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INVESTIGATION OF BEDROCK DEPTHS  
BY ELECTRICAL-RESISTIVITY METHODS  
IN THE RIPON-FOND DU LAC AREA, WISCONSIN

By

H. Cecil Spicer

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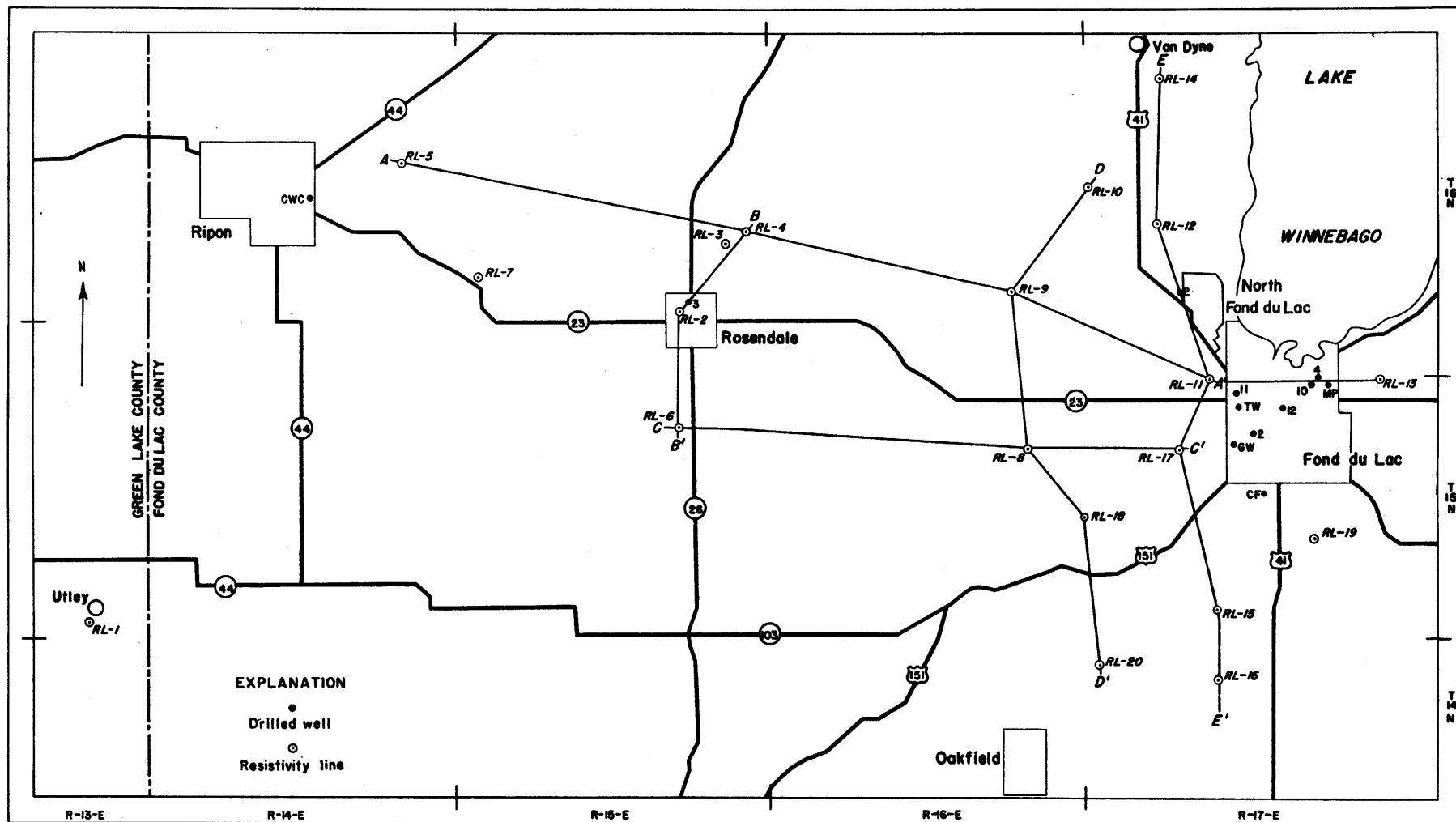
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## ABSTRACT

Resistivity measurements are reported for an area in east-central Wisconsin which is mainly in Fond du Lac County. The geological materials overlying the pre-Cambrian bedrock surface are glacial drift, dolomites, sandstones, siltstones, and limestones. The resistivity measurements were made with the Earth Resistivity Apparatus, a Gish-Rooney-type instrument. The pre-Cambrian rocks were identified

on the apparent resistivity curves by their higher resistivity. The depths to the pre-Cambrian rocks, as geophysically determined, ranged from 355 feet to more than 1,000 feet. The field measurements indicate that with favorable surface conditions, resistivity methods may be used in this area to locate the pre-Cambrian rocks to depths of approximately 1,500 feet.



Base from Wisconsin State Highway Map,  
issued 1946

Figure 1.-Map of Ripon-Fond du Lac area, Wisconsin

H. Cecil Spicer, 1948

Showing location of resistivity lines, lines of cross sections, and drilled wells

0 1 2 3 4 5 6 MILES

## INTRODUCTION

The geophysical investigation of the depths to bedrock was undertaken upon request of the Ground Water Branch Office of the U. S. Geological Survey at Madison, Wis. The Wisconsin Geological Survey cooperated in the work by providing funds and field assistants. The field measurements were made during the period May 22 to June 10, 1947; the apparent resistivity curves were interpreted during March and April 1948; and the report was prepared after the curves were interpreted.

The writer is grateful to Mr. Ernest F. Bean, State Geologist, Wisconsin Geological Survey, to Mr. Frank C. Foley, District Geologist, U. S. Geological Survey, and his staff, and to Mr. George J. Edwards, the author's co-worker, for the splendid assistance and generous cooperation extended, thus enabling the completion of the field assignment.

## LOCATION AND GEOLOGY

The area in which the measurements were made is in the southern part of east-central Wisconsin in Fond du Lac and Green Lake Counties. (See fig. 1.)

The geology of the area has been described by Chamberlin <sup>1/</sup> and Thwaites, <sup>2/</sup> and numerous drill holes in the vicinity have been logged from the cuttings by Thwaites. <sup>2/</sup> The following summary was taken from the above sources.

The soils of the area are variable, but mainly are clay, loam, or sandy loam. They are derived from the glacial drift and in some localities have considerable vegetable material and a resultant relatively dark color. The drift of the area was found to be usually less than 100 feet thick although locally thicker.

At one typical location southeast of Fond du Lac, the formations in succession below the drift are: Galena dolomite; Platteville formation, including the Glenwood shale member; St. Peter sandstone; Prairie du Chien ("Lower Magnesian") dolomite; Jordan sandstone; sandstone and siltstone of the Trempealeau formation; Franconia sandstone; Dresbach sandstone; and pre-Cambrian rocks.

The pre-Cambrian rocks of the area, as found by drilling, are mainly quartzites and slates of the buried Fond du Lac range. These quartzitic rocks are similar in character to those of the Baraboo range to the southwest. The slates and quartzites have high electrical resistivity, thus making it possible to differentiate between them and the overlying sandstones and dolomites, even though the latter have a moderately high resistivity.

## FIELD MEASUREMENTS

The measurements were taken with the Earth Resistivity Apparatus, which is a Gish-Rooney-type instrument as modified and constructed by the Geophysical Instrument Co., Arlington, Va. The electrodes are copper-clad steel rods with steel driving heads which were pushed or driven into the earth to make

contact for the potential and current connections to the instrument. Whenever contact with the earth was inadequate, the soil around the electrodes was wetted and tamped to reduce the resistance of the electrode contact.

Depth profiling was used throughout this survey, as the character of the earth materials and depths to pre-Cambrian rocks were of main importance. A modification of the Lee variation of the Wenner electrode configuration was used and the electrode intervals were expanded outward from the central station. With this method of taking observations, three apparent resistivity curves were obtained at each station, one in each direction from the center and one over the full interval. These are termed the  $P_1$ ,  $P_2$ , and Full curves and indicated by  $\Delta$ 's, x's and o's, respectively, when plotted. Bearings for the depth profiles are referred to magnetic north and given for the  $P_1$  direction. Power for driving the instrument was obtained from the truck battery, and current to pass through the earth was provided by a band of extra-heavy-duty "B" batteries. The fundamental technique for operating the Earth-Resistivity Apparatus is described by the maker of the instrument and in literature by Heiland <sup>3/</sup> and others.

## METHOD OF INTERPRETING THE RESISTIVITY CURVES

The resistivity curves obtained from this investigation were interpreted, in part, by means of procedures explained in literature on geophysics. The methods of interpreting resistivity curves, described in the references cited below, are based upon theoretical and mathematical considerations, and are presumed by the writer to be more reliable than any of the empirical methods of interpretation that have been advanced. Furthermore, all the methods mentioned below are based upon the theory of images <sup>4/</sup> and apply to two or more layers.

A partial list of references on interpretation follows:

Hummel, J. N., A theoretical study of apparent resistivity in surface potential method: Am. Inst. Min. Met. Eng. Tech. Pub. 418, 1931.

Roman, Irwin, How to compute tables for determining electrical resistivity of underlying beds and their application to geophysical problems: U. S. Dept. Commerce, Bur. Mines Tech. Paper 502, 1931.

Roman, Irwin, Some interpretations of earth resistivity data: Am. Inst. Min. Met. Eng. Trans., vol. 110, p. 183, 1934.

Roman, Irwin, Superposition in the interpretation of two-layer earth resistivity curves: U. S. Geol. Survey Bull. 927-A, 18 pp., 1941.

Tagg, G. F., Interpretation of earth resistivity curves: Am. Inst. Min. Met. Eng. Tech. Paper 755, 1937.

Watson, R. J., A contribution to the theory of the interpretation of resistivity measurements obtained from surface potential observations: Am. Inst. Min. Met. Eng. Tech. Paper 518, 1934.

Watson, R. J., and Johnson, J. F., On the extension of two-layer methods of interpretation of earth resistivity data to three and more layers: Geophysics, vol. 3, no. 1, pp. 7-21, 1938.

<sup>3/</sup>Heiland, C. A., Geophysical exploration, Prentice-Hall, 1940.

<sup>4/</sup>Jeans, J. F., Mathematical theory of electricity and magnetism, 5th ed., Cambridge Univ. Press, 1925.

<sup>1/</sup>Chamberlin, T. C., Geology of eastern Wisconsin: Geology of Wisconsin, vol. 2, survey of 1873-77, pp. 97-404, 1877.

<sup>2/</sup>Thwaites, F. T., personal communication.

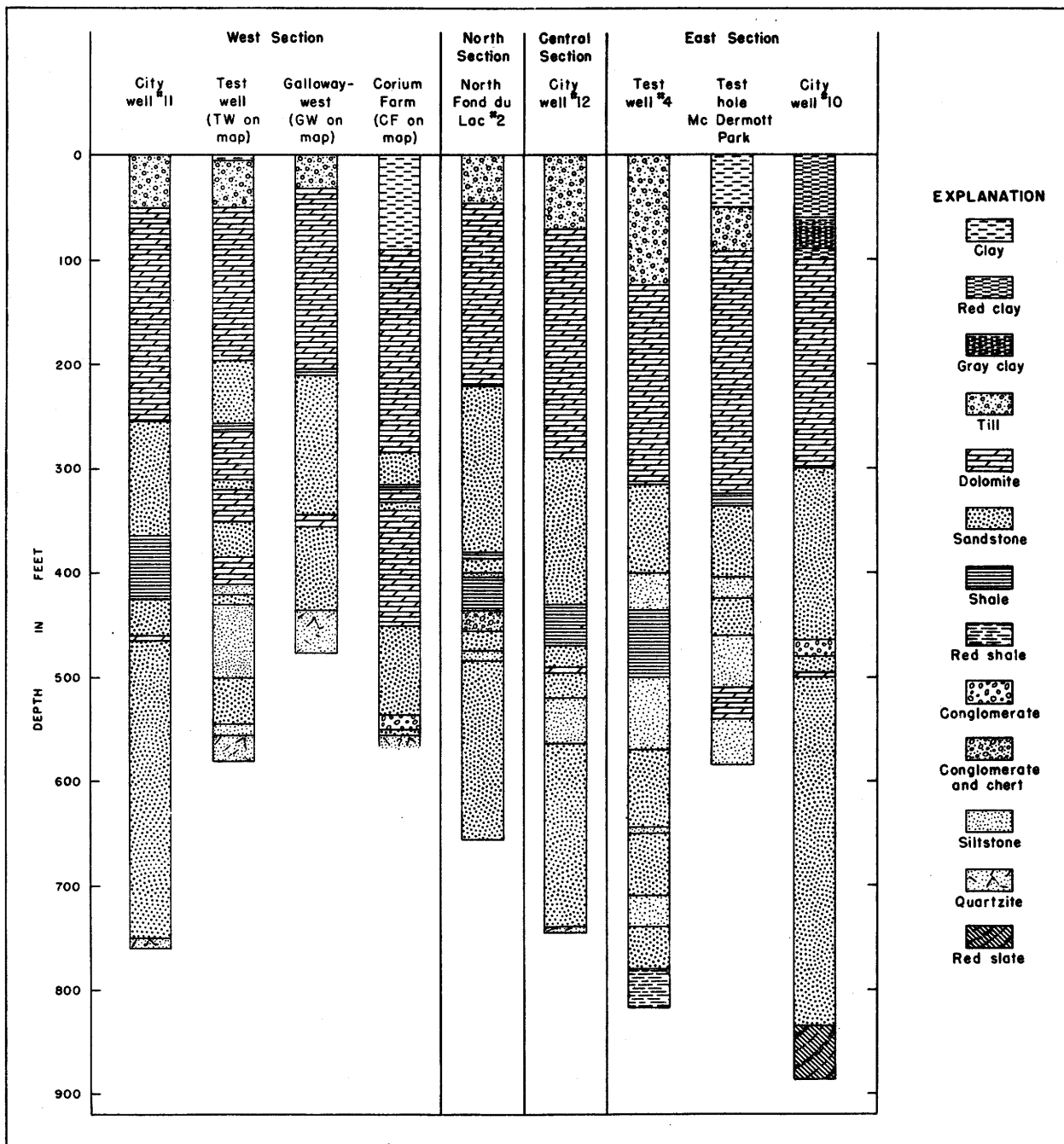


Figure 2.—Comparison of lithology in wells drilled in Fond du Lac, Wisconsin

All wells, except the Corium Farm well and the North Fond du Lac No.2 well, are within the city limits of Fond du Lac, Wisconsin.

## SUMMARY OF RESULTS

Profile RL-1 was taken southwest of Utley near an exposure of pre-Cambrian acidic rock to determine the electrical characteristics and extent of this body. According to the interpretation, a dense, compact rock having very high resistivity is present and is similar to the exposed acidic rock in electrical characteristics.

The resistivity depth profiles RL-2 through RL-20 were taken in the vicinity of Ripon and Fond du Lac to ascertain the depth to the pre-Cambrian surface, and profile RL-21, near Hartford, was taken to determine whether or not the pre-Cambrian could be reached here by resistivity methods. Unfortunately, a network of ground-return power lines surrounding the area in which profile RL-21 was taken caused serious interference with the resistivity measurements and as a result the interpretations from the curve, line 21, are considered uncertain. The depth to the pre-Cambrian rocks is estimated to be about 800 feet at the center of profile RL-21. The P<sub>1</sub> and P<sub>2</sub> curves indicate a rather steep slope on the pre-Cambrian surface. The depth to the pre-Cambrian on the P<sub>2</sub> end is about 750 feet, and on the P<sub>1</sub> end about 850 feet.

Locations of depth profiles RL-1 through RL-20 are shown on figure 1, but the location of profile RL-21 could not be shown because this profile was taken about 30 miles south of the area included in this figure. The appendix contains copies of the apparent-resistivity curves and their interpretations, locations for the centers of the profiles, the direction in which the electrode intervals were taken, and the surface elevations at the centers of the profiles. The interpretations of the apparent-resistivity curves are based mainly upon the in-place formation tests and the electrical resistivities computed for the materials of each apparent-resistivity curve.

Some information was available in the area from both drilled wells and test wells. Copies of the well logs will be found in the appendix and locations of the wells are shown on figure 1. With the exception of well No. 2 at North Fond du Lac and the Central Wisconsin Canning Co. wells at Ripon and Rosendale, the wells are grouped near the city of Fond du Lac in an area about 2 miles wide and 2½ miles long. In figure 2 nine logs in the vicinity of Fond du Lac are compared by groups, namely, west section, north

section, central section, and east section. The extreme variability in the depth to the pre-Cambrian quartzite and red slate, as well as the failure of some holes to reach the pre-Cambrian, are apparent in this figure.

As the primary purpose of this geophysical investigation was to determine the depth to the pre-Cambrian surface, the interpretations of the resistivity curves have been depicted graphically. (See figs. 3-7.) All the cross sections in this group are plotted with the altitude above sea level in feet as ordinate, and distance in miles as abscissa. Figure 1 shows the location of these profiles. Figure 3, a west-east section from Ripon to Fond du Lac, shows that the greatest depth to the pre-Cambrian surface is below RL-9. Figure 4, a north-south section at Rosendale, shows that the greatest depth to pre-Cambrian is beneath RL-2. Another west-east section from Rosendale to Fond du Lac, figure 5, shows the pre-Cambrian deepening markedly near Fond du Lac. Figure 6 is a north-south section showing an almost continuously deep section except for RL-8, just west of Fond du Lac. Another north-south section, figure 7, indicates that the pre-Cambrian is deeper north of Fond du Lac but rises to the south and then drops steeply again beyond RL-15.

Perhaps the generalized picture of the pre-Cambrian surface as determined by the geophysical results can be more easily visualized from figure 8, which shows the predicted contours on the pre-Cambrian. The resistivity-line locations were taken directly from figure 1 and are plotted on the same scale. Attention is directed to the contour intervals of figure 8; in the eastern part the intervals are 20 feet, whereas in the western part they are 100 feet. The smaller intervals were omitted in the western part because the stations were more widely spaced.

The altitudes of the pre-Cambrian surface within the city limits of Fond du Lac, as determined by drilling, are given in table 1. Comparison of these altitudes of the pre-Cambrian surface with those altitudes determined by the geophysical method employed shows very good correlation except for the TW and GW wells. If the drill-log altitudes of the pre-Cambrian for wells TW and GW are presumed to be correct, then the surface of the pre-Cambrian is almost clifflike between these locations and the

Table 1 - Altitudes of pre-Cambrian surface as determined from drilling logs

Well designation	Altitude of pre-Cambrian (feet)	Well designation	Altitude of pre-Cambrian (feet)
11	± 0	12	= 0
TW	+ 200	10	- 80
MP*	- -	4	- 30
GW	+ 320	2*	- -

\*Did not reach pre-Cambrian.



locations of wells 11 and 12. This is, of course, not an impossible subsurface condition, but it is not indicated either by the other drilling results or by the geophysical measurements.

On the other hand, the altitudes of the pre-Cambrian surface for wells 11 and 12 are approximately zero and are close to the geophysically predicted zero contour. Wells 10 and 4 closely correspond to the results for depth profile RL-13 and, furthermore, correlate well with the geophysically predicted -100 foot contour. The correlation between predicted contours and the drill-log data of the Corium Farm well, CF on figure 1, is poor if the questionable depth to quartzite is considered correct.

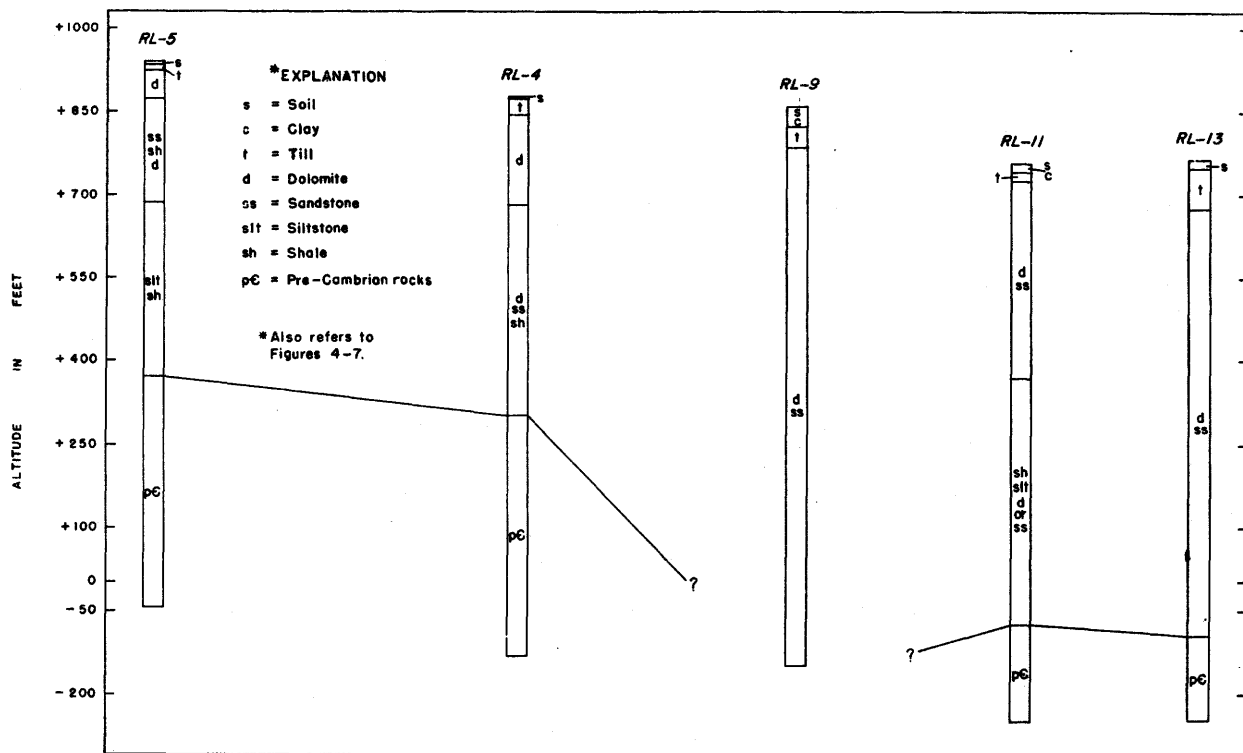
One particularly disconcerting anomaly was found at Rosendale, between the resistivity measurements and the drill log of the No. 3 well of the Central Wisconsin Canning Co. A resistivity measurement made about a quarter of a mile southwest indicated no pre-Cambrian rocks to a depth of 1,000 feet. The material occupying the position where the pre-Cambrian was expected had a very low resistivity, more like clay in its electrical characteristics. A test northeast of this well, RL-4, indicated pre-Cambrian at an altitude of 305 feet above sea level. A large number

of resistivity lines, or drill holes, would be needed to explain what is present here beneath the surface.

## CONCLUSION

The resistivity results have shown that it is possible to determine the depth to the pre-Cambrian basement rocks where it is less than 1,000 feet. With favorable near-surface conditions, it probably would be possible to increase the depth determinations to at least 2,000 feet in this area.

Several factors limiting electrical-resistivity measurements are generally present throughout the area. These are: (1) All the land is in use or under cultivation, (2) wire fences with metal fence posts are prevalent, (3) ground-return power lines form a network over a considerable part of the area. These limiting factors could be minimized by choosing the autumn months for the field work so that access could be had to all fields, thus making it possible to get far enough away from sources of disturbances. In many instances, however, there would be no suitable area free from all the above-mentioned limiting factors, because of the great spread of electrodes needed to reach depths of 1,000 feet or more.





# APPENDIX

## Interpretations of apparent resistivity curves

Line 1 (G-2) 5/27/47. Along south side Chicago, Milwaukee, St. Paul and Pacific Railroad branch and opposite marker 68 on pole. NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 35, T. 15 N., R. 13 E. P<sub>1</sub> - N. 41 $\frac{1}{2}$ ° E. Altitude 900 feet.

Electrical depth profile	Depth (In feet)
Drift and till.....	0 - 4 $\frac{1}{4}$
Clay.....	4 $\frac{1}{4}$ - 23
Dolomite and sandstone.....	23 - 190
Sandstone either with a large amount of shale or saturated with mineralized water.....	190 - 445
Very dense, compact rock, probably acidic igneous similar to nearby outcrop.....	445 - 900

Line 2 (G-2) 5/29/47. About 200 feet west of central Wisconsin Canning Co. well No. 3. 0.25 mile north and 0.25 mile east of the southwest corner of sec. 35, T. 16 N., R. 15 E. P<sub>1</sub> - N. 6° W. Altitude 956 feet.

Electrical depth profile	Depth (In feet)
Soil and clay.....	0 - 6.5
Till, large amount of rock.....	6.5 - 32
Dolomite, probably some sandstone...	32 - 184
Shale, or dolomite and sandstone saturated with highly mineralized water; probably highly fractured. No indication of pre-Cambrian rocks to 800 feet.....	184 - 800

Line 3 (G-2) 5/29/47. 0.25 mile west of center of sec. 25, T. 16 N., R. 15 E. P<sub>1</sub> - N. 82° E. Altitude 875 feet.

### Electrical depth profile

Line abandoned after the 300-foot electrode interval because of some unaccountable electrical disturbance that caused very large galvanometer oscillations and a great divergence of the P<sub>1</sub> and P<sub>2</sub> readings.

Line 4 (G-2) 5/29/47. 0.25 mile north of center of sec. 25, T. 16 N., R. 15 E. P<sub>1</sub> - N. 3° E. Altitude 875 feet.

Electrical depth profile	Depth (In feet)
Clay soil.....	0 - 4.5
Till with clay and stones.....	4.5 - 34
Dolomite, some sandstone and shale.....	34 - 195
Sandstone and dolomite, dense and of low permeability.....	195 - 570
Pre-Cambrian rocks.....	570 - 1,000

Line 5 (G-2) 5/30/45. On Lietz farm. NW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 14, T. 16 N., R. 14 E. P<sub>1</sub> - N. 67° E. Altitude 941 feet.

Electrical depth profile	Depth (In feet)
Clay soil.....	0 - 6.2
Till.....	6.2 - 16
Dolomite.....	16 - 67
Sandstone, shale, dolomite.....	67 - 255
Siltstone, shale, some sandstone....	255 - 568
Pre-Cambrian rocks.....	568 - 1,000

The bottom layer of pre-Cambrian is dipping rapidly in the P<sub>1</sub> direction and is approximately 80 feet deeper than in the P<sub>2</sub> direction. The resistivity of this layer has an anomalous value, being higher than a theoretically perfect insulator.

Line 6 (G-2) 5/30/46. 0.25 mile east of southwest corner of sec. 11, T. 15 N., R. 15 E. P<sub>1</sub> - N. 82° E. Altitude 954 feet.

Electrical depth profile	Depth (In feet)
Clay soil.....	0 - 11.5
Dolomite, some shale and sandstone...	11.5 - 235
Shale, dolomite, sandstone.....	235 - 355
Pre-Cambrian rocks.....	355 - 800

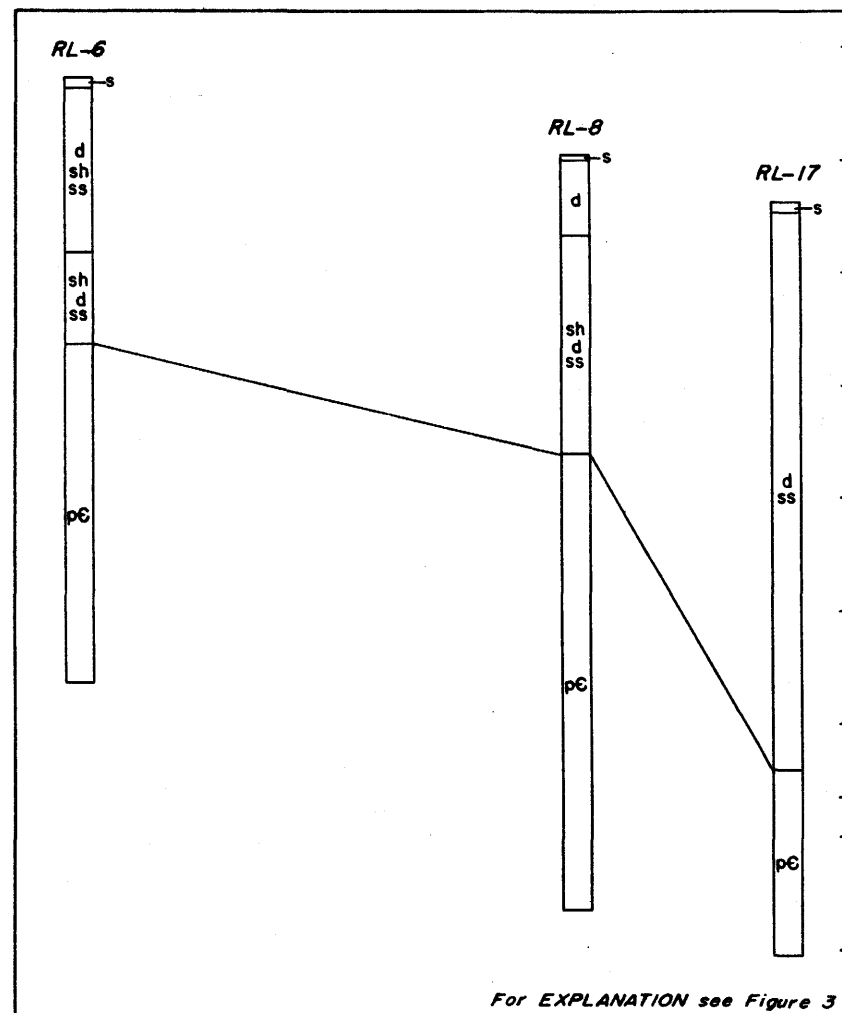
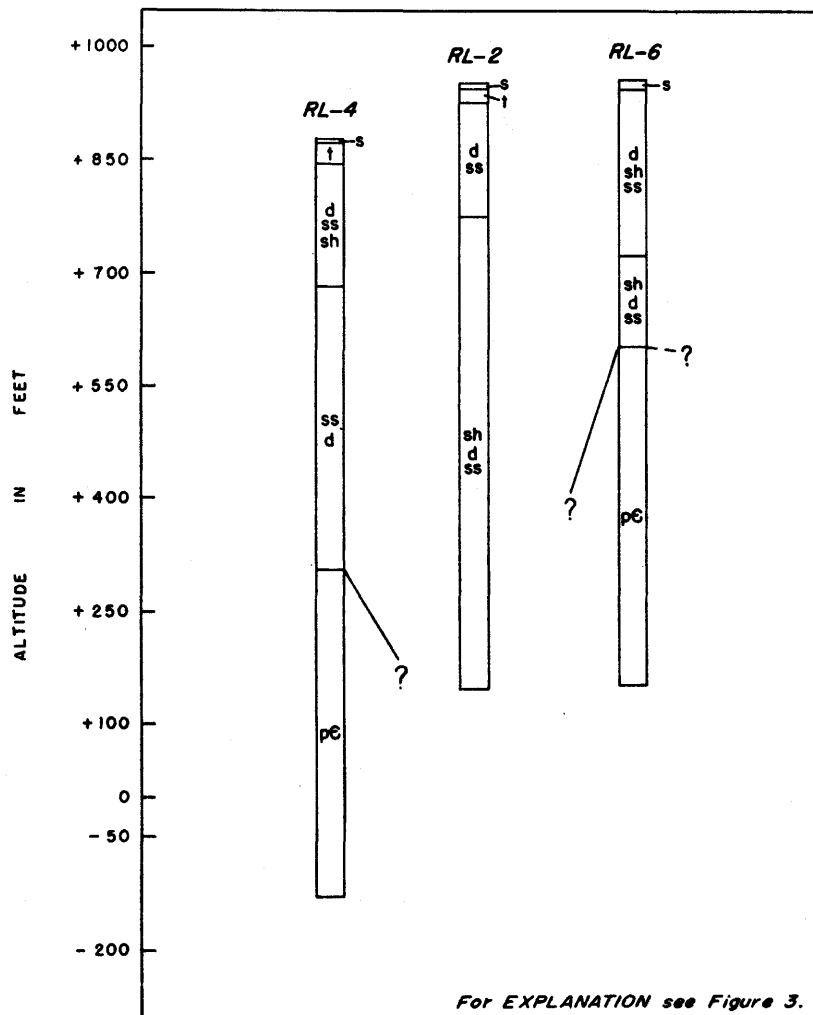
Line 7 (G-2) 6/1/47. 0.35 mile east of junction of KK with Highway 23 along south side of KK and on line between secs. 30 and 31, T. 16 N., R. 15 E. P<sub>1</sub> - N. 85° E. Altitude 939 feet.

Electrical depth profile	Depth (In feet)
Clay soil.....	0 - 8.5
Dolomite, some sandstone and shale...	8.5 - 335
Shale.....	335 - 355
Sandstone.....	355 - 585
Shale, some sandstone.....	585 - 655
Pre-Cambrian rocks.....	655 - 1,000

The interpretation of depth to the pre-Cambrian rocks is from the P<sub>2</sub> curve. It appears that the depth to pre-Cambrian is much greater on the P<sub>1</sub> side of the profile.

Line 8 (G-2) 6/2/47. 0.3 mile south from road KK on line between secs. 13 and 14, T. 15 N., R. 16 E. P<sub>1</sub> - N. 3° W. Altitude 853 feet.

Electrical depth profile	Depth (In feet)
Clay soil.....	0 - 6.75



Line 8 (G-2) 6/2/47 - Continued

Dolomite; perhaps some till above... 3.75 - 107

Shale, dolomite, sandstone..... 107 - 395

Pre-Cambrian rocks..... 395 - 1,000

The depth to pre-Cambrian is about 30 feet greater on the P<sub>2</sub> side of the profile.

Line 9 (G-2). 0.35 mile west of road I on east-west line of sec. 35, T. 16 N., R. 16 E. P<sub>1</sub> - N. 86° E. Altitude 861 feet.

Electrical depth profile

Depth  
(In feet)

Clay soil..... 0 - 38

Till..... 38 - 76

Dolomite, sandstone..... 76 - 1,000

No certain indication of pre-Cambrian rocks. The last four or five observations indicate the presence of a layer having relatively low resistivity which might be slate.

Line 10 (G-2). 0.35 mile south of road N and 1.0 mile west of Highway 41 along west side of road, sec. 19, T. 16 N., R. 17 E. P<sub>1</sub> - N. 5° W. Altitude 814 feet.

Electrical depth profile

Depth  
(In feet)

Clay soil..... 0 - 15

Dolomite, perhaps some till above.... 15 - 85

Dolomite and sandstone..... 85 - 1,000

No indication of pre-Cambrian rocks. A change of material is indicated at about 650 - 700 feet and has lower resistivity than the layer above.

Line 11 (G-2) 6/4/47. 0.3 mile west of Highway 41 on road 000 along north line of sec. 9, T. 15 N., R. 17 E. P<sub>1</sub> - N. 85° E. Altitude 757 feet.

Electrical depth profile

Depth  
(In feet)

Clay soil..... 0 - 15

Till, probably considerable clay.... 15 - 34

Dolomite, sandstone..... 34 - 385

Interpreted qualitatively because of some extraneous electrical interference..... 385 - 1,000

The material in the 385 - 825-foot zone has a generally low resistivity except for a somewhat higher resistivity in the 650 - 750-foot layer. The material in this zone is probably shale or siltstone interbedded with dolomite or sandstone. Based on the P<sub>2</sub> curve, mainly, the material below 825 - 875 feet appears to be of pre-Cambrian age.

Line 12 (G-2) 6/4/47. 0.29 mile east of Highway 41 on north line of sec. 29, T. 16 N., R. 17 E. P<sub>1</sub> - N. 84° E. Altitude 788 feet.

Line 12 (G-2) 6/4/47 - Continued

Electrical depth profile

Depth  
(In feet)

Soil, clay, drift..... 0 - 32

Dolomite..... 32 - 94

Dolomite, sandstone..... 94 - 420

Shale, siltstone, sandstone..... 420 - 1,000

There is a large variation in the depth to the lowest layer along the profile. The above-interpreted depth is from the F-curve but is controlled by the P<sub>2</sub> curve. The depth to the lowest layer from the interpretation of the P<sub>1</sub> curve is ± 700 feet. There is no indication of pre-Cambrian rocks.

Line 13 (G-2) 6/5/47. 0.35 mile north of Highway 23 on center line of sec. 12, T. 16 N., R. 17 E. P<sub>1</sub> - N. 7° E. Altitude 762 feet.

Electrical depth profile

Depth  
(In feet)

Soil, clay..... 0 - 11

Till..... 11 - 86

Dolomite and sandstone..... 86 - 850

Pre-Cambrian rocks..... 850 - 1,000

The depth to pre-Cambrian is less on the P<sub>1</sub> side of the profile, being about 675 feet. The P<sub>2</sub> side of the profile has a depth of about 950 feet to pre-Cambrian.

Line 14 (G-2) 6/5/47. On old interurban roadbed and parallel to Milwaukee Railroad. 0.3 mile south of north line of sec. 8, T. 16 N., R. 17 E. P<sub>1</sub> - N. 20° W. Altitude 799 feet.

Electrical depth profile

Depth  
(In feet)

Soil, clay..... 0 - 10

Clay..... 10 - 16

Till, dolomite, sandstone..... 16 - 392

Shale, siltstone, dolomite..... 392 - 470

Sandstone and shale..... 470 - 1,000

There is a pronounced low-resistivity layer on the P<sub>1</sub> side of the profile between 375 and 550 feet that is hardly apparent on the P<sub>2</sub> curve. Similarly, there is a low-resistivity layer on P<sub>2</sub> between 825 and 1,000 feet that is not present on P<sub>1</sub>. These layers are considered to be shale or siltstone.

Line 15 (G-2) 6/6/47. About 100 yards west of center of sec. 33, T. 15 N., R. 17 E. P<sub>1</sub> - N. 89° E. Altitude 826 feet.

Electrical depth profile

Depth  
(In feet)

Soil, clay..... 0 - 10

Till..... 10 - 82

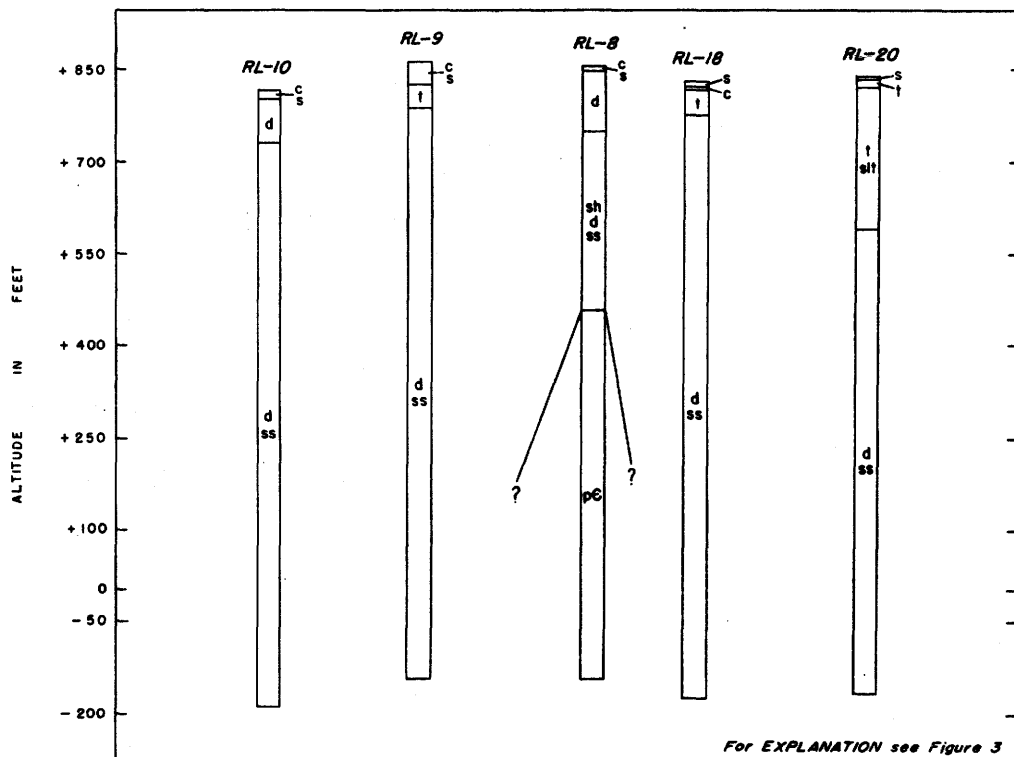


Figure 6. Cross section D-D' Fond du Lac, Wisconsin

0 1 2 3 4 5 6 MILES

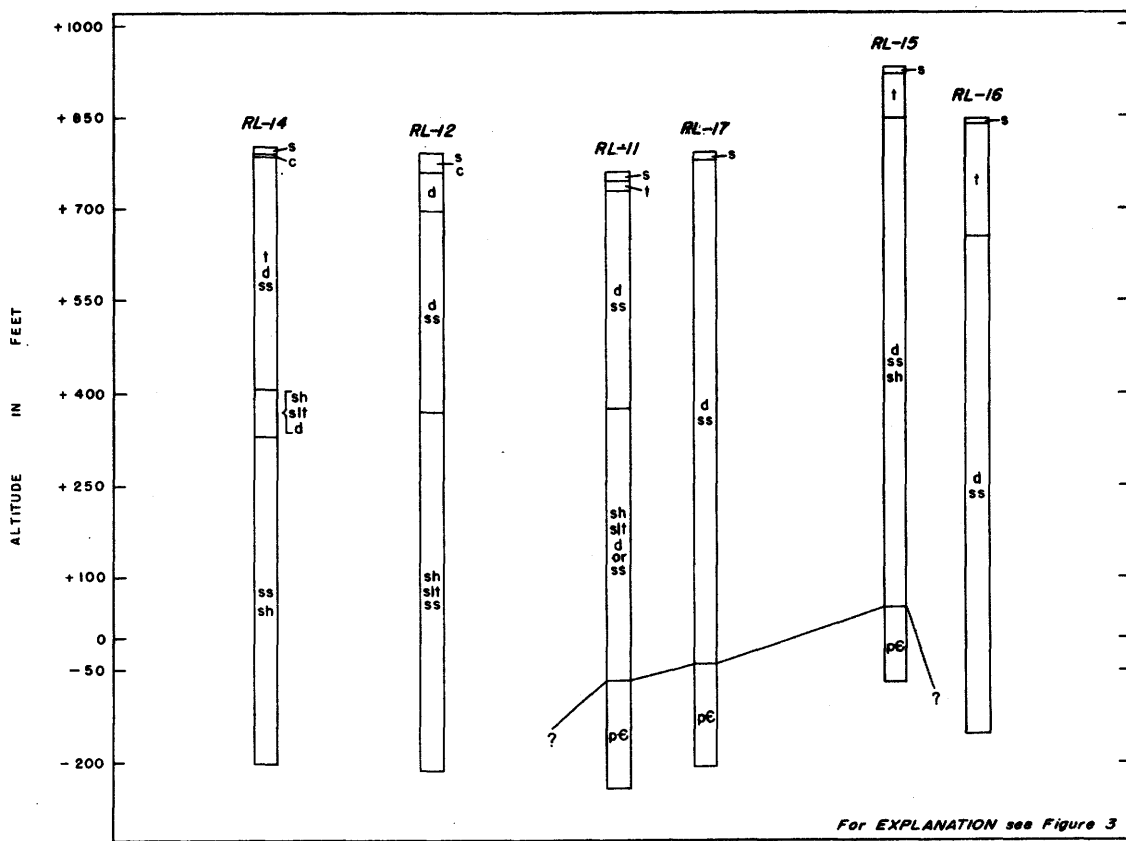


Figure 7. Cross section E-E' Fond du Lac, Wisconsin

0 1 2 3 4 5 6 MILES

Line 15 (G-2) 6/6/47 - Continued

	Depth (In feet)
Dolomite, sandstone; shale or siltstone layer 710 - 770 feet.....	82 - $\pm$ 875

Pre-Cambrian rocks; last three observations have a steep rise but are not adequate to make a good interpretation.....  $\pm$  875-1,000

Line 16 (G-2) 6/6/47. 0.3 mile south of county trunk highway FFF on center line of sec. 4, T. 14 N., R. 17 E.  $P_1$  - N.  $0^\circ$  E. Altitude 842 feet.

Electrical depth profile	Depth (In feet)
Soil, clay.....	0 - 7.5
Till.....	7.5- 192
Dolomite, sandstone.....	192 - 1,000

No indication of pre-Cambrian rocks.

Line 17 (G-2) 6/9/47. 0.3 mile west of east line and on center line of sec. 17, T. 15 N., R. 17 E.  $P_1$  - N.  $90^\circ$  W. Altitude 790 feet.

Electrical depth profile	Depth (In feet)
Soil, clay.....	0 - 14
Dolomite, sandstone.....	14 - 750
Pre-Cambrian rocks.....	750 - 1,000

Line 18 (G-2). 0.7 mile south of county trunk highway T on west line of sec. 19, T. 15 N., R. 17 E.  $P_1$  - N.  $10^\circ$  W. Altitude 828 feet  $\pm$  2 feet.

Electrical depth profile	Depth (In feet)
Soil, clay.....	0 - 7.25
Clay.....	7.25- 13
Till.....	13 - 55
Dolomite and sandstone.....	55 - 1,000

Line 19 (G-2) 6/10/47. 1,500 feet northwest of overpass on Chicago and Northwestern Railroad in NW $\frac{1}{4}$  sec. 26, T. 15 N., R. 17 E. Abandoned because of some unidentified electrical interference with the measurements.

Line 20 (G-2) 6/10/47. Along county highway D, 0.25 mile north of county highway FFF in sec. 6, T. 14 N., R. 17 E.  $P_1$  - N.  $25^\circ$  E. Altitude 840 feet.

Electrical depth profile	Depth (In feet)
Soil.....	0 - 4
Till, considerable coarse material...	4 - 19
Till, some silty material.....	19 - 252
Dolomite and sandstone.....	252 - 1,000
No indication of pre-Cambrian rocks.	

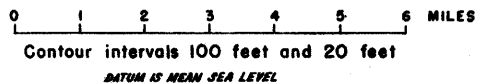
Line 21 (G-2) 6/11/47. Near Hartford, Wis. 0.25 mile west of east line and 0.3 mile north of south line of sec. 29, T. 10 N., R. 18 E.  $P_1$  - N.  $3^\circ$  W. Altitude 1,026 feet.

Electrical depth profile	Depth (In feet)
Soil.....	0 - 4
Clay.....	4 - 8
Till.....	8 - 26
Limestone.....	26 - 195
Shale, dolomite.....	195 - $\pm$ 800
Pre-Cambrian rocks.....	$\pm$ 800 - 950

The indication from the  $P_2$  curve is  $\pm$  750 feet and from the  $P_1$   $\pm$  850 feet. However, because of serious interference from a ground-return power line, the indications are considered uncertain.

H. Cecil Spicer, 1948

Figure 8. Contours on the pre-Cambrian surface from resistivity results



# Well logs

Central Wisconsin Canneries Well, Ripon, Wis.  
(NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 22, T. 16 N., R. 14 E. Altitude about 940 feet)

	Depth (in feet)		Depth (in feet)
Drift.....	0 - 25	Dolomite.....	145 - 220
Dolomite.....	25 - 65	Sandstone and siltstone.....	220 - 280
Sandstone.....	65 - 110	Sandstone and siltstone.....	280 - 380
Shale.....	110 - 115	Shale.....	380 - 395
Dolomite.....	115 - 135	Sandstone.....	395 - 495
Sandstone.....	135 - 145		

Well No. 3, Central Wisconsin Canning Co., Rosendale, Wis.  
(NE $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 35, T. 18 N., R. 15 E. Altitude 905 feet)

	Depth (in feet)		Depth (in feet)
Stony till.....	0 - 29	Shale.....	175 - 180
Dolomite.....	29 - 130	Dolomite.....	180 - 280
Sandstone and shale.....	130 - 145	Sandstone.....	280 - 440
Dolomite.....	145 - 175	Quartzite.....	440 - 442

City well No. 11, Fond du Lac, Wis.  
(NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 10, T. 15 N., R. 17 E. Altitude 755 feet)

	Depth (in feet)		Depth (in feet)
Red till.....	0 - 20	Sandstone.....	415 - 460
Stony till.....	20 - 70	Dolomite.....	460 - 465
Dolomite.....	70 - 255	Sandstone.....	465 - 545
Sandstone.....	255 - 350	Siltstone.....	545 - 560
Red shale.....	350 - 415	Sandstone.....	560 - 750

Test well (TW on map), Fond du Lac, Wis.  
(NE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 9, T. 15 N., R. 17 E.)

	Depth (in feet)		Depth (in feet)
Clay.....	0 - 5	Sandstone.....	310 - 320
Red till.....	5 - 10	Dolomite.....	320 - 350
Stony till.....	10 - 50	Sandstone.....	350 - 385
Dolomite.....	50 - 195	Dolomite.....	385 - 410
Sandstone.....	195 - 255	Sandstone and siltstone.....	410 - 555
Shale.....	255 - 265		
Dolomite.....	265 - 310	Quartzite.....	555 - 580



Test well, Galloway-West Co. (GW on map), Fond du Lac, Wis.  
(SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 16, T. 15 N., R. 17 E.)

	Depth (in feet)		Depth (in feet)
Till.....	0 - 31 $\frac{1}{2}$	Dolomite.....	345 - 355
Dolomite.....	31 $\frac{1}{2}$ - 205	Sandstone.....	355 - 435
Shale.....	205 - 210	Quartzite.....	435 - 477
Sandstone.....	210 - 345		

Corium Farm well (CF on map), Fond du Lac, Wis.  
(NW $\frac{1}{4}$  sec. 22, T. 15 N., R. 17 E.)

	Depth (in feet)		Depth (in feet)
Clay and hardpan.....	0 - 80	Dolomite.....	340 - 450
Dolomite.....	80 - 285	Sandstone.....	450 - 535
Sandstone and shale.....	285 - 320	Conglomerate.....	535 - 550
Dolomite.....	320 - 332 $\frac{1}{2}$	Sandstone.....	550 - 555
Sandstone.....	332 $\frac{1}{2}$ - 340	Quartzite (?).....	555 +

Test well No. 4, Fond du Lac, Wis.  
(NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 11, T. 15 N., R. 17 E. Altitude 753 feet)

	Depth (in feet)		Depth (in feet)
Red clay.....	0 - 10	Siltstone.....	645 - 650
Till.....	10 - 125	Sandstone.....	650 - 710
Dolomite.....	125 - 315	Siltstone.....	710 - 760
Sandstone.....	315 - 400	Sandstone.....	760 - 780
Siltstone, shale.....	400 - 570	Red shale.....	780 - 817
Sandstone.....	570 - 645		

Test well, McDermott Park (MP on map), Fond du Lac, Wis.  
(NW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 11, T. 15 N., R. 17 E. Altitude 765 feet)

	Depth (in feet)		Depth (in feet)
Clay and till.....	0 - 50	Siltstone.....	405 - 425
Till.....	50 - 142	Sandstone.....	425 - 460
Dolomite.....	142 - 325	Siltstone.....	460 - 510
Shale.....	325 - 335	Dolomite.....	510 - 540
Sandstone.....	335 - 405	Siltstone.....	540 - 585

City well No. 10, Fond du Lac, Wis.  
(NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 11, T. 15 N., R. 17 E. Altitude 755 feet)

	Depth (in feet)		Depth (in feet)
Red clay.....	0 - 60	Sandstone.....	480 - 490
Clay.....	60 - 100	Dolomite (no sample).....	490 - 500
Dolomite.....	100 - 300	Sandstone.....	500 - 835
Sandstone.....	300 - 465	Slate.....	835 - 885
Conglomerate.....	465 - 480		

Well No. 2, North Fond du Lac, Wis.  
(sec. 32, T. 16 N., R. 17 E.)

	Depth (in feet)		Depth (in feet)
Drift.....	0 - 10	Sandstone.....	387 - 400
Till.....	10 - 46	Siltstone and shale.....	400 - 435
Dolomite.....	46 - 225	Conglomerate and chert.....	435 - 455
Sandstone.....	225 - 380	Sandstone.....	455 - 655
Shale.....	380 - 387	(siltstone 475 - 485)	

Well No. 2, West Ice and Cold Storage Co., Fond du Lac, Wis.  
(NW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 15, T. 15 N., R. 17 E.)

	Depth (in feet)		Depth (in feet)
Red clay.....	0 - 10	Dolomite.....	35 - 200
Till.....	10 - 35		

City well No. 12, Fond du Lac, Wis.  
(NW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 10, T. 15 N., R. 17 E.)

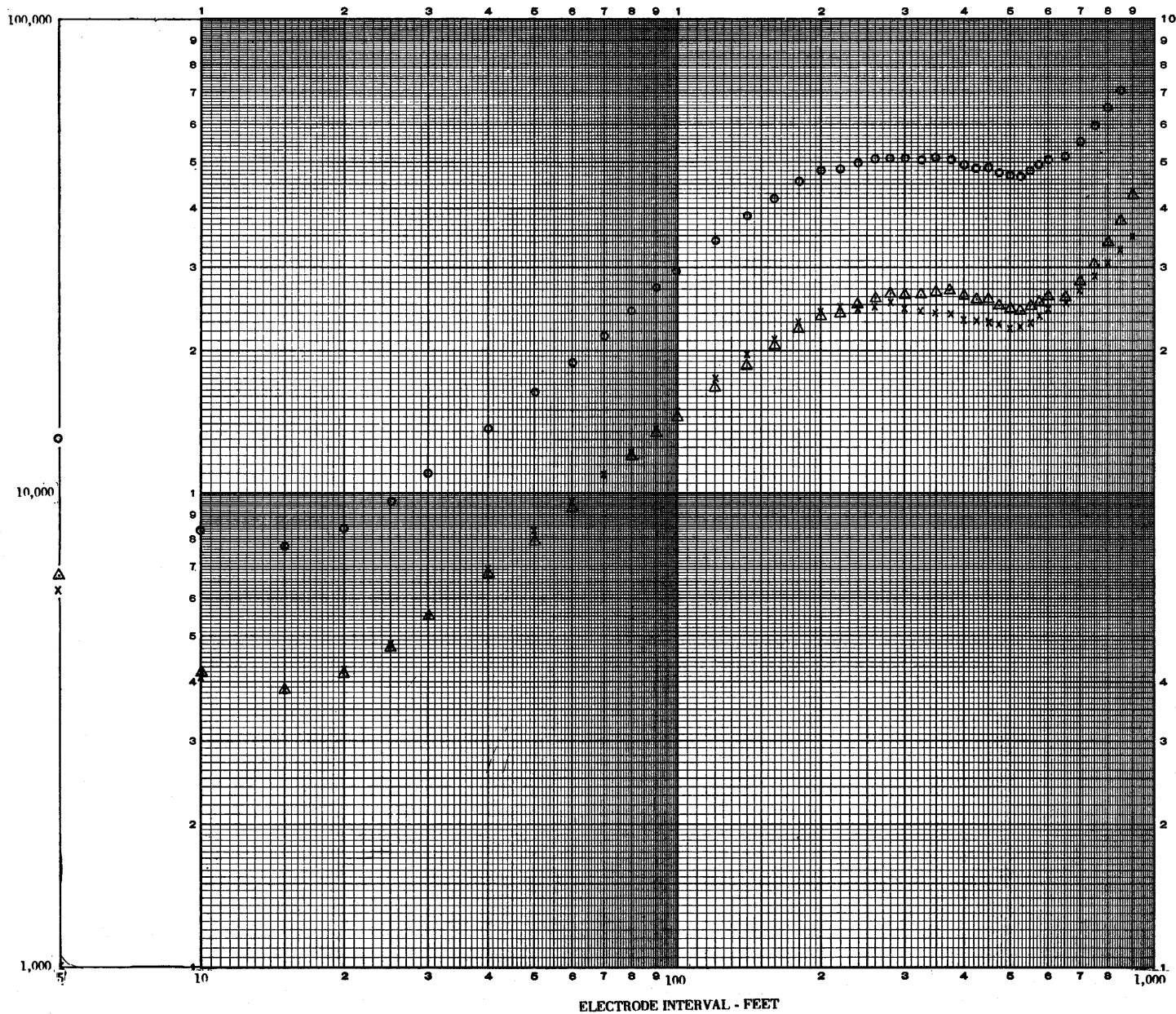
	Depth (in feet)		Depth (in feet)
Till.....	0 - 35	Sandstone.....	470 - 490
Stony till.....	35 - 105	Dolomite.....	490 - 495
Dolomite.....	105 - 290	Sandstone.....	495 - 520
Sandstone.....	290 - 430	Siltstone.....	520 - 565
Shale.....	430 - 470	Sandstone.....	565 - 740

City well, Hartford, Wis.  
(NW $\frac{1}{4}$  sec. 16, T. 10 N., R. 18 E. Altitude 1010 feet)

	Depth (in feet)		Depth (in feet)
Glacial drift.....	0 - 35	Shale.....	100 - 300
Limestone.....	35 - 55	Limestone.....	300 - 535
Shale.....	55 - 85	Sandstone.....	535 - 550
Limestone.....	85 - 100	Quartzite.....	550 - 735

City well No. 2, Hartford Wis.  
(T. 10 N., R. 18 E., sec. not given)

	Depth (in feet)		Depth (in feet)
(Old filled pit).....	0 - 66	Dolomite.....	165 - 190
Shale.....	66 - 95	Shale.....	190 - 280
Dolomite.....	95 - 105	Dolomite.....	280 - 532
Shale.....	105 - 115	Quartzite.....	532 -1370
Dolomite.....	115 - 130	Basalt or diabase.....	1,370 -1,385
Shale.....	130 - 165	Quartzite.....	1,385-1,410

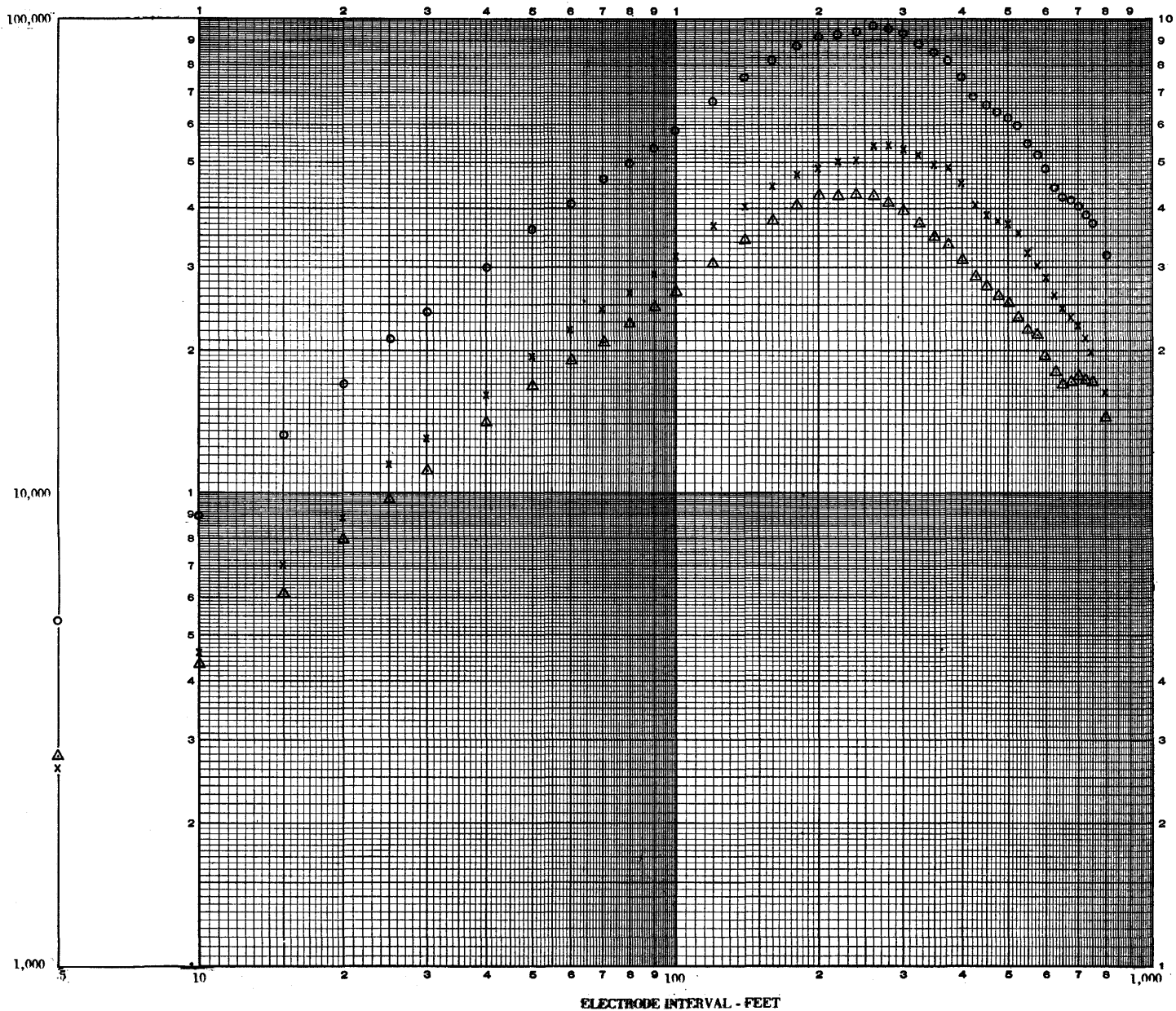


Line 1 (G-2) Ripon, Wis. 5/25/47

Location: NE. 1/4 35, T. 15 N., R. 13 E.,  
On S. side of Milwaukee R. R. Branch  
opp. marker 68 on R. R.

Bearing: P-1 N. 41 1/2° E.  
Elev. 900'

Bearing: P-2 N. 41 1/2° E.  
Elev. 900'



Line 2, Ripon, Wis. 5/29/47

Location: 1/4 mi. N. E., 1/4 mi. E. of the  
SW corner sec. 35., T. 16 N., R. 15 E.,  
200' W. of Rosendale cannery well W. of  
Rosendale, Wis.

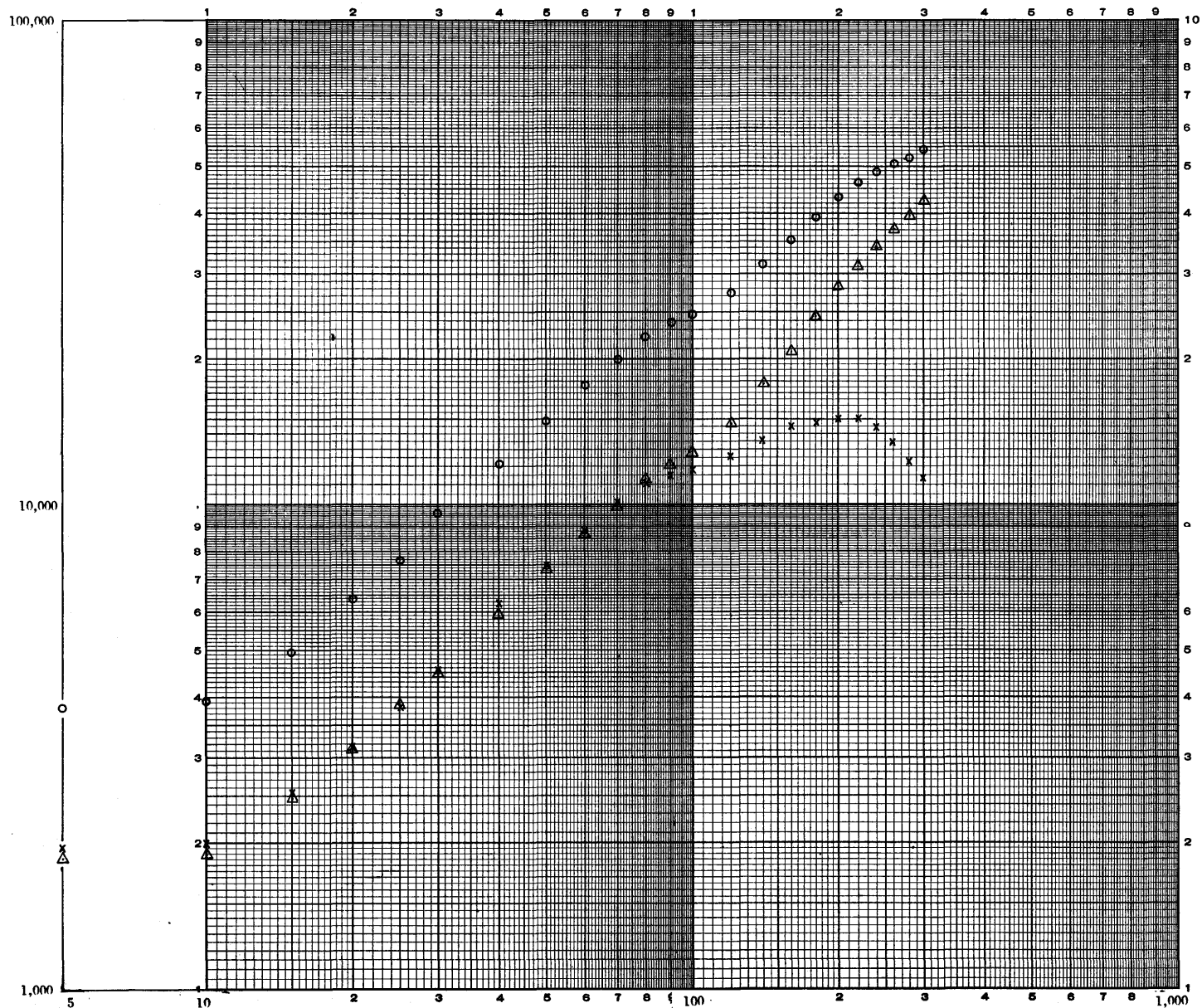
Dip: P-1 N. 6° W.

Elev. 956'

○ - Full curve

x - P-2 curve

△ - P-1 curve



Line 3 (G-2) Ripon, Wis. 5/29/47

Location: 1/4 mi. W. of center sec. 25,  
T. 16 N., R. 15 E.

Bearing: P-1 N. 82° E.

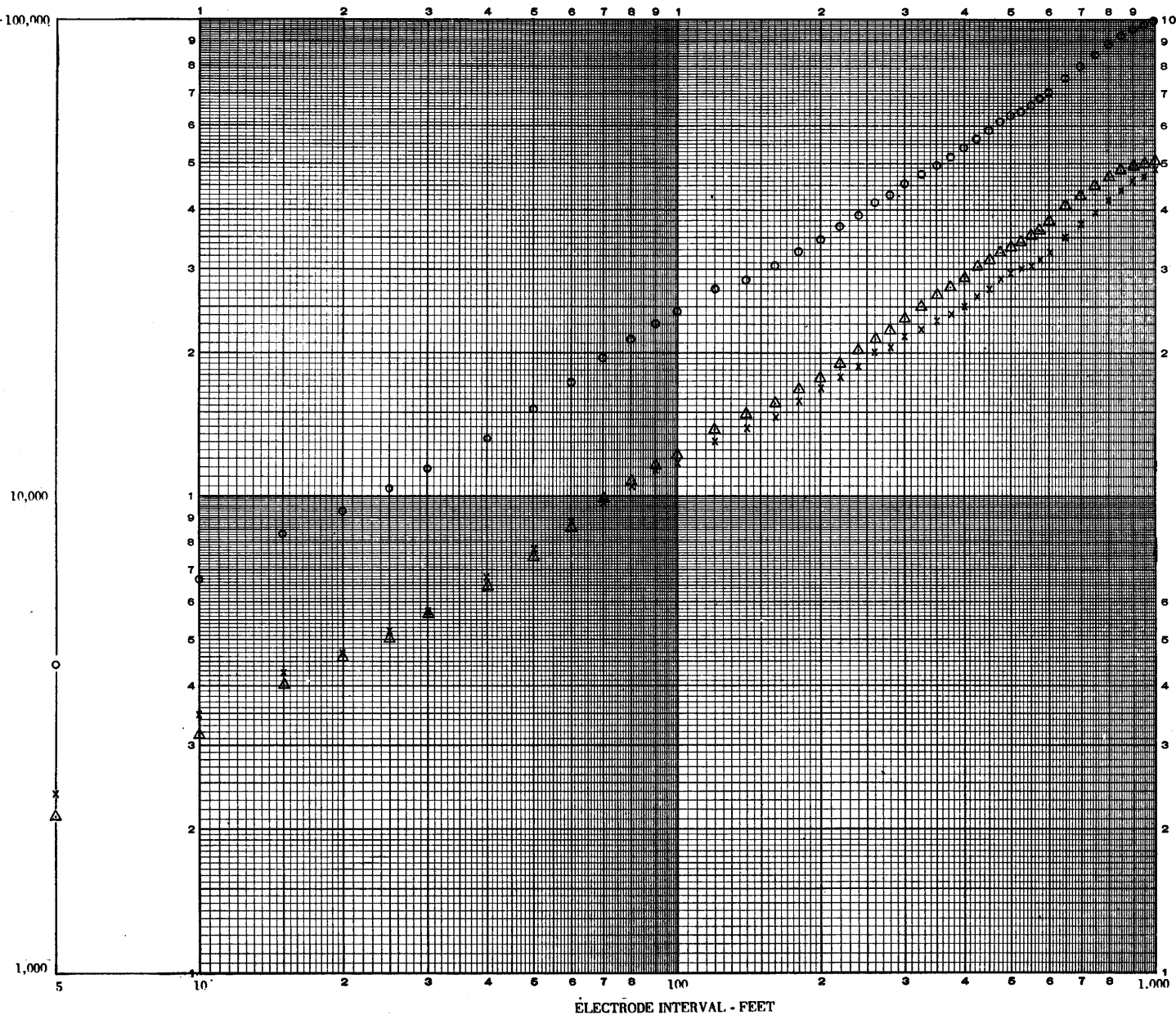
Elev.: 875'

○ - Full curve

x - P-2 curve

△ - P-1 curve

ELECTRODE INTERVAL--FEET



Line 4 (G-2) Ripon, Wis. 5/29/47

Location: 1/4 mi. N. of center sec. 25,  
T. 16 N., R. 15 E.

Bearing: P-1 N. 3° E.

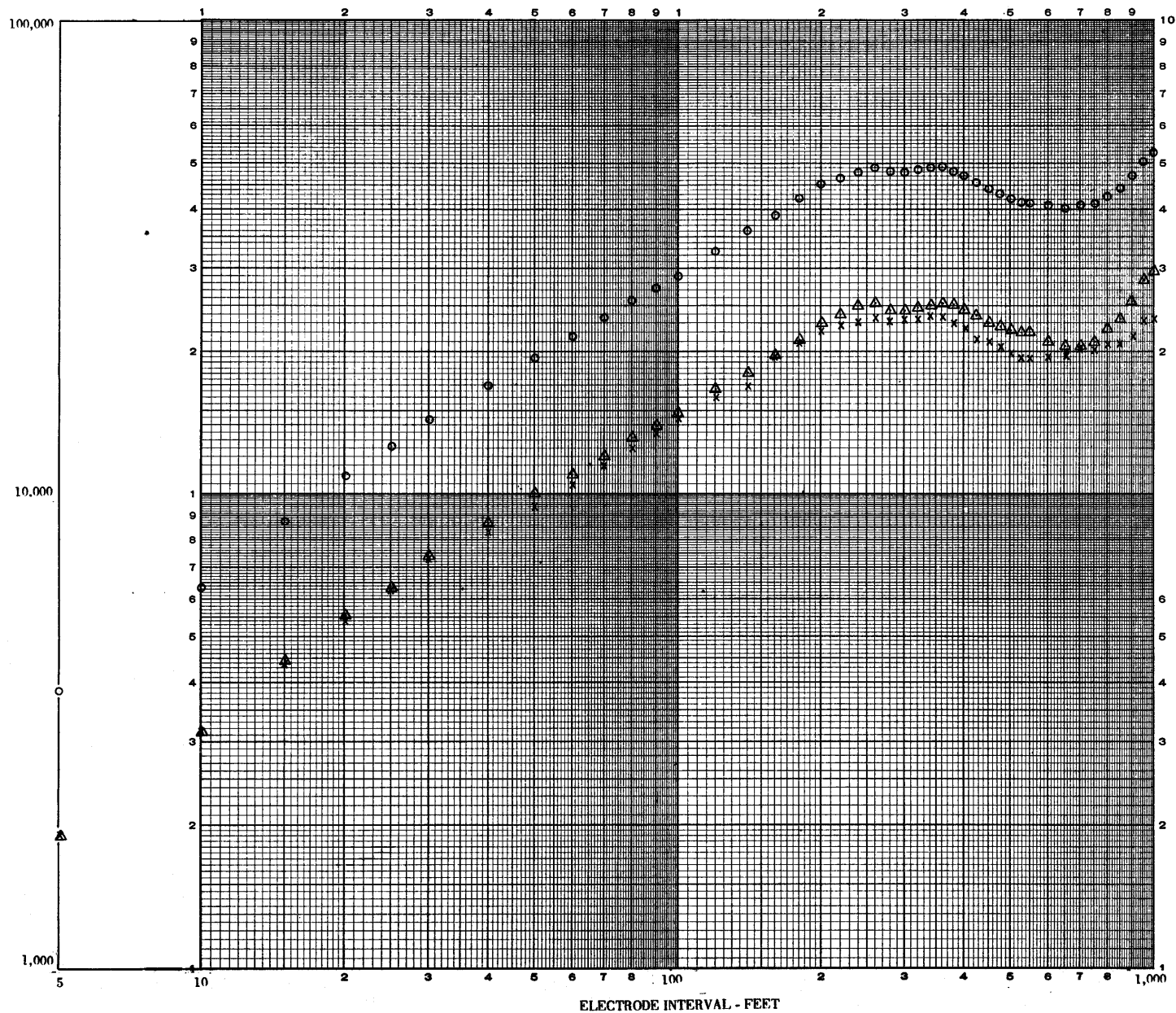
Elev.: 875'

○ = Full curve

x = P-2 curve

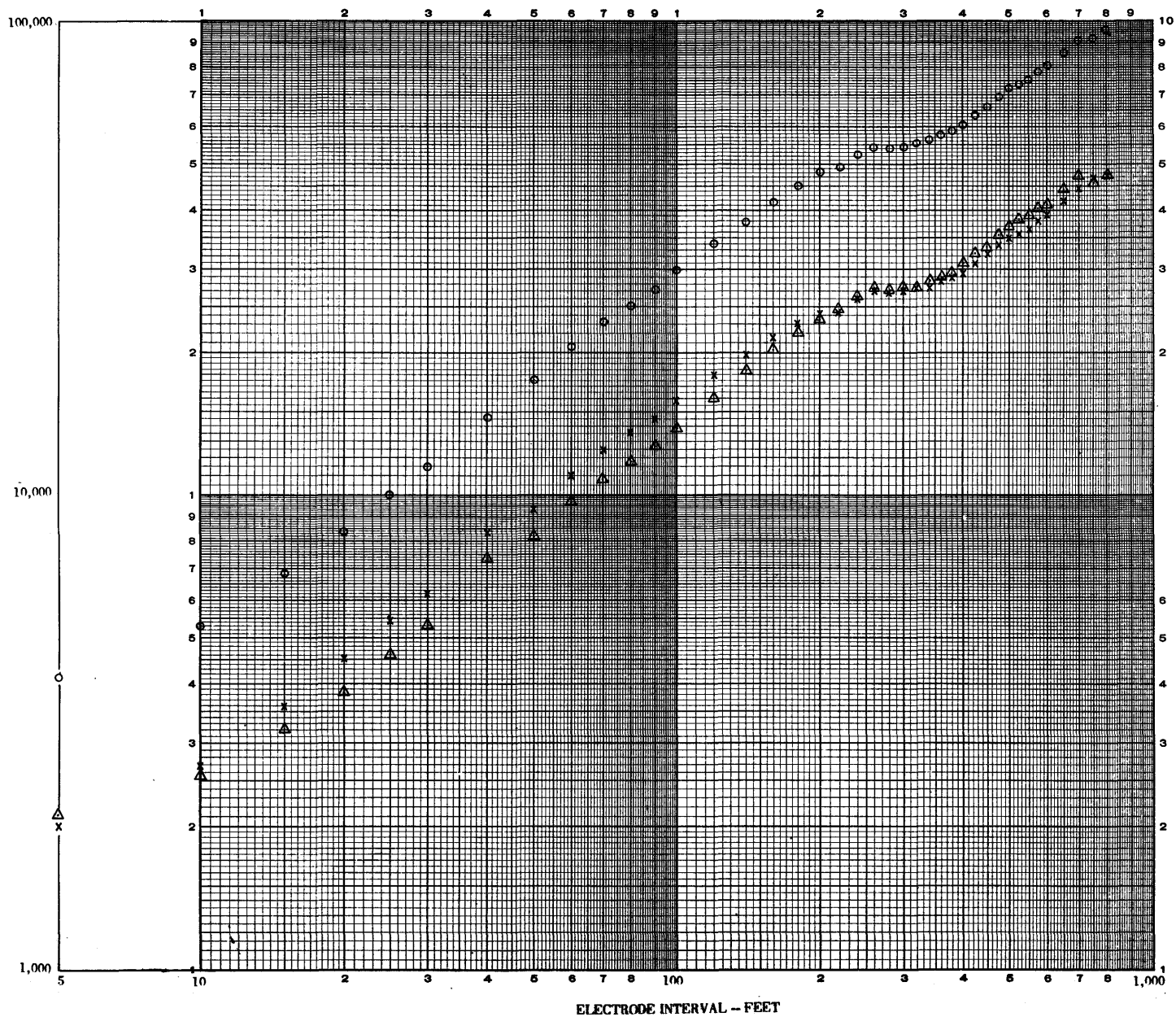
△ = P-1 curve

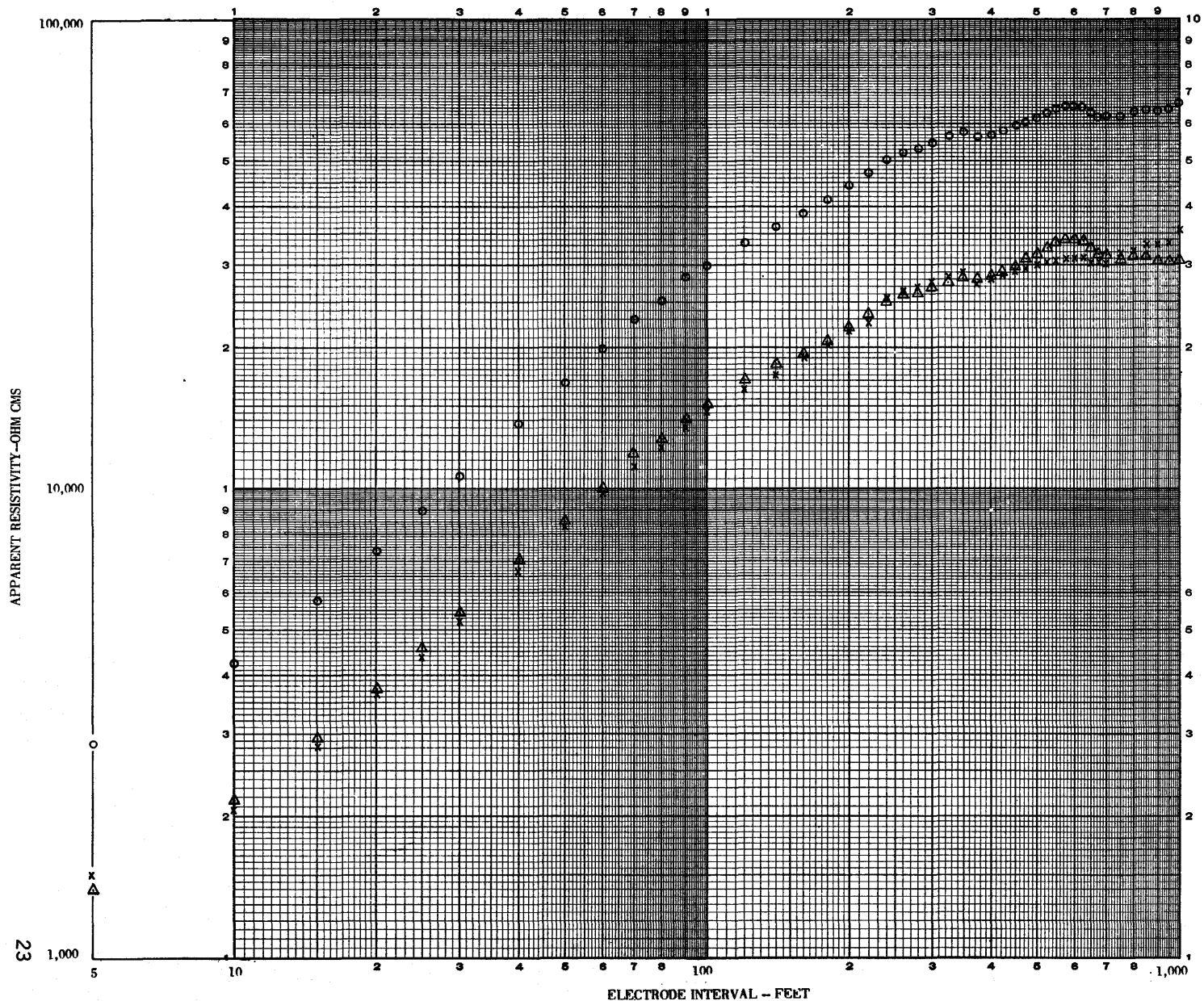




Line 5 (G-2) Ripon, Wis. 5/30/45  
 Location: NW. 1/4 SE. 1/4 sec. 14.  
 T. 16 N., R. 14 E. on Lietz's farm.  
 Bearing: P-1 N. 67° E.  
 Elev.: 941

- - Full curve
- x - P-2 curve
- △ - P-1 curve



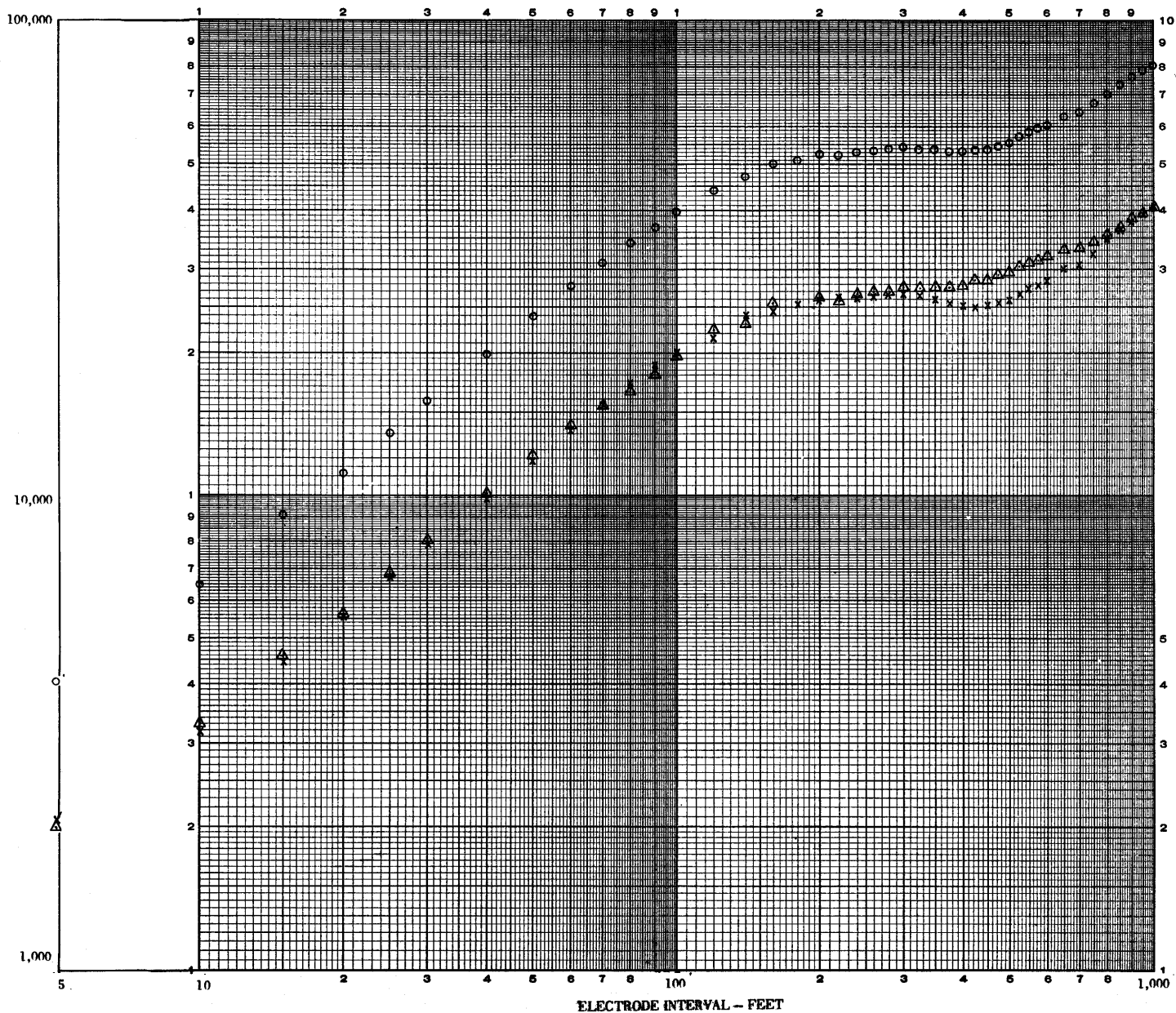


Line 7 (G-2) Ripon, Wis. 6/1/47

Location: 0.35 mi. E. of Junction KK.  
with Hwy. 23. On S. side of KK. on  
line between secs. 30 and 31, T. 16 N.,  
R. 15 E.

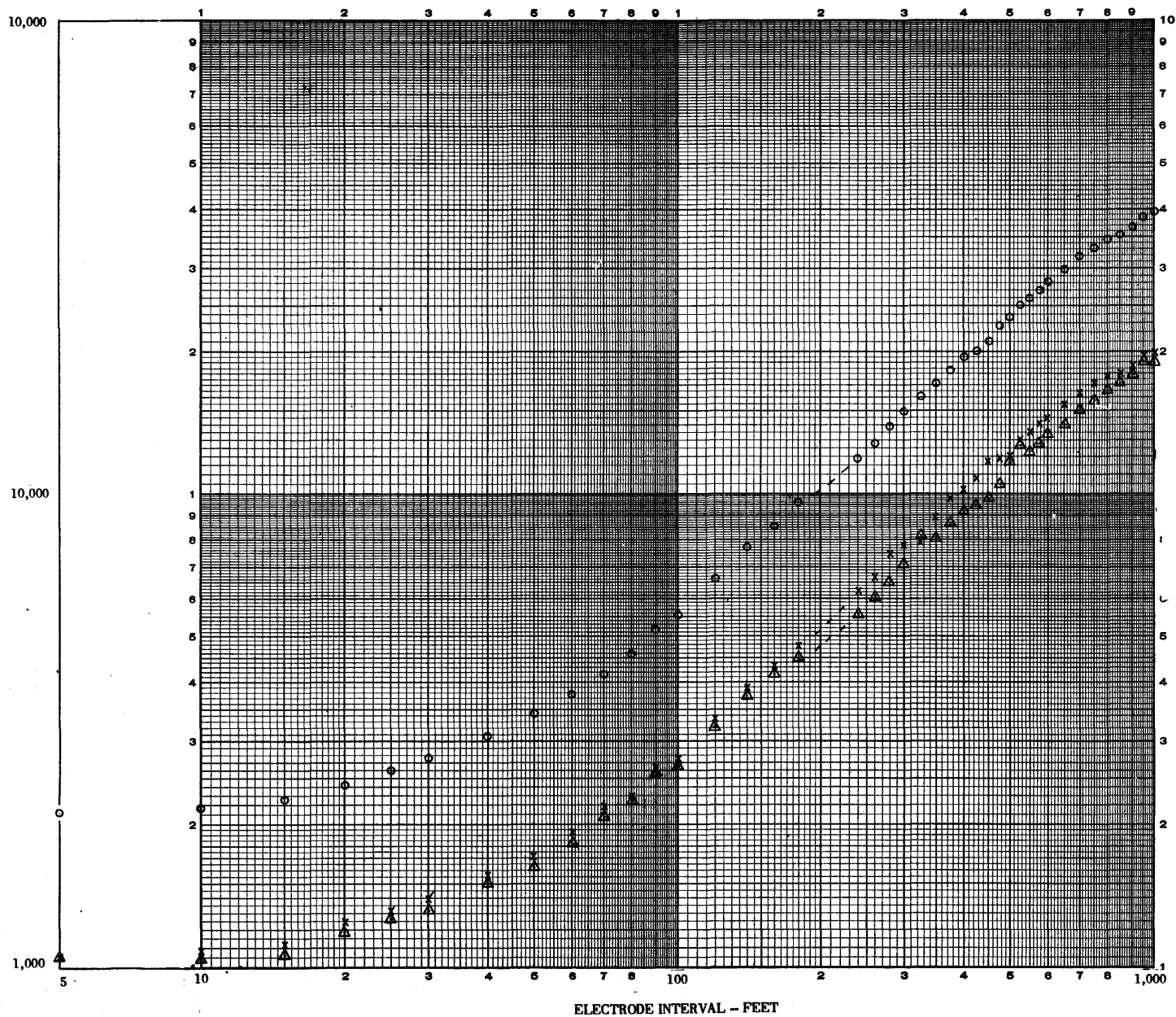
Bearing: P-1 N. 85° E.

Elev.: 939'



APPARENT RESISTIVITY—OHM CMS

25



Line 9 (G-2) Fond du Lac, Wis.

Location: 0.35 mi. W. of road 1 along E-W road, center of sec. 35, T. 16 N., R. 16 E.

Bearing: P-1 N. 86° E.

Elev.: 861'

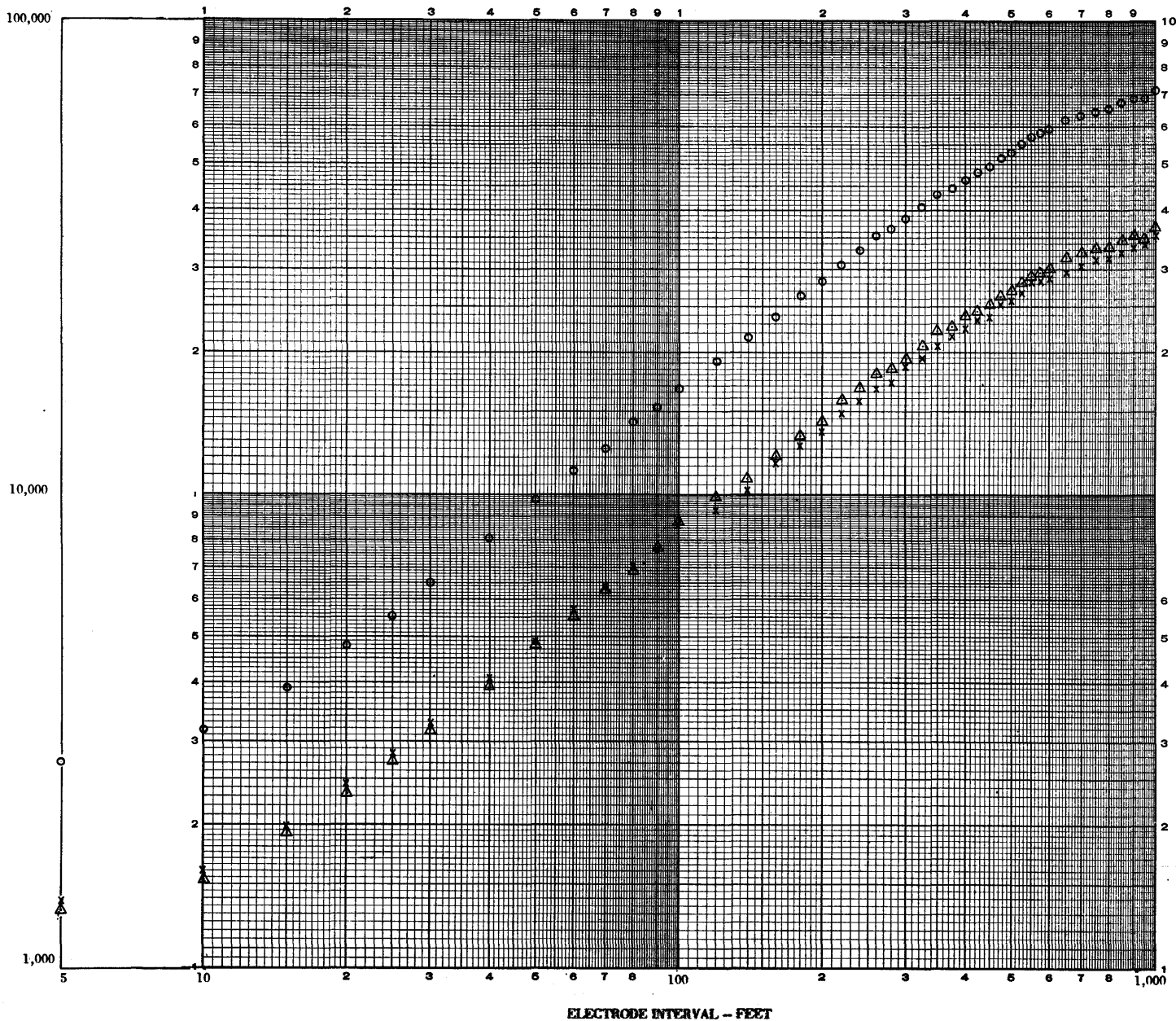
O = Full curve

x = P-2 curve

Δ = P-1 curve

ELECTRODE INTERVAL - FEET





Line 10 (G-2) Fond du Lac, Wis.

Location: 0.35 mi. S. of Rd. N 1 mi. W. of  
Hwy. 41 W. side of sec. 19 T. 16 N., R. 17 E.

Bearing: P-1 N. 50° W.

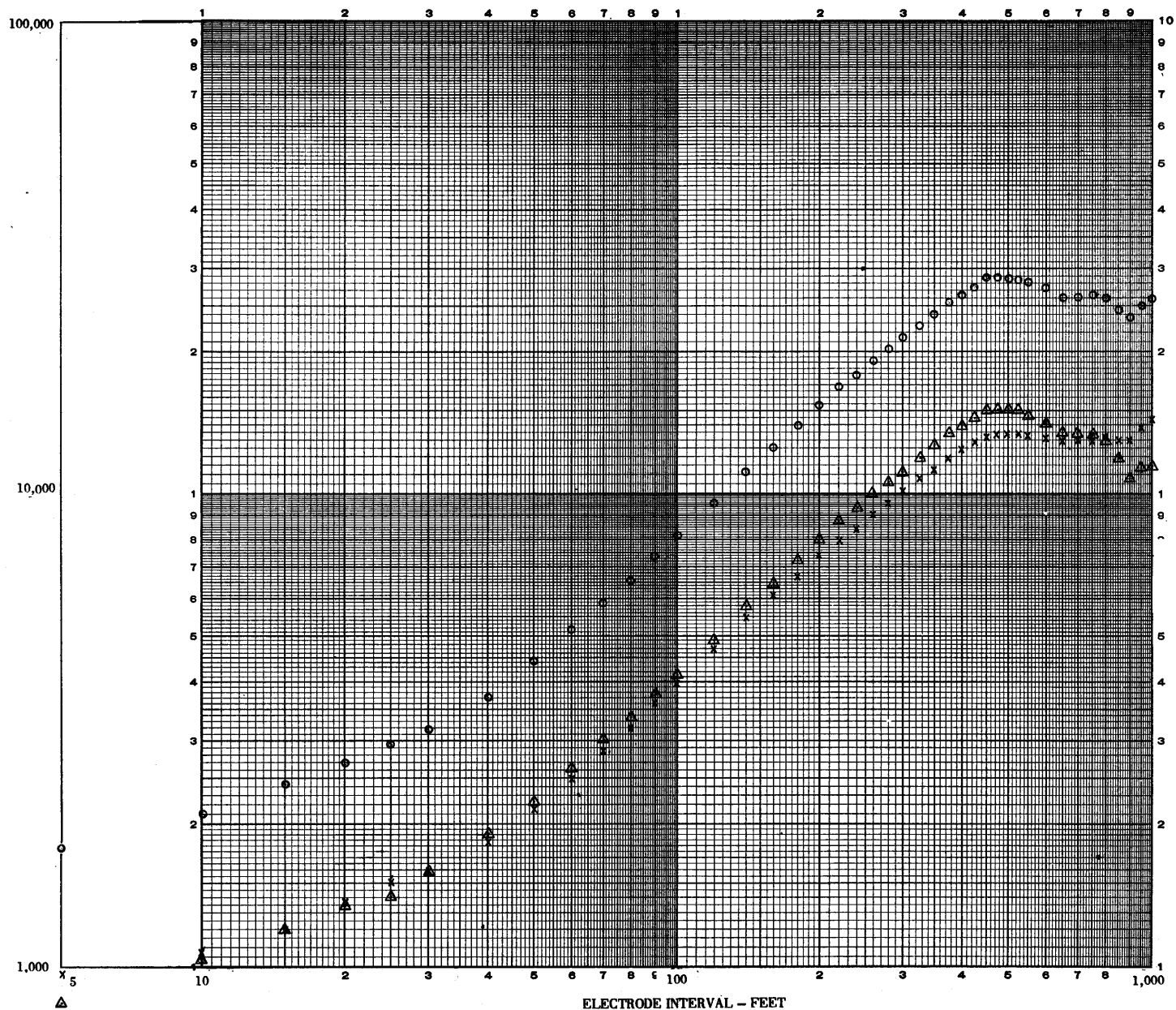
Elev.: 814'

O = Full curve

x = P-2 curve

Δ = P-1 curve

ELECTRODE INTERVAL -- FEET



Line 11 (G-2) Fond du Lac, Wis. 6/4/47

Location: 0.3 mi. W. of Hwy. 41 on Rd. 000.  
N. line of sec. 9, T. 15 N., R. 17 E.

Bearing: P-1 N. 85° E.

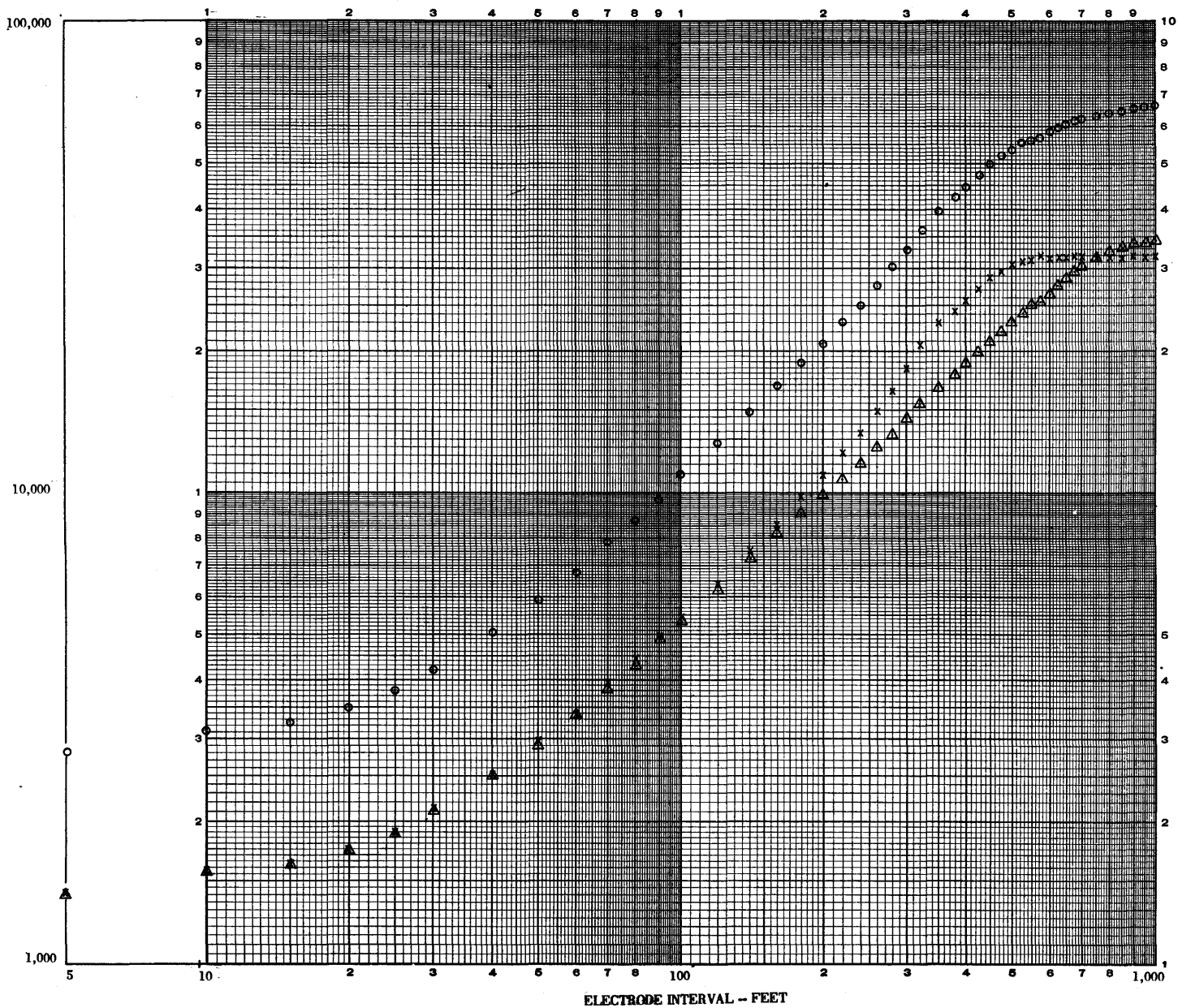
Elev.: 757'

○ - Full curve

x - P-2 curve

△ - P-1 curve





Line 12 (G-2) N. Fond du Lac, Wis. 6/4/47

Location: 0.29 mi. E. of Hwy 41 on N. line  
sec. 29, T. 16 N., R. 17 E.

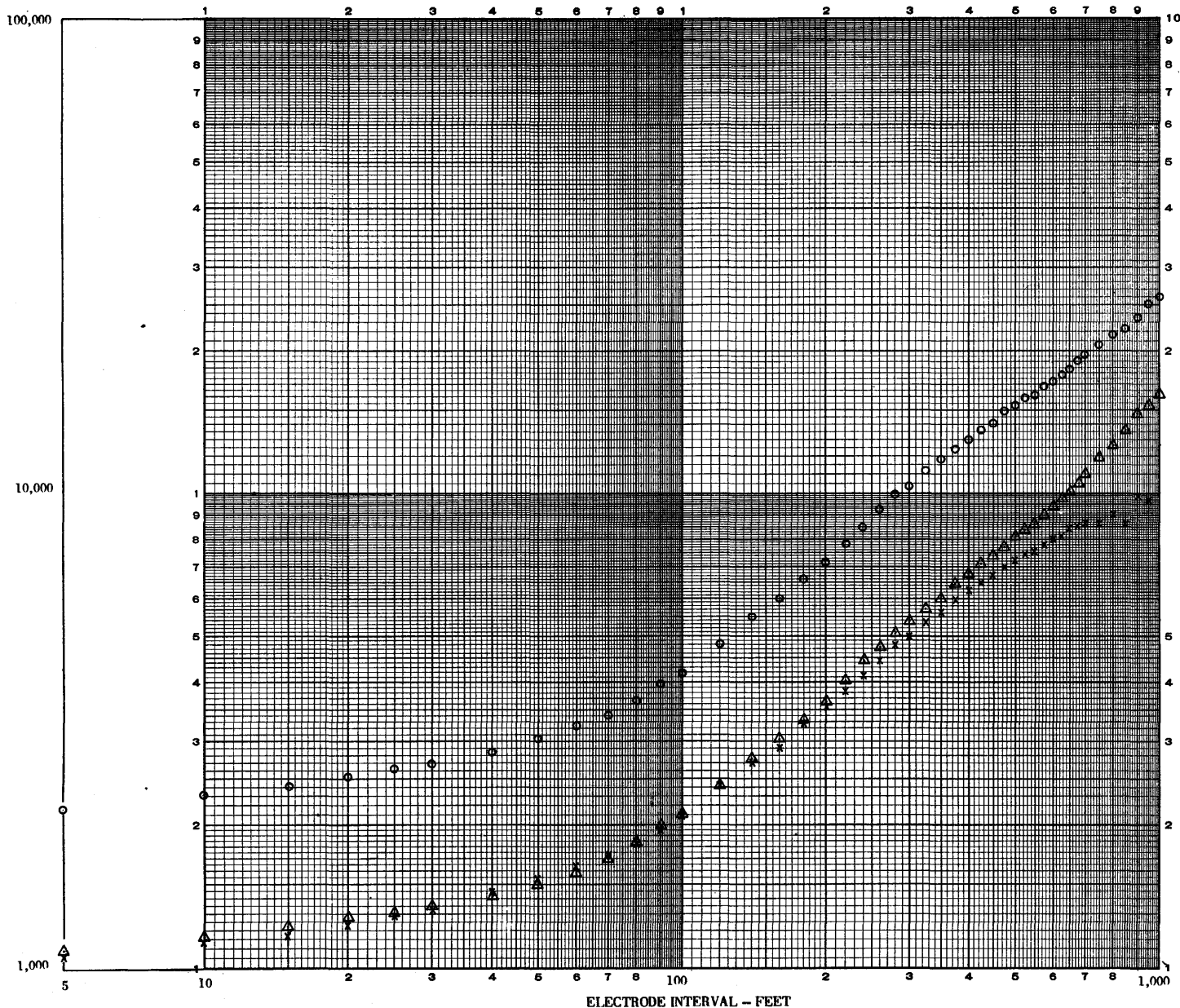
Bearing: P-1 N. 84° E.

Elev.: 788'

○ = Full curve

x = P-2 curve

△ = P-1 curve



Line 13 (G-2) Fond du Lac, Wis. 6/5/47

Location: 0.35 mi. N. of Hwy. 23 on center line  
sec. 12, T. 16 N., R. 17 E.

Bearing: P-1 N. 7° E.

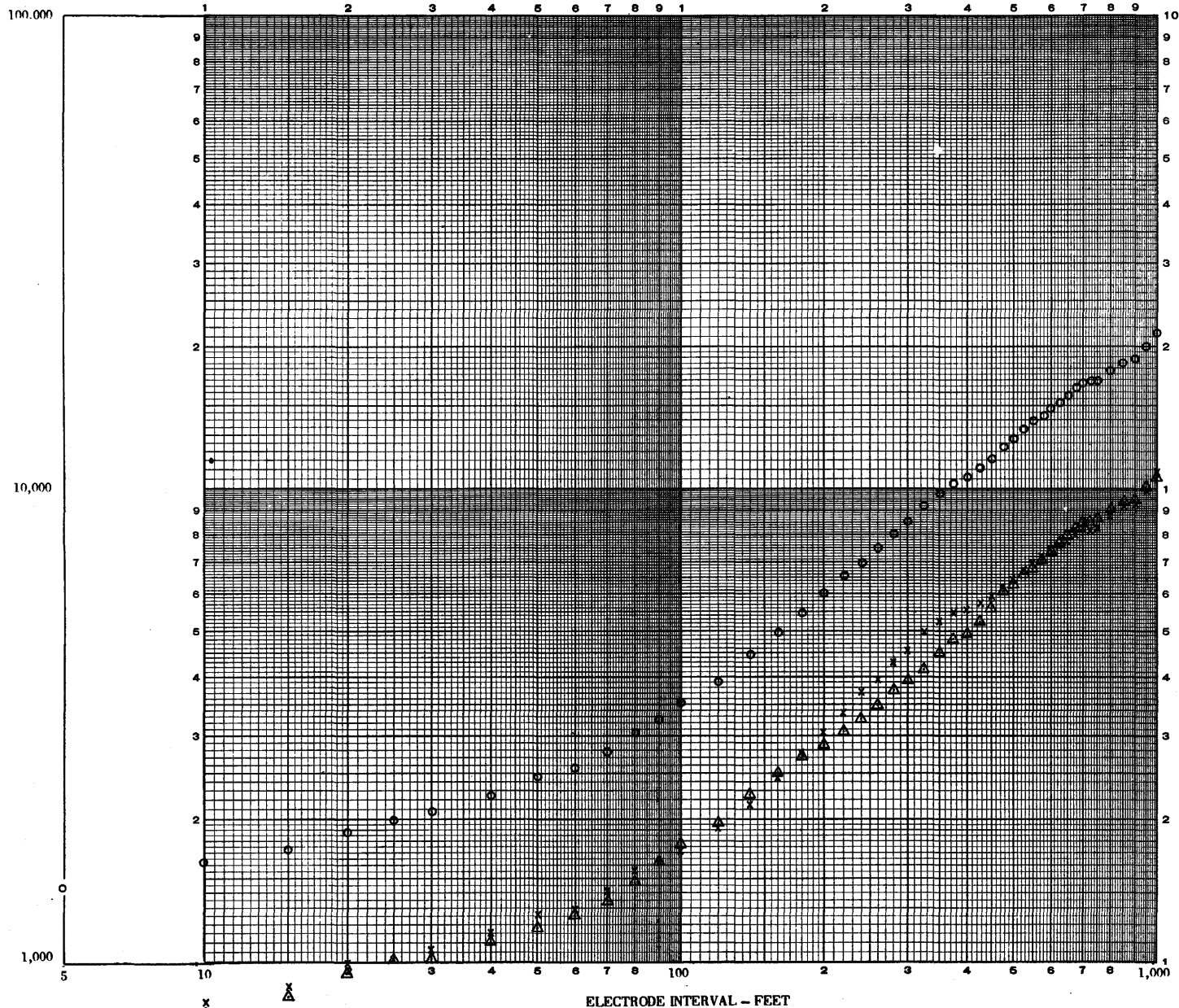
Elev.: 762'

O - Full curve

x - P-2 curve

Δ - P-1 curve





Line 15 (G-2) Fond du Lac, Wis. 6/6/47

Location: 100± yds. W. of center sec. 33,  
T. 15 N. R. 17 E.

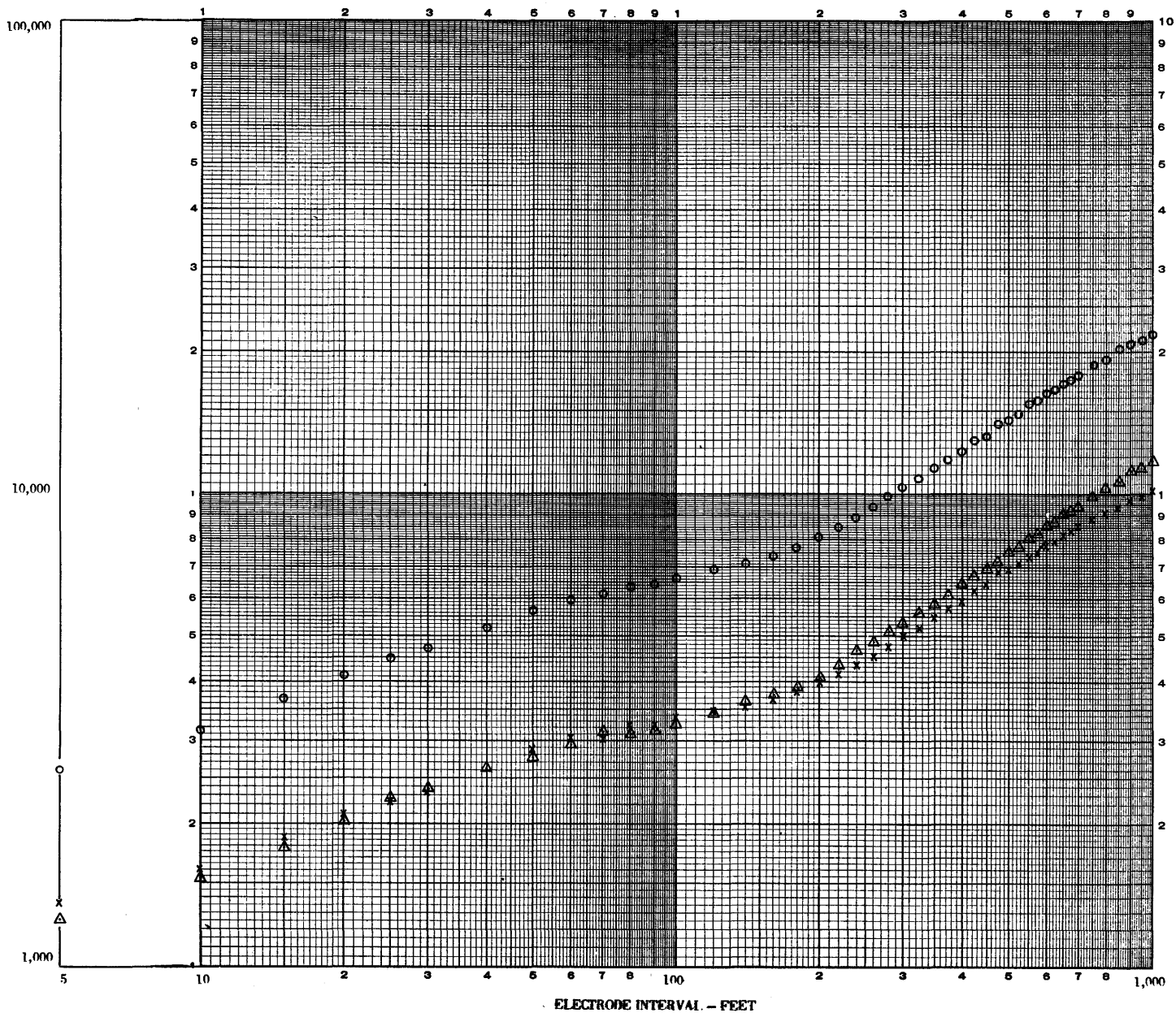
Bearing: P-1 N. 89° E.

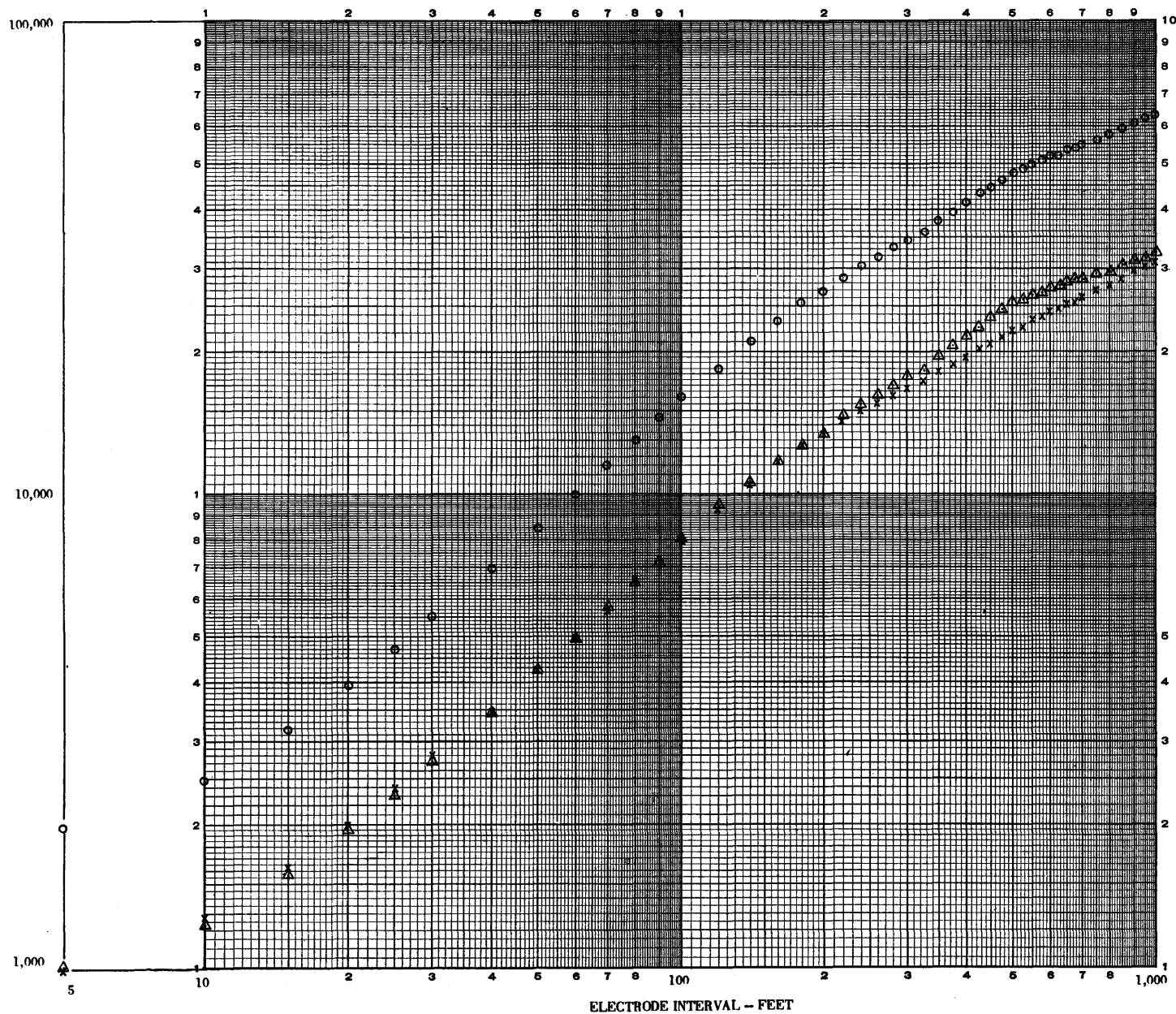
Elev.: 926'

○- Full curve

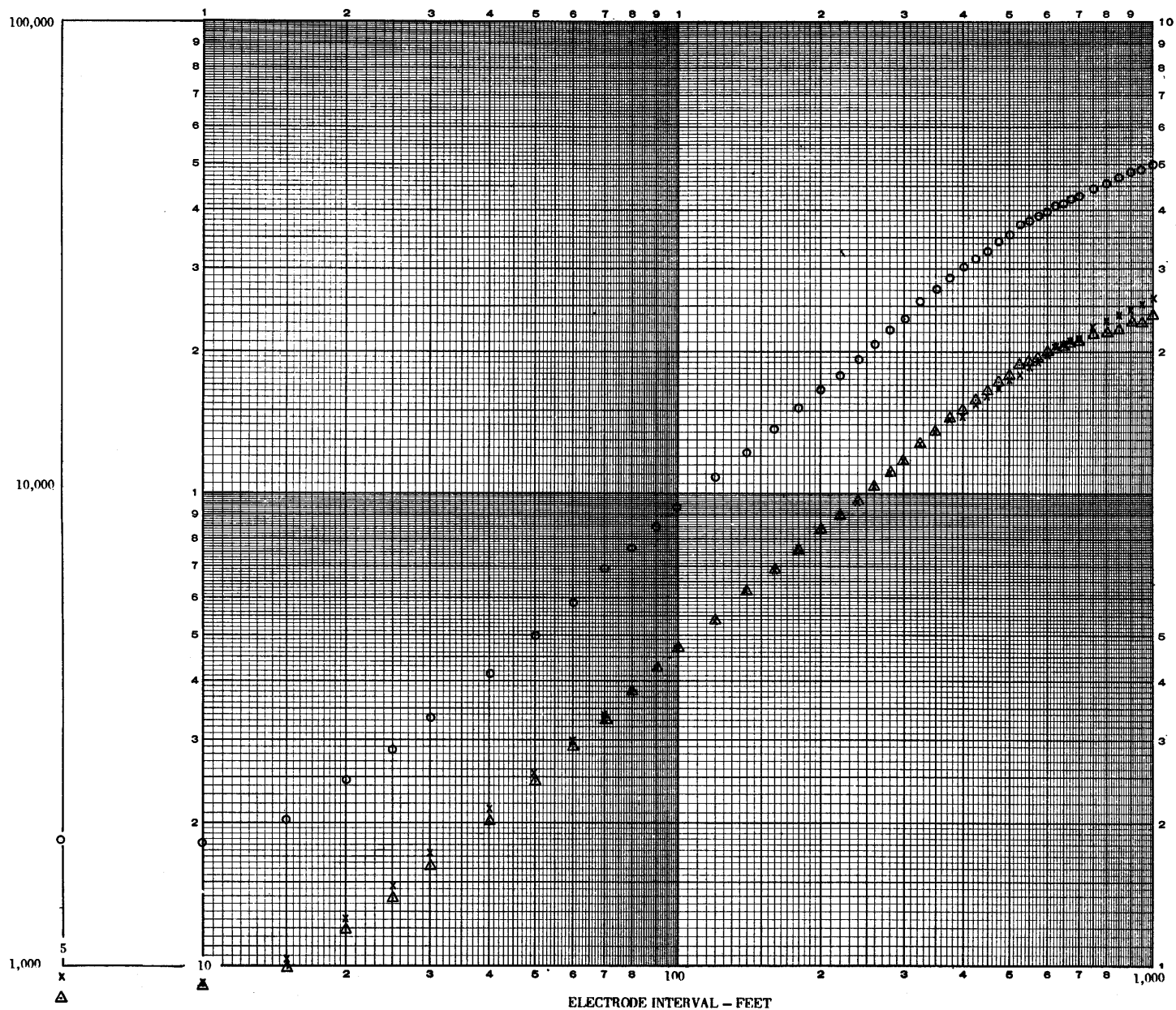
×- P-2 curve

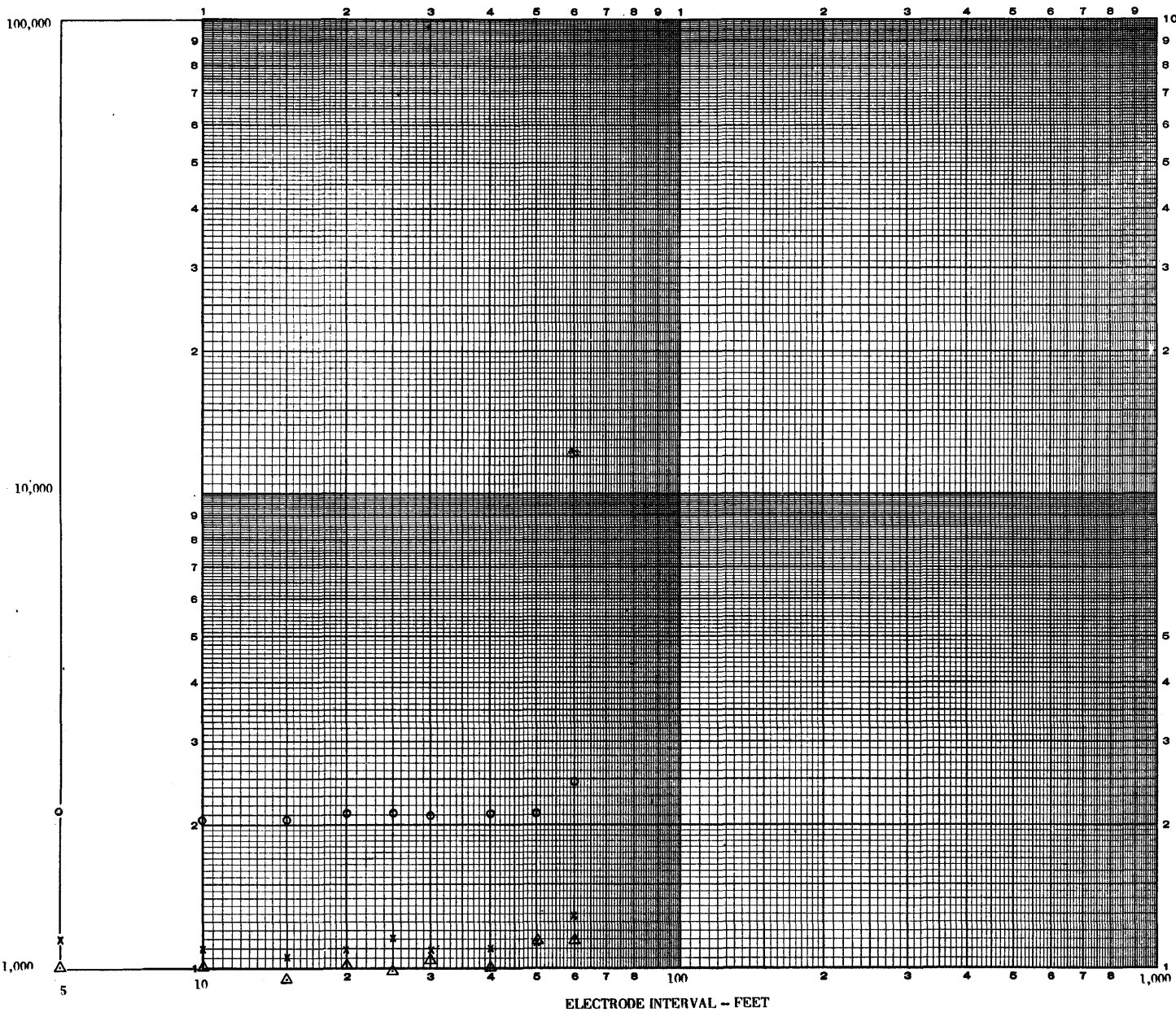
△- P-1 curve











Line 19 (G-2) Fond du Lac, Wis 6/10/47

Location: 1500 ft. N.W. of overpass on  
C. & N.W. Ry. NW¼ sec. 26, T. 15 N.,  
R. 17 E.

Bearing: Not taken.

Elev.: Not taken.

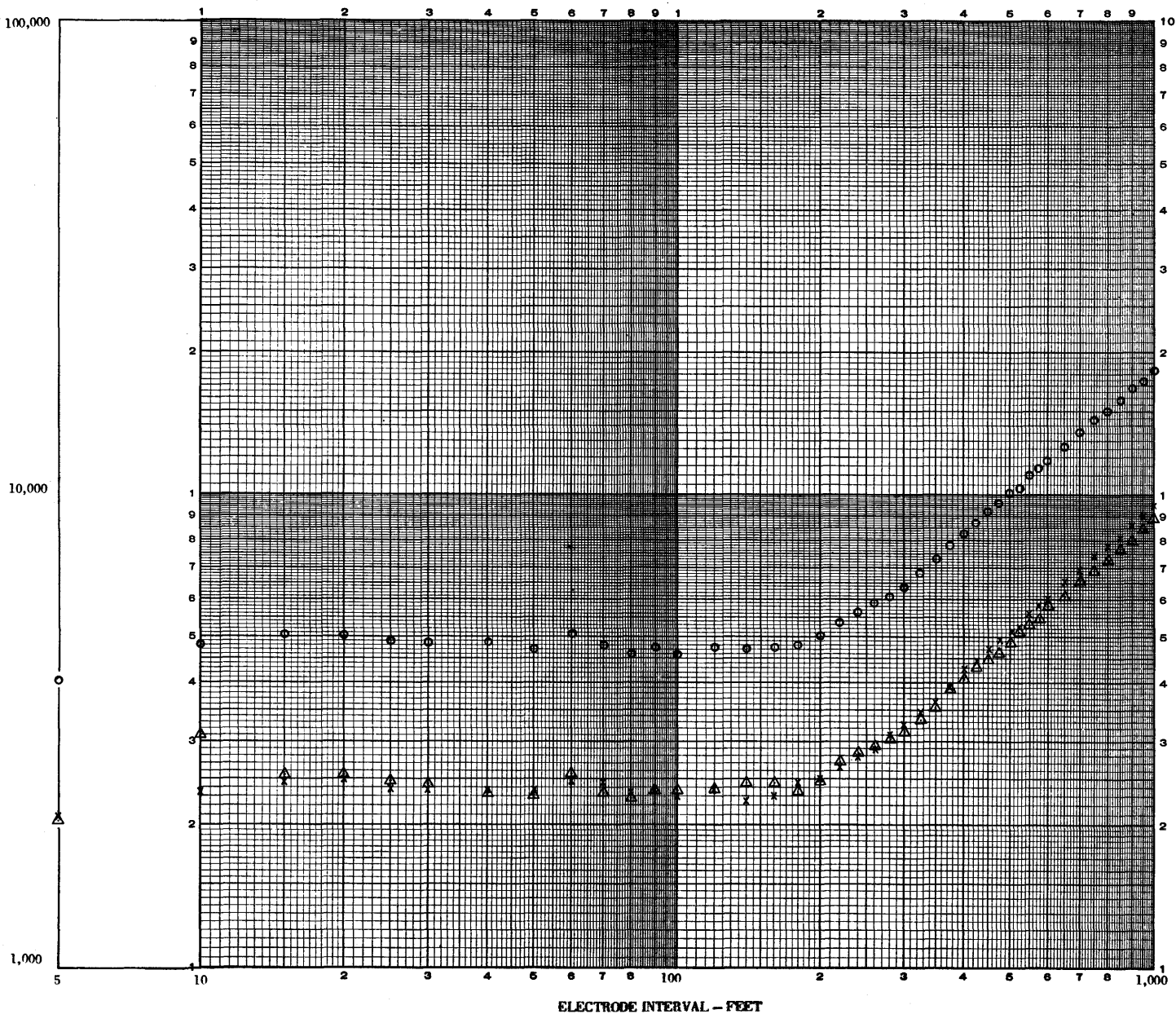
Given up due to a buried conductor  
along R.R. track.

O = Full curve

x = P-2 curve

Δ = P-1 curve





ELECTRODE INTERVAL — FEET

