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

RECORDS 1955 No. 35

PROGRESS REPORT ON A SEISMIC SURVEY OF THE POOLE RANGE-PRICE'S CREEK AREA

KIMBERLEY DIVISION, W.A.

by

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ABSTRACT

This is a progress report on a seismic survey extending over the Poole Range and Price's Creek areas and the Pinnacle Fault, near the north-eastern boundary of the Fitzroy Basin. The survey was conducted during the winter of 1953.

The Poole Range Dome has been mapped in outcropping rocks of Permian age, but its western closure is not certain. It is at the south-eastern end of a line of anticlinal folding which includes the St. George Range Dome and Nerrima Dome.

The target beds for an oil test bore would be the Devonian and/or Ordovician rocks, which crop out on the north-eastern side of the Pinnacle Fault, and over which the Permian rocks of the Poole Range are believed to lie unconformably.

The seismic results indicate a thick section of sediments on the south-western side of the Pinnacle Fault and show a fair degree of conformity between shallow and deep reflections on the northern flank of the dome. Further investigation was made in 1954 around the flanks of the dome, to determine whether or not the domal structure persists at depth, but the interpretation of the results of the 1954 survey is not yet complete. The Ordovician rocks on the north-eastern side of the Pinnacle fault are shown to have a probable unexposed thickness of about 900 feet.

1. INTRODUCTION

The survey described in this report forms part of the overall programme in the search for oil in the Fitzroy Basin in the Kimberley Division of Western Australia, which is being conducted by both the Commonwealth Government and private companies. This survey was made during the second field season spent in that area by a seismic party of the Bureau of Mineral Resources.

The first season was spent in attempting to detail by refraction methods the deep structure underlying Nerrima Dome (Vale, Smith and Garrett, 1953), after it had been found impossible to record reflections over the Dome.

An assessment of the Fitzroy Basin on a regional basis by Schneeberger (1952) placed the Poole Range in the most favourable position in the Fitzroy Basin for the occurrence of oil. The Poole Range was then selected to be covered by a detailed gravity survey and a seismic survey.

The seismic survey included reflection and refraction traverses, the location of which is shown on Plate 2. Traverses "A" and "T" are reflection traverses. Traverse "A" extends from the Ordovician outcrop at Price's Creek to a point near the surface axis of the Poole Range Dome. Traverse "T" extends along the main Fitzroy Crossing-Halls Creek road from Traverse "A" to Christmas Creek Homstead. Refraction shooting was done along Traverse "A" between S.P.'s 33 and 45. Traverse "Z" is a refraction traverse approximately along the strike on the Ordovician outcrops near Price's Creek.

Headquarters and camp for the party were established about one mile north-east of the main Fitzroy Crossing-Halls Creek road and midway between Bloodwood Bore and Dusty Outcamp. At full strength the party consisted of two geophysicists, one radio technician, surveyor, driller, drilling assistant, mechanic, shooter, eight field assistants, cook and cook's offsider. K.R. Vale, Senior Geophysicist of the Bureau's Seismic Group, supervised the work for the first two months.

The recording instrument used was a 24-channel type made by the Swedish Electrical Prospecting Company, and mounted on a Morris one-ton truck. Other vehicles used by the party were a cable truck, a shooting truck, a Failing "750" drill, two 400-gall. water tenders, a workshop truck, a supply truck and two Land-Rovers.

Although the drill was operated for two eight-hour shifts per day, the rate of drilling, in general, was slow, being approximately 7½ holes per week.

2. GEOLOGY

A general discussion of the geology of the Fitzroy Basin is given by Schneeberger (1952). A comprehensive preliminary report on the geology is given by Guppy (1953). The following notes are based on the above reports. The problems for which a seismic solution may be possible have been discussed by Vale et al (1953).

The Poole Range Dome is at the south-eastern end of a line of folding which includes the St. George Range Dome and Nerrima Dome, and has been mapped in Permian sediments. The Grant Formation and Poole Sandstone are exposed in the central part of the structure, and the Noonkanbah Formation and the Liveringa Group are exposed on the northern and southern flanks. Freney Kimberley Oil Company's Poole Range Bore No.3, reached a depth of 3,264 feet and finished in the Grant Formation. With 200 feet of Grant Formation outcropping above the bore site this proved a minimum thickness of 3,460 feet for this formation. The thickness of the Poole Sandstone is approximately 200 feet in the Poole Range, but increases in a north-westerly direction, being 600 feet in the western St. George Range and 1,200 feet at Nerrima, as shown by the bore there. The Noonkanbah Formation is approximately 1,260 feet thick in the Poole Range area, and is generally between 1,200 and 1,300 feet thick throughout the Fitzroy Basin. Outcrops of the Noonkanbah Formation in this area consist of interbedded siltstone, sandstone, limestone and shale, whereas in the Nerrima area the Formation is predominantly shaly. A full section of the Liveringa Group is not exposed in the area under review as the upper members have been largely eroded.

The Poole Range Dome is cut by numerous faults trending approximately north-south, which are thought to be an expression of the competency of the Permian sediments at the time of folding. These extend well down the flanks of the structure and may be observed as far as eight miles from the axis.

Schneeberger (1952) advanced the following two reasons for selecting the Poole Range Dome as being most favourably located for the accumulation of oil.

(a) Oil shows were obtained from the Grant Formation in the Poole Range Bore No.3 (This oil is thought to have originated in the Devonian sediments assumed to underlie the Permian).

(b) Of the structures mapped, the Poole Range Dome is the closest to the outcropping Ordovician and Devonian limestones (which, under favourable circumstances, could provide source beds for oil) and consequently it is more likely that these rocks exist under the Poole Range than under the other structures.

Ordovician rocks crop out over an area of approximately 12 square miles about 16 miles north-east of the apex of the Poole Range Dome, near Price's Creek. Three shallow bores were put down in this section and it was reported that they showed traces of oil (Schneeberger, 1952, p.7). The Ordovician contains two formations, the upper of which, the Gap Creek Dolomite, is 780 feet thick, and the lower one, the Emanuel Limestone, has 1,670 feet exposed. This gives a known thickness of 2,450 feet for the Ordovician section, but as the base of the Emanuel Limestone is not exposed, this is not the total thickness. The Middle Devonian Pillara Limestone unconformably overlies the Ordovician rocks and contains reef formations.

Two tectonic features intervene between the Poole Range Dome and the Ordovician and Devonian limestones to the north-east. The first is the Pinnacle Fault, which has a north-west trend and a downthrow on the south-west side, probably of several thousands of feet. Neither Ordovician nor Devonian rocks are exposed south-west of this fault. The other feature is the Talbot Syncline which lies to the south-west of, and is roughly parallel to, the Pinnacle Fault.

The specific tasks of the seismic survey were :

(i) To evaluate the thickness of the unexposed section of the Ordovician.

(ii) To evaluate the thickness of the total sedimentary section on the south-western side of the Pinnacle Fault.

(iii) To establish, if possible, whether or not the domal structure of the Poole Range persists at depth.

At Nerrima, it was found that, although good reflections could be recorded on the synclines north and south of the Dome, none were recorded on the Dome itself. This was thought to be due to the extensive faulting present in the central part of the structure. It seemed likely that the same conditions might apply in the Poole Range and that if they did, evidence on the flanks of the Dome would be sufficient to answer (iii).

The work along Traverses "A" and "Z" provides answers to (i) and (ii) in terms of minimum thicknesses, and the work along Traverse "A" south-west of S.P. 28 and along Traverse "T" is a contribution towards the answer to (iii). It is hoped that the work in 1954 on the eastern and southern flanks of the dome will, when interpreted, provide a final answer.

The purpose of the refraction spread along Traverse "A" was to check the existence of a fault suggested by the reflection cross-section at S.P. 39.

3. SHOOTING METHOD EMPLOYED

The reflection shooting employed the conventional continuous profiling technique. Holes were drilled at $\frac{1}{4}$-mile intervals with geophone stations marked out at 110 feet intervals between the shot points. Each hole was shot with 12 geophone stations set out on either side of it. Normally the furthest station on either side would fall at the adjacent shot point, but, to avoid abnormal effects on reflection times due to the proximity of the geophone to the shot hole, the end stations were moved a further 110 feet along the line. Experimental shooting was done using more than one geophone at the stations and improvement in the quality of reflections was noted on these records. Consequently, in all subsequent shooting at least two geophones per station were used. These were placed 10 feet apart and connected in parallel. The party had insufficient geophones to use more than two per station for normal shooting, but in places where reflections were poor or even non-existent, the holes were shot with geophones laid out on only one side at a time and four geophones per station were then used, these being connected with two pairs in series and each pair in parallel.

4. REDUCTION AND PRESENTATION OF REFLECTION DATA

The final results of the reflection traverses are presented in the form of cross-sections showing the reflections recorded from various horizons (Plates 3 and 4). Each reflection is indicated by a straight line, which is drawn to show the calculated depth, horizontal displacement and dip of the reflecting horizon. The length of the line indicates the actual portion of the reflecting horizon covered by the recorded reflection. This is equal to half the spread of the geophones. Each reflection is graded both for certainty of it being a reflection and for accuracy of the dip angle calculated from it. The system of grading used is that described by Gaby (1947). The grade of accuracy assigned to a reflection is shown on the cross-section by drawing a full line for good accuracy, a line with one break for fair accuracy, a line with three breaks for poor accuracy, and alternating dots and dashes for questionable reflections.

To present a clearer picture of the information set out on the cross-section a "phantom" horizon has been drawn. Broadly speaking, this is a line drawn thro gh a zone of the cross-section in which the reflections are conformable, so that it shows the average dip of the reflections within that zone. The width of the zone is kept constant and the phantom horizon is always at its centre. The dip of the phantom horizon was calculated at intervals of 200 feet along the traverse. In calculating the average dip, the reflections were weighted according to quality.

The reflection times and dips have been corrected for surface variations such as the elevations of the shot points and geophone positions, and the thickness of low velocity or weathering layers beneath these points. The elevation of the stations and the weathering thickness are plotted at the top of each cross-section.

5. RESULTS

(a) Near-surface velocity information

Shooting was done on several different formations which outcrop in the area, and from the first arrivals on the normal reflection records the following near-surface or "sub-weathering" velocity information was obtained:-

PERMIAN ROCKS

Formation	Sub-weathering Velocity	Average Weathering Velocity
Liveringa Group	7,600 ft/sec	2,700 ft/sec
Noonkanbah Formation	9,000 ft/sec	3,000 ft/sec
Poole Sandstone and/or Grant Formation	Approx. 10,000 ft/sec	---

ORDOVICIAN ROCKS

Formation	Sub-weathering Velocity	Average Weathering Velocity
Emanuel Limestone	12,000 ft/sec	-----

The difference in the sub-weathering velocity when shooting on the Liveringa Group and the Noonkanbah Formation supplies a means of plotting the boundaries between these formations. The two boundaries either side of the Talbot Syncline are shown to be at S.P. 22 and S.P. 30. These positions do not agree with the geological map (Plate 2), but the geological boundaries are marked as uncertain in this area.

(b) Average velocity information from reflection shooting.

To convert the reflection times obtained from the records into depths below the surface, some knowledge of the seismic velocity distribution in the sedimentary section is needed.

Average velocity information was obtained by a t -Δt analysis (Dix, 1952, 124-126), in which t is the reflection time and Δ t the "spread correction" ("move out") or that difference in times between the closest and furthest geophones recording a reflection, which is caused by the length of the geophone spread.

Reflections used in the analysis were subject to the following conditions :-

(i) Accuracy grade to be at least "Fair".

(ii) Either (a) reflections to be recorded on all 24 geophones from the one shot, or (b) reflections to be recorded on the same 12 geophones from shots at each end of the geophone spread.

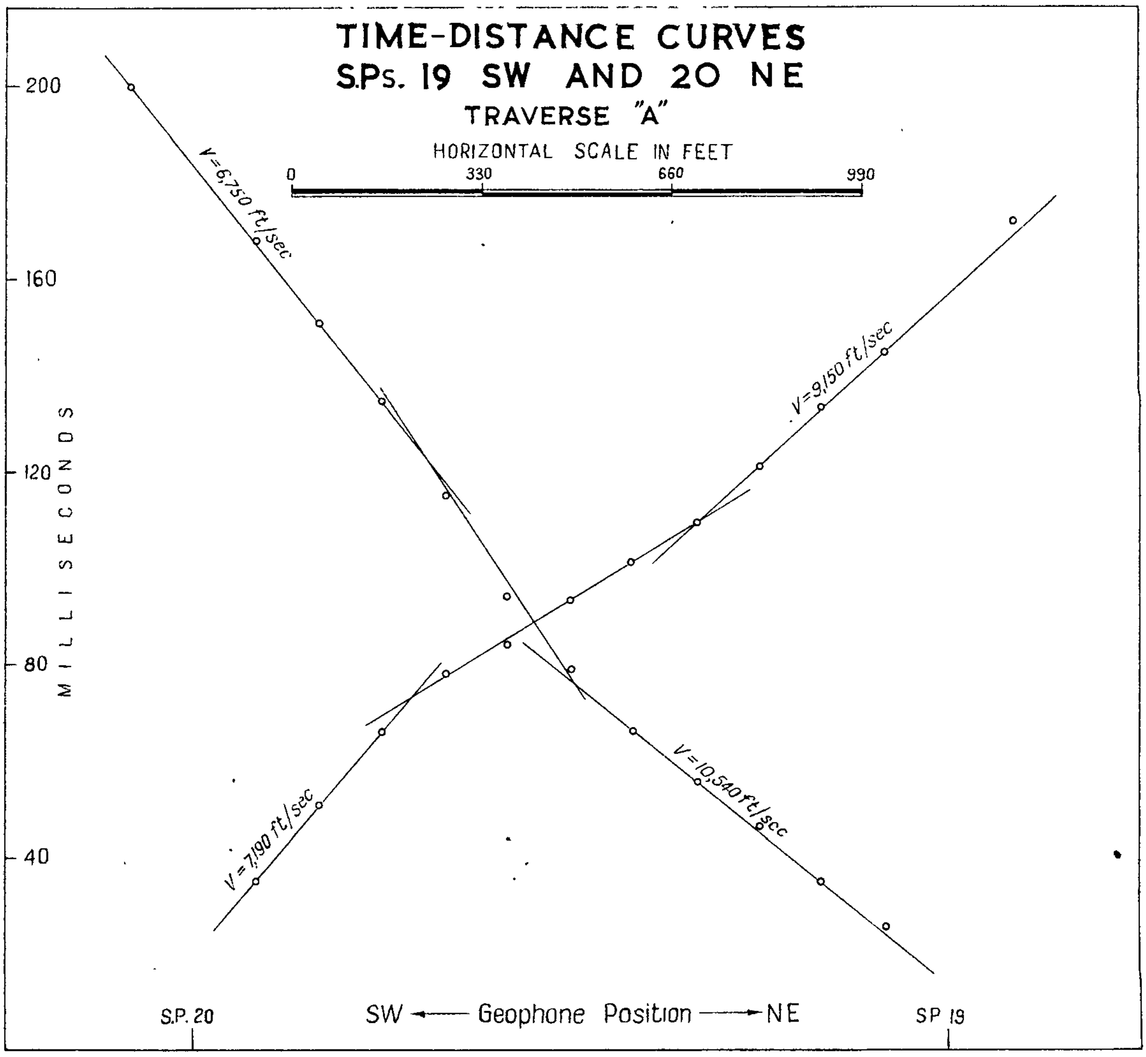
(iii) Reflections arriving at times later than 1.2 sec were excluded, because the "spread corrections" for zero dip reflections are then too small to allow an accurate velocity determination.

For reflections of type (a) in condition (ii), the Δt values supplied by each half of the reflection were corrected for weathering and elevation variations before being averaged to eliminate the dip component. However, a simple average of the two Δ t values obtained from type (b) reflections eliminates both weathering and elevation variations as well as the dip component.

With the limitations imposed by the above conditions, the number of reflections available was reduced considerably and there were none of sufficient quality recorded at times less than 0.8 seconds. The average velocities calculated were:

Velocity from surface to 4,000 feet	-	10,000 ft/sec
Velocity from surface to 5,500 feet	-	11,000 ft/sec
Velocity from 4,000feet to 5,500 feet	-	15,000 ft/sec

FIG. 1



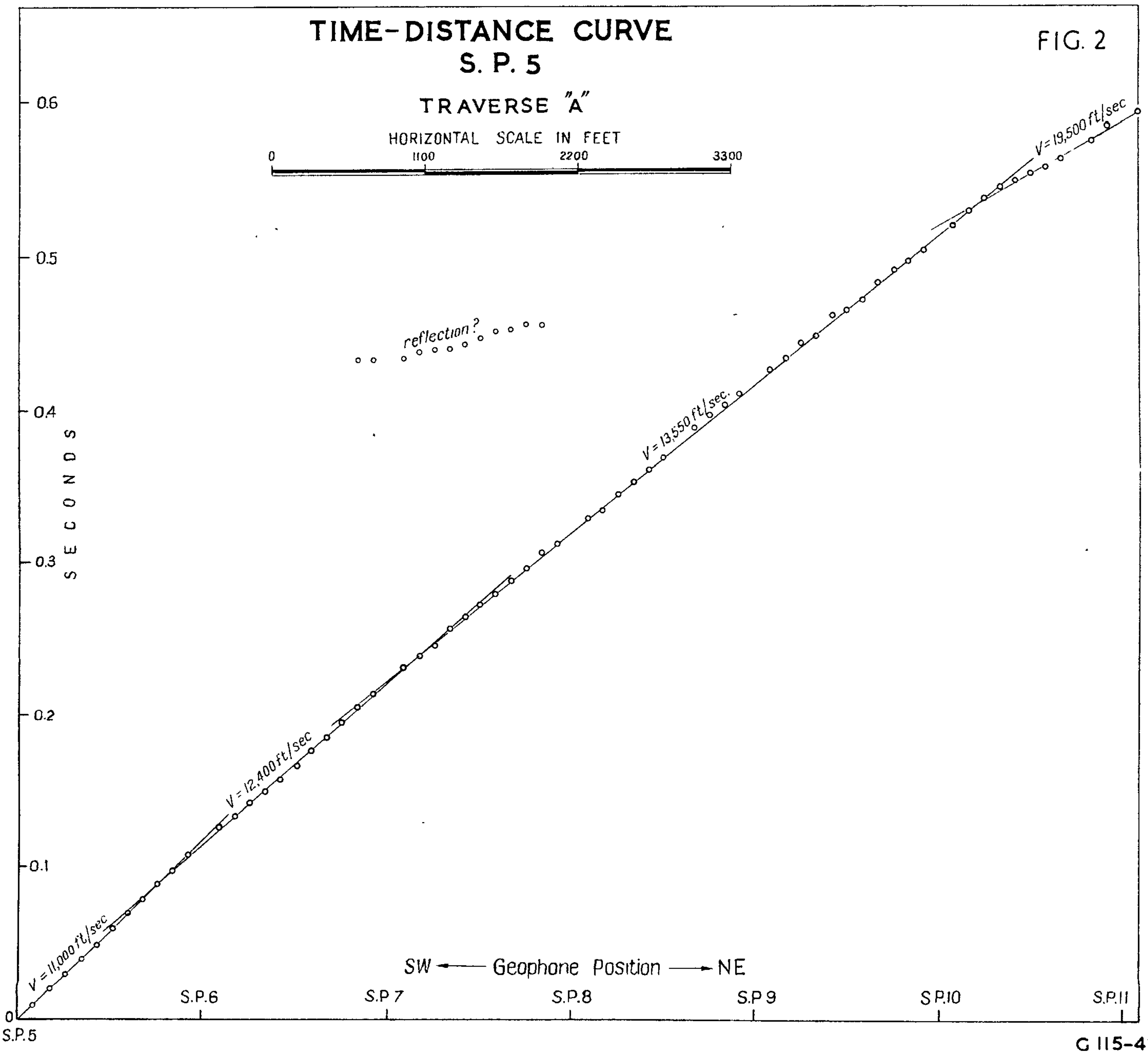


FIG. 2

G 115-43

(c) Traverse A.

The surface trace of the Pinnacle Fault crosses traverse "A" between S.Ps. 19 and 20. The presence of the Fault is shown by the first refraction arrivals for the spread of geophones between S.Ps. 19 and 20 when shooting from those shot points. The time-distance curves from each of these shot points showed two abrupt changes in apparent velocity - a decrease and then an increase for S.P. 19SW and an increase and then a decrease for S.P. 20NE. (Fig.1, opposite).

North-east of the Pinnacle Fault no reflections were recorded by the normal spreads. However, shooting from S.P.5, with geophone spreads extended $1\frac{1}{2}$-miles to the south-west, two interesting results were obtained.

Firstly, an event which could be a reflection was recorded on a few geophones at a distance of approximately $\frac{1}{2}$-mile from the shot point. It is calculated that this would come from a reflector at a depth of approximately 2,200 feet. Secondly, the first refraction arrival between the shot point and 1.3 miles from the shot point showed a gradation in apparent velocity from 11,000 ft/sec. to 13,550 ft/sec. for the near-surface formation, but between 1.3 and 1.5 miles from the shot point the slope of the time-distance curve (Fig.2) showed the presence of a refractor with an apparent velocity of 19,500 ft/sec. at a depth of approximately 1,600 feet.

South-west of the Pinnacle Fault reflections were recorded along traverse "A" from S.P.20 to S.P.48. Plate 3 is a cross-section of traverse "A" on which are plotted all reflections recorded. The quality of the reflections, in general, is poor. Only 14 per cent are graded as being of fair accuracy, 33 percent are graded as being of poor accuracy, and 53 percent are regarded as questionable reflections. Nevertheless, there are very few reflections which show large discrepancies in dip when compared with neighbouring reflections. This general conformity of dips indicated by the reflections lends much weight to their reliability.

The reflections are most dense from 3,000 feet to 8,000 feet. A phantom horizon, which shows the structural configuration along the traverse, was constructed through this part of the cross-section using a zone 4,000 feet wide. The detailed information supplied by this phantom horizon is as follows:-

From S.P.22 to S.P.25	: no appreciable dip.
From S.P.25 to S.P.27	: 5^{o} dip to south-west.
At S.P.27	: trough of syncline.
From S.P.27 to S.P.31	: $5\frac{3}{4}^{o}$ of dip to north-east.
From S.P.31 to S.P.37	: $3\frac{1}{4}^{o}$ of dip to north-east.
From S.P.37 to S.P.39	: $\frac{1}{2}^{o}$ of dip to south-west.
From S.P.39 to S.P.42	: 3^{o} of dip to south-west.
From S.P.42 to S.P.46	: $2\frac{1}{2}^{o}$ of dip to north-east.

From S.P.39 to about 660 feet north-east of S.P.41, there is only one questionable reflection controlling the phantom horizon and there are very few reflections from other depths. This zone of few reflections indicates possible faulting and to test this hypothesis a refraction profile was shot along this part of traverse "A". The refraction profile showed that there was no fault of any appreciable throw (see below), and the phantom horizon has therefore been carried across this zone. However, the phantom horizon must be considered as of doubtful accuracy across this part of the traverse, where it is shown as a dashed line.

Below 8,000 feet, reflections are not as plentiful and are generally of poorer quality. From S.P.26 to S.P.38 the reflections between 8,000 and 13,000 feet are conformable with the phantom horizon. However, between S.P.43 and S.P.45 there are several reflections of fair accuracy from 8,000 to 13,000 feet, which indicate strong north-east dip of approx. 11°. This is below the 2½° north-east dip shown by the phantom horizon to exist at shallower depth and indicates an unconformity at a depth of approximately 8,000 feet. This may represent the Permian/Devonian contact.

Other events are recorded which, if they are true reflections, come from depths between 13,000 feet and 20,000 feet. It is possible that these events are multiple reflections from shallower beds, but no direct evidence is available from the cross-section to support this theory. Assuming they are true reflections, reliable dips indicated by them are:-

Below S.P.32	:	16° to north-east.
Below S.P.37	:	1° to north-east.
Below S.P.46	:	3½° to south-west.

Comparison of these dips with those calculated at other depths, indicates another unconformity at about 13,000 feet.

Near the Pinnacle Fault, reflections indicating dips of the order of 30° to 40° were obtained. These are thought to be reflections from the fault plane. Their positions and dips have been calculated, assuming that the travel paths of the reflections are straight. If calculations were made using curved travel paths, the positions of the reflections would be moved to the south-west and their dips would be steepened. They would then agree with the known position of the Pinnacle Fault (between S.P.19 and S.P.20 at surface) and show it as dipping at 50° - 60° to the south-west.

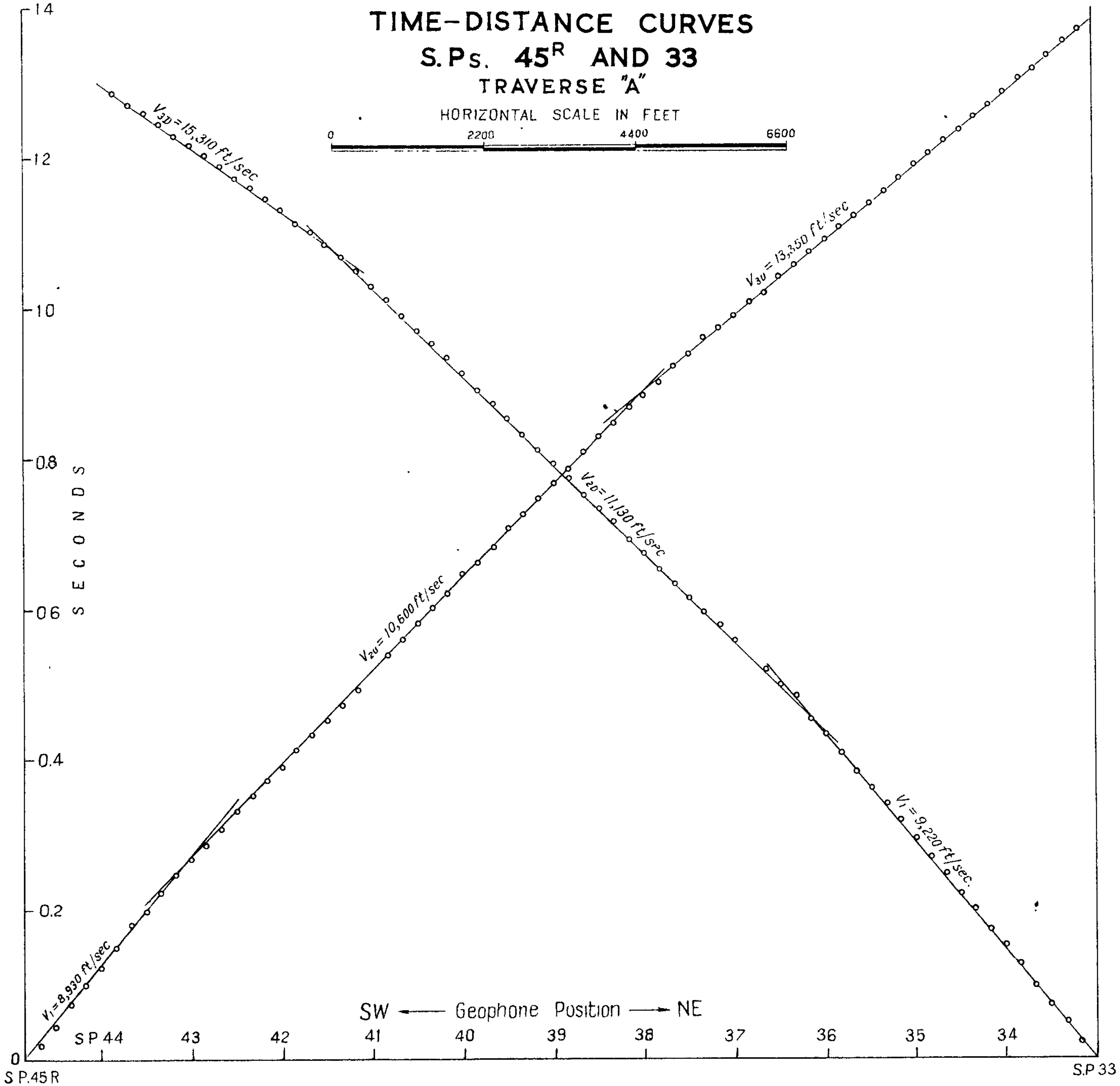
At S.Ps. 47 and 48 reflections became scarcer and from S.P.49 to S.P.53 no reflections were recorded. Holes at S.P.57 and S.P.65 were also shot without giving any reflections. At all these shot points four geophones per trace and 50 per cent mixing in the amplifiers were tried without producing any improvement.

(d) Traverse T.

Plate 4 is the cross-section showing the reflections recorded along Traverse T. From S.P.44 to S.P.100, reflections were fairly plentiful, but south-east of S.P.100 towards Christmas Creek Homestead only a few reflections of poor quality were recorded, these giving no reliable dip information. Between S.P.112 and the homestead, holes were drilled at S.Ps.116 120, 124 and 128 only and these were shot using four geophones at each station and 50 per cent mixing of the energy from the adjacent station. No reflections of usable quality were recorded from these holes.

Between S.P.44 and S.P.92 the dip of the shallow reflection along the traverse (down to 8,000 ft.) is about 4° to the south-east and from S.P.93 to S.P.97 it is about 1° to the north-west. However, below 8,000 feet the dips below S.Ps.44 to 93 average 10° to the south-east. This confirms the indications of an unconformity at 8,000 ft. which was observed on Traverse "A". The second unconformity at 13,000 ft., indicated on Traverse "A", is not apparent on Traverse "T".

FIG. 3


TIME–DISTANCE CURVES
S.Ps. 45R AND 33
TRAVERSE "A"
HORIZONTAL SCALE IN FEET
0
2200
4400
6600
SECONDS
14
12
10
0.8
0.6
0.4
0.2
0
V3D = 15,310 ft/sec
V3U = 13,350 ft/sec
V2D = 11,130 ft/sec
V2U = 10,600 ft/sec
V1 = 8,930 ft/sec
V1 = 9,220 ft/sec.
SW ← Geophone Position → NE
SP 44
43
42
41
40
39
38
37
36
35
34
S P.45 R
S.P 33

(e) Refraction shooting along Traverse "A"

In order to test the possible existence of a fault indicated at S.P.39 on the reflection cross-section of Traverse "A", a refraction profile was shot from S.Ps.33 and 45. Geophones were laid out from each shot point at 220 ft. intervals along the traverse between the two shot points. The time-distance curves obtained from the shooting are shown on Fig.3, opposite.

Three distinct velocities were recorded from this profile:-

(i) The sub-weathering velocity was 9,075 ft/sec.

(ii) A velocity of 10,850 ft/sec. was recorded from a refractor at a depth of 650 feet below S.P.33, and dipping to the north-east of 2°.

(iii) A velocity of 14,300 ft/sec. was recorded from a refractor at a depth of 2,650 feet below S.P.33, and dipping to the north-east at 4°.

The following table compares these velocities and their depths with those obtained at Nerrima (Vale et al, 1953, p.6) and suggests a relationship with geological information.

Geological Formation	Information on Traverse "A"			Information at Nerrima		
	Velocity	Depth at S.P. 33	Depth from Geol. Data at S.P. 33	Velocity	Average Depth	Depth from Nerrima Bore
	(ft/sec)	(ft)	(ft)	(ft/sec)	(ft)	(ft)
Noonkanbah Formation	9,075	0	0	8,500 9,700	0 300	0
Poole Sandstone	10,850	650	800	11,550	1,000	800
Grant Formation	Not Recorded		1,000	12,650	2,500	2,000
Layer within Grant Formation	14,300	2,650		14,500	4,000	
?				16,000	7,000	

The portion of the Noonkanbah formation, which at Nerrima extends from the surface to 300 feet and has a velocity of 8,500 ft/sec. has been eroded away at S.P.33 on Traverse "A".

The decrease in the velocity of the lower part of the Noonkanbah Formation from 9700 ft/sec. in the Nerrima area to 9075 ft/sec in the Christmas Creek area is possibly caused by the facies change from a shaly formation to a sandy one. The decrease in the velocities of the Poole Sandstone and Grant Formation may be due to a smaller depth of burial. The table shows that, allowing for the decrease in thickness of the Poole Sandstone (from 1,200 ft. at Nerrima to 200 ft. at Christmas Creek), the depths of refractors and geological formations correspond fairly well in both areas.

There are no sudden increases or decreases in apparent velocity on the time-distance curves for the refraction profiles that could be assigned to faulting. This is positive evidence that there is no fault of appreciable throw near S.P.39.

(f) Traverse "Z"

This is a refraction traverse shot over the Ordovician sediments near the north-eastern end of Traverse "A". It was shot in order to confirm the existence of a high velocity refractor at an approximate depth of 1,600 feet which was indicated by the test shooting from S.P.5 on Traverse "A". The time-distance curves for Traverse "Z" are shown on Fig.4, opposite.

The velocity of a shallow refractor recorded from a depth of approx. 200 ft. is 13,300 ft/sec. and calculations from intercept times show this as dipping at $\frac{1}{2}^{\circ}$ to the south-east. At a distance of $1\frac{1}{2}$ miles, velocity of 19,950 ft/sec. was recorded from an estimated depth of 1,600 feet. The time-distance curve shows a discontinuity midway between S.P.81 and S.P.82 which indicates an erosional scarp or fault with a down-throw to the north-west of 250 feet. On the north-west side of this feature the refractor dips slightly to the south-east. On the other side it dips to the south-east at approximately $1\frac{1}{2}^{\circ}$.

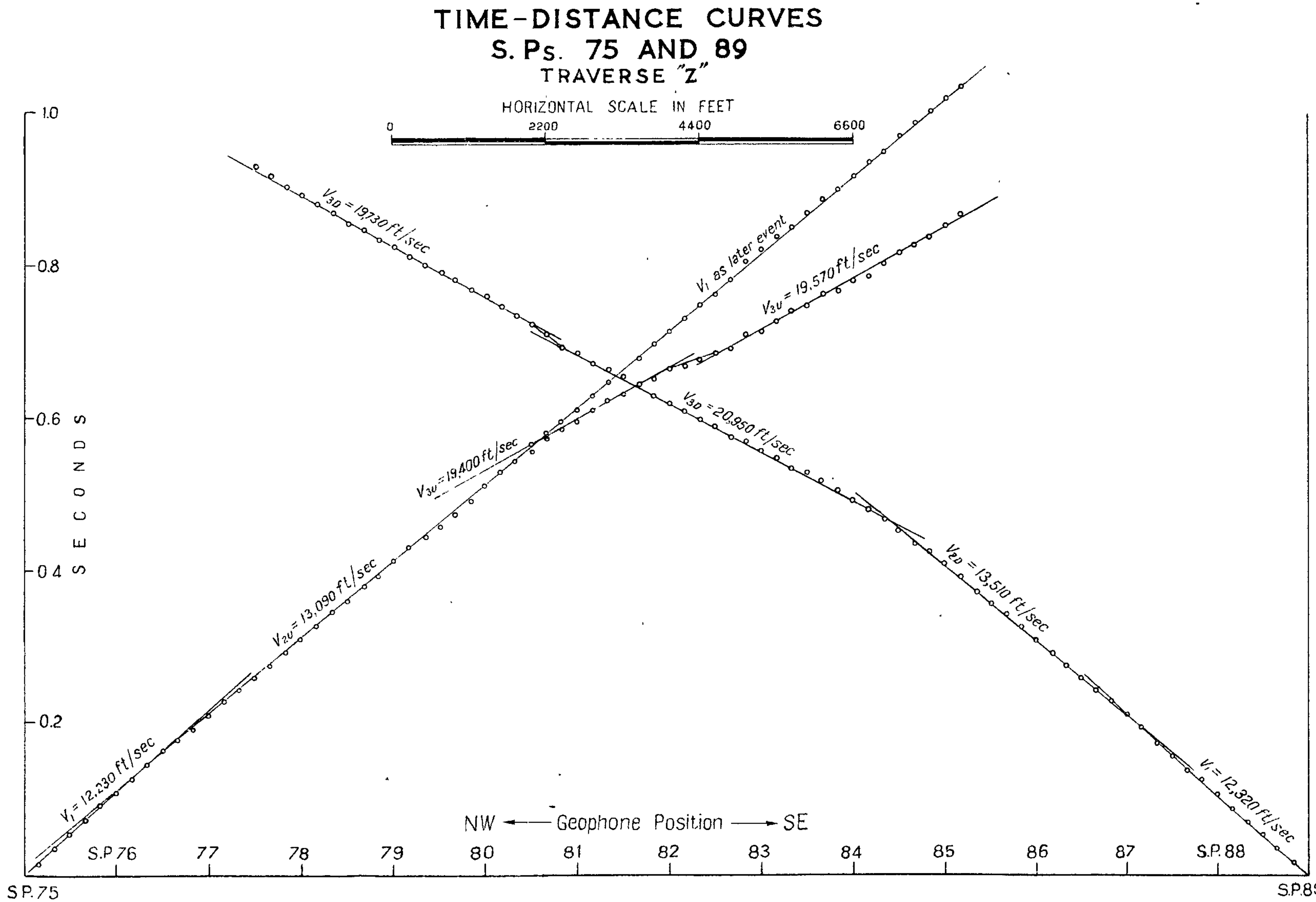
6. CONCLUSIONS

The foregoing results have supplied the following answers to the three problems raised in Section 2.

(i) North of the Pinnacle Fault the sedimentary section is probably comparatively thin. This is indicated by the lack of reflections in this region, and also by the presence of a refractor with the high velocity of 19,950 ft/sec. at a depth of 1,600 feet beneath the Ordovician outcrop. Rocks known to have a velocity as high as this are limestones, dolomites, basic igneous rocks, and metamorphics. Twelve miles north of the Ordovician outcrop the Lamboo complex of pre-Cambrian age is exposed on the surface. This consists of granite and metamorphic rocks, and could possibly be present at 1,600 feet beneath the Ordovician section, and give rise to the high velocity refractor recorded at this depth on Traverse "Z".

It is estimated that 800 feet of the known section of the Ordovician rocks are present at S.P.80 on Traverse "Z" where the estimated depth of the high velocity refractor is 1,700 ft. If the high velocity refractor represents pre-Cambrian rocks, there is a further 900 ft. of Ordovician sediments below the known section.

FIG. 4



TIME-DISTANCE CURVES
S. Ps. 75 AND 89
TRAVERSE "Z"
HORIZONTAL SCALE IN FEET
0
2200
4400
6600
1.0
0.8
0.6
0.4
0.2
SECONDS
V3D = 19,730 ft/sec
V1 as later event
V3U = 19,570 ft/sec
V3D = 20,950 ft/sec
V3U = 19,400 ft/sec
V2U = 13,090 ft/sec
V2D = 13,510 ft/sec
V1 = 12,230 ft/sec
V1 = 12,320 ft/sec
NW ← Geophone Position → SE
S.P 76
77
78
79
80
81
82
83
84
85
86
87
S.P. 88
S.P. 75
S.P. 89

(ii) South-west of the Pinnacle Fault the reflections obtained suggest a sedimentary section of approximately 20,000 feet, with angular unconformities at 8,000 feet and 13,000 feet. It seems reasonable to assume that the unconformity at 8,000 feet represents the Permian-Devonian contact. Three alternative possibilities for the rest of the section are shown below.

	(1)	(2)	(3)
0-8000ft.	Permian	Permian	Permian
8000-13000ft.	Devonian-Ordovician	Devonian-Ordovician	Devonian
13000-20000ft.	pre-Cambrian sediments	pre-Ordovician sediments	Ordovician and pre-Ordovician sediments.

The depth to the pre-Cambrian in (1) agrees with Guppy's (1953, p.42) estimate of this depth as being 12,000 feet in the Poole Range. (The depth to the unconformity on the seismic cross-section is measured on the northern flank of the Poole Range where there is approximately an extra 1,000 feet of Permian cover). In (1) and (2) the Devonian and Ordovician rocks would have the same dip within the limits of resolution of the seismic method (probably about 2° to 3° in this survey). The zone from 13,000 feet - 20,000 feet is not necessarily a conformable zone, but the reflections were too sparse to enable unconformity to be detected if present.

(iiia) On the north flank of the Poole Range Dome, between Christmas Creek and the Pinnacle Fault, there is general conformity between the near surface beds and the deeper beds down to a depth of 8,000 feet. There is, however, a small crest at S.P.38 and a trough at S.P.42 on Traverse "A", which are not disclosed on the surface. These are probably masked by the Quaternary sands and soils covering this region. The axis of the Talbot Syncline is shown to be at S.P.27, which is approximately $\frac{3}{4}$ mile south-west of its position shown on the geological map. The axis of the syncline at S.P.27, however, correlates better with the position of the boundaries between the Liveringa Group and Noonkanbah Formation, as inferred from the sub-weathering velocity measurements. These differences between the geological map and the seismic results are probably due to difficulties in plotting accurately the position of geological boundaries in this area.

(iiib) North-east of S.P.38, within the Talbot Syncline, the reflections are conformable in the cross-section below traverse "A" to 13,000 feet. Closer to the Dome, however, near the junction of Traverses "A" and "T" there is an unconformity between the reflections above 8,000 feet and those below. At S.P.44 the true dip can be calculated from known components along Traverses "A" and "T" giving $3\frac{1}{2}°$ east-south-east at 5,000 feet and $10\frac{1}{2}°$ east at 10,000 feet. This unconformity at 8,000 feet may represent the Permian/Devonian contact.

7. RECOMMENDATIONS

(i) Present indications are that the Poole Range Dome may persist in depth to at least 8,000 feet. Further information is however required on the southern, eastern and western flanks of the Dome and it is recommended that reflection traverses be shot on these flanks when the survey is resumed. It is suggested that the faulted part of the structure be avoided if possible. If conformity with the surface structure is again established at depth, then the Poole Range Dome would become a first class target for a deep drilling test, assuming that other factors are favourable.

(ii) It is thought that velocity information obtained from refraction shooting may be useful in indicating the type of rocks present beneath the Permian section south-west of the Pinnacle Fault. The presence in the Christmas Creek area of the 16,000 ft/sec. refractor recorded at Nerrima would be proved or disproved by a refraction traverse, which should preferably be along the axis of the Talbot Syncline. If the distance between shot point and geophones is extended far enough this traverse may also reveal the presence of the high velocity refractor that was recorded north of the Pinnacle Fault. Velocity shooting on outcrops of the various Devonian limestones and pre-Cambrian rocks may then give a correlation between the outcrop velocities obtained and the velocities obtained at depth south of the Pinnacle Fault.

(iii) If a scout drill is available in the Kimberleys, it is recommended that a hole be drilled on the Ordovician outcrop. If this was located at the base of the exposed section, it would have an excellent chance of revealing the remainder of the promising Ordovician section, which, on the basis of the seismic results, is expected to be approximately 900 feet thick.

8. REFERENCES

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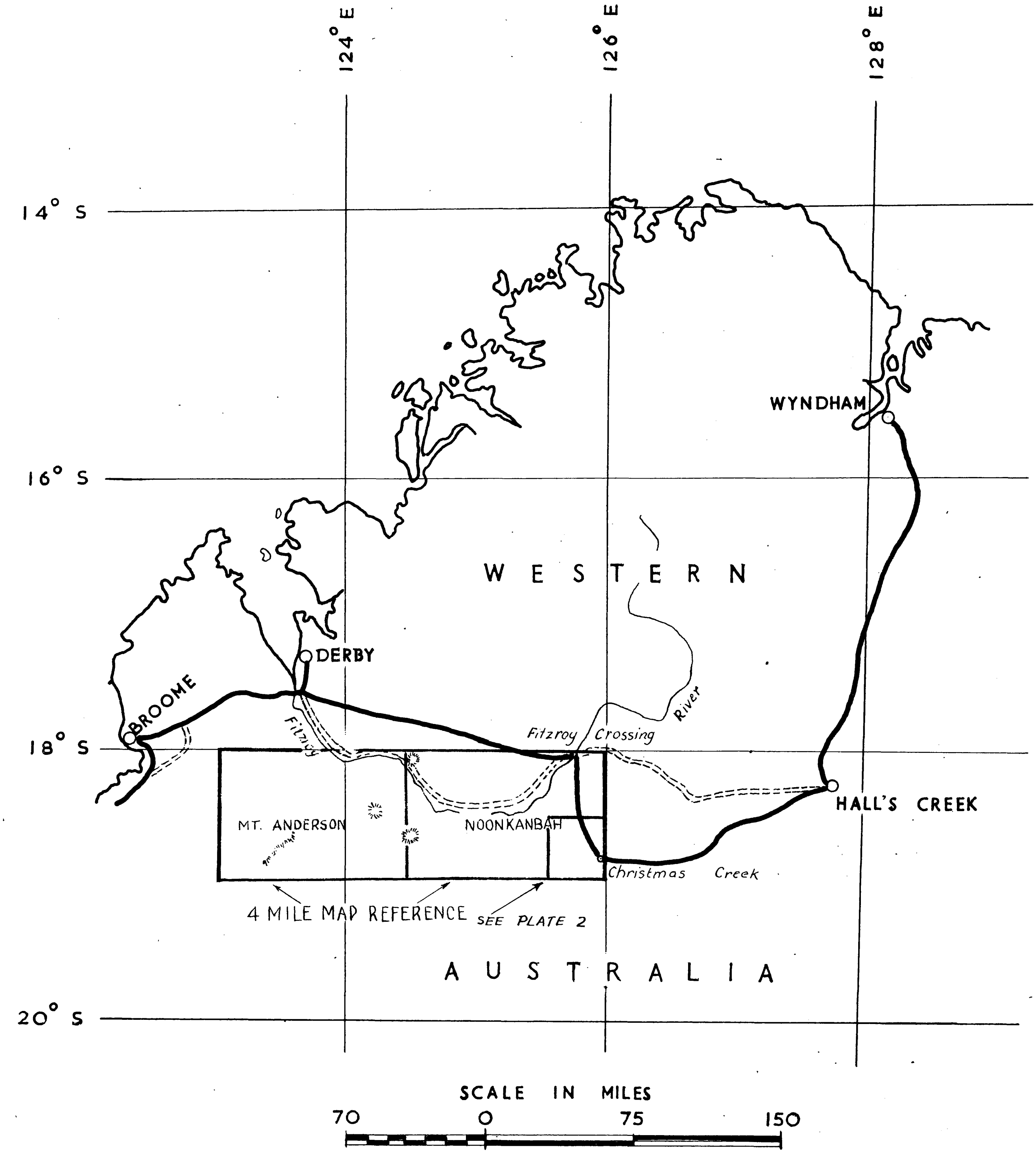
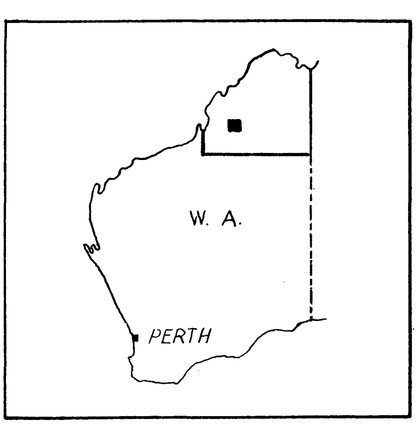
PLATE I





PROGRESS REPORT ON A SEISMIC SURVEY OF THE POOLE RANGE-PRICE'S CREEK AREA, KIMBERLEY DIVISION, W. A.

LOCALITY MAP

SHOWING POSITION OF AREA DEALT WITH IN REPORT AND REFERENCE TO AUSTRALIAN FOUR MILE SERIES

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Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics

To accompany Record 1955 N°35

SCALE IN MILES

2 0 2 4 6

PROGRESS REPORT ON A SEISMIC SURVEY OF THE POOLE RANGE-PRICE'S CREEK AREA, KIMBERLEY DIVISION, W.A.

SEISMIC TRAVERSES

IN RELATION TO SURFACE GEOLOGY

(AFTER D.J. GUPPY, 1953)

LEGEND

Quaternary	Qrb	RESIDUAL BLACK SOIL
	Qrr	OTHER RESIDUAL SOILS
	Qra	ALLUVIUM
	Qrc	CALICHE
	Qs	SAND, SAND-DUNES
Permian	Pl	LIVERINGA GROUP
	Pn	NOONKANBAH FORMATION
	Pp	POOLE SANDSTONE
	Pg	GRANT FORMATION
Upper Devonian	Dub	BUGLE GAP LIMESTONE
	Dup	MT. PIERRE GROUP
	Duj	J.B. CONGLOMERATE
Mid Devonian	Dud	SADDLER BEDS
	Dmp	PILLARA FORMATION
Ordovician	Og	GAP CREEK DOLOMITE (PRICE'S CREEK GROUP)
	Oe	EMANUEL LIMESTONE (PRICE'S CREEK GROUP)

GEOLOGICAL BOUNDARIES

- ESTABLISHED BOUNDARY - ACCURATE
- ESTABLISHED BOUNDARY - APPROX
- INFERRED BOUNDARY
- ESTABLISHED BOUNDARY - CONCEALED
- INFERRED BOUNDARY - CONCEALED

FAULTS

- ESTABLISHED FAULT - ACCURATE WITH RELATIVE MOVEMENT (U / D)
- ESTABLISHED FAULT - APPROX
- INFERRED FAULT
- INFERRED FAULT - CONCEALED
- ESTABLISHED FAULT - CONCEALED

FOLDS

- ESTABLISHED ANTICLINAL CREST
- ESTABLISHED SYNCLINAL TROUGH
- ANTICLINAL CREST - APPROX.
- SYNCLINAL TROUGH - APPROX.

TOPOGRAPHIC SYMBOLS

- MAIN ROAD
- TRACK
- FENCE
- TELEPHONE LINE
- HOMESTEAD
- YARD
- HILL

BORES

- B • BORE
- A • ARTESIAN
- SA • SUB-ARTESIAN
- S • SPRING
- HOTSPRING
- W • WELL
- T ■ TANK (EARTH)

E. R. Smith
Geophysicist

G149-2

Geophysical Section Bureau of Mineral Resources Geology and Geophysics

PROGRESS REPORT ON A SEISMIC SURVEY
OF POOLE RANGE – PRICE'S CREEK AREA,
KIMBERLEY DIVISION, WESTERN AUSTRALIA.

REFLECTION CROSS SECTION
TRAVERSE A

GEOPHYSICIST

LEGEND

CODE USED IN DRAWING REFLECTIONS

ACCURACY GRADE	GRADE SYMBOLS	
GOOD	GG, FG, PG	———
FAIR	GF, FF, PF	— —
POOR	GP, FP, PP	— — —
QUESTIONABLE REFLECTION	RP	—·—·—

NOTE: FIGURES AND LETTERING SHOWN ON REFLECTIONS INDICATE REFLECTION TIME (IN MILLISECONDS), GRADE, AND TANGENT OF DIP ANGLE

PLATE 4
SURFACE ELEVATION
BASE OF WEATHERING OR LOW VELOCITY LAYER
DATUM LEVEL = 450'
"PHANTOM HORIZON"
DEPTH IN FEET
DEPTH SCALE IN FEET
LEGEND
CODE USED IN DRAWING REFLECTIONS
ACCURACY GRADE
GRADE SYMBOLS
GOOD
GG, FG, PG
FAIR
GF, FF, PF
POOR
GP, FP, PP
QUESTIONABLE REFLECTION RP
NOTE: FIGURES AND LETTERING SHOWN ON REFLECTIONS INDICATE REFLECTION TIME (IN MILLISECONDS), GRADE, AND TANGENT OF DIP ANGLE
PROGRESS REPORT ON A SEISMIC SURVEY OF POOLE RANGE - PRICE'S CREEK AREA, KIMBERLEY DIVISION, WESTERN AUSTRALIA.
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