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COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1952 No. 79

PRELIMINARY REPORT ON
SCINTILLOMETER

AIRBORNE SURVEYS OVER THE RUM JUNGLE AREA AND OTHER PORTIONS OF THE NORTHERN TERRITORY

by

F.W. WOOD
and
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PRELIMINARY REPORT ON SCINTILLOMETER AIRBORNE SURVEYS OVER THE RUM JUNGLE AREA AND OTHER PORTIONS OF THE NORTHERN TERRITORY.

1. INTRODUCTION

The first airborne scintillometer surveys to be carried out by the Geophysical Section of the Bureau have now been completed. In this work the Shoran radar positioning system was also used for the first time. Detailed surveys were made over an area of about one thousand square miles surrounding the Rum Jungle granite and one of about twenty square miles in the Edith River district. In addition, flights were made over several other known granite masses in the northern part of the Northern Territory and along both sides of the railway line from Batchelor to Katherine.

The Bureau's Dakota aircraft VH-BUR left Melbourne with personnel and equipment on 11th August, 1952, and arrived at Darwin on 13th August. The aircraft left Darwin on the return journey on 8th October after completing all the work that was practicable this season before the weather became unsuitable. The aircraft arrived back in Melbourne on 9th October.

The vehicle-borne units of the survey party left Melbourne on the outward journey on 1st August and arrived back in Melbourne on 23rd October, 1952.

In addition to the Dakota aircraft, an Auster aircraft was chartered for some experimental low-level flights over areas of special interest selected on the basis of indications discovered during the survey by the Dakota.

2. INSTRUMENTS AND METHODS

A temporary office was set up in one of the hangars at the Darwin aerodrome for the immediate analysis of results day by day. The final detailed reduction of records is carried out in Head Office. However, the present survey presented problems of interpretation not previously encountered and these required a preliminary examination during the progress of the survey in case the plan of operation required modification.

The airborne scintillometer and Shoran equipments had not previously been operated except for short test runs carried out near Melbourne a week or so before the survey commenced. During the surveys all the equipment operated very satisfactorily with only a few minor troubles due principally to climatic conditions. The success of the operation reflects great credit on all members of the team including G. B. Clarke, J. Newman, T. Edwards, J. Barlow, K. Kennedy, J. Quilty, I. A. Mumme (geophysicists), A. Pattison (technician), L. Siebert (photographer) and Miss M. Wall (computer).

The following equipment was used :-

(a) Airborne Scintillometers -

(i) Chalk River Scintillometer, Type 1903R, Mark II, Serial No.1, developed by the Canadian Atomic Energy Commission and purchased recently by the Bureau;

(ii) Two Brownell Scintillometers, Model Mark VI, Serial Nos. 607 and 608, developed by Nuclear Enterprise Inc. of Winnipeg, Canada, and lent to the Bureau by the United States Atomic Energy Commission.

(b) Airborne Magnetometer -

Modified Magnetic Airborne Detector, Type AN/ASQ-1, as used by the Bureau in its previous airborne magnetic surveys. The magnetometer was operated as an essential part of the present survey to assist in the delineation of geological structure over the radio-active areas.

(c) Radar positioning system -

Shoran air navigation equipment, Type AN/APN3, AN/CPN2, developed by the Radio Corporation of America and lent to the Bureau by the Radiophysics Laboratory of C.S.I.R.O., Sydney. This consists of one airborne unit carried in the Dakota and two units set up at known points on the ground adjacent to the area to be surveyed. For the survey of the Rum Jungle area the beacons were set up near Mt. Peel and Mt. Tolmer, a distance of 28.26 miles apart and about twenty miles north-west and south-west, respectively, of the Rum Jungle mining camp.

(d) Photographic equipment -

(i) Photography was not used for positioning the aircraft during this survey. However, it was used to tie-in roads, railways and other features to the Shoran-controlled network. Also, the Rum Jungle mining area was photographed at low level as an aid to geological interpretation. The usual F.24 camera was used for these purposes.

(ii) In addition, some experimental runs were made with a 35 m.m. strip camera lent by the U.S. Atomic Energy Commission but the results were not up to expectation.

The greater part of the survey was flown at a height of 500 feet above terrain. At this height the scintillometer effectively scans a strip of ground about a thousand feet wide. Therefore, the flight lines were spaced at intervals of 0.2 miles or approximately 1,000 feet. This ensured that the whole of the surface was covered by the scintillometer. The total flight-line distance flown was approximately 7,000 miles involving a total of 138 hours' flying time. The speed of the aircraft was about 140 miles per hour when flying at 500 feet. This was reduced to about 100 miles per hour over a small area in the immediate vicinity of the Rum Jungle mining camp which was flown at a height of 250 feet along lines spaced at intervals of 500 feet.

The Chalk River scintillometer and the magnetometer were flown throughout the survey in the Dakota. The Brownell scintillometer, which is not as sensitive as the Chalk River model,

was flown in the Dakota on certain occasions for comparison purposes. It was also flown in the Auster aircraft in a few local spotting surveys at a height of about 100 feet.

3. RESULTS

A preliminary analysis only has yet been made of the results of the scintillometer survey but no measurements at all have been made of the magnetometer records. A considerable amount of analysis, plotting and mapping must be carried out before a complete report can be prepared. However, the following provisional comments may be made regarding the results of the investigation so far :-

(a) Rum Jungle District.

Plate 1 shows, on a scale of one inch to two miles, the area flown in the Rum Jungle district. On this map are shown the centres of radio-activity classified arbitrarily as first-, second-, and third-order anomalies. A third-order anomaly is the smallest and has a deflection on the scintillometer record of at least three times the amplitude of the statistical variation of the background count. Similarly, a second-order anomaly has at least six times this amplitude and a first-order anomaly at least nine times.

Altogether there are over 80 first-order, 200 second-order and 400 third-order anomalies. Of these, about 50 first-order, 70 second-order and 90 third-order anomalies occur within the Hundred of Goyder. These figures are only tentative and a re-assessment of each anomaly is now being made. The plotting of the positions of the anomalies is also subject to revision and the positions shown on Plate 1 must not be taken as final.

It must be emphasised, moreover, that little is known yet about the size or radio-activity of the areas on the ground that could produce such anomalies on the scintillometer record. Any one anomaly might be produced, for example, by a small (point source) area of high radio-activity or by a broad area of disseminated radio-activity of low intensity. Until investigations have been carried out to determine this relationship, no firm conclusion can be drawn regarding the extent or activity of the areas producing the anomalies.

Furthermore, the magnitude of an anomaly depends partly upon the position of the aircraft relative to the radio-active area, especially for a point source. If the aircraft passes directly over the source, the scintillometer will record a certain response but if the aircraft passes, as it might do, as much as five hundred feet to one side or other of the source, two anomalies of lower order will be recorded.

In addition to these factors, the effect of soil cover must be allowed for. An active source of radiation, capable of producing a first-order anomaly, could be reduced to the equivalent of a second- or third-order source, or even be completely screened, by only a few inches of soil cover.

Some of the third-order anomalies may therefore be significant and may warrant examination especially where they occur in groups.

An answer, at least in part, may be obtained when ground geophysical surveys have been carried out over some of the anomalies. A vast amount of geological and ground geophysical surveying will be required to check the importance of the deposits giving rise to all the anomalies shown even in this relatively restricted aerial survey.

First-order anomalies appear on the map (Plate 1) in positions corresponding to White's (W), White's Extended (E), Dyson's (D) and the Bomb Crater (C). In addition, an impressive line of first-order anomalies appears within the granite to the south-east of Dyson's deposit. The line has a north-north-westerly trend and its extension would pass through Dyson's deposit.

A feature of general interest is the manner in which anomalies have been recorded along lines following the trend of the granite contact around its southern, eastern and northern boundaries. To the north of the granite there are two quite well-marked parallel zones of activity conforming in direction with the northern boundary of the granite. A detailed geological survey has not yet been made in this area.

Many scattered anomalies have been recorded in the area south of Rum Jungle where detailed geological surveying has not yet been carried out. Some of these appear to coincide with hills or ridges. In addition, there are eight broad areas over which the scintillometer recorded a count equal to a second-order anomaly. These areas are hachured on Plate 1. Their significance is not yet certain but they are probably extensive areas of relatively low activity.

The attempts at low-level flying with the Auster aircraft, to follow up certain of the more prominent anomalies, were not very successful. When flying at 100 feet over the tree-covered terrain around Rum Jungle, it is difficult to see any of the ground features such as roads, tracks, creeks, etc. Positioning is therefore difficult and identification of a locality almost impossible.

However, it was found practicable to fly the Dakota at 250 feet above terrain with Shoran control and this was done over the Rum Jungle mining area in order to obtain greater detail. The records obtained in this operation have not yet been analysed.

In the course of the survey a ground party visited one area in which a prominent first-order anomaly had been detected. The position of the anomaly was marked on the appropriate military 1-mile map using the measured Shoran co-ordinates, and the anomaly was found without any trouble. The active area, giving counts from three to nine times background, is about five hundred yards long and twenty yards wide at a point (marked B) just south of the Brodribb Track north of the northern boundary of the granite. The success of this search suggests that low flying may not be necessary because in areas for which military maps or aerial photo-mosaics are available it should be possible to locate all anomalies of any importance by using map co-ordinates and

either hand or vehicle-borne radiometric equipment.

(b) Edith River District.

A small area was flown at Edith River surrounding the line of surface indications found there by prospectors about two months ago. Plate 2 shows the boundary of the area flown. Flights were made at 500 feet above terrain along lines running east-west and spaced about 1,500 feet apart. No marked anomalies were recorded over the known indications but the Edith River granite showed a high level of background activity. However, a first-order anomaly was found about six miles west-south-west of the known deposit. The results have not yet been analysed and plotted but from the indications found it seems certain that a general survey in the Fergusson and Edith River districts should be given high priority.

(c) Railway line from Rum Jungle to Katherine, and selected granite masses.

The locations of reconnaissance flights made over the principal granite masses in the northern part of the Northern Territory are shown on Plate 3 (flights 1 to 10). The two flights along the railway linw are also shown (Nos. 11 and 12).

The results of these flights have not yet been analysed in detail, but they indicate that the radio-active count was much higher than normal over four of the areas, namely,

(i) Along flight No.4.

(ii) Along flight No.8.

(iii) Along flight No.9.

(iv) Over a portion of the Edith River granite north of Edith River Siding, along flights 11 and 12.

4. CONCLUSIONS

(a) The Chalk River scintillometer is a very effective instrument for locating from the air areas of radio-activity on the ground.

(b) In conjunction with the Shoran equipment it is possible to pin-point radio-active areas sufficiently accurately to enable ground parties to locate them. This reduces the amount of ground surveying to a minimum and so speeds up greatly the rate at which an area can be investigated.

(c) There are many points within the Rum Jungle district and one in the Edith River area at which preliminary geological and geophysical investigation will be needed to determine the possible significance of the radio-active areas.

(d) Following this, there will need to be detailed geological and geophysical surveys in selected areas, followed by drilling to test for continuation of radio-activity in depth. It is quite

impossible at this stage to indicate how many of the observed anomalies may prove to be due to useful deposits.

(e) Future airborne scintillometer programmes will depend to some extent upon the results of the investigations of the anomalies found in this first survey. Other districts containing granite bodies will have to be surveyed with the airborne scintillometer but it is suggested that the next survey should be carried out in the Fergusson-Edith River district.

F.W. Wood.

(F. W. Wood)
Geophysicist.

E McCarthy.

(E. McCarthy)
Geophysicist.

Melbourne.
October, 1952.

PLATE I

RUM JUNGLE DISTRICT

AIRBORNE SCINTILLOMETER SURVEYS

MILES 0 1 2 3 4 5 MILES

SCALE

LEGEND

- 1ST ORDER ANOMALY = GREATER THAN NINE TIMES AVERAGE STATISTICAL VARIATION
- 2ND ORDER ANOMALY = GREATER THAN SIX TIMES AVERAGE STATISTICAL VARIATION
- 3RD ORDER ANOMALY = GREATER THAN THREE TIMES AVERAGE STATISTICAL VARIATION
- REGION OF CONTINUOUS RADIO-ACTIVITY WITH AVERAGE OF SECOND ORDER ANOMALY
- BOUNDARY OF HUNDREDS
- AREA FLOWN
- FAULT
- QUARTZ
- GRANITE
- PROSPECT
- TRACK
- RAILWAY
- HIGHWAY
- MINOR ROAD

G71-52

PLATE 2

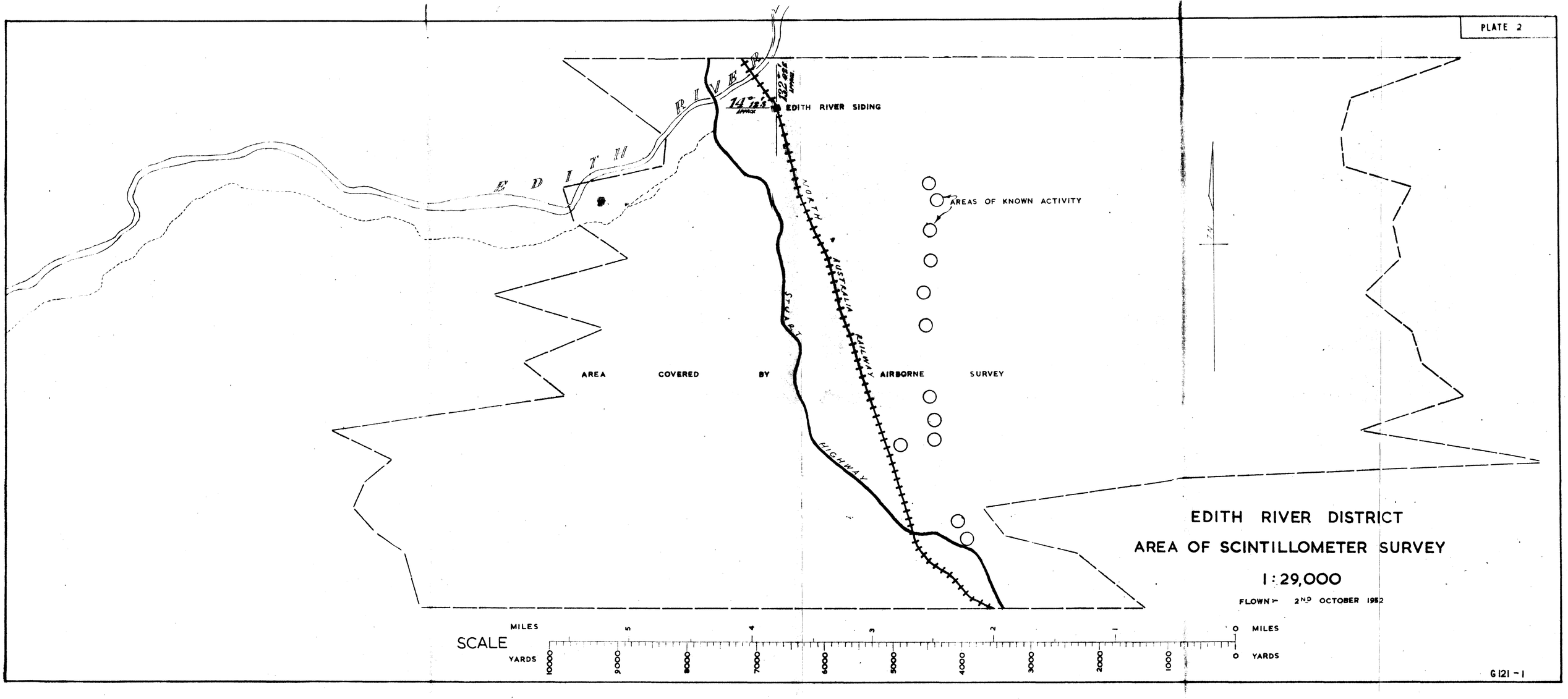
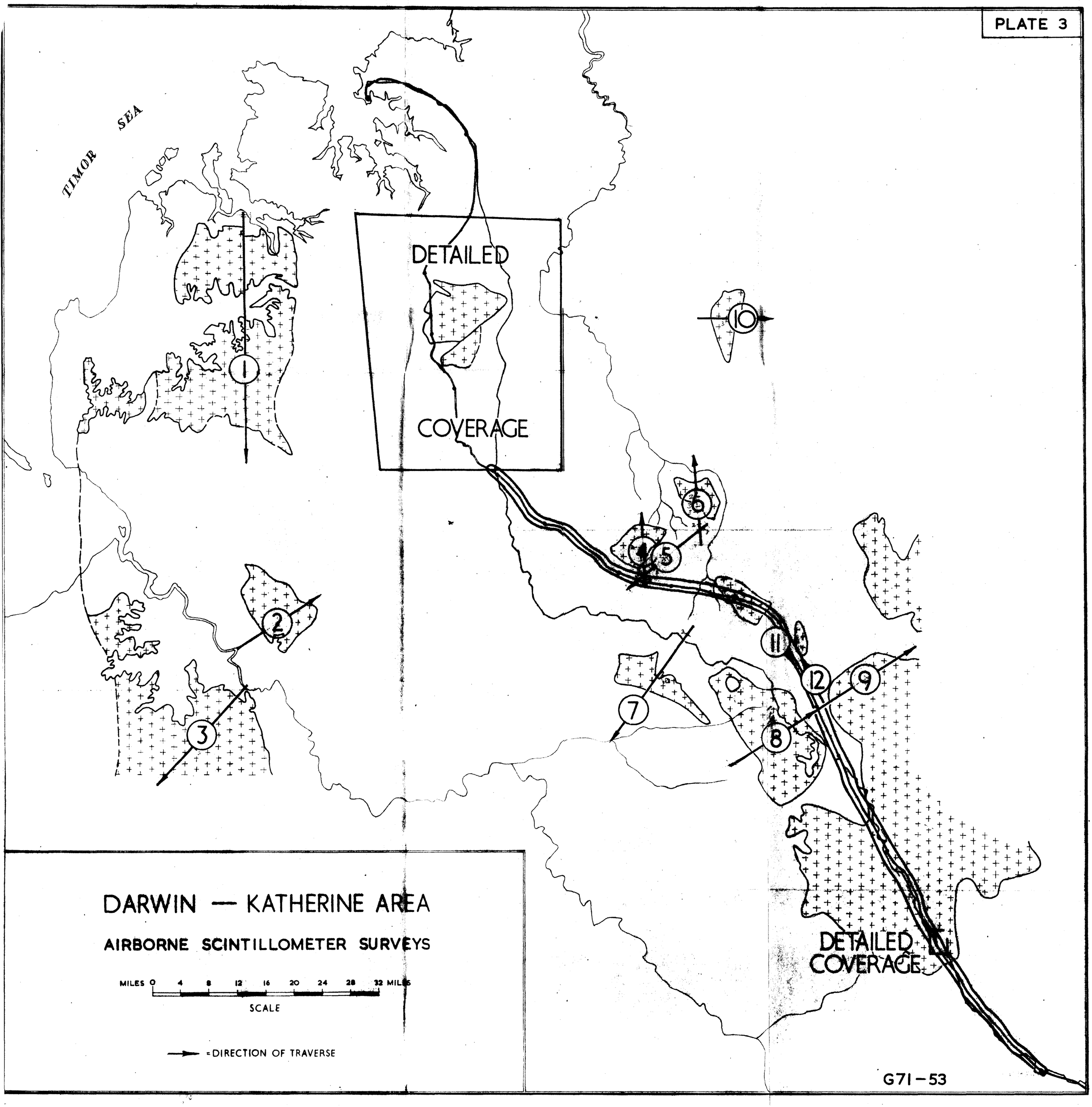

EDITH RIVER
EDITH RIVER SIDING
14 MILES
182 MILES
NORTH AUSTRALIA RAILWAY
STUART HIGHWAY
AREAS OF KNOWN ACTIVITY
AREA COVERED BY AIRBORNE SURVEY
EDITH RIVER DISTRICT
AREA OF SCINTILLOMETER SURVEY
1 : 29,000
FLOWN :- 2ND OCTOBER 1952
SCALE
MILES
YARDS
0 MILES
0 YARDS
G121 - 1

PLATE 3


TIMOR SEA
DETAILED COVERAGE
DETAILED COVERAGE
1
2
3
5
6
7
8
9
10
11
12
DARWIN — KATHERINE AREA
AIRBORNE SCINTILLOMETER SURVEYS
MILES 0 4 8 12 16 20 24 28 32 MILES
SCALE
= DIRECTION OF TRAVERSE
G71-53