23.5	2.9	3.5	3.6	15.4	8.2	6.2
Al_2O_3	44.7	29.9	44.4	39.6	38.5	37.2	42.2	39.8
Fe_2O_3	23.1	22.1	23.6	28.9	30.3	25.6	28.0	28.5
TiO_2	3.1	5.0	3.1	3.3	2.7	4.7	5.2	4.9
Ignition loss	26.2	18.4	26.0	24.0	23.2	15.3	15.1	20.0
P_2O_5	0.27	0.17	0.18	0.25	0.24	0.28	0.34	0.35
V_2O_5	0.05	0.07	0.05	0.04	0.04	0.07	0.07	0.06
Cr_2O_3	0.04	0.05	0.04	0.04	0.06	0.03	0.05	0.05
	99.96	99.19	100.27	99.63	98.64	98.58	99.16	99.86
Available Al_2O_3	40.5	8.4	40.4	34.0	33.7	16.7	28.1	28.1
Na_2O loss in cwt/ton of Al_2O_3 extracted	0.69	-	0.65	1.01	0.77	8.35	2.73	1.71

Minerag. Report No.395

Examination of thin sections of the specimensregeals that they are derived from olivine-basalt, or related tuffs; and that they consist essentially of gibbsite, cliachite[xx], limonite, and clay minerals, in varying proportions, with minor amounts of ilmenite, leucoxene and (?) iddingsite (Fe_2O_3, MgO,3SiO2, $4H_2O$).

Gibbsite is the main aluminous mineral present. Much of it occurs as microcrystalline grains intermixed with limonite, with the individual crystals not more than 10 to 15 microns across. In places, however, the gibbsite is concentrated into relatively iron-free areas, 2 to 3 mm. across, where it occurs as clusters of spherulites, with individual spherulites up to 0.1 mm. across. It also tends to occur as relatively coarse crystals lining open spaces that are encrusted by the linonite. It is readily distinguished by its low polarisation colours, positive interference figure, and small optic axial angle. Its refractive index is about 1.535, and the coarser grains show a prominent cleavage, and in some instances lamellar twinning, with oblique extinction.

It occurs in part as pseudomorphs after felspar laths, and after olivine, the original minerals being replaced by a mosaic of fine crystals of gibbsite. The outline of the original mineral is commonly preserved by a narrow rim of limonite.

The clay, which is presumed to be a koalin, is not easily recognised in some sections, and is generally a minor constituent, except in Specimen No.2, in which it comprises the bulk of the rock. In specimen No.6 which has a pronounced relict basaltic texture, coupled with high silica and low available alumina, the clay mineral can be observed as occasional patches up to 0.1 mm. across and as innumerable minute greyish particles, a few microns across, dispersed through the areas of fine-grained gibbsite, giving it a dusty appearance. In Specimen No.8 which has much the same preservation of basaltic texture, the clay is not so readily detected, which conforms with the lower silica and higher though still low available alumina content of this rock. Specimen No.7 though chemically similar to No.8, has much less relict texture, and in it the gibbsite tends to occur in clusters of clear spherulites, up to 3.0 mm. across. The original form of the olivine phenocrysts which were 0.5 to 1.5 n.m. across, can still be distinguished, but much of the rock has been converted to cliachite or areas of reddish brown limonite with cores of cryptocrystalline gibbsite. In No.5 a clot of clay aboutl.0 mm. across occurs as a pseudomorph after a felspar phenocryst. In Nos. 6 and 8 the original ilmenite of the basalt is retained as numerous lath-shaped crystals about 0.2 x 0.02 mm., but in No.7 a proportion of the ilmenite has been altered to leucoxene. The leucoxene tends to occur partly as distinct grains, and partly as a fine dust dispersed through a cloudy grey area that apparently marks the position of a grain of titaniferous pyroxene.

Cliachite occurs chiefly in the rocks which have lost theiroriginal basaltic texture, and tends to be associated with areas of brownish limonite, which may be aluminous, and commonly shows colloform textures. It is more abundant in Specimen 3, 4 and 5 from the shaft, than in Specimens 6, 7, and 8 from the bore.

The limonite in the bauxites varies considerably in colour, presumably as a result of varying degree ofhydration. Much of it is reddish-brown to golden-brown and isotropic. Such limonite commonly shows colloform textures, and shrinkage cracks, and is evidently a gel. Some of it shows anomalous polarisation colours, indicating dehydration, and crystallization as either geothite or lepidocrocite. The golden-yellow limonite showing these features probably approximates to lepidocrocite; the reddish-brown limonite that is anisotropic approximates to goethite.

The limonite forming the rims of the altered olivine crystals is severely dehydrated. Some of it takes a good polish and is isotropic. Much of the limonite replacing the olivine phenocrysts, and also the small olivine crystals o.05 to 0.1 mm. across originally present in the groundmass of the basalt, is pleochroic and anisotropic, and bears considerable resemblance to iddingsite. In some instances it forms the whole of the pseudomorph; in others it occurs as a replacement of a fibrous alteration product (serpentine) that developed in the original olivine along cross fractures. Some of this material has quite high polarisation colours, and appears to have relatively low fractive index, so that it may be iddingsite. However, much of the limonite-gel in the bauxite also has a relatively low refractive index. In view of the fact that iddingsite is known to form as a deuteric mineral, and not as a weathering product of olivine in basalts, it is thought that this mineral is an anisotropic form of limonite, rather than iddingsite; but it must be a hydrated mineral, and it probably contains some magnesium, because an occasional olivine grain retains a residual core of olivine.

Specimen No.2 differs from the others in the suite in that it appears to consist essentially of clay, with some dispersed microcrystalline gibbsite, and fine grained quartz through which are scattered occasional sharply defined fragments of bauxite, consisting of gibbsite and limonite, and showing typical relict basaltic texture. The extremely high silica, low total alumina, and very low available alumina corresponds well with the mineralogical appearance. The high titania is not readily explicable, however. The titania must occur as finely divided leucoxene, masked by the clay minerals, or absorbed into the clay.

(Sgd.) AUSTIN EDWARDS.
8.11.48.

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xx The term cliachite is used here in the sense of Rogers and Kerr. Optical Mineralogy, McGraw-Hill, 1942, to indicate an amorphous form of hydrated alumina. Much of it is light coloured, when it probably approximates to gibbsite in composition, but some contains a variable proportion of iron oxide and appears brownish or reddish.

It seems likely that there is a complete gradation from alumina-gel to ferric hydrate-gel.

The term cliachite is intended to specify the material in which alumina predominates over iron oxide. It corresponds to the "amorphous bauxite" of some authors.

MAP OF PART OF NEW ENGLAND DISTRICT, NEW SOUTH WALES, SHOWING BAUXITE AREAS MENTIONED IN THE ACCOMPANYING REPORT.

Scale : 1 in = 4 miles

Bauxite deposits held by A.A.P.C. shown .... ▲3
Others shown .. △

ASHFORD
BARNYARE RIVER
SEVERN RIVER
GRAMAN
BUKKULLA
CHERRY TREE HILL
EMMAVILLE
DEEPWATER
OAKWOOD
NULLAMANNA
WELLINGROVE
MT RUSSELL
To Moree
INVERELL
Gwydir Highway
Waterloo Range
GLEN INNES
New England Highway
DIVIDING RANGE
GREAT
To Armidale
TINGHA

△7 △6 △15 ▲1 △8 9△ △16 △17 △20 ▲3 △22 ▲4 ▲5 19△ ▲2 △18 △25 △26 △24 △10 △27 △23 △21 △28 △12 △11 △14 △13

PARISH of SCONE

PARISH of STRATHBOGIE

PARISH BOUNDARY

Deposit A

Deposit B

P.M.L. 19
LEASE No 565

P.M.L. 10
LEASE No 3114

P.M.L. 10
LEASE No 3109

Excision Line

513

700

703

38

699

29

35

702

BAUXITE DEPOSITS
PHS. OF STRATHBOGIE AND SCONE
COUNTY OF GOUGH

0 100 300 500 700 feet

Topographic Survey by John McDowall & T.C. Hughes.

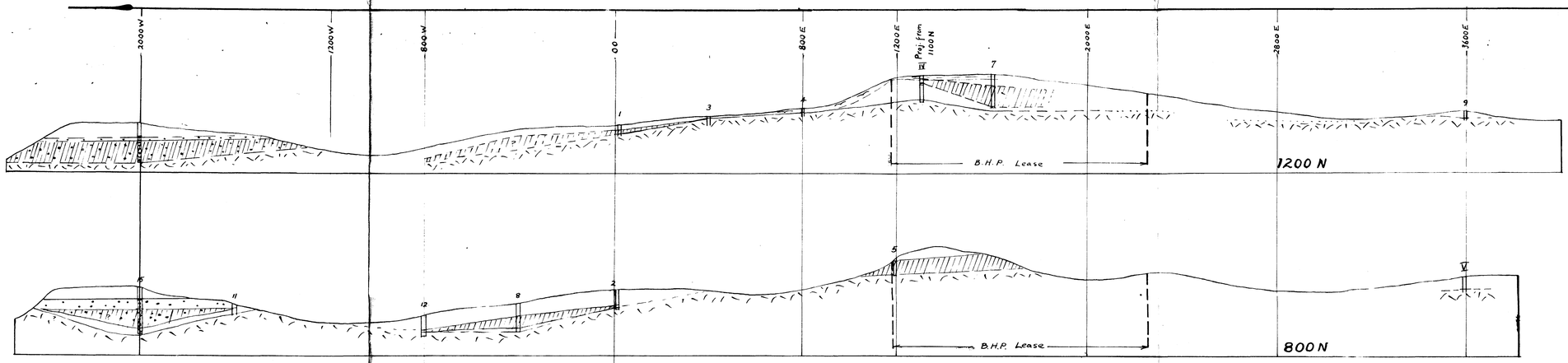
H.D. Clarke.
Bureau of Mineral Resources
September 1949

N

Shafts shown thus 16 8/23 2133'
where
16 is Shaft Number
8 " thickness of overburden in feet
23 " " " bauxite " "
2133' " R.L. at Shaft Collar.

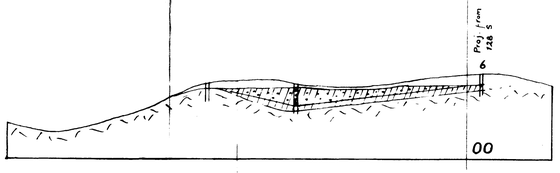
Areas underlain by economic bauxite shown thus

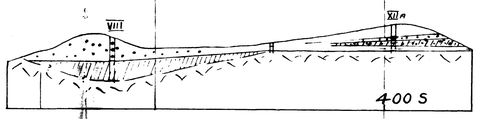
Plate 2

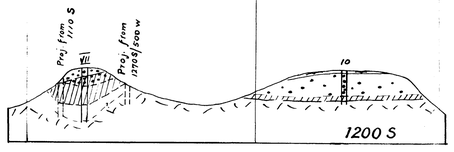


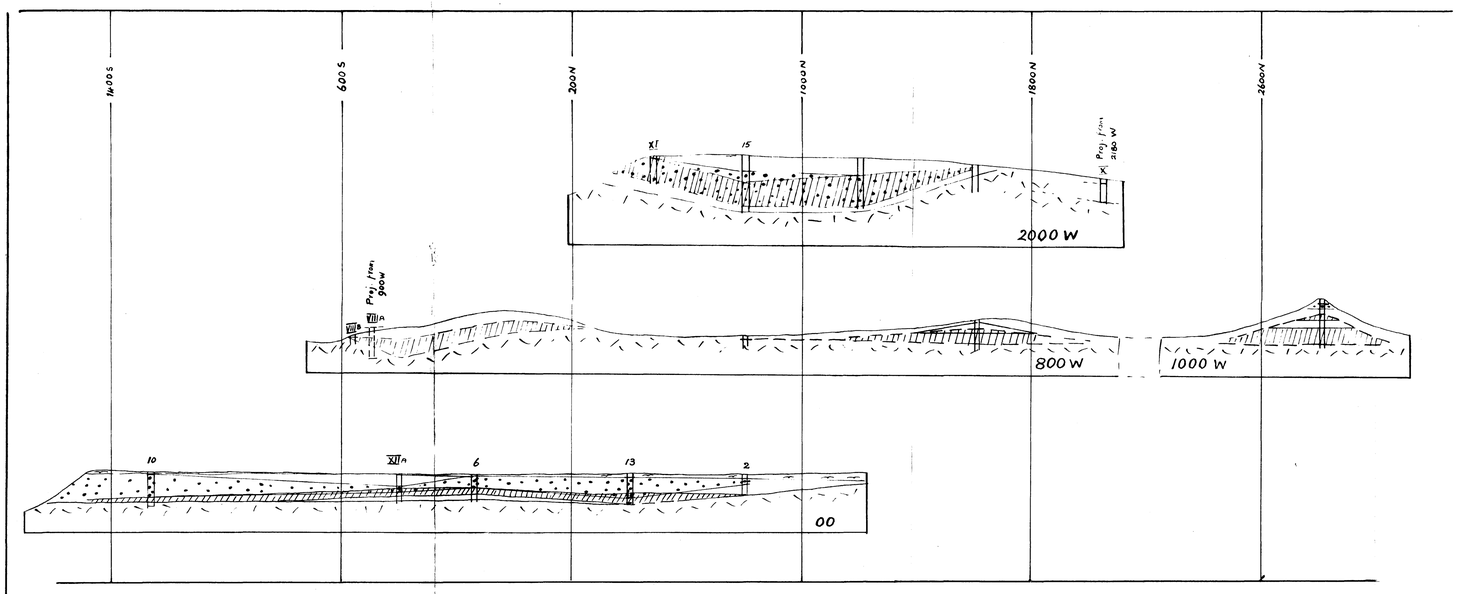
Legend.

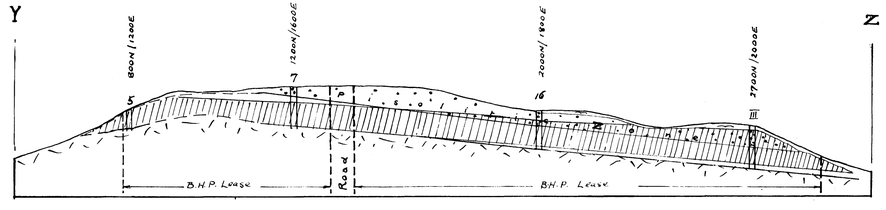
- Economic bauxite
- Uneconomic bauxite
- Pisolitic zone
- Lateritized & kaolinized basalt











Sections

Bauxite Deposit near Emmaville

Phs. of Strathbogie & Scone, Co. Gough.

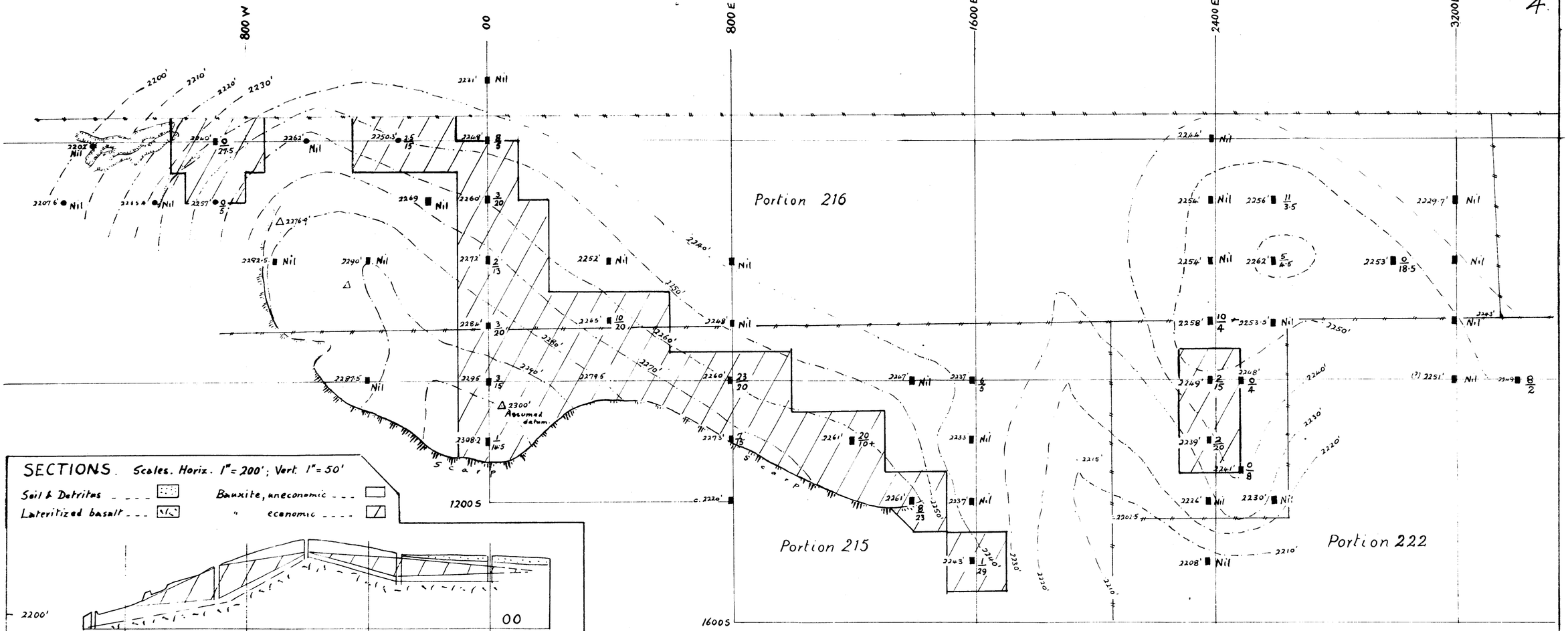
N.S.W

Horiz. scale : 1" = 200'

Vert. scale : 1" = 50'

H.B. Owen.
March 1949.

Plate 3



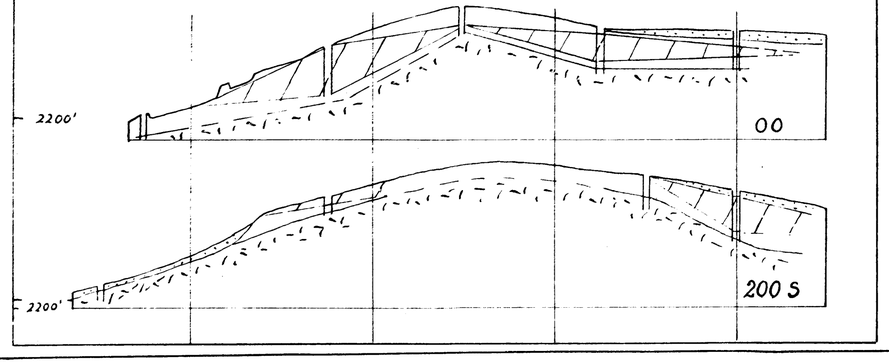
SECTIONS. Scales. Horiz. 1" = 200'; Vert. 1" = 50'

Soil & Detritus

Lateritized basalt

Bauxite, uneconomic

" economic



BAUXITE DEPOSIT

Ph. Campbell : Co. Gough

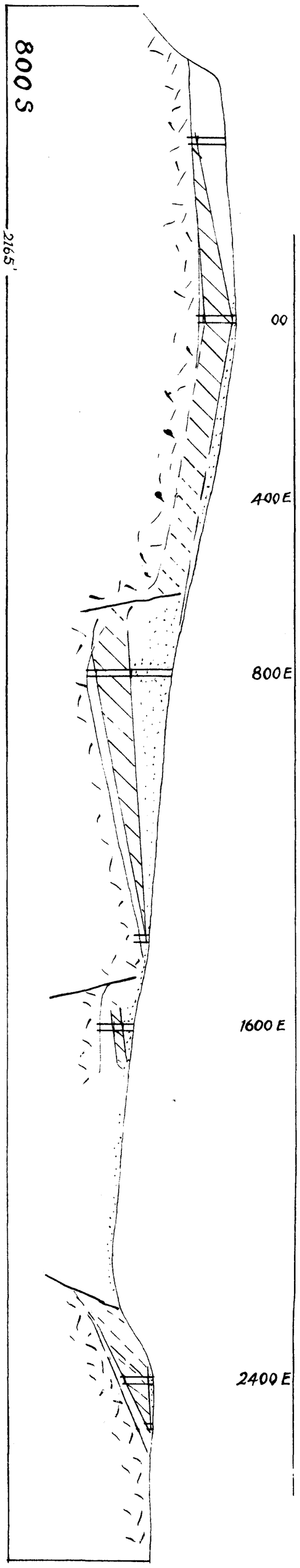
N. S. W.

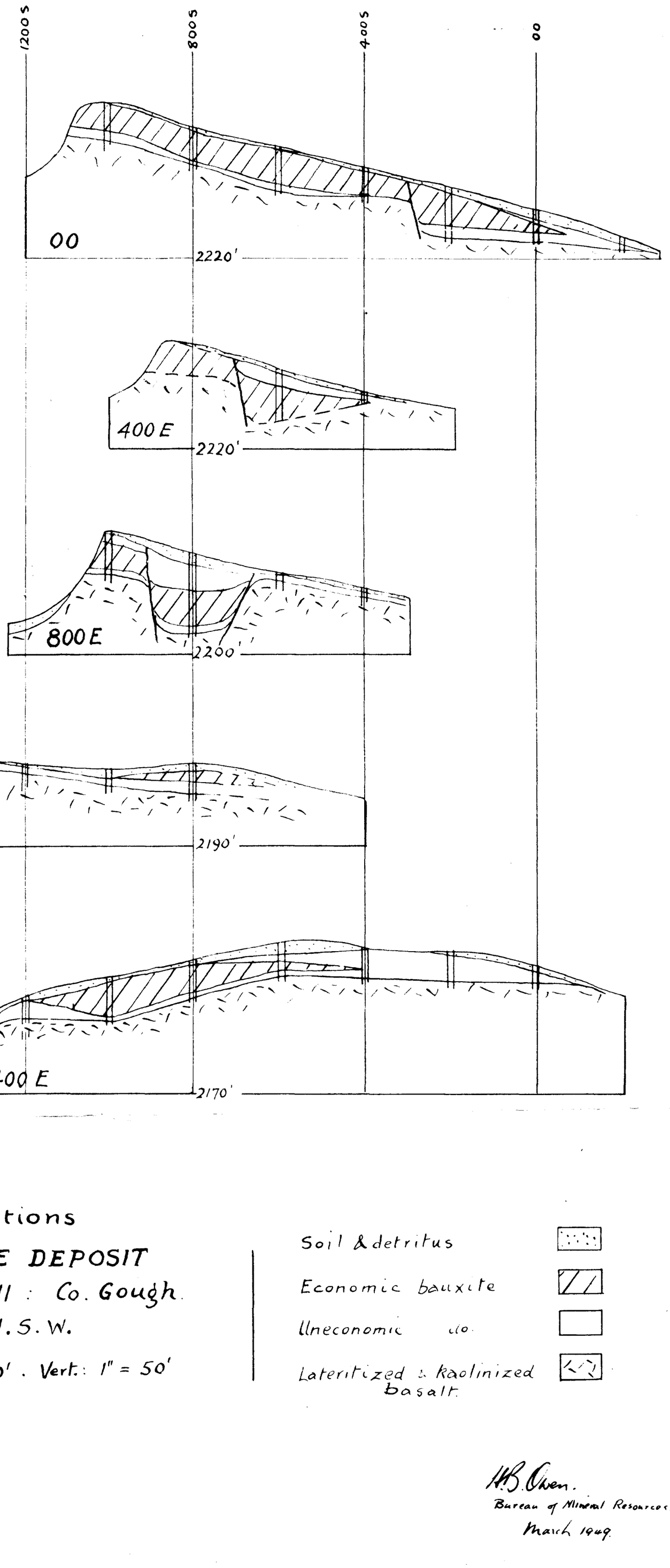
Also known as "Nullamanna East" Deposit

Scale : 1 in = 200 ft.

Areas underlain by economic bauxite shown

H.G. Owen
Bureau of Mineral Resources
March 1969





Sections
BAUXITE DEPOSIT
Ph. Campbell : Co. Gough.
N.S.W.

Horiz.: 1" = 200' . Vert.: 1" = 50'

Soil & detritus

Economic bauxite

Uneconomic do.

Lateritized & kaolinized basalt

H.B. Owen.
Bureau of Mineral Resources.
March 1949.

Plan of BAUXITE DEPOSITS

Ph. Champagne : Co. Arrawalta

N. S. W

Scale : 1" = 200'

Basalt : post-laterite _ _ _ _ _ _ ^

Laterite, including bauxite _ _ _ _ _ +

Basalt, parental to laterite _ _ _ _ V

Figures at shafts and bores indicate depth to and thickness of economic bauxite in feet.

Area underlain by economic bauxite ....

Portion 72

Portion 73

Portion 74

Portion 75

Portion 79

Portion 80

1500W 1100W 700W 300W 100E 500E 900E 1300E

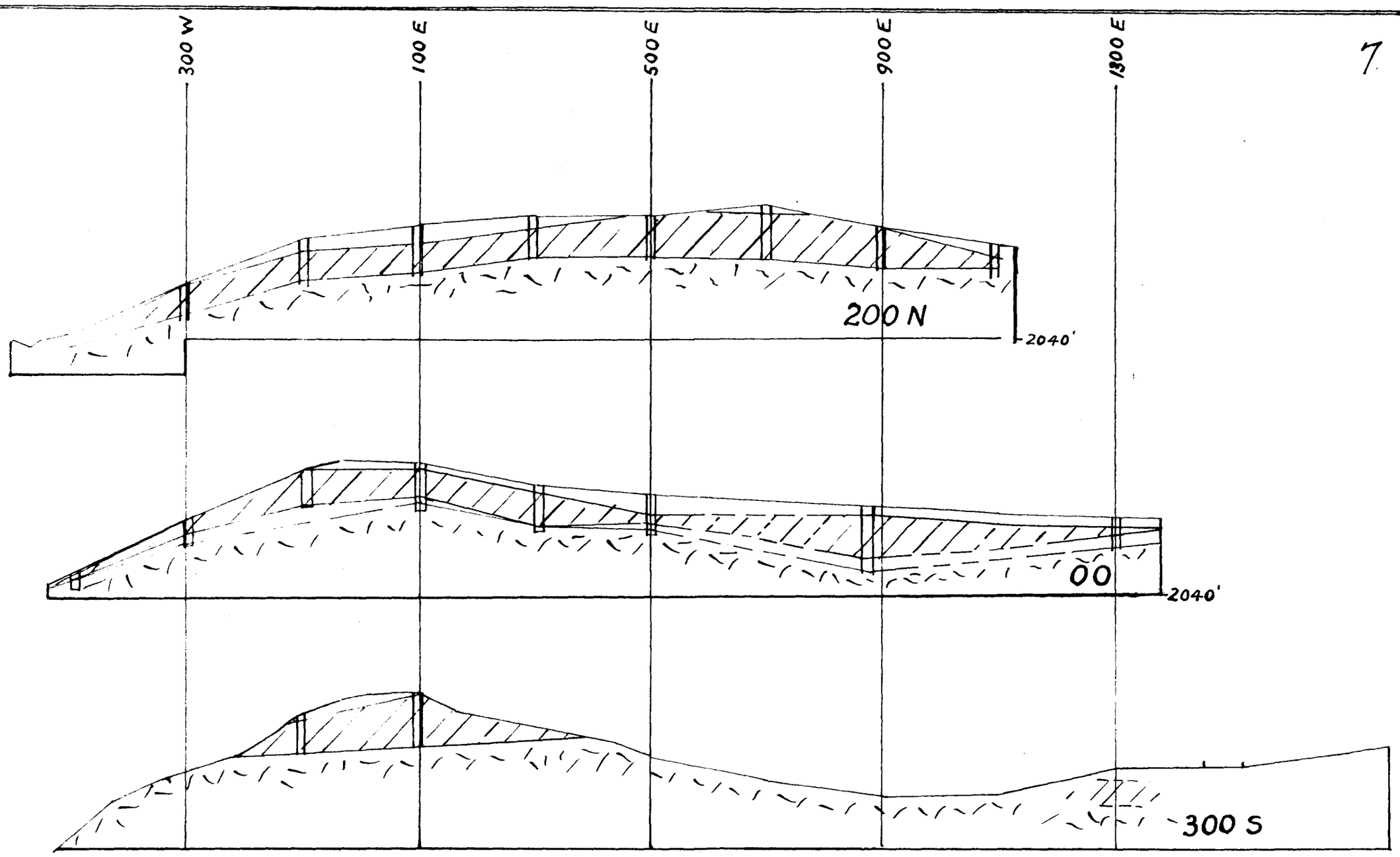
400N 00 400S 800S 1600S 2000S

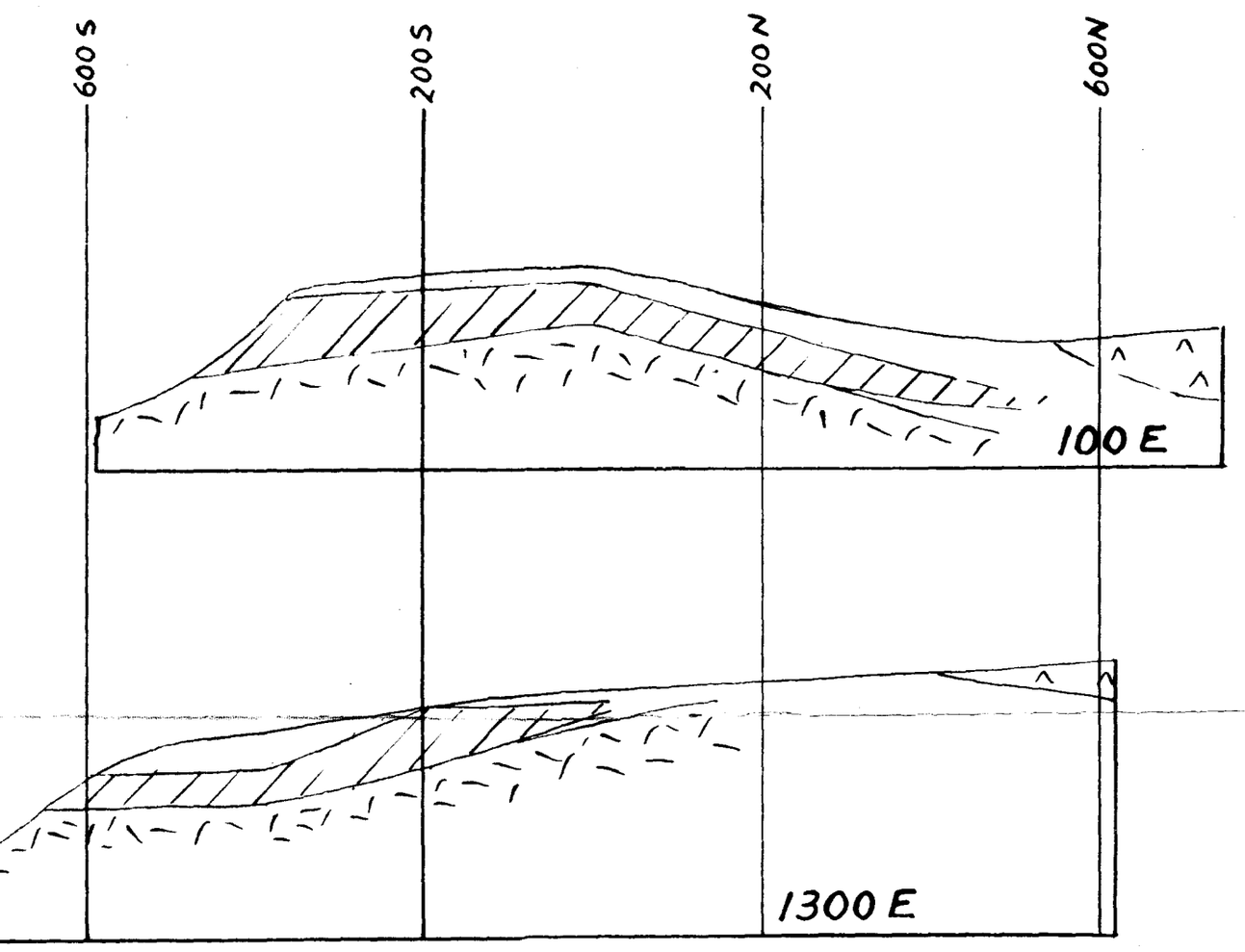
Nil

2100'

2080' 2070' 2060' 2050' 2040' 2030' 2020' 2010' 2000'

H. B. Clarke
Bureau of Mineral Resources.
March 1949.





Basalt : post-Bauxite ..

Economic Bauxite ....

Uneconomic do. ....

kaolinized basalt .....

Sections

BAUXITE DEPOSIT

Ph. Champagne : Co. Arrawatta

N. S. W

Horiz : 1" = 200' : Vert. 1" = 50'

H.B. Owen.
Bureau of Mineral Resources,
March, 1949

Plan of "Lockwood's" Bauxite Deposit Por. 113, Ph. Byron. Co. Arrawatta

Portion 82 Ph. of Champagne

Parish Boundary

Portion 113 Ph. of Byron.

Scale:

100 50 0 100 200 300 feet

Figures at Shafts indicate thickness of overburden over thickness of bauxite in feet.

"Nil" indicates absence of bauxite of economic grade.

Outcropping Laterite shown .. ..

" Basalt " .. ..

Area underlain by bauxite of economic grade

H.B. Owen.
Senior Geologist
Bureau of Mineral Resources.
August 1949.

Topography by John Mc Dowell. Aust. Aluminium Production Commission.

300 S 00 300 N

fence

200 W — 2040'

fence

00 — 2040'

fence

200E — 2040'

Longitudinal Sections

Scales: Horiz. 0 50 100 200 feet
Vert. 0 50 100 feet

Bauxite shown thus: Above economic limit .. Below economic limit ..

200W 00 200E

2040' 2050' 2060' 2070' 2080'

Nil Nil Nil Nil Nil Nil Nil

18/3 2/15 12/11.9 6/12 7/4 6/6 12/3 2/12 1/10 3.5/11.5 3/8

2100' 2090'

300 S

PLAN OF
PARISH'S BAUXITE DEPOSIT
Ph Byron, Co Arrawatta N. S. W.

SECTIONS
PARISH'S BAUXITE DEPOSIT
Ph. Byron, Co. Arrawatta, N.S.W

Scales
Hor. 100 200 400 Feet
Vert. 25 50 100 Feet

Reference:

- Alluvium
- Basalt: Post-laterite
- Bauxite: Economic grade
- Bauxite: Uneconomic
- Basalt: lateritized & kaolinized

Based on topographic survey by John McDowell & T.C. Hughes
H.B. Owen.
Bureau of Mineral Resources
Sept 1949.

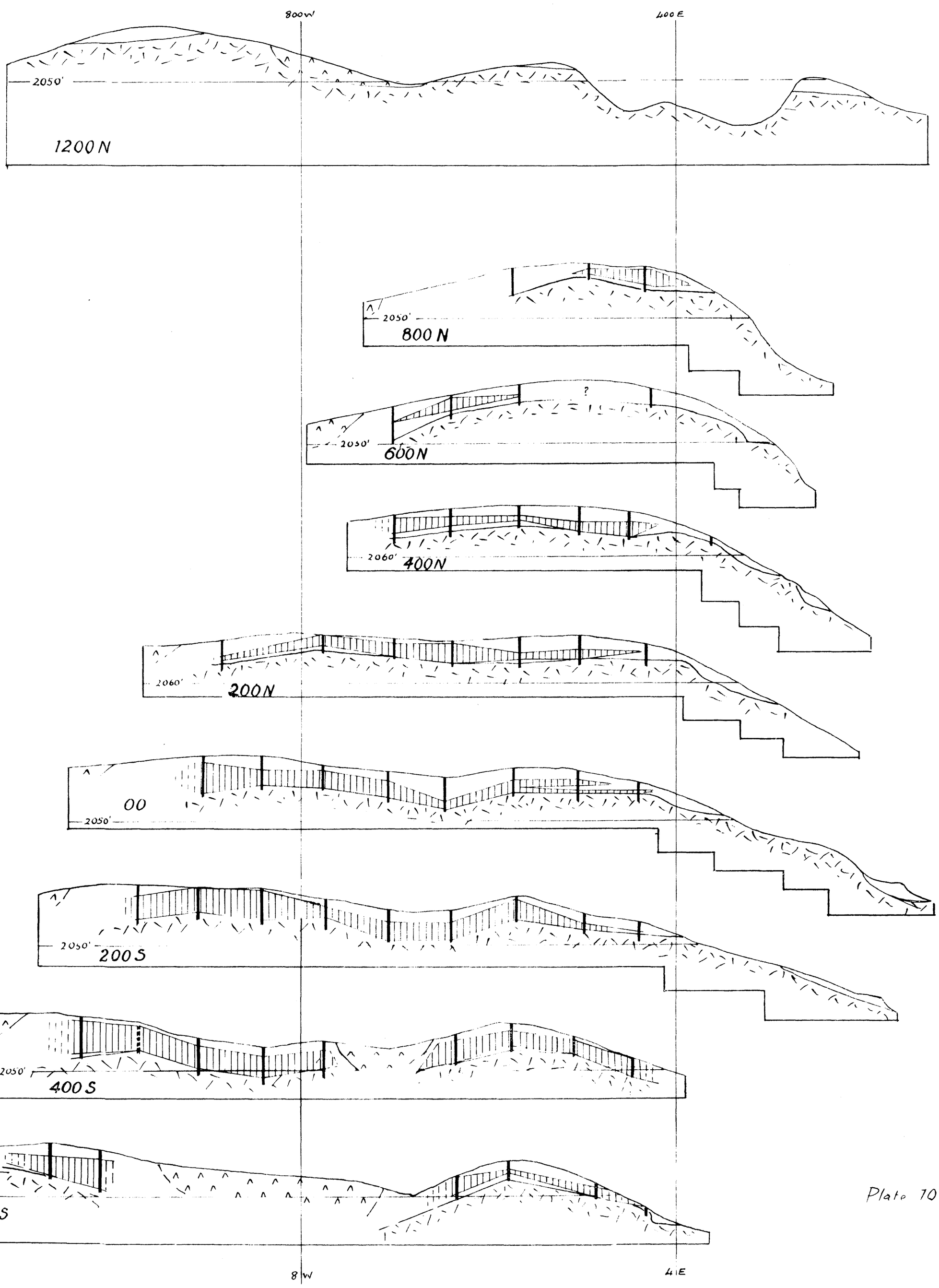


Plate 10a

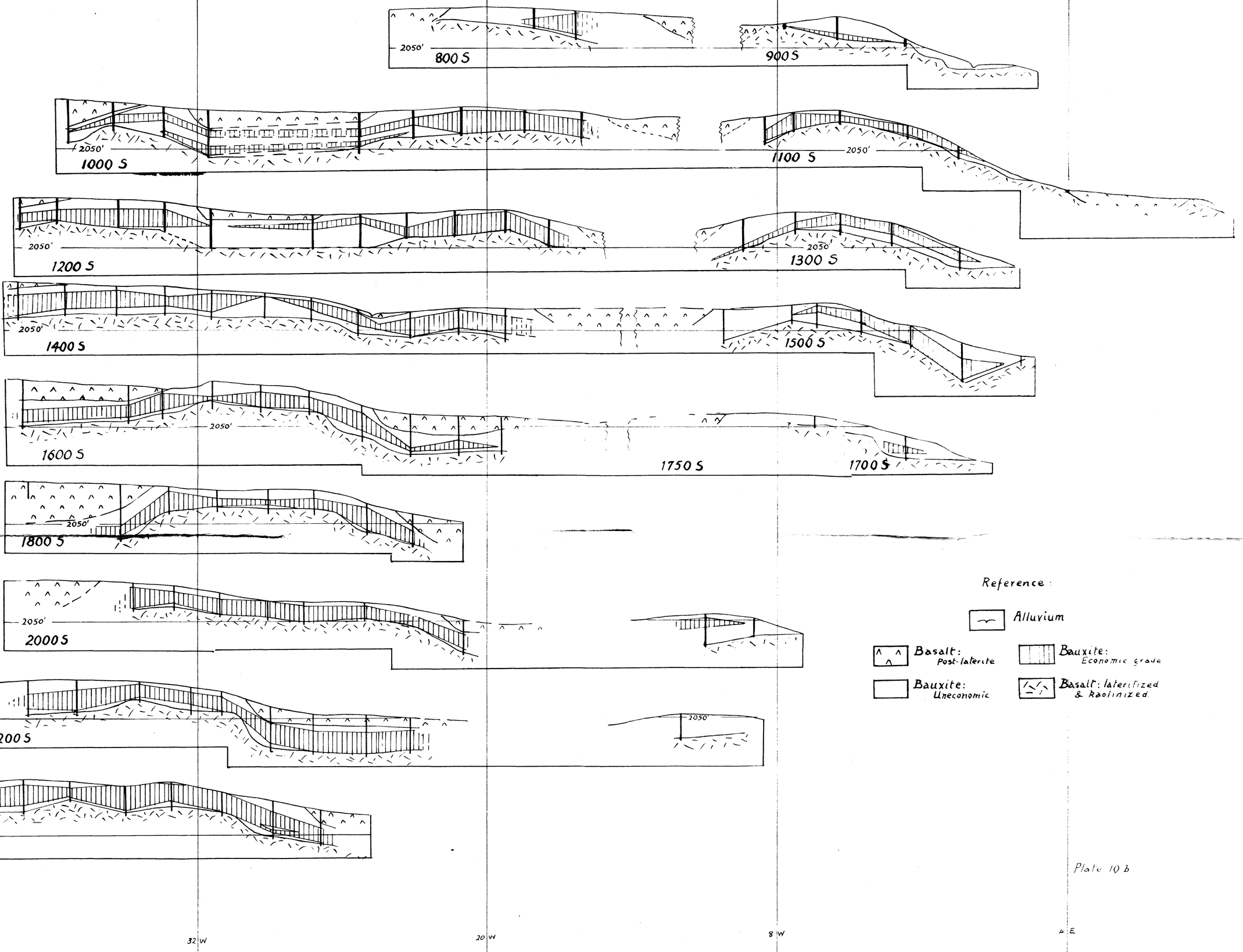
4400 W

3200 W

2000 W

800 W

400 E



Reference :

- Alluvium
- Basalt: Post-laterite
- Bauxite: Economic grade
- Bauxite: Uneconomic
- Basalt: lateritized & kaolinized

Plate 10 b

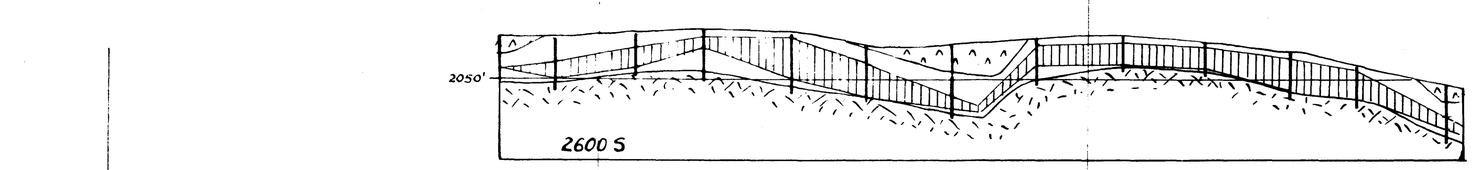
32 W

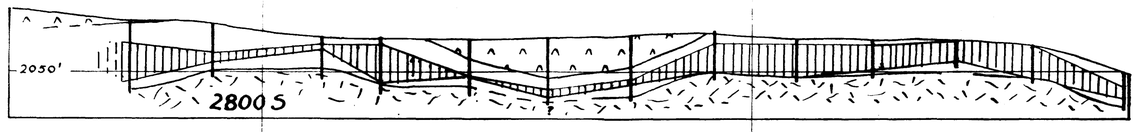
20 W

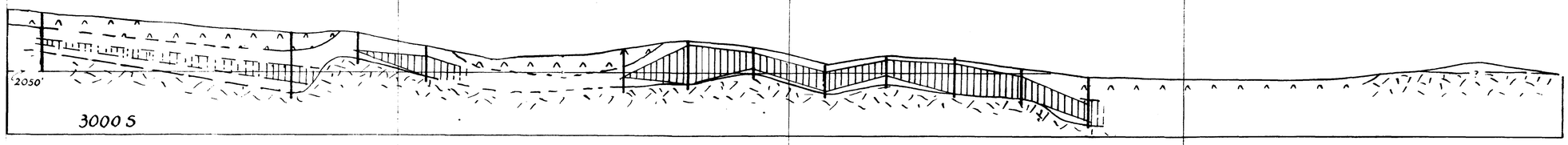
8 W

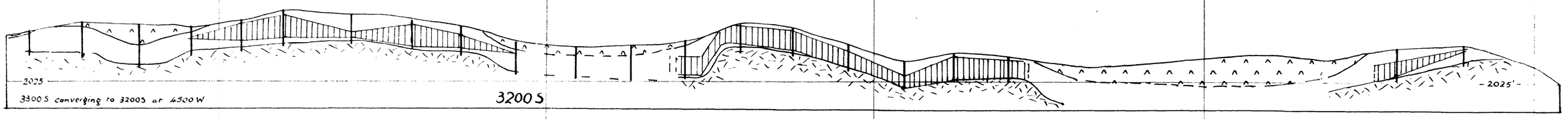
4 E

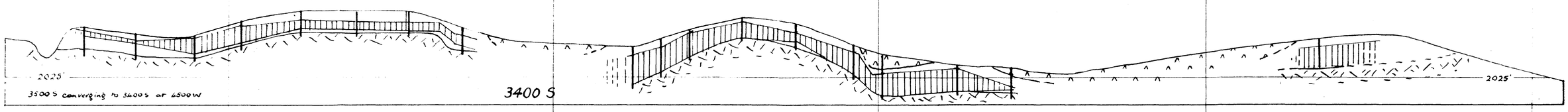
5600 W 4400 W 3200 W 2000 W 800 W

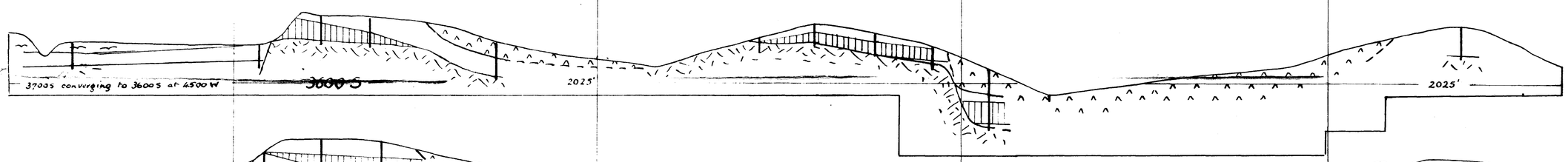


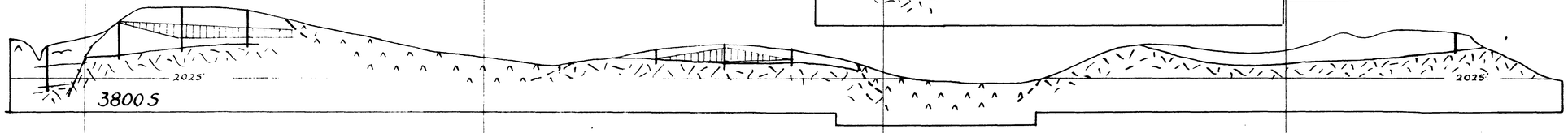


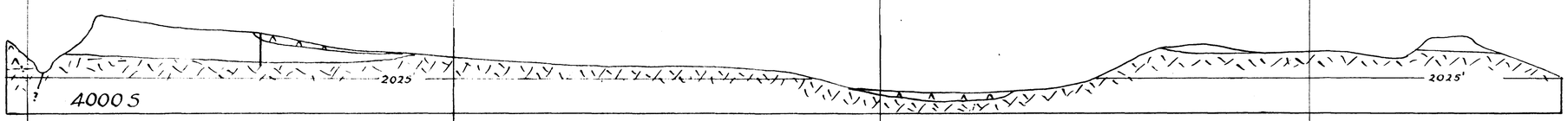


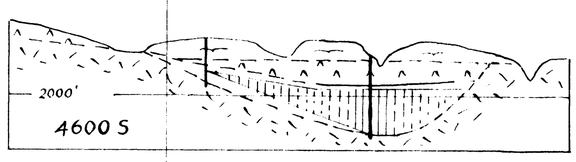


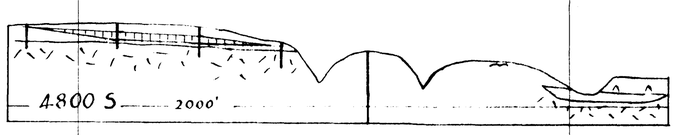


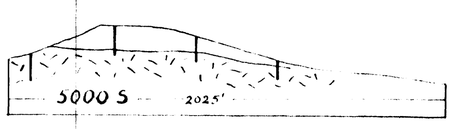












Reference :

- Alluvium
- Basalt : Post-laterite
- Bauxite : Economic grade
- Bauxite : Uneconomic
- Basalt : lateritized & kaolinized

Plate 10 c.

3900 S 2700 S 1500 S

5100 W

3900 W

2900 W

Reference :

Basalt : Post laterite

Bauxite : Economic grade

Bauxite :

Basalt : laterilized & kaolinized

2300 W

3900 S 2700 S 1500 S

2100 S 900 S 300 N

1300 W

00 100 E

2100 S 900 S 300 N

1500 S 300 S 900 N

1000 E

1500 S 300 S 900 N

Geological Plan of Parish's Bauxite Deposit

Ph. Byron, Co. Arrawatta. N.S.W.

Scale of feet

200 100 0 200 400 600 1000

Basalt (Post-laterite) . . . . . ^

Laterite (including bauxite) . . . [ ]

Basalt (Pre-laterite) . . . . . v v

H.B. Owen.
Senior Geologist.
Bureau of Mineral Resources. August 1949.

Topography by John McDowell, T.C. Hughes + H.B. Owen.

Lackwood's Area

113 114 115 116 176 79 80 67 66 52 10

A B C D E F G H J K L M N O P Q R S T U W

2040' 2020' 2000' 1980' 2080' 2060' 2100'

Farm-house

To Yetman

To Inverell

10 mile post

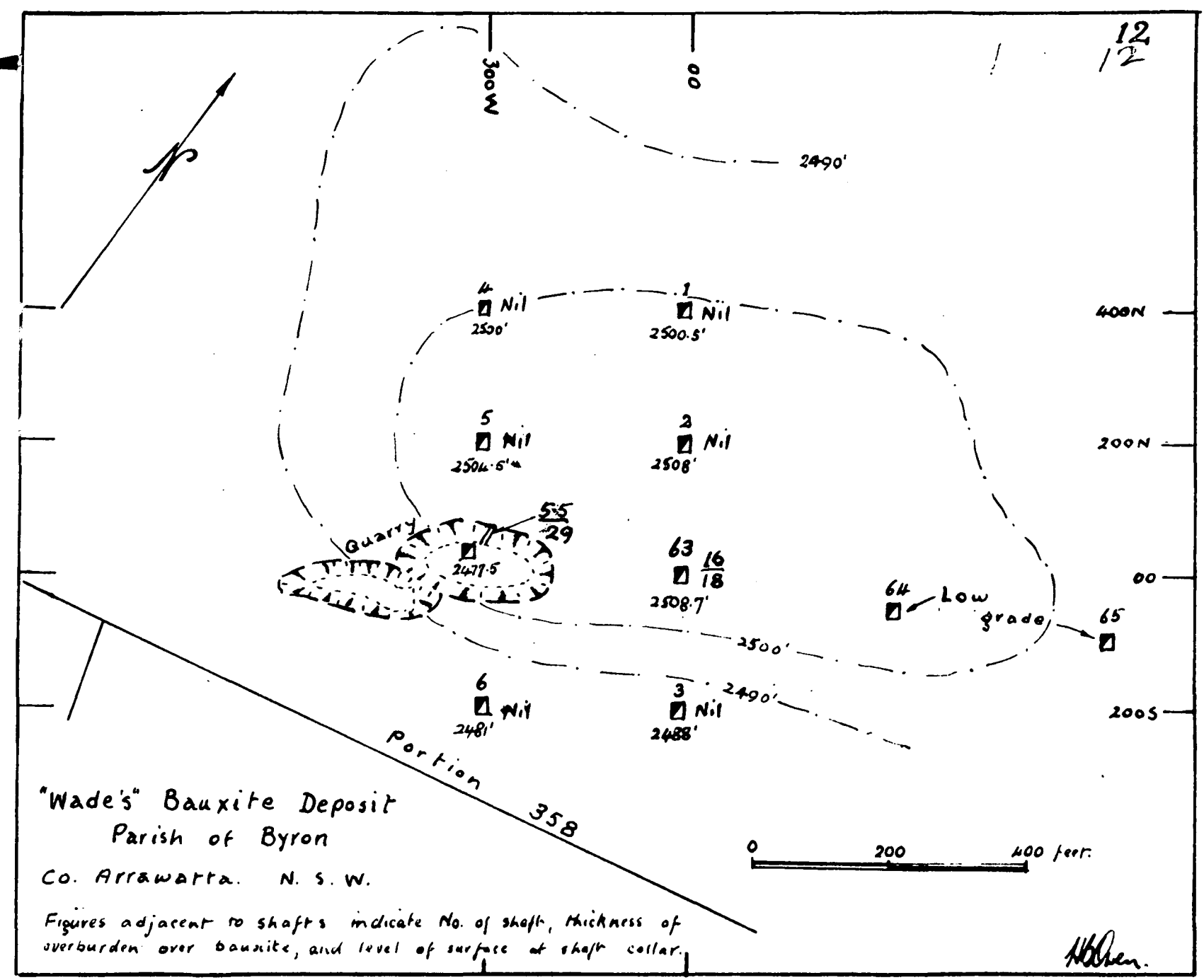
Trig. S.M. (Approx.)

Gully

Apple tree

"Secondary" laterite

34W 10W



"Wade's" Bauxite Deposit
Parish of Byron
Co. Arrawarra. N. S. W.

Figures adjacent to shafts indicate No. of shaft, thickness of overburden over bauxite, and level of surface at shaft collar.