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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS

1956, No.111

INTERIM REPORT on an AIRBORNE SCINTILLOGRAPH SURVEY of the EASTERN HIGHLANDS AND STRATHBOGIE AREAS, VICTORIA

by

J.M. MULDER

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ABSTRACT

During the period February to June, 1956, a start was made on an airborne scintillograph reconnaissance survey of areas in the Eastern Highlands of Victoria selected by the State Department of Mines.

Unsuitable weather caused the abandonment of the survey before the whole area had been covered but some portions of another area were surveyed before the aircraft returned to Melbourne; the second area is near the Strathbogie Ranges.

The results obtained show that the surface rocks in both areas have a low radioactive content. No radioactive anomaly of any significance was recorded but it is considered that the survey of some of the remaining parts of the Eastern Highlands should be made at a later date.

1. INTRODUCTION.

An airborne scintillograph survey for radioactive mineral deposits was conducted in the Eastern Highlands and Strathbogie areas of Victoria, by the Bureau of Mineral Resources, at the request of the Victorian Mines Department. The survey was made between early February and early June 1956, when field operations ceased on account of unsuitable weather.

An Auster aircraft (VH-GVC) was specially equipped for this work with a scintillograph which records continuously the intensity of the gamma radiation from the ground over which it is flown. 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. The gamma-ray intensity over any area is generally uniform but shows variations above and below an average value. This survey was undertaken as part of the search for uranium deposits in Victoria.

The field party comprised J.M. Mulder (party leader), J.E.F. Gardener (geophysicist), and W. Gerula (draftsman). The aircraft was piloted by E. Bartlett of Southern Airlines, the company from which the aircraft was chartered.

2. GEOLOGY.

The rock types in the Eastern Highlands within the boundaries of this survey, as shown on the geological map of Victoria, issued by the State Mines Department, are:-

(a) Mainly metamorphics, but also slates and sandstones, of Ordovician age;

(b) Granites, granodiorites and syenites;

(c) Middle Devonian Snowy River volcanics, limestones, slates and sandstones;

(d) Tertiary volcanics (basalts).

Recent deposits overlie these rocks in many parts of the area, particularly in the valleys and along the rivers. These deposits become more widespread in the northern portion near the Hume Reservoir.

The survey in the Strathbogie Area was conducted over rock types described as:-

(a) Upper Devonian Cerberean volcanics;

(b) Granitic rocks.

3. OPERATIONS.

A light aircraft equipped with the necessary instruments can fly closely-spaced flight lines at about 100 to 200 feet above ground level. It is possible to survey an area of approximately 30 to 40 square miles per day in two flights of about three hours each, when a centrally-situated landing field is available. The area surveyed depends largely on the topography because sometimes dead flying cannot be avoided, as in very rugged areas where flights have to be made in one direction only, i.e. from the ridges into the valleys.

Survey flight lines were spaced about ¼ mile apart and were generally kept parallel to each other, but when this became impossible on account of steep terrain such as high peaks and narrow valleys, flights were made along contours at approximately constant level and at different heights above sea level. On such flights the aircraft was flown at a constant distance of 100 to 200 feet measured perpendicularly from the side of the mountain or valley. The flight path of the aircraft was plotted on aerial photographs, during flight, by an observer who also kept the scintillograph record of gamma radiation under close observation.

4. EQUIPMENT USED.

Two types of scintillograph were used:-

(a) A Brownell scintillometer, and

(b) A Chalk River detector head with a ratementer designed and built in the Bureau's workshops.

Both instruments gave no serious maintenance trouble during the operations in the field. Each ratemeter has an output meter calibrated in counts per minute, and this in turn was connected in series with an Esterline-Angus milliampere recorder which continuously recorded the gamma-ray intensity along each flight line.

Immediately before and after each flight a standard sample (C.A.E. No. 1628) was used to check the calibration of the instrument. The sample was placed at a pre-determined fixed distance from the detector head and the increase in intensity it produced at the detector was recorded on the chart. If necessary, adjustments were made to the instrument to maintain the recorded increase from the standard sample constant within certain small limits, in order that data obtained from day to day could be correlated satisfactorily.

5. AREAS SURVEYED.

(a) Eastern Highlands.

At Benambra, near Omeo, a temporary landing ground was made on the southern part of the "Lake Omeo Reserve" after prior approval had been obtained from the Department of Crown Lands and Surveys and the Civil Aviation Department.

The survey commenced in three areas which were selected on the following basis:-

(i) A high and rugged area for morning flights when there was little turbulence;

(ii) A lower and smoother area for afternoon flights when usually the turbulence increased and often there were winds which made flying along high ridges impossible because of dangerous downdrafts;

(iii) An alternative area close to base for occasions when part of a morning or afternoon was lost due to fog, wind or instrumental breakdown.

Plate 1 shows the three areas chosen for survey first; they are:-

(i) Near Mount Benambra and east of the Omeo highway, where mainly metamorphic rocks, but also igneous and sedimentary rocks, are exposed;

(ii) South-east of Omeo, where there are only metamorphic rocks;

(iii) South and east of Benambra, where both metamorphic and igneous rocks are exposed.

Rain interfered frequently with the field work during the survey, and operations from Benambra were suspended on 26th April when the landing ground became almost water-logged. The party transferred to Albury at the northern end of the Eastern Highlands where operations continued from an all-weather air strip.

Three new areas were then selected to suit the weather conditions prevailing and to meet as far as possible the three requirements listed above. The three areas in their order are:-

(iv) South-east of the Hume reservoir; the rocks here are mainly metamorphics of Ordovician age;

(v) West of the Kiewa River, where mainly metamorphic rocks of Ordovician age occur;

(vi) West of Albury, where similar rock types occur.

Because Recent deposits overlie these areas rather extensively and because of the continued unsatisfactory weather, it was decided to withdraw the field party from the Eastern Highlands, after only four weeks operations from the base at Albury. By this time an area of approximately 925 square miles had been surveyed and about 3000 flight line miles had been flown in the Eastern Highlands area.

(b) Strathbogie Area.

The party transferred to Benalla at the end of May to survey the Strathbogie Area (Plate 1). However, only scattered portions of the area could be flown because rain and floods closed the aerodrome for all traffic before these portions could be linked together. Survey flights were suspended after a fortnight's operations.

To that date about 320 flight line miles had been flown over a surveyed area of approximately 105 square miles.

6. PRESENTATION OF THE RESULTS.

The various factors that affect the characteristics and significance of the scintillograph records obtained in low-level airborne surveys have already been discussed in some detail by Howard (1956).

In the analysis of the results of this survey a method of measuring the radiation levels has been adopted which offers a satisfactory, standard basis for comparing results from different areas. A number of arbitrary, fixed levels of the gamma-ray intensity are established, on the basis of the calibration by standard sample (see Plate 2), and these levels are marked at each point of the record along each flight line. Contour lines can then be drawn through points of equal intensity on all flight lines.

It is necessary to establi h a "reference" level from which the final data can be derived. This "reference" level is normally chosen to be approximately equal to the average background count (i.e. ground radiation plus cosmic and instrument radiation). The cosmic and instrument components are determined on a flight at 2,000 feet at the beginning and end of each survey flight; slight drifts in recorder output produced by instrument noises, voltage variations and other sources during the flight can then be eliminated. At 2,000 feet the background count consists almost entirely of the cosmic and instrument components. The intensity recorded at that altitude is considered to represent "zero" ground radiation. The cosmic component of the radiation is considered to be approximately the same at lower altitudes as it is at 2,000 feet. The background count at 2,000 feet can thus be subtracted from intensities recorded along flight lines to give values of nett ground radiation.

A standard radioactive source was used in the calibration of the radiation levels used in measuring the scintillograph record. The first, or "reference" level, has been chosen arbitrarily and the other levels have been selected at intervals equal to one quarter of the deflection produced by the standard source. The levels used on the survey were determined each day on the basis of the calibration deflections produced by the standard sample. Plate 2 shows the manner in which the levels were derived.

The level of gamma radiation from the general country rock changes from one rock type to another and these different levels show as different contour values on the plan of the scintillograph results. However, although some areas may have, in general, a higher intensity, this does not necessarily mean that they contain useful deposits of radioactive minerals. In such areas the increase from one level to the next is gradual and of no particular significance. Any source of intense gamma-radiation, such as a deposit of uranium minerals cropping out at the surface, will produce a sharp and marked increase which stands out from the varying background as a distinct "anomaly". Some variations are due to changes in the height of the aircraft above ground but such occurrences are noted and appropriate corrections made to the record.

7. RESULTS OBTAINED.

The final radioactive anomaly map (see Plate 3) shows a few areas in the Eastern Highlands with a slightly higher background than normal. The intensities recorded were so small that no radiation exceeding the No. 3 level was detected. It was therefore not practicable to draw contours of radiation levels. The shaded areas on Plate 3 are those in qhich the ground radiation is between level No. 2 and level No. 3 on the intensity scale. These areas contain no radioactive anomalies which might be associated with radioactive deposits.

8. CONCLUSIONS AND RECOMMENDATIONS.

The investigation so far has not revealed any area with radioactive anomalies which might be related to radioactive mineral deposits. In fact, the areas surveyed showed a fairly uniform intensity irrespective of rock type. It is not even possible from the results obtained to outline areas of outcropping igneous rock, even though there is usually a slightly higher concentration of radioactive minerals in rocks of this type than in sedimentary and metamorphic rocks.

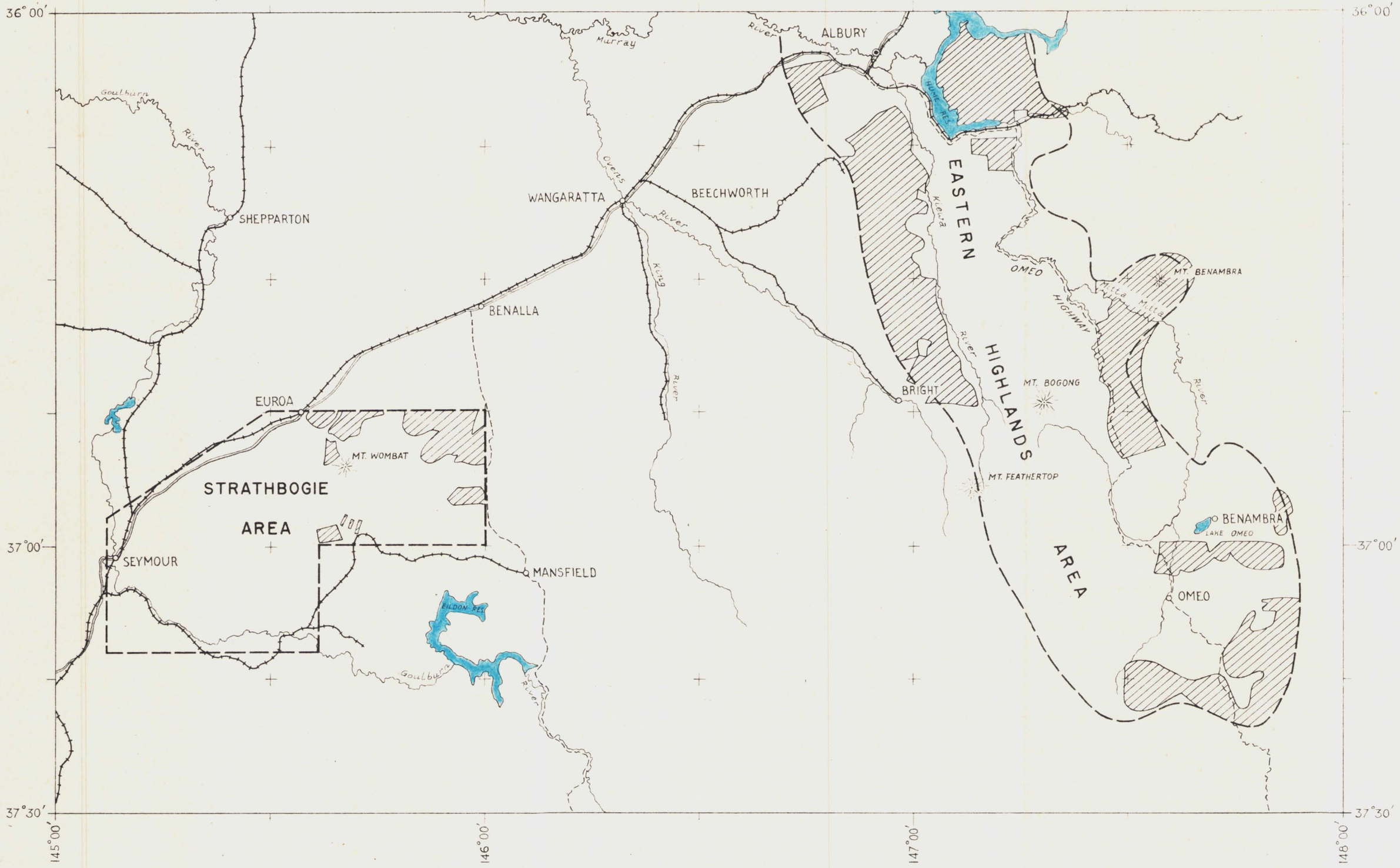
The portions of the Eastern Highlands sampled in this survey do not appear to warrant further investigation but there is a large area about the Bogong high plains which is still virtually untested. It is recommended that this area be given first priority when the survey is resumed.

Little comment is needed on the Strathbogie area, where a fair cross-section of the country has been surveyed without detecting any radiation above normal background. The igneous rocks show the same low intensity as those surveyed in the Eastern Highlands. The completion of the survey of this area may, therefore, be given a very low priority.

9. REFERENCE.

Howard, L.E., 1956 - Airborne Scintillograph Survey, Tasmania, 1955, Bur.Min.Res., Records 1956, No.99.

PLATE 1



EQUATORIAL SCALE 1 : 1000 000

MILES 10 0 10 20 30 40 50 60 70 MILES

AREA TO BE SURVEYED

LIMIT OF 1956 GEOPHYSICAL SURVEY

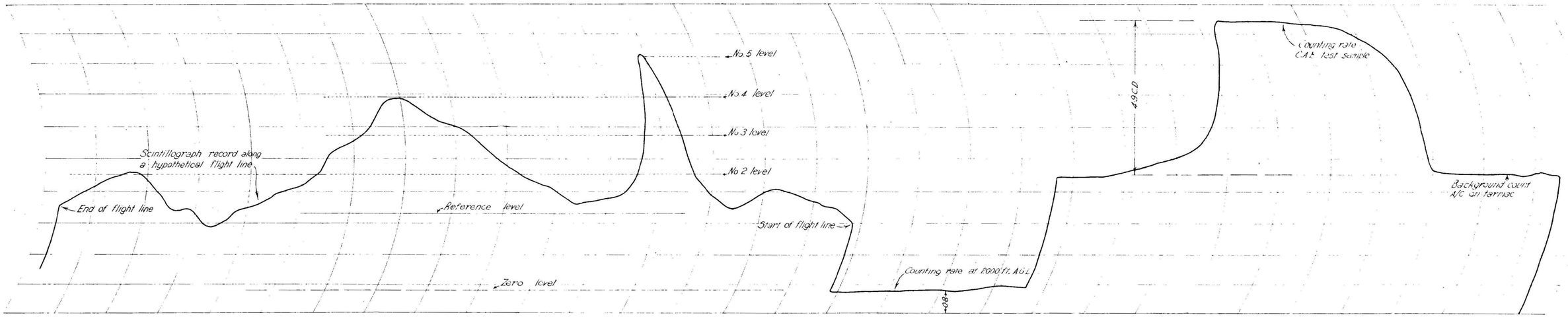
10¼° TRUE NORTH MAGNETIC NORTH

LOCALITY MAP

AIRBORNE SCINTILLOGRAPH SURVEY EASTERN HIGHLANDS and STRATHBOGIE AREAS, VICTORIA

MERCATOR PROJECTION

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics G 249-1



DETERMINATION OF RADIATION LEVELS

STANDARD SAMPLE	4·9 C.D.
½ SAMPLE COUNT	2·5 C.D.
ZERO LEVEL	0·8 C.D.
FIRST "	3·3 "
SECOND "	3·3 + 1·2 = 4·5 "
THIRD "	3·3 + (2 x 1·2) = 5·7 "
FOURTH "	3·3 + (3 x 1·2) = 6·9 "

ETC. IN STEPS OF ¼ SAMPLE COUNT WHICH IS 1·2 C.D. APPROX.

NOTE: THE FIRST LEVEL IS THE REFERENCE LEVEL.

C.D. = CHART DIVISIONS.

AIRBORNE SCINTILLOGRAPH SURVEY,
EASTERN HIGHLANDS AND STRATHBOGIE AREAS, VICTORIA.

SCINTILLOGRAPH SCALE FOR MEASURING ANOMALIES

INSTRUMENTS:

(a) BROWNELL SCINTILLOMETER
(b) CHALK RIVER (M.E.L.) DETECTOR WITH B.M.R RATEMETER
} WITH ESTERLINE-ANGUS RECORDER

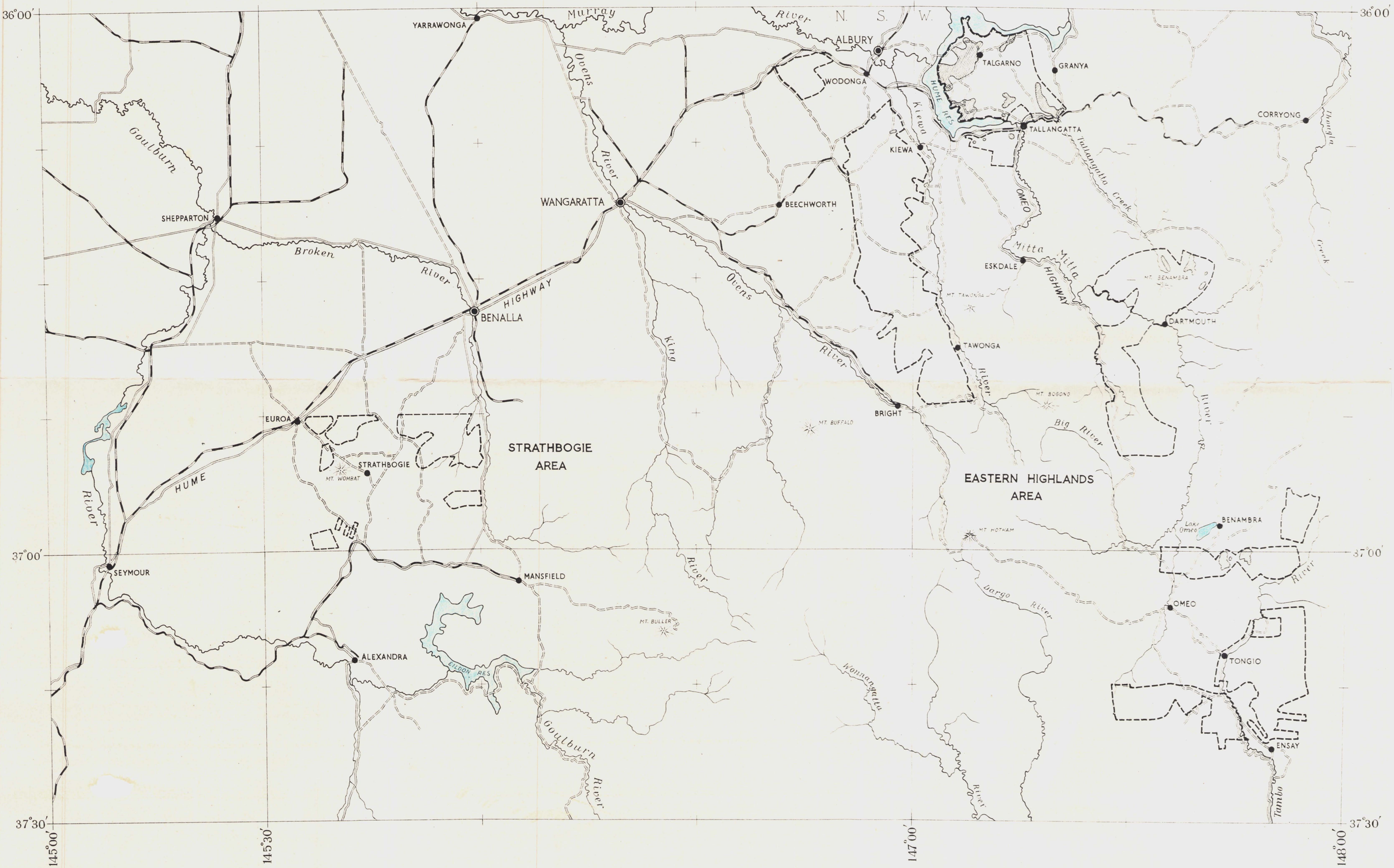
STANDARD SAMPLE:

CANADIAN ATOMIC ENERGY (C.A.E)
SAMPLE No. 1628

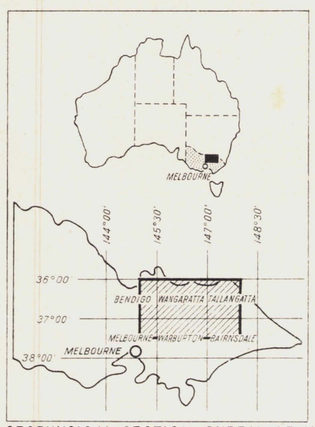
GEOPHYSICIST

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics G249-3

PLATE 3



LOCATION DIAGRAM
WITH INDEX TO 4 MILE MILITARY MAP SERIES



LEGEND

TOPOGRAPHY
- HIGHWAY
- ROAD
- RAILWAY
- RIVER OR CREEK
- MOUNTAIN

SCINTILLOGRAPH
- LIMIT OF THE 1956 GEOPHYSICAL SURVEY
- AREA WHERE RADIOACTIVITY IS SIGNIFICANTLY GREATER THAN AVERAGE

10° TRUE NORTH MAGNETIC NORTH

AIRBORNE SCINTILLOGRAPH SURVEY EASTERN HIGHLANDS AND STRATHBOGIE AREAS VICTORIA

SCALE

8 0 8 16 24 32 MILES

MAP DATA

PROJECTION : TRANSVERSE MERCATOR, AUSTRALIAN NATIONAL SERIES

DETAIL : PLANIMETRIC DETAIL WAS COMPILED FROM 4 MILES TO 1 INCH MILITARY MAPS

ACCURACY : 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 THE NATURALLY-OCCURRING RADIOACTIVE ELEMENTS, URANIUM AND THORIUM AND THEIR DECAY PRODUCTS, AND TO A LESSER EXTENT, POTASSIUM.

THE AIRCRAFT WAS FLOWN AT A CONSTANT ALTITUDE ABOVE THE GROUND WHERE POSSIBLE. THIS ALTITUDE WAS USUALLY ABOUT 100 FEET, BUT MAY HAVE BEEN AS MUCH AS 150 FEET, ON THE AVERAGE. THE SCINTILLOGRAPH EFFECTIVELY SCANNED A STRIP OF GROUND APPROXIMATELY 100 TO 150 YARDS WIDE, EXCEPT WHEN FLYING OVER RIDGES OR GORGES OR OTHER AREAS OF SHARP RELIEF. UNDER THESE CONDITIONS THE COVERAGE MAY BE LESS. THE RECORDED GAMMA-RAY INTENSITY THEREFORE REPRESENTS THE AVERAGE INTENSITY WITHIN A RADIUS OF 50 TO 75 YARDS OF THE AIRCRAFT.

THE GAMMA-RAY INTENSITY OVER ANY AREA IS GENERALLY UNIFORM BUT SHOWS VARIATIONS ABOVE AND BELOW AN AVERAGE VALUE. AREAS IN WHICH THE RECORDED INTENSITY IS SIGNIFICANTLY HIGHER THAN THIS AVERAGE ARE HACHURED ON THE MAP.

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 ACTUALLY 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.

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

G 249-2
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