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BAUXITE ON MANUS ISLAND TERRITORY OF PAPUA AND NEW GUINEA.

by

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SUMMARY.

Bauxite was found on Manus Island in 1952 by J. E. Thompson, Senior Resident Geologist, Territory of Papua and New Guinea, at three separate localities.

At Lepatuan a dacite flow overlies bedded tuffs and both have been bauxitized. The former parent rock yields a porous granular bauxite containing about 1 percent silica, 55 percent alumina, 10-13 percent ferric oxide and 1 percent titania. Bauxite developed on the tuffs is nodular in character, and consists of gibbsite nodules embedded in soft clay-like bauxite. The composition of one sample of this bauxite is 11.7 percent silica, 51.0 percent alumina, 10.8 percent ferric oxide and 1.0 percent titania.

The bauxite is forming at the present day by direct alteration of the dacite without an intervening clay zone, but the tuffs are kaolinized in the first stage of alteration. It is of high significance that bauxite can develop on small flat elevated areas (50 acres at Lepatuan) during the present weathering cycle. Essential conditions for bauxitic alteration to take place appear to be - (a) high mean temperature, high rainfall and dense vegetation, (b) relatively flat terrain, and (c) elevation above immediate surroundings to ensure adequate ground-water movement.

Total resources of bauxite at Lepatuan are about 600,000 tons, and possible reserves are negligible at the other localities. Difficulties of access and distance from markets militate against commercial exploitation of the deposit, but prospects of finding more bauxite in the islands of the volcanic arcs of Bismark Archipelago cannot be lightly dismissed.

INTRODUCTION

A rumour of obscure origin and to the effect that bauxite occurred on Manus Island reached the Australian Aluminium Production Commission during 1947. The then Senior Geologist at Port Moresby was subsequently instructed to make a reconnaissance survey of the island. Before this could be done the Senior Geologist (A. K. M. Edwards) met his death in an accident and it was not until 1952 that his successor (J. E. Thompson) could undertake the investigation.

Nodules of high grade bauxite were found by Thompson at three localities on the island, and the writer was instructed to join forces with him and visit the localities for a more detailed investigation. The examination was made during March-April, 1953; in the meantime Thompson had returned to Manus and engaged native labour to sink test pits. All arrangements were carried through without a hitch for which the writer is very grateful to his colleague's organizing ability and knowledge of local customs and procedure.

Manus Island, the largest island of the Admiralty Group, is within the United Nations Trust Territory of New Guinea which is administered as part of the joint Territory of Papua and New Guinea. The island, including Los Negros Island which is narrowly separated at the eastern end of Manus by Loniu Passage, is approximately 67 miles long from east to west and up to 20 miles wide. It is enclosed by Latitudes $1^{\circ}55'S$ and $2^{\circ}15'S$ and Longitudes $146^{\circ}30'E$ and $147^{\circ}30'E$.

European and inland native populations are concentrated towards the eastern end of Manus and on Los Negros. Navy and Air Force maintain establishments at Lombrom and Momote respectively, and the civil administrative headquarters are at Lorengau on the north-east coast of the main island. Total white population of Lorengau is about 30 persons.

Communications are difficult and slow. Seventeen miles of

poor motor road, which crosses decayed and dangerous wooden bridges, connects Lorengau with Momote aerodrome and Lombrom, and short motor roads radiate from Lorengau to former U.S. military establishments. The eastern third of the island is fairly well served with native tracks but the remainder is sparsely populated and mountainous and movement is difficult on overgrown tracks or through trackless rain forest.

The entire island is covered with dense rain forest and there is little game.

Temperature and humidity are uniformly high throughout the year, and mean maximum and minimum temperatures at Lorengau are 90 and 72°F respectively. Annual rainfall on the coast ranges between 130 and 150 inches but is much greater inland, particularly in the mountainous central area.

GENERAL GEOLOGY.

During August-September 1952 J. E. Thompson visited Manus and made four traverses on foot across the island in a successful search for bauxite. He incorporated his observations in a report (1952) which has been consulted by the writer and from which, with some additions, the following brief notes have been taken.

The sequence of deposition as interpreted from scattered observations in 1952, and confirmed by a second visit in 1953, is simple. Tertiary and younger sediments have been laid upon a basement of plutonic rock of intermediate composition.

The complete sequence probably is:-

Quaternary	(Recent (Recent to (Pleistocene)	Raised coral Volcanic tuffs and flows
Tertiary	(Miocene (Lower Miocene	Marine tuffaceous sediments Hinterland limestone
Palaeozoic(?)	-	Plutonic basement

Basement

Basement rocks have not been seen *in situ* but gravels of the Harlu and Watani Rivers, which drain from the highest peaks, contain igneous pebbles and boulders from a medium acid suite. One typical boulder from the bed of the Watani River submitted to petrological examination consisted of quartz-diorite.

Hinterland Limestone.

This limestone is a dense crystalline rock which has brought about a karst topography in the north central part of the island. It is much obscured by overlying tuffaceous sediments and is exposed in stream channels. Lithologically the rock is similar to the Miocene limestone of New Britain and New Guinea mainland. It is believed to represent marginal reefs formed on the coasts (particularly north-east to south-east coasts) of a pre-Tertiary island composed of igneous basement rocks.

Marine Tuffaceous Sediments.

The sediments range from agglomerates to fine siltstones and in places are richly foraminiferal. They are well bedded and dip seaward at angles up to 30 degrees. They are exposed at Lorengau, and on the road to Momote, at numerous places along No. 1 road between Kawaliap and Lorengau, at Droli on the south coast.

Volcanic Tuffs and Flows.

Comparatively recent vulcanism, renewed as late as June 1953

at Lou Island 20 miles south of Manus, has spread basaltic and acid flows and tuffs over large areas of the island. These formations are sub-horizontal and unconformably overlie the Miocene marine sediments. They are generally covered with a clay mantle which contains highly aluminous nodules in some localities; at Lepatuan dacite is weathering directly to bauxite of very low silica content.

BAUXITE LOCALITIES.

Aluminous enrichments have been observed at (1) one mile south of Lorengau, (2) Nabobi, about ½ mile east of Kawaliap on No. 1 Road, (3) at Lepatuan, near the western end of Manus and (4) at a few points along No. 1 Road between Nabobi and Lundret. Of these localities all of which are shown on the locality map, Lepatuan is the most important.

1. Lorengau.

Tabular nodules of bauxitic composition occur in narrow bands in red residual clay and are exposed in road excavations about 1 mile south of the town. The nodules appear to have formed by the selective bauxitization of thin seams of coarse tuff. Some greyish nodules show faint, lath-like relict textures of a coarse grained rock. Pale brown nodules are more uniform and relict textures are absent or indistinct. Analyses of both types of nodules are given; the first is of grey nodules and the second of pale brown textureless specimens:-

Lab No.	8441	8442
SiO_2	10.7	12.1
Al_2O_3	55.9	55.0
Fe_2O_3	5.0	5.0
TiO_2	0.7	0.8
Ignition loss	26.8	26.1
Avail. Al_2O_3 (1)	44.3	42.3

(1) Extracted by alkaline solution under pressure.

(Analyses by Australian Aluminium Production Commission.)

On the assumption that all SiO_2 is present in clay minerals, which is supported by the low available alumina figure, the probable mineralogical compositions are:-

	8441	8442
Halloysite or Kaolin	23	26
Gibbsite(a)	66	63
Beohmite	4	4
Hematite	5	5
Titania	0.7	0.8

(a) In this context throughout "gibbsite" includes amorphous aluminium hydroxide - $Al(OH)_3$.

The nodules are sparsely distributed and the deposit does not constitute a potential source of commercial bauxite.

2. Nabobi.

Nabobi is a deserted village and mission station on No. 1 road in close proximity to the village of Kawaliap ("liap is dropped locally and the village is known to natives and Europeans simply as Kawa). Nodules and fragments of spherical bauxite shells are exposed at the surface of the cleared area of the old village and along the native tracks. The surface nodules represent a residual accumulation formed by removal of the clay by rain. The nodules and fragments include varieties composed largely of white

vesicular gibbsite or of altered granular rock not obviously bauxitic. Analyses of three collections of surface specimens, and probable mineral compositions are:-

AAPC. Lab. No.	8438	8437	8440
Total SiO_2	3.7	3.6	15.8
Quartz	-	-	10.5
Al_2O_3	52.3	54.4	42.9
Fe_2O_3	13.7	12.3	16.0
TiO_2	0.8	1.2	1.5
Ignition loss	28.5	27.8	23.2
Avail. Al_2O_3	47.7	50.6	38.1
Halloysite or Kaolin	8	8	11
Quartz	-	-	10.5
Gibbsite	75	77	58
Boehmite	(b)	1.5	(b)
Goethite) Hematite)	14.5	12.3	17.5
Titania	0.8	1.2	1.5

(b) Boehmite probably present in small amounts.

Notes descriptive of the megascopic appearance of these nodules are:-

No. 8438. Hard vesicular gibbsitic nodules and softer white nodules coated with yellow clay. No distinct relict texture.

No. 8439. Crustiform fragments with texture suggestive of altered medium to coarse-grained tuff. Platy inclusions may be mica.

No. 8440. Rounded nodules of altered, originally felspathic, rock with coating of brown clay.

Similar nodules are scattered over a moderately flat area roughly 600 feet from north to south by a width of about 400 feet. Shafts were sunk at two points 400 feet apart on a north-south line within this area. Logs of these shafts are :-

Southern shaft at Nabobi

Depth	
Surface to 9' 0"	Brown clay with purplish tinge in patches, thin reddish stains and few small patches of blue kaolinized tuff. No bauxite nodules.
9' 0" - 21' 0"	Brown and blue mottled kaolinized tuff.
21'0" - 27' 6"	Blue clay with brown patches and rare harder nodules of greyish-brown clay. Concentric weathering shells discernible.

The sparse distribution of the nodules was aptly described by a native assistant as "one fella - one fella". No samples were taken from this shaft.

(On arrival at Nabobi at noon on 2nd April, this shaft was found to be filled with CO_2 to a depth of 3 or 4 feet in sufficient strength to immediately extinguish a kerosene lamp. The gas dispersed overnight.)

Northern Shaft at Nabobi

Surface to 7'8"	Brown and red variegated clay with few small

(up to 1 inch) nodules of bauxite and patches and fragments of kaolinized tuff between surface and 5 feet. Larger nodules (up to 6 inches) at 5 feet, one with soft kaolin (?) are surrounded by $\frac{1}{4}$-inch shell of bauxite. Yellow patches at 6 feet and purplish tinge towards base, merging into -

7'8" to 20'0" - purplish kaolinized tuff, red and yellow irregular bands which tend to dip north at 10 to 20 degrees. Granular texture well displayed. One bauxite nodule at 11 feet. Some yellow patches have sharp straight boundaries, which presumably represent joints.

Two samples were taken, viz. (a) 0-7'8" and (b) 7'8" to 20'. The first sample was divided; one portion was submitted to analysis in its natural state and the nodules from the other portion, which constituted about 20 percent of the sample, were examined separately. The analytical work was carried out by the Tasmanian Department of Mines Laboratory, Launceston.

Sample No.	14	15 (nodules only)	16
Depth	0'-7'8"	0'-7'8"	7'8"-20'
Insoluble matter	25.5	7.3	-
Al_2O_3	38.0	56.5	-
Fe_2O_3	16.4	7.7	-
TiO_2	1.6	0.6	-
Ignition loss	18.2	27.9	14.3
Soda soluble			
Al_2O_3	23.9	53.9	14.8
SiO_2	7.9	3.6	9.9

The low ignition loss (combined water) in sample 15 suggests that the nodules contain an appreciable quantity of boehmite but the proportions cannot be computed reliably from the data available.

Plainly the deposit is of no commercial value.

3. Lepatuan

The name Lepatuan is applied by natives to the small relatively flat area on which bauxite has been found towards the western end of Manus. There is no village of that, or any other, name in the vicinity.

Locality and Access

The area is traversed by a little-used native track between the north coast opposite the island village of Saboi and Droli on the south coast. Respective distances from Lepatuan to north and south coasts are approximately 5 and 4 miles. Lepatuan is at an elevation of about 950 feet and is the widest part of the crest of a narrow ridge which extends from the south coast for the greater part of the width of the island.

Mangrove swamps at either coast would present difficulties to the construction of access roads and dense rain forest on the route and on the bauxite deposits would be difficult to clear.

Geology

The surface is much obscured by a carpet of decaying vegetation lying on black clay-like soil. A few residual boulders

of dark-grey aphanitic dacite show through the soil in places, particularly near the margins of the central and northern bauxite bodies (see Fig.2), and nodules and small pellets of bauxite have accumulated on the bare and eroded surface of the narrow native track which traverses the length of the area..

The surface is deeply dissected by streams on either side (east and west) of the bauxite-bearing areas and finely bedded tuffs, deeply weathered, are exposed in the stream channels and were penetrated in test pits 2 and 2A near the southern end of the area. The tuffs have a low regional dip to the north.

The tuffs are overlain by dacite flows of unknown thickness, but probably exceeding 100 feet at the northern edge of the area and also probably enclosing relatively thin beds and lenses of tuff.

The dacite is a dark grey to nearly black dense rock of sub-vitreous lustre containing minute vesicles. No granular texture is resolvable by naked eye or hand lens. Two largest observed vesicles on one fresh face measured 0.7 by 0.4 and 0.25 by 0.15 millimetres. Vesicles are elongated in the direction of flow and tend to occur in thin sheets which alternate with bands of denser rock. This characteristic is revealed only in weathered specimens, which, by preferential weathering of the more vesicular zones, may acquire a banded aspect.

The widely banded appearance of the rock may be replaced by, or have superimposed on it, a finely honeycombed surface caused by enlargement of the vesicles by weathering. Specimens recovered from within the bauxite profile, when cleaned of bauxite, possess a light grey skin commonly less than 0.01 millimetre thick, and to the eye have a striking resemblance to pumice. Such specimens have an extremely rough surface with small sharp projections which are very harsh to the touch and easily lacerate the skin. Surface boulders have lost the finer detail of this fretted surface but nonetheless may be deeply pitted.

An analysis of the fresh rock is given in the discussion on the origin of the bauxite.

Descriptions of the Bauxite

The approximate area over which bauxite nodules have been observed is shown in the sketch map of the locality and totals about 50 acres of which the marginal areas are of doubtful value. Several varieties of nodules were noticed:-

1. Reddish-brown, vesicular and reddish-brown, crustiform
2. Dense greyish-pink and dense pale reddish purple; both varieties are fine-grained, hard and tough
3. White, very rough surface and irregular shape.

Analyses of specimens of the nodules by the Aluminium Commission returned very favourable results and led to sub-surface prospecting of the area. The initial analyses are:

Nodules from Lepatuan.

Lab. No.	8435	8437	8436
Type	Fine-grained dull red and white bauxite. Tubular cavatities. Smooth chocolate-brown skin.	Pinkish-grey dense fine-grained bauxite smooth surface.	Soft greyish white concretionary bauxite with irregular grains of waxy gibbsite. Very rough surface.
SiO_2	3.2	4.5	2.2
Al_2O_3	54.8	60.0	58.1
Fe_2O_3	11.1	4.2	7.4
TiO_2	0.9	0.4	0.9
Ignition loss	29.0	30.1	30.5
Avail. Al_2O_3	51.3	56.2	54.8

Assumed mineralogical compositions of the specimens are :-

Halloysite or Kaolin	7	9.5	5
Gibbsite	78.5	82.5	83.5
Boehmite	1	2.5	1.5
Goethite } Hematite }	12	4	8
Titania	0.9	0.4	0.9

During February-March, 1953, pits were sunk at seven points in the area. The site of No. 1 (southernmost) pit was chosen in an attempt to trace the extent of the bauxite down slope but proved too far from the ridge crest to encounter bauxite. All the other pits disclosed bauxite nodules or earthy bauxite.

Logs of the pits and results of sampling are:-

Pits at Lepatuan

Pit No. 2

Depth	Sample No.	
0' - 4'	1	Clay with dense pink bauxite nodules
4' 10'	3	Brown clay with sparse nodules

Sample 2 - nodules only picked free from clay matrix and comprising approximately 33 percent of the original sample.

Sample No.	1	2	3
Insol. matter	11.7	4.3	-
Al_2O_3	51.0	62.0	-
Fe_2O_3	10.8	3.8	-
TiO_2	1.0	0.3	-
Ign. loss	26.0	30.1	16.7
Soda soluble Al_2O_3	43.8	60.9	19.6
Soda soluble SiO_2	2.9	2.5	7.4

Pit No. 2A

0' - 12' Clay with nodules. Very thin tabular bauxite fragments in kaolinized tuff below 5 feet.
No samples analysed.

Pit No. 3

Depth	Sample No.	
0'3"-2'4"	4	Soft yellow-brown clay-like bauxite with nodules.
2'4"-3'6"		Hard red clay-like bauxite.
3'6"-8'	5	Gritty soft earthy bauxite with tubular fragments of hard bauxite. Brown.
8'-12'	6	Ditto with purplish tinge.
12'-15'	7	Purplish and grey mottled clay with hard nodules.

Sample No.	4	5	6	7
Insol. matter	1.5	1.1	-	-
Al_2O_3	51.3	53.4	-	-
Fe_2O_3	17.4	15.3	-	-
TiO_2	2.0	1.6	-	-
Ign. loss	28.2	28.6	28.6	23.7
Soda-soluble				
Al_2O_3	50.8	52.8	53.4	40.5
SiO_2	1.4	1.0	2.3	4.0

Pit No. 4

Depth	Sample No.	
0-2'6"	8	Soft brown clay-like bauxite with very sparse hard nodules, hardening slightly with depth and merging into -
2'6"-4'6"	9	Few nodules of hard bauxite dispersed through soft red-brown earthy bauxite. Seam of yellow clay.
4'6"-6'6"	10	Dark brown granular bauxite containing residual fragments and boulders of fresh dacite (latter removed from sample).
6'6"-8'6"	11	As above, lighter colour, but no unaltered rock on side of pit from which sample was taken.
8'6"-11'6"	12	As above, lighter colour, no unaltered dacite.
11'6"-13'	13	Red brown bauxitic clay.

Sample No.	8	9	10	11	12	13
In Insol. matter	1.9	0.6	0.6	1.1	1.1	-
Al_2O_3	45.7	51.7	55.4	55.8	56.4	-
Fe_2O_3	22.7	17.0	13.1	12.3	11.5	-
TiO_2	2.2	1.9	1.2	1.1	1.1	-
Ign. loss	27.3	28.7	29.8	29.4	30.0	25.9

Sample No.	8	9	10	11	12	13
Soda-soluble						
Al_2O_3	43.7	50.8	54.8	55.0	55.9	48.2
SiO_2	1.6	0.6	0.6	1.0	1.1	4.4

Assumed mineralogical compositions are:-

Halloysite or Kaolin	4.1	1.3	1.4	2.2	1.3
Quartz	Nil	Nil	Nil	trace	0.5
Gibbsite	66.8	77.7	83.9	84.1	85.5
Boehmite	0.5	0.5	Trace	Nil	Nil
Goethite } Hematite }	26.3	18.4	13.9	12.3	11.7
Titania	2.2	1.9	1.2	1.1	1.1

Pit No. 5

0'-2'6" Variegated yellow and red clay

2'6"-7'6" Red clay with few hard nodules.

Pit No. 6

This pit filled with water to within 2 or 3 feet of the surface and could not be examined. The visible portion consisted of variegated yellow, red and light-brown clay. The spoil dump contained red clay with very few hard red nodules of ferruginous bauxite.

Quantity of Bauxite

Only a very approximate estimate of the total volume of bauxite at Lepatuan can be made as the margins of the deposits could not be determined without a considerable amount of excavation which was beyond the resources available. The boundaries on the sketch map are based mainly on topographic evidence but the limits of the central (i.e. the largest) body have been sketched in by tape or pacing, and compass traverses to several points beyond which no nodules could be found in the soil and where downward slopes became steeper.

Bauxite in the central area may occupy an area of 40 acres with an average thickness of 6 feet; this is equivalent to roughly 500,000 tons, but the commercial value of the bauxite is much diminished by the presence (Pit No. 4) of blocks and fragments of unaltered rock.

The limits of the southern body are known with even less exactness but the narrowness of the ridge and limited depth of bauxite (Pit No.2) indicate a much lower tonnage, probably less than 100,000 tons.

Quantities in the northern body are for all practical purposes negligible. Pits 5 and 6 sunk in the most favourable positions revealed only variegated clays with very sparsely distributed nodules.

4. Between Nabobi and Lundret

Native villages along No. 1 road are built on hill tops or on the gently rounded but narrow crests of ridges. On the cleared and worn ground surfaces of some village squares, few pellets of hard kaolinized (halloysitic ?) tuff and, less commonly, of bauxitic material may be picked up. Fragments of obsidian and other humanly transported rocks may also be found but it is unlikely that the bauxitic pellets would have been carried into the villages.

The rarity of the bauxite nodules when compared with their comparative abundance at the three principal localities mentioned, does not hold out much promise of useful deposits existing beneath the villages. However the existence of clay-like bauxite with few or no nodules is a possibility which could be easily overlooked.

ORIGIN OF THE BAUXITE

Parent rock

Three types of bauxite occur at Lepatuan, viz.

(a) Tabular nodules, up to 1 inch thick, of dense pink or greyish pink bauxite embedded in a matrix of bauxitic (i.e. highly aluminous) clay passing downwards to recognisable kaolinized tuff. The nodules contain about 4 percent SiO_2, and 60 or more percent Al_2O_3 and 4 percent Fe_2O_3. The matrix contains approximately 15 percent SiO_2, 45 percent Al_2O_3 and 14 percent Fe_2O_3.

(b) Rounded and irregular greyish white, also brown and red, nodules in a light-brown clay-like matrix. Such bauxite contains about 2 percent SiO_2, 45 to 51 percent Al_2O_3 and 17 to 23 percent Fe_2O_3. Separated nodules may contain about 55 to 58 percent Al_2O_3.

(c) Gritty earthy brown bauxite underlying type (b) and in direct contact with unaltered parent dacite. Composition ranges between 0.4 to 1.5 percent SiO_2, 51 to 56 percent Al_2O_3 and 11 to 23 percent Fe_2O_3.

Type (a) is derived from medium to coarse finely-bedded tuff which has been seen only in small weathered outcrops in stream courses and, thoroughly kaolinized, in the test pits.

The derivation of type (b) is somewhat obscure, but it probably represents a residual accumulation of bauxitic material derived from tuffaceous beds overlying or intercalated with the dacite. The boundary between types (b) and (c) is sharp.

The third type (c) results from the direct alteration of dacite. The two analyses which follow are of the fresh parent rock and of bauxite crusts adhering thereto:

	Dacite	Bauxite crust	
SiO_2	67.31	0.36	
Al_2O_3	14.22	56.71	
Fe_2O_3	0.90	10.78	(a) not detected
FeO	4.68	0.06	(b) Moisture 1.03
MgO	2.55	..... (a)	percent:
CaO	4.30	..... (a)	analysis
Na_2O	2.70	..... (a)	on dry basis.
K_2O	2.80	..... (a)	
H_2O-	Nil	.....Nil (b)	
H_2O	Nil	..... 31.19	
TiO_2	0.53	1.09	
MnO	0.28	0.006	
	100.27	100.196	

Analysts - Avery and Anderson.

The presence in Pit No. 4 of completely bauxitized rock beneath a stratum of partly corroded dacite suggests that the former represents a bed of less resistant tuff or a more highly vesicular zone in the dacite.

Mode of Formation

The attack on the dacite is extraordinarily rapid and

complete. The bauxite crust in immediate contact with the tenuous grey film that coats the fresh rock consists almost wholly of gibbsite and goethite; clay minerals if present are in insignificant amount. From the foregoing analyses the following assumed mineralogical compositions of the parent and adhering bauxite have been computed.

Dacite (Norm.)			Bauxite crust
Quartz	25.1	Silica (1)	0.36
Orthoclase	16.7)	Gibbsite	86.7
Andesine	41.0)	Boehmite	trace
Diopside	3.2)	Goethite (2)	11.8
Hypersthene	12.0)	Magnetite	0.2
Magnetite	1.4)		
Ilmenite	0.9	Titania	1.1
	100.3		100.16.

(2) Includes some adsorbed water.
(1) Probably dispersed residuals of quartz.

The alteration is brought about in the oxidizing zone by acid ground water charged with organic matter. Drainage conditions are exceeding good and it is apparent that all constituents of the parent rock with the possible exception of alumina are removed in part. At Nabobi the ground water evolved CO_2 freely, and presumably evolution of the gas also takes place at Lepatuan. The presence of free CO_2 would keep iron in solution as ferrous bicarbonate and precipitate alumina. There is no ground for assuming that alumina is added from some extraneous source and therefore the inescapable conclusion is that less alumina is lost than is the case with any other original constituent. On the assumption that the alumina remains fixed, or is wholly reprecipitated, the loss of the other constituents are:-

	Percentage eliminated
SiO_2	99.9
Fe	49.5
TiO_2	48.5
MnO	99.5
Na_2O)	
K_2O)	100.
MgO)	
CaO)	

Balanced against gains of water and oxygen the total nett loss of weight from the original rock is slightly more than 50 percent. This figure accords reasonably well with the high porosity of the bauxite.

The favourable conditions that operate at Lepatuan and without which the bauxite could not form, or if formed, could not survive are:-

(a) High mean temperature and rainfall, abundant vegetation.

(b) Relatively flat terrain with little erosion of the surface.

(c) Deep dissection of the surroundings by streams in narrow and consequently steep walled valleys.

The last mentioned feature ensures rapid lateral removal

of ground water with its load of dissolved silica etc.

The nodular bauxite is of two types, viz.

(a) Nodules in situ within bauxitized and partly kaolinized tuff, and

(b) Nodules in compacted clay-like bauxite overlying the granular dacitic bauxite.

The former has developed in three stages, passing through the normal kaolinitic (halloysitic ?) stage to earthy or textureless bauxite. This in turn has been subject to solution of part of the alumina which has been reprecipitated about favourable nuclei to form concretionary nodules, or along bedding planes to give thin tabular forms of highly aluminous bauxite. This process has operated at Nabobi and in the vicinity of Pits 2 and 2A, Lepatuan.

The second type may have originated in the same way from tuff overlying the dacite but the tabular forms of bauxite are absent and compaction and slumping have destroyed any relict texture that may have survived previously. It is unlikely that solution of alumina within the dacitic bauxite immediately beneath the shallow soil and its segregation in concretions may have taken place as the boundary between nodular and underlying dacitic types is sharp and shows no gradation.

CONCLUSION.

The significance of these discoveries is very great. It has been shown that, in the tropics, bauxite of high quality can develop on small elevated areas of low relief by lateritic weathering during the present cycle. All necessary conditions are fulfilled by remnants of a gently sloping or relatively flat land surface composed of amenable rocks, e.g. extrusives or pyroclastics containing alumina.

The deposits on Manus Island are too small or too difficult of access to be of much direct commercial interest, but when it is realised that an area of only one square mile could contain 10,000,000 tons of bauxite, the prospects of discovery of commercially valuable deposits within the volcanic arcs of the Bismark Archipelago cannot be dismissed lightly. In this connexion it is worth mentioning that bauxitic clays containing 27 and 28 percent gibbsite have been reported from Santa Cruz and Vanikoro in the British Solomon Islands.(1) These are at least an indication that lateritic weathering is taking place in these localities.

(1) Specimens collected by J. C. Grover, Senior Geologist, Honiara, B.S.I., 1951, and analysed at Tasmanian Mines Department Laboratory, Launceston.

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REFERENCE.

Thompson, J. E., 1952 - Report on the geology of Manus Island, Territory of Papua and New Guinea, with reference to the occurrence of bauxite. Bur. Min. Resour. Aust. Records 1952/82.

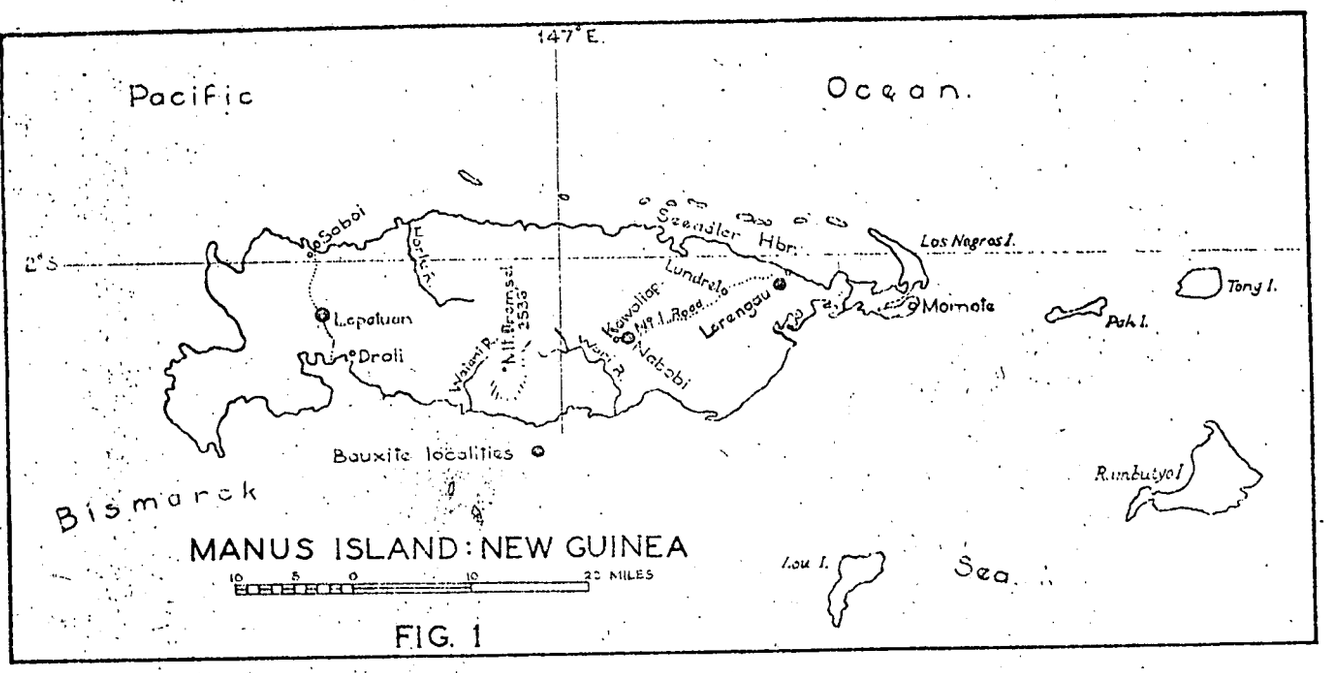
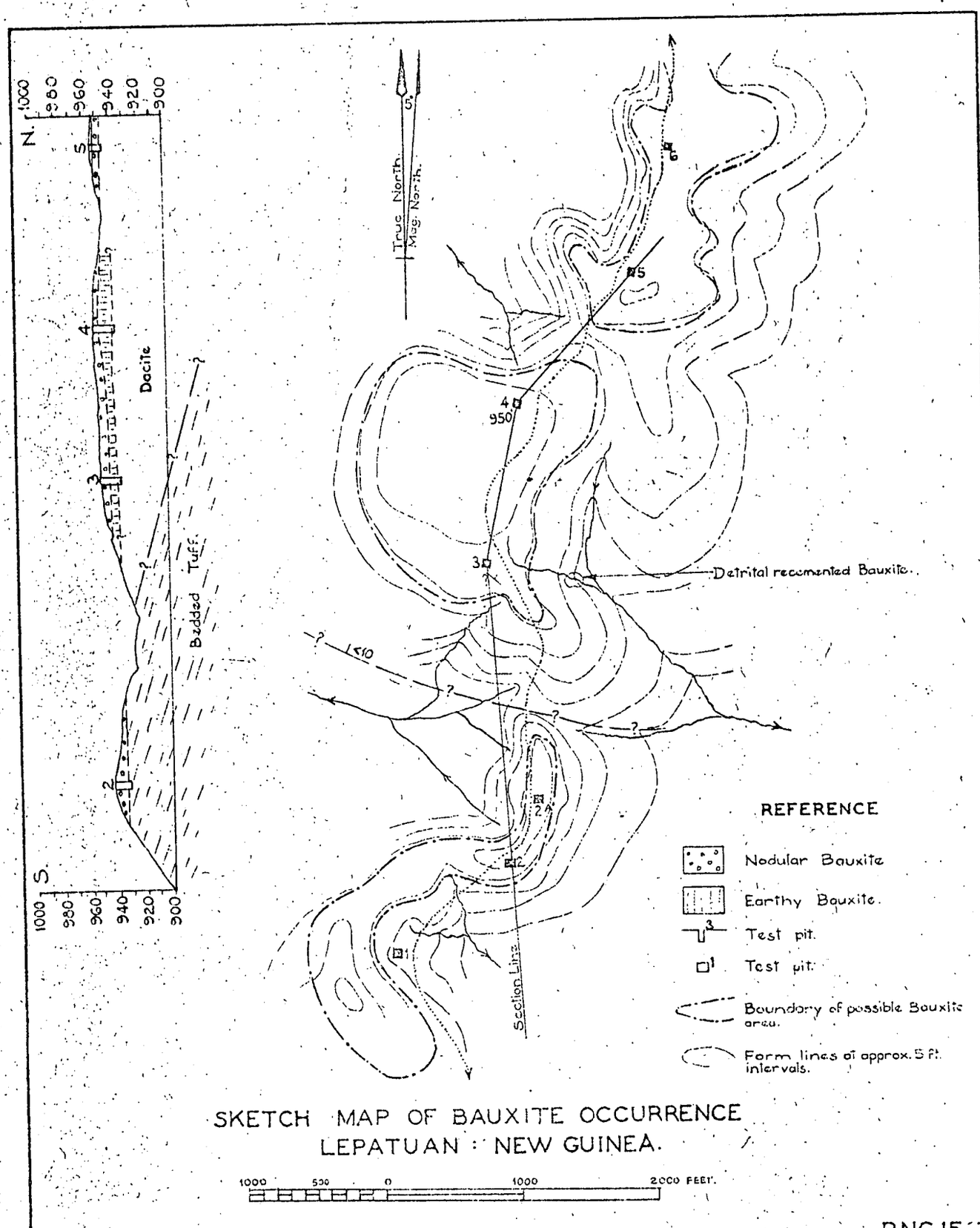


FIG. 1



SKETCH MAP OF BAUXITE OCCURRENCE
LEPATUAN : NEW GUINEA.

FIG. 2

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