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THIRD — FOURTH CREEKS AREA MORIALTA

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1961

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Field Report

THIRD - FOURTH CREEKS AREA
MORIALTA

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December, 1961.

ABSTRACT

This report describes the stratigraphic sequence and the structural geology of the area. The stratigraphic sub-divisions have been discussed in detail and also many features defining deformation within the units. Often phenomena pertaining to points largely of academic interest have been mentioned. Although not always significant in determining the regional geology, these have been included to provide a possible basis for future detailed work in this area.

C O N T E N T S

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I INTRODUCTION

The following report and accompanying maps are submitted as an Honours field project 1961.

The area mapped is located on the Adelaide one mile sheet between Third Creek and Fourth Creek which bound the southern and northern extremities respectively. Total area mapped was about 1½ square miles.

The most recent previous mapping was done by Sprigg in 1951.

The aims of this project were ;

1. To map and describe the lithologic units and derive a stratigraphic sequence.

2. To determine the geological structure of the area, with with special attention to the faults.

II PHYSIOGRAPHY

The drainage of the area is mainly towards the west giving rise to deep, fairly rounded gullies orientated east west. The gullies tend to widen out along the western front of the area where broad protruding grass-covered spurs with gentle slopes are the dominant features.

By the process of erosion upstream, Fourth Creek has cut a rugged gorge through the horizontal quartzite in the north-east of this area and several falls of up to 150 feet have developed. Further downstream the gully characteristically widens as its course passes through phyllites eventually giving rise to alluvial flats.

Along most of the gullies accumulations of scree exist to a varying extent.

The gullies generally support heavy vegetation, however the steep sides show fairly good outcrop. The hill tops are covered by grass or light scrub and rock outcrop is either poor or lacking.

III TECHNIQUES

a. Field Procedure involved

1. Following the quartzite beds which provided stratigraphic marker horizons and mapping the distinct continuous units within the phyllites.
2. Recording the structural elements shown on the structural fact map, principally obtained from the phyllites and slates exposed along the road cuttings.

b. Laboratory Procedure

1. Selective units were sampled and macro and microscopically examined.
   These selected specimens were not intended to represent a complete petrological coverage of the area.
2. Stastistical analysis of structural data was done by plotting the poles of the planes of bedding, foliation, cleavage and joints; and the directions and plunge of lineations on a Schmidt type equal area net.

Field data was placed on kodatrace overlays on enlargements of air photos numbers 121 (9624,9625) Department of Lands Survey 327 (1959). The scale of these photos was 1" represents 660'.

This data was transferred to the Department of Lands topographic plans of "Adelaide and Environs" of the same scale.

Fact maps of the geology and structure were compiled and over-lays of interpreted geology and structural trends were used to show the results as clearly as possible.

IV THE STRATIGRAPHIC SEQUENCE

a. General

The area mapped includes the upper part of the Stonyfell Quartzite Formation and the lower part of the Upper Slates and ~~Phk~~ Phyllites represented in the Torrensian Series of the lower Adelaide System. These beds are of upper Proterozoic age.

The Stonyfell Quartzite unit forms the steep sides of Fourth Creek and about 600 feet of outcrop are recorded in the north-east part of the area mapped.

Stratigraphically overlying this quartzite is a monotonous succession of slates, phyllites, and siltstones with interbedded thin quartzite and sub-arkose horizons and discontinuous lenses of dolomite. This Formation reaches a maximum thickness of about 700 feet.

b. Stratigraphic Subdivisions

Considering all the mappable horizons in stratigraphic succession, it is possible to distinguish nine distinct lithologic sub-units which can be grouped into four generalised units.

The complete stratigraphic sequence is seen in table I.

ADELAIDE SYSTEM

TORRENSIAN SERIES

Formation	Unit	Sub-unit	Lithology
UPPER SLATES + PHYLLITES FORMATION	UNIT. D.	Sub-unit 9	Felspathic quartzite
		Sub-unit 8	Sub arkose
		Sub-unit 7	Massive quartzite (field name)
		Sub-unit 6	White well-jointed quartzite (field name)
	UNIT. C.	Sub-unit 5	Massive siltstone with interbedded quartzite (field name)
		Sub-unit 4	Siltstone
		Sub-unit 3	Subarkose
	UNIT. B.		Calcareous argillites with silty dolomite bands and associated pyrite
		Sub-unit 2	Siltstone
			Calcareous argillites and occasional thin dolomites.
STONYFELL QUARTZITE FORMATION	UNIT. A.	Sub-unit 1	Quartzite (field name)

<u>Table I</u> <u>The Stratigraphic sequence 3rd-4th Creeks area, Morialta.</u>

Between all the units 3 - 9 undifferentiated slates, phyllites and siltstones occur.

Where the rock types have been microscopically described and classified this name is applied to the appropriate unit in the above sequence. For the units not microscopically examined it is considered adequate for this report to retain the field terms.

For the basis of classification and any inference drawn from the thin section study, refer to Appendix A.

c. Description of Stratigraphic Sequence

Unit A.

Sub-unit 1. Quartzite.

This unit is represented by the upper 600 feet of the Stonyfell Quartzite. It is extremely massive and persistant and extends north and east of the boundaries of the area mapped. Dense horizons within relatively less massive rocks, give rise to the water-falls in Fourth Creek.

Bedding and cross-bedding are discernable in this unit and within the quartzite this interbedded shaley layers show well developed foliation.

Unit B.

This unit is dominated by calcareous slates and phyllites with interbedded discontinuous lenses of dolomite. One mappable siltstone horizon is also represented.

In the western part of this area outcrop is poor, however kunkar is abundant as 'float' in some areas and as a continuous calcareous capping cementing highly decomposed fragments of phyllite and slate.

Blue and buff colored dolomite bands are highly siliceous in nature, and reaching a thickness of up to 10". The most strongly out-cropping bed may be followed for about ten chains. The attitude of the dolomite beds suggest they are interbedded with the adjacent slates.

The dolomite band represented by specimen 25 shows a marked lateral facies change within a short distance from siliceous dolomite to a calcareous siltstone.

Some dolomites have small amounts of pyrite associated with them.

<u>Sub-unit 2</u>. <u>Siltstone</u> Refer Appendix A. Spec. No. 215/24

This horizon is distinct but its poor extent limits its use as a marker horizon. It outcrops as discontinuous low cliffs, about 8' high, and is typically dark-grey brown in color.

This sub unit consists of an indurated siltstone inter-bedded with slates, phyllites, and dense fine-grained quartzites. These members average about 9 " - 12 " in thickness and are intermittent.

Foliation is well developed and often obliterates bedding planes, however good bedding and cross-bedding are exhibited in the enterbedded quartzites.

<u>Unit C</u>

Immediately overlying Unit B is an arenaceous horizon followed by 2 strongly developed horizons of indurated siliceous siltstones. These three sub-units are grouped as Unit C.

<u>Sub-Unit 3.</u> <u>Sub-Arkose</u>. Refer Appendix A. Spec. No 215/8

This arenaceous sub-unit marks the transition from the underlying calcareous rocks to the dominantly siliceous rocks of the area.

This is a mappable unit, easily distinguished in the field by its friable, limonite stained, pitted, weathered surface. The boundaries are not always easily observed. However from those seen in the pattern of the scattered out-crop, it is believed that this sub-unit is essentially continuous and about 15' thick. Along its eastern extent this sub-arkose grades upwards into the siltstones of sub-unit 4. To the south it lenses out into phyllites and siltstones.

The lithology is generally consistent throughout but it tends to become more massive towards the south west where vertical jointing is strongly developed.

Macro and microscopic study fail to find any specific feature peculiar to this horizon and in these aspects it appears similar to the sub-arkose in the overlying unit D.

Sub Units 4 and 5. Siltstones. For sub-unit 4, Refer Appendix A Spec. No 215/16

These siltstones outcrop discontinuously and may form cliffs of up to 20' in the sides of the valleys.

Within both these sub-units the lithology varies vertically and laterally between extremes of soft grey-buff phyllites, indurated siltstones, slates and fine grained massive quartzites. These members vary in thickness between ½" and 2' averaging about 9". Lensing out is common as an original sedimentary phenomena and as a secondary feature due to the development of boudinage structures.

The sub-units are characterised above all else, by wide-spread occurrence of well developed foliation, most clearly defined in the more incompetent members.

These units tend to lens out laterally into undifferentiated phyllites.

Unit D.

This unit is dominated by a rapid succession of arenaceous members becoming more felspathic towards the top.

Each sub-unit has a specific characteristic which may be distinguished in the field and for this reason they are good stratigraphic marker horizons. Their use is limited because of the discontinuity of outcrop and their lensing out.

All the sub-units are less than 20' thick.

Sub-Unit 6. White well jointed quartzite.

This unit is a white, fine grained dense quartzite which breaks easily along well developed joint planes. This jointing is specific to this unit.

A series of shallow pits follow this horizon which ~~were~~ apparently were dug to quarry this quartzite for building stone.

Sub-Unit 7. Massive Quartzite.

This unit was first defined in the field along its eastern extremities as a dense clean grey quartzite containing hematite, //

The bed varies in thickness and in the amount of hematite along its extent. However its markedly massive character persists.

In the west of this area this bed has developed into a white-grey massive quartzite intercalated with dense siltstones and some slates.

Sub-Unit 8 Sub-Arkose   Refer Appendix A.
Spec. No 215/6,32,35.

This is the most extensive marker horizon in the area and may be recognised in the field as a fairly coarse grained quartzite-sandstone, iron stained, pitted, and has a friable weathered surface.

The representative thin sections were studied to determine what petrological and textural consistency could be expected along such a marker horizon. The results show that the constituents and their textural relationships are remarkably persistent.

Field study also generally implies this. However towards the eastern extremity this bed tends to become extremely massive.

Sub-Unit 9. Felspathic Quartzite.   Refer Appendix A.
Spec. No 215/18,36.

This is the uppermost mappable stratigraphic unit in the area. Lithologically it is a fine grained, iron stained, white quartzite. Textually it varies along its extent developing a poor foliation toward its eastern limits. This feature is shown by a difference in the textural relationships of the representative thin sections of this sub-unit.

The outcrop pattern of this unit forms a closed structure, the nature of which will be described later.

Undifferentiated Phyllites and Slates.

These occur between all the described units, above the Stonyfell Quartzite. These rocks show great variety in lithology, homogeniety and strength of outcrop.

The exposures available show a maximum degree of metamorphism equivalent to the Greenshist Facies. The phyllites are generally strongly crenulated, developing strong foliation planes along which chlorite and sericite accumulate. Compositional banding is also a common feature.

Associated with the zones of maximum deformation, irregular veins and masses of secondary quartz are commong.

Throughout these phyllites there are zones showing varying degrees of decomposition to white, red, and extremely calcareous clays.

V ENVIRONMENT OF DEPOSITION.

In such a limited area it is not expected that a full understanding of the depositional environments of the formations represented can be obtained. However the rock types and their relationships do provide certain implications.

Previous workers have postulated a regional interpretation of the Torrensian Series. They suggest that the transgressive nature of the beds and their distribution combined with the characteristic lateral and vertical facies changes indicate a continental or paralic environment of sedimentation, with deposition in isolated basins ~~have shallow in~~ having shallow interconnections.

The members of the Torrensian Series in this area do show marked facies changes. Low in the section the dominantly calcareous argillites show numerous scattered lenses of bedded dolomite containing pyrite grading to silty dolomites and calcareous argillites.

Such phenomena are characteristic of a restricted lagoonal environment.

Overlying the calcareous beds of Unit B the features of the rocks in the succession of siliceous argillites are indicative of a deltaic environment on a stable shelf zone. Slight instability of the depositional site is suggested since in 600 feet of sediments atl least 8 distinct interbedded horizons are included.

This area then appears to offer good evidence supporting the postulated regional interpretation.

VI STRUCTURAL GEOLOGY

General.

Bedding planes, joints and major folds are exhibited best by the competent beds of the area. Between these beds, the more incompetent rocks provide most of the structural data.

It is intended to

1. Briefly describe the structural elements recorded and

Two generations of flow cleavage exist in this area.

(a.) Most foliations recorded in the undeformed areas represent flow cleavage or slatey cleavage. These generally dip slightly east striking 0° - 20° about the North -south direction, These have been produced by flow parallel to the bedding.

(b.) Within the phyllites true axial plane cleavage from minor folds and flexures can be determined.

Most of these show a generalised attitude of strike 30° and dip 40° east which are markedly steeper than flow cleavage (a.) These steep attitudes are widely distributed throughout the area and the fact is significant that the axial plane cleavage of the west dipping beds in the brick works quarry complies with this regional trend.

2. <u>Strain Slip Cleavage.</u>

Strain slip cleavage is understood to represent a physical break within rocks on an extremely small scale. Refer Appendix B. Photo 5.

This is commonly seen ~~on a small scale~~ in the phyllites where it appears to deform the earlier formed gently dipping flow cleavage.

The attitude of the strain slip cleavage is generally consistent with the steeply east dipping axial plane cleavage measured throughout the area.

D. <u>Lineations</u>

Of all the structural data plotted statistically, the lineations show the best concentration of points. The plunges are generally between 0° - 20° in directions approximating to 235° and 55°.

Measurements in most cases were made on foliation on cleavage planes. Generally they are produced by extremely small crenulations.

Significant is the fact that occasionally within close proximity well defined lineations were recorded plunging in markedly different directions and by different amounts; in fact several single specimens exhibit two different directions of lineations, superimposed. (Refer Appendix B. photo 6).

All the above mentioned lineations are 'b' lineations which represent axes of rotation and in effect, fold axes. The value of the plunge of these lineations is important and it was not uncommon to find low angle plunges completely reversing direction within close proximity.

Distinct from the magnificent abundance 'b' lineations throughout the area two examples of 'a' lineations were observed.

During the formation of some boudin structures flow around massive quartzite boudins, commonly formed lineations parallel to the flow direction. These are 'a' lineations.

In the zone of intense flexuring in sub-unit 6 'a' lineations were produced on the foliation planes representing slippage along these planes normal to the axis of the fold.
No 'a' lineations are plotted on the map.

some local implications.

2. Discuss the significance of these elements and apply them to the structural interpretation of the area.

Note. For statistical analysis of structural data it is now realised THAT the numbers of readings were inadequate to be wholly effective. The results do, however define general trends and these are used together with field evidence in the structural interpretation.

I. DESCRIPTION OF FIELD OBSERVATIONS.

A. Bedding Planes.

The best attitudes are obtained from fine grained quartzites interbedded with siltstones and from some arenite units. Interpretation of bedding is often doubtful because of the dominance of foliation in the argillaceous rocks.

The plotted attitudes observed on the stereographic net show a marked concentration of dips between 0° and 30° and strikes varying 20° east and west of north. Irregulatities can be explained by proximity to fault and flexure zones.

Cross bedding throughout the area is on a small scale and indicates that none of the sub-units ~~in the area~~ have been over turned, although local overturning is observed in some phyllites.

B. Foliation.

Any plane seen in the field which was not interpreted as bedding or axial plane cleavage has been recorded as foliation.

The recorded attitudes were plotted and the widely scattered results indicate considerable flexuring within the phyllites.

The recorded data showed a maximum concentration having attitudes generally coincidental with bedding.

This phenomena is obvious in the field where the foliation of the phyllites is commonly coincidental with the bedding plane of the members of intercalated quartzites. Several exceptions occur;

1. Adjacent to the Montacute Fault Zone the foliations recorded in the phyllites and in the shaley bands in the Stonyfell Quartzite show a fairly constant attitude, i.e. striking generally north-south and dipping 45° E. Bedding in this area has a steep westerly dip in both units.

2. Scattered vertical foliations are recorded related to the more intense flexure zones.

C. Cleavage.

Two main types are recorded.

1. Flow cleavage

2. Strain-slip cleavage.

1. Flow Cleavage.
(also known as slatey cleavage and commonly as axial plane cleavage.)

Flow cleavage develops essentially by recrystallisation and consequent orientation of minerals, controlled by pressure. This should not be assumed necessarily parallel to the axial plane unless proven.

E. Minor Folding.

It is intended to distinguish between the two types of minor folding represented in this area by the use of genetic term (over turned minor folding) for the most dominant type. The two types are;

1. Overturned minor folding
2. Drag folding.

1. Overturned minor folding.

The axial planes of these folds are north-south striking with a steep easterly dip. (refer Appendix B. photo 2.)

In almost every case the displacement in these folds shows the top block moving to the west.

The intense flexure zone in sub-unit 6 exhibits this type of minor folding in a more competent bed and the structures here indicate the development of insipient imbricate structures.

On a small scale ~~example~~ complete overturned folds were observed, and the long attenuated limbs of the folds were parallel with the regional flow cleavage. (Refer Appendix B. photo 4.)

2. Drag Folding

True drag folding may be distinguished from the overthrust minor folds by the continuity of their roots.

Of the few drag folds seen, the best examples were displayed in the competent quartzite beds intercalated with the siltstone horizons.

F. Jointing.

Jointing is well developed throughout this area particularly in the dense siliceous siltstone units. All joints are essentially vertical.

Two generalised strike patterns are dominant;

1. Strike 20° about a north-south direction.
2. Strike 20° about an east-west direction.

Vertical tension cracks in flat lying boudins are commonly developed and filled with secondary quartz. These appear consistent with the regional joint patterns of this area.

II MICROSCOPIC OBSERVATIONS.

Incidental to the original aims of the thin section study two factors of structural significance have been observed. It is not intended to use these phenomena quantitatively in the structural interpretation, however controlled sampling of orientated specimens from the area could achieve this.

The features noted are;

(a.) Textural Relationships of the Grains.

In the arenite rocks a dominant secondary growth of quartz surrounds the original detrital grains and fills the intergranular spaces. As a result of this redistribution the intergranular boundaries of the quartz grains are characteristically sutured. In most sections undulose extinction was observed.

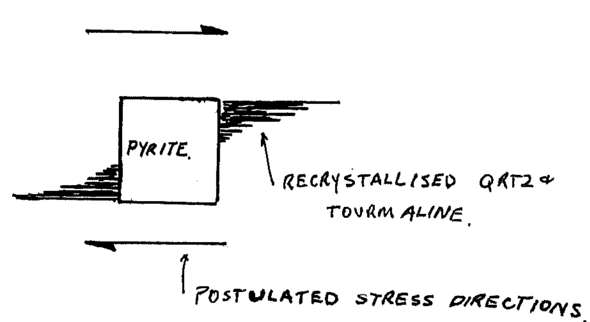
This regeneration of quartz is the direct result of pressure within the rock and the quartz is redistributed according to the Reicke principle.

During this period of deformation and directly related to the applied stresses, the grains have developed a well defined elongate orientation.

(b.) "Pressure Shadow" Development.

In thin section 215/13 large cubes of pyrite are dispersed throughout a dolomatic siltstone rock. Recrystallised quartz occurs as veins throughout, and more significantly concentrated as "tails" diagonally opposed across the pyrite cubes. The crystallised quartz and the associated tourmaline in these "tails" represent "pressure shadows" of the pyrite.

This phenomena indicates stress within this rock about a couple; (Refer. Fairbairn 1949). [SEE DIAG. BELOW]



III STRUCTURAL INTERPRETATION

The structure of this area has resulted from two distinct phases of deformation. These were probably successive stages of the same period of diastrophism since the rocks have been deformed about the same generalised north-south axis of rotation in both places.

(a) Phase 1.

In the first phase the structure of this area was dominated by the east limb of a broad gentle regional anticline. This is suggested by the generalised low easterly dipping bedding planes and the fact that the minor drag folding shows displacement of the top block to the west.

During this first phase the more incompetant rocks developed a distinct flow cleavage and statistically this plane is generally coincidental with the bedding planes. The regional strike is generally about the north-south direction.

No evidence was found in this area to suggest that this flow cleavage was necessarily axial plane cleavage of the regional limb structure.

~~Also associated with phase 1 is the development of banding and jointing. The wide spread occurrence of banding~~

In this first phase the main folding about a generalised north-south axis was complicated by the interference of a weakly ~~developed~~ developed cross folding about axis approximately east-west.

This cross folding commonly results in flexuring and reversals of plunge which are shown on the structural trend map. Although the cross folding is slight it was sufficient to develop the insipient basin structure as exhibited by sub-unit 9. This gives rise to the unusual closed out crop pattern cutting across the topographic contours.

Several other trend lines on this map also show marked degrees of closure. In particular the trend in the centre of the map indicates an initial anticline with an approximate north-south axis related to flexuring in the regional anticline and a superimposed axial depression caused by the secondary east-west fold system.

Also associated with phase 1 is the development of boudinage and jointing. The wide spread occurrence of boudinage is considered a feature of this early phase of broad folding.

Most of the joints of the area are the vertical tensional type described by Badgley.

The two dominant joint strike patterns of the area show vertical joints essentially parallel to AND perpendicular to the fold axis of the initial regional anticline. These are a late stage development of the first period of deformation following the release of pressure from the rocks of the area.

(b) Phase 11

A second phase of deformation suggests strong overthrusting from the east, showing relatively greater deformation than the first phase.

The time interval between the two phases could not be determined. This second phase of deformation is suggested by ;

1. Over-turned minor folding
2. Strong over thrust faulting
3. Lineations.

1. Overturned minor folding.

The pre-described attitude and displacement relationship of the abundant root-less over-turned folds and strain slip cleavage in the phyllites suggests strong deforming forces from the east. These phenomena are secondary because the earlier formed flow cleavage is deformed by the folds and intersected and displaced by the axial plane cleavages.

Further evidence is seen from the intense flexuring and insipient imbricate structures of sub units 6 and 7, and the sharp localised flexuring in sub-unit 4. Deformation in these two latter examples takes place about axes slightly east of north.

2. Overthrust faulting.

The attitudes of bedding and foliation in the Montacute fault zone show marked differences from the generalised trends of this area. Observation of both sides of the Fourth Creek gorge a quarter of a mile east of the Morialta Falls kiosk the thick horizons in the Stonyfell Quartzite (sub-unit 1) change in attitude from essentially flat lying beds to dips of 30-50 degrees west. (Refer Appendix B. photo 1) The bedding attitude of the phyllites immediately west of these sudden flexures also show a general 40 degrees westerly dip.

Foliation in this zone of both the phyllites and in shaley bands within the Stonyfell quartzite have been described as steeply dipping to the east.

The lithological contact between the Quartzite and adjacent phyllites forms a V shape upstream indicating an easterly dipping contact plane. Calculation indicates an easterly dip of 33 degrees. Secondary quartz occurs scattered around the north east extremity of sub-unit 3 andvein quartz is also common in this vicinity.

It is thus interpreted that the north-south contact between the phyllites and Stonyfell Quartzite is a reverse fault dipping about 35 degrees to the east, the eastern quartzite block having been overthrust to the west.

Similarly the steeply west dipping beds in the brick works quarry and on the road entering Morialta reserve and the steeply east dipping axial plane of a small over thrust fold in the quarry supports the presence of the postulated Eden fault less than ¼ mile to the west of the quarry. This fault has been postulated by numerous workers. Kerr Grant (1952) showed a displacement of about 500' from gravity survey results.

The Eden Fault is here thought to have originated as an overthrust fault dipping east, consistent with the attitude of the Montacute Fault.

Referring to Map 1 and the cross sections, the spatial relationships of the Stonyfell quartzite appear anomalous.

Along the north-south fault the Stonyfell quartzite has been thrust over slates and phyllites which stratigraphically are only just above the calcareous horizons. These calcareous horizons are about 400' below the marker horizons 5,6,7, and 8. (seen from east-west cross section)

Along the east-west contact between the Stonyfell quartzite and the phyllites (parallel to the Norton Summit Road) the quartzite is almost immediately over lain by the marker horizons 5,6,7, and 8.

The calcareous beds are absent.

Because of this space relationship between the Stonyfell quartzite and the phyllites, it is assumed that the fault swings around to a south-east direction and the quartzite block also over-rides the phyllites group to the south.

The structural trends on the western side of the fault do imply some rotation towards the south-east.

This fault then becomes a hinge fault which is a common phenomena throughout the Mount Lofty Ranges.

3. Lineations.

Since lineation is essentially a descriptive term the genetic relationship of the lineations in this area is not easy to define. These lineations are linked with some process of rotation and do therefore indicate the directions of movement in this area.

In both phases of deformation rotation about a "generalised north-south axis" has been used throughout this report, ~~although the lineations show varying plunges in directions approximating to~~ Analysis of the lineations show varying plunges in directions approximating to 235 degrees and 55 degrees. Their abundance and highly developed nature suggest they were produced by fairly severe regional deformation.

These facts suggest that the majority of lineations in this area were produced by the more severe overthrusting activity which caused rotation about an axis slightly more east of north than the approximate north-south axis of the phase 1 folding.

However marked variation in plunge directions in short distances and even in the same specimen (refer Appendix B., photo 6) suggest, the lineations of this area can be related to at least two patterns of deformation. These lineation directions and plunge values indicate superimposed folding (or more specifically rotation) in this area.

VII ECONOMIC GEOLOGY

The only rocks in this area of commercial interest are the Stonyfell Quartzite and the deeply weathered slates and shales along the western boundary.

North and south of this area large quarries are producing road metal from the Stonyfell Quartzite horizon. Although all factors of quality, reserves and access etc. are favourable it is doubtful if the quartzite in this area will ever be quarried since most of it is within a national reserve.

The brick works quarry at the beginning of the Norton Summit Road has been established for many years. Raw material ~~consumption~~ consumption is 150 - 200 tons of weathered shale per day. PProduction is about 20,000 bricks per day. The brickmaking shales in the quarry are extremely weathered and have to be quarried selectively.

Shales occur along the entire western front of this area and test drilling would probably delineate isolated reserves of brick-making shales. The suitability depends on the colour, degree of weathering and impurities.

VIII SUMMARY AND CONCLUSIONS.

The rocks out-cropping in this area are mainly undifferentiated phyllites, slates and shales. The stratigraphic sequence may be divided into four units and 9 sub-units. These rocks are highly calcareous and dolomitic in the west as distinct from those in the east which are straticraphically higher and show ~~marked~~ a marked development of siliceous siltstones and an interbedded succession of thin quartzites. These quartzites constitute good marker horizons.

In the north east of the area the thick quartzite represents the Stonyfell Quartzite Formation. This is a specific unit and stratigraphically underlies the phyllites.

The rock types and their relationships indicate a shallow water environment of deposition on a fairly stable shelf zone.

The structure is dominated by a broad east limb of a regional anticline with an approximate north-south axis, which was produced by an early phase of folding.

Subsequently this limb has been gently deformed by cross folding about east-west axes.

A later phase of deformation involved strong over thrusting from the east. The competent Stonyfell Quartzite reacted by being thrust over the phyllites to the west along a steeply east dipping reverse fault.

The incompetent phyllites define the deforming forces by complex flexuring, overthrust folding and movement along foliation planes.

These phyllites show an abundance of structural phenomena and it is suggested that with greater numbers of field observations, statistical analysis of this data may disclose more detail of this aspect.

ACKNOWLEDGEMENTS

I would like to thank Professor Rudd for suggesting this project and for his help throughout the year. To Mr. Talbot and Mr. A. Whittle I extend special appreciation for their supervision and advice. I also gratefully acknowledge other members of the Department for their valuable encouragement, in particular R. Offler for his helpful and constructive critisism.

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APPENDIX A.

Selected Rock specimen and thin section descriptions.

The following specimen locations are shown on the geological interpretation map (Map 1.)

Nos.	18,36	represent sub-unit	9
	6, 52, 35	represent sub-unit	8
	16	represent sub-unit	4
	8	represent sub-unit	3
	24	represent sub-unit	2
	13, 25	represent Dolomitic horizons	

Classification of these rocks are based on Pettijohn's Classification.

Unit D. Sub Unit 8

Sample 215/6

Locality Refer Map 1.

Classification. Felspathic quartzite or sub arkose

Description

Macro. Clean,white fairly massive arenite with some limonite staining. Weathered surface pitted, brown .

Micro Principle components, quartz and felspar. Dominantly close packed, no cementing agent between grains.

Texture essentially an interlocking mosaic of anhedral quartz and felspar. The grain boundaries are characteristically sutured and most grains show undulose extinction, and show a distinct common elongated orientation.

Quartz. About 80% of the rock, two generations suggested. The irregular sutured intergranular boundaries exhibit secondary growth of quartz around the detrital grains.

Felspar. Up to 25% of the rock, consists dominantly of microcline. The grain boundaries are definite and sub-rounded representing original detrital grains.

Unit D. Sub Unit 8.

Sample 215/32

Classification. Felspathic quartzite or sub arkose

Description.

Macro and Micro essentially as in 215/6 (above)

Unit D. Sub Unit 8.

Sample 215/35

Classification. Felspathic quartzite or sub arkose

Description

Macro and Micro essentially as in 215/6 (above) with a greater degree of limonite impregnation.

Unit D. Sub Unit 9.

Sample 215/18

Classification . Sub arkose

Description

Macro Clean, grey white fine grained arenite containing sericite on a poorly developed foliation plane. Small pits on weathered surface show weathering out of felspar grains.

Micro Principle constituents quartz, felspar and sericite. Texture essentially equigranular sub rounded grains. Dominantly open packed. The intergranular pore space contains abundance of sercite and chlorite.

Quartz. About 65 % of the rock. Equigranular, grain boundaries definite and rounded showing only a slight development of secondary quartz. Undulose extinction not dominant but less than 20% show the original detrital grain shape. Fracturing of the grains is rare.

Felspar. About 20% of the rock. Mainly microcline and orthoclase. The orthoclase shows greater degree of decomposition. The felspar grain boundaries are distinct.

Sericite. About 15 % of the rock most of which is not derived from the felspars. Occurs as intergranular matrix. The flakes tend to show a common orientation producing the weak foliation planes in the rock.

Unit D. Sub Unit 9/
Sample 215/36
Classification. Felspathic Quartzite.
Description .

Macro White sub-friable to quartzitic texture relatively coarse grained arenite. Slight reddish-brown iron stained weathered surface.

Micro Principle constituents quartz and felspar. Most grain boundaries sutured. Few (especially felspars) show original detrital shape. Grains are fairly close packed.

Quartz. Constitutes about 75% of the rock. Secondary quartz growth common and often the original grain shape shown by a rim of inclusions. Grains commonly fractured although undulose extinction observed in only about 50%.

Felspar. About 15% microcline and orthoclase in approx. equal proportions. The microcline retains its original detrital sub-rounded grain boundaries. The orthoclase shows varying degrees of decomposition to sericite and chlorite.

Unit C. Sub Unit 3.
Sample 215/8
Classification Sub arkose
Description

Macro Essentially a clean white sub friable arenite.

Micro Principle components quartz and felspar. Texture is an interlocking mosaic of anhedral grains, the boundaries of which are sutured and irregular and have one common orientation.

Quartz. About 60% of the rock. Some grains fractured, most show an envelope of regenerated quartz. Undulose extintion in most grains.

Felspar. Orthoclase and microcline occur in about the same amount.

The grains have been stressed as shown by the markedly wavy twin patterns. The sub rounded original grain boundaryes are generally preserved. The Orthoclase has decomposed to sericite and chlorite. However barely shows xxxxxxx complete replacement of the grain. This is a weathering effect since it occurs in areas of greater concentration of dispersed limonite.

Unit B. Sub Unit 2.
Sample 215/24
Classification Siltstone
Description.

Macro Buff-grey massive, indurated argillite. Well developed cleavage poorly developed lineations. Weathered surface dark grey-brown and is extremely tough

Micro Main constituents, quartz, orthoclase and platey minerals mostly of iron stained chlorite, sericite, and muscovite. All grains commonly orientated giving rise to the well-developed cleavage. A cross structure is shown by a series of waves across the main cleavage at right angles. Quartz. silt size, fairly angular grains generally show undulose extinction. All grains are elongated in the direction of the foliation.

Platey minerals. Interstitial iron stained chlorite and muscovite are interbedded with the quartz layers, and with layers of detritus of similar composition. Accessory amounts of hematite and limonite are dispersed thoughout.

Unit c. Sub Unit 4.
Sample 215/16
Classification. Chloritic Siltstone.
Description

Essentially as in 215/24. Does possess a greater development of chlorite giving this siltstone an olive green appearance.

Unit B. Dolimitic Horizons.

Sample 215/13 Ca Mg CO_3

<u>Classification</u>. Pyrite rich dolomitic silt.

<u>Description</u>

Macro Grey-buff dense calcareous argillite, showing one foliation plane. Pyrite and pseudomorphs of limonite after pyrite are scattered randomly throughout. Acid test suggests that this rock is a dolomite.

Micro Main constituents are densely packed dolomite and quartz of silt size and scattered pyrite. Throughout this mass streaks of chlorite occur orientated along the foliation direction.

Quartz. Occurs throughout the dolomitic arillaceous matrix in veins and isolated pockets, generally parallel to the foliation. Recrystallised quartz together with tourmaline also occurs concentrated as "Tails" representing pressure shadows diagonally opposed across the cubic pyrite crystals. The quartz and tourmaline here have a common orientation.

Pyrite. Cubuc grains of various sizes up to 1/16 inch across distributed generally parallel to the foliation direction.

Unit B. Dolomitic Horizons.

Sample 215/25 and 215/11

<u>Classification</u>. Silty Dolomite.

<u>Description</u>

Essentially the same as in 215/13 (above) slightly greater proportion of silt. Lacking in pyrite.

APPENDIX B. *SELECTED PHOTOS*

1. Flexuring in Stonyfell Quartzite adjacent to the Montacute Fault.

2. Overthrust folding in phyllites showing steeply east dipping axial planes.

3. Boudinage in sub-unit 5, showing characteristic siltstone and interbedded quartzite.

4. A - B is regional flow cleavage (foliation). X - Y is poorly developed strain slip cleavage which is parellel with the axial plane of an overturned fold just off the photo. Bedding shows minor recumbent folding.

5. A - B. is strain slip cleavage dipping east. X - Y is flow cleavage (foliation) showing slight dip to the east.

6. Cross 'b' lineations.

a - b represents the fold axis of the minor folding in this specimen.

Orientation a ----> b 360°

plunge 20°

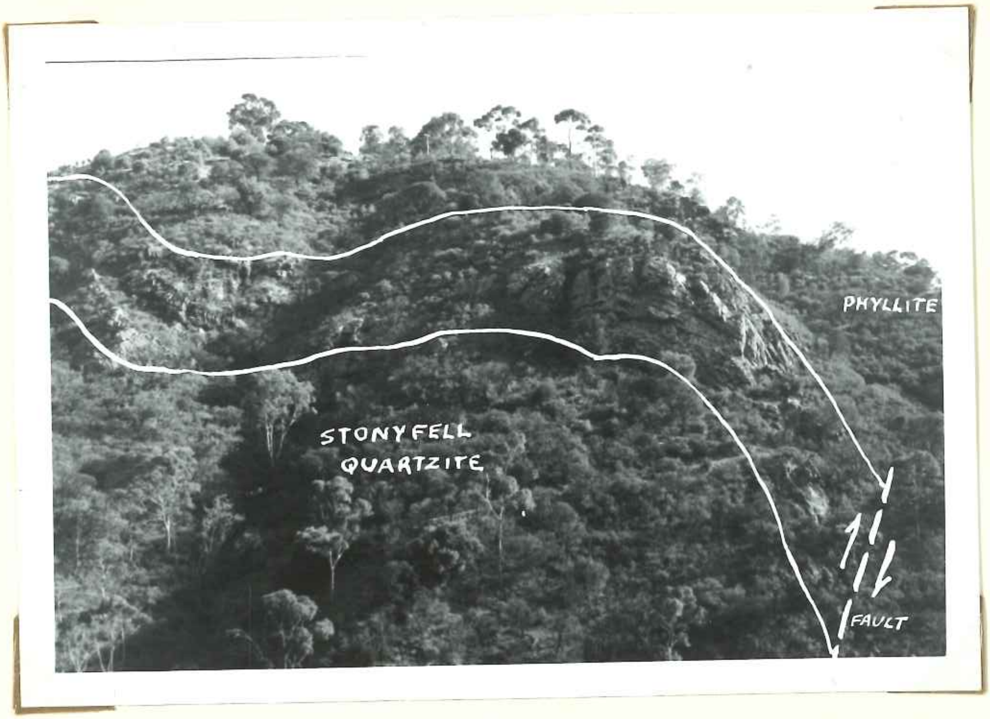
c - d represents cross folding direction.

Orientation c ----> d 35°

plunge 5°

APPENDIX B.

Selected photographs. Locations are shown on Map 1.



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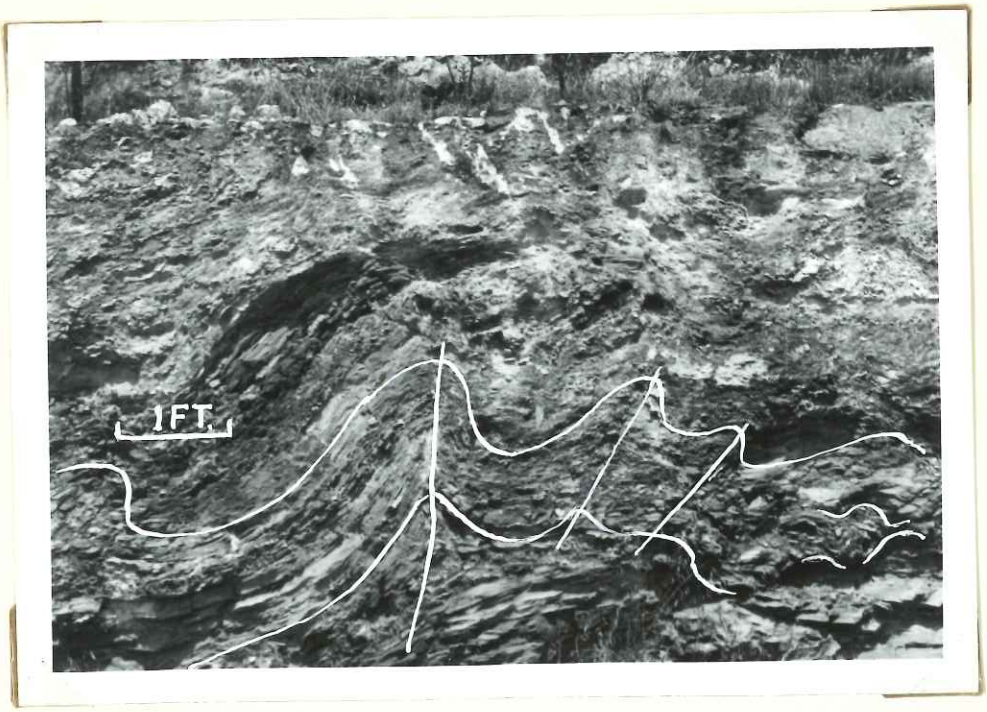
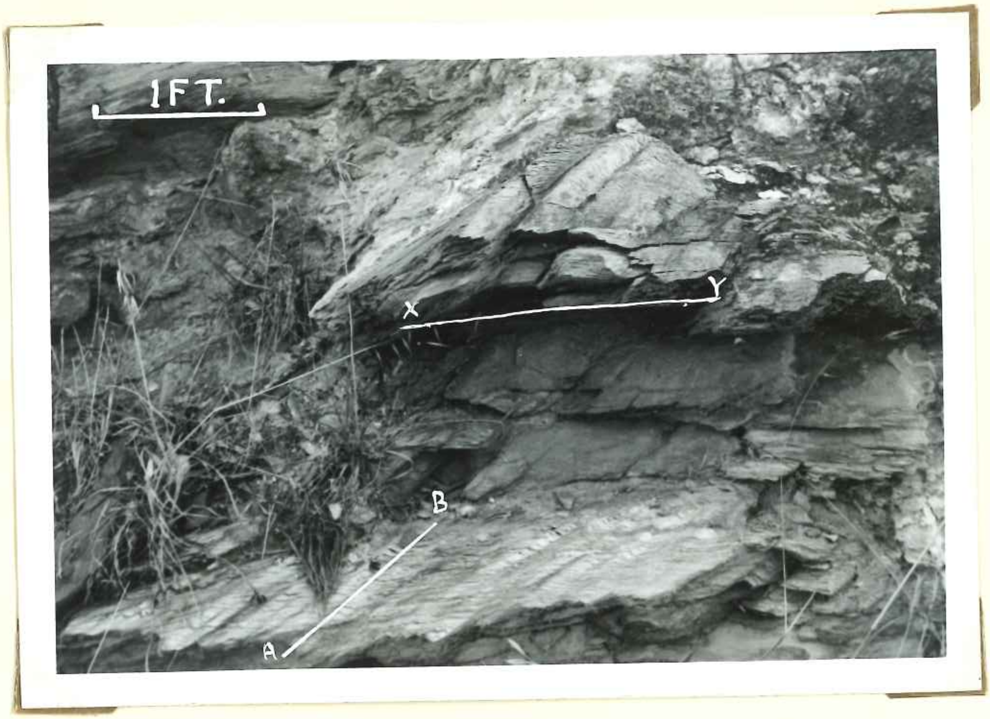


No. 2

No. 3

No. 4



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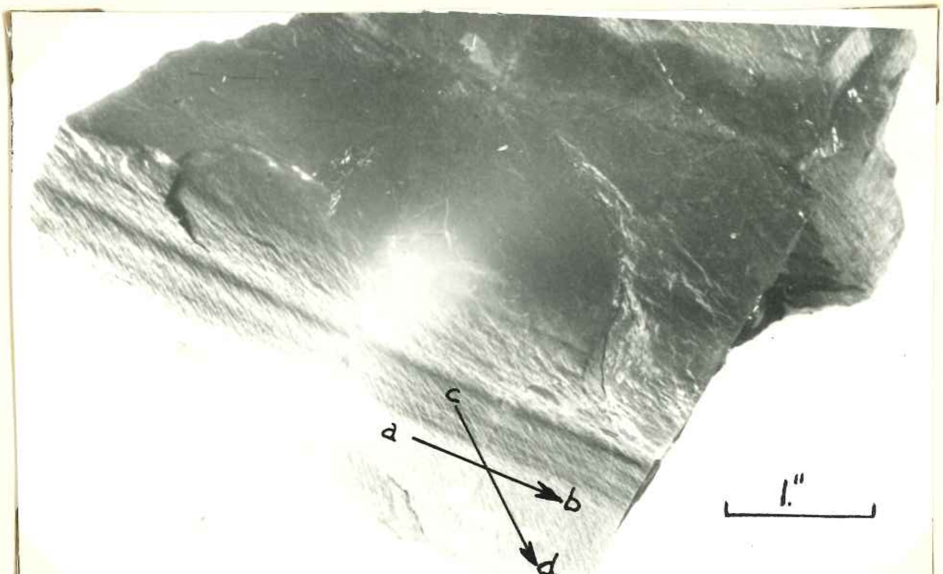
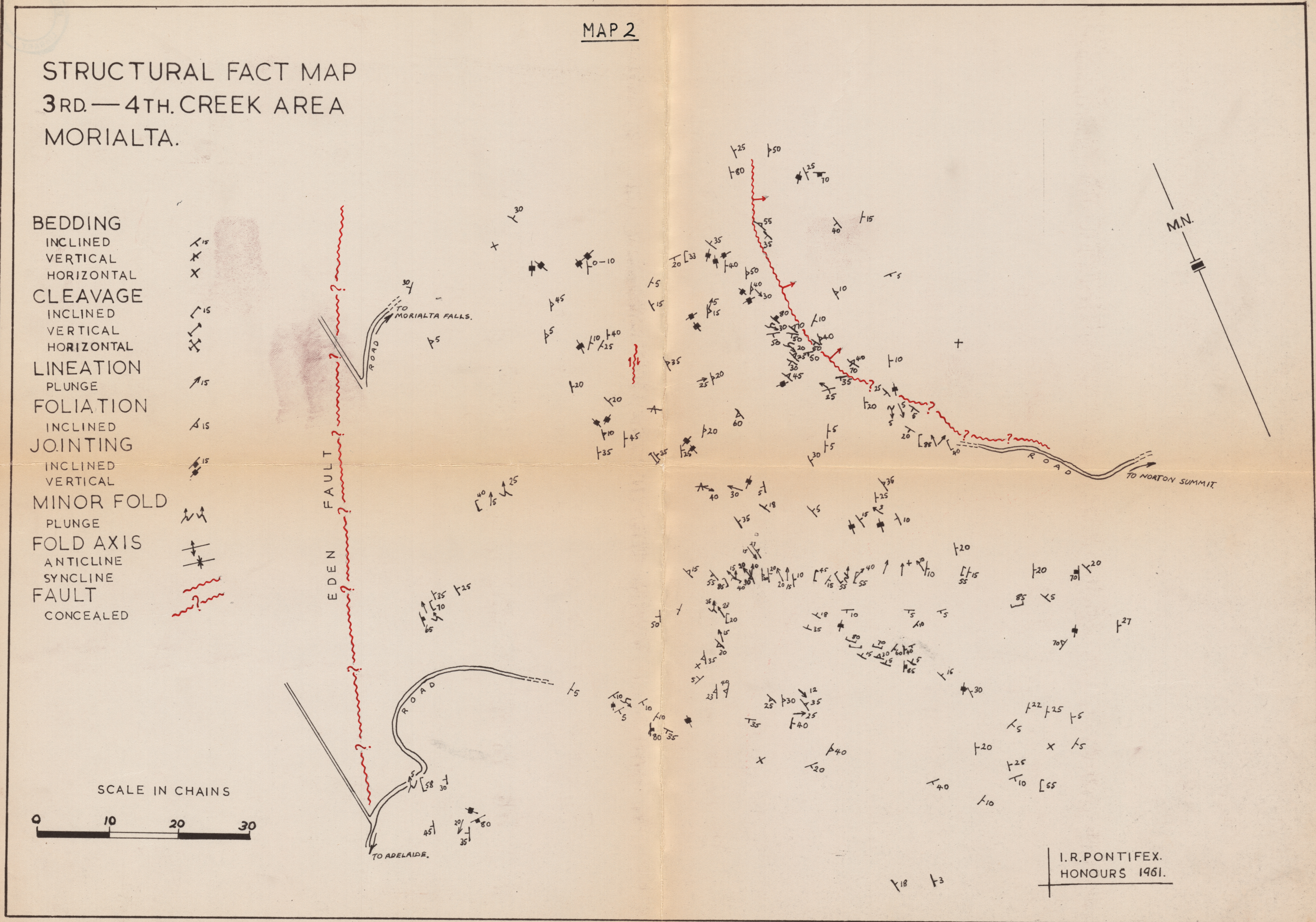
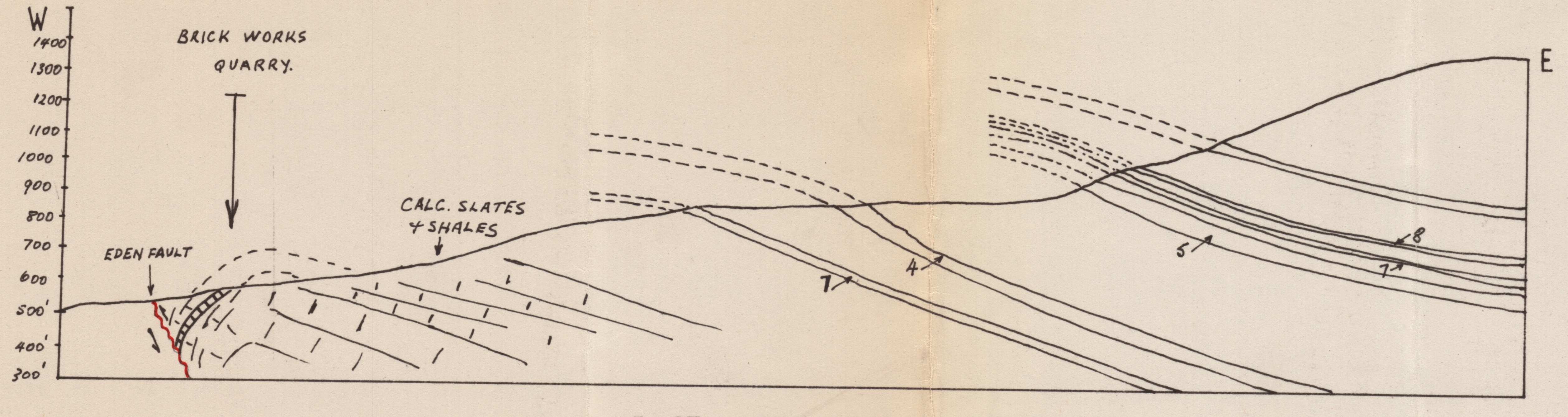


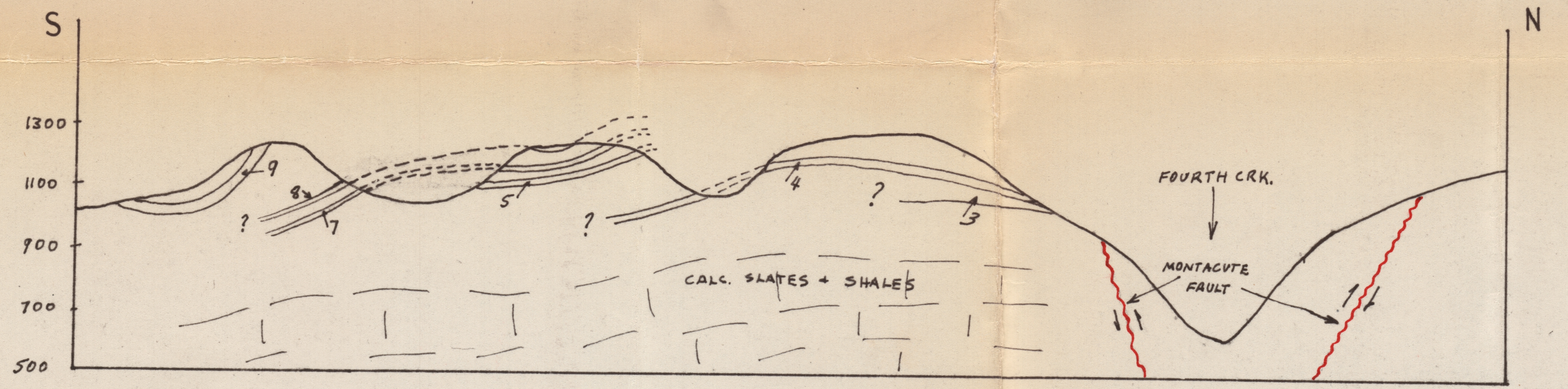
No. 6


MAP I.
GEOLOGICAL FACT MAP
3RD. — 4TH. CREEK AREA
MORIALTA.
DOLOMITE
SANDSTONE.
DOLOM.
VERY CALCAREOUS
SHALES + SLATES
MOSTLY POOR KUNKAR O/C
QRTZITE
QRTZITE – SANDSTONE
DARK BROWN MASSIVE SILTSTONE
BOUNDARY NOT FOLLOWED IN DETAIL
M.N.
PYRITE
DOL
V. MASSIVE PHYLLITE
PHYLLITES
HIGHLY DECOMPOSED + CONTORTED
PHYLLITES AREAS OF CLAY + QUARTZ INTRUSIONS SCATTERED THROUGHOUT
TO MORIALTA FALLS
PHYLLITIC SLATE
SILTSTONES
ROAD
DOL.
PHYLLITE
SILTSTONE +
SOME SANDSTONE
"FLOAT"
SILTSTONE
QRTZITE – SANDSTONE
PHYLLITE SLATES SILTSTONE
BUCK QRTZ.
SILTSTONES
SANDSTONE
SANDSTONE – QRTZITE
DOL FLOAT
SCATTERED
KUNKAR
BEDDED PYRITE
SANDSTONE
PHYLLITES SLATES SILTSTONES
DECOMPOSED PHYLLITES
ROAD
TO NORTON SUMMIT.
VERY
POOR
OUTCROP
DECOMPOSED PHYLLITE + KUNKAR + CLAY
SLATES
SANDSTONE
DENSE SILTSTONES & INTERBEDDED QRTZITE
GREY QRTZITE
QUARRY
QRTZITE – SANDSTONE (REDDISH WEATHERING SURFACE)
PHYLLITES
GREY MASSIVE QRTZITE
PHYLLITES + SLATES
MASSIVE SILTSTONE + INTERBEDDED QRTZITE
CONTORTED + DECOMPOSED PHYLLITES.
PHYLLITES + CLAYS SHOWING NUMEROUS OVERTHRUST FOLDS ETC.
MASSIVE SILTSTONE
MASSIVE QRTZITE
PHYLLITES +
CALCAREOUS
SLATES SCATTERED
PHYLLITE
QRTZITE
CONTORTED PHYLLITES & QUARTZ INTRUSIONS
SANDSTONE QRTZITE
QRTZITE – SANDSTONE
SCATTERED QRTZITE FLOAT IN FLEXURE ZONE
SLATES, SILTSTONES & QRTZITE
SILTSTONE
CLAY KUNKAR + SLATES
PHYLLITES, CLAY
QUARTZ INTRUSIONS
PIT IN QRTZITE
QUARRY
QRTZITE
SILTSTONES + SLATES
PHYLLITES
GREY QRTZITE
FELSPATHIC SANDSTONE.
REDDISH SANDSTONE
HIGHLY DECOMPOSED SLATES MUCH CLAYS
QUARRY
SCALE IN CHAINS
0
10
20
30
TO ADELAIDE
VERY CALCAREOUS
SLATES + PHYLLITES
SCATTERED KUNKAR.
I. R. PONTIFEX
HONOURS 1961


MAP 2
STRUCTURAL FACT MAP
3RD. — 4TH. CREEK AREA
MORIALTA.
BEDDING
INCLINED
VERTICAL
HORIZONTAL
CLEAVAGE
INCLINED
VERTICAL
HORIZONTAL
LINEATION
PLUNGE
FOLIATION
INCLINED
JOINTING
INCLINED
VERTICAL
MINOR FOLD
PLUNGE
FOLD AXIS
ANTICLINE
SYNCLINE
FAULT
CONCEALED
SCALE IN CHAINS
0 10 20 30
EDEN FAULT
TO MORIALTA FALLS.
ROAD
TO NORTON SUMMIT.
TO ADELAIDE.
M.N.
I.R. PONTIFEX.
HONOURS 1961.



EAST-WEST CROSS-SECTION



NORTH-SOUTH CROSS-SECTION

SCALE:

VERTICAL 1" = 400'

HORIZONTAL 1" = 660'

I.R.PONTIFEX.
HONOURS 1961