COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES

GEOLOGY AND GEOPHYSICS.

RECORDS.

1955/64.

BAUXITE SURVEY, GOVE PENINSULA, ARNHEM LAND, N.T.

PROGRESS REPORT ON GEOLOGICAL INVESTIGATION

by

D.E. Gardner.

BAUXITE SURVEY, GOVE PENINSULA, ARNHEM LAND, N.T.

PROGRESS REPORT ON GEOLOGICAL INVESTIGATION

by

D.E. Gardner

RECORDS 1955/64.

CONTENTS

BAUXITE SURVEY, GOVE PENINSULA, ARNHEM LAND, N.T.

PROGRESS REPORT ON GEOLOGICAL INVESTIGATION

INTRODUCTION

A deposit of aluminous laterite on Gove Peninsula (Plate 1) is being investigated by New Guinea Resources Prospecting Co.Ltd., Personnel comprise Mr. G.A. Daniels who is in charge of the work and five Europeans, one of whom is cook and another driver-mechanic. Native labour is obtained from the Yirrkala Mission.

Access to the area is by sea and air. A jetty inside Melville Bay can accommodate vessels up to a few hundred tons and a concrete ramp constructed in wartime is suitable for landing barges. The jetty has not been maintained since the war and though usable needs repairing. The air strip is 6000 feet long and in good condition. MacRobertson-Miller run a fortnightly Avro-Anson service from Darwin. Wartime roads constructed around the Air Force Station, and from it to Melville Bay and Yirrkala Mission are generally in good condition. Buildings near the air strip are of corrugated iron and undressed local timber, and have cement floors. Some of them are sufficiently well preserved to be usable, after some repairs, for living quarters, office etc. The area is covered by tall straight eucalypts which provide excellent timber for building. They are not closely spaced, and except for grass about 2 feet high there is little other vegetation. Vehicles can be driven through the country with little need for clearing.

The area is characterized by low surface relief. Outcrops of granite near the jetty probably rise a little above 100 feet and the laterite farther south forms a flat surface which has an elevation between 50 and 100 feet above sea level. Elsewhere the land surface is little above sea level. Maximum rainfall is probably between December and May, but the wet season is more prolonged than it is farther west, and a little rain can be expected each month during the dry season. Several inches fell during the week ending 12th June. Despite the long wet season, surface supplies of fresh water are not plentiful. A few small creeks flow down gullies near the edge of the laterite but they are not permanent. Water for the Air Force Station during wartime was pumped from a creek at Yirrkala Mission but the pipeline and pumping plant have been removed. Water for the bauxite investigation is carted from the Mission.

THE BAUXITE INVESTIGATION

The main body of laterite extends for about 6 miles from west to east and 3 miles from north to south (Plate 1). It is being sampled from boreholes which are put down at the intersections of grid lines that trend (magnetic) north-south and east-west. At present the holes are spaced at intervals of 2000 feet from north to south and 4000 feet from east to west. Two hand augers are operated, each by a team of four natives under the control of a European. A little water poured into the borehole turns the comminuted laterite into a thick mud which adheres to the auger. The holes are not cased. To avoid contamination of samples the driller discards the upper three inches of mud brought up on the auger, and the outer quarter-inch of the remainder of the sample. A small power-driven percussion drilling plant has been transported to the job but because of shortage of water the rate of drilling is slow and uneconomical. However the samples recovered contains larger fragments than those obtained with the augers. During week-ends, when native labour is not available, the percussion plant is used to do check boring and to obtain samples in which some of the laterite-fragments are large enough for visual examination.

One drill hole in every eight is sampled in 2-foot sections and the remainder in 4-foot sections. The samples are prepared by native labour for despatch by air to the laboratory of the British Aluminium Co., Burntisland, Scotland. They are sun-dried, hand-ground to pass a 60-mesh sieve, and suitably reduced by repeated splitting through Jones riffles. A considerable delay is inevitable before assay results can be returned to Gove.

A preliminary map of the area based on photo-interpretation was supplied by British Aluminium Co. It is on a scale of 4000 feet to 1 inch, and shows air strip, some of the roads, and the probable boundary of the laterite. The scale of the map is too small to allow a field man to accurately locate his position on it, for the purpose of plotting boundaries and outcrops. This difficulty is being overcome by mapping roads and bore lines by means of compass-tape surveys. Air photos were requisitioned early in April and when they arrive the work will be facilitated.

GEOLOGICAL INVESTIGATION

GENERAL

Geological work started on 4th June. Because of difficulty of transport, only one vehicle was brought into the area and it is needed continually for the general work of the bauxite survey. Where access is convenient, by road or track, the geologist is transported to the area in which he intends to work but apart from that the geological field work has to be done on foot. Preliminary reconnaissance traverses have been made in lateritic country within easy reach of the camp-site, and boundaries and outcrops have been plotted by means of compass-tape traverses within the lateritic spur that is followed northwards by the jetty road.

Apart from the laterite, the only rock sufficiently unweathered to be identified in hand specimen is a small outcrop of granite exposed by erosion of the laterite at locality A, 3 miles north of the origin of the grid coordinates. At localities B and C, where the jetty road crosses spurs that extend westwards from the laterite, weathered ferruginous outcrops exposed in the road-drain contain angular quartz-fragments and appear to have a relict granitic texture. The outcrops may be of weathered granite. In the detritus below the laterite scarp at D, half a mile north of the Mission road, slab-like blocks up to 1 foot square and 6 inches thick contain small angular fragments of quartz embedded in a ferruginous matrix. They may represent weathered and lateritized thin bands of arkosic sandstone.

LATERITE

Where it is exposed in gullies around its margin the laterite consists of several distinct zones underlain by friable red earth or non-plastic red clay. Boring results indicate that its maximum thickness is 30 feet. The laterite is almost completely covered by dark red clay which contains spherical pisolites 0.1 to 0.2 inch in diameter. Pisolites washed free of the red clay are cream coloured or very pale brown on the outside. Beneath the outer "skin" the pisolite is compact, brick-red in colour and has a dull earthy appearance. The inner part, or core, which makes up about half the diameter of the pisolite, has a sub-vitreous or resinous lustre, is red-brown to brownish black, and appears to be amorphous. Presumably the darker colour is due in part to its sub-transparency and in part to an increase in the content of ferric oxide. The outer part of the pisolite, from the exterior to about one third the distance towards the centre consist of concentric bands or shells distinguished by faint colour differences. The inner part is not visibly banded. It is assumed that the pisolites are composed of hydrated oxides of alumina and iron which were precipitated together from colloidal gels or sols in the form of homogeneous amorphous mixtures. If so the term cliachite may be used for them. The observed thickness of the red clay, where exposed along roads, is about 2 feet, but it is likely that an effort was made to site the roads in localities where the surface clay is thin.

Where the clay has been removed in shallow escavations the underlying laterite consists of small pisolites loosely held in a soft matrix. They are similar in size and appearance to those contained in the red clay, except that the lustrous core is noticeably larger. The matrix is earthy and resembles the material that forms the outer portions of the pisolites, except that it is slightly porous and weathered. In contrast with the pisolites, which are compact and impervious, it is pervious to seeping ground water.

Near the boundaries of the laterite where the clayey surface and the loosely cemented pisolites have been removed by erosion, hard pisolitic laterite is exposed. The pisolites are similar to those in the upper layers. The matrix is hard, compact and earthy, pale-brown to red brown, and resembles the material that forms the outer zones of the pisolites. In some specimens it is dense and impervious, and completely fills the interstices between the pisolites. In others it seems to occur as a thin skin which envelopes each pisolite and cements it to the adjoining ones, but fails to fill the cavities between them. Specimens collected within a small area show gradations from the firmly cemented but porous and open-textured aggregate of pisolites to the laterite in which the voids are completely filled by a hard compact matrix. The specimens which contain cavities give the impression of having consisted initially of nothing more than spherical pisolites in contact with one another but devoid of matrix and cementing medium. If so, the matrix was subsequently deposited in the open cavities.

The pisolitic layer seems, from boring records, to have a maximum thickness of about 15 feet. This is not a firm figure, because a sample from an auger is generally broken or ground to small fragments and some doubt exists concerning the type of laterite which it represents. Where it is exposed in gullies near the margins of the laterite the pisolitic zone has been reduced by erosion to a thickness of 5 feet or less, but the slope of the land surface commonly suggests a thickness of about 10 feet at no great distance from the gully.

The lower part of the pisolitic layer contains nodules, which range from about quarter of an inch to one inch diameter. Towards the bottom of the pisolitic layer, they increase in numbers to form a nodular layer, in which some pisolites are present. In comparison with the pisolites, which can reasonably be described as spherical, the nodules are less symmetrical in outline. Some are spherical, others pear-shaped, and some have rounded triangular, rhombic and polygonal outlines. Some nodules enclose pisolites. The spherical nodules and most of the less regularly-shaped ones resemble the pisolites in having an outer banded or zoned, compact, earthy outer layer and a slightly lustrous core. The core occupies a much larger proportion of the nodule than it does of the pisolite. Probably these nodules formed in the same way as the pisolites but under slightly differing conditions, e.g. there may have been a higher concentration in the surrounding ground-water of aluminous and ferric oxides. When growth brought adjacent nodules into contact, they apparently continued to grow in the cavities, thus losing the initial spherical shape. Other nodules seem to differ internally. Their cores are slightly porous and have a suggestion of a granular texture. They may represent residuals of an earlier pre-lateritic rock which were surrounded by concretionary evelopes of hydrated alumina and ferric oxide and protected from further leaching and alteration sufficiently to retain vestiges of original texture.

The nodular layer is succeeded rather abruptly by a pale red-brown, amorphous band which is dull and earthy in appearance where it is slightly weathered, and elsewhere has a sub-vitreous lustre. In hand specimen it is compact, homogeneous and lacking in structure. For convenience it will be termed compact laterite. Its constituent material resembles the material which forms pisolites and nodules, or probably more closely, the matrix in fresh pisolitic and nodular laterite. It commonly has crude horizontal or nearly horizontal joints or parting-planes. As a result, detritus derived from the compact laterite resembles fragments of bedded sedimentary rock. The compact laterite contains elongated, irregular, rounded cavities like miniature caves or solution channels which tend to follow the crude horizontal parting planes. Although much of the compact laterite is homogeneous, the outlines of former pisolites and nodules can be seen clearly in some specimens of it and faintly detected in others. Apparently this compact band represents in the lateritic profile a horizon at which the ground water was continuously saturated with ferric and aluminous oxides.

The compact laterite is succeeded downwards by a zone of tubular laterite which appears to be more clayey and ferruginous. The tubules are vertical and may be several feet long, persisting through the thickness of the zone. In the upper part, the laterite between the tubules is compact and unbroken, and may contain pisolites and nodules; the tubules are continuous, smooth surfaced, and apparently coated with hydrated aluminous and ferric oxides. Pisolites line some tubules. Near the bottom of the zone the tubules are not so well defined, and the laterite between them appears to consist of sub-angular fragments or nodules enclosed in a compact matrix. Cavities occur between some of the fragments or nodules and the tubules tend locally to lose their identity and merge into them. As suggested above for some of the nodules above the compact laterite, the fragments may represent masses of pre-lateritic rock isolated by deposition around them of ferruginous and aluminous coatings.

The lower part of the tubular laterite passes downwards into a zone of sub-rounded and rounded fragments which resembles a poorly-cemented conglomerate. Probably the only important difference between the two zones, in regard to their origin, is that deposition has been a more dominant process in the tubular zone. The fragmental-looking zone probably represents leached and weathered country rock in which hydrated iron oxide was deposited to form concretions. These may have been so numerous that their outside boundaries were in contact, like those of the pisolites and nodules higher up in the profile. The masses of weathered country rock enclosed within the concretions were to some extent shielded from further weathering, but the material between the concretions was continually leached and removed in solution by seeping ground water. The resulting rock which may be termed a pseudo-conglomerate, yields abundant rubble over a wide area to the slopes below the margins of the laterite.

At the head of the gorge at locality E, 2½ miles east of the origin of the grid-coordinates, the pseudo-conglomerate is underlain by friable earth which looks like clay, but is not plastic. When broken down in water, a small proportion of it goes into suspension and the remainder settles to the bottom as friable angular fragments. This material has been given the field name "non-plastic red clay". It was observed to a depth of 1 foot below the pseudo-conglomerate, by digging away some of the detritus.

CONCLUSIONS

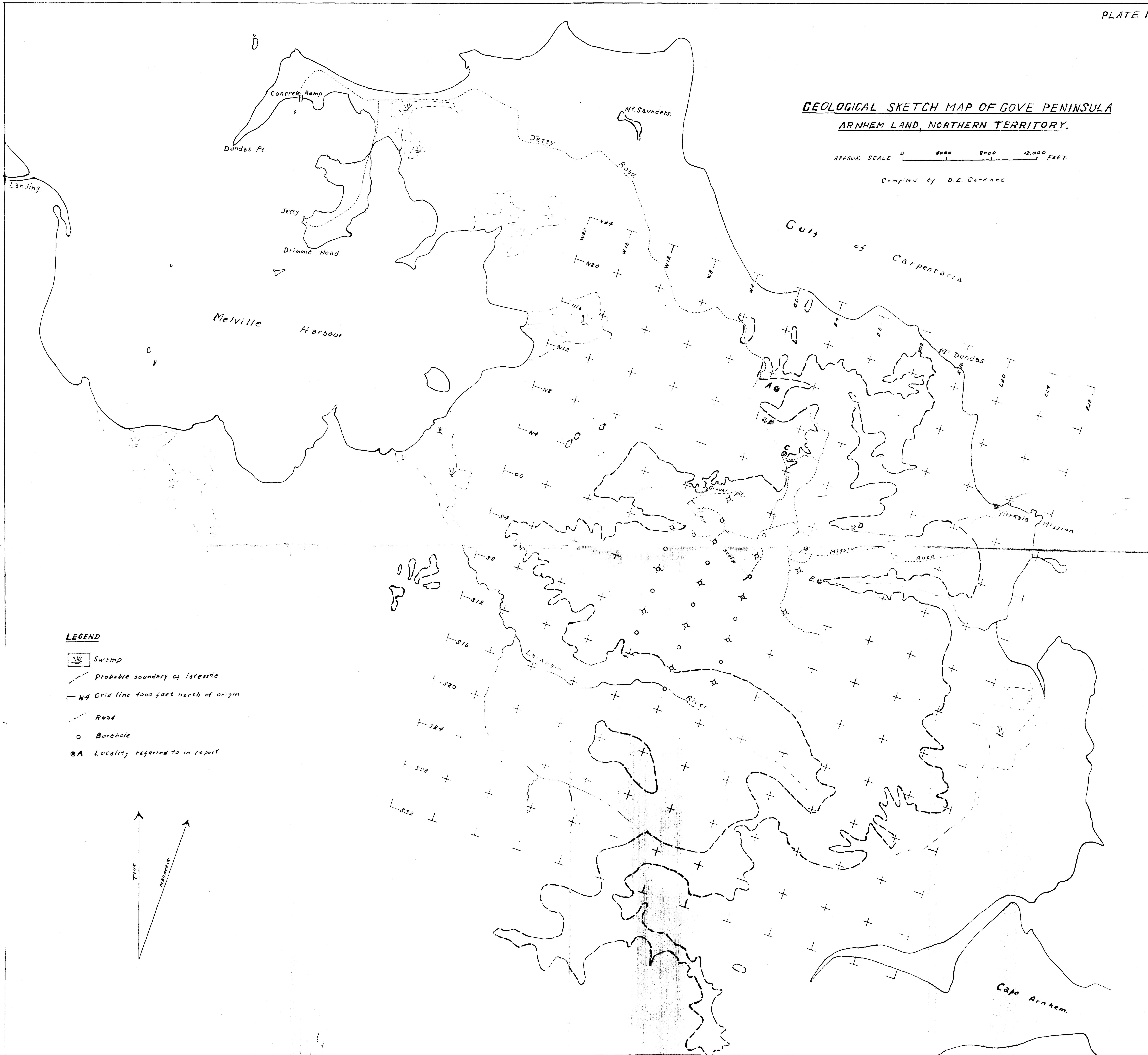
The superficial dimensions of the main body of the deposit indicate that more than 50,000,000 tons of aluminous laterite per yard of thickness occurs on Gove Peninsula. The total average thickness of the laterite is probably between 20 and 25 feet and the average thickness of the pisolitic laterite, which appears to be the most highly aluminous, is probably about 10 feet. The compositions of the several types of laterite are not yet known.

From the limited observations that have been made, the impression is gained that the several zones or types of laterite have a common origin, each representing a particular stage in the process of lateritization or in the secondary changes resulting from solution and redistribution of the constituents after lateritization. The source rock of the laterite is not known.

PROPOSED FUTURE GEOLOGICAL WORK

Mapping of boundaries within the lateritic area will be continued. The greater part of this work can be done concurrently with or shortly after the marking out and clearing of bore lines. The several types of laterite will be examined at other localities and specimens collected for assay and for reference. The perimeter of the lateritic area will be searched for outcrops of the underlying rocks. As opportunity offers, mapping will be extended to areas outside the boundaries of the laterite.

PLATE I


GEOLOGICAL SKETCH MAP OF GOVE PENINSULA
ARNHEM LAND, NORTHERN TERRITORY.
APPROX. SCALE 0 4000 8000 12,000 FEET
Compiled by D.E. Gardner.
LEGEND
Swamp
Probable boundary of laterite
N4 Grid line 4000 feet north of origin
Road
Borehole
A Locality referred to in report.
True
Magnetic
Gulf of Carpentaria
Melville Harbour
Concrete Ramp
Dundas Pt
Landing
Jetty
Drimmie Head.
Jetty Road
Mt Saunders.
Mt Dundas
Yirrkala Mission
Mission Road
Gravel pit
Air strip
Latram River
Cape Arnhem.
N24
N20
N16
N12
N8
N4
00
S4
S8
S12
S16
S20
S24
S28
S32
W20
W16
W12
W8
W4
E4
E8
E12
E16
E20
E24
E28
A
B
C
D
E