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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1961-119

ADELAIDE RIVER, BROCKS CREEK, AND McKINLAY RIVER AREAS
AIRBORNE RADIOMETRIC SURVEY, N.T. 1960

by

J.E.F. Gardener

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ABSTRACT

During April and May 1960, a Cessna aircraft of the Bureau of Mineral Resources carried out a low-level airborne radiometric survey in the Adelaide River, Brocks Creek, and McKinlay River areas of the Northern Territory.

An area of 752 square miles was surveyed and 26 radiometric anomalies were located. The survey technique is described and the positions of the anomalies are shown on a map.

1. INTRODUCTION

This Record describes a low-level airborne radiometric survey for uranium in the Adelaide River, Brocks Creek, and McKinlay River areas of the Northern Territory. The survey was done in April and May 1960 by the Geophysical Branch of the Bureau of Mineral Resources, using a Cessna-180 aircraft.

A high-level airborne radiometric survey over part of the area covered by the present survey had been done by the Bureau in 1953, using a DC.3 aircraft. The positions of anomalies detected during that high-level survey were published in 1954 on maps G156-1, G159-1, and G170-1.

Regional and detailed geological mapping in the Darwin-Katherine area has been done by the Geological Branch of the Bureau for many years, and the areas selected for the present survey were determined by information gathered in this mapping programme.

Those who took part in the survey were J.E.F. Gardener (Party Leader, Geophysicist), C.J. Braybrook (Geophysical Assistant), A. Crowder (Drafting Officer), and N.A. Ashmore (Field Assistant) of the Bureau of Mineral Resources, and K.M. Dodds (Pilot) of Trans-Australia Airlines.

2. EQUIPMENT

The scintillation counter used consisted of two units, detector head and ratemeter, both built by Austronic Engineering Laboratories Pty Ltd of Melbourne. The ratemeter output was recorded on one channel of an RD-47A dual-channel recorder; a continuous record of radioactivity was thus provided. Operation of the scintillation counter was controlled and monitored in flight by a remote control unit.

The detecting element in the scintillation counter consisted of a cylindrical thallium-activated sodium iodide crystal, 4½ in. in diameter and 2 in. thick, mounted with its axis vertical; this was optically coupled to a photomultiplier tube.

A radio-altimeter type AN/APN-1 was fitted in the aircraft and assisted the pilot to maintain a near-constant height above ground level. Divergence from a preselected altitude above ground level was indicated to the pilot by a system of limit lights on the aircraft dashboard. A record of the aircraft's height above ground level was made on the second channel of the recorder.

3. OPERATIONS

The survey was flown at a height of 200 ft above ground level; at this height the lane scanned by the scintillation counter is about 500 ft in width. The flight line spacing was one tenth of a mile and the aircraft speed was about 105 knots.

During flight the observer navigated, and he plotted on aerial photographs the aircraft's path and check points along the flight lines. Simultaneously with marking the check points on the photographs, the observer marked the check points on the recorder chart with an electrically-operated side pen. Correlation between the recorder chart and the plotted position of the aircraft was thus obtained.

The ratemeter range used was 500 counts per second full-scale deflection. The time constant used was ½ second and the recorder chart speed was 3 inches per minute.

The survey party was based at Batchelor and the operation was completed in 147 flying hours. The area was covered as follows:-

Area	Square miles covered	Flight-line miles flown
Adelaide River	133	1548
Brocks Creek	524	4998
McKinlay River	95	1069

Delays due to aircraft maintenance and equipment failures were negligible but some survey time was lost owing to unfavourable weather.

4. GEOLOGY

The geology of the areas surveyed has been described by Malone (1958) and Walpole and White (1955).

Adelaide River area

Most of the Adelaide River area is covered by the Lower Proterozoic Burrell Creek Formation. The predominant rock types in this Formation are siltstone, greywacke siltstone, and greywacke. Two uranium prospects, the Adelaide River and the George Creek prospects, occur in the Formation.

At the Adelaide River prospect, uranium mineralisation occurs in north-trending shears produced by intense folding of the country rocks. Torbernite has been found throughout these shears and is associated with pitchblende, chalcopyrite, and arsenopyrite at depth (Clarke, 1955).

At the George Creek prospect, uranium mineralisation is localised by weak shears in greywacke. The mineralisation closely resembles that at the Adelaide River prospect (Arkin and Walpole, 1960).

Neither the Adelaide River nor the George Creek prospect is being worked, because ore reserves are not considered sufficient.

The extreme northern part of the Adelaide River area is covered by the Lower Proterozoic Noltenius Formation. This Formation consists of conglomerate, quartz greywacke, quartz sandstone, greywacke, and siltstone.

Upper Proterozoic Stray Creek Sandstone occurs in the centre of the Adelaide River area. It is a member of the Buldiva Sandstone and consists of quartz sandstone, flaggy siltstone, and shale.

Brocks Creek area

Most of the Brocks Creek area is covered by the Lower Proterozoic Golden Dyke Formation which is mainly quartz siltstone and chert; other members of the Formation are carbonaceous rocks, limestone, greywacke, and siltstone. The Formation is extensively intruded by basic sills which have been folded with the sediments.

The Golden Dyke Formation contains the Fleur de Lys uranium prospect. Here uranium mineralisation has been found in two localities where the sediments have adjusted to stress by bedding-plane shears, cross-shearing, and jointing. One locality is in and adjacent to a bed of quartzose siltstone and the other locality is in a shale bed (Firman, 1955). The prospect is no longer being worked.

Lower Proterozoic Burnside Granite crops out extensively in the northern part of the Brocks Creek area. Burrell Creek Formation rocks occur in the southern part of the area.

McKinlay River area

The eastern part of the McKinlay River area is covered by the Lower Proterozoic Masson Formation. This Formation consists mainly of quartz sandstone, quartz greywacke, pyritic siltstone, quartz siltstone, and carbonaceous siltstone.

The western part of the McKinlay River area is covered by the Golden Dyke Formation, which here is represented mainly by chert. Burrell Creek Formation rocks occur in the southern part of the area.

5. METHOD OF INTERPRETATION

After each survey flight, anomalies were selected by a critical examination of the record of radioacitivity. The positions of increases in radioactivity above the background radioactivity were plotted on aerial photographs as anomalies, and the topography and geology of each position were noted.

Anomalies that appeared to be associated with weakly radioactive materials disseminated over a large area were not considered to be significant anomalies and were discarded. These anomalies were generally caused by laterite or by igneous rocks.

Anomalies that were considered to be caused by outcrops of rock types known to be more radioactive than neighbouring rock types were also discarded. Most rocks show some radioactivity due to the inclusion of disseminated radioactive minerals, and there is a wide range of radioactivity among such rock types, even though none of them contains useful concentrations of radioactive minerals; in addition, a cover of only a few inches of non-radioactive overburden is sufficient to absorb the greater part of any gamma radiation originating below. Consequently as the aircraft passes over different country rock types the ratemeter output will show considerable fluctuations, and many anomalies will be recorded. Rock types consistently associated with anomalies are therefore noted, and such anomalies are not usually considered significant unless they are large. It is usually necessary to re-fly these anomalies to check their geological environments.

Anomalies that it was considered might be due to topographical effects were re-flown at different heights to measure the variation of radioactivity with height. Many known uranium prospects occur on or close to the tops of hills and ridges, and a careful examination of geological data should be made before an anomaly is discarded because of topographical effects alone. However, in this survey many anomalies were discarded because they were considered to be due partly to topographical effects and partly to a change in rock type as discussed in the previous paragraph. The Burnside Granite, for example, showed high radioactivity.

Any anomalies not discarded after these examinations had been made, were re-flown. A final assessment of the anomalies was made during the re-flying, and those retained were plotted on the final map (Plate 1). Experience, and the extent of the geological information available in the area surveyed, were important factors in assessing anomalies.

The radio-altimeter record was seldom used as an aid in assessing anomalies, because of the many difficulties involved; it is therefore not shown on the anomaly profiles on Plates 2, 3, and 4. Accurate signal-to-height relations were very difficult to determine because of the varying types of country rock and overburden; in fact, it was not considered worth while to attempt this, even though some traverses ran fairly continuously along one formation. Also, the cone of acceptance of the detector head of the scintillation counter did not coincide with the more restricted cone of acceptance of the radio-altimeter receiving antenna. In country as rugged as much of the survey area is, it could not be assumed that the radioactivity recorded was from the point, approximately beneath the line of flight, from which the radio-altimeter transmission was reflected.

6. RESULTS

Twenty-six anomalies were detected during the survey. Their positions are shown on Plate 1 and their profiles on Plates 2, 3, and 4. Map G355-3 (Plate 1) showing the positions of the anomalies, has already been published separately. During a ground inspection by Rhodes and Skattebol (1960) the localities of anomalies 7 to 10 and 14 to 26 were visited.

Anomalies 1, 6, and 13 are due to the Adelaide River, George Creek, and Fleur de Lys uranium prospects respectively. The anomalies are probably due to dumps of radioactive material on the surface rather than the prospects themselves.

Anomalies 2, 3, 4, and 5 are in the Stray Creek Sandstone. Although fairly broad they are considered to be of interest as they occur in an area of low general radioactivity.

Anomalies 7, 8, and 9 are located along George Creek and are probably due to concentrations of radioactive material washed down the creek.

Anomalies 10 and 16 are in the Burrell Creek Formation. Anomaly 10 is a strong localised anomaly which lies three-quarters of a mile north of the new Daly River road; this road is not shown on the aerial photographs as the photographs were taken before the road was built. Rhodes and Skattebol state that the anomaly is possibly due to detrital thorium minerals. They state that Anomaly 16 is probably due to radioactive minerals disseminated throughout the metasediments.

Anomalies 11, 12, 14, and 15 are in the Golden Dyke Formation. According to Rhodes and Skattebol, Anomalies 14 and 15 are associated with laterite.

Anomalies 17 to 26 are in the Masson Formation. They include the strongest anomalies (i.e. 21, 22, and 26) recorded during the survey and were considered to be the most promising anomalies detected. However, this opinion was not confirmed by the ground inspection by Rhodes and Skattebol. Anomalies 17, 20, 23, 24, 25, and 26 appeared to be associated with only weak radioactivity and Anomalies 18, 19, 21, and 22 were not located on the ground. It is proposed that further ground investigation of these anomalies should be made in order to clear up the discrepancies between the airborne and ground results.

7. CONCLUSIONS

Anomalies 1, 6, and 13 coincide with existing uranium prospects. Anomalies 7 to 10 and 14 to 16 have been examined on the ground and in general are not very promising. Anomaly 16 is close to the Hayes Creek fault which is associated with the Iron Blow and Yam Creek prospects, and the area may warrant further investigation. A ground examination of anomalies 17 to 27 in the McKinlay River area gave results which are difficult to reconcile with the airborne scintillograph data and it is proposed that a further ground examination in this area should be made.

A ground investigation of the remaining anomalies, 2 to 5, 11 and 12, would be necessary to determine whether they are of importance.

8. REFERENCES

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CLARKE, G.F.,	1955	Report on radioactive grid survey at Adelaide River prospect, N.T. Bur. Min. Resour. Aust. Rec. 1955-56.
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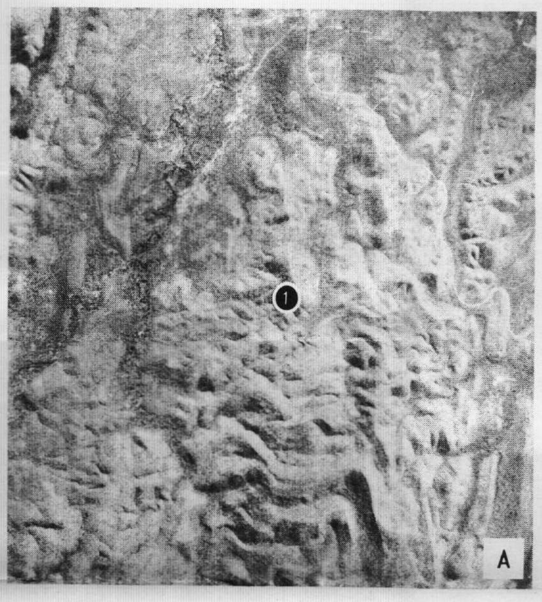
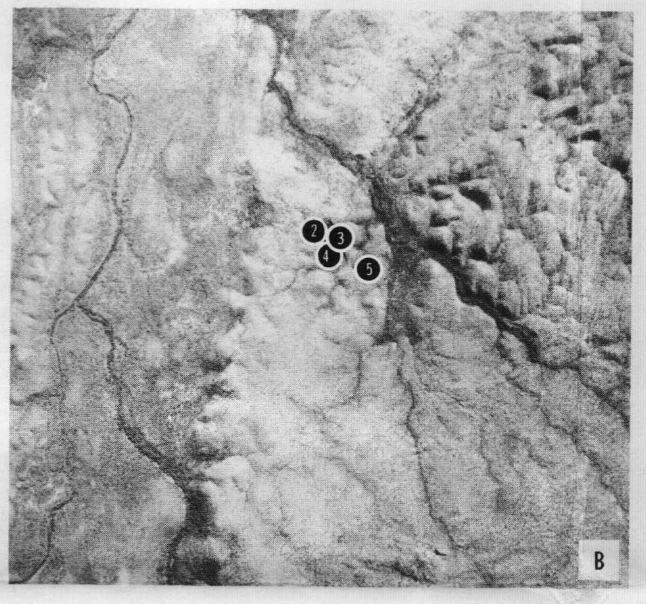
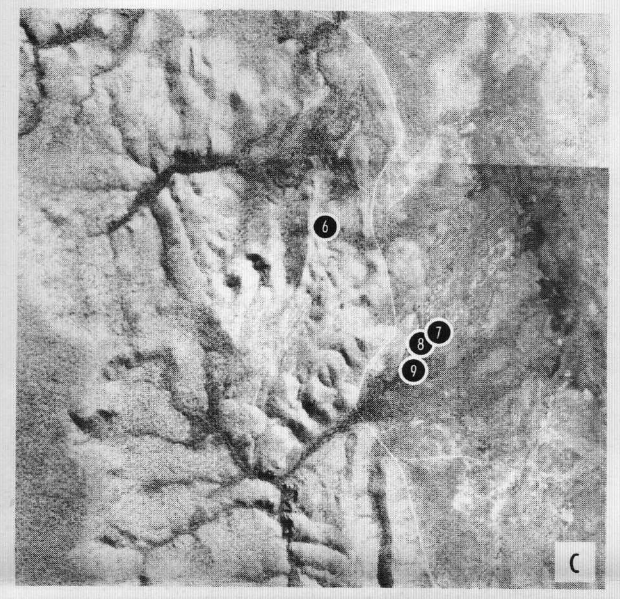
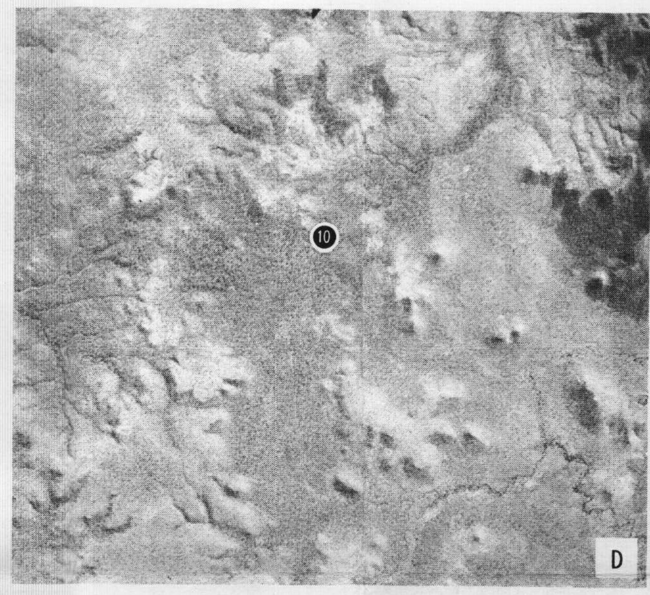
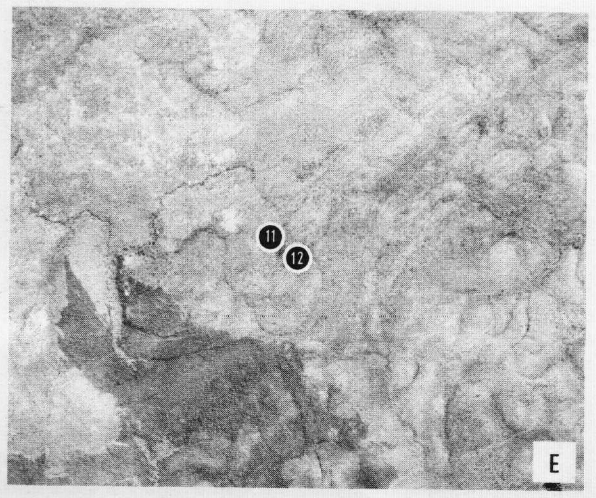
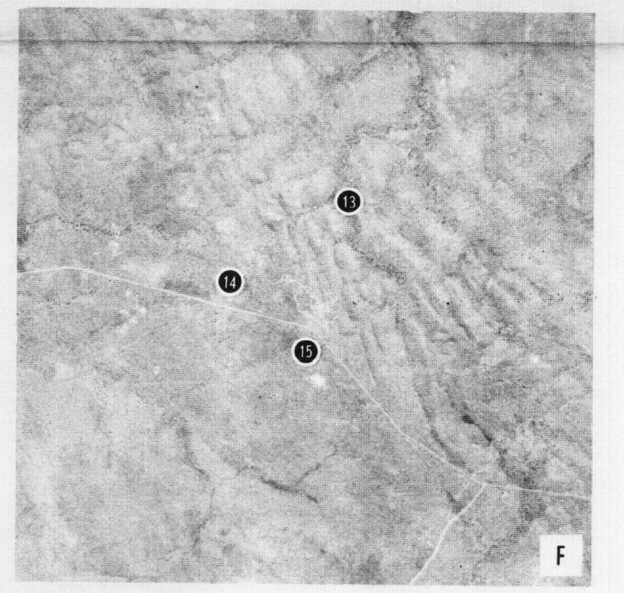


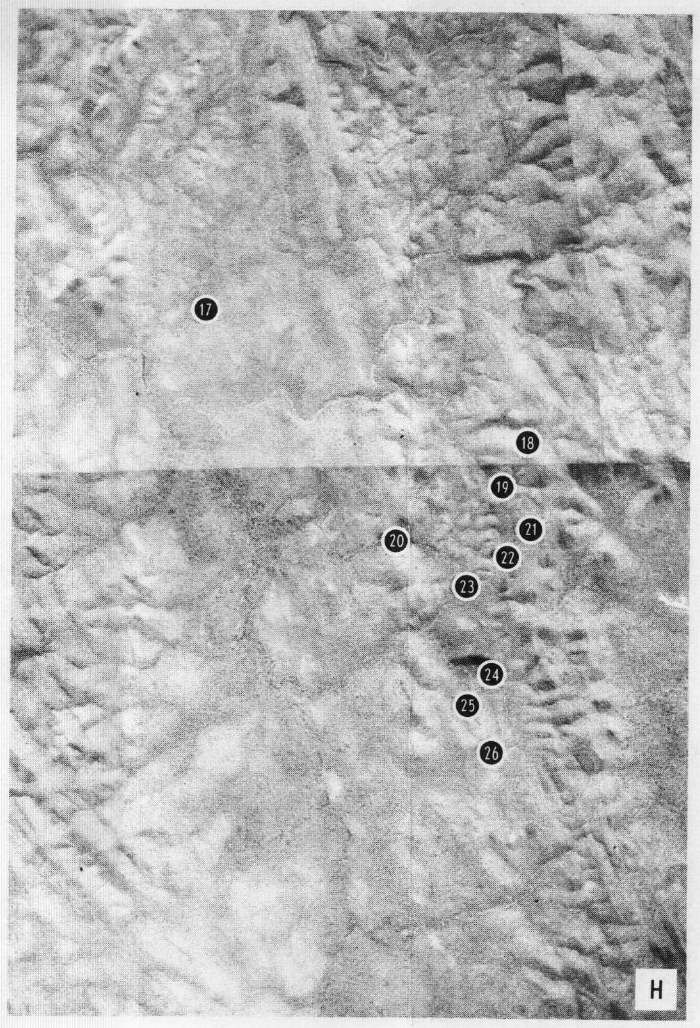


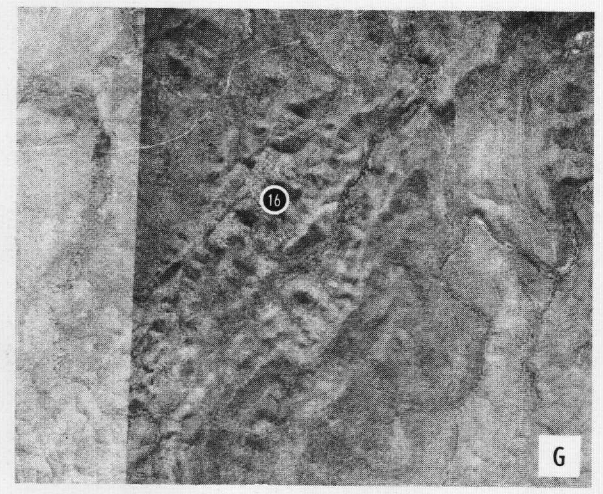


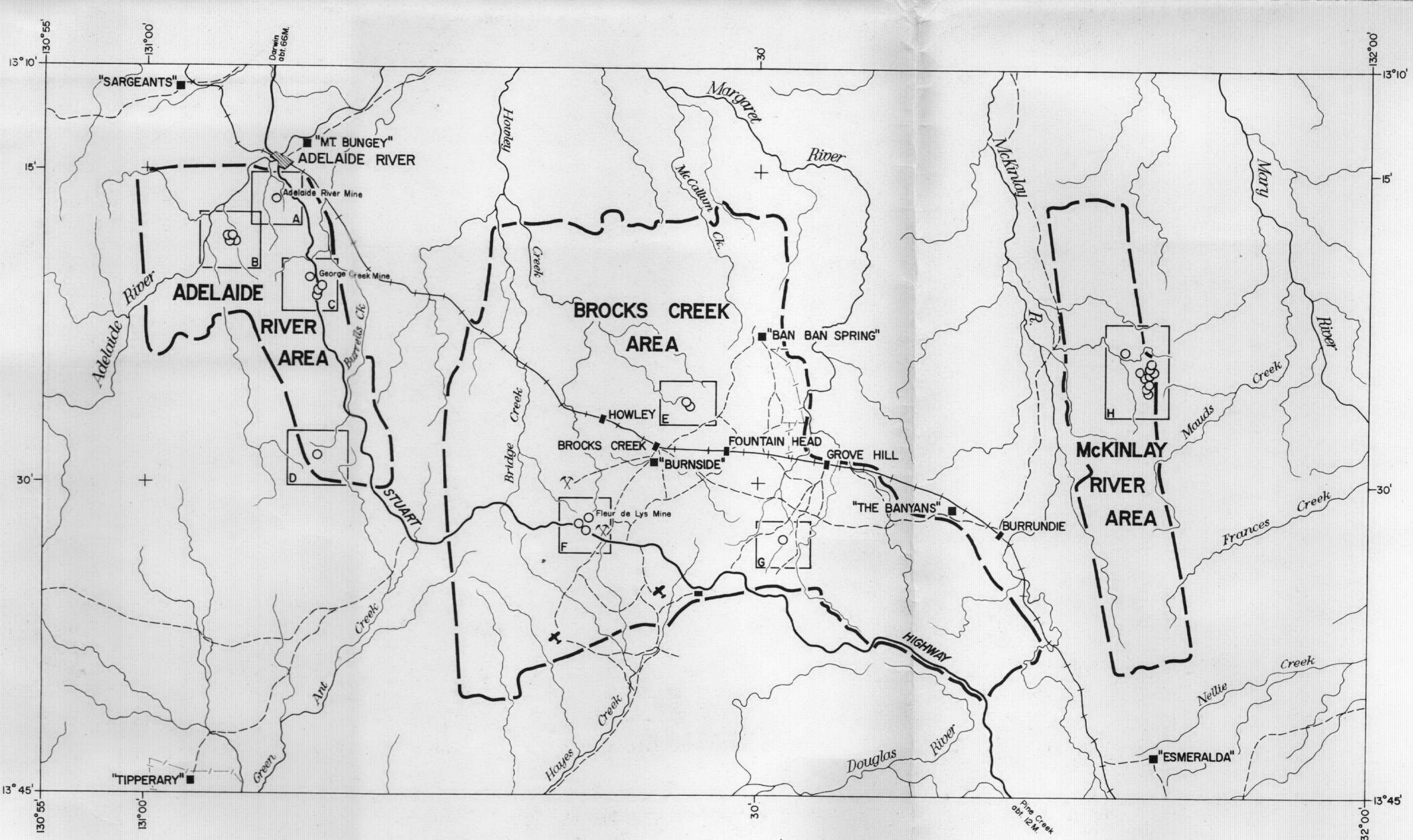




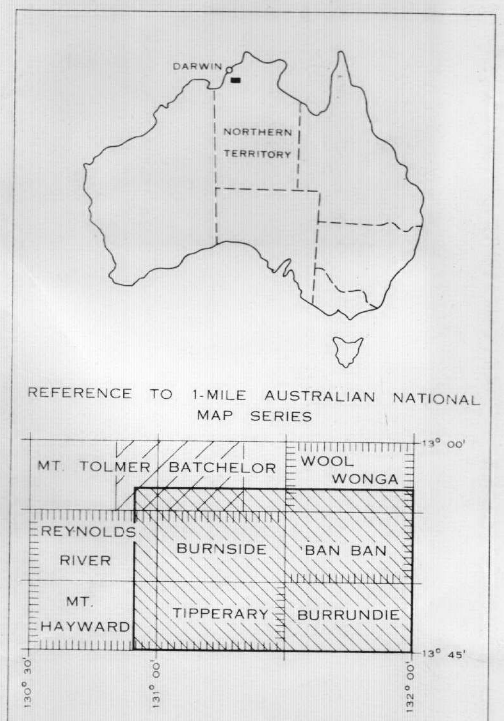








LOCATION DIAGRAM



INDEX OF AIRBORNE SCINTILLOGRAPH SURVEY MAPS PUBLISHED

RUM JUNGLE DISTRICT (1952 SURVEY) G 71-92
RUM JUNGLE REGION (1957 SURVEY) G 71-173

BAN BAN G 156-2. BURNSIDE G 159-2. REYNOLDS RIVER G 165-2. MT. HAYWARD G 168-2. TIPPERARY G 170-2. WOOL WONGA G 245-2

ADELAIDE RIVER, BROCKS CREEK AND MCKINLAY RIVER AREAS (1960 SURVEY)

Department of National Development

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Compiled and drawn in the Geophysical Branch

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES

DETAIL: PLANIMETRIC DETAIL WAS COMPILED FROM 1-MILE MAPS AND AIR PHOTO MOSAICS OF THE AREA PRODUCED BY DIVISION OF NATIONAL MAPPING

RELIABILITY: RELIABLE SKETCH

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

NORTHERN TERRITORY

ADELAIDE RIVER, BROCKS CREEK AND McKINLAY RIVER AREAS

MAP SHOWING

RADIOMETRIC ANOMALIES

DETECTED BY AIRBORNE SCINTILLOGRAPH

APRIL-MAY 1960

TRUE NORTH
MAGNETIC NORTH

APPROXIMATE SCALE OF PHOTO MAPS

MILES 1 0 1 2 3 MILES

SCALE OF PLANIMETRIC MAP

MILES 8 4 0 8 16 24 32 MILES

LEGEND

TOPOGRAPHICAL DATA

- RIVER OR CREEK
- RAILWAY WITH STATION OR SIDING
- HIGHWAY
- ROAD OR TRACK
- TELEGRAPH LINE
- FENCE
- AERODROME OR LANDING GROUND
- TOWN
- HOMESTEAD
- SHED OR HUT
- MINE

SCINTILLOGRAPH DATA

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

EXPLANATORY NOTES

The airborne scintillograph continuously records the intensity of gamma radiation from the ground over which the aircraft flies. On this survey the scintillograph was carried in a Cessna aircraft flown at an average altitude of 200 ft above the ground. At that height it effectively scanned a strip of ground approximately 500 ft 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.

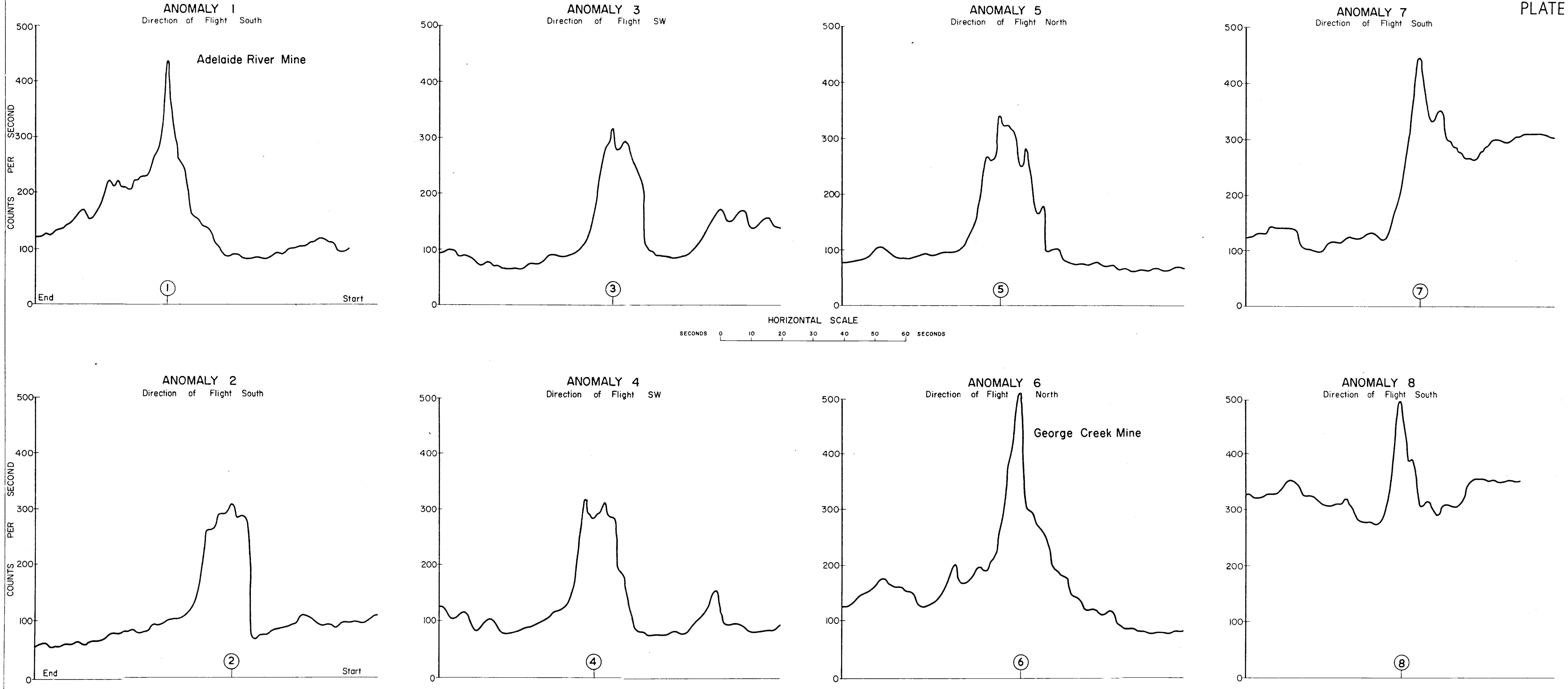
The map shows the positions and grouping of the anomalies. To assist in making investigation on the ground, all the anomalies have been reproduced on aerial photographs. The position of these anomalies is considered to be accurate to within 300 ft.

No claim is made that the anomalies are due to uranium deposits. Some anomalies may be due to igneous rocks, which contain a slightly higher concentration of radioactive elements than other rocks. Investigation on the ground would be necessary to determine the significance of the anomalies.

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 355-3

PLATE 2



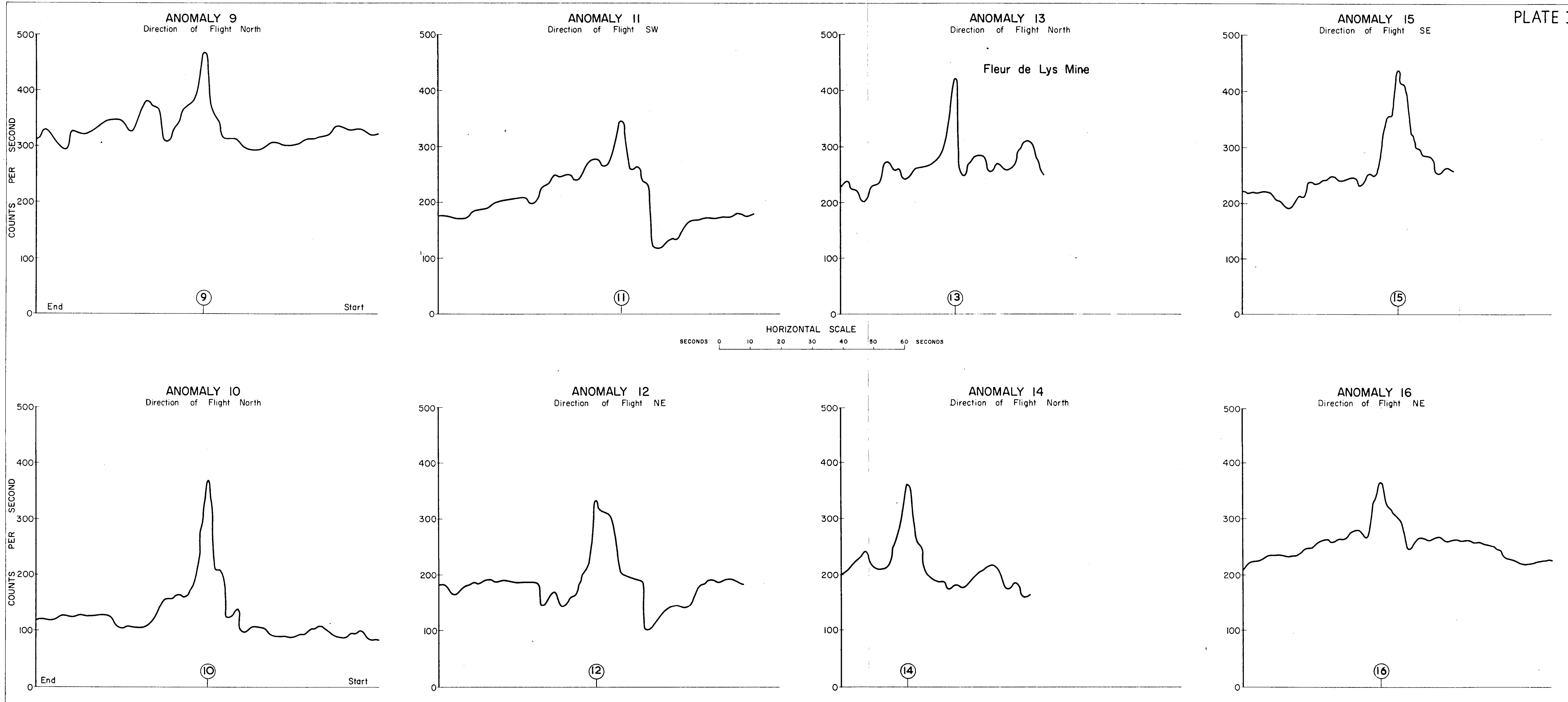
ADELAIDE RIVER, BROCKS CREEK & McKINLAY RIVER AREAS

RADIOMETRIC ANOMALY PROFILES

G355-4

To Accompany Record No. 1961–119

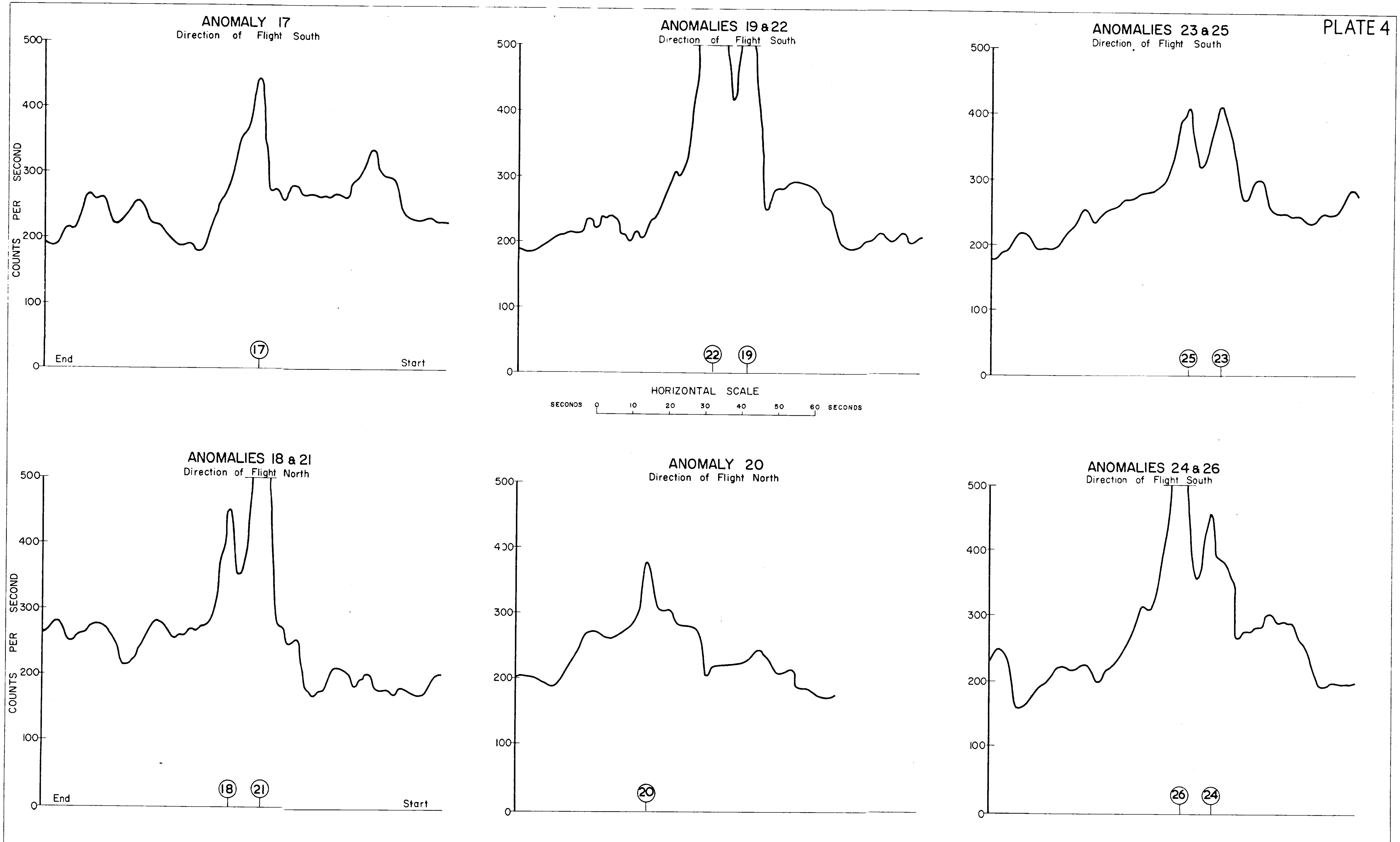
PLATE 3



ADELAIDE RIVER, BROCKS CREEK & McKINLAY RIVER AREAS RADIOMETRIC ANOMALY PROFILES

G355-5

To Accompany Record No 1961— 119



ADELAIDE RIVER, BROCKS CREEK & McKINLAY RIVER AREAS RADIOMETRIC ANOMALY PROFILES

G355-6

To Accompany Record No 1961-119