COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1961 No. 14

WINTON No. 2 BORE LOGGING, QUEENSLAND 1960

by

E.E. Jesson and A. Radeski

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ILLUSTRATIONS

ABSTRACT

The electric logs of Winton Bore No. 2, to a depth of 3979 ft, are discussed with reference to formation boundaries and possible aquifers.

Sandstone beds between 3231 and 3815 ft should be useful artesian aquifers of the Blythesdale Group.

A correlation is shown between Winton No. 2 Bore and Corfield No. 1 Bore approximately 52 miles north-east of Winton.

1. INTRODUCTION

The Winton No. 2 Bore was drilled for the Winton Shire Council to supplement the town water supply.

The bore was drilled to a depth of 4010 ft and surface casing set to 305 ft. It is approximately 265 ft south-east of the junction of Chernside and Manifold Streets, Winton, which has a grid reference 629207 on the Winton 4-mile military map. (Plate 1).

At the request of the drilling contractor, W.L. Sides and Son, Pty. Ltd., the hole was logged by the Bureau of Mineral Resources. The logging was done by the authors, using a "Widco" 10,000-ft logger.

The logging operations which were carried out on 11th and 12th October 1960 lasted approximately 15 hours. Following a breakdown of the power-driven winch, used to lower and raise the logging tools in the hole, logging was abandoned at 2 a.m. on 12th October. Because of the breakdown, the only logs obtained were self-potential, short-normal resistivity, and single-point resistance logs.

As the principles and techniques of logging are fully described in current literature (for example Schlumberger, 1958), they will not be described in this Record.

2. GEOLOGY

In this area, which lies in the northern part of the "Channel Country", a thin cover of Tertiary sandstone overlies blue clay of the Winton Formation. The geological sequence, after Whitehouse (1954), is: -

Tertiary		Eyrian Formation
Cretaceous	Rolling Downs Group	Winton Formation (shale) Tambo Formation (shale) Roma Formation (shale)
Cretaceous – Jurassic (?)	Blythesdale Group	Transition Beds Mooga Sandstone Fossil Wood Beds Gubberamunda Sandstone
Triassic	Bundamba Group	Boxvale Sandstone Evergreen Shale Precipice Sandstone

Whitehouse (1954, p.10) considers that in bores, the lacustrine Winton Formation, which at Winton is 1050 ft thick (Mott, 1960), is readily distinguished from the marine Tambo Formation, owing to the "increase in sandstone members" in the Winton Formation.

The Blythesdale - Roma boundary is lithologically abrupt.

The Mooga Sandstone in the Blythesdale Group is the uppermost aquifer of the Great Artesian Basin, but useful water is produced by sub-artesian bores from sandy beds within the Rolling Downs Group. A structural contour plan presented by Whitehouse (ibid., Fig. 17) indicates that the boundary between the Roma Formation and the Transition beds of the Blythesdale Group is approximately 2700 ft below sea level at Winton, but only about 1500 ft below sea level in the region of Corfield, where a similar bore was logged (Jewell, 1960). A simplified driller's log of Winton No. 2 Bore is shown below.

Depth			Rock type
67	-	91 ft	Clay with sand and gravel
91	-	213 ft	Blue clay or mudstone with coal bands
213	-	309 ft	Blue and yellow mudstone and clay with coal bands
309	-	439 ft	Blue mudstone
439	-	1529 ft	Blue silty mudstone with a few hard bands
1529	-	3295 ft	Mudstone with hard shale bands
3295	-	3716 ft	Muddy or silty sandstone
3716	-	4016 ft	Sandstone.

3. INTERPRETATION

The equipment depth measuring device was originally designed to use a cable 0.27 inches in diameter, which has been changed for a cable 0.192 inches in diameter. This causes a small cumulative error in the depth measurements amounting to 9 ft per 1000 ft which has to be subtracted from the indicated depth. For the purpose of this report, depths shown in the text are corrected depths followed by the indicated depth (as shown on the log) in brackets. Thus an indicated depth of 1009 ft will have a true depth of 1000 ft and is shown in the text as 1000 (1009) ft.

The appearance of the logs (Plate 2) suggests a division into three distinct zones: -

(1) from the bottom of the casing to 1308 (1320) ft

(2) from 1308 (1320) ft to 3220 (3250) ft

(3) from 3220 (3250) ft to 3979 (4015) ft.

Zone 1

The resistance and resistivity logs show only occasional small variations. The S-P. log indicates that the zone consists of shale, sandy shale, and sandstone beds. The drill log describes this portion of the sequence as blue silty mudstone with hard bands. The S-P. log suggests that this zone may be subdivided into upper and lower parts with the boundary at 743 (750) ft. In the upper part the individual beds are generally thicker than in the lower part, and appear to have a higher shale content. The significance, if any, of this division into two parts, is not known.

The whole of this zone is considered as representing the Winton Formation although its upper boundary is not defined here because it is probably less than 300 ft deep and is above the bottom of the casing. A thickness of 1318 ft for the combined Tertiary sandstone and Winton Formation is in good agreement with the values 1050 ft for the Winton Formation and up to 320 ft for the Tertiary sandstones, recorded in a water bore south-west of Winton (Mott, 1960).

The sandstone beds within the Winton Formation, marked by their negative self-potential, would represent the aquifers tapped by the sub-artesian bores in the area.

Zone 2

With the exception of a shaly sandstone bed between 2368 (2390) ft and 2423 (2445) ft which may be a useful source of water, and two or three thin sandstone beds near the base of the zone, the electric logs indicate that Zone 2 is shale. The driller's log describes it as being mudstone with hard shale bands.

It is considered that this zone represents the Tambo and Roma Formations, but the log is unable to distinguish between them.

The exact boundary between the Roma Formation and the underlying Blythesdale Group represented by the Transition beds, is not easily determined from the logs. Whitehouse (ibid. p.10) says that one or two sandstone beds, indicative of transition conditions, are usually included in the base of the Roma Formation. It is considered probable that the sandstone beds indicated by the negative S-P. peaks between 3112 (3140) ft and 3221 (3250) ft are within the Roma Formation, and that the base of the Roma Formation is at 3220 (3250) ft.

If so, the depth to the base of the Rolling Downs Group, 3220 (3250) ft, when corrected to sea level is 2610 ft, which agrees well with the value of 2700 ft abstracted from the structural contour plan presented by Whitehouse. (see Section 2. Geology).

Zone 3

The high values of resistance and resistivity in this zone, associated with negative self-potentials, are characteristic of permeable sandstone beds which will be the water sources for this bore. The electric logs show that distinct sandstone and shale beds occur in this zone, rather than the fairly uniform formation suggested by the driller's log, which shows muddy or silty sandstone between 3295 and 3716 ft and sandstone between 3716 and 4016 ft.

This zone obviously represents part of the Blythesdale Group but subdivision into the various formations is not possible from the electric logs.

Between 3141 (3170) ft and 3969 (4005) ft the S-P. values for the shale beds in this zone show a definite drift towards the positive S-P. direction equivalent to about 20 millivolts. The cause of this cannot be determined with certainty, but it is thought it may be due to formation waters having contaminated the mud column and altered its characteristics. It may also result from streaming potentials due to the flow of water within the formations and the bore.

The uncertainty resulting from the disturbed S-P. log and the absence of temperature and long-normal resistivity logs make salinity and porosity computations unreliable, and they are not attempted here.

The fact that the S-P. curve is "normal" (i.e. has negative peaks opposite the sandstone beds) would generally be interpreted as meaning that the formation water is more saline than a filtrate of the drilling mud. This suggests that in Zone 3 the formation water salinity is greater than an equivalent of 2300 p.p.m. sodium chloride. Such an interpretation is unacceptable here because it is known that water from the nearby Winton No. 1 Bore is excellent drinking water, and therefore must have a salinity much less than 2300 p.p.m.

To overcome this anomaly, reference is made to a paper by Gondouin, Tixier and Simard (1956) in which they consider the way in which the S-P. is affected by formation waters containing appreciable quantities of salts other than sodium chloride. This usually occurs in waters of low salinity. In these circumstances calcium and magnesium salts have an important S-P. effect which is normally masked by the effect of sodium chloride. The paper gives a relation between the true resistivity of the formation water and its "equivalent resistivity" (the value of resistivity inferred from the S-P. log).

In the Winton No. 2 Bore it is the "equivalent resistivity" of the formation water which is less than the resistivity of the drilling mud filtrate; i.e. less than 2.4 ohm-metres at 75°F. The relation given by Gondouin et al. shows that the corresponding true resistivity is less than 11 ohm-metres at 75°F., which means that it has a salinity equivalent to more than 450 p.p.m. of sodium chloride. A chemical analysis of water from this bore shows that it contains 465 p.p.m. of salts, which include sodium and magnesium carbonates, calcium sulphate, and sodium chloride. This salinity is equivalent to 512 p.p.m. of sodium chloride.

4. CORRELATION WITH CORFIELD No. 1 BORE

The Corfield No. 1 Bore, located at grid reference 669287 on the Manuka 4-mile military map, is about 52 miles north-east of Winton, and was logged by the Bureau of Mineral Resources in March 1960 (Jewell, 1960).

The Corfield No. 1 and Winton No. 2 electric logs are compared in Plate 3. They are broadly similar in character although the individual logs differ owing to the difference in salinity of the drilling muds in the two holes; the higher-salinity mud used in the Winton bore gives an S-P. log with more detail than that of the Corfield bore, but the resistance and resistivity logs have less detail.

The correlations shown on Plate 3 indicate that the formation groups penetrated by the bores are uniformily thicker at Winton than at Corfield, by about 40 per cent.

The interpretation of the depth to the base of the Winton Formation at Corfield, shown on Plate 3, does not agree with Jewell's interpretation. He considered that the character change in the electric logs at a depth of 540 ft represents the base of the Winton Formation. The present interpretation in based on the accuracy of correlation, which is considered good, and on the correctness of the value 1318 (1330) for the depth to base of the Winton Formation at Winton. This value is considered reliable, as discussed under "Zone 3, Section (3)".

It is therefore considered that the base of the Winton Formation at Corfield is at 950 ft. This is the boundary between a section with many thin high-resistance sandstone beds and one with few sandstone beds; and below 950 ft the average resistivity decreases by about 1 ohm-metre, suggesting a decrease in the sand content of the shales. This is as would be expected when passing from the Winton to the Tambo Formation.

5. CONCLUSIONS

The Winton No. 2 Bore has penetrated various clay, shale, mudstone, and sandstone formations of the Rolling Downs Group and the upper part of the Blythesdale Group.

The sandstone beds from

3231	(3260)	ft	to	3315	(3345)	ft
3350	(3380)	ft	to	3389	(3420)	ft
3548	(3580)	ft	to	3667	(3700)	ft
3726	(3760)	ft	to	3815	(3850)	ft

are permeable aquifers containing water whose salinity is known to be equivalent to about 500 p.p.m. of sodium chloride.

A good correlation exists between the logs of this bore and Corfield No. 1 Bore, and shows that the Formations penetrated by the bores are uniformily thicker at Winton than at Corfield, by about 40 per cent.

6. REFERENCES

GONDOUIN, M., TIXIER, M.P. and SIMARD, G.L., 1956 - An experimental study on the influence of the chemical composition on the S-P. curve. Petroleum Transactions Reprint Series No. 1 - Well Logging. Society of Petroleum Engineers of Amer. Inst. min. Engrs.

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MOTT, W.D., 1960 - The geology of Queensland. Edited by D. Hill and A.K. Denmead. Melb. Univ. Press.

SCHLUMBERGER, 1958 - Introduction to Schlumberger well logging; Schlumberger Document No. 8. Schlumberger Well Surveying Corporation.

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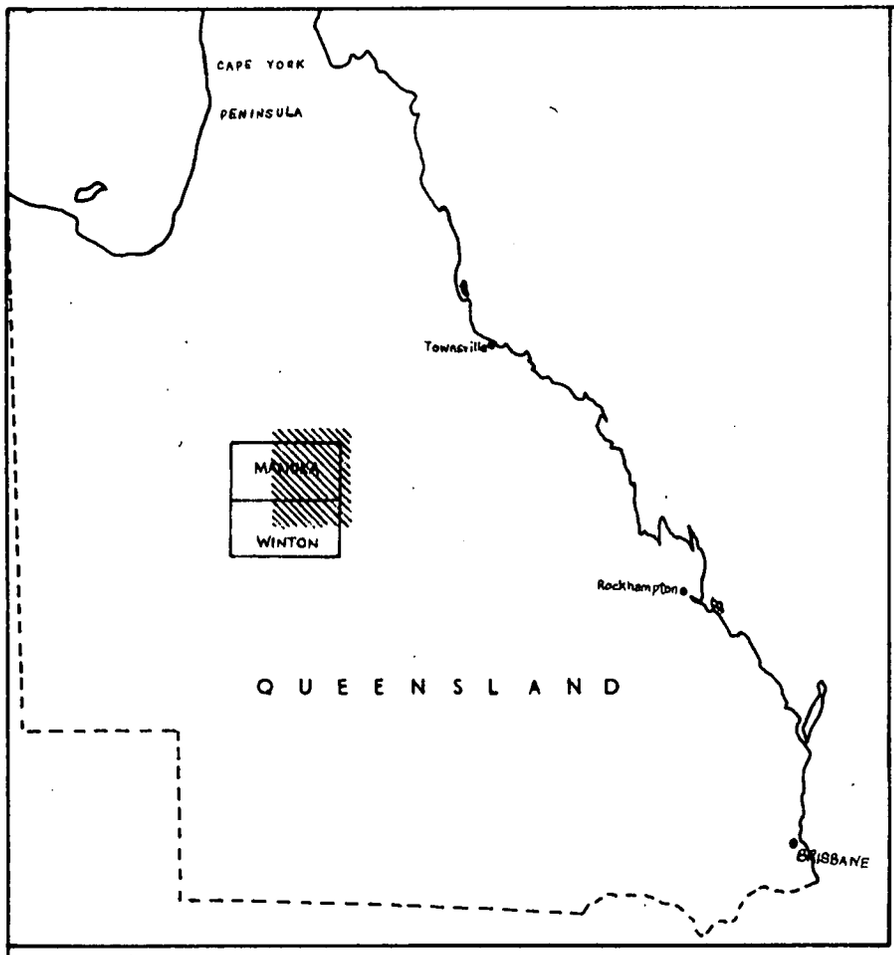
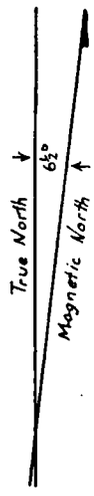
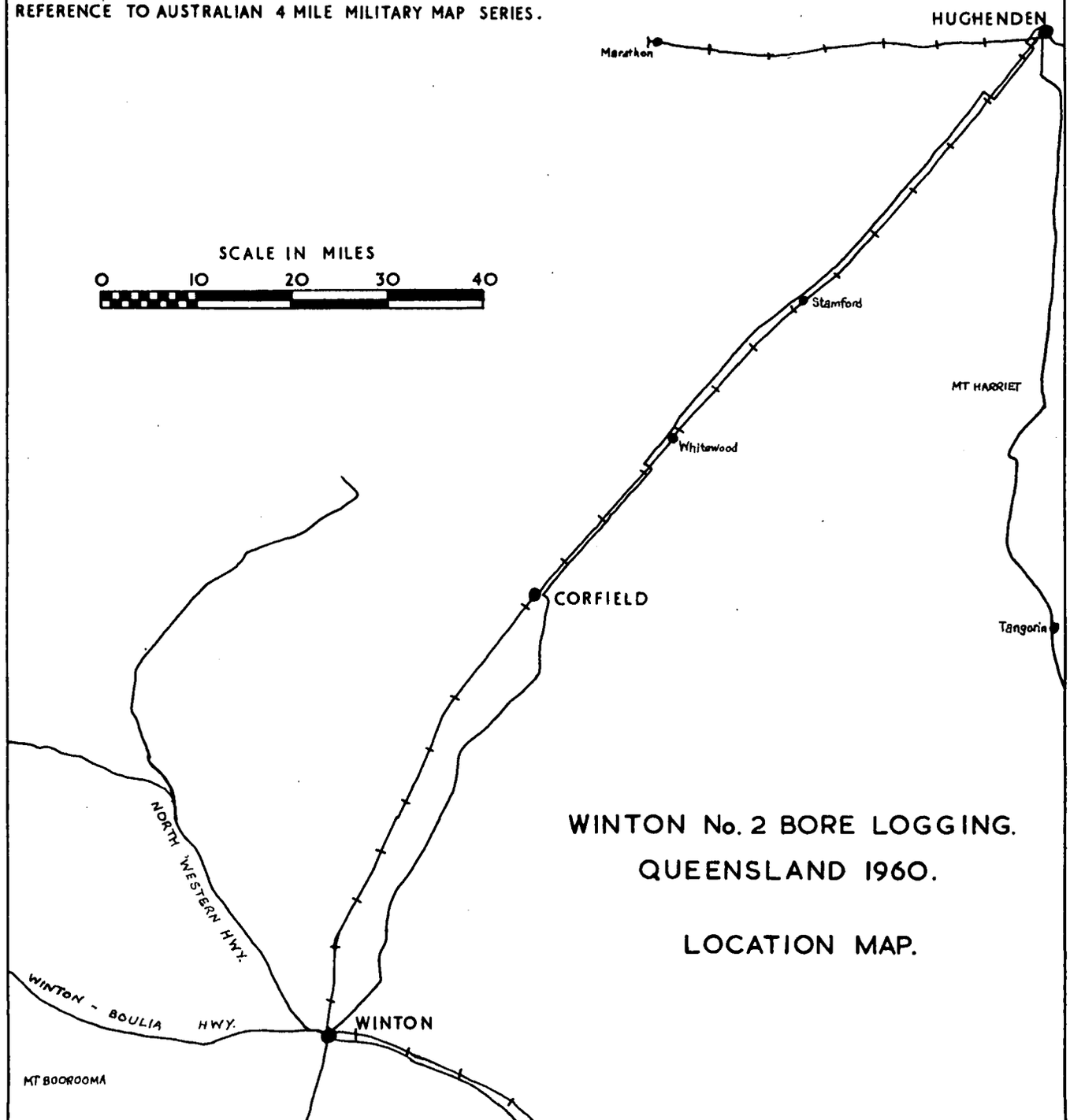
PLATE I.





REFERENCE TO AUSTRALIAN 4 MILE MILITARY MAP SERIES.



WINTON No. 2 BORE LOGGING.
QUEENSLAND 1960.

LOCATION MAP.

Plate 2

COMPANY WINTON SHIRE COUNCIL

AREA CENTRAL QUEENSLAND

WELL WINTON No.2

COUNTY STATE QUEENSLAND

COORDINATES N S

ELEVATION: State Datum
D.F.
K.B. 617
G.L. 610

	Run No. 1	Run No. 2
Date	11 October 1960	
First Reading	4015'	
Last Reading	308'	
Footage logged	3707'	
Bottom (Driller)	4016'	
Casing (From Log)	308'	
Casing (Driller)	305'	
Casing Size	10¾"	
Bit Size (Below casing)	9⅞"	
Bit Size		

MUD	Run No. 1	Run No. 2
Nature	Bentonite	
Density	1.2	
Viscosity	53 @ 132 °F	@ °F
Resistivity	2.5 @ 97 °F	@ °F
Res. @ BHT	@ °F	@ °F
pH		
Circ. Temp.		
B.H. Temp.		
Logged by	Jonson & Radecki	
Witnessed by	Jewell	

REMARKS Depths relative to rotary table, 6 ft above ground level. See note below.
Equipment: Widco 10,000 ft. logger

COMPOSITE ELECTRIC LOG.

SELF-POTENTIAL.
– 10 mV/inch +

SHORT NORMAL RESISTIVITY.
Ohm metres
0 10 20

SINGLE POINT RESISTANCE.
10 ohms/inch

NOTE
A DEPTH CORRECTION OF 9FT /1000 FT. SHOULD BE SUBTRACTED FROM THE INDICATED DEPTHS.

300
500
1000
1500
2000
2500
3000
3500
4000

– 10 mV/inch +
SELF-POTENTIAL.
0 Ohm metres 10 20
10 ohms/inch
SHORT NORMAL RESISTIVITY.
SINGLE POINT RESISTANCE.

In accompanying Report on Plate No. 4

Geological Branch, Bureau of Mineral Resources, Geology and Geophysics

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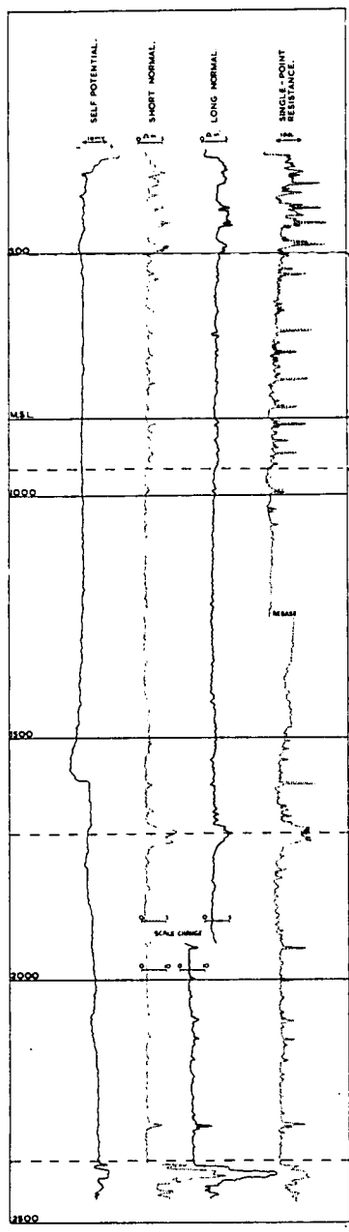
CORFIELD NO. 1.



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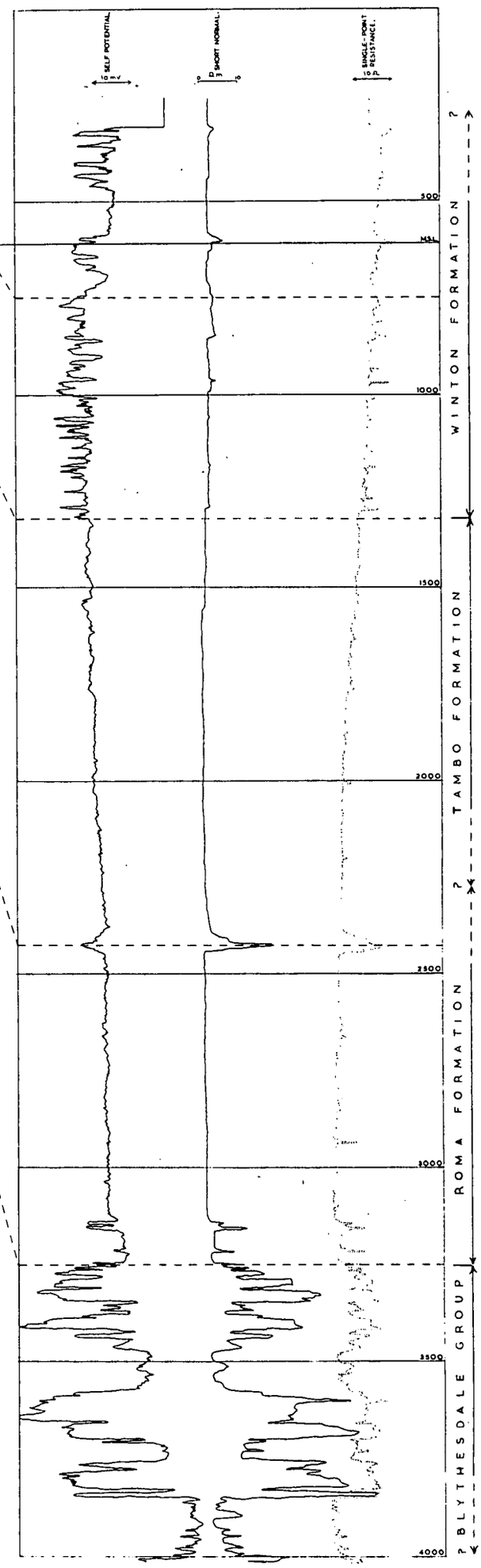

WINTON No. 2 BORE LOGGING.
QUEENSLAND, 1960.

CORRELATION BETWEEN
WINTON No. 2 AND CORFIELD
No. 1 BORES.

To accompany Records 1961, No 14

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