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A REPORT ON

FURTHER GRADIENT EIP SURVEYS

OVER EXTENSIONS TO THE FEDERATION GRID

TRIAL HARBOUR ROAD, NEAR ZEEHAN, TASMANIA

ON BEHALF OF

RENISON LIMITED

E.L. 11/76

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PRIVATE AND CONFIDENTIAL

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FURTHER GRADIENT EIP SURVEYS
OVER EXTENSIONS TO THE FEDERATION GRID
TRIAL HARBOUR ROAD, NEAR ZEEHAN, TASMANIA
ON BEHALF OF
RENISON LIMITED

BY

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SYDNEY, N.S.W.

MAY, 1980

TAS-074D

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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

SUMMARY

A further gradient array electrical induced polarization survey using a small 10 metres dipole carried out along a north-east trend to the south-west of work carried out on the Federation grid in December, 1977 has revealed a number of chargeability anomalies worthy of further comment. For the most part, however, these are only marginally above the 16 millivolts/volt background, and in the case of those described as being of tertiary and secondary geophyiscal interest may be due to formational changes only. Those of primary geophysical interest warrant close follow-up work.

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INTRODUCTION

Following a gradient reconnaissance survey over the Federation grid carried out in November and December, 1977 and described in report TAS-052 dated May 1978, it was decided to extend the grid to the south-west and south.

These surveys were carried out at the request of Mr. L. Newnham, Chief Geologist for Renison Limited. The on site supervision was carried out by Mr. K. Wells while the author provided such additional technical supervision as was required. This work involved about 18 kilometres of line (about 1900 readings including overlaps). The work was carried out by Mr. G. Street,M.Sc.,DIC, assisted variously by Mr. P. Gillespie,B.Sc. and G. Cahill,B.Sc. The work was carried out over 5½ single days and 7 double operator days between 4th and 17th December, 1979. Although only two whole days were completely lost due to rain, rain throughout the period of the survey resulted in much slower progress than would have been the case with better weather.

EQUIPMENT

The equipment consisted of a Scintrex 3 kilowatt time domain transmitter powered by a 10HP Briggs and Stratton motor generator for energisation of the current dipole, and Scintrex time domain induced polarization receivers

(types IPR-8 and IPR-10).

The energisation cycle chosen was a 2 second square wave, while the receiver used a 2 second programme with three slices being read at each station. The decay form, while not plotted, is commented on where significant.

METHOD

Brief notes on the gradient array are included in the appendix to this report.

DATA PRESENTATION

The data is plotted in profile form on the horizontal scale of 1:2000 with vertical scales of:

1 centimetre = 2 millivolts/volt for chargeability
10 centimetre log cycle for resistivity in ohm-metres.

The data has been contoured at a scale of 1:5000 and is presented in two plates - Plate 1, chargeability, and Plate 2, resistivity.

DISCUSSION OF RESULTS

The area was surveyed using three current dipoles as follows:

325N and 1420S on line 1300W - lines 9W, 10W, 11W, 12W, 13W, 14W, 15W, 16W
450S and 1900S on line 600W - lines 3W, 4W, 5W, 6W, 7W, 8W and 9W
690S and 2460S on line 00 - lines 3W, 2W, 1W, 00, 1E and 2E

Each of the significant anomalies located on the survey is separately discussed

below. The letters A to S signify anomalies on the first (1977) Federation grid survey. Numerics 1 to 12 have been used to identify those located on the second survey.

ZONE 1 ..... The most westerly manifestation was on line 16W. Here, three distinct sources are inferred at 945S, 925S and 900S with chargeabilities of 9, 8 and 4 millivolts/volt above background. The estimated maximum depths to source on the former and latter are respectively 40 metres and 15 metres. The decay form is markedly fast which indicates a fine grained disseminated source. A distinct resistivity low of 1500 ohm-metres(+) as against backgrounds of 3000 to 5000 ohm-metres was noted between about 840S and 960S. Only the southern edge (or 'contact') is chargeable. The anomaly is open to the west, and is much reduced in amplitude to the east where it is centred at 885S+50 metres as a 4 millivolt/volt +2 millivolt/volt. The overall resistivity is about 2500 ohm-metres over the anomaly to 3500 ohm-metres either side. A slight increase in chargeability of 5 millivolts/volt above background of 16 millivolts/volt is recorded at 935S on line 14W (Zone Is) and is also associated with a decrease in resistivity to 2000 ohm-metres(+) from 4000 ohm-metres(+). The zone is of secondary interest on line 15W.

ZONE 2 ..... A significant 8 to 9 millivolts/volt above background (16 millivolts/volt) anomaly situated at 560S on line 16W is associated with resistivities of the order of 2500 ohm-metres. The maximum depth to source is estimated to be 40 metres. The decay form is again fast (ΔMn = -8%), which again infers a fine grain size to the source. The anomaly is open to the west, and closes before line 15W is reached. Of secondary interest.

Minor Zones - Line 16W ..... A number of minor zones were defined on line 16W at 060S, 170S(±10 metres), 235S, 280S and 375S. All are of the order of 6 millivolts/volt against background, and infer only minor variations in the mafic mineral background or minor sulphide occurrences. The depth to source is always less than 20 metres, and, in the case of the 8 millivolts/volt response at 235S, about 35 metres.

ZONE 3 ..... On the southern flanks of lines 14W, 13W and 12W a marked fall-off in resistivity was noted south of about 920S, 955S and 970S respectively from 3000 ohm-metres to the north to 1200 ohm-metres to the south. On line 13W at 980S a well defined induced polarization response of 6 millivolts/volt above the local 14 millivolts/volt background was recorded which shows a markedly fast decay form of ΔMn =-10%. This infers the source to be finely disseminated material while the form of the anomaly suggests a maximum depth of 30 metres, and a south dip. The anomaly is not clearly seen to the east, and may merge into zone 1 to the west.

ZONE 4 ..... Within a broad resistivity low of 1500 ohm-metres(±) as against a background of 2000 ohm-metres(±), a broad increase in chargeability from the 14 millivolts/volt background to as high as 22 millivolts/volt was noted between 560S and 700S on line 12W. Individual sources are inferred at 675S and 635S. The absolute value above background of 4 to 6 millivolts/volt is minor, and the depths inferred are shallower at 20 metres. On the adjacent line to the west (13W), between 550S and 680S, higher chargeabilities of 2 to 4 millivolts/volt above the 16 millivolts/volt background were recorded. To the east at 710S and 635S on line 11W, sharp minor chargeability highs of 2 to 4 millivolts/volt above background may also be related. Overall the anomaly located probably

represents a compositional change in the underlying granite, and as such is of tertiary interest.

ZONE 5 ..... A small sharp response of 6 to 8 millivolts/volt was recorded at 850S on line 9W on the overlap between current dipoles on lines 13W and 6W. The maximum depth to source is estimated to be about 10 to 20 metres, and the source is probably less resistive than the enclosing rocks. The decay form suggests a fine grained source. Of secondary to primary interest, though the anomaly is restricted to just this line.

ZONE 6 ..... A single 6 millivolts/volt above background anomaly was located at 040S on line 13W within 1000 ohm-metres material. The maximum depth to source is estimated at about 25 to 30 metres, which shows a fast decay form (ΔMn = -15%) which in turn infers a very fine causative source. Of tertiary to secondary interest.

ZONE 7 ..... Another single significant anomaly of 12 millivolts/volt above the abnormally low 8 millivolts/volt background was defined at 635S on line 11W. The resistivity is also a low 600 ohm-metres against the local 1000 ohm-metres background. The location of this response could marginally have influenced or exaggerated the amplitude of the anomaly due to array 'end effect', however, a lack of this effect on the end line of the array infers the anomaly to be genuine. The decay form observed is again fast at ΔMn = -15%, inferring a fine grain size. The depth to source is about 20 metres. Of primary geophysical interest. The anomaly is not seen to the east or west.

ZONE 8 ..... On the northern ends of lines 7W, 6W and 5W, a marked , broad

increase in chargeability from a background to the south of 16 millivolts/volt to over 8 to 10 millivolts/volt above that background was noted north of 830S, 825S and 835S respectively. The anomaly is open to the north and to the east. On no line is there any significant change in the 1600 ohm-metres(+) background resistivity, while the decay form is again faster than normal (ΔMn = =10%+). The source is interpreted as being due to finely disseminated sulphides or a greater mafic minerals content at a maximum depth of the order of 25 metres+. Of secondary interest.

ZONE 9 ..... Within resistivities of the order of 2500 ohm-metres, a sharp decline to 1000 ohm-metres was defined at 1390S/2W. Accompanying this decline was a significant chargeability maximum of 14 millivolts/volt as against the background of 16 millivolts/volt. A broader increase in chargeability of about 2 to 4 millivolts/volt was noted for about 30 metres(+) of the anomaly centre. The decay form at 1390S is a very fast -25%, and less fast either side. The interpretation is a finely disseminated sulphide source within a host less resistive than the enclosing material.

To the east on line 1W a sharp resistivity low was recorded at 1365S, associated with high background chargeabilities of 20 millivolts/volt as against 14 millivolts/volt which may be related, but is less significant. Thus, only on line 2W at 1390S is the response considered of primary to secondary interest.

ZONE 10 ..... A single sharp chargeability anomaly was recorded centred at 1635S(+5 metres)/3W on the less resistive south side of a material resistivity contrast which shows a ten fold change. (This anomaly is similar for the current dipole on 00 and 6W). The absolute level of chargeability is about

8 millivolts/volt above background, with the maximum depth to source being about 20 metres and the width 10 metres or so. The decay form is fast. The source is considered to be finely disseminated sulphides (and/or an increase in mafic minerals) within a less resistive host.

ZONES 11 & 12 ..... On line 00 generally higher chargeabilities by about 4 to 6 millivolts/volt were observed between about 1400S to 1500S (zone 11) and between 1260S and 1320S (zone 12). Both these weak increases in chargeability are associated with high resistivity of 2500 to 3000 ohm-metres which indicates a disseminated source which the decay form infers to be fine grained. Both are most likely due to formational change only, and as such are of tertiary interest at best. Some continuation to the east is also inferred but is very weak.

CONCLUSIONS AND RECOMMENDATIONS

1. As with the original Federation grid work the chargeability trends grid east west.

2. Similarly, the resistivity data also has the same trend, i.e., grid east west. Overall the resistivity remains within the limits 2500 ohm-metres $\pm$1500 ohm-metres. As such they are somewhat higher than observed on the bulk of the original grid.

3. The background chargeability observed is about 16 millivolts/volt $\pm$1 millivolt/volt with low backgrounds of 11 millivolts/volt observed in the extreme north-west of the new grid.

4. The decay forms observed are invariably fast, which infers fine grain size to the source and/or an inefficient source such as mafic minerals. The fast decay is observed both in the background and within all anomalies.

5. The number of significant anomalies located is significantly less than on the first survey. They have been assessed and graded on the same basis as the 1977 survey. In summary, the conclusions are:-

ZONE 1 ..... Significant maxima of 9 and 8 millivolts/volt at 945S and 925S above the background of 16 millivolts/volt were recorded from sources of the order of 40 metres or less deep. The northern section is associated with resistivities of 3000 ohm-metres which infers a disseminated origin, while the high at 925S has significantly lower resistivity of 1500 ohm-metres which may infer weak interconnection. This anomaly is open to the west The main sources show a fast decay form which infers a fine grained source. The anomaly on line 16W is of secondary geophysical interest.

ZONE 2 ..... An 8 millivolts/volt response centred at 560S on line 16W is accompanied by high 2500 ohm-metres resistivities. The chargeability has a fast decay form (ΔMn = -8%) which infers a fine disseminated source closed to the east and open to the west. Of secondary interest.

ZONE 3 ..... The sole significant anomaly in this zone was defined at 980S within a broad resistivity low which can be traced both east and west. The fast decay form suggests a minor sulphide source, disseminated in nature, or a compositional change at a maximum depth of 20 metres. Of tertiary to secondary interest.

ZONE 4 ..... Higher than background chargeabilities of 2 to 4 millivolts/volt between 550S and 680S on line 13W, 4 to 6 millivolts/volt between 550S and 700S on line 12W, and at 635S and 710S on line 11W are associated with lower resistivity, and are considered to be due to compositional variation within the underlying granites. Of tertiary interest.

ZONE 5 ..... A sharp response of 6 to 8 millivolts/volt recorded on 9W at 850S from the current dipole on line 13W is considered of secondary to primary interest. The maximum depth is 10 to 20 metres, while the source is fine grained and contained within a less resistive host.

ZONE 6 ..... A 6 millivolts/volt anomaly above an 8 millivolts/volt background showing a fast decay (ΔMn = -15%) was defined at 040S/13W. The resistivity of 1000 ohm-metres suggests a disseminated source at 20 metres depth. Of secondary to tertiary interest.

ZONE 7 ..... A single 12 millivolts/volt anomaly on line 11W at 035S showing a markedly fast decay form and a decline in resistivity to 600 ohm-metres is interpreted as being due to a fine grained sulphide source within a slightly less resistive host than the enclosing rocks and is at a maximum depth of 20 metres. Of primary interest subject to the slight possibility of 'end-array' effect.

ZONE 8 ..... A broad increase in chargeability on lines 7W, 6W and 5W north of 830S, 825S and 835S respectively of about 8 to 10 millivolts/volt against the 16 millivolts/volt is interpreted as being due to a finely disseminated sulphide source or an increase in the mafic mineral content

of the underlying granite. The maximum depth to source is about 20 metres. This response is of secondary interest.

ZONE 9 ..... Within resistivities of the order of 2500 ohm-metres(±) a 1000 ohm-metres resistivity low associated with a 14 millivolts/volt chargeability high (against background) was recorded. The source is shallow probably less than 10 metres in depth, and is surrounded by a lesser disseminated halo. The decay form is very fast, inferring either a finely disseminated sulphide source and/or an increase in the mafic mineral content.

ZONE 10 ..... An 8 millivolts/volt response observed at 1640S on line 3W (on both overlapping current dipoles) is considered to be due to finely disseminated sulphides (and/or mafic minerals) within a host less resistive than the enclosing rocks. The response lies on a ten fold change in resistivity. Of secondary importance.

ZONES 11 & 12 ..... were observed at 1450S ±50 metres and 1280S ±25 metres on line 00 as 4 to 6 millivolts/volt anomalies above the 16 millivolts/volt background and are considered of minor importance only.

6. The depth to source rarely exceeds 40 metres, and commonly ranges about the 20 metres mark.

The final evaluation of the anomalies located on this survey must be made with the drilling results of the first survey being borne in mind. The amplitude of the anomalies detected in the second survey vary little from those expected

in normal variations within a rock unit. This is certainly true for anomalies categorised as being of tertiary and secondary importance. Perhaps the results of a precise magnetic field survey may assist in this evaluation.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.

A.W. HOWLAND-ROSE, MSc, DIC, AMAusIMM, FGS.

GEOPHYSICIST

SCINTREX

APPENDIX

BRIEF SIMPLE COMMENTS ON THE GRADIENT, DIPOLE-DIPOLE AND POLE-DIPOLE ARRAYS AND ON DECAY FORM

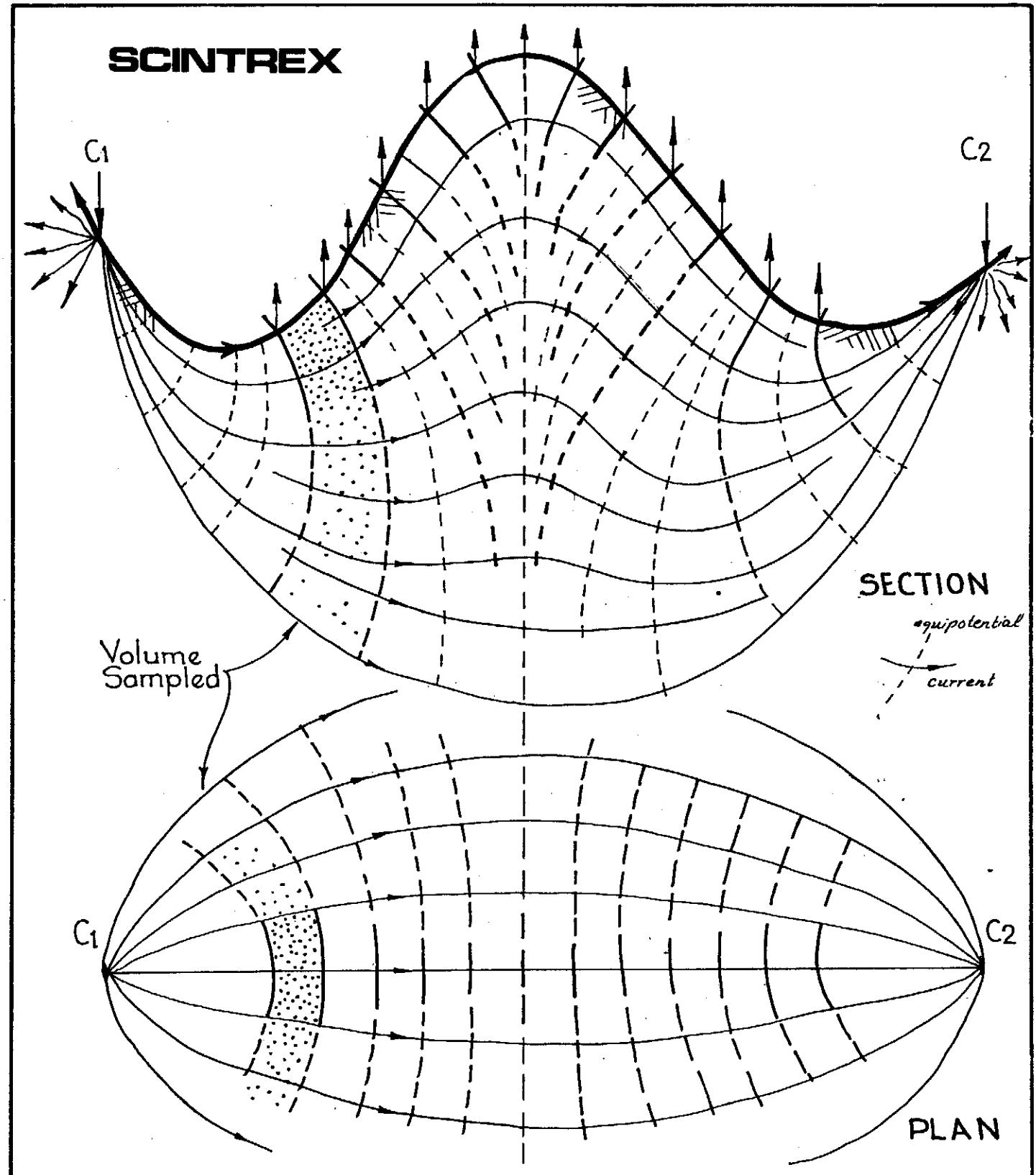
INTRODUCTION

In the case of the surveys discussed in this report, it is important that the geologist can relate the geophysical data to the underlying geology if he is to make the best use of this data. It is the author's opinion that *only* the geologist will be able to relate the data to geology. For this reason brief, simple comments follow on the salient features of the gradient, dipole-dipole and pole-dipole arrays. These comments show how the data relates to the volume of underlying rock which influences it. Comments are also made on the decay form.

DISCUSSION

Gradient Array:- In this array both current electrodes are distant from the potential dipole. Figure 1 displays the salient features of the *primary* current flow and primary equipotential field generated during energisation and shows the influence of terrain on the current paths. From this diagram it can be seen that the *apparent resistivity* measurement is a summation of a volume of material normal to the local slope, *beneath* the surface and at *right angles* to the line.

The apparent resistivity will be *biased by* the influence of each current electrode, but the *relative* values of *adjacent* readings can be considered to be *reliable*. As each electrode is approached, the readings become *increasingly biased by* that electrode.



Diagrammatic Representation of Primary Current and Potential Field in Steep Topography.

FIGURE 1.

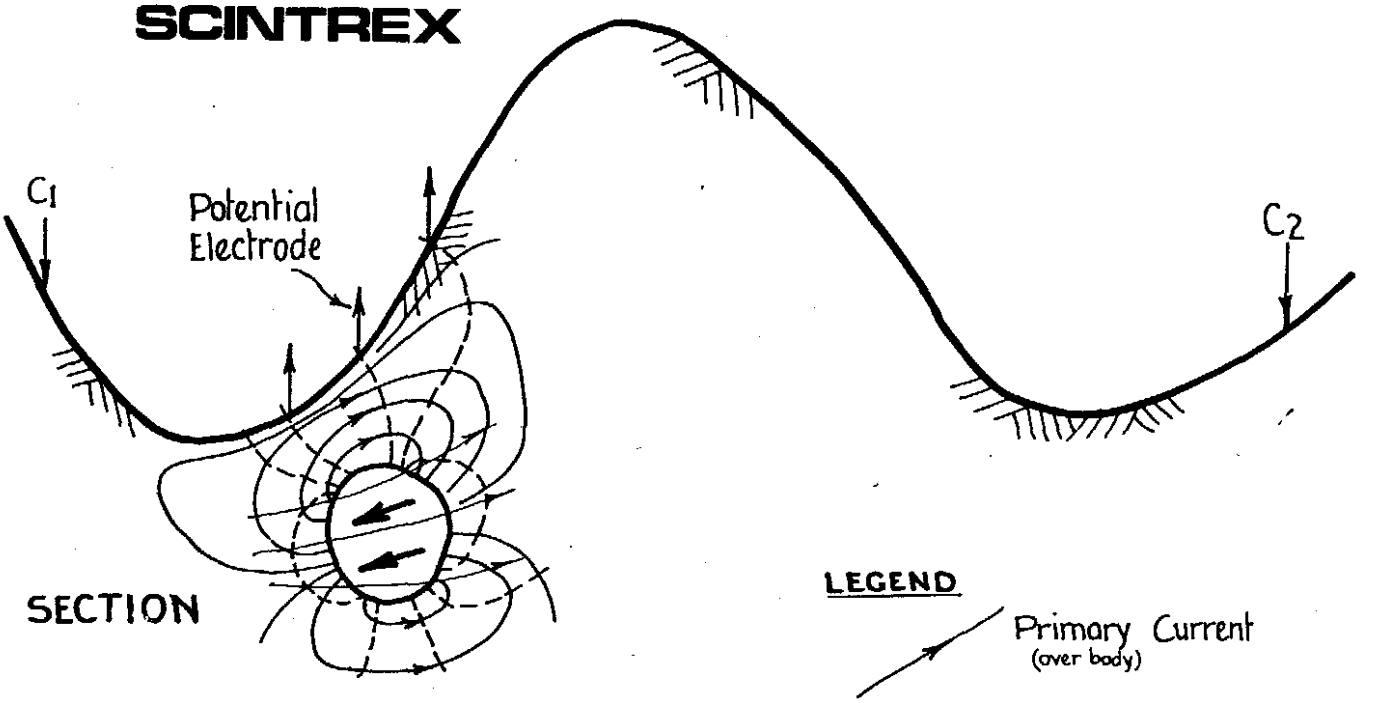
Note particularly that the *source volume* is *normal to slope* and not vertically beneath the potential dipole. Therefore all maximum depths refer to depths below surface *normal to the slope*.

Note also that the volume of material *closest to* the potential electrodes will influence the data most. It is difficult to easily quantify the complex relationship between the volume of material sampled and its distance from the potential dipole.

Figure 2 displays the secondary current pattern generated from the decay of induced polarization effect *within* a chargeable sulphide source, together with the equipotential field generated by that decay. Note that due to the necessarily curved nature of the current flow outside the body, the on-surface manifestation is *wider than* the *source width*. Note also that the volume sampled in the primary potential field (apparent resistivity ρa) is not necessarily the same volume as is the secondary potential field (apparent chargeability *Ma*). This is, of course, true for *any* array.

Dipole-Dipole:- In this array the current dipole is generally small, generally 20 to 100 metres. Figure 3 displays the current pattern in section and in plan for a dipole-dipole array. The equipotential P_1 and P_2 tap a volume as shown in this diagram whose characteristics are read on the n = 1 station and plotted as a single point midway between the transmitting dipole C_1 to C_2 and the potential dipole P_1 to P_2. As progressively higher n values are read, a deeper and wider volume of material is sampled, this always being plotted midway between the transmitting and receiving dipole, and at a deeper level in the pseudo-section presentation used in this report. It is *vital* to realise that this data point

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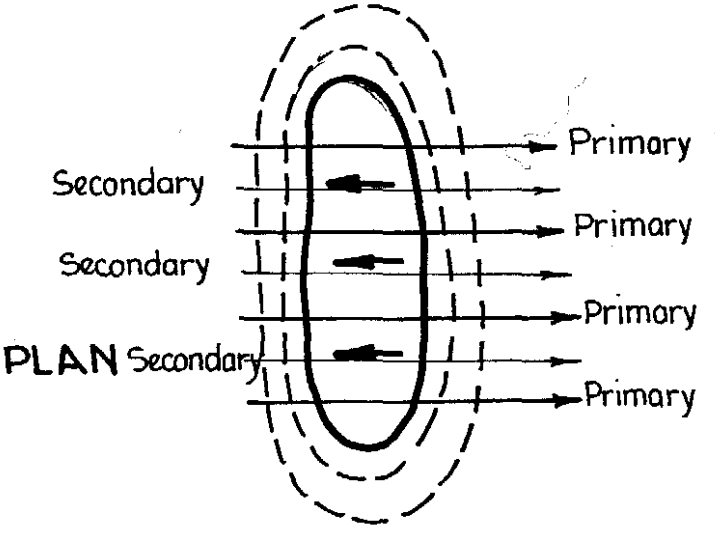
LEGEND

Primary Current (over body)

Internal Polarization (at depth within body)

Secondary Current (I.P)

Secondary Potential Field

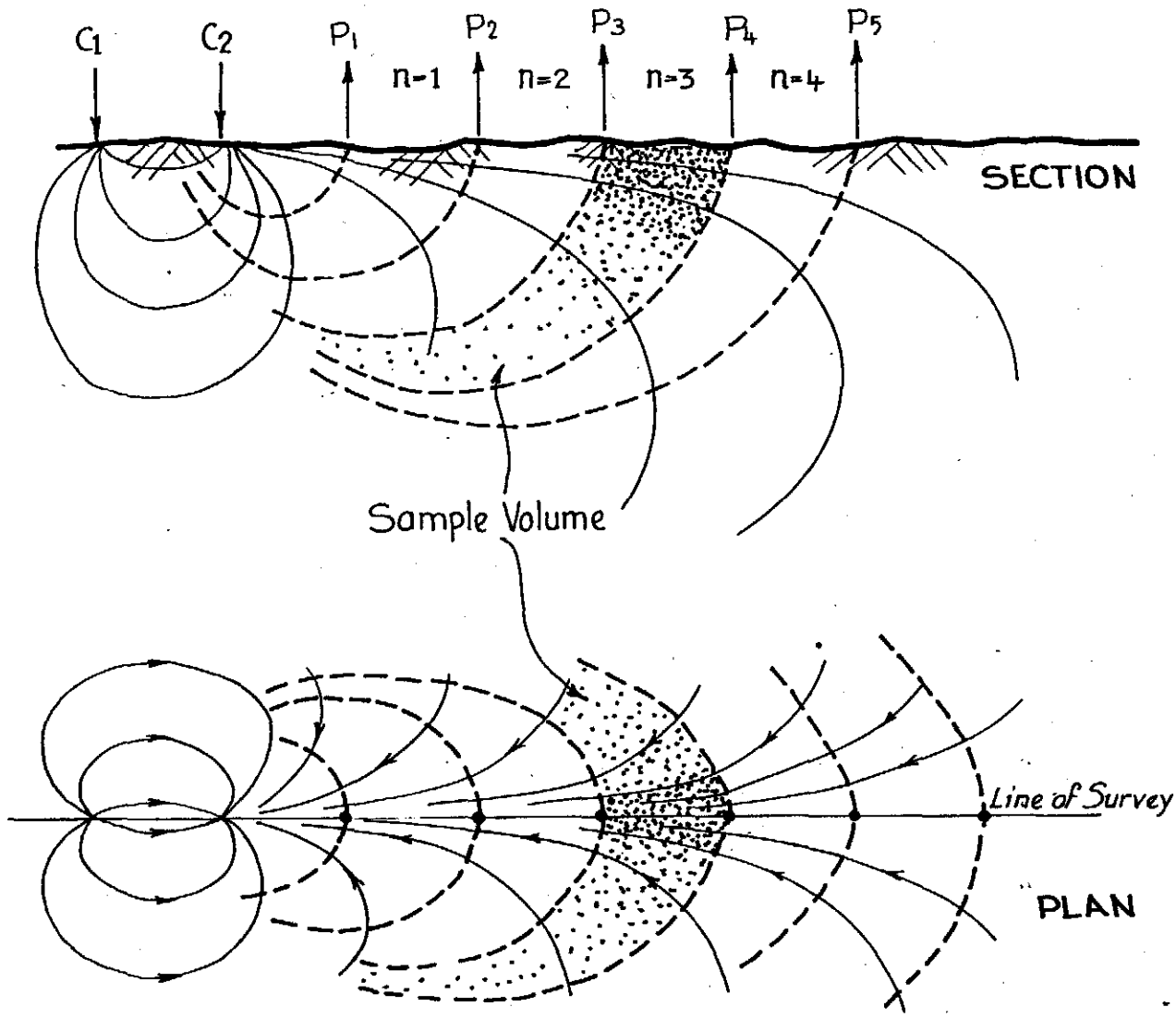


Diagrammatic representation of secondary current (I.P. effect) and secondary potential field in steep terrain.

5 cm

FIGURE 2.

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Dipole - Dipole Array
Primary current paths and equipotential field
Showing volumes sampled

5 cm

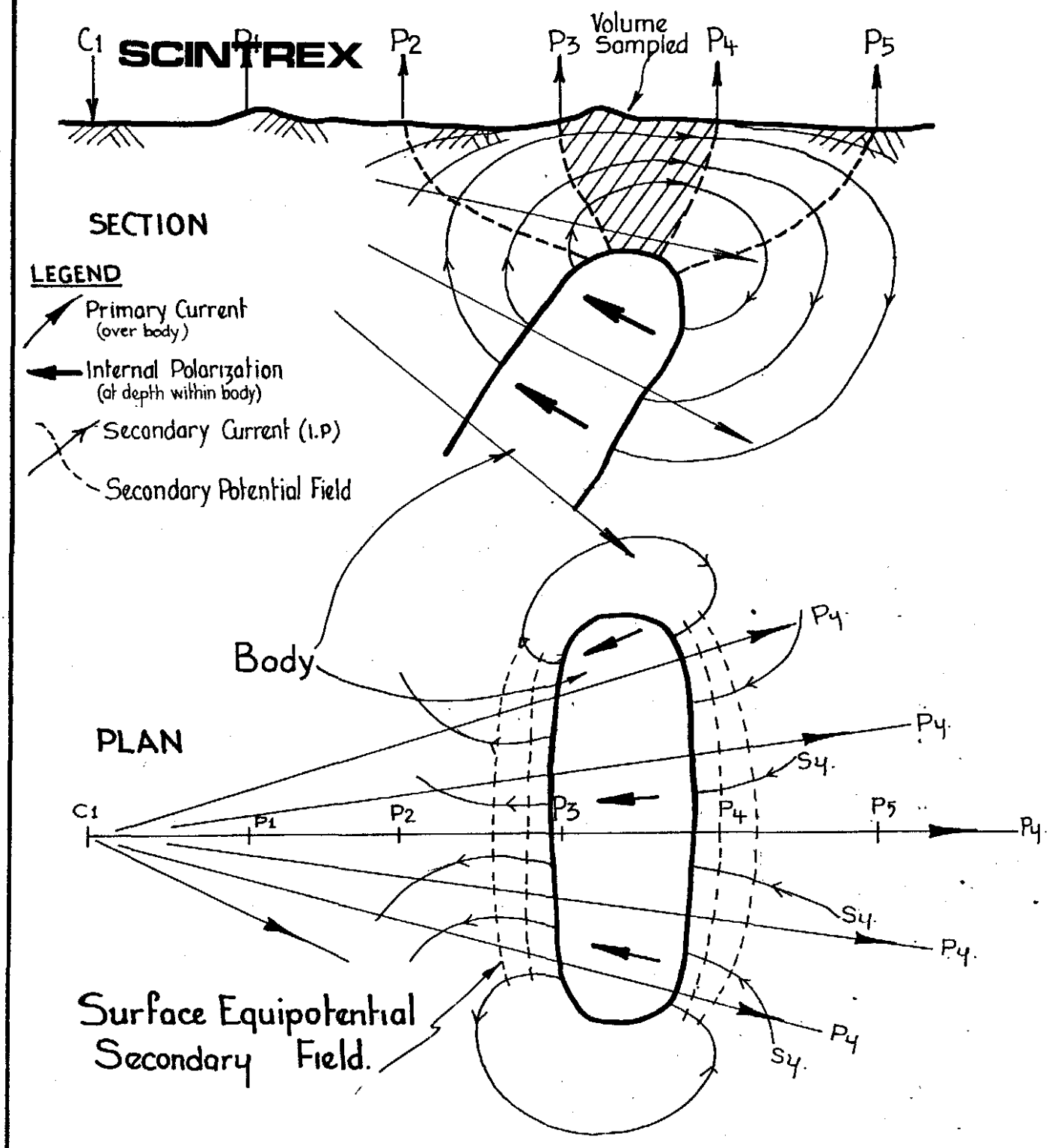
FIGURE 3.

does not represent the characteristics of the ground at the point plotted, but that of the *total volume* sampled.

A further characteristic of the array is that where the effective spacing ($n \times a$) is greater than the depth to the source, a 'high' (or 'low', depending on characteristics) will occur as each of the dipoles (i.e. transmitting C_1 and C_2 and potential P_1 and P_2) pass over the source of that anomaly. The resultant 45° patterns on the pseudo-section DO NOT represent dip, or even depth extent, but merely represent a complex interference pattern over the source due to the potential and current dipoles. For a single source, this *double peak effect* can be recognised as it tends to have two maxima displaced by ($n \times a + w$) where w is the width of the source. For multiple bodies this is difficult if not impossible to resolve by dipole-dipole arrays alone.

The enclosed Figure 4 shows the discharge of the energy stored in the body. As can be seen, the area sampled in section is tapped between the equipotentials generated by the discharge of the stored energy. These will not necesssarily be of the same form as those for the resistivity data, although they are, for convenience, plotted in the same format as for resistivity. Again, it is vital to note that theyrepresent the volume sampled as shown in Figure 4, *and not* the characteristics of the point at which they are plotted. Double peaks also occur as each of the two sets of electrodes pass over a source, where $n \times a$ is greater than the depth to source. Where $n \times a$ is less than the depth to source, a single maximum will be produced midway between the energising and measuring dipoles $C_1/C_2$and P_1/P_2.

Pole-Dipole:- This array is similar in principle to the dipole-dipole array,



Current path and secondary equipotential field due to discharge of stored energy (I.P. effect) in the case of Pole-Dipole or Dipole-Dipole.

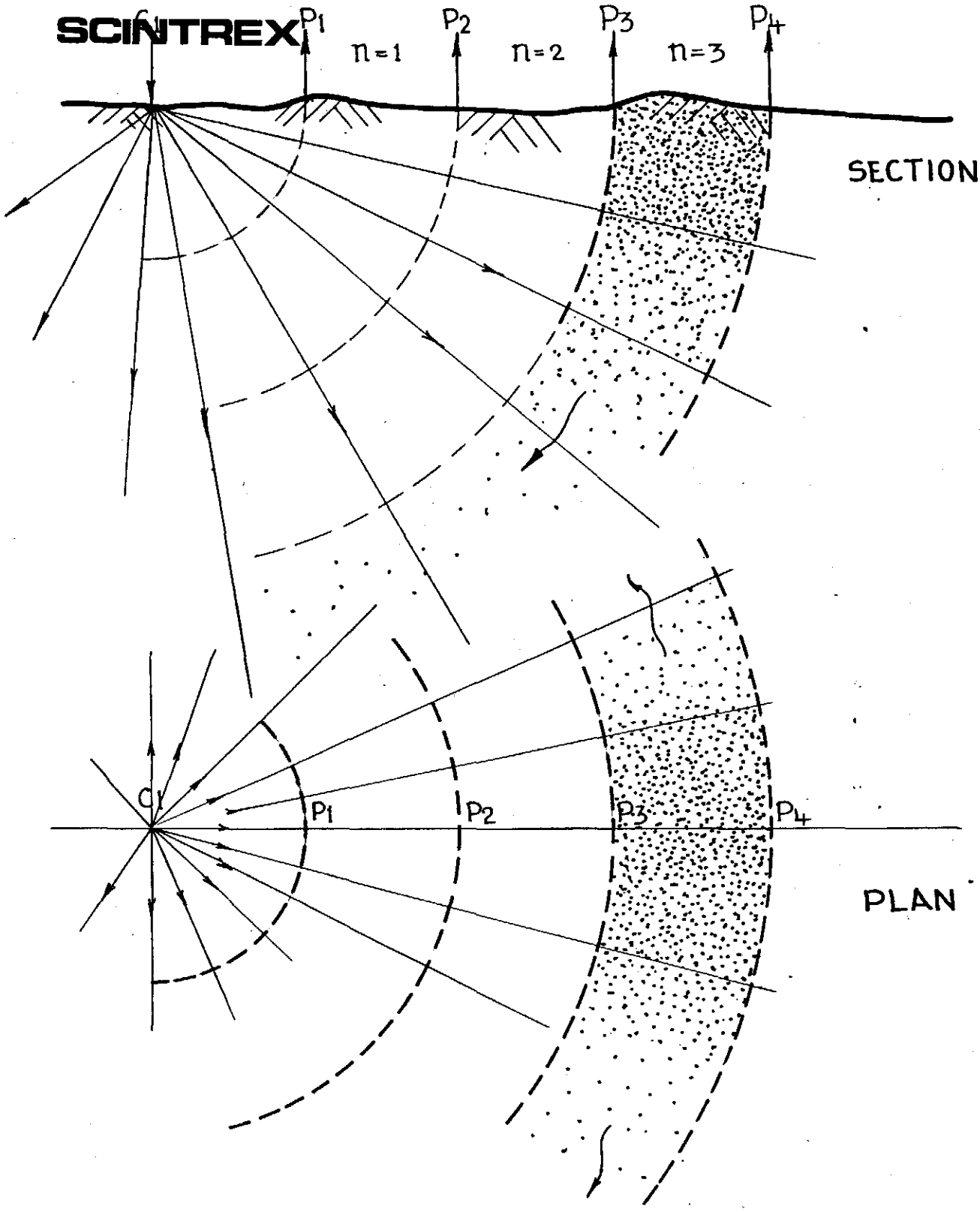
5 cm

FIGURE 4.

except that a single electrode is placed 'close' to the potential dipole, with an 'infinite' electrode placed 10 $\times n \times a$ away from the 'pole-dipole' set-up, and, where practical, at right angles to it. The enclosed Figure 5 shows the distribution of current flow in section and in plan, about the pole source C_1. The potential electrodes P_1 and P_2 tap off the volume between them, which is contained between spheres whose centres are the pole source. The primary current reading is normalised for the geometry and plotted in profile or pseudo-section format as per dipole-dipole, namely, midway between the closest potential and current dpoles, which in the pseudo-section format is 45° towards the pole source. The chargeability reading is generated in a similar fashion to that described for dipole-dipole (Figure 4).

As with the dipole-dipole array, a double peak will result when $n \times a$ is greater than the depth to source, however, with pole-dipole it will be asymmetric. This will be true for both major resistivity features as well as for chargeability features. An example of this asymmetry for different depth to spacing arrays is shown for the three-array. (The three-array is a pole-dipole array when $n = 1$ and the a spacing is varied.)

The Choice Between Arrays:- Even after some thirty years of active use of gradient, dipole-dipole and pole-dipole arrays, controversy still reigns as to the relative merit of the various arrays. Much depends on the object of the programme, the terrain, the type of source sought, the type and complexity of the overburden/oxidation. Table 1 shows a comparison between arrays which may be helpful, taken from a fairly recent Canadian Geological Survey publication. In resistive mountainous terrain the author prefers the gradient array as the prime reconnaissance method due to the high productivity (2 to 5 times that for



Current Path and Primary Equipotential Field
from Pole-Dipole Array

5 cm

FIGURE 5

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SPHERE RESPONSE THREE ELECTRODE ARRAY

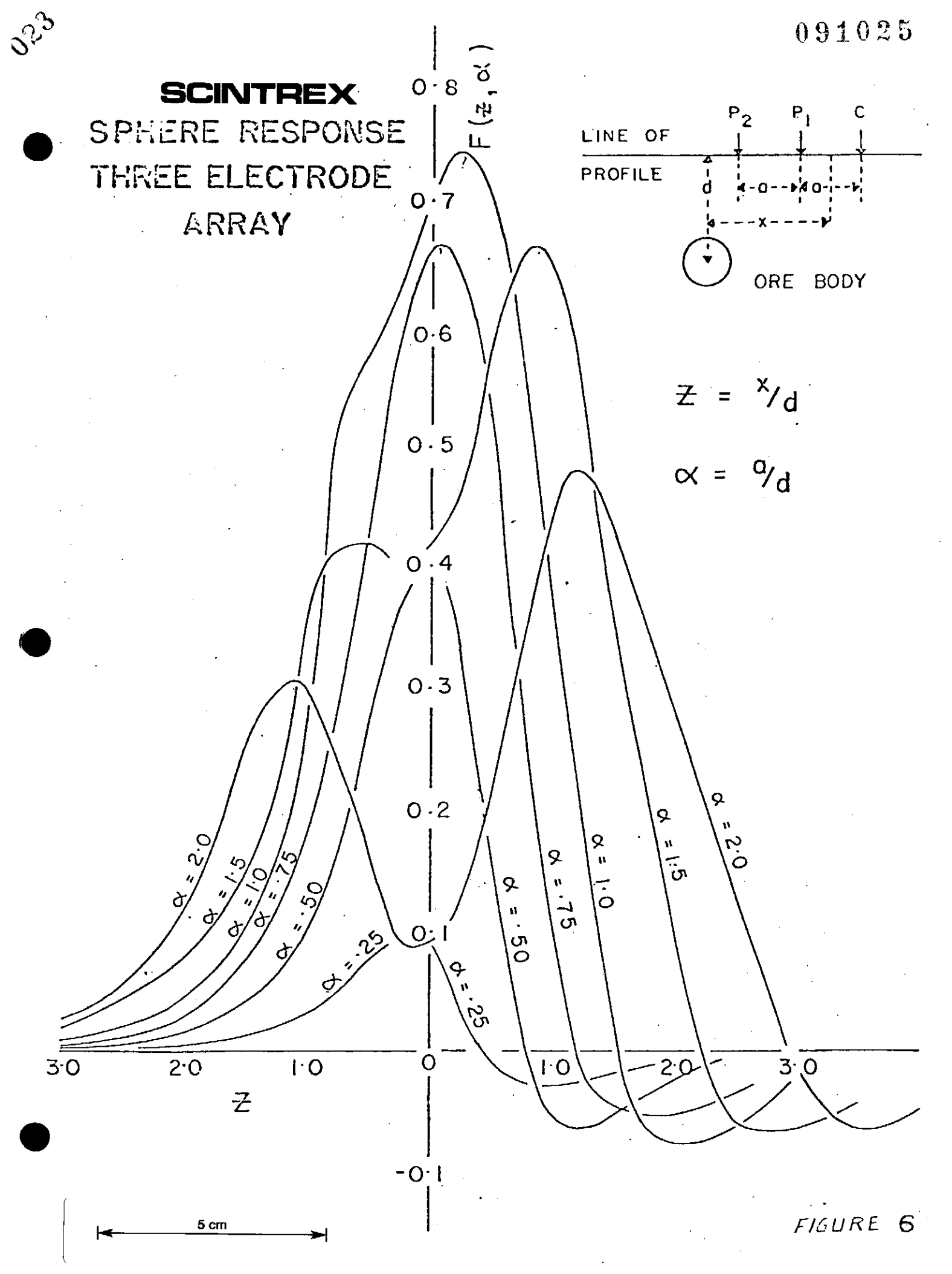


FIGURE 6

TABLE 1
(Table 3.1)

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SCINTREX Comparison of IP Survey Electrode Arrays

(after Sumner, 1972)

	Advantages	Disadvantages	Survey Speed	Signal to-Noise	EM Coupling Rejection
Parallel Field Arrays Wenner	Anomalies symmetrical Synchronous detector possible Many case histories available	Requires more wire: larger field crew Poor resolution Unfavourable in capacitive coupling situations	Fair	Good	Fair
Schlumberger	Symmetrical array Synchronous detection possible Fewer men required Works well in layered earth Type curves available	Less horizontal resolution Unsuitable for horizontal profiling Capacitive coupling possible	Fair	Fair	Fair
Gradient	Map interpretation easier Less masking by conductive overburden Penetration good; safer Communications easier Can use two or more receivers Less topographic effect Data easily contoured in plan Useful where difficulty in making good current contacts	Poor resolution with depth Poor in low resistivity areas Geometric factor varies complexly	Good	Fair	Poor
Potential-About-a-Point					
Three-Array	Good reconnaissance array Fairly good resolution	Asymmetrical More wire needed	Fair	Good	Good
Pole-Dipole, Collinear	Good resolution Good subsurface coverage	Asymmetrical Asymmetrical	Fair	Fair	Fair
Perpendicular Three-Array, Pole-Dipole, Pole-Pole	Virtually eliminates EM coupling	More wire needed	Fair to Poor	Fair	Very Good
Pole-Pole (Two-Array)	Smaller crew needed Less wire needed than for some arrays Good penetration in nonconductive overburden	Susceptible to masking by conductive over-burden	Good	Fair	Poor
PDR (Potential Drop Ratio)	Sensitive to lateral variations "Common mode" noise rejection	Complex interpretation	Fair	Good	Fair
Dipole Field Array					
Dipole-Dipole Collinear	Symmetrical, good resolution Good penetration Less survey wire needed	Slow unless equipment is portable Resistivity topographic effects Interpretation somewhat involved	Fair	Poor	Fair
Dipole-Dipole, Parallel	Special use for EM coupling interpretation	Not used for routine surveying	Poor	Poor	Fair
Down-the-Hole Arrays					
Azimuthal Array (One Potential Electrode Down the Hole)	Fair for exploration purposes Useful in finding the best search direction	Interpretation complex Negative anomalies Strong geometric effects Mainly measures changes in resistivity	Fair	Good	Good
Radial Array (One Current Electrode Down the Hole, mise-à-la-masse)	Good for exploration purposes Useful in finding the best search direction Hole need not stay open	Interpretation complex Negative anomalies Not good for obtaining rock properties	Fair	Good	Good
In-Hole Arrays					
(More than One Electrode in the Hole)	Good for obtaining rock properties Good for assaying Interpretation simple	Current densities may be too large Possible capacitive coupling problems Not designed for exploration purposes Special equipment, expensive	Good	Fair	Good

Extract from: Geological Survey of Canada - Paper 75-31 "Borehole Geophysics Applied to Metallic Mineral Prospecting: A Review"

dipole-dipole), but this should be followed-up by detailed dipole-dipole or pole-dipole surveys as the gradient array, while giving 'maximum depths', cannot give 'minimum depths' as moving source arrays can. Similarly pole- or dipole-dipole surveys which have complex or muliptle sources can very often be resolved by use of limited gradient array detail. While pole-dipole is more efficient to apply in mountainous terrain, it tends to yield asymmetric double peak anomalies, however, to the trained observer, this is no disadvantage.

Brief Comments on Decay Form:- In most surveys three 'slices' of the decay form for the induced polarization reponse are acquired for each station as shown in Figure 7. While six slices are capable of being measured (M_1 to M_6), they are normally combined into pairs $M_1 + M_2 = M_1$ etc. as shown in Figure 7(C). Each of the slices M_1 to M_6 is normalised for a 'normal' decay form such that should the decay form be 'normal' $M_1 = M_3 = M_5$. Thus the operator can immediately recognise any anomalous decay forms which may arise from one of two major sources. Firstly the type of the source can influence the decay form. Coarse grained efficient sources such as sulphides show *slow* decay forms, magnetic and fine grained sulphides often show *fast* decay forms. This can be shown as $\Delta M = M_5 - M_1$, where positive ΔM infers *slow* decay form and negative ΔM *fast* decay form. A superior parameter is ΔMn where

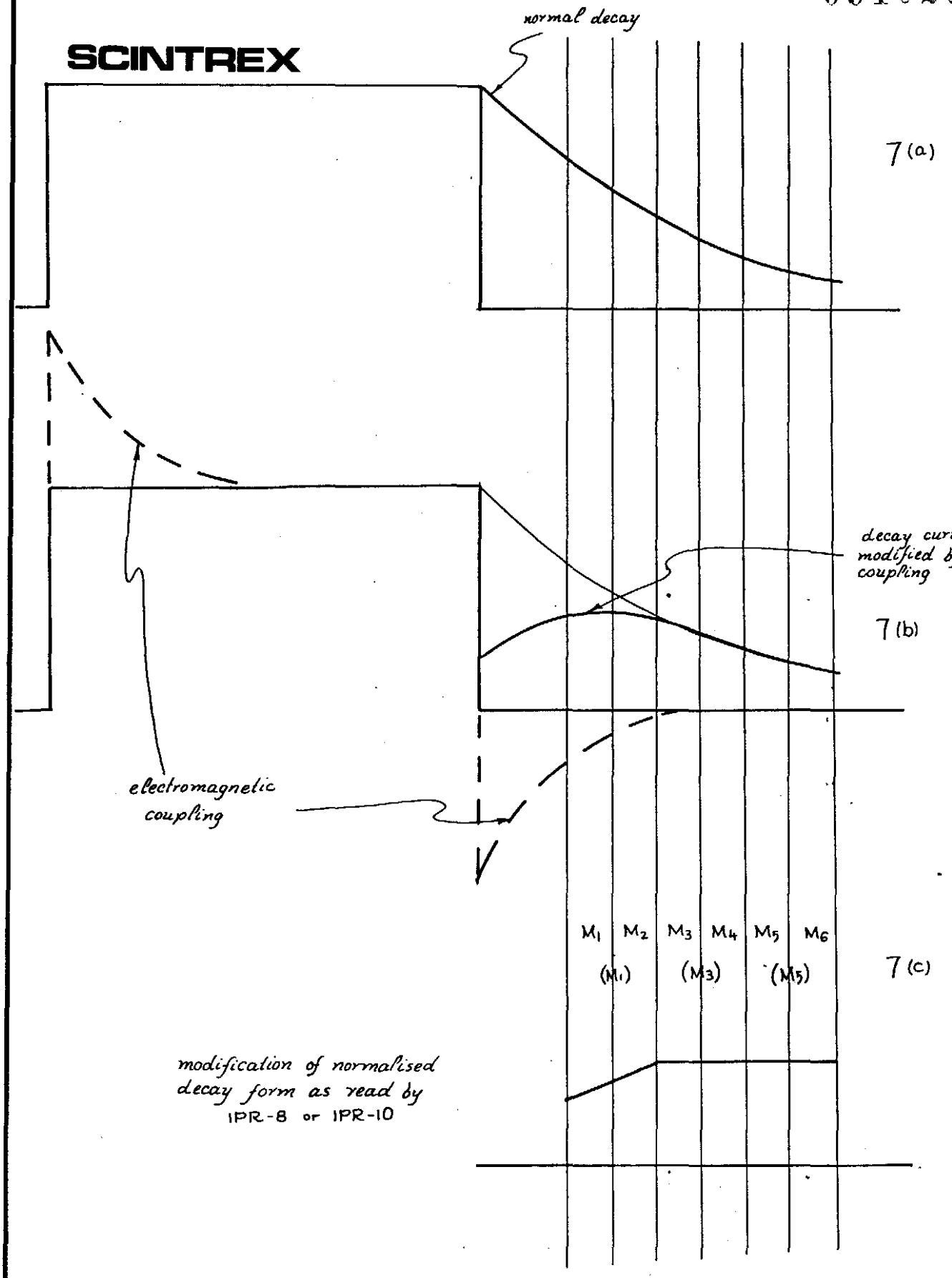
$$\Delta Mn = \frac{M_5 - M_1}{M_3} \times 100 \text{ (in percent)}$$

which is essentially ΔM normalised for the amplitude of the decay. ΔM and ΔMn are merely short hand ways to profile changes in decay form and are essentially qualitative and relative.

Decay forms can also demonstrate the presence of electromagnetic coupling as Figure 7 shows. This is a regional effect as shown on Figure 7(b). This will

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EFFECTS OF ELECTROMAGNETIC COUPLING ON IPR-8 / 10

Fig. 7

produce a normalised M_1 smaller than either M_3 or M_5.

Conclusion:- The above comments are indeed simplistic, and should be considered as a guide only. The author would be pleased to supply references on additional reading on any of the points commented upon.

A.W. HOWLAND-ROSE, MSc, DIC, AMAusIMM, FGS.

028

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24

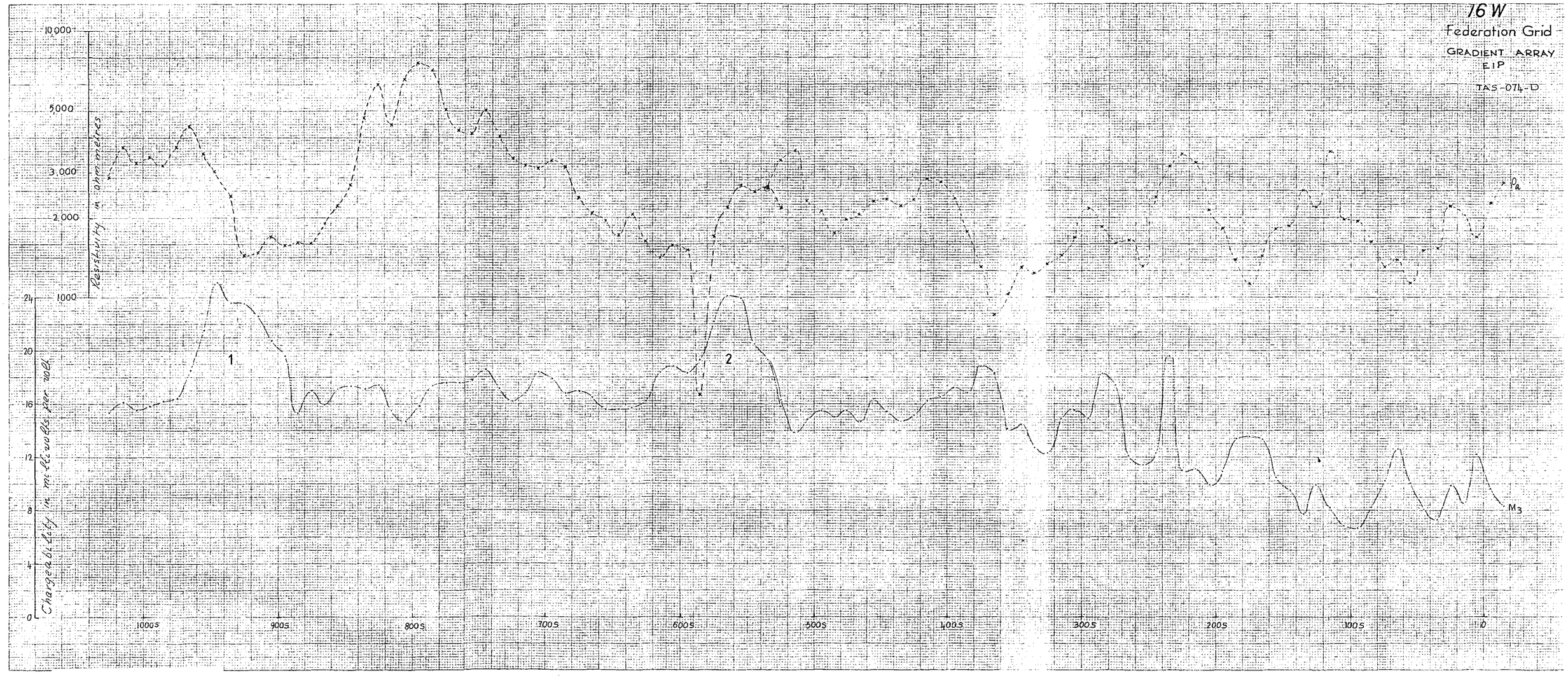
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Federation Grid

GRADIENT ARRAY

EIP

TAS-074-D



5 cm

029

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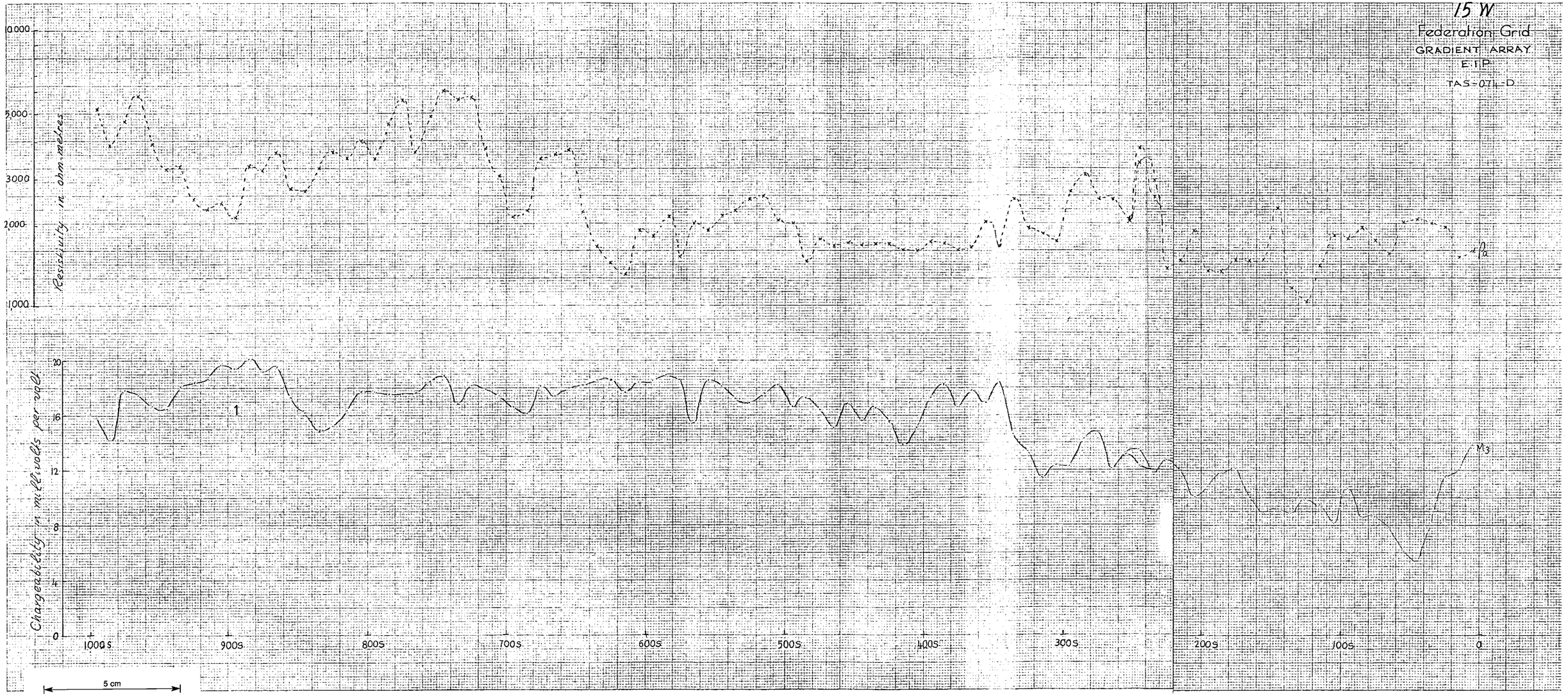
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Federation Grid

GRADIENT ARRAY

E TIP

TAS-071-D



030

091032

30

14W

Federation Grid

GRADIENT ARRAY E.I.P.

TAS-074-D



5 cm


091039
13W
Federation Grid
GRADIENT ARRAY
E.I.P.
TAS-01A-D
Resistivity in ohm-metres
10,000
5,000
3,000
2,000
1,000
Chargeability in milliVolts per volt
24
20
16
12
8
4
0
3
4
6
M3
10005
9005
8005
7005
6005
5005
4005
3005
2005
1005
0
5 cm

032

091034 032

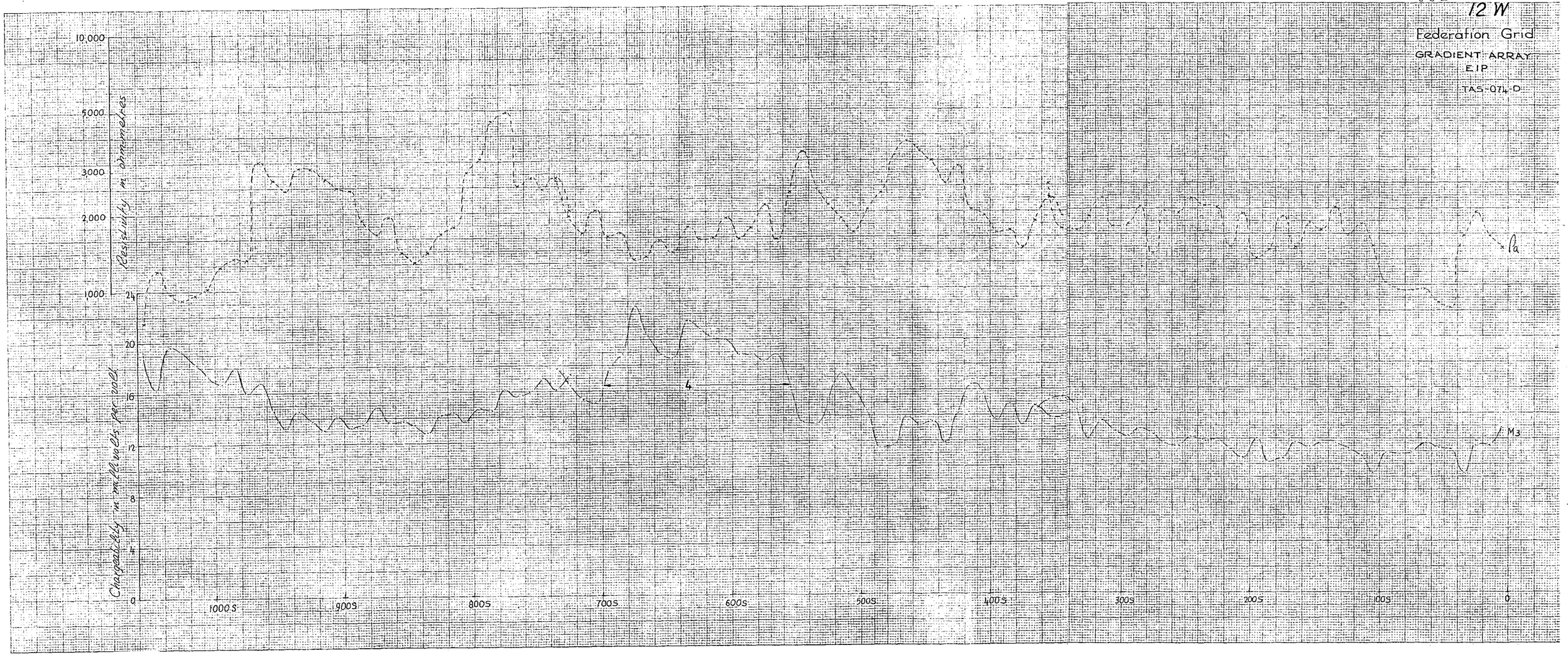
12 W

Federation Grid

GRADIENT ARRAY

E.I.P.

TAS-074-D

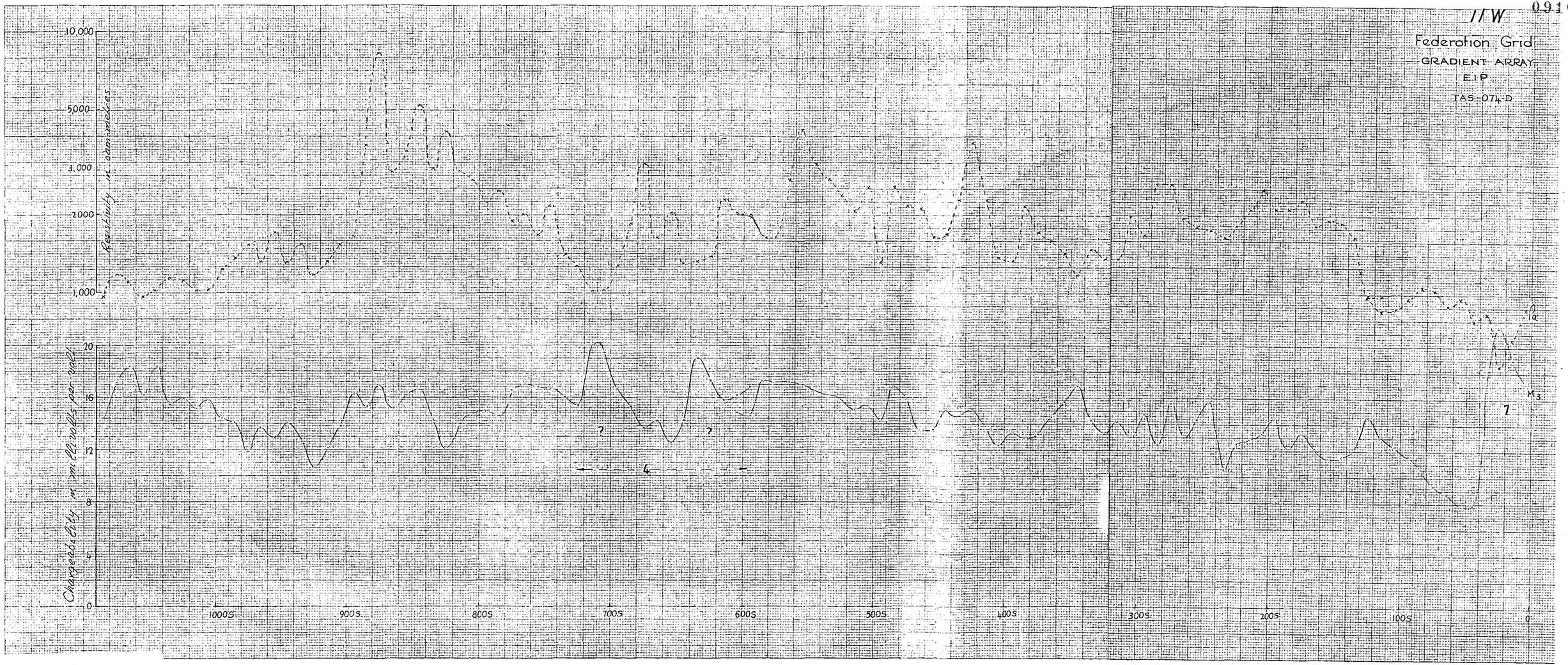


5 cm

033

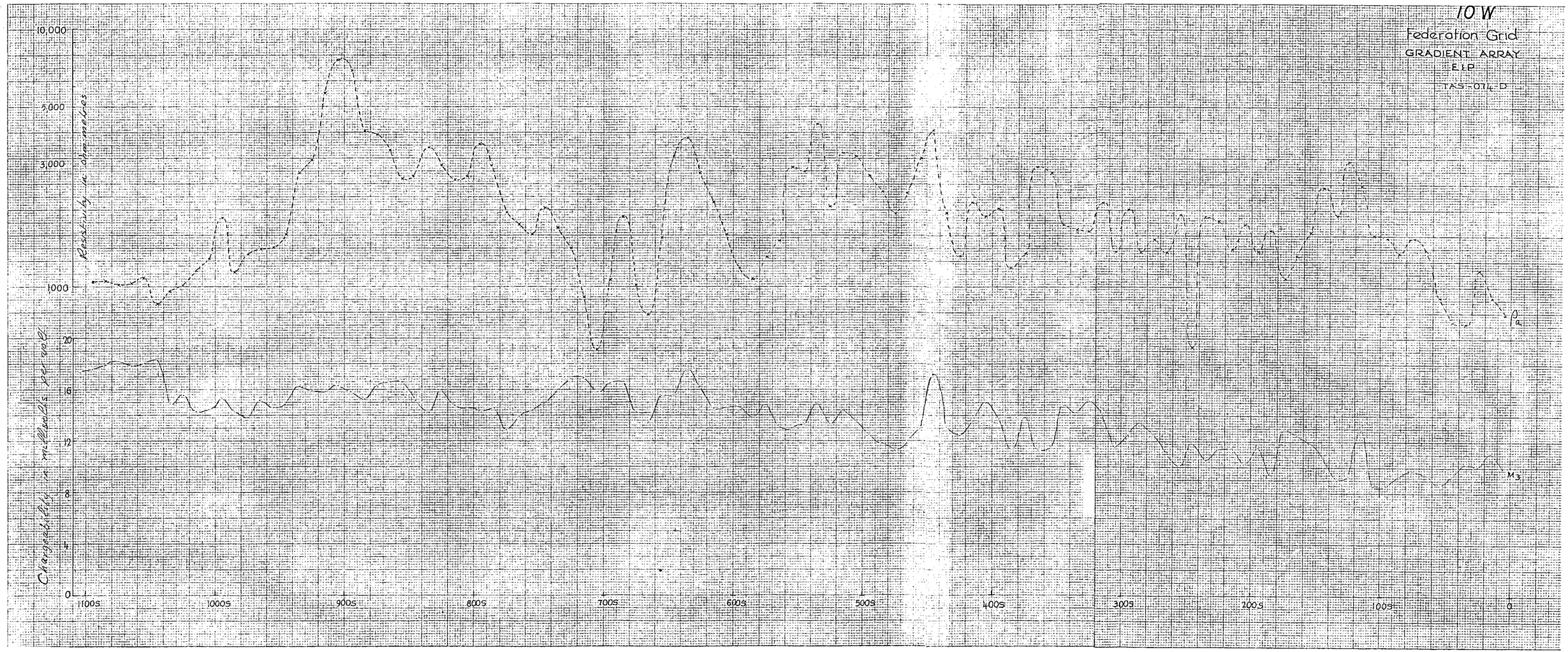
033

091035



034

091036 034



035

091037

9 W

Federation Grid

GRADIENT ARRAY EIP

TAS-074-D

C_1-C_2 on line 13W

Chargeability in milliVolts per volt

Resistivity in ohm-metres

10000
5000
3000
2000
1000

24
20
16
12
8
4
0

5

1100S
1000S
900S
800S
700S

5 cm

KEUFFEL & ESSER CO. MADE IN U.S.A.
10 X 10 TO THE CENTIMETER • 25 X 38 CM.

036

091038

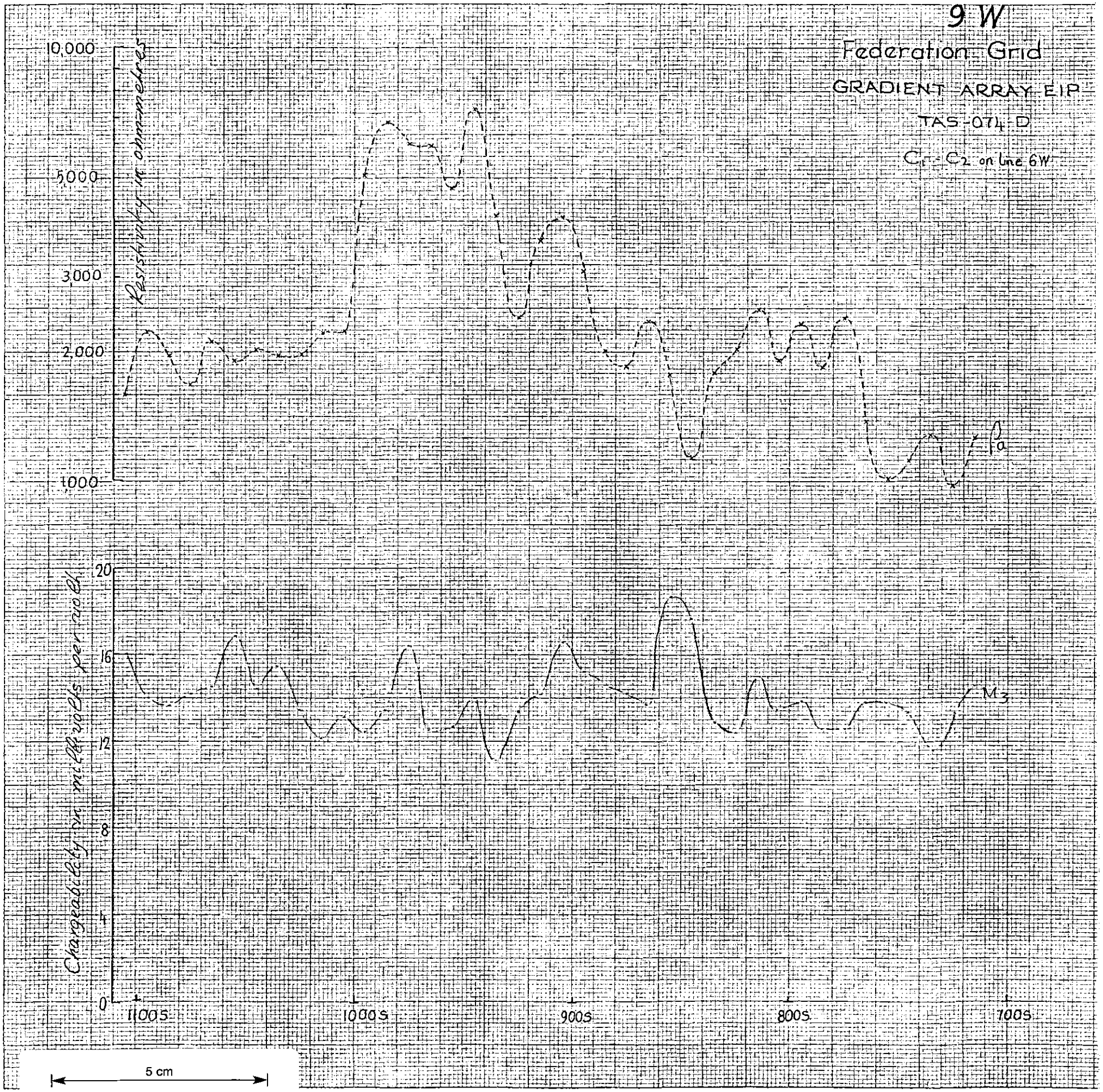
9 W

Federation Grid

GRADIENT ARRAY EIP

TAS-074-D

$C_1 = C_2$ on line 6W



KEUFFEL & ESSER CO. MADE IN U.S.A.
10 X 10 TO THE CENTIMETER • 25 X 38 CM.

47 1514

037

091039

8W

Federation Grid

GRADIENT ARRAY

EIP

TAS-071-D

Resistivity in ohm-metres

10000
5000
3000
2000
1000

Chargeability in milliseconds per volt

20
16
12
8
4
0

1200S
1100S
1000S
900S
800S
700S

P_a

M_3

5 cm

KODAK TRI-X PAN 10 X 10 TO 25 CENTIMETERS • 25 X 38 CM

VIEW 42

038

091040

7W

Federation Grid

GRADIENT ARRAY

EIP

TAS-074-D

10,000

5,000

3000

2000

1000

Resistivity in ohm metres

24

20

16

12

8

4

0

Chargeability in milliVolts per Volt

N.R. Creek

N.R. Creek

P_{10}

M_3

8

1400S

1300S

1200S

1100S

1000S

900S

800S

5 cm

039

091041

6W

Federation Grid

GRADIENT ARRAY E.I.P.

TAS-074-D

Resistivity in ohm metres

10,000

5000

3000

2000

1000

Chargeability in milliradians per sec

24

20

16

12

8

4

0

1400S

1300S

1200S

1100S

1000S

900S

800S

P_a

M_3

8

5 cm

040

040

091042

5W

Federation Grid

GRADIENT ARRAY EIP

FAS-074-D

10,000

5000

3000

2000

1,000

Resistivity at mid-grades

20

16

12

8

4

0

Chargeability in milliseconds per volt

1600S

1500S

1400S

1300S

1200S

1100S

1000S

900S

800S

Pa

M_3

8

5 cm

041

041 091043

4W

Federation Grid

GRADIENT ARRAY

E I P

TAS-074-D

Resistivity in ohm-metres

Chargeability in milliseconds per volt

10,000
5,000
3000
2,000
1,000
500
400

20
16
12
8
4
0

1600S 1500S 1400S 1300S 1200S 1100S 1000S 900S 800S

P_a

M_3

5 cm

KEUFFEL & ESSER CO. MADE IN U.S.A.
10 X 10 TO THE CENTIMETER 25 X 25 CM

4A 1214

042

042

091044

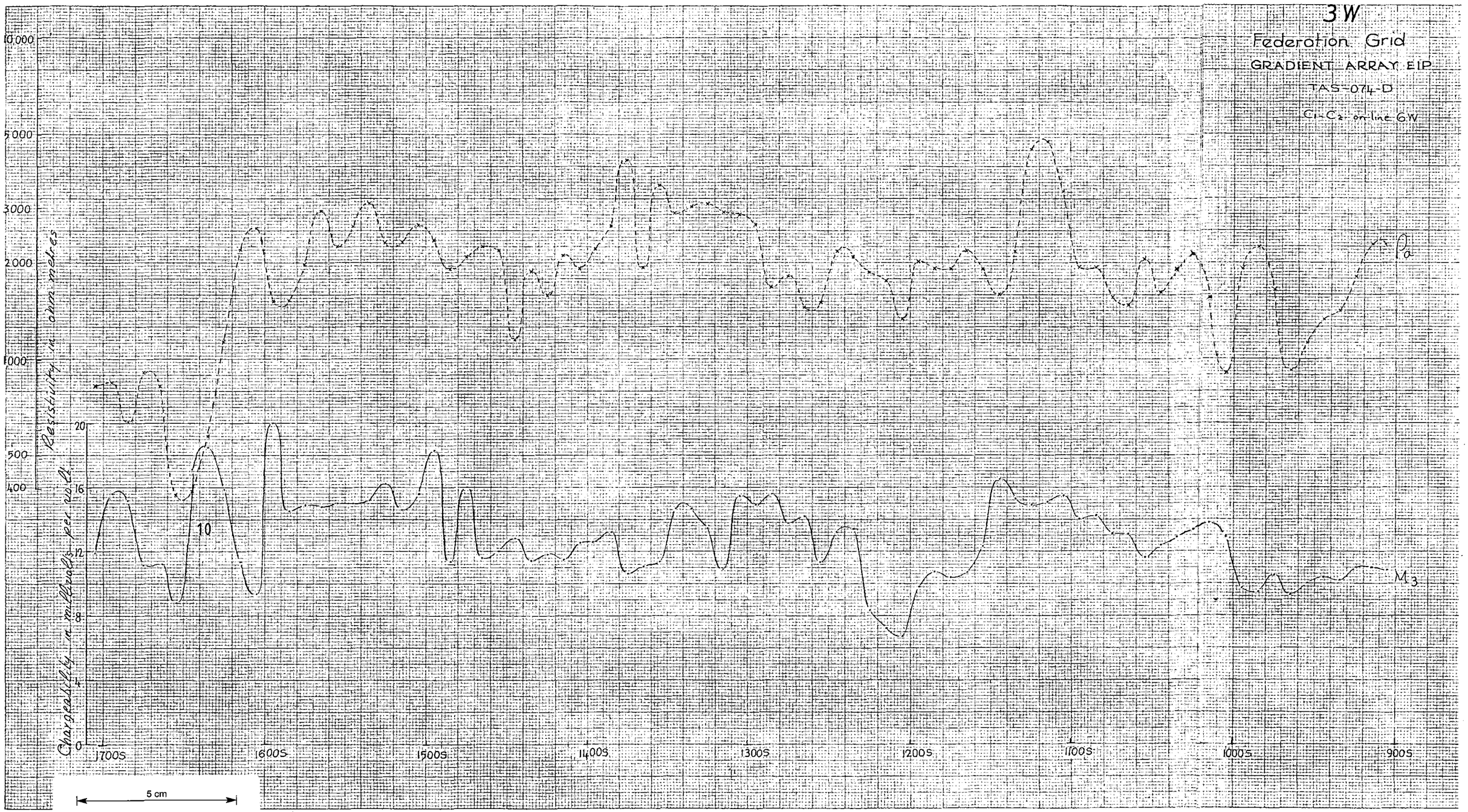
3W

Federation Grid

GRADIENT ARRAY EIP

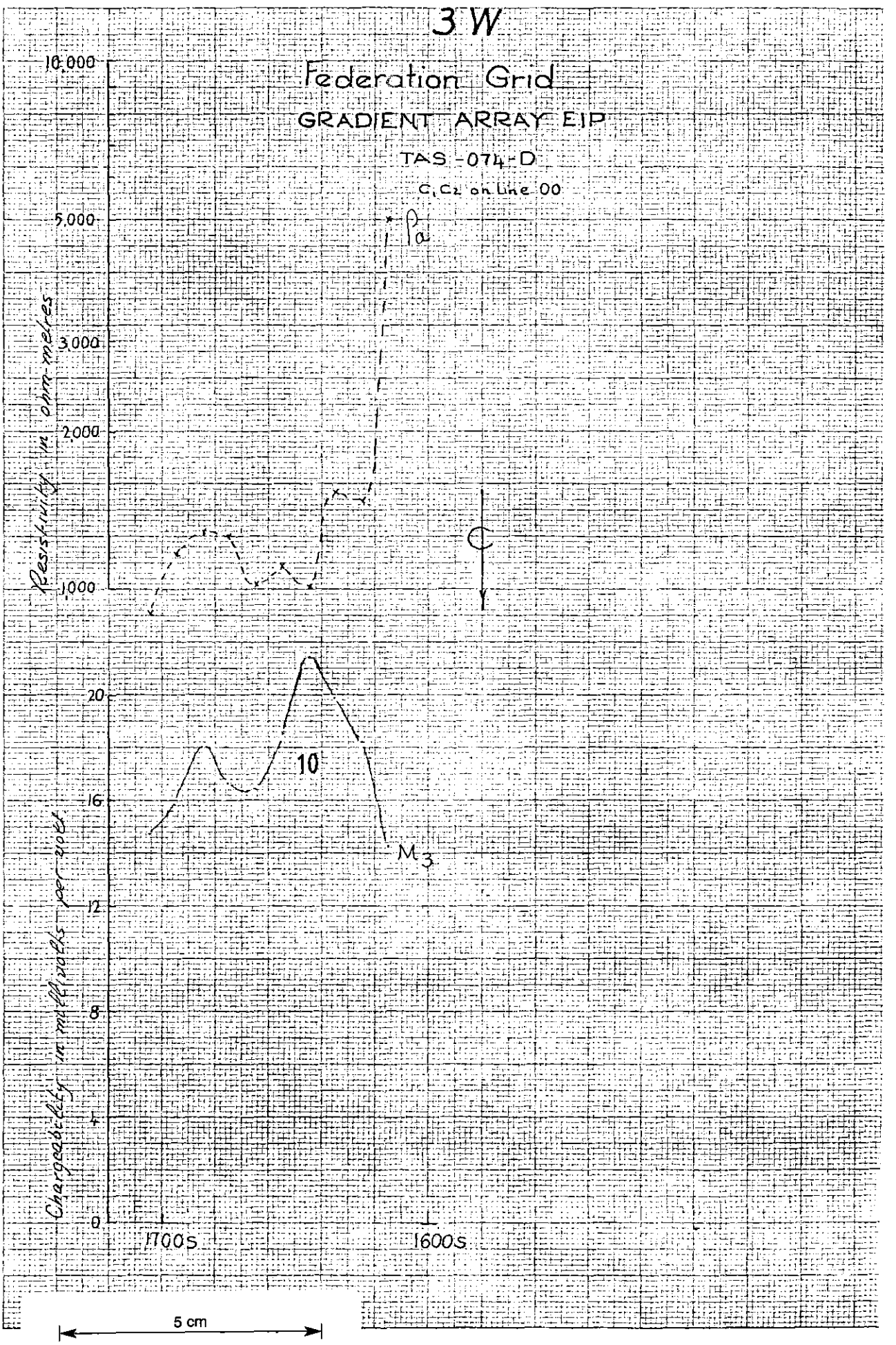
TAS-074-D

C1-C2 on-line 6W



043

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3W
Federation Grid
GRADIENT ARRAY EIP
TAS-074-D
C1C2 on line 00
Pa
C
M3
10
Resistivity in ohm-metres
10,000
5,000
3,000
2,000
1,000
Chargeability in milliseconds per volt
20
16
12
8
4
0
1700S
1600S
5 cm

044

044

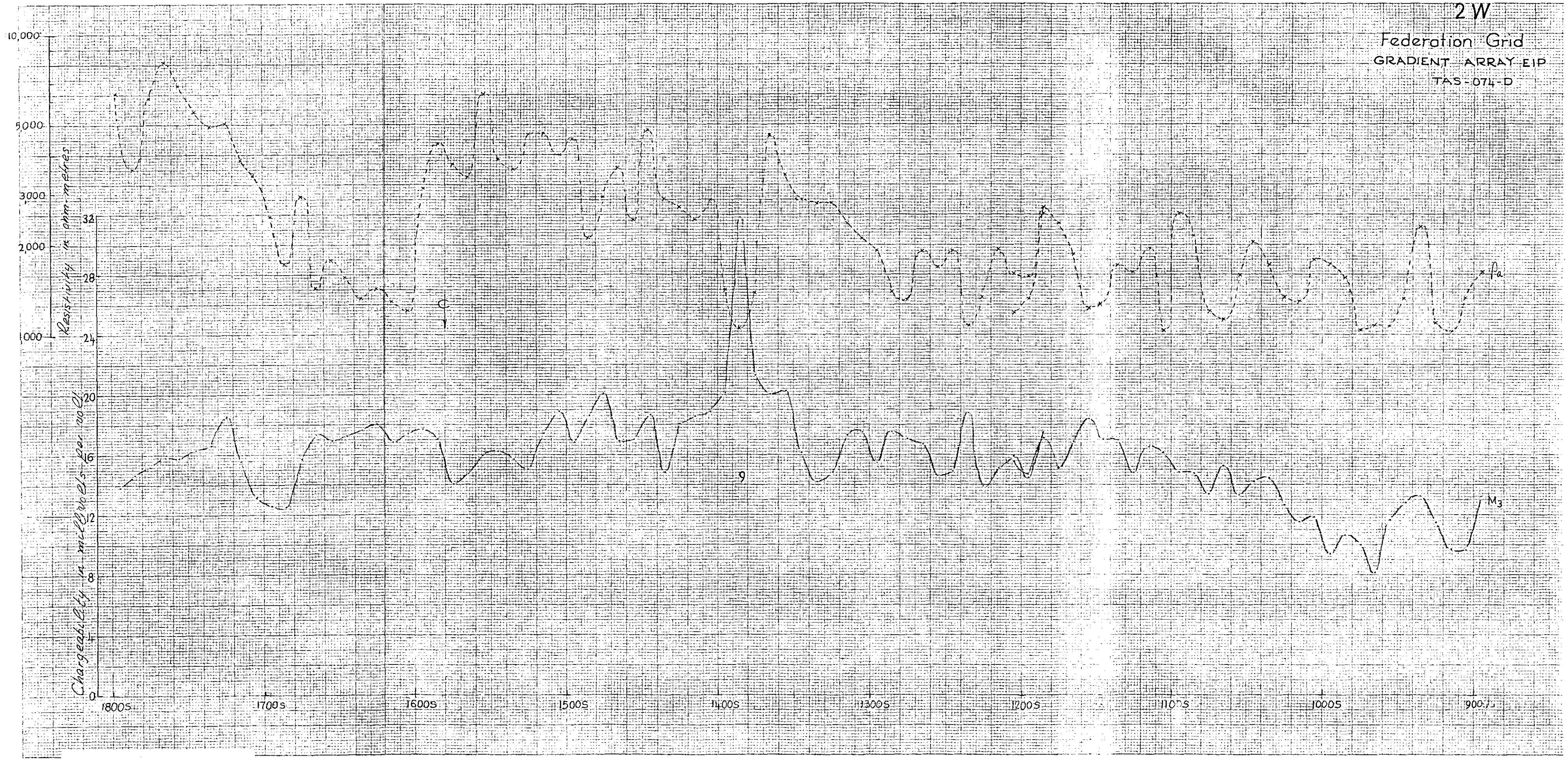
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2 W

Federation Grid

GRADIENT ARRAY EIP

TAS-074-D



045

045

091047

IW

Federation Grid

GRADIENT ARRAY

EIP

TAS-014-D



046 046

046

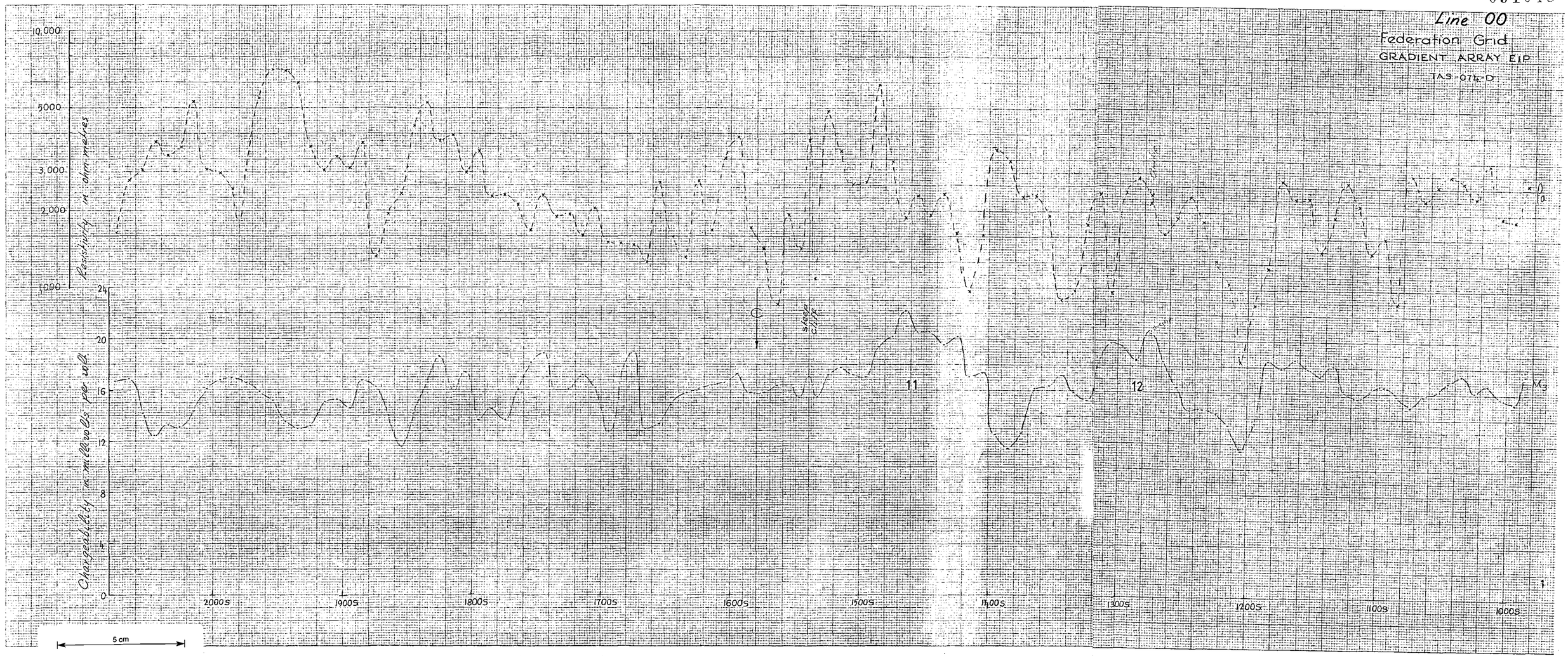
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Line 00

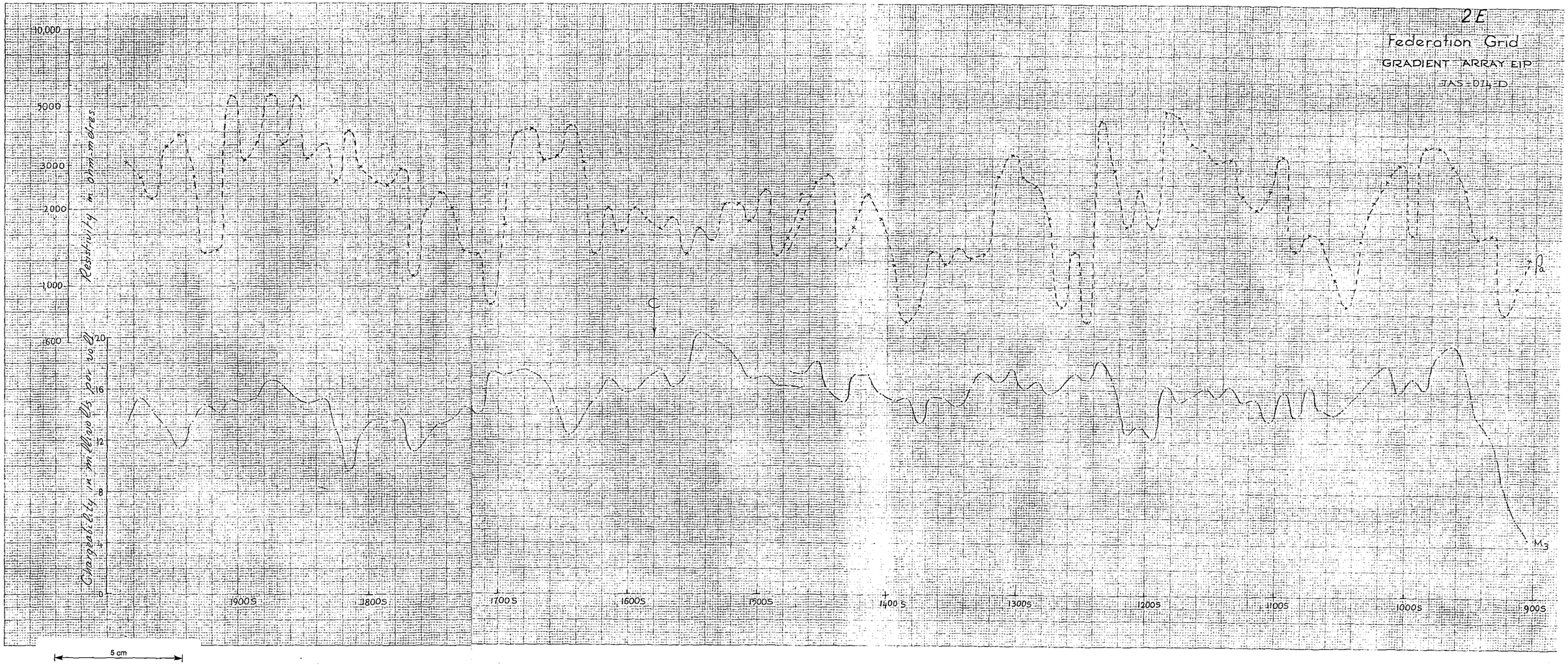
Federation Grid

GRADIENT ARRAY EIP

TAS-074-D



047 047 047 091049



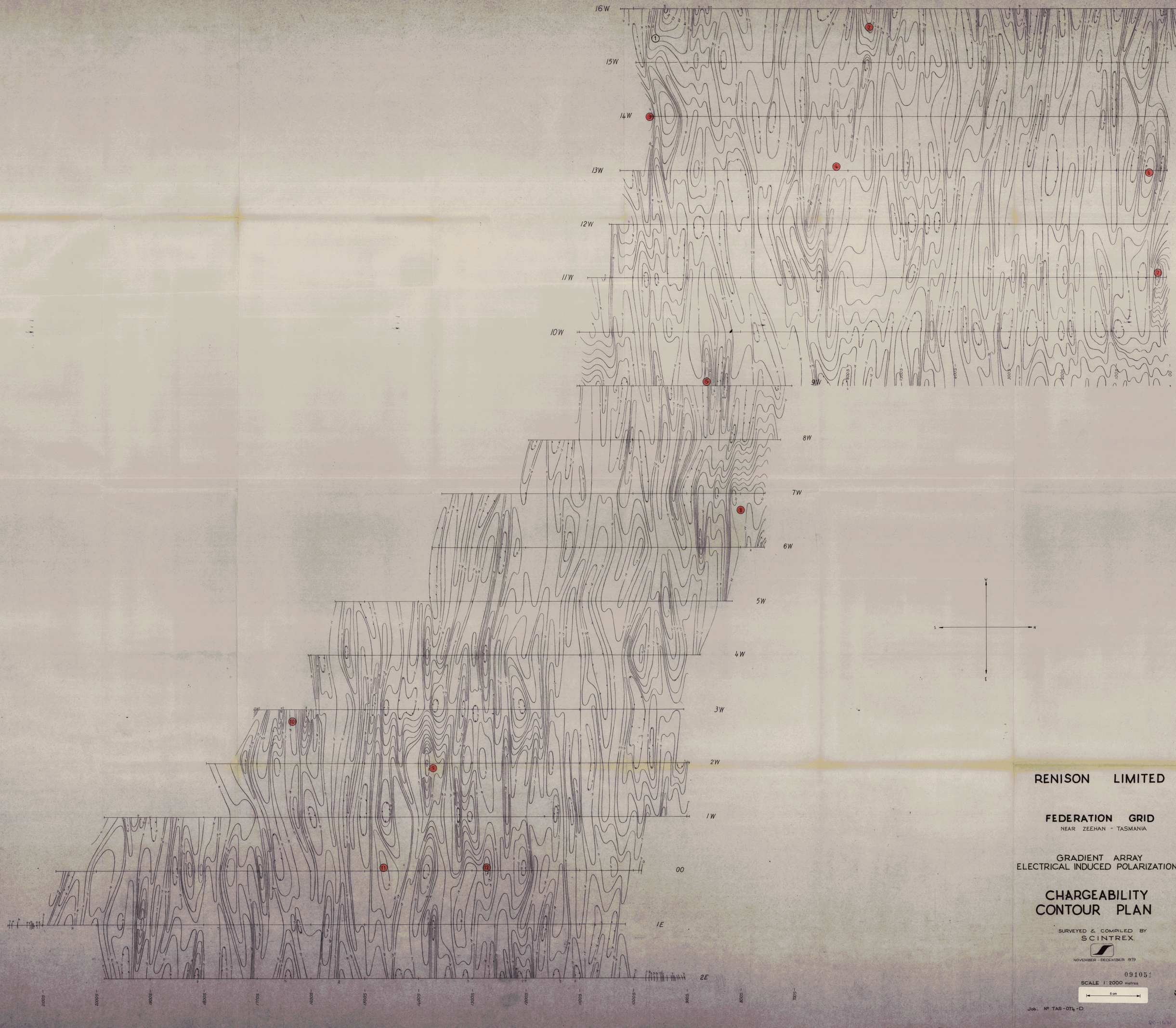
048 048 048

091050

IE
Federation Grid
GRADIENT ARRAY EJP
TAS-074-D



3196



RENISON LIMITED

FEDERATION GRID

NEAR ZEEHAN - TASMANIA

GRADIENT ARRAY
ELECTRICAL INDUCED POLARIZATION

CHARGEABILITY CONTOUR PLAN

SURVEYED & COMPILED BY
SCINTREX
NOVEMBER - DECEMBER 1979

091051

SCALE 1:2000 metres

5 cm

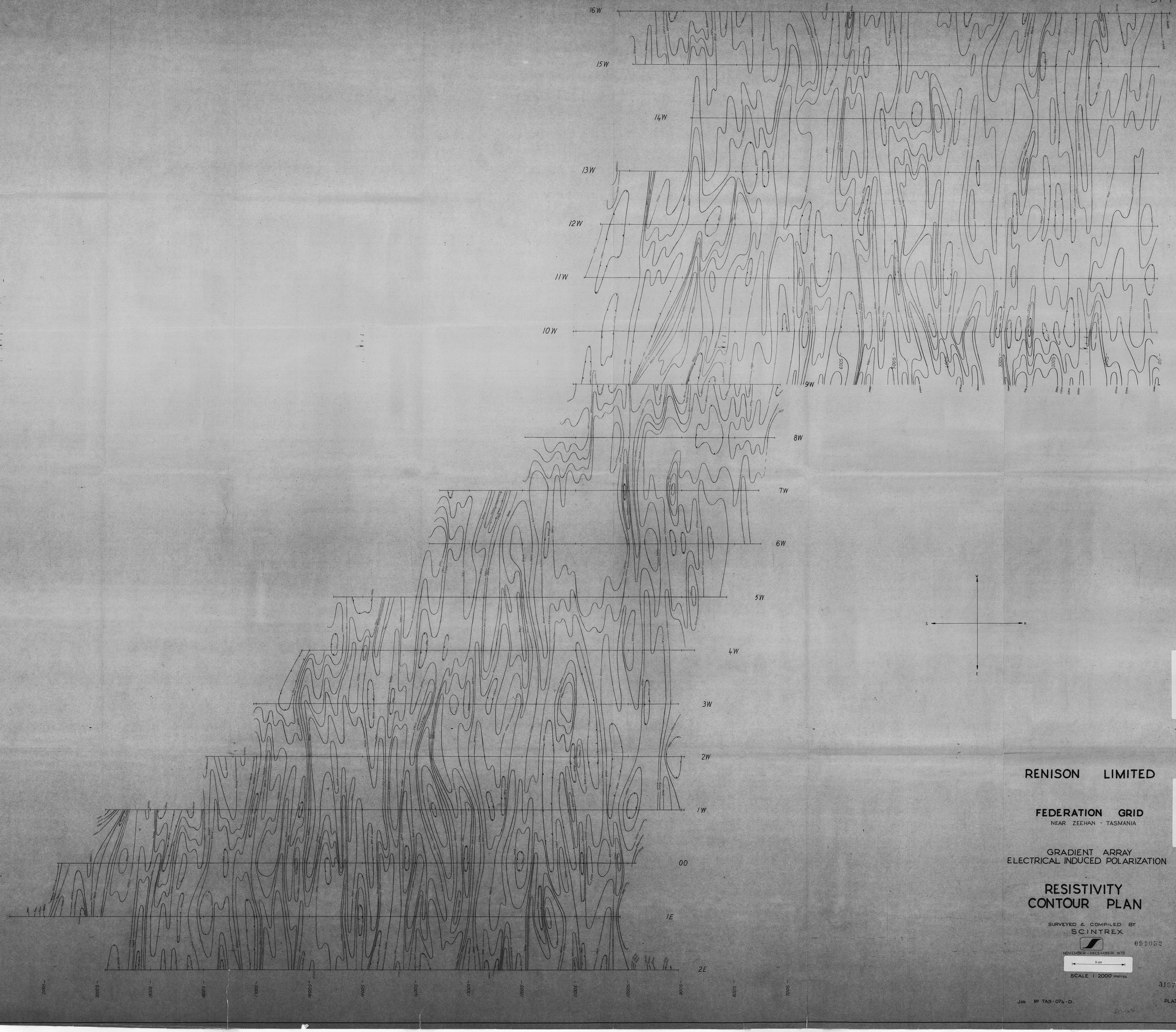
3196

Job. Nº TAS-074-D

PLATE 1

80-1431

3197



RENISON LIMITED

FEDERATION GRID

NEAR ZEEHAN - TASMANIA

GRADIENT ARRAY
ELECTRICAL INDUCED POLARIZATION

RESISTIVITY CONTOUR PLAN

SURVEYED & COMPILED BY
SCINTREX

091052

NOVEMBER - DECEMBER 1979

5 cm

SCALE 1: 2000 metres

3197

Job Nº TAS-074-D

PLATE 2

80-1131