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ALLUVIAL TIN PROSPECTS IN NORTH QUEENSLAND

by

J.G. Best

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SUMMARY

Cainozoic uplifting and faulting over a large area of North Queensland have had a profound effect on the drainage system in that area : rivers which originally flowed west were beheaded and captured by east flowing streams, and the original divide was moved up to 50 miles to the west of its pre-Cainozoic position. The North Queensland tin province lies partly within this area. Most of the alluvial tin deposits were formed before these earth movements began, and it is therefore probable that there are within the area alluvial tin deposits which are divorced from the present drainage. Some of these deposits may be buried beneath Tertiary basalt flows, others may be partly or completely masked by more recent alluvium.

A preliminary geomorphological study of the region has indicated several new prospects.

INTRODUCTION

The North Queensland tin province has an area of about 20,000 square miles (Fig.1). The main part of the province lies between latitudes 15° 30' S. and 19° 30' S. and includes the Cooktown Mining District (portion of the Cooktown and Cape Peninsula Gold and Mineral Fields), the Herberton and Russel Extended Mineral Field, the Kangaroo Hills Mineral Field, the Mareeba Gold and Mineral Field, the Mossman District and Mount Perseverance Mineral Field, and part of the Chillagoe Gold and Mineral Field.

Tin was first discovered in North Queensland near Ewan, in the Kangaroo Hills Mineral Field, in 1875. During the succeeding thirty or forty years tin mining flourished, and a large number of deposits were discovered.

To the end of 1960 the province has yielded 140,000 tons of tin concentrates. In the Herberton and Chillagoe Fields about half the production has come from alluvial deposits; in the Cooktown, Mossman, and Mareeba Fields most was from alluvial deposits, and in the Kangaroo Hills Field about two-thirds was from tin-bearing lodes. Since 1925 the production of tin concentrate from the North Queensland province has averaged about 900 tons per annum: the yield from primary deposits has decreased and the yield from alluvial deposits increased (Fig.II), with the main production coming from the Mount Garnet district (Figs. I & III).

Several geological and geophysical surveys of the area have been made by private companies and by government agencies during the past 25 years. Most attention has been paid to the Herberton Gold and Mineral Field, but no new tin deposits were found.

In 1956 the Bureau of Mineral Resources and the Geological Survey of Queensland began a joint programme of regional geological mapping of North Queensland, and by the end of 1961 about 50,000 square miles were surveyed. This area included all of the tin province with the exception of the Kangaroo Hills Mineral Field.

Many writers have drawn attention to examples of stream diversion and capture in North Queensland, one of the earliest being Griffith Taylor (1911) who found numerous instances of drainage changes caused by Tertiary earth movements and volcanic activity throughout eastern Australia. These ideas, and the data obtained from the regional geological mapping led to the recognition of three alluvial tin prospects in North Queensland during 1961. The prospects are "A.T.R." and "Wurruma" both a few miles south of Mount Garnet, and King's Plains about twenty miles south-west of Cooktown. These three prospects have been reconnoitred, and appear to contain large areas of deep alluvium, but test-boring is necessary to determine whether they contain economic concentrations of cassiterite.

GEOLOGICAL HISTORY OF THE TIN DEPOSITS

The primary tin mineralisation in the area is associated with the intrusion of acid granites. There are lodes in the country rock as well as lodes and cassiterite-bearing greisens in the granite.

There appear to have been two distinct periods of intrusion of stanniferous granite, the earlier in the Carboniferous, and the later in the Upper Permian or Lower Triassic. The older granite, referred to as the Mareeba type, is grey, massive, medium-grained and contains abundant ferromagnesian minerals; it was intruded into Upper Devonian - Lower Carboniferous greywacke, shale and sandstone in the northern half of the stanniferous province. In the southern part of the province the stanniferous granite is known as the Elizabeth Creek type. It ranges from coarse-grained and porphyritic to a medium-grained massive type. It is dominantly pink, almost devoid of ferromagnesian minerals and was intruded into rocks ranging from Precambrian to probable Lower Mesozoic.

The cassiterite deposited by the Mareeba-type granite appears to be mainly in tourmalinized and greisenized zones around the margin of the granite, and is commonly coarsely crystalline. Only a few small lodes have been found in the country rock. The Elizabeth Creek Granite by contrast, appears to have introduced much cassiterite in lodes in the country rock. This difference in distribution of the primary deposits may be illusory, and may be due to the fact that much more of the cover of the Mareeba - type intrusives has been eroded.

Most of the province appears to have been above sea level since the stanniferous granites were intruded. In general the stanniferous granites in most places are more resistant to erosion than the country rock, and they now form prominent ranges, particularly in the northern part of the province where the older granites crop out. The younger granite crops out in the southern part of the province, but is partly covered in the eastern part.

The time when the primary tin deposits were first exposed is uncertain but west of Fossilbrook outliers of Cretaceous marine sediments unconformably overlie Elizabeth Creek Granite. Elsewhere the evidence is not so definite, but it does seem likely that most of the primary deposits were exposed, and in places deeply eroded, during the Mesozoic and early Tertiary. The cassiterite freed from the primary deposits by weathering was transported into stream channels and there sorted and concentrated.

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Up to about the middle of the Tertiary the divide was much closer to the present coast-line than it is now, and most of the alluvial tin was concentrated in streams which drained to the west. Epeirogenic movement in the Middle Tertiary caused many of these streams to be beheaded and captured by east-draining streams; the divide migrated west, in places up to about fifty miles, and in some areas several miles of stream channel were abandoned. The area most affected was a strip, about fifty to sixty miles wide, adjacent to the present coast, (Fig.I.) and it is in this area that the less easily recognizable alluvial tin prospects are believed to lie. This hypothesis is supported by the results of detailed mapping of the Fossilbrook district, about fifty miles west of Mount Garnet, carried out in 1961 (Zimmerman and Ruker, 1962). This area is west of the zone affected by Tertiary earth movements, and no large areas of deep alluvium were found, nor was there any evidence of Cainozoic stream capture.

The Tertiary tectonic activity was accompanied by basic vulcanism, and large areas were covered by basalt flows. Tongues of basalt coursed down valleys beyond the edges of the main basalt sheets, and diverted streams, dammed tributaries, and buried alluvium. The basalt was erupted sporadically over a long period, and remnants of these flows help greatly in tracing the old drainage pattern.

DESCRIPTION OF THE RECENTLY FOUND PROSPECTS

About half of Australia's present tin production comes from the Mount Garnet area where two dredges working Battle and Smith's Creeks currently produce between 1,000 and 1,500 tons of cassiterite concentrates per annum. These creeks are now tributaries of the Herbert River (Fig.III). They are deeply alluviated and the cassiterite is sporadically distributed in seams through the alluvium. Most of it was deposited when the streams were part of a west-flowing drainage system.

The Ancestral Tate River Prospect is thought to be part of the ancient system, and the Wurruma Prospect may be an ancient channel of Return Creek. (Fig.III). Likewise the King's Plains Prospect is probably the old channel of the Annan River (Fig.V, Plate III).

Ancestral Tate River Prospect

The A.T.R. Prospect is about five miles south-west of Mount Garnet and lies along the break-of-slope between undulating hills to the north and almost flat plains to the south. The prospect is an abandoned portion of an old river channel. It is up to one mile wide and trends south-west for about seven miles. On the east side it is bounded by Return Creek and on the west by Smith's Creek. Stanniferous gravel banks about ten to fifteen feet high clearly define the edges at the eastern end of the old valley, but farther west the banks merge with the surrounding plain and the valley is difficult to distinguish, even on air photographs (Plate II).

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II. Wurruma Prospect

The Wurruma Prospect is about two miles south-east of Mount Garnet, and is thought to be a former channel of Lower Return Creek which was abandoned when faulting lowered the area west of the town site and moved the channel to the west. (See Fig. I, III and IV).

There is a pattern on the airphotographs which suggests a former stream channel, but on the ground the channel is difficult to detect because of the very low relief.

A number of small gullies incised in this area have exposed gravels which were successfully prospected for cassiterite during the recent investigation; these gravels, although somewhat lateritized, are ~~smaller~~ similar to those found higher up Return Creek.

Fig. III is a map of the Mount Garnet area. It shows the present drainage, the areas dredged for tin, and the location of the A.T.R. and Wurruma prospects.

Fig. IV illustrates diagrammatically the evolution of the drainage in the area south of Mount Garnet.

Plate I shows the southern levee bank at the east end of the prospect. The photograph was taken looking south from Point A. (Fig. III). Plate II is a stereoscopic pair of airphotographs covering the eastern end of the A.T.R. Prospect.

III. King's Plains Prospect

The King's Plains Prospect was first recognized on air photographs by K.G. Lucas*, and was subsequently confirmed by ground examination by K.G. Lucas and L. Cutler**, during the course of geological mapping of the Cooktown 1:250,000 Sheet. The prospect is about twenty miles south-west of Cooktown and is a west trending valley about sixteen miles long and up to four miles wide.

The valley has been eroded in greywacke, shale, and chert of the Hodgkinson Formation; these sediments strike north, dip steeply and form prominent hills on both sides. Strike-ridges of chert dominate the hills, and in places project into the valley, and divide it into several partly closed basins. The floor of the valley is flat, and is in places swampy, most of the alluvium appears to be deep, possibly up to about one hundred feet. The chert ridges probably form bars over which the alluvium is shallow.

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* Bureau of Mineral Resources.

** Geological Survey of Queensland.

The Normanby River flows north-westwards past the western end of the valley and the Annan River flows northwards past the eastern end. But formerly the Annan River appears to have drained westwards along the valley into the Normanby River (See Fig. V and Plate III). North of the eastern end of King's Plains the Annan River flows through a gorge. This is the area of capture. Above and below the gorge the Annan River Valley is alluviated and has been test-bored for alluvial tin. In both areas the deposits were below economic grade.

At first glance this does not enhance the prospects of the King's Plains area, but the distribution of the alluvial tin in the headwaters of the Annan River and its tributaries offers a possible explanation for this apparent anomaly. Most of the tin which has been mined in this area has been recovered from terraces (See Plate IV) which have ranged from a few feet to hundreds of feet above the present stream beds. Some of the terraces are covered by deeply weathered basalt. In general these terraces have proved richer in alluvial tin than the beds of present-day streams and indicate that most of the tin was shed and concentrated during a former cycle of erosion. It is thought that the capture of the Annan River took place somewhere about Middle Tertiary; if this is so, it is possible that the streams which deposited the cassiterite in the terraces were tributaries of the stream which flowed through the King's Plains area.

CONCLUSION

The investigation which led to the finding of the alluvial tin prospects evolved from a joint programme, with the Queensland Geological Survey, of regional geological mapping of metalliferous provinces in Queensland. The theory which led to the identification of the prospects had its foundation in the concept that broad-scale mapping is an essential preliminary to the geological investigation of an area. The object of the investigation, so far, has been only partly realised. Even if all three prospects prove to be uneconomic the investigation will not have been fruitless, because it has drawn attention to a type of deposit which could occur in other stanniferous areas of the North Queensland Tin Province.

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MAPS:

ATHERTON: Aust. 1:250,000 Series Sheet. E/55/5. Aust.National Grid. Bur.Min.Resour.Aust. (in preparation).

MOSSMAN : Ibid. Sheet E/55/1 (in preparation).

COOKTOWN: Ibid. Sheet D/54/13 (in preparation).

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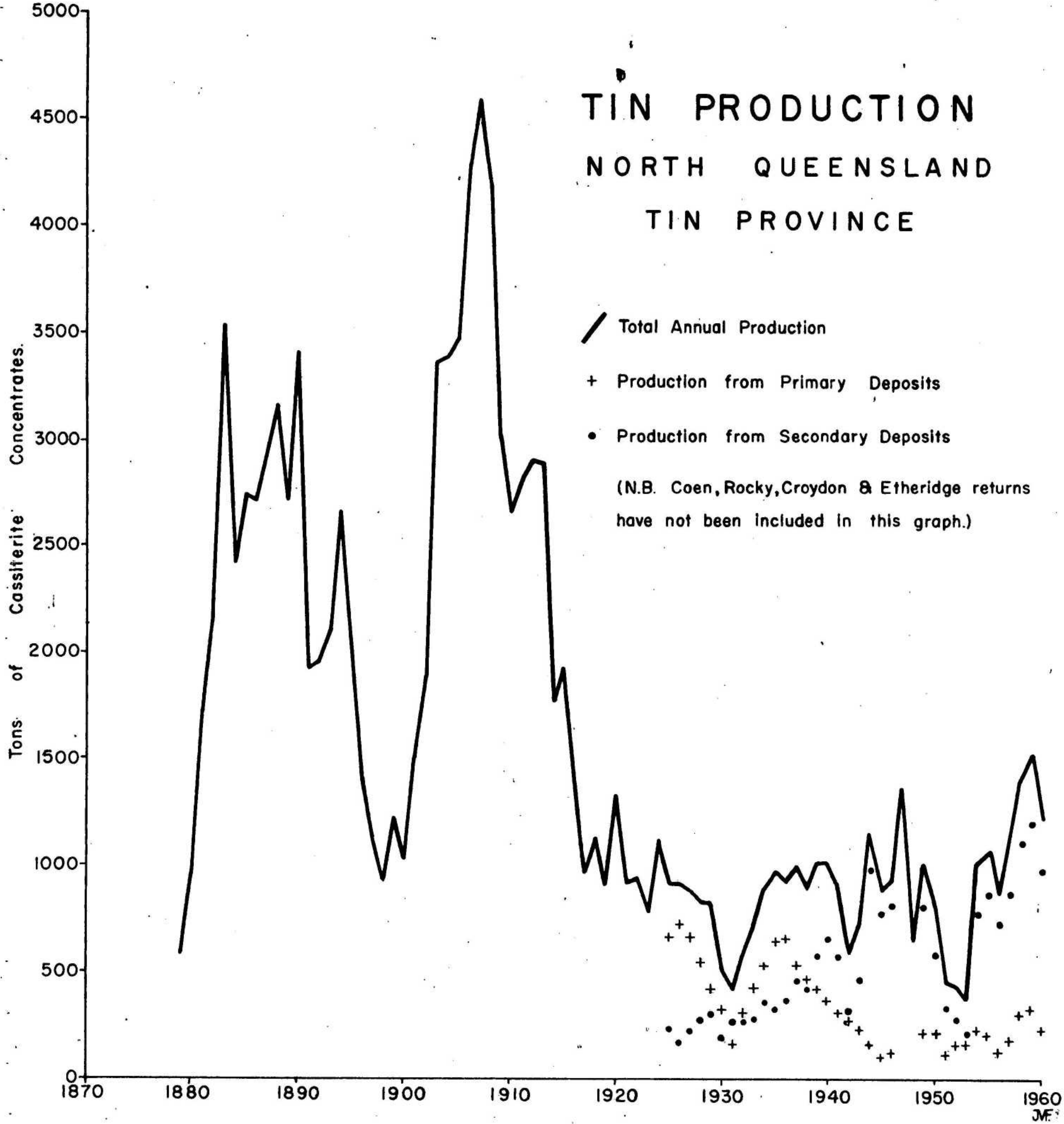
Figure I. Map of portion of North Queensland, showing area affected by Tertiary earth movements, approximate limit of the stanniferous province, and the position of the new prospects.



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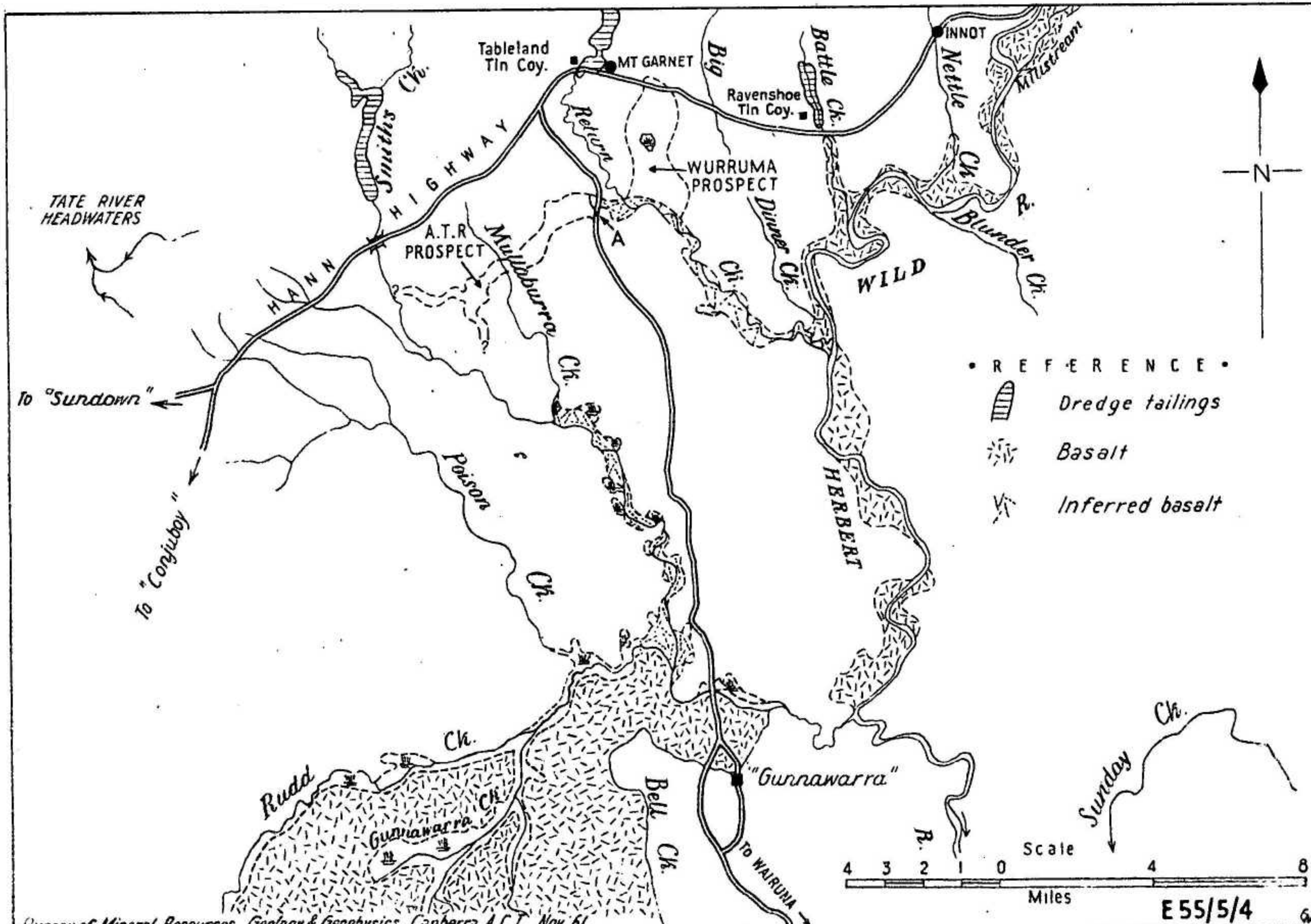
Tableland Tin Coy.
MT GARNET
INNOT
Big
Battle Ck.
Ravenshoe Tin Coy.
Nettle Ck.
Millstream
Smiths Ck.
HANN HIGHWAY
Return
WURRUMA PROSPECT
TATE RIVER HEADWATERS
A.T.R PROSPECT
Mullaburra Ck.
A
Dinner Ck.
Ck.
WILD
Blunder Ck.
R.
To "Sundown"
To "Conjuboy"
Poison Ck.
HERBERT
R.
• REFERENCE •
Dredge tailings
Basalt
Inferred basalt
Ck.
Rudd
Gunnawarra Ck.
Bell Ck.
"Gunnawarra"
To WAIRUNA
Sunday Ck.
Scale
4 3 2 1 0 4 8
Miles
E55/5/4
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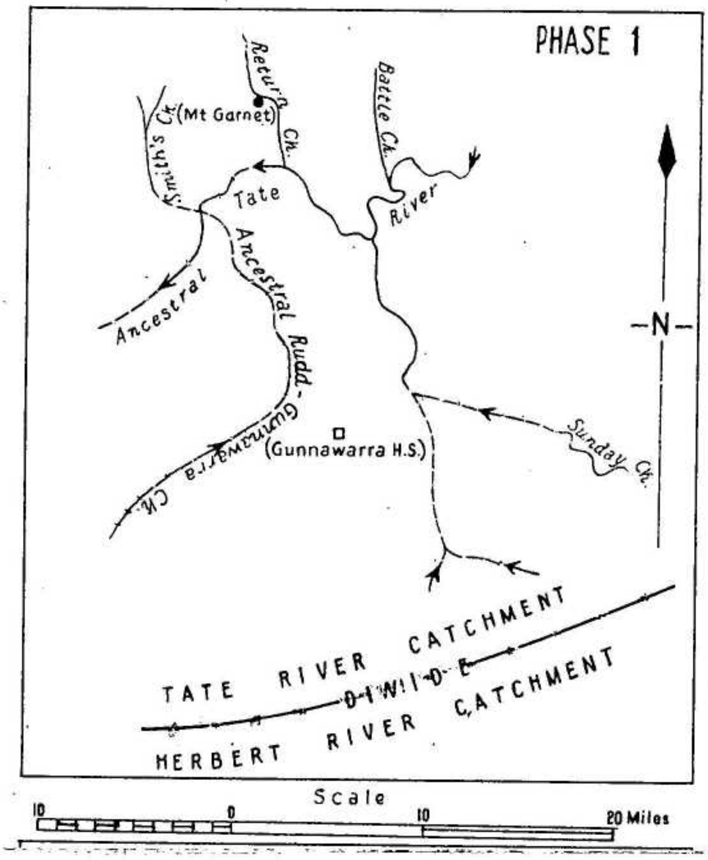
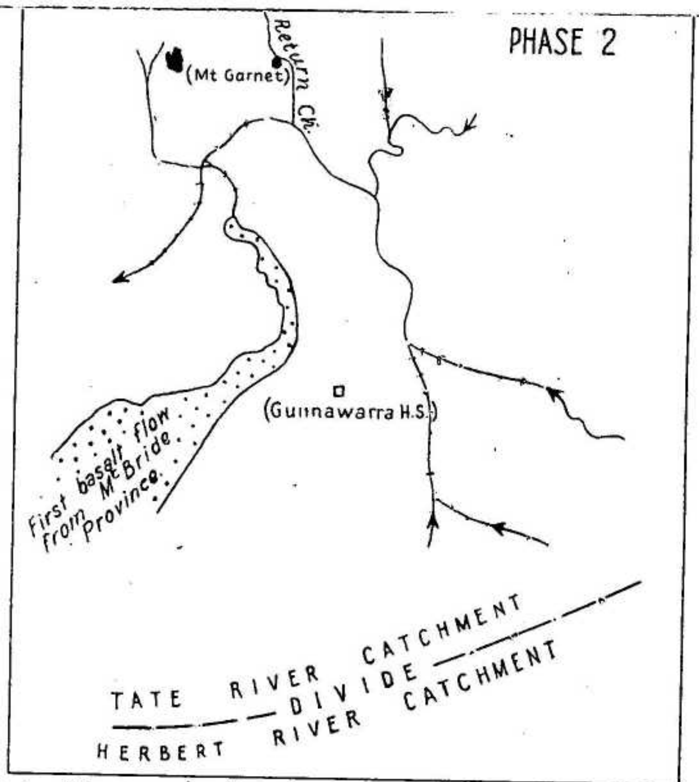
Figure IV. Phases 1 to 7 show the probable evolution of the drainage in the Mount Garnet area.



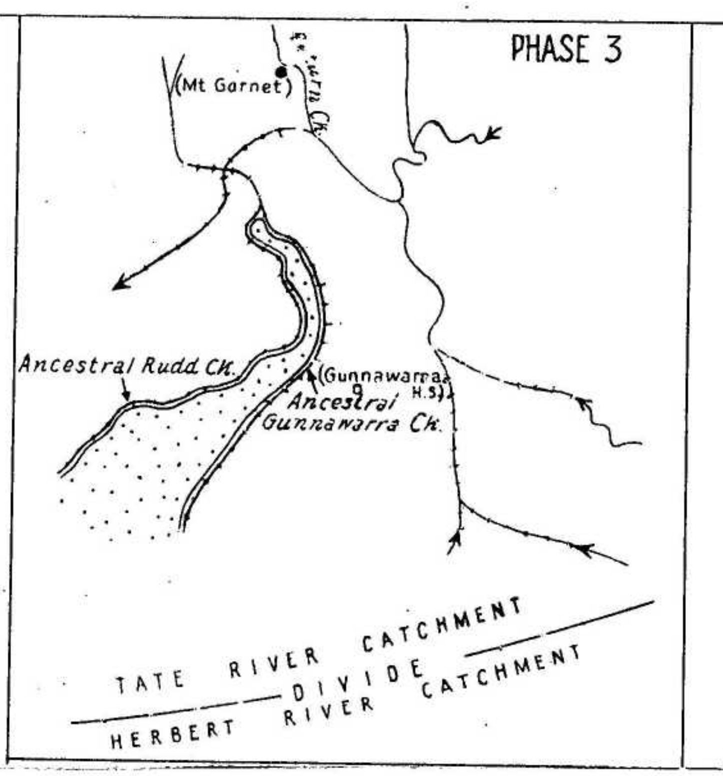
Phase 1: is the drainage as it is assumed to have been early in the Tertiary.

Figure IV. (Continued).



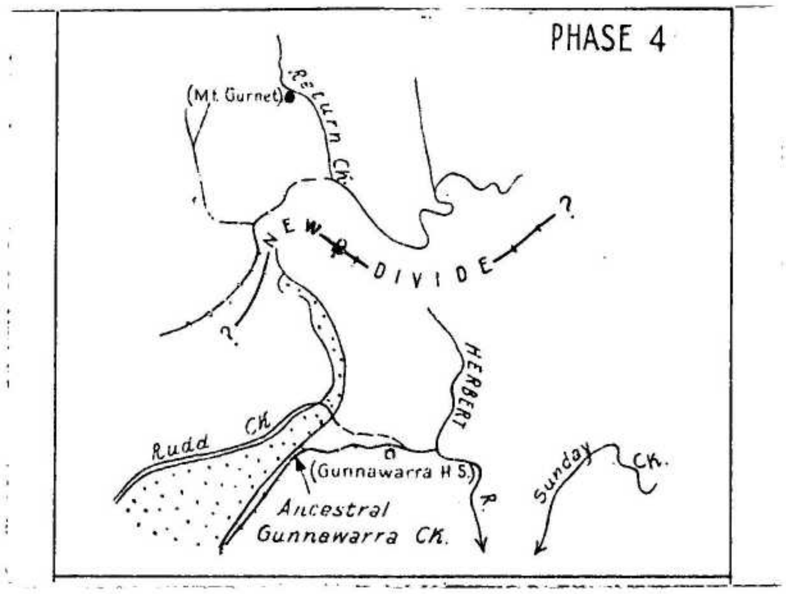
...ces Geology & Geophysics Nov '61.

Phase 2: Basalt from volcanoes about fifty miles to the south of Mount Garnet coursed north down a creek which was the ancestor of Rudd and Gunnawarra Creeks.

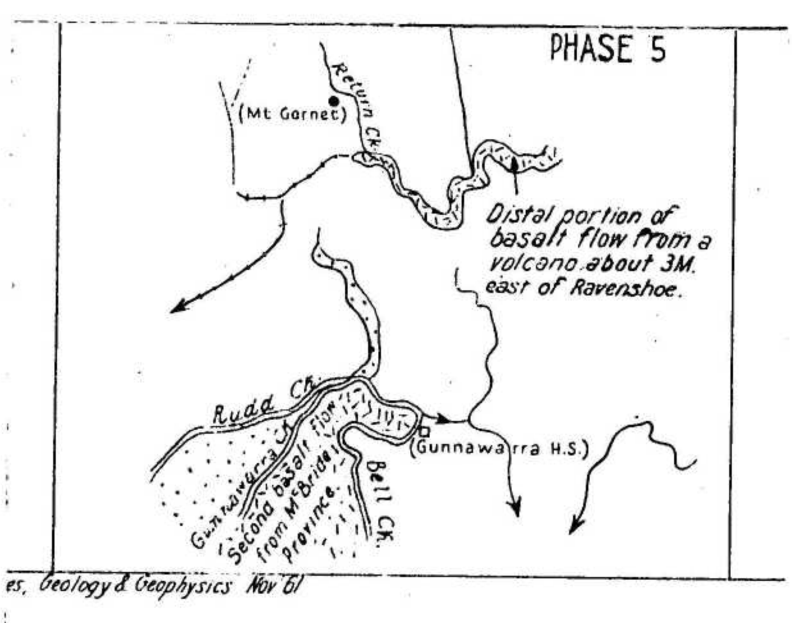


Phase 3: Twin lateral streams, the ancestral Rudd and Gunnawarra Creeks, were developed along the sides of this flow.

Figure IV. (Continued)

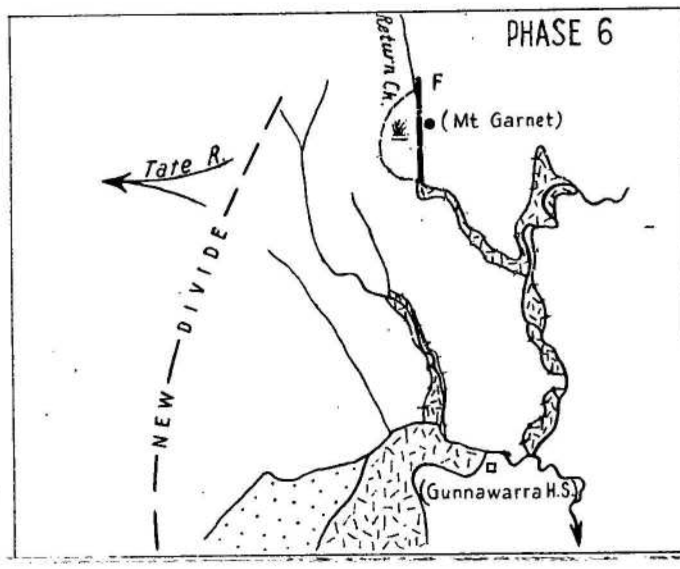


Phase 4: Slight faulting or warping severed the southern tributaries of the ancestral Tate River, and diverted them into the headwaters of the Herbert River.



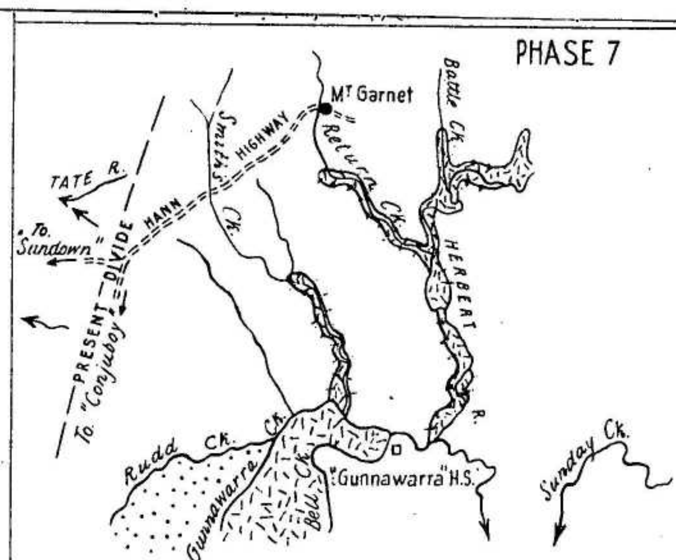
Phase 5: Another flow of basalt coursed along the eastern side of the earlier flow and terminated part-way down the new valley draining into the Herbert River. Bell Creek developed along the eastern side of the younger flow. Basalt from a volcano about three miles east of Ravenshoe flowed down the ancestral Tate River, and terminated about four miles south of Mount Garnet.

Figure IV. (Continued)



Phase 6: Slight faulting or warping formed a north-trending divide about ten miles west of Mount Garnet. All streams east of this drained into the Herbert River.

Movement on a north-trending fault through Mount Garnet lowered the area to the west and temporarily dammed Return Creek against it.



Phase 7: The present-day drainage.

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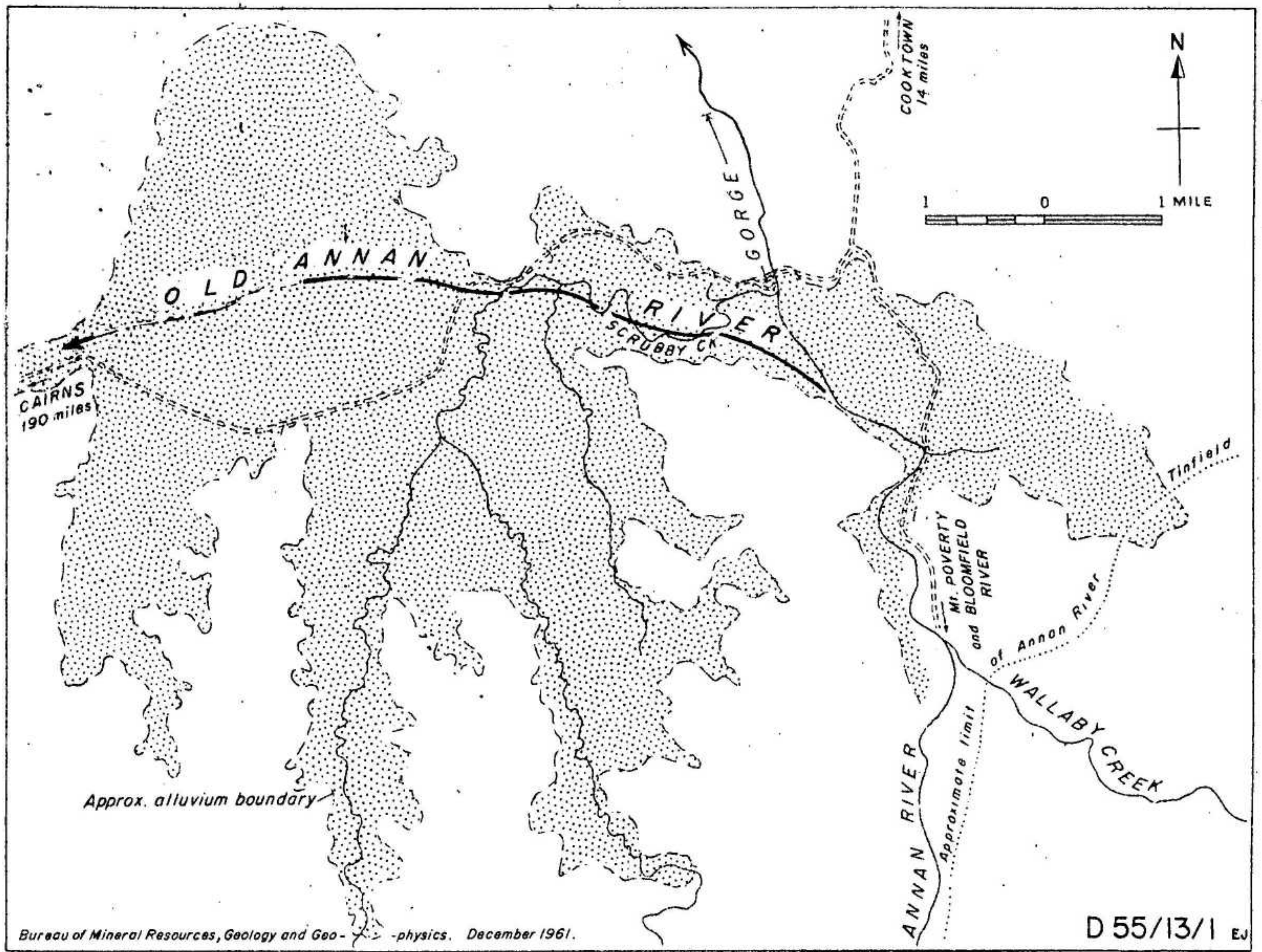


Figure V. Map of King's Plains Prospect.
Photo - scale 1:85,000.

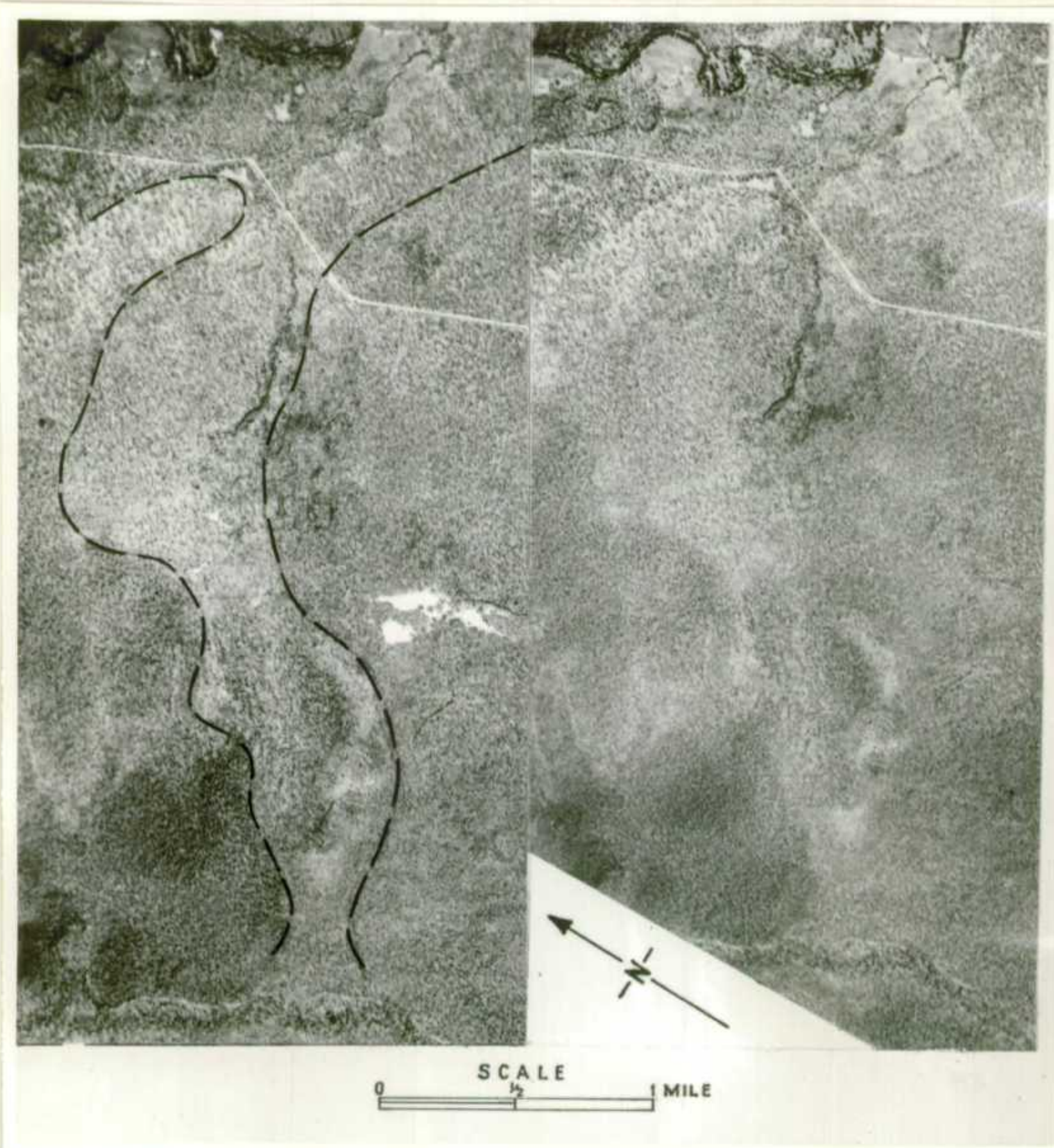
PLATE I.

Photo, J.G.Best.
B.M.R.Neg.No.G/4171

View south down Gunnawarra Road showing levee bank on the southern side of the ancestral Tate River valley.

PLATE II.

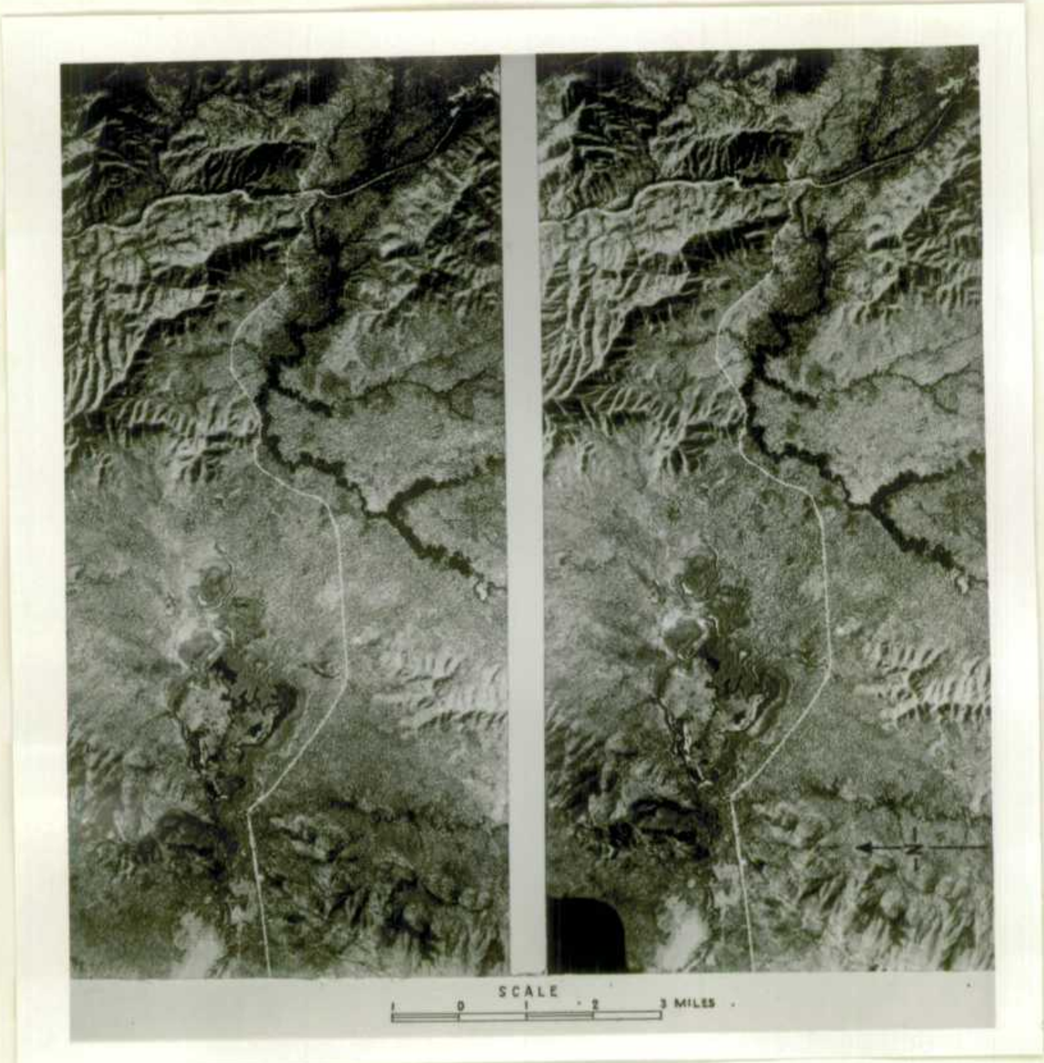
Photos, R.A.A.F.
B.M.R.Neg.No.G/4298



Stereopair of air-photographs showing the eastern end of the A.T.R. Prospect. The broken black line on the left-hand photograph marks the bank of the abandoned stream channel. The present drainage (western end of the photographs) crosses the former channel almost at right angles.

PLATE III.

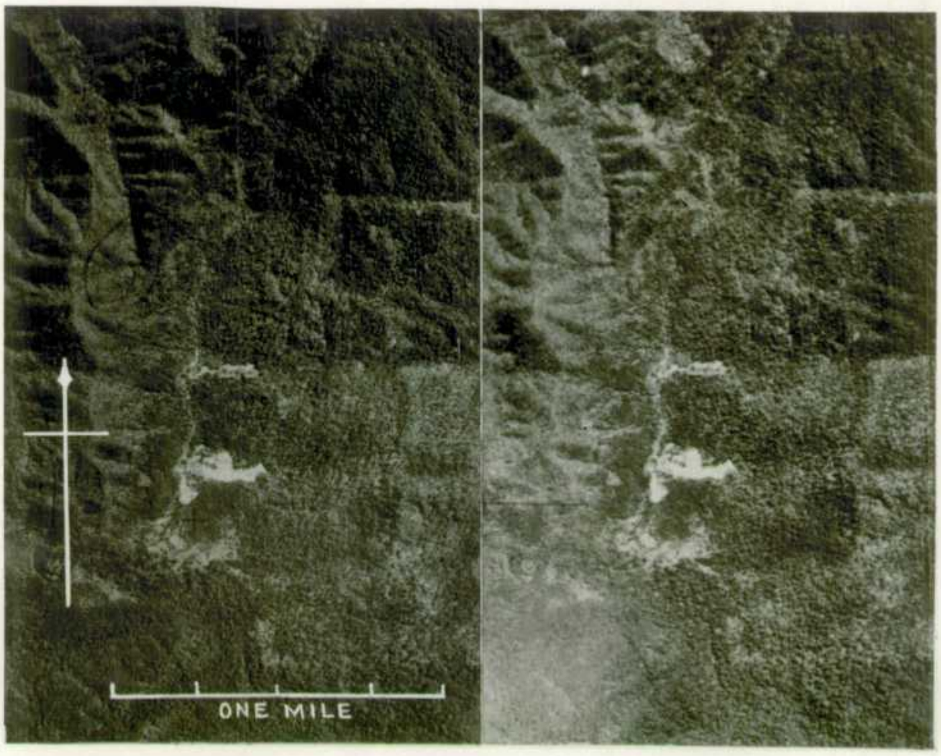
Photos, Adastra.
B.M.R. Neg. No. G/4297



Stereopair of air-photographs showing the King's Plains Prospect. These photographs should be examined in conjunction with Fig.V.

PLATE IV.

Photos, Adastra.
B.M.R.Neg.No.G/4299.



Stereopair of air-photographs showing the Mount Poverty area, Annan River Tinfield. The alluvial tin deposits are in the mature south-trending valley (centre of photo) and were deposited during a former cycle of erosion. The streams formed by the current cycle of erosion have youthful valleys and are cutting back towards the old high-level valley.