COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1961 No. 23

NORTH-EASTERN TASMANIA AIRBORNE RADIOMETRIC SURVEYS, 1957-60

by

J.M. Mulder

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ILLUSTRATIONS

ABSTRACT

This report describes low-level airborne scintillograph surveys conducted in north-eastern Tasmania during the summer months of 1957, 1958, and 1960 in areas selected by the Tasmanian Department of Mines.

An area of 1835 square miles was surveyed and 18 radiometric anomalies were recorded. However, the results do not indicate that these anomalies are likely to be caused by uranium mineralisation of economic importance.

1. INTRODUCTION

Following the discovery of uranium mineralisation in the Avoca district, the Tasmanian Department of Mines requested the Bureau to conduct an airborne survey for radioactive minerals in the north-eastern part of the state.

To obtain the best results it was decided that this survey would be made at a low level by a light aircraft, as a larger aircraft such as a DC.3 would be unable to maintain a constant height above the rugged terrain. Even with a light aircraft difficulties are encountered when flying at the usual operating height of 200 ft above ground level. Consequently the flying was done only in the summer months, when the weather is usually most favourable.

Three field seasons were spent in Tasmania, the first two from January to the end of March in 1957 and 1958, and the third from early February to the end of March in 1960. The first and second surveys were done in the Bureau's Auster aircraft which was fitted with scintillograph and associated equipment. By the end of the 1958 season the areas which remained were so rugged that further operations had to be postponed until the Auster was replaced by a more suitable aircraft. This was done at the end of 1959 when a Cessna-180 was purchased by the Bureau, and survey flying was resumed in February 1960. The Cessna, although much more powerful than the Auster, was also operated to the limit of its safety requirements in the more rugged parts of the survey area.

The officers who took part in the surveys were :-

1957 : J.M. Mulder, party leader

A.F.S. Young, assistant geophysicist

W.C. Gerula, draftsman

First Officer P. Worley, pilot, of T.A.A., later relieved by

First Officer K. Purnell, also of T.A.A.

1958 : J.M. Mulder, party leader

P. Frazer, geophysical assistant

A. Miglis, draftsman

First Officer P. Worley, pilot, of T.A.A.

1960 : J.M. Mulder, party leader

C. Braybrook, geophysical assistant

J. Janulaitis, drafting assistant

First Officer K. Dodds, pilot, of T.A.A.

Operations for the three surveys were based on St. Helens and Launceston.

Maps showing the results of the surveys were prepared and issued, in each case, a few months after completion of the field work. These maps appear as Plates 1, 2 and 3 in this Record.

2. GEOLOGY

The geology of north-eastern Tasmania has been described by Nye and Blake (1938).

The oldest exposed strata in the district appear to be the Cambro-Ordovician Mathinna slates and sandstones. They are intruded by granite of Devonian age which occupies large parts of the Blue Tier, Ringarooma, and Oyster Bay areas. No sedimentary rocks belonging to the Devonian period are known to occur. Permo-Carboniferous sediments containing conglomerate, grit, sandstone, and limestone outcrop extensively, and unconformably overlie the Devonian granites and Cambro-Ordovician rocks.

The younger rocks exposed in the area include Triassic sandstone, grit, mudstone, carbonaceous shale; Tertiary gravel, basalt, and clay; and Quarternary sand and gravel.

Deposits of uranium-bearing minerals are known to occur in the granites along Storeys Creek near Rossarden in the Avoca district. These occurrences have been investigated by Noakes (1955), Walpole (1955), Ostle (1956), Rowston (1956), Langron (1957), and Daly (1958).

3. EQUIPMENT

The scintillograph used on these surveys was an Austronic Engineering Laboratories ratemeter and detector head Type AS-1. This instrument was coupled to one channel of a Texas Instruments Incorporated dual-channel recording milliammeter.

The scintillograph detecting element consisted of a cylindrical thallium-activated sodium iodide crystal, 4½ in. in diameter and 2 in. thick. Gamma rays impinging on this crystal produce scintillations, which are converted into electrical pulses in a photomultiplier tube optically coupled to the crystal. The pulses are fed into the ratemeter, where they are integrated and converted into a current proportional to the gamma radiation detected over a pre-selected short time interval. This current is registered on the recording milliammeter, which thus presents a continuous record of the intensity of gamma radiation at the detecting crystal.

An AN/APN-1 radio altimeter was coupled to the second channel of the recorder. This instrument provides a continuous indication of the ground clearance along the flight path. The pilot is guided for height control by a set of limit lights which show him whether the aircraft is within the pre-determined range 185-215 ft above ground level.

4. OPERATIONS

K-17 and other aerial photographs were used for navigation. Flight lines and check points were plotted on these photographs by the observer during flight. The air speed of the Auster was closely maintained at 80-90 knots, whereas the Cessna flew approximately 20 knots faster. At the nominal height of 200 ft above ground level a lane width of approximately 500 ft was scanned by the scintillograph. However, this width is related to the nature of the terrain, and varies in rugged country where correct height cannot be maintained.

The line separation was chosen according to the geology and the topography, and ranged from $\frac{1}{4}$ mile over the granites to 1/3 mile over the sedimentary rocks.

Flight lines were usually flown at right angles to the strike of geological formations, but where the topography imposed a safety hazard some other method, e.g. contour flying, was adopted.

Experience has shown that on long flight lines the positioning of anomalies by proportion between starting and finishing points on the chart is inaccurate. This is caused by changes in air and ground speeds relative to the uniform chart speed. To reduce errors due to such causes, intermediate check points were marked on the photograph and on the chart, and any point of interest was located by interpolation between the check points.

To make all radiometric results uniform, the response to the scintillograph equipment was checked before and after each survey flight by measuring the signal from a standard radioactive source placed at a certain fixed distance from the detector head. These tests were done at an altitude of 2000 ft, where ground radiation is negligible.

Checks on the operation of the radio altimeter were also carried out regularly by flying at 200 ft over the airstrip and comparing the barometric altimeter indication with the operation of the limit lights.

Although the weather is generally good during the summer, survey flying was frequently interrupted by winds, which affect low-level surveys, particularly in such rugged country as north-eastern Tasmania.

5. METHOD OF INTERPRETATION

Anomalies were assessed by examining the scintillograph records together with the altitude records and all available information on the local geology.

Any anomalies of intensity greater than $1\frac{1}{2}$ times the background count, and whose lateral extent (measured by flying time between points half way up and half way down the anomaly curve) was less than 8 seconds, were recommended for further investigation. Wherever possible such anomalies were re-flown at a line separation of 1/7 miles.

The radio altimeter record was inspected for large deviations from the normal operating height which occur over gorges, escarpments, and ridges. The height of the aircraft above the ground over these features often ranged from 500 ft to less than 50 ft. In such cases height corrections were not applied but instead these runs were re-flown in a different direction if the results looked sufficiently promising.

6. AIRBORNE RESULTS

Plates 1, 2, and 3 show respectively the results of the 1957, 1958, and 1960 surveys. The method of the 1957 presentation differs from that of the other surveys in that isorads are shown in addition to anomalies. Plate 2 shows the positions of the 1958 anomalies on the map and also their positions on the aerial photographs which are partly or wholly reproduced around the edge of the map. The 1960 anomalies are shown by their map positions only, on Plate 3.

Plate 1, 1957 survey

Anomaly No. 1 occurs in the granites near Mussel Roe Bay.

Anomalies 2 and 4 occur in the Permo-Carboniferous conglomerates and sandstones near outcropping granites.

Anomalies 5, 6, and 7 occur in Tertiary and Quarternary sand and gravel which overlie the granite.

Anomalies 3 and 8 were detected over dredgings at disused tin mines and may be associated with monazite sand which has been reported in the area.

Plate 2, 1958 survey

Six anomalies were detected over the granites of the Blue Tier. Some of the anomalies occurred on the sites of tin mines, which indicates that monazite sand may be the cause of anomalous count rates.

Plate 3, 1960 survey

Four anomalies were detected over the granite of the Oyster Bay district.

7. RESULTS OF GROUND INSPECTION

The results of the three airborne surveys showed that 18 anomalies were detected during the course of the three surveys. Of these, 10 were located during the 1958 and 1960 surveys and were inspected on the ground in 1960 by Messrs. T.D. Hughes and W. Pitulej of the Tasmanian Department of Mines. The result of the ground inspection showed that most of the anomalies were associated with granite rocks or monazite sand. Some anomalies could not be found on the ground.

A summary of the investigations, incorporating the author's comments, is given below:-

(1) Follow-up of the 1958 airborne survey

(a) Anomalies 1 to 4 are located about 7 miles south-south-east of Gladstone. These anomalies occur in granite country along one of the headwaters of the Great Mussel Roe River. Examination of the area revealed no significant increases in the count rate; however, higher counts were observed 1 mile to the south-west over a belt of red granite which runs parallel to the line of anomalies and is approximately of the same length. It was concluded therefore that the anomalies should have been plotted one mile farther west than shown on the map.

The possibility that these anomalies have actually been mis-plotted by one mile is puzzling because they occurred at the beginnings of each of four adjacent flight lines where topographic features were reasonably distinct. As there remains some doubt as to the correct positioning of these anomalies, it would be desirable to re-fly them, if the aircraft is again stationed in Tasmania.

(b) Anomaly 5, located on the western bank of Ansons River below the junction of Spurr Rivulet, appears to be caused by granite rocks.

(c) Anomaly 6, located near the headwaters of Ansons Rivulet, appears to be associated with granite outcrops but may be caused by outcrops of pegmatite 900 ft south of the plotted position of the anomaly.

(2) Follow-up of the 1960 airborne survey

(a) Anomalies 1 and 2 are located on the northern slope of a small hill one mile east of the town of Bicheno and south of the highway. The outcropping rock is a grey biotite granite near which no appreciable increase in count rate was measured. The cause of these anomalies is unknown.

(b) Anomaly 3 is located just behind Half Moon Bay, 5 miles south of Bicheno. This anomaly is a linear anomaly and occurs along a hill which runs at an angle inland from the southern edge of the beach at Half Moon Bay. All along the face of the hill are outcrops of grey biotite granite which have no appreciably higher count at any one place. However, the beach sand nearby has varying concentrations of zircon monazite which is considered to be the cause of the anomalies.

(c) Anomaly 4 is located on the eastern or seaward side of a small ridge showing Permian arkose conglomerates. However, these conglomerates are only slightly radioactive and it is considered that the anomaly may be due to an accumulation of monazite in the sand of the neighbouring Friendly Beaches a quarter of a mile to the east.

8. CONCLUSIONS

A large part of north-eastern Tasmania has been covered by the airborne surveys described in this report. 18 anomalies have been detected and recommended for further examination on the ground. 10 of these anomalies have now been inspected by ground parties, but the results show no indication of uranium mineralisation.

The 1960 survey completed the exploration programme requested by the Department of Mines, with the exception of a few small areas too rugged for low-level flying. It appears that not all the anomalies have been investigated on the ground, but the results of aerial work and ground work generally offer no promise of the occurrence of economic uranium deposits in the area surveyed.

9. REFERENCES

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NYE, P.B. and BLAKE, F.	1938	The geology and mineral deposits of Tasmania. Bull.geol.Surv. Tasm. 44.
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PITULEJ, W.	1960	Examination of radiometric anomalies between Gladstone and St. Helens. Department of Mines, Hobart. (unpublished report).
ROWSTON, D.L.	1956	Radiometric logging of diamond drill hole No. BG80 at the Royal George Mine, near Avoca, Tasmania. Bur.Min.Resour.Aust.Records 1956/28.
WALPOLE, B.P.	1955	Uranium occurrence Avoca area, Tasmania. Bur.Min.Resour.Aust. Records 1955/30.

BASS STRAIT

TASMAN SEA

WATERHOUSE ISLAND

ANDERSON BAY

RINGAROOMA BAY

LAGOON

SURVEY

MUSSEL ROE BAY

AIRBORNE

1957

LIMIT OF THE 1957 AIRBORNE SURVEY

NOT SURVEYED

GLADSTONE

MT. CAMERON

OPEN CUT

SOUTH MT. CAMERON

EDDYSTONE PT.

BRADSHAWS CREEK

PIONEER DAM

WINNALEAH

DERBY

MOORINA

BRANXHOLM

SCOTTSDALE

WELDBOROUGH

RINGAROOMA

ALBERTON

PYENGANA

GOSHEN

ST. HELENS

GEORGE BAY

ANSONS BAY

HIGHWAY

TASMAN

DAM

RES.

Tomahawk River

Ringarooma River

East Branch of the Ringarooma River

Great Mussel Roe River

Great Forester River

Boobyalla River

Great Fraser River

Ansons River

Last River

Arnon River

Frome Weld R.

Wynyard R.

Cascade R.

Dorset River

Maurice R.

George River

41°00′

41°15′

41°20′

147°26′

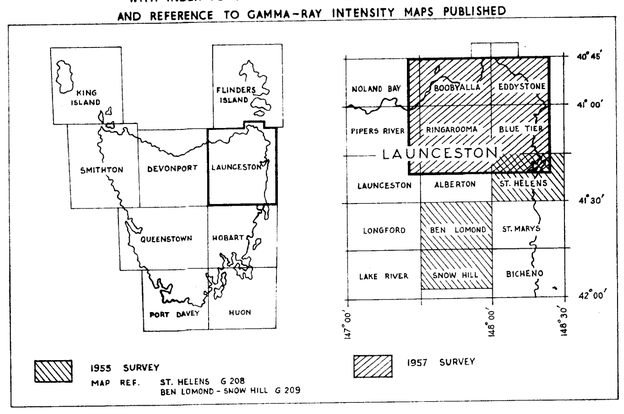
147°30′

148°00′

148°23′

LOCATION DIAGRAM

WITH INDEX TO 4-MILE AND 1-MILE MILITARY MAP SERIES AND REFERENCE TO GAMMA-RAY INTENSITY MAPS PUBLISHED



SCOTTSDALE — GLADSTONE REGION

(NORTH - EASTERN TASMANIA)

ANOMALIES AND CONTOURS OF GAMMA - RAY INTENSITY

DETERMINED BY AIRBORNE SCINTILLOGRAPH

(JANUARY - MARCH 1957)

SCALE

MILES 2 0 2 4 6 8 MILES

LEGEND

TOPOGRAPHICAL DATA

- HIGHWAY
- ROAD OR TRACK
- RAILWAY
- RIVER OR CREEK
- TOWNSHIP

RADIOMETRIC DATA

- ⊗¹ ANOMALY (ANOMALIES ARE NUMBERED FOR REFERENCE PURPOSE ONLY)
- 2 CONTOUR OF GAMMA-RAY INTENSITY
- LIMIT OF THE 1957 AIRBORNE SURVEY

MAP DATA

PROJECTION : TRANSVERSE MERCATOR, AUSTRALIAN NATIONAL SERIES

DETAIL : PLANIMETRIC DETAIL WAS COMPILED FROM AERIAL PHOTOGRAPHS CONTROLLED BY ONE-MILE PHOTO-MOSAICS

ACCURACY : RELIABLE SKETCH

EXPLANATORY NOTES

THE AIRBORNE SCINTILLOGRAPH RECORDS CONTINUOUSLY THE INTENSITY OF GAMMA RADIATION FROM THE GROUND OVER WHICH THE AIRCRAFT FLIES. THIS RADIATION IS DUE TO THE PRESENCE OF NATURALLY OCCURRING RADIOACTIVE ELEMENTS, URANIUM AND THORIUM AND THEIR DECAY PRODUCTS, AND TO A LESSER EXTENT POTASSIUM.

THE SCINTILLOGRAPH WAS CARRIED IN AN AUSTER AIRCRAFT WHICH WAS FLOWN AT AN AVERAGE ALTITUDE OF ABOUT 200 FEET ABOVE THE GROUND. THE SCINTILLOGRAPH EFFECTIVELY SCANNED A STRIP OF GROUND APPROXIMATELY 150 YARDS WIDE. THE RECORDED GAMMA-RAY INTENSITY THEREFORE REPRESENTS THE AVERAGE INTENSITY WITHIN A RADIUS OF ABOUT 75 YARDS OF THE AIRCRAFT.

THE GAMMA-RAY INTENSITY OVER AN AREA MAY SHOW CONSIDERABLE VARIATIONS, DEPENDING ON THE GEOLOGY AND TOPOGRAPHY OF THE AREA. ANOMALIES OF GAMMA-RAY INTENSITY HAVE BEEN PLOTTED WHERE THE INTENSITY SHOWED A SIGNIFICANT INCREASE. THE GENERAL DISTRIBUTION OF THE GAMMA-RAY INTENSITY IS REPRESENTED BY CONTOUR LINES, THE VALUES OF WHICH ARE MULTIPLES OF AN ARBITRARY UNIT.

THE HIGHER INTENSITIES RECORDED BY THE SCINTILLOGRAPH ARE NOT NECESSARILY DUE TO THE PRESENCE OF URANIUM DEPOSITS. MANY OF THE HIGH INTENSITIES MAY BE DUE TO OUTCROPS OF IGNEOUS ROCKS, PARTICULARLY GRANITE, WHICH CONTAIN A SLIGHTLY HIGHER CONCENTRATION OF THE RADIOACTIVE ELEMENTS, URANIUM, THORIUM AND POTASSIUM, THAN OTHER ROCKS. NO CLAIM IS MADE THAT ALL, OR EVEN ANY, OF THE HIGH INTENSITIES CORRESPOND TO URANIUM DEPOSITS OF ECONOMIC SIGNIFICANCE, BUT IT IS POSSIBLE THAT SOME DO.

IT SHOULD BE NOTED THAT IT IS VIRTUALLY ONLY THE RADIOACTIVITY OF THE SURFACE OF THE GROUND THAT HAS BEEN RECORDED BECAUSE THE RADIATION FROM ANY BURIED DEPOSIT IS SUBSTANTIALLY REDUCED BY A FEW INCHES OF SOIL OR ROCK COVER.

G 283-2

COMPILED AND DRAWN BY GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, MELBOURNE

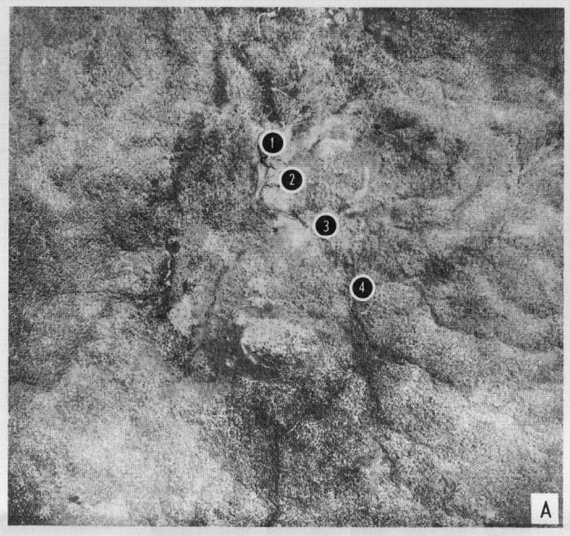
MAP DATA

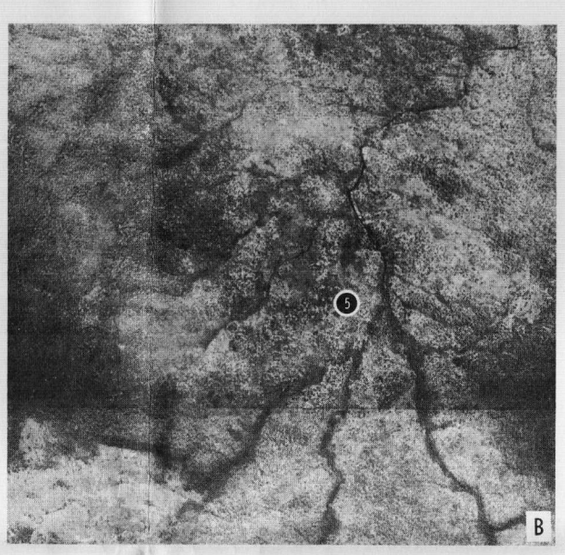
PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES

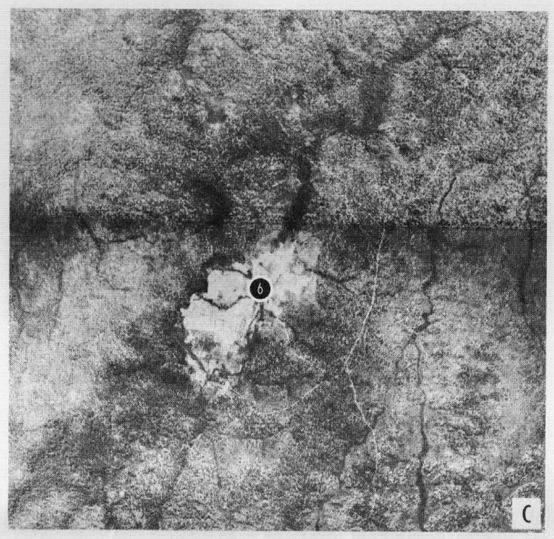
DETAIL: PLANIMETRIC DETAIL WAS COMPILED FROM ONE-MILE AIR PHOTO MOSAICS PREPARED BY DIVISION OF NATIONAL MAPPING. ALSO ROYAL AUSTRALIAN SURVEY CORPS 1:253,440 MAPS

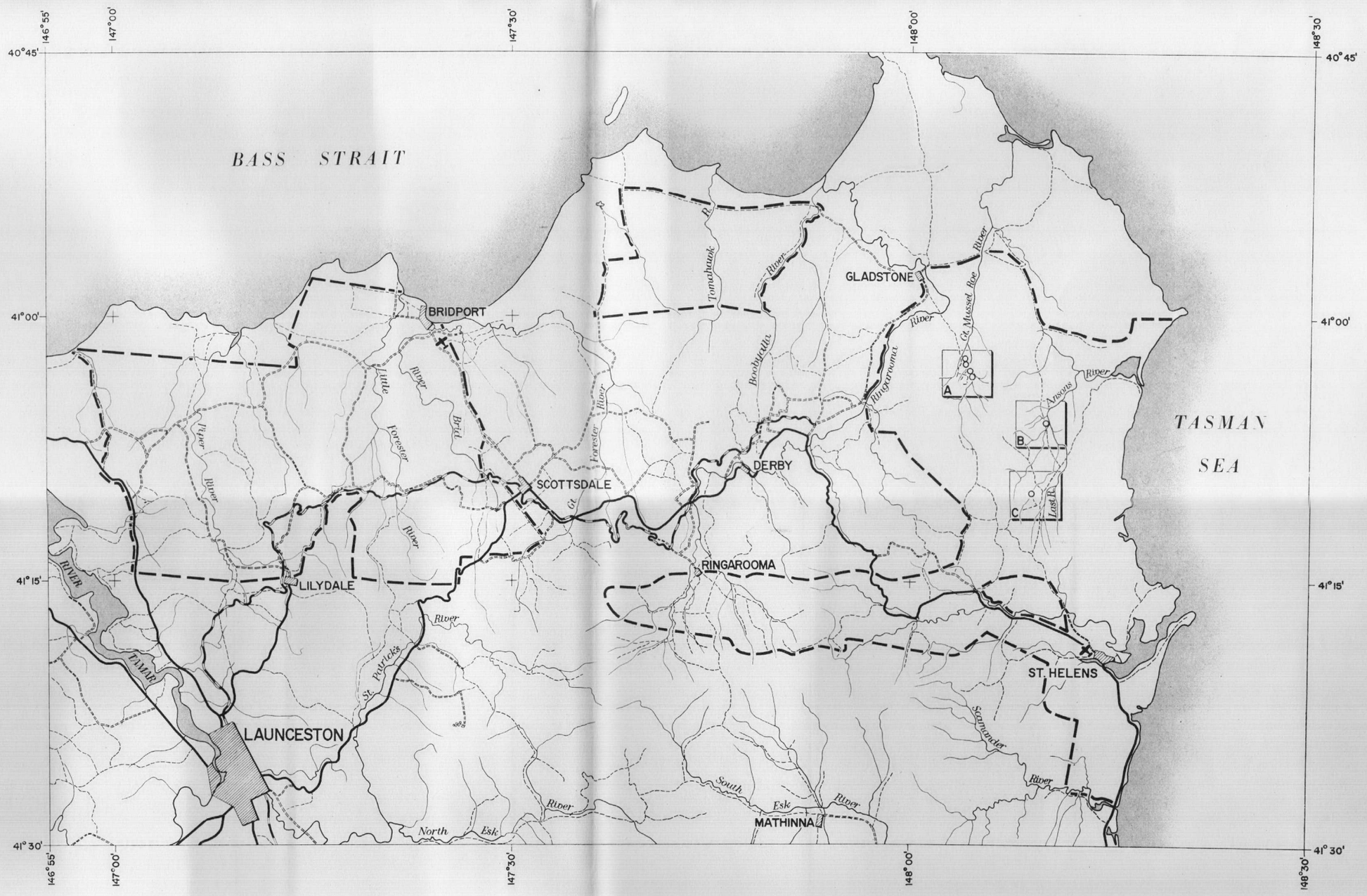
RELIABILITY: SKETCH ONLY

NOTE: IMPERFECTIONS ON AIR PHOTO MAPS ARE DUE TO FAULTS ON ORIGINAL NEGATIVES.









LEGEND

TOPOGRAPHICAL DATA

- RIVER OR CREEK
- RAILWAY
- HIGHWAY
- MAIN ROAD
- BYE ROAD OR TRACK
- TELEGRAPH LINE
- FENCE
- AERODROME OR LANDING GROUND
- TOWN
- MINE

SCINTILLOGRAPH DATA

- (5) ANOMALY (ANOMALIES ARE NUMBERED FOR REFERENCE ONLY)
- LIMIT OF THE 1958 AIRBORNE SURVEY

EXPLANATORY NOTES

The airborne scintillograph records continuously the intensity of gamma radiation from the ground over which the aircraft flies. This radiation is due to the presence of the naturally occurring radioactive elements, radium and thorium and their decay products, and to a lesser extent potassium.

The scintillograph was carried in an AUSTER aircraft which was flown at an average altitude of 200 feet above the ground. The scintillograph effectively scanned a strip of ground approximately 500 feet wide.

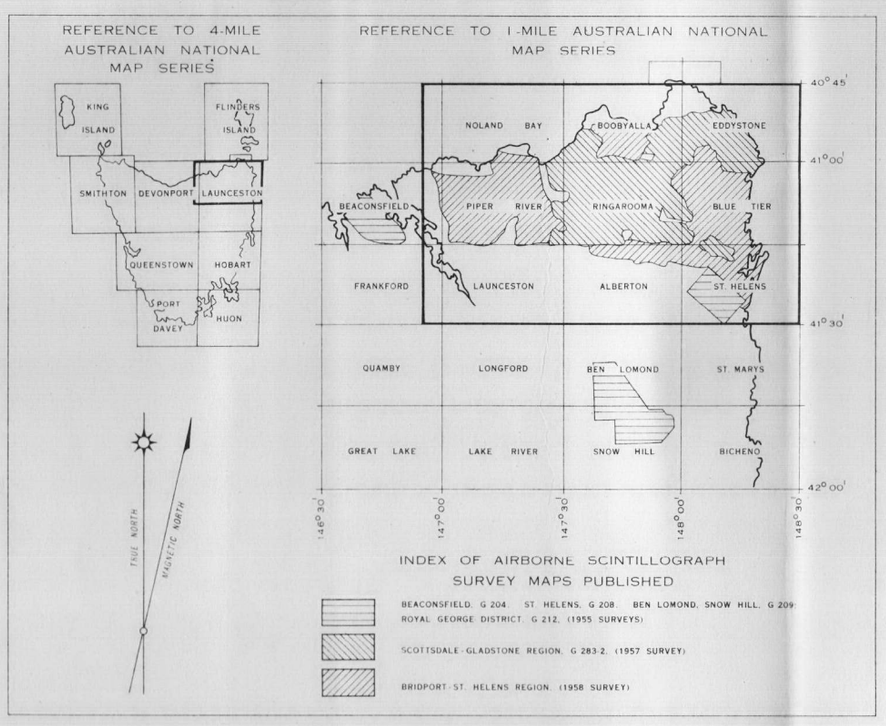
The gamma-ray intensity over an area may show considerable variations, depending on the geology and topography of the area. Anomalies of gamma-ray intensity have been plotted on the map where the intensity showed a significant and localised increase.

The map shows the position and grouping of the anomalies. To assist in making investigations on the ground, all the anomalies have been reproduced singly or in small groups on aerial photographs. The positioning of these anomalies is considered to be accurate to within 300 feet.

The higher intensities recorded by the scintillograph are not necessarily due to the presence of uranium deposits. Some of the higher intensities may be due to igneous rocks, which contain a slightly higher concentration of the radioactive elements, uranium, thorium and potassium, than other rocks. No claim is made that all, or even any, of the higher intensities correspond to uranium deposits of economic significance, but it is possible that some do.

It should be noted that it is virtually only the radioactivity of the surface of the ground that has been recorded, because the radiation from any buried deposit is substantially reduced by a few inches of soil or rock cover.

LOCATION DIAGRAM



N-E TASMANIA

BRIDPORT - ST. HELENS REGION

MAP SHOWING

RADIOMETRIC ANOMALIES

DETECTED BY AIRBORNE SCINTILLOGRAPH

JANUARY-MARCH, 1958

APPROXIMATE SCALE OF PHOTO MAPS

MILES 1 0 1 2 3 MILES

SCALE OF PLANIMETRIC MAP

MILES 8 4 0 8 16 24 MILES

COMPILED AND DRAWN BY GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, DEPARTMENT OF NATIONAL DEVELOPMENT, MELBOURNE

G 283-3

PLATE 3

N-E TASMANIA

LAUNCESTON - ST. MARYS REGION

MAP SHOWING

RADIOMETRIC ANOMALIES

DETECTED BY AIRBORNE SCINTILLOGRAPH

FEBRUARY - MARCH, 1960

SCALE

MILES 4 0 4 8 12 16 MILES

LEGEND

TOPOGRAPHICAL DATA

- RIVER OR CREEK
- RAILWAY
- MAIN ROAD
- ROAD OR TRACK
- AERODROME OR LANDING GROUND
- TOWN

SCINTILLOGRAPH DATA

- ANOMALY (ANOMALIES ARE NUMBERED FOR REFERENCE ONLY)
- LIMIT OF 1960 AIRBORNE SURVEY

MAP DATA

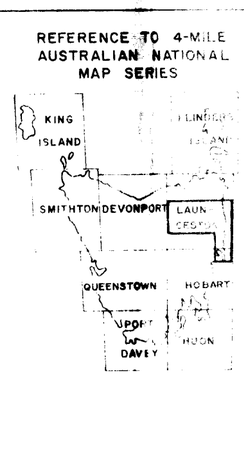
PROJECTION: TRANSVERSE MERCATOR AUSTRALIAN SERIES

DETAIL: PLANIMETRIC DETAIL WAS COMPILED FROM ONE MILE AIR PHOTO MOSAICS PREPARED BY DIVISION OF NATIONAL MAPPING, AND THE FOUR MILE STATE MAP No. 4 COMPILED BY THE TASMANIAN DEPARTMENT OF LANDS AND SURVEYS.

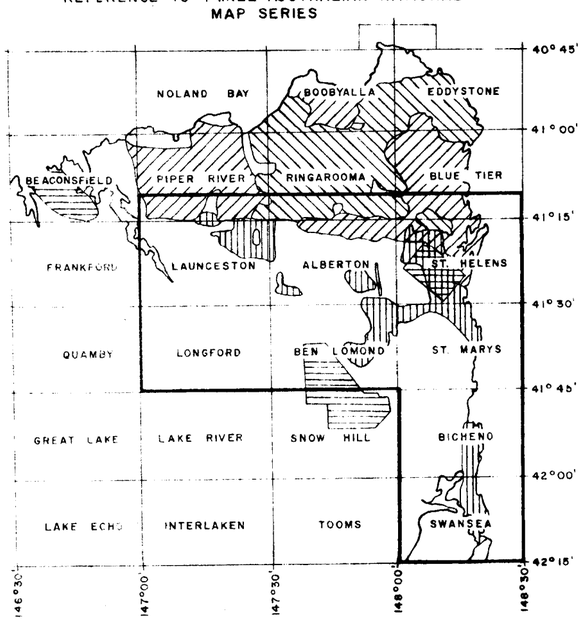
RELIABILITY: SKETCH ONLY

LOCATION DIAGRAM

REFERENCE TO 4-MILE AUSTRALIAN NATIONAL MAP SERIES



REFERENCE TO 1-MILE AUSTRALIAN NATIONAL MAP SERIES



INDEX OF AIRBORNE SCINTILLOGRAPH SURVEY MAPS PUBLISHED

- BEACONSFIELD, G 204; ST. HELENS, G 208; BEN LOMOND, SNOW HILL, G 209; ROYAL GEORGE DISTRICT, G 212, (1955 SURVEYS).
- SCOTTSDALE-GLADSTONE REGION, G 283-2, (1957 SURVEY).
- BRIDPORT-ST. HELENS REGION, (1958 SURVEY).
- LAUNCESTON-ST. MARYS REGION, (1960 SURVEY).

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The airborne scintillograph records continuously the intensity of gamma radiation from the ground over which the aircraft flies. This radiation is due to the presence of the naturally occurring radioactive elements, uranium and thorium and their decay products, and to a lesser extent potassium.

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The higher intensities recorded by the scintillograph are not necessarily due to the presence of uranium deposits. Some of the higher intensities may be due to igneous rocks, which contain a slightly higher concentration of the radioactive elements, uranium, thorium and potassium, than other rocks. No claim is made that all, or even any, of the higher intensities correspond to uranium deposits of economic significance.

It should be noted that it is virtually only the radioactivity of the surface of the ground that has been recorded, because the radiation from any buried deposit is substantially reduced by a few inches of soil or rock cover.

COMPILED AND DRAWN BY GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS. DEPARTMENT OF NATIONAL DEVELOPMENT, MELBOURNE.

G 283-5