COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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# GEOPHYSCAL SURVEY IN THE CHILLAGOE - MUNGANA DISTRICT QUEENSLAND 1949

BY

W. J. LANGRON

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## ABSTRACT.

Results are given of a geophysical survey made in 1949 by the Bureau of Mineral Resources in the Chillagoe-Mungana copper-lead mining field. The survey was requested by Broken Hill South Ltd., which in 1949 was actively engaged in prospecting in the area for metalliferous deposits, and the Company's request was supported by the Queensland Department of Mines. Surveys were made in the Mungana, Redcap and Zillmanton areas.

Promising results had been obtained previously in the area by the Imperial Geophysical Experimental Survey using electrical methods, and it was decided to use these and in particular, the electro-magnetic method. Magnetic and gravity methods were also used on selected portions of the layouts.

Only weak electromagnetic indications were obtained in the Mungana area but some well defined magnetic anomalies in the Lady Jane section may be due either to mineralization or to ferruginous clay which in some of the known deposits is associated with mineralization.

In the Zillmanton area, strong electromagnetic anomalies were obtained over known mineralization. The main anomaly axis in the Shannon section is most probably due to conductivity associated with a regional shear, but a branch axis is considered to be favourable as regards mineralization.

Some strong electromagnetic indications which could be due to mineralization were located in the Redcap area; gravity measurements also indicate structure which is considered favourable for ore deposition. In the Queenslander section, only weak electromagnetic results were obtained.

Recommendations are made for testing indications at Mungana by diamond drilling and costeaning, and at Redcap and Shannon by diamond drilling.

## 1. INTRODUCTION

The town of Chillagoe is situated 84 miles west-south west of, and 139 miles by rail from Cairns, with which it is also connected by road (Plate 1). Chillagoe and Mungana, which is situated 11 miles farther west, are the principal centres of the surrounding mineral field.

The chief ores produced in the district have been those of copper and lead, but at the time of the survey no mining operations were in progress. Most of the ore had been treated at the Chillagoe Smelters and the total production has been valued at approximately £2,700,000.

At the time of the geophysical survey, Broken Hill South Limited was actively engaged in the search for base metals in the district. By the end of 1948, the Company reached an encouraging stage in their geological investigations but it was realised that the geological work alone did not provide sufficient data for the satisfactory planning of a drilling programme. An application was made to the Bureau for assistance, using geophysical methods, in the search for ore-bodies in the more favourable geological structures.

Earlier geophysical surveys conducted by the Imperial Geophysical Experimental Survey (Edge and Laby, 1931) in the Redcap and Griffiths areas had shown that electrical prospecting methods could be of assistance in the exploration for mineral deposits in the Chillagoe field. In the present survey electrical methods were used particularly the electromagnetic method which had not been employed by the I.G.E.S. at Chillagoe. In addition magnetic and gravity methods were also used.

The areas investigated by the present survey are situated at Mungana, Redcap and Zillmanton. The pegging of the necessary traverses was undertaken by the Company.

The results of the survey were made available to the Company. However at that stage other circumstances led to the Company relinquishing its interest in the area so that the results have not been tested in any way. A report on the survey was prepared in draft form but its completion was given low priority because there seemed to be little prospect of any action being taken by prospectors or mining companies to make use of the results. It is considered that the results are worth presenting at the present time because recent detailed geological mapping may re-stimulate mining interest in the area. Results give an indication of the type of geophysical anomalies to be expected in this area and the recent geological mapping may suggest further targets for geophysical investigation.

## 2. SUMMARY OF OPERATIONS

The geophysical survey party arrived at Chillagoe on 4th June, 1949. After an inspection of the areas recommended by the Company for investigation, field work was commenced on 8th June. By 15th December, when the field work ended, geophysical surveys had been carried out in the Mungana, Queenslander, Redcap, Zillmanton and Shannon areas. The electromagnetic method was used in all these areas, the gravity, magnetic and self-potential methods in most of them, and some resistivity measurements were made on selected traverses in the Redcap and Shannon areas.

Officers of the Bureau, in addition to the writer, who took part in the surveys were geophysicists C.H. van der Waal and M.G. Allen, and field assistant K. Swann. Other field assistants were engaged locally and the strength of the party varied from four to six persons. The investigations were carried out under the general direction of L.A. Richardson, Superintending Geophysicist.

## 3. GEOLOGY.

The following brief description of Geology is based on early reports (A.G.G.S.N.A. (1941), Edge & Laby (1931) and on work by geologists of Broken Hill South Ltd. (1949). During recent years, a large area surrounding the Chillagoe-Mungana mineral field has been mapped in considerable detail by geologists of the Bureau of Mineral Resources, and it is possible that this work will lead to revision of some of the earlier ideas. For this reason, only sufficient detail to illustrate the geophysical surveys is given here.

The oldest rocks in the district are those of the Etheridge series, comprising schists, gneisses, porphyries and other rock types indicative of a high degree of metamorphism. Most of the ore deposits occur in a corridor of later rocks of the Chillagoe series. These include reef limestones (containing fossils of Silurian age), quartzites, and chert breccias associated with later volcanic action.

These rocks have been intruded by acid and basic granites and dykes of several ages. The Chillagoe series was also affected by volcanic action, arising through vents, or "diatremes", confined to the reef limestones. This activity gave rise to the Coral-Reef Volcanic series, from which the chert breccias, referred to above, were derived. Five such diatremes have been recognised in the Mungana-Redcap area (Broadhurst, 1949).

Mineralisation is considered to be associated with a younger granite, and with the abovementioned diatremes.

The ore-bodies have been worked mainly for copper and lead.

### (a) MUNGANA AREA (Plate 2).

This area is centred about the Girofla and Lady Jane Mines, the lodes of which crop out as pipe-like bodies within diatremes and were originally worked by open-cut methods. The Girofla Mine was the largest lead producer in the district and was worked to the 830-ft. level. The Lady Jane Mine produced both copper and lead and was stoped to the 420-ft. level. The ore is pyritic in both mines and the sulphide zone was reached at a depth of about 200 feet.

It appears that the diatremes are located in a fairly wide fractured zone in the Silurian sediments. It is possible that further ore-bodies may occur in this zone, especially between the two mines, where sparse mineralisation has been observed.

### (b) SHANNON-ZILLMANTON AREA (Plate 5).

This area is centred about the old site of Zillmanton, 3½ miles west of Chillagoe. The rocks consist of limestones and cherty rocks of Silurian age which have been intruded by granites. The gossan outcrop of the Zillmanton lode can be traced for about 5,000 ft.; it ranges in width from 20 to 60 ft. and has a general easterly strike and a steep southerly dip. Near the midpoint of this outcrop, cross-faulting has displaced the western portion of the lode to the south by about 1,000 feet.

The Zillmanton lode is of the shear type and is the largest copper lode in the Chillagoe district. The shears occur close to the granite contact and the lodes are found in a narrow bed of tuffaceous grit between the granite and limestone.

The main workings are on the eastern portion of the lode where three shafts were sunk to depths of approximately 375 feet. Mining operations ceased in 1913 when the lower levels collapsed due to an inrush of water. According to mine reports there should still be considerable reserves of ore assaying up to 6 per cent copper.

It appears that, with the exception of the Shannon shaft, little work was done on the western portion of the lode.

(c) REDCAP-QUEENSLANDER AREA (Plate 11)

Mineralisation is closely associated with the Redcap Fault whose course is indicated by several prominent outcrops. The most favourable loci for ore deposition seem to be the intersections of subsidiary shears (which are parallel to the Redcap Fault and which dip at $45^{\circ}$ to the south-west) and the volcanic breccias of the Redcap Diatreme. Sandstones (tuffs) and rhyolites occur above the Coral Reef-Volcanic Series, but the Redcap Fault, which occurs near the axis of a syncline, brought this series contiguous to the rhyolites.

The diatremes are usually filled with chert breccia, and their centres are distinguished by their bulge down into the underlying rocks.

The Redcap ore body, unlike the Queenslander and Morrison, seems to be an irregular impregnation of the tuffs and breccia above the shears. The outcrop of the Redcap lode is a manganese-rich volcanic breccia containing up to 6 per cent lead (mainly as cerussite), but both the outcrop and the adjacent fragmental rocks contain abundant manganese oxides without lead values. The richest ore however, is "wad" which is manganese-impregnated tuff assaying up to 12 per cent lead. Little mining of the Redcap lode has been done.

The Queenslander lode is formed on the shear which dips about $50^{\circ}$W and strikes from $0^{\circ}$-$30^{\circ}$. The Queenslander was opened as a silver mine and in 1891 "at a depth of 113feet the lode is 35 feet wide and the ore, mainly lead ore, assays up to 400 oz/ton" (Broadhurst, 1949). Silver values, however, were sporadic. After 1901, the mine was worked for copper. The best ore reported (pyritic ore containing 2-3% copper), was from the 100-ft. level of the No.1 shaft. Massive iron pyrites containing 1% copper was reported from the 200-ft. level. Enriched ore, at shallow depths in the shaft, assayed up to 10% lead. It is probable that only ore from the oxidized zones was mined.

Some test drilling has been carried out in the area. Broadhurst (1950) states that in a diamond drill hole drilled in 1907, "near the creek near the Queenslander" zinc and sulphides were reported between 519ft - 600ft. The Broken Hill South Ltd. drilled four diamond drill holes (see Plate 11) but with the exception of sludge assays in the breccia, averaging 0.5% in D.D.H. No.1, no mineralisation was encountered. It is interesting to note that D.D.H. No.1 was drilled on the site of an I.G.E.S. Equipotential-Line anomaly.

## 4. METHODS USED AND TECHNICAL DETAILS

(i) General.

Reference has already been made to work done previously in the Redcap and Griffiths areas by the I.G.E.S. (Edge and Laby, 1931). Although that work was not extensive, several well-defined conductive zones were located and subsequent drilling tests suggested that the indications were due to clay or other lode-filling of low resistivity. The I.G.E.S. employed the equipotential line and A.C. potential-ratio methods. In the present survey it was considered that the electromagnetic method would prove the most suitable for the detection of conducting zones. Although electromagnetic work occupied the greater part of the survey, gravity, self-potential and magnetic methods were also used.

(ii) Electromagnetic Method.

In this method, an insulated primary cable is laid parallel to the probable line of lode and along one side of the area to be investigated. A portable generator maintains an alternating current of frequency 500 cycles per second in this cable, which is usually about one mile in length and is earthed at both ends by means of several iron spikes driven deeply into the ground.

The alternating current in the primary cable produces an electromagnetic field, called the primary field, and by electromagnetic induction, electric currents are induced in neighbouring conductors. These secondary currents are in turn the source of alternating magnetic fields, and by measuring the secondary magnetic fields the position and relative strength of their source may be determined. It will be appreciated that the secondary field as measured at the surface has a horizontal component and furthermore may differ in phase from the primary current. The field vector may have any direction in space but is completely defined by the following components:-

Real (in-phase) )
Imaginary (out-of-phase)) Horizontal Component

Real (in-phase) )
Imaginary (out-of-phase)) Vertical Component

In practice, the magnetic field strength is measured by determining the e.m.f. induced in a search coil. The e.m.f. is measured with a compensator (an A.C. co-ordinate potentiometer), in which the unknown e.m.f. is compared with a constant e.m.f. derived from a "feed" coil, which is inductively coupled to the primary cable. The values of the four components are obtained in semi-absolute measure, being independent of variations in the primary current, and are expressed in units of microgauss per ampere of primary current.

The search coil consists of 1,000 turns of wire on a 24-inch square wooden frame. To measure the horizontal components the coil is placed in a vertical plane parallel to the primary cable, in which position it is not cut by the primary field. In measuring the vertical components the plane of the search coil is kept horizontal and corrections have to be applied to the results for the effect of the primary field. Measurements are made at regular intervals (in the present work, intervals of 25 feet or 50 feet were used) along pegged traverses normal to the primary cable.

A general guide to the interpretation of the electromagnetic profiles is given by the expressions for the horizontal (H) and vertical (V) components of the secondary field (measured at the surface) due to a conducting body which is long compared to its depth below the surface. These expressions are:-

$$H = \frac{K.t.}{x^2 / t^2} \qquad V = \frac{K.x.}{x^2 / t^2}$$

in which K is a constant, t the depth of the conductor and x its horizontal distance from the observation point. From these expressions it follows that the conductor is located immediately below the point where H has its maximum value and V an inflexion point, and that V has its maximum value at a horizontal distance from the conductor equal to the depth of the conductor below the surface.

(iii) Resistivity Method.

The conventional Wenner arrangement of four, equally-spaced electrodes was used for the resistivity determinations. Current from a battery is applied to the two outer electrodes and the potential drop is measured across the two inner non-polarizing type electrodes. This enables the resistance between the two equipotential surfaces which are in contact with the inner electrodes to be calculated, and the "apparent" resistivity of the ground is determined from Wenner's formula (Edge and Laby, 1931, p.21).

(iv) Self-potential Method.

In this method, use is made of the natural earth currents which often accompany the oxidation process in sulphide bodies. The currents flow down through the body and the circuit is completed through the surrounding country rock; the resulting distribution of potential at the surface is such that a negative centre occurs immediately above the body.

The potential differences between various points on the grid are measured by means of a sensitive voltmeter and two non-polarizing type electrodes. As the voltages being measured are usually small (of the order of millivolts), it is necessary to check readings frequently; this is best done by interchanging electrodes and by working around the grid in loops. Any misclosures present will then become apparent and may be corrected.

(v) Magnetic Method.

Variations in the vertical component of the earth's magnetic field were measured to test for the presence of local magnetic anomalies.

A Watts vertical force variometer (No.15977), with a sensitivity of 31.9 gammas per scale division, was used.

(vi) Gravity Method.

It was hoped that by locating anomalies in the earth's gravitational field, such anomalies could be correlated with structural features associated with ore-bodies.

A Western meter (No.29) was used for the gravity survey. Readings were made at a base station at approximately hourly intervals and from the "drift curve" so obtained corrections were taken and applied to the field station readings. Corrections were also made for elevation (combining "Free Air" and "Bouguer" effects) and latitude. At some places (e.g. at Mt. Redcap) terrain effects had to be considered and generally some form of regional correction was also made.

## 5. INTERPRETATION ASPECTS AND RESULTS OF SURVEY.

(a) MUNGANA AREA.

(i) Electromagnetic Method.

The pegged grid shown on Plate 2 was surveyed by this method, with the primary cable along 10850N and the electrodes at 10850N/9300E and 10850N/15800E. The four components of the field vector were measured at intervals of either 25 feet or 50 feet; profiles of the real components are shown on Plate 3.

The presence of a good sub-surface conductor is usually indicated in all four components of the electromagnetic field, but in the present work at Mungana only very weak indications were obtained in the real horizontal component profiles and no indications in either of the imaginary components; the interpretation has therefore been based on the real horizontal components.

Each profile is subject to a correction for normal ground conductivity, which, for the real horizontal component profiles, is shown as a dotted curve. This "normal ground conductivity curve" may be regarded as the real horizontal component profile (R.H.C.) due to a source lying in the surface soil near to the primary cable. Although the surface soil is much less conductive than the conductors being sought, it is so close to the primary cable that it is subject to a very intense primary field and hence an appreciable secondary current is induced in it. The values of the normal ground conductivity along the traverses have been determined by inspection from those profiles which appear to contain no anomalies (e.g. 12800E, 14400E and others) and then a correction has been applied to other traverses throughout the area.

Anomalies therefore appear as departures from the normal ground conductivity curve. The strength of an anomaly depends primarily upon the distance from the exciting cable. During electromagnetic surveys at Moonta and Kadina, South Australia, Thyer (1943) established that over a wide range of conditions, the strength of the secondary field varies inversely as the distance from the primary cable. Hence anomalies which are close to the exciting cable appear to be more significant than those remote from the cable and allowance has to be made for this factor.

The profiles on Plate 3 reveal several anomalies, particularly at the south-eastern end of the area. Any feature which is considered significant has been emphasised by drawing in the standard anomaly profile form which is suggested, and the axes of the inferred conductors are indicated by arrows. The profiles show the following indications:-

(1) An anomaly whose axis is near the northern ends of traverses 12900E to 13700E. Although small in magnitude and of indefinite length, it is reasonably well defined on several traverses. It could be tested by a costean along line 13050E across the axis of the anomaly.

(2) An anomaly near the southern ends of traverses 13900E to 14300E. This anomaly is closer to the primary cable than (1) and is not so well defined. Trenching to test this anomaly on traverse 14200E would assist interpretation.

(3) The anomaly at 11530N on traverse 14500E is of interest because it coincides with a strong magnetic anomaly (referred to in a later section) and with an equipotential-line anomaly recorded by the I.G.E.S.

No indications were obtained over the known deposits at the Girofla and Lady Jane Mines. The presence of lead in the ore should not greatly lower the conductivity of the lode, but the pipe-like nature of the ore-bodies (which have been stoped out to considerable depth) and the depth of oxidation (about 200 feet) could account for the absence of distinct anomalies in the area.

(ii) Magnetic Method.

The pegged grid was surveyed with this method and most traverses were extended in a north-easterly direction so that readings could be taken over the massive limestone. The magnetic vertical force profiles for the area are shown on Plate 4.

Much scrap iron, old mine machinery and pipes are scattered over the area and these caused numerous magnetic disturbances. These effects can be easily distinguished from those due to more deep-seated sources, however, and most of the anomalous readings can be correlated with deposits of scrap iron and the like which are visible at the surface.

A noticeable feature in the profiles is the increase in magnetic intensity towards the north along all traverses. This increase is more gradual at the north-western end of the area than at the south-eastern end, where, on some profiles (e.g. traverse 14700E), the magnetic intensity over the massive limestone to the north-east is about 100 gammas greater than that over the sediments to the south-west - the increase takes place over a relatively short distance.

Ball (1931) concluded that the highly-tilted Silurian sediments in the area have been intruded by acid igneous rocks in the north and at depth. If this distribution of granite at depth is as widespread as it is at the surface in other parts of the Chillagoe field (A.G. & G.S.N.A. 1941, Plate No.2), it could account for the general trend in the magnetic profiles.

The sharpness of the change in magnetic values along some profiles may possibly be related to faulting (?post intrusive), which is common in the area. This change is very sharp on some traverses (e.g. at 11600N on traverses 13600E and 13700E); elsewhere it is partially masked by other features, but in general it lies in a zone between 11400N and 11700N and is traceable as a continuous feature from traverse 13600E to 14700E.

Any effects produced by the two known deposits are obscured by disturbances due to superficial magnetic material around the shafts. There are, however, several distinct anomalies present, and of particular interest is the one on traverse 14500E and adjacent traverses. This anomaly coincides in position with the electromagnetic indication referred to earlier and also with the equipotential-line anomaly located by the I.G.E.S. The magnetic profiles show that the body causing the magnetic anomaly lies close to the surface and suggest rather vaguely that the body may dip to the north. However, this dip is different from that of the fracture zone, which from evidence of the worked lodes is, in general, to the south-west. A vertical hole was drilled to test the I.G.E.S. equipotential-line anomaly (Ball, 1931), but no mineralisation was reported nor are any details of the core available. It is doubtful therefore whether the anomaly was adequately tested.

Near the Griffiths Open Cut, which is situated approximately one mile south-east of the Lady Jane shaft, two other equipotential-line anomalies located by the I.G.E.S. were tested by drilling (Edge and Laby, 1931, p.133). In both these holes, a ferruginous clay and ironstone formation was encountered at depths less than 100 feet and the only mineralisation reported was 10 feet of low-grade copper ore below this depth in one of the holes. It appears therefore, that the electrical anomalies may be due largely to this ferruginous material, but whether the magnetic anomaly is caused by the same formation is uncertain. Several samples of ore on the Lady Jane dump were tested for magnetic properties but only two were found to be magnetic and these only weakly so.

It is recommended that the magnetic anomaly on traverse 14500E be tested by drilling from the northern side. A hole collared at 11600N, 14500E, depressed at an angle of 50° and drilled in the azimuth of traverse 14500E would test the anomaly at a depth of about 110 feet below its axis. It would be desirable to examine the magnetic properties of the core from this hole before making recommendations to test other magnetic anomalies in the area.

(iii) Self-Potential Method.

It was hoped by this method to detect sulphide bodies which are undergoing oxidation and, more particularly, to confirm the electrical indications which had been previously obtained. Good ground contacts could not be obtained however, and although the ground was moistened at each station, readings were not reliable and the method was discontinued. The method may prove successful if carried out after heavy rain - the present work was done during the driest time of the year.

(b) ZILLMANTON AREA.

Two separate grids were pegged at Zillmanton. One, centred about the western portion of the Zillmanton line of lode, is called the Shannon area and is discussed separately under that heading. The other grid extends eastwards from the Shannon shaft and includes the eastern portion of the line of lode; this is the Zillmanton area considered here. General remarks have already been made concerning the geology of the two areas, the layouts of which are shown on Plate 5.

(i) Electromagnetic Method.

The grid which was surveyed by this method extends for 3,600 feet in an easterly direction and ranges from 500 ft. to 1,600 feet in width. Because of the large width it was necessary to have two positions for the primary cable. The first position of the primary cable was along the zero line and traverses extending to the south were surveyed. The cable was then relaid along line 8S and readings were taken along traverses extending to the north.

Well-defined indications were obtained in all four components, with the primary cable in the first position. The imaginary component profiles for the second position of the primary cable contain no anomalies. Profiles of the real horizontal and vertical components for both positions of the primary cable, are shown on Plate 6.

The axes of the indications which are present on the profiles are shown on Plate 5. The anomaly in the southern part of the area is a prominent feature of traverses 0 to 20E, but terminates near the Oruba Shaft. It may be regarded as a continuation of the anomaly in the Shannon area and is discussed under that section.

In the northern part of the area there is a strong anomaly which is much broader than that in the southern part and which is closely related to known mineralisation. As mentioned earlier, this lode was worked from three shafts, the deepest of which, Reid's Shaft, was sunk to 375 feet. The lode ranges up to 60 feet in width and dips to the south at about 55 degrees. Plate 7 (inset "B") shows the relation between the axis of the electromagnetic indication and the position of underground workings as taken from old mine records.

In general, the conductivity of a mineralised formation is highest in the primary zone, so that the current concentration is usually just below the ground water level. The depth to ground water in the Zillmanton area ranges from 80 to 100 feet. The position of the electromagnetic anomaly in relation to the underground workings shows that the anomaly can be attributed to a current concentration in the lode formation at, or just below, the 100-foot level. The symmetrical form of the electromagnetic indication is what would be expected from a near-vertical lode.

The anomaly persists fairly strongly between the two main workings, indicating that the conducting body is continuous. The intensity of the anomaly varies along its length, but this variation may be connected with the distribution of old workings.

The planning of a drilling programme should take into consideration the known attitude of the ore-body, as well as the geophysical results. These results suggest that the conductor is continuous between the two worked portions and that drilling should not be carried out west of 13200E (mine co-ordinates). No specific drilling targets are recommended as it is thought that the feature requires systematic testing along its length, and this could best be done by inclined holes drilled from the south and in the zero azimuth.

(ii) Gravity Method.

The gravity survey covered an area extending from traverse 6E to traverse 36E, and the profiles are shown on Plate 7, inset 'A'.

The principal feature of the results is the strong regional trend in the form of an increase in gravity towards the south. This trend persists over the whole of the area surveyed and increases in strength easterly from traverse 15E. This feature is most probably due to some geological condition of major proportions, such as the basement rock distribution.

There are few local anomalies on the profiles, the most prominent one being that on profile 24E. Density determinations were made on rock samples collected near the gravity stations along traverse 24E. These density values are shown along the datum line of the 24E profile (Plate 7). The average density of the rock (which can be described as an iron-garnet epidote rock) over which the anomaly was observed, is about 3.1; that of the surrounding rock is about 2.5. Calculations made on simple bodies whose lateral dimensions are the same as those suggested by the extent of the higher density rocks, indicate that the anomaly on traverse 24E and adjacent traverses may reasonably be attributed to the epidote - garnet rock there.

It was not expected that the gravity method would be capable of detecting the ore-bodies directly, but it was thought that structural features associated with the electrical indications might be located and that this would assist in localising the possibilities for ore. However, the gravity results are of little value in this respect, but the method may be useful in a regional investigation and may be of assistance in geological interpretation.

(c). SHANNON AREA.

The pegged grid extends from just east of the Shannon Shaft for more than 3,000 feet to the west and averages 800 feet in width (Plate 5). The area is centred about the western extension of the Zillmanton line of lode, which has apparently been cross-faulted about 1,000 feet to the south from its position in the eastern (or main Zillmanton) portion. As the only workings on this section are the Shannon Shaft, which is about 80 feet deep, and a few scattered pits, little is known concerning the underground formations.

(i) Electromagnetic Method

Readings were taken along all traverses and the profiles of the horizontal and vertical components are shown on Plate 8. The main feature of the profiles is the presence of a well-defined anomaly on all traverses. The easterly continuation of this anomaly is shown on the profiles of the Zillmanton grid. The feature decreases in intensity to the east and, as previously stated, terminates near the Oruba shaft. This anomaly is also present on the imaginary component profiles, though of lesser intensity (see Plate 9, Inset 'A'), and interpretation has therefore been based mainly on the real component profiles.

The main anomaly extends for a distance of more than a mile and its axis coincides approximately with the inferred contact between the granite and limestone. As alluvium is widespread between the outcrops of granite and limestone, the position of the granite/limestone contact is not known with certainty. It may be noted here that contact metamorphic products appear to be confined to the south-eastern portion of the Zillmanton area, occurring in association with the impure (sandy) limestone there. During the survey, none of the characteristic metamorphic minerals was observed in the Shannon area.

The real horizontal and real vertical component profiles along traverse 6W are typical of the main anomaly. The form of the profiles clearly indicates the presence of a conducting zone. This could represent mineralisation, but could equally well be due to mineralised waters within the shear. Associated with shearing is an increase in the porosity of the formations involved and also in the mineral content of the water present and for these reasons alone it is to be expected that a shear zone would be a good conducting medium. Because the main anomaly is such a prominent and continuous feature it would be desirable to establish the nature of the conducting zone by drilling.

The profiles along traverses 1W to 5W indicate the presence of a second anomaly. The axis of this anomaly coincides in position with an occurrence of 'lode material' (see Plate 5) and it is thought that this may indicate mineralisation at depth. The second anomaly is most clearly defined on traverses 2W and 3W, on both the real horizontal and vertical components. Along each of these traverses, if allowance is made for the distances of the two axes from the primary cable, the two anomalies are of similar strength.

The method of applying a correction for the ground conductivity at both Zillmanton and Shannon was similar to that used at Mungana. The 'normal ground conductivity' curve (Plate 8) is remarkably uniform over the area. The anomalies could be correlated on a common basis by using the relation that the strength of the anomaly varies inversely as the distance of its axis from the primary cable, but in the present work there seems little advantage in doing this. As at Mungana, double features on some profiles may be considered as being composed of the effects of separate conductors as shown on profiles 2W and 3W.

The Shannon profiles differ considerably in form from those observed at Zillmanton. At Zillmanton, the anomalies are broad and the dip of the lode (about 55 degrees to the south) is indicated quite clearly, whilst the anomalies shown on the Shannon profiles are narrow and suggest that the dip of the conductor is nearly vertical.

It is recommended that two test holes be drilled on the Shannon area and until further information is known concerning the dip of the beds, these should be drilled from the south and depressed at an angle of 50 degrees. The first hole, to test the northern anomaly on traverse 2W at a depth of about 150 feet, should be collared at 2W/5S (geophysical co-ordinates) and drilled in the azimuth of the traverse. The second hole, collared at 6W/9S (geophysical co-ordinates) and drilled in the azimuth of traverse 6W, would test the main anomaly at a vertical depth of about 150 feet.

Recommendations for more comprehensive drilling of the Shannon anomalies are deferred until the results from these two test holes have been analysed.

(ii) Resistivity Method.

At the conclusion of the electromagnetic work, one day was spent in making resistivity measurements.

Traverse 00 was selected for this work as it is soil-covered over its entire length and good ground contacts could therefore be obtained; there was also a well-defined electromagnetic anomaly on this traverse.

Using the"extending electrode" method with a conventional Wenner four-electrode arrangement, resistivity determinations were made at station 00/7E. Readings were first made with the electrodes along traverse 7E, with electrode separations up to 200 feet, and then with the line of the electrodes at right angles to the traverse and with separations up to 90 feet. The effective depth penetration of the resistivity measurements is approximately equal to the electrode separation and curves (known as 'depth profiles') are used to determine the relation between electrode separation and the measured resistivity. Constant electrode separation measurements were also made along traverse 7E using a separation of 25 feet. The resulting resistivity profile is shown on Plate 9 (inset 'B'), together with the "depth profiles" for station 00/7E.

When compared with standard "three-layer" curves, the depth profiles indicate the presence of a low-resistivity layer, probably only a few feet thick, at a depth of about 20 feet and underlain by a high-resistivity formation. The constant separation profile shows a zone about 150 feet wide with a low average resistivity of about 800 ohm-cm. The resistivity increases to about 3,000 ohm-cm over the limestone to the south and also northwards (probably due to the effect of the granite) to about 5,000 ohm-cm. Such a zone of relatively high conductivity in a horizontal surface layer may have a considerable effect on the secondary electromagnetic field. It is considered, however, that this shallow conducting layer could not account for the observed electromagnetic indication, as the axis of the electromagnetic anomaly is about 100 feet to the north of the centre of the shallow conducting zone; furthermore, the form of the electromagnetic profiles suggests a narrow current concentration at a depth of about 90 feet.

(iii) Self-potential Method.

Measurements were made over an area extending from traverse 7W to traverse 8E. In contrast to the self-potential survey at Mungana, ground contacts were good and readings were consistent, as was evidenced by the absence of large misclosures. The profiles obtained, however, were flat and devoid of anomalies. No self-potential measurements were made over the known lode in the Zillmanton area, but it has been found in other areas that results obtained over old workings are not comparable with results to be expected over an unworked lode.

(iv) Magnetic Method.

A magnetic survey was conducted over the area to ascertain if the ore-bodies which were thought to be present could be detected by this means. The profiles obtained are shown on Plate 10, and it will be seen that most profiles are intensely disturbed. Samples of the 'lode capping, (which appears to be ferruginous cherty type of rock) were tested and found to be highly magnetic. In most instances disturbed readings occur over this capping. Unfortunately, no ore samples could be found for testing, but from an analysis of the profiles it appears that there are no anomalies which would be due to ore-bodies of the type expected.

(v) Gravity Method.

Gravity measurements were made along some traverses but the profiles obtained show nothing of interest near the electrical indications. There is a steady increase in the value of gravity from north to south; this is similar to that shown on the gravity profiles of the Zillmanton area, but as the traverses in the Shannon area are much shorter, this regional effect is not as obvious.

(d) REDCAP AREA.

Two separate areas were pegged, one on each side of Mt. Redcap, to include the Redcap Fault and subsidiary shears with which the mineralisation in this area is associated.

The Redcap area which is treated in this section of the report lies on the western side of Mt. Redcap. The area to the east of Mt. Redcap, referred to as the Queenslander area, is centred about the old mine and workings of that name, and is discussed in the next section. A plan of the two areas, showing the geology, geophysical layout and principal results, is shown on Plate 11. The Morrison Workings are situated about 3,200 feet south-east of Mt. Redcap (Plate 1).

In the Redcap section, the lode material is essentially manganese oxide, or 'wad', containing lead, but no sulphide ore has been recorded. The dip of the lode in the Redcap mine is almost vertical but little is known of the attitude of the lode west of the mine.

(i) Electromagnetic Method.

An electromagnetic survey was conducted over the pegged grid and the profiles of the real and imaginary horizontal and vertical components are shown on Plate 12. The profiles of the real components show a well-defined anomaly which is a continuous feature from 2W to 11W; the axis of this anomaly is shown on Plate 11. This feature is not so well-defined on the profiles of the imaginary components.

Because of the paucity of geological information, the nature of the conducting body indicated by the electromagnetic results is doubtful. It is suggested, therefore, that the anomaly be tested by drilling, and two drill holes are recommended. The first hole should be collared at 2W/10N (geophysical co-ordinates) drilled from the south-west in the azimuth of the traverse and depressed at an angle of 50 degrees. Because the electro-magnetic evidence suggests that the dip of the conductor changes from south to north along its length, the second hole should be drilled from the north-east; the hole should be collared at 6½W/13¼N (geophysical co-ordinates), and also be in the azimuth of the traverse and depressed at an angle of 50 degrees. However, the specifications for this hole may need to be modified should the results of the first hole produce any evidence of dip of the conducting body contrary to that which is inferred from the electro-magnetic results. The company's proposed D.D.H. No.4 is not favourably placed to test the electrical results, though cores from it may be useful for density measurements.

(ii) Resistivity Method.

The resistivity measurements were limited to one day's operations and were made along traverse 2W, where the electro-magnetic profile shows a well-defined anomaly and where there is a fairly thick soil cover.

Using the "expanding electrode" method with a conventional Wenner four-electrode arrangement, resistivity determinations were made at station 2W/12N, firstly with the electrodes in the line of traverse 2W with a maximum separation of 200 feet, and then with the electrodes in a line at right angles to the traverse and with a maximum separation of 90 feet. Constant electrode-separation measurements were also made along traverse 2W using separations of 25,50 and 100 feet. The 'depth profiles' and the constant electrode separation profiles are shown on Plate 13 (Inset 'B').

The 'depth profiles' indicate a layer of low resistivity beneath a fairly resistive shallow surface layer, but no satisfactory depth determinations are possible as it is clear that the profiles are affected, particularly at the larger separation, by horizontal discontinuities in the formations.

The 'constant separation' profiles indicate a broad zone of relatively low resistivity. There is a sharp drop in resistivity values in passing from the limestone to the soft grits and a gradual rise where the traverse reaches the cherts and porphyry.

The form of the profile for the 100-feet separation and, to a lesser extent, that for the 50-foot separation tend to confirm the existence of a synclinal structure as suggested by Broadhurst (1949). He considers that a syncline lies parallel to the porphyry contact and that the Redcap Fault occurs near its axis.

The profile for the 100-foot separation indicates that the low resistivity zone persists below a depth of 100 feet but with considerably reduced width. As the minimum resistivity values coincide with the axis of the electromagnetic anomaly, the profile confirms the existence of a conducting body as deduced from the electromagnetic results, but does not throw any more light on the nature of the conducting body.

(iii) Self-potential Method.

Measurements using this method were made in the area but, as at Mungana, good ground contacts could not be obtained. The procedure used was to read around closed loops within the area and then distribute, if possible, the amount of misclosure present. It was found that these misclosures were too large and too inconsistent in value to permit reliable interpretation of the results and the method was therefore abandoned.

(iv) Potential-drop Ratio Method.

In the limited time available, it was proposed to read traverse 2W with this method, but although the electrodes (consisting of iron spikes driven deeply into the ground) were watered the contact resistance proved to be too high and the method had to be discarded.

(v) Magnetic Method.

Magnetic readings were made over the pegged grid and all traverses were extended (by pacing) for 500 feet in both directions. The magnetic vertical force profiles obtained are shown on Plate 13 (inset 'A').

No indications were obtained which could be directly related to mineralisation, although strong magnetic disturbances were recorded over the 'lode capping'. The pronounced regional trend, which is such a prominent feature of the Mungana profiles, is not present at Redcap.

(vi) Gravity Method.

A gravity survey was made over the pegged area. Near the fault zone, readings were taken at intervals of 25 feet but towards the ends of the traverses the intervals were increased to 50 feet. Corrections were applied for instrument drift, elevation and latitude and, in addition, terrain corrections were necessary at all stations. The terrain corrections were largest for readings taken near Mt. Redcap and exceed 0.7 milligal on traverse 0. On traverse 14W, however, the terrain corrections averaged 0.1 milligal. The gravity profiles and countours are shown on Plate 14.

A gravity "low" occurs on most of the profiles and, as shown by the countours, the depression consists of two or possibly three negative anomaly centres. There is close agreement between the line of gravity 'lows' and the axis of the electromagnetic anomaly. It is considered that the gravity results provide further evidence of the synclinal structure postulated by Broadhurst. Comparison of the observed profiles with calculated ones indicates that the presence of a low density formation, such as the tuffs and grits, would produce a gravity "low" of the order of that observed. If, as Broadhurst suggests, the ore solutions were directed by the Redcap Fault, gravity "lows" may assist in locating the most favourable environment for ore occurrence.

Density values of samples of "wad", which contains most of the lead values, range from 2.4 (barren) to 4.8 (hard "manganite" kernels), but the average density of the lode material is probably little different from that of the surrounding rocks (taken as 2.6). The possibility of detecting the ore directly by gravity measurements is therefore slight.

The test holes recommended in the previous section, in addition to testing the electromagnetic anomalies, would also provide useful data for a more complete analysis of the gravity results. Of the two holes recommended, the one collared at 6½W/8N, being directed towards the centre of one of the gravity 'lows', would be the more favourably located to provide useful data for analysis of the gravity anomaly.

(b) QUEENSLANDER AREA.

(i) Electromagnetic Method.

On the Queenslander side of Mount Redcap, an area measuring 1,000 feet by 800 feet was surveyed with the electromagnetic method. The profiles of the real and imaginary horizontal and vertical components are shown on Plate 15.

Broad, but poorly defined anomalies are present on most of the real component profiles. There are no anomalies on the imaginary component profiles of traverses 0 to 5S and on traverses 1N, 2N and 3N there is a weak anomaly in the horizontal components, the axis of which does not however correspond to the axis of the anomaly in the real components. This disagreement is not present in other work done in the district and no explanation can be offered for it. Some uncertainty exists therefore with regard to the position of the electromagnetic axis shown on Plate 11, which has been based solely on the indications in the real components.

Electrical surveys were conducted by the I.G.E.S. (Edge and Laby, 1931) on the Morrison-Mt.Redcap line of lode. The position of an anomaly located by the equipotential-line method is shown on Plate 11. The anomaly axis of the real horizontal components of the electromagnetic profiles is approximately 90 feet to the north-east of the I.G.E.S. indication. The anomaly in the imaginary horizontal components on traverses 1N, 2N and 3N, however, coincides in position with the equipotential-line indication.

The anomaly axis of the real components shows an "en echelon" trend; this is in agreement with the geological evidence which suggests that the sequence in this area has been interrupted by faulting. There is no confirmation, however, of the "en echelon" trend in the imaginary components.

Because of the difference in positions of the indications in the real and imaginary components, it is not proposed to make a drilling recommendation for the northern portion of the electromagnetic indication. However, the southern portion of the indication (i.e. that portion situated south of the cross-fault shown on plate 11) could be tested by a hole collared at 3S/5W (geophysical co-ordinates), drilled from the south in the azimuth of the traverse and depressed at an angle of 50 degrees. Such a hole, 350 feet in length, would test the ground about 200 feet below the anomaly axis.

(ii) Self-potential Method.

Some self-potential measurements were made, but the method was abandoned because of unreliable readings caused by poor ground contacts.

## 6. SUMMARY AND CONCLUSIONS.

The electromagnetic method proved to be the most successful of the methods used at Chillagoe. Several distinct zones of high electrical conductivity were located and these could possibly indicate the presence of ore-bodies. However, they may also indicate the presence of clay bodies of low electrical resistivity, as was shown by bore holes put down to test some of the I.G.E.S. electrical anomalies in the Griffith and Morrison sections. Many of the mineral deposits are, however, associated with clay or other lode filling of low resistivity and the clay formations could therefore be of definite value as indicators of mineralisation.

For most of the areas where the geophysical work was done, there is insufficient geological information available to form a basis for a complete analysis of the results. It is considered preferable, therefore, to test the anomalies in only one or two of the more favourable positions and after the geophysical results have been analysed in the light of the additional information obtained, it should be possible to recommend a more complete testing programme.

Strong electromagnetic anomalies were obtained in the Shannon and Zillmanton areas. The principal axis may be related to a shear zone near the granite/limestone contact and the indication may be due to an accumulation of mineralised waters in this zone. In the Shannon area, a short branch axis occurs over surface 'lode material' and this is more likely to indicate mineralisation. Another strong axis along the northern side of the Zillmanton grid can be correlated with known mineralisation.

The electromagnetic indications in the Redcap and Queenslander areas are not as well-defined and their interpretation is uncertain without additional drilling information. Results in the Redcap section suggest that the axis of the electromagnetic anomaly follows a synclinal depression which is considered to be favourable for the occurrence of ore.

In the Queenslander area, the electromagnetic indications show some correlation with the geology, but the indications are not definite enough for firm drilling recommendations.

Only weak electromagnetic indications were obtained during the work at Mungana and these are confined to a group of traverses in the Lady Jane area. Some of the better defined anomalies should be tested by costeaning.

Some well-defined magnetic anomalies were obtained in the Lady Jane section at Mungana but whether these anomalies are due to mineralisation or to the presence of a ferruginous clay formation is uncertain until drill core samples can be obtained and tested. Another interesting feature of the Mungana magnetic profiles is that readings over the massive limestone to the north-east are much higher than those over other Silurian sediments and Etheridgean rocks; these results may be of interest in regional investigations.

Most of the magnetic profiles in the Shannon area show intense disturbances due to the presence of a highly magnetic rock capping. Readings in the Redcap area were less intensely disturbed. No anomalies which can be associated with mineralisation are present on the profiles for these areas.

The self-potential method was used in the Mungana, Redcap and Shannon areas. In the Mungana and Redcap areas, ground contact conditions were unsatisfactory and readings were unreliable. In the Shannon section, good ground contacts were obtained, but the self-potential profiles contained no anomalies.

Results of the gravity survey in the Redcap area confirm the presence of the synclinal depression suggested by geological evidence. As mineralisation is associated with this syncline, the gravity results may be helpful as a guide to further exploration.

In the Zillmanton area, a well-defined gravity anomaly was observed over an occurrence of epidote-garnet-limestone. Density tests on samples indicate that the difference in density between this and the enclosing rocks is sufficient to account for the observed anomaly. Gravity measurements in the Shannon section showed few features of interest.

The testing which has been recommended to enable a more complete analysis of the geophysical results to be made is summarised below :-

A. Diamond Drill Holes (to be depressed at 50°).

| Area | Co-ordinates of Collar | Azimuth (Mag.) | Length of Hole. |
|---|---|---|---|
| Redcap | 9420N, 10030E(2W/10N) | 30° | 300 ft. |
| Redcap | 9895N, 10035E($6\frac{1}{2}$W/$13\frac{1}{4}$N) | 210° | 250 ft. |
| Mungana | 11600N, 14500E | 220° | 200 ft. |
| Shannon | 9845N, 10525E(2W/5S) | 20° | 300 ft. |
| Shannon | 9790N, 10080E(6W/9S) | 20° | 300 ft. |

Note: Geophysical grid co-ordinates are given in brackets.

B. Costeans.

| | |
|---|---|
| Mungana | (1) Between 11570N/13050E and 11670N/13050E.<br>(2) Between 11160N/14200E and 11260N/14200E. |

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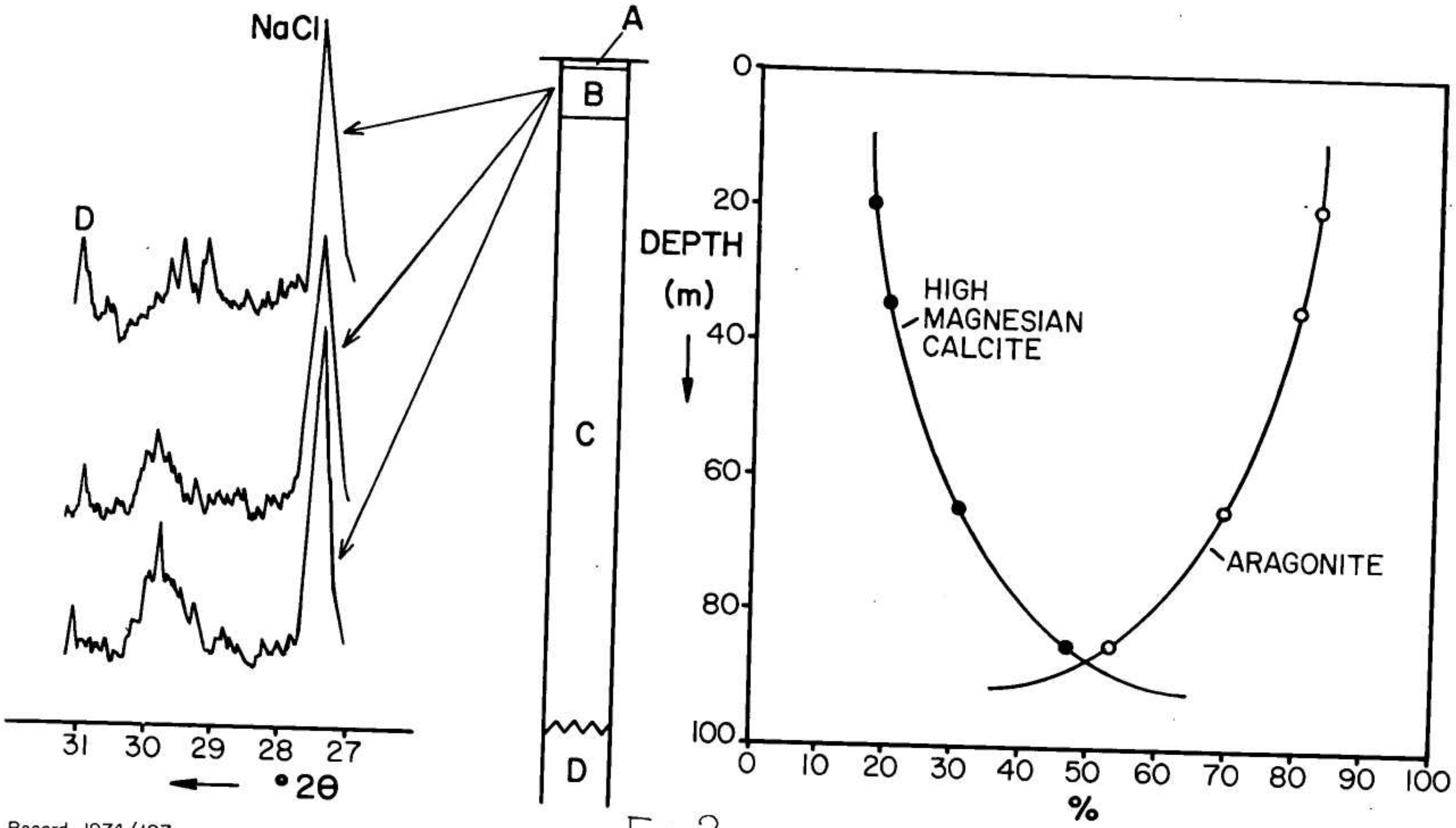
Thyer, R.F., 1943 - Report on the Geophysical Surveys Moonta-Wallaroo Copperfield, South Australia. Min.Res.Sur. Report No.1943/19.

# CORE 4 — ONE TREE ISLAND

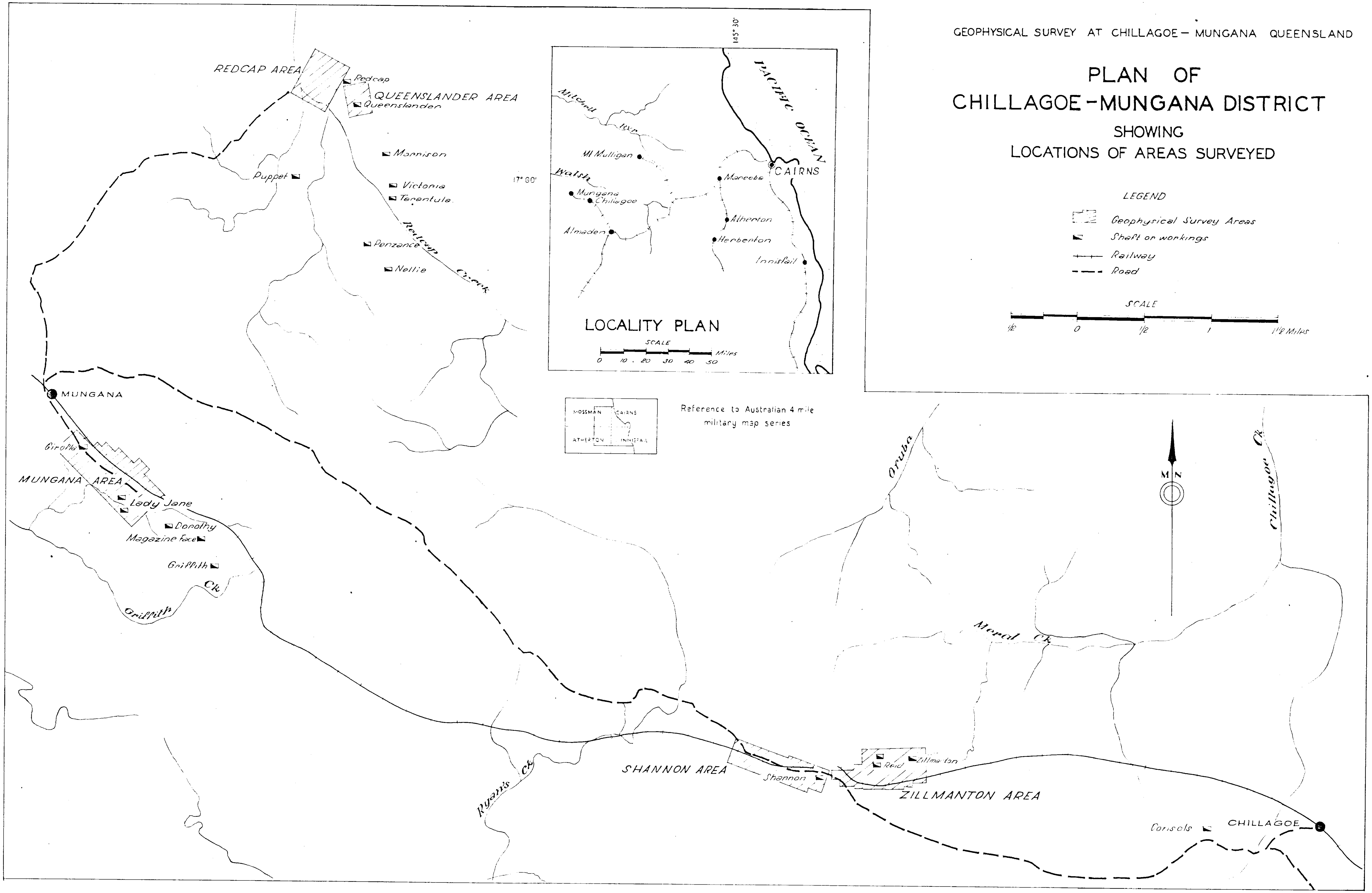



Record 1974/197

FIG. 2

M(Pt) 228

PLATE I




12.10.50

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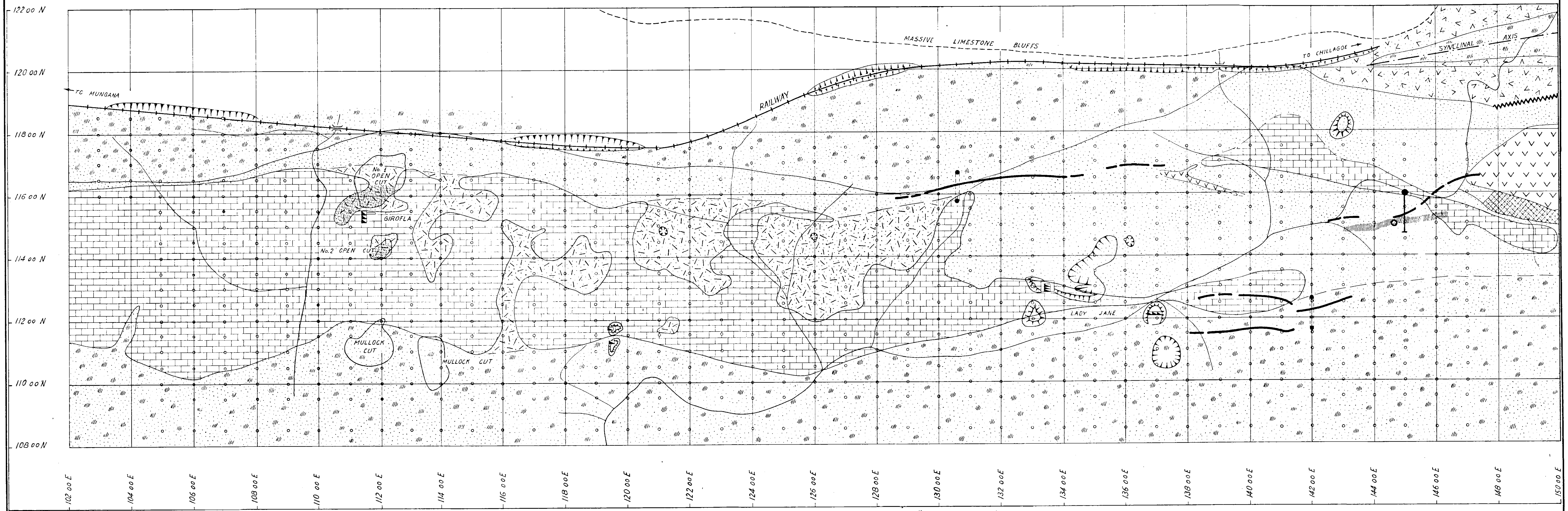
PLATE 2




## LEGEND

- UPPER SEDIMENTS
- CALDERA SEDIMENTS
- VENT ROCKS
- CORAL REEF LIMESTONE
- ORE
- BASALT TUFF
- BASALT
- GOSSAN

- AXIS OF ELECTROMAGNETIC INDICATION
- POSITION OF EQUIPOTENTIAL LINE INDICATION (I.G.E.S)
- PROPOSED COSTEAN
- DIAMOND DRILL HOLE (Q'LD Dpt. Mines)
- RECOMMENDED DIAMOND DRILL HOLE
- SHAFT
- BRECCIATED FAULT ZONE

SCALE

200 0 200 400 600 FEET

W. J. Langron
GEOPHYSICIST

MAGNETIC NORTH

# GEOPHYSICAL SURVEY AT CHILLAGOE – MUNGANA, QUEENSLAND

## MUNGANA AREA

PLAN OF AREA SHOWING

GEOLOGY, GEOPHYSICAL LAYOUT, & AXES OF

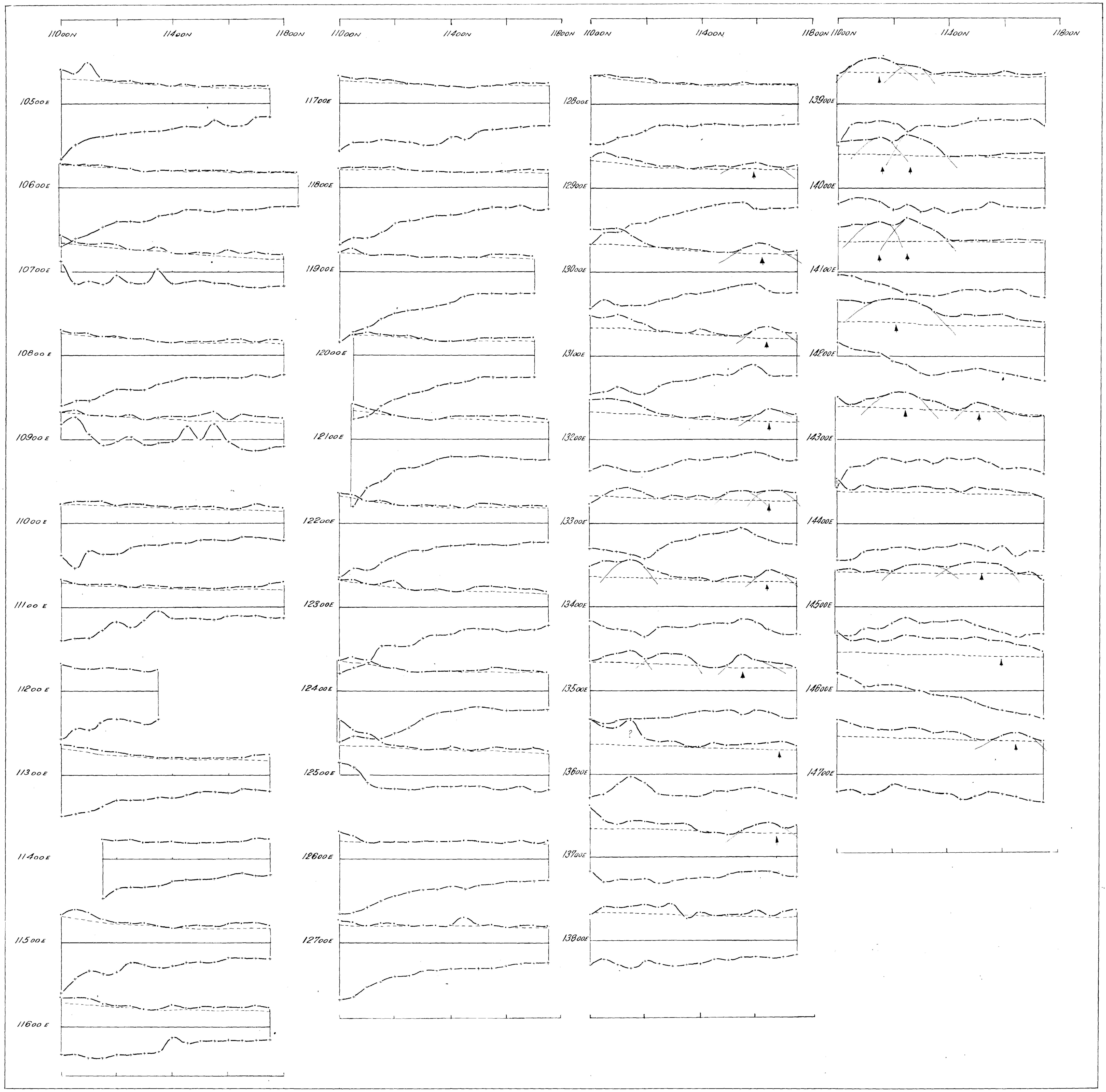
ELECTROMAGNETIC INDICATIONS

(GEOLOGY SUPPLIED BY BROKEN HILL SOUTH LTD.)

G84-2

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics.

To Accompany Records 1957, No 99




**LEGEND**

- Real horizontal component (R.H.C)
- Real vertical component (R.V.C)
- Assumed normal ground conductivity
- Axes of E.M. anomalies

**SCALES**

Horizontal: 200 — 0 — 200 — 400 — 600 Feet

Vertical: 10 — 0 — 10 — 20 — 30 Micro gauss/ampere primary current.

Geophysicist

GEOPHYSICAL SURVEY AT MUNGANA – CHILLAGOE, QUEENSLAND.

# MUNGANA AREA

## ELECTROMAGNETIC PROFILES OF REAL HORIZONTAL & VERTICAL COMPONENTS

*Primary cable along 10850N*

G84-3

*Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics 12.10.50*


**LEGEND**

ϕ — Position of axis of E.M. indication

⊖ — " " " E.P. indication (I.G.E.S.)

Railway line

S — Scrap metal

D — Dump

SCALES

Horizontal 200 0 200 400 600 Feet

Vertical 200 0 200 400 600 Gammas

Geophysicist

GEOPHYSICAL SURVEY AT CHILLAGOE – MUNGANA, QUEENSLAND

# MUNGANA AREA
# MAGNETIC VERTICAL FORCE PROFILES

G84 – 4

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PLATE 5
ZILLMANTON
WORKINGS
SHANNON
AREA
LEGEND
SCALE
GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND
SHANNON-ZILLMANTON AREA
PLAN OF AREA SHOWING
GEOLOGY, GEOPHYSICAL LAYOUT & AXES OF ELECTROMAGNETIC INDICATIONS
(GEOLOGY SUPPLIED BY BROKEN HILL SOUTH LTD.)
G84-5


**LEGEND**

- Real horizontal component (R.H.C)
- Real vertical component (R.V.C)
- Assumed normal ground conductivity
- Axis of E.M indication

**SCALES**

Horizontal 200 0 200 400 600 Feet

Vertical 10 0 10 20 30 Micro gauss/ampere primary current.

Geophysicist

GEOPHYSICAL SURVEY AT CHILLAGOE- MUNGANA, QUEENSLAND

# ZILLMANTON AREA
# ELECTROMAGNETIC PROFILES OF REAL HORIZONTAL AND VERTICAL COMPONENTS

G84-6

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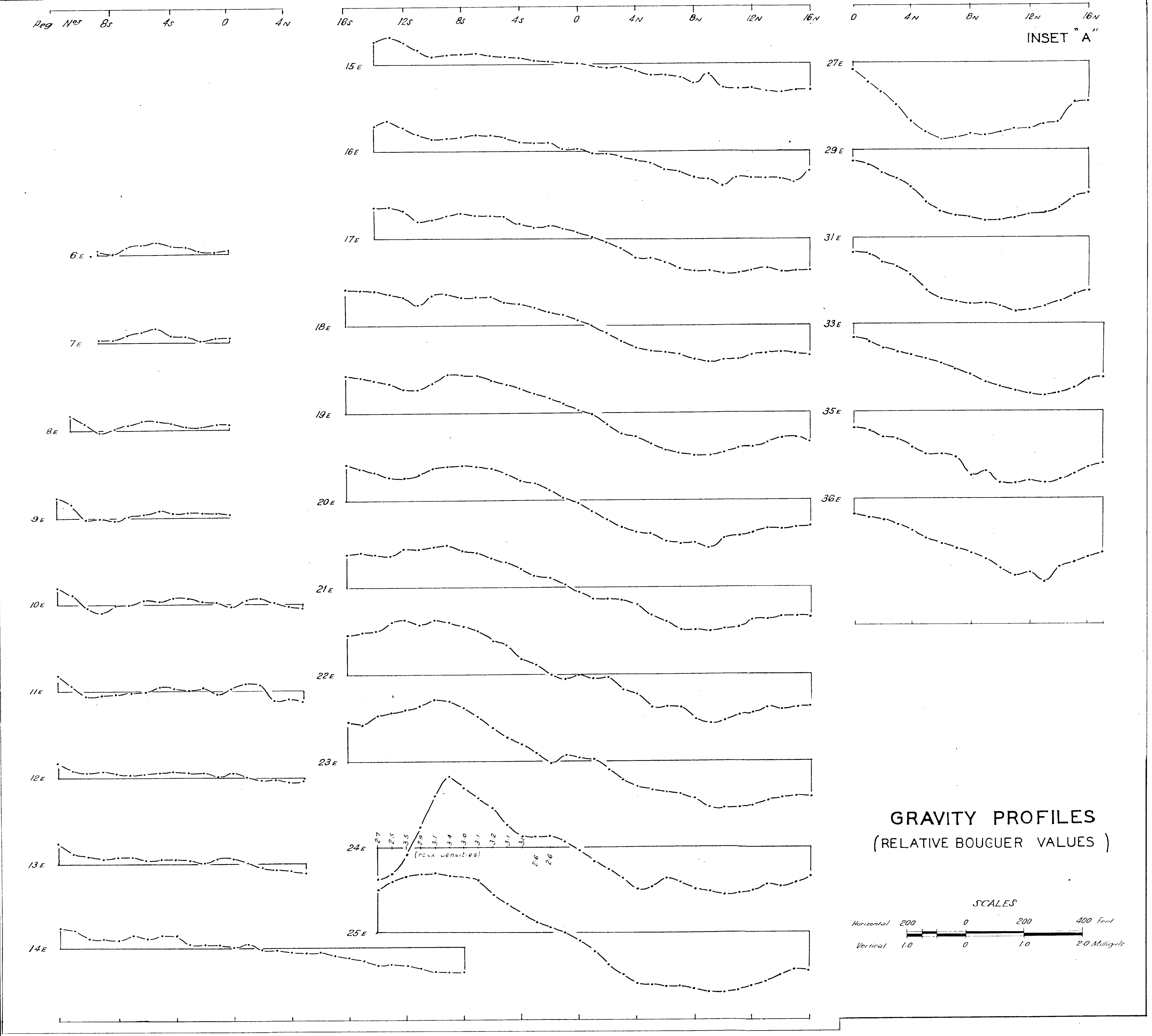
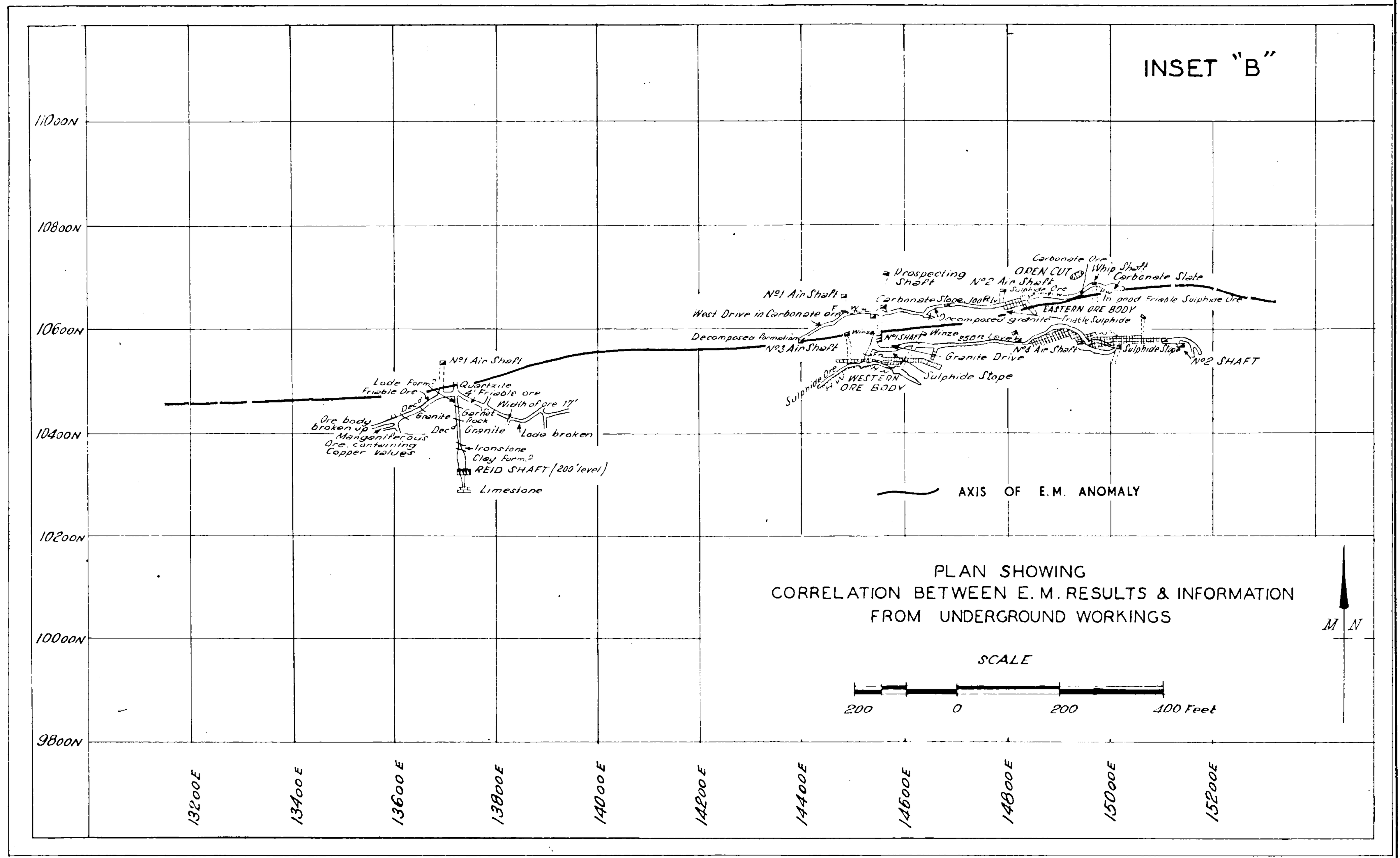
To Accompany Records 1957, No. 99




GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA QUEENSLAND

# ZILLMANTON AREA

## GRAVITY PROFILES AND CORRELATION BETWEEN ELECTROMAGNETIC AXIS AND KNOWN ORE

Geophysicist

G84-7

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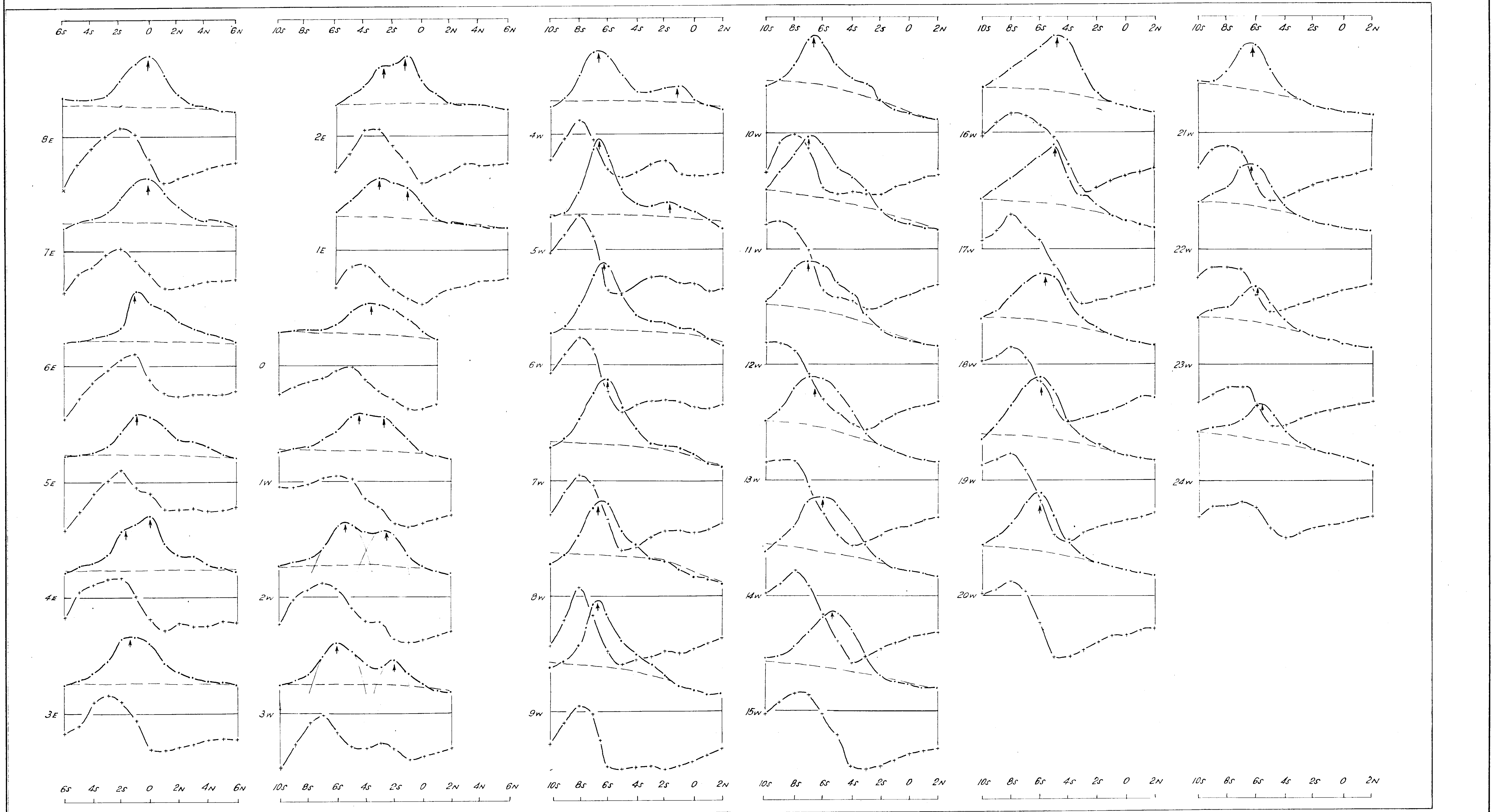
To Accompany Records 1951, No. 39




**LEGEND**

- Real horizontal component (R.H.C.)
- Real vertical component (R.V.C.)
- Assumed normal ground conductivity
- Position of axis of E.M. indication

**SCALES**

Horizontal: 200 0 200 400 600 Feet

Vertical: 10 0 10 20 30 μ gauss per ampere of primary current

Geophysicist

GEOPHYSICAL SURVEY AT CHILLAGOE – MUNGANA, QUEENSLAND

# SHANNON AREA

## ELECTROMAGNETIC PROFILES OF REAL HORIZONTAL & VERTICAL COMPONENTS

(Primary cable along 13S for traverses 24W to 0)
(Primary cable along 9S for traverses 1E to 8E.)

G84 - 8

Geophysical Section, Bureau of Mineral Resources Geology & Geophysics. 12.10.50

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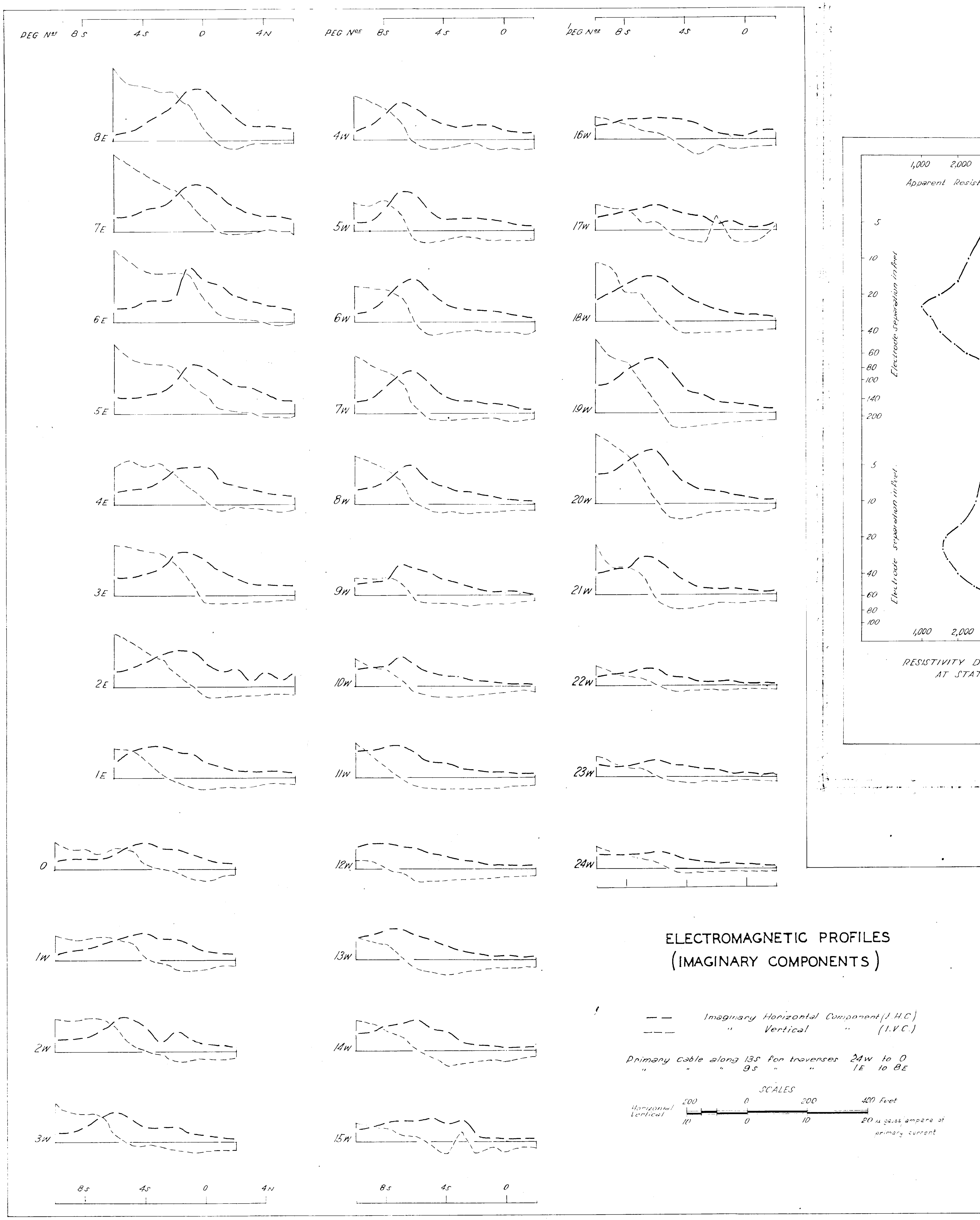
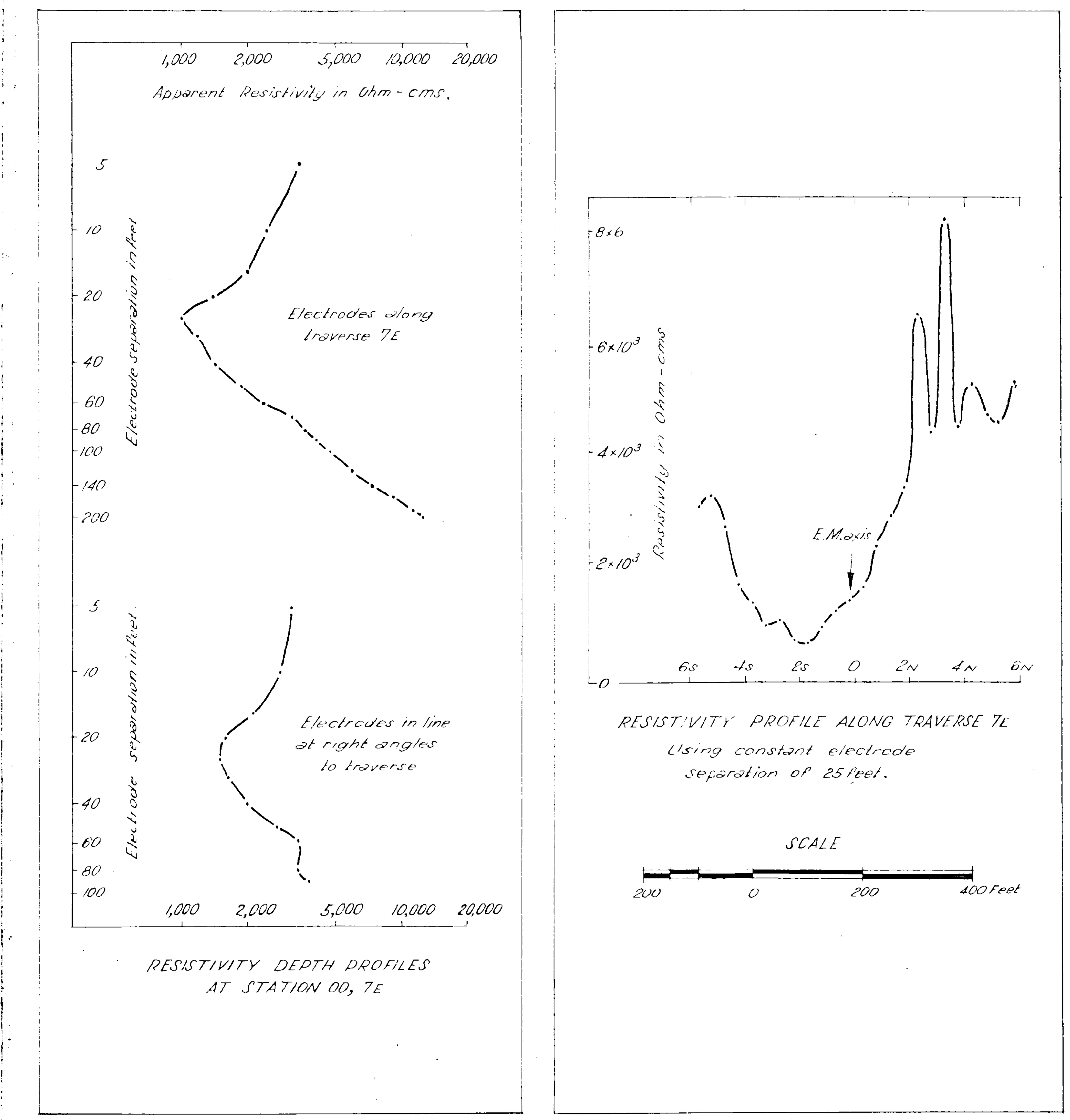
INSET "A"




INSET "B"

RESISTIVITY DETERMINATIONS




GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND.

# SHANNON AREA

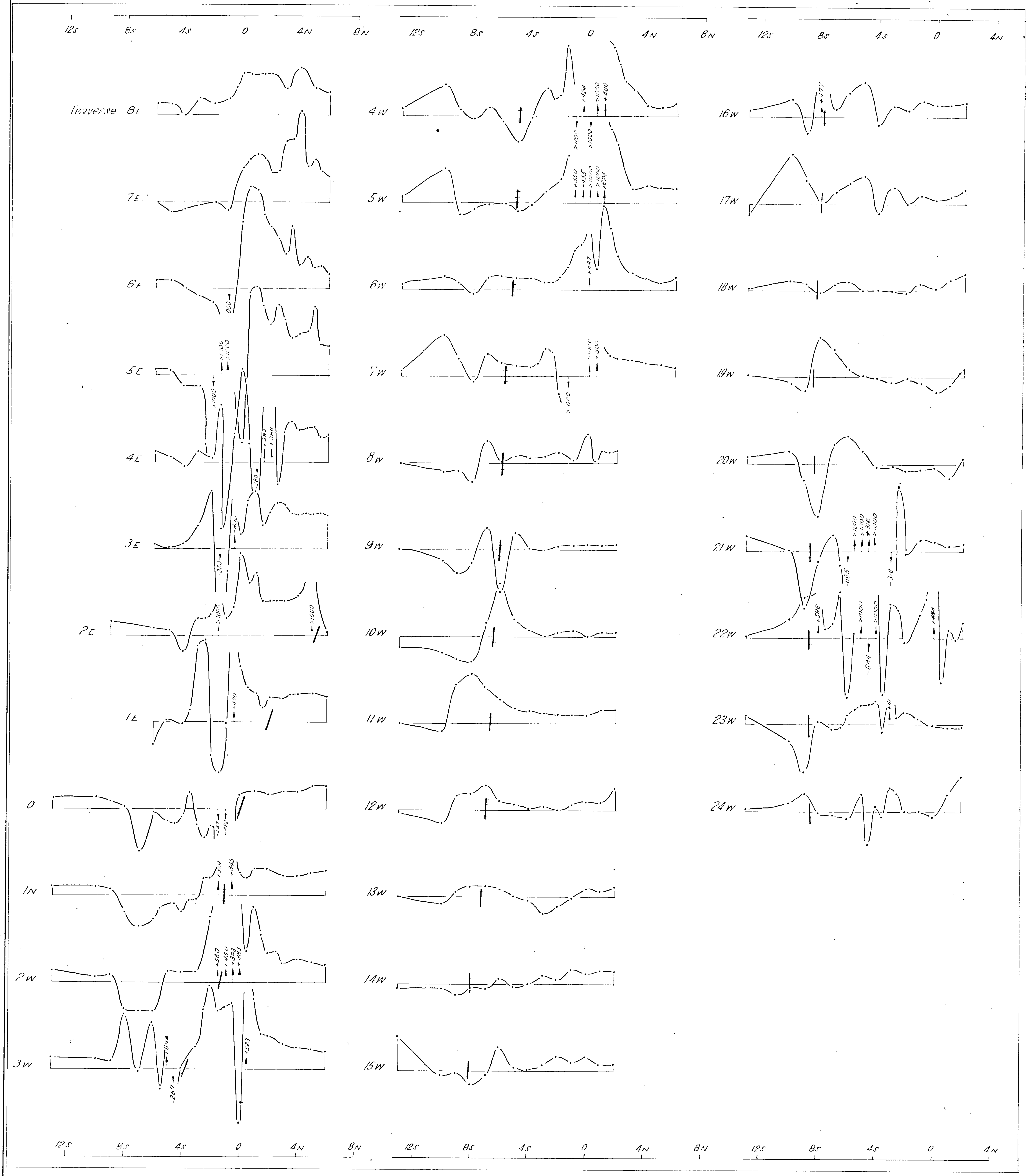
## ELECTROMAGNETIC PROFILES (IMAGINARY COMPONENTS) & RESULTS OF RESISTIVITY TESTS

Horizontal 200 0 200 400 600 Feet
Vertical 10 0 10 20 30

Geophysicist

G84 - 9

Geophysical Section, Bureau of Mineral Resources Geology & Geophysics 12-10-50




LEGEND

Position of Railway Line

GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND.

# SHANNON AREA

## MAGNETIC VERTICAL FORCE PROFILES

Horizontal 200 0 200 400 600 800 1,000 Feet

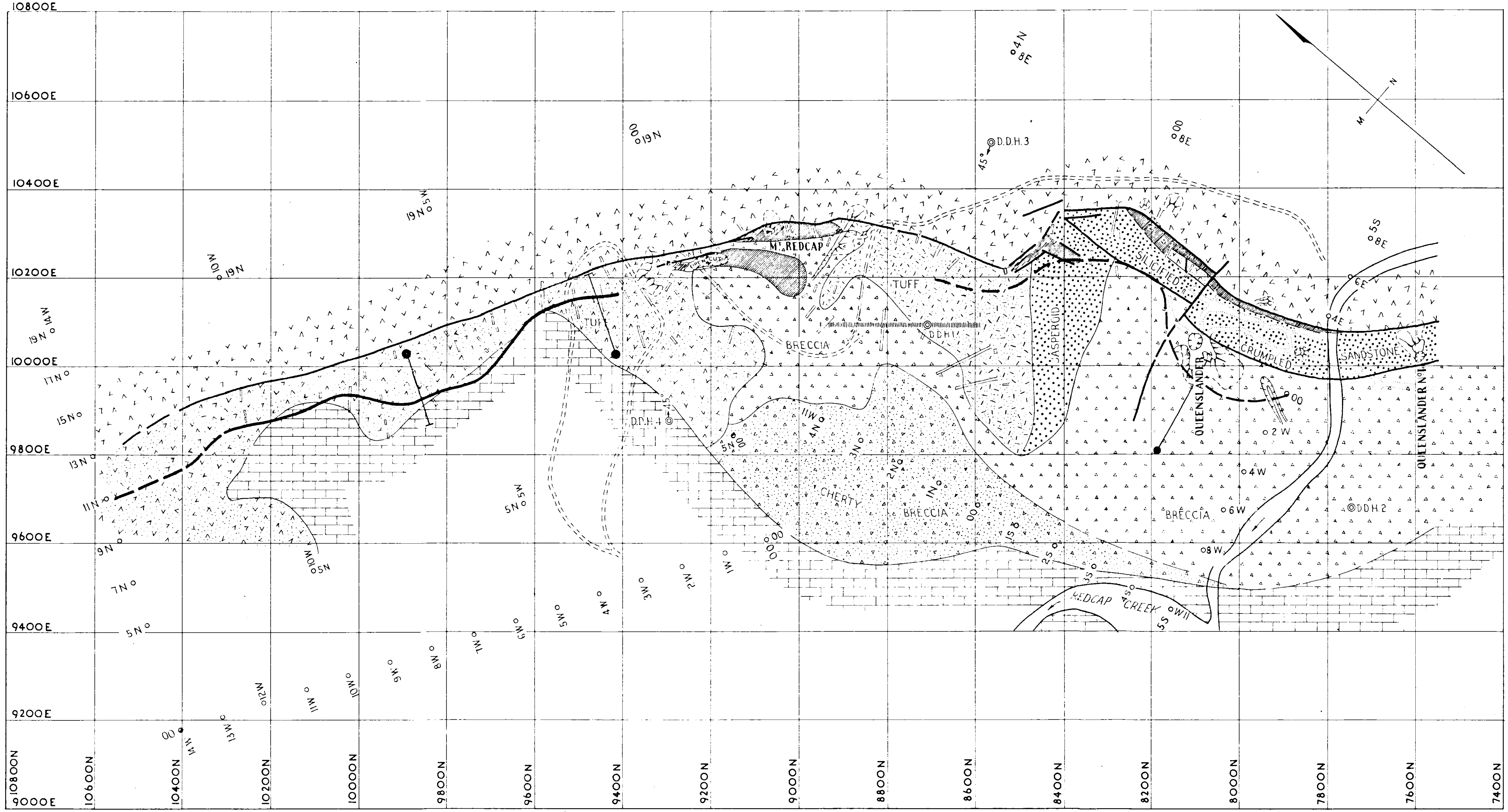
Vertical 200 0 200 400 600 800 1000 Gammas

Geophysicist

G84-10

Geophysical Section, Bureau of Mineral Resources Geology & Geophysics 12.10.50

PLATE II




LEGEND

- RHYOLITE
- LIMESTONE
- SUPERGENE ROCKS
- ORE
- TUFF (Undifferentiated)
- BRECCIA ( " )
- CHERTY BRECCIA
- BASALT TUFF

SCALE

200 0 200 400 600 FEET

- FAULT
- AXIS OF ELECTROMAGNETIC INDICATION
- POSITION OF I.G.E.S. EQUIPOTENTIAL LINE ANOMALY
- ◎DDH DIAMOND DRILL HOLE (B.H.S. LTD.)
- TRENCH
- RECOMMENDED D.D.H.

GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND

# REDCAP - QUEENSLANDER AREA

PLAN OF AREA SHOWING

GEOLOGY, GEOPHYSICAL LAYOUT AND AXES OF ELECTROMAGNETIC INDICATIONS

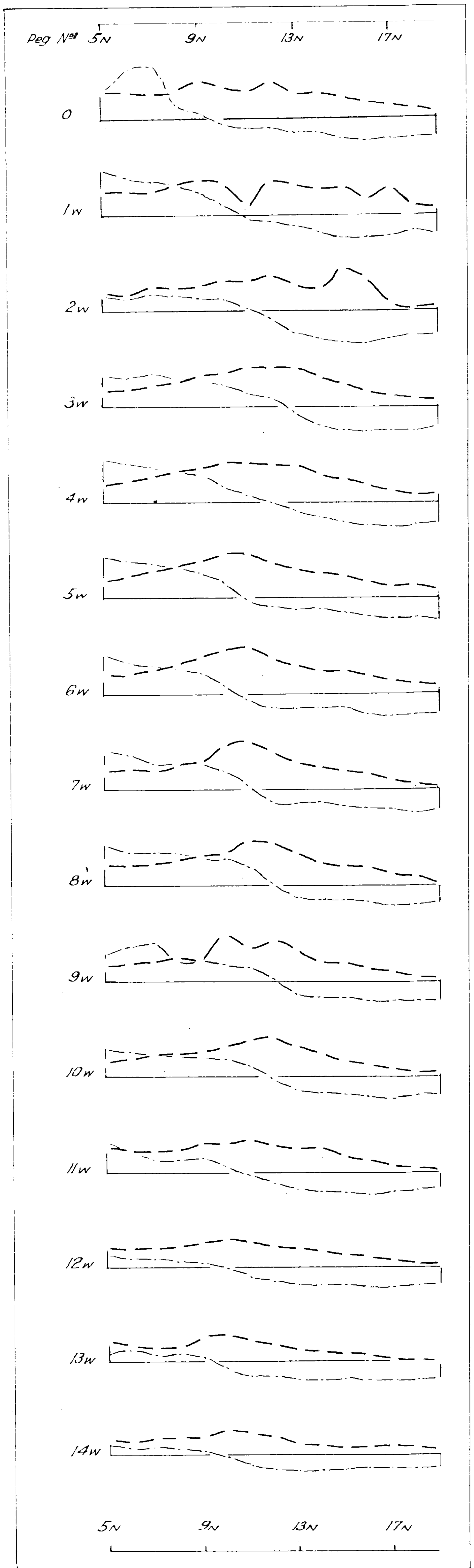
[signature]
GEOPHYSICIST

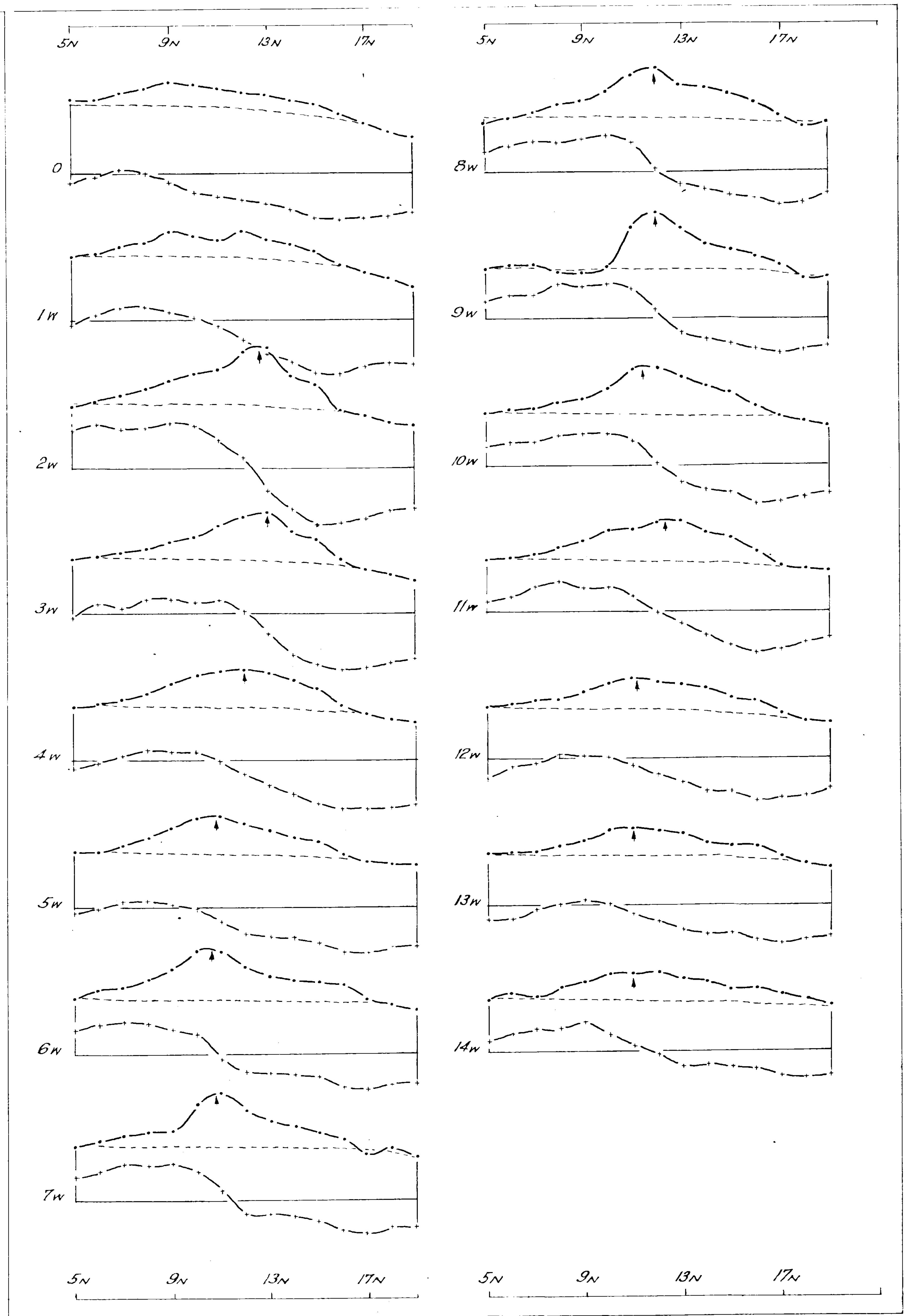
(GEOLOGY SUPPLIED BY BROKEN HILL SOUTH LTD)

Geophysical Section, Bureau of Mineral Resources Geology & Geophysics.

G84-11

To Accompany Records 1957, No 99




GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND

# REDCAP AREA

# ELECTROMAGNETIC PROFILES OF REAL & IMAGINARY HORIZONTAL & VERTICAL COMPONENTS

*PRIMARY CABLE ALONG 00*

**SCALES**

Horizontal 200 0 200 400 Feet

Vertical 10 0 10 20 Micro gauss per ampere of primary current

**LEGEND**

- Real horizontal component (R.H.C)
- Real vertical component (R.V.C)
- Imaginary horizontal component (I.H.C)
- Imaginary vertical component (I.V.C)
- Normal ground conductivity curve
- ↑ Position of axis of E.M. anomaly

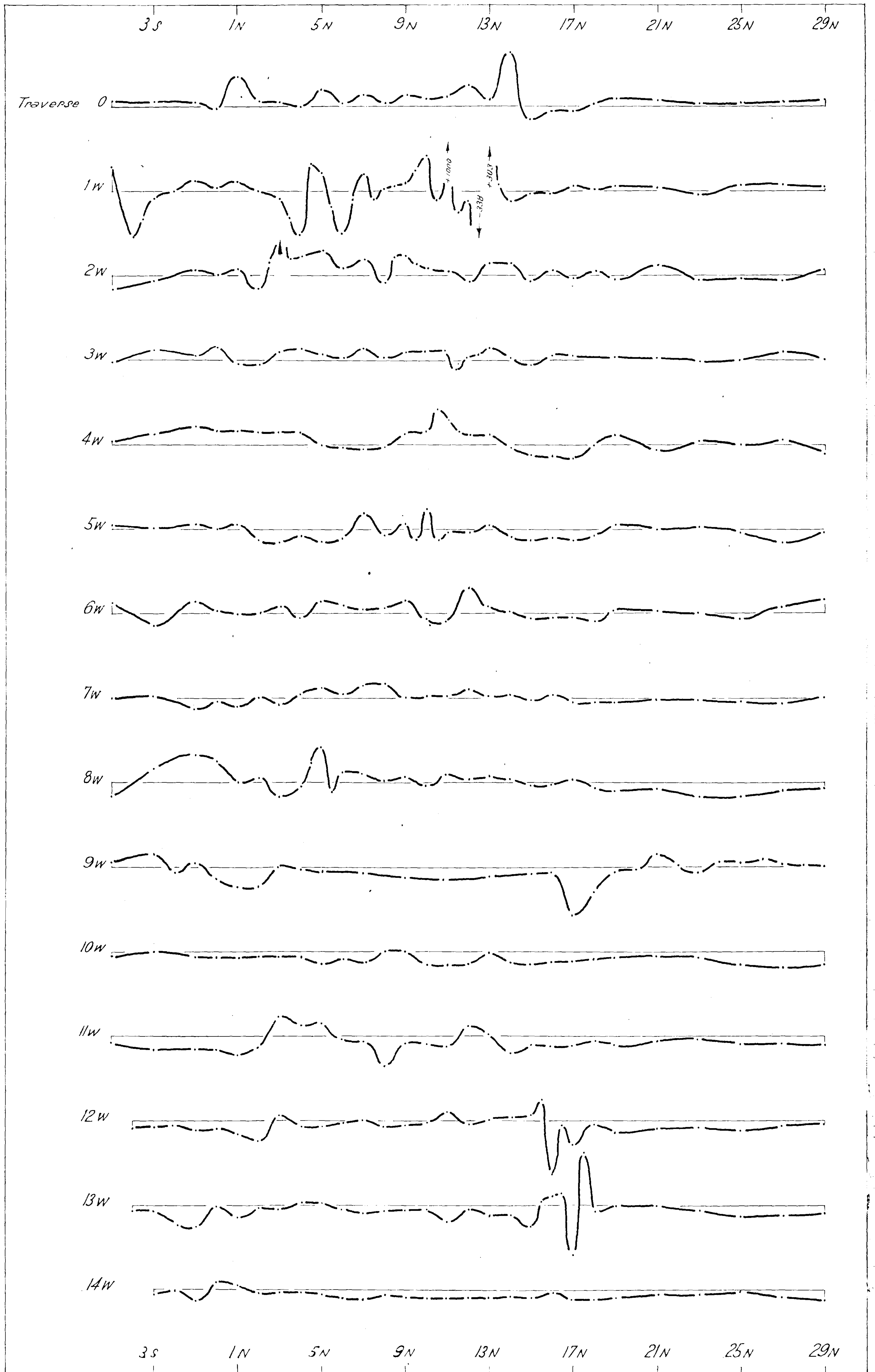
Geophysicist

G84-12

*Geophysical Section, Bureau of Mineral Resources Geology & Geophysics.* 12.10.50

*To Accompany Records 195[illegible], No 99*

## INSET "A"



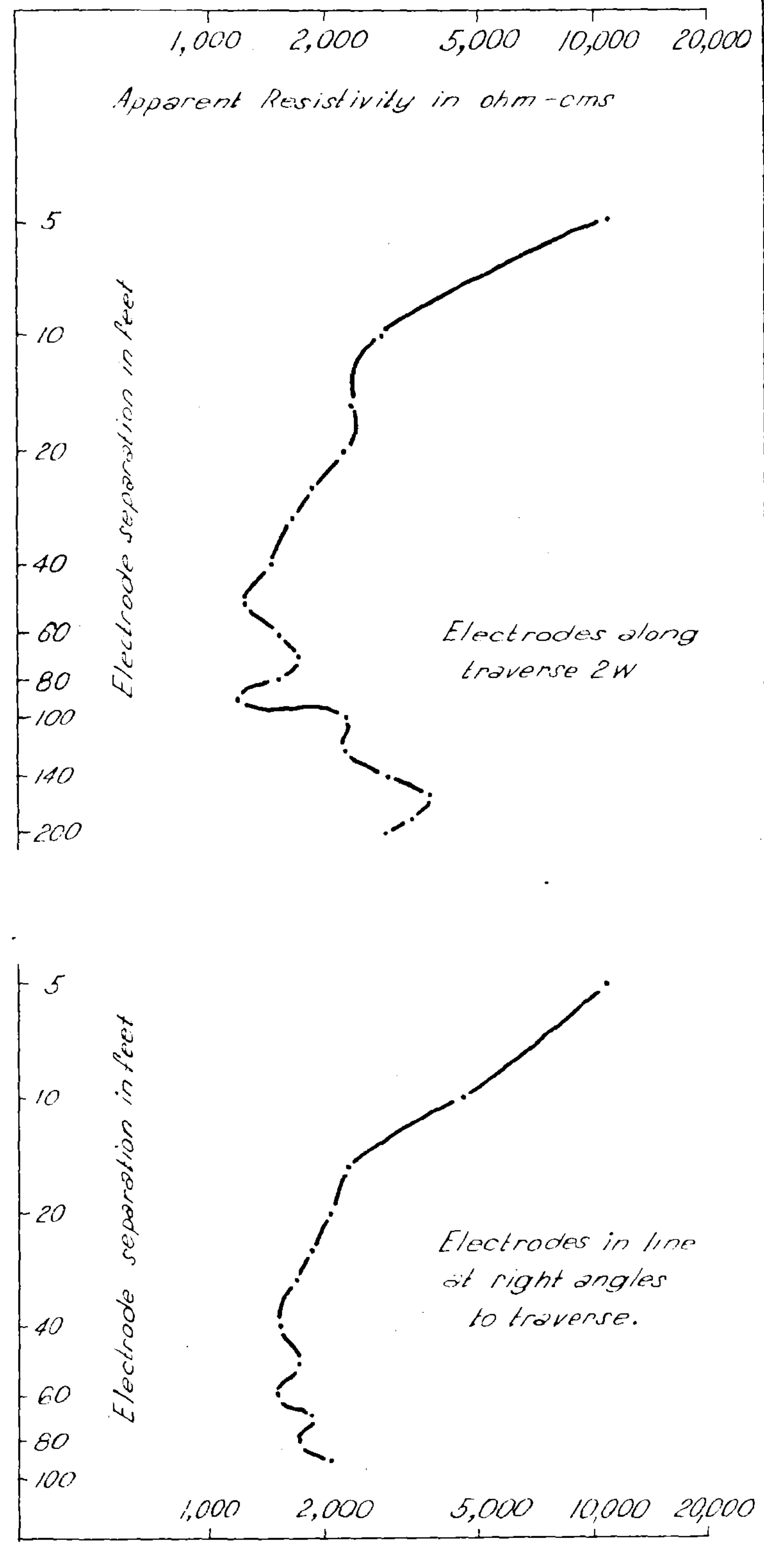

MAGNETIC VERTICAL FORCE PROFILES

Horizontal 200 0 200 400 600 800 Feet

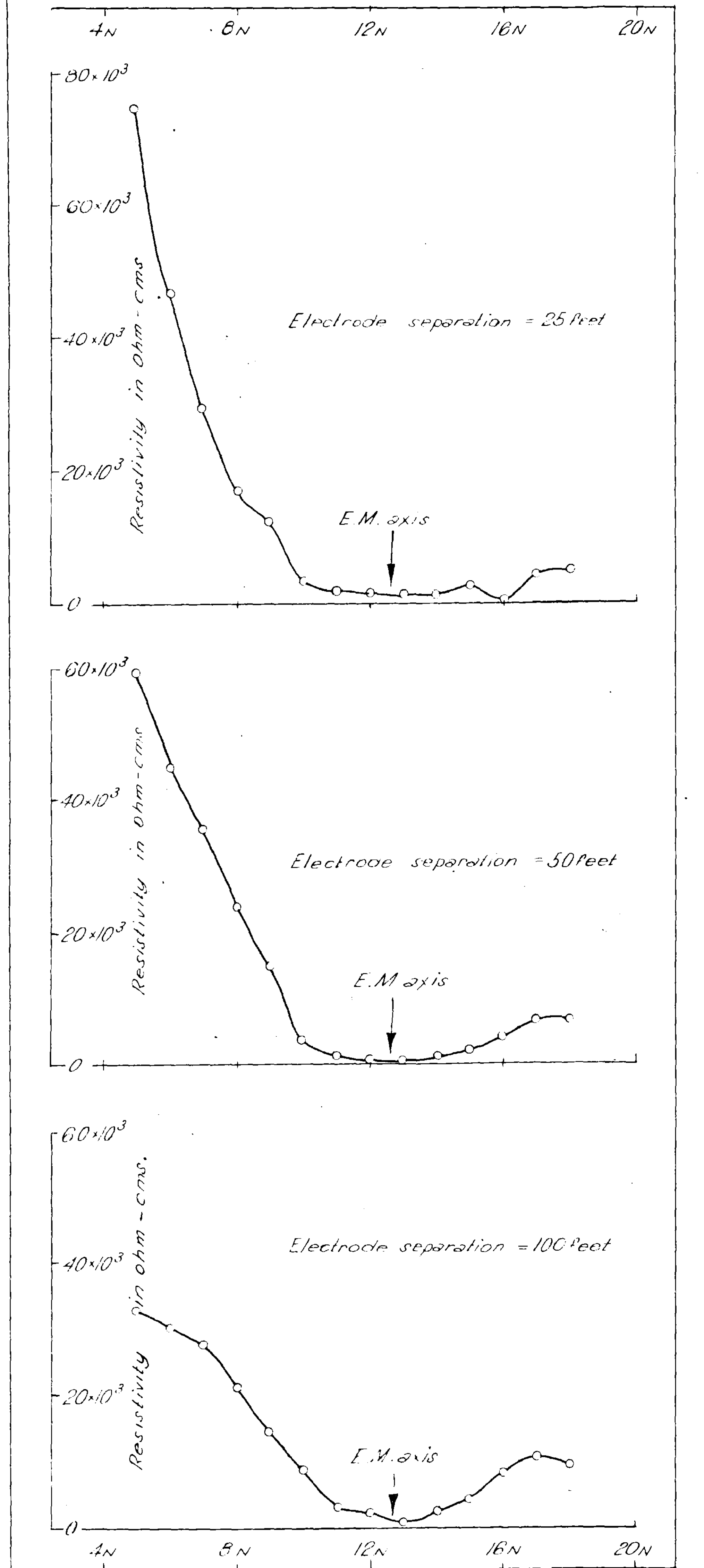
Vertical 200 0 200 400 600 800 Gammas

## INSET "B"

### RESISTIVITY DETERMINATIONS




RESISTIVITY DEPTH PROFILES AT STATION 2W, 12N




RESISTIVITY PROFILES ALONG TRAVERSE 2W USING CONSTANT ELECTRODE SEPARATIONS

200 0 200 400 Feet

GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND

# REDCAP AREA

## RESULTS OF MAGNETIC SURVEY & RESISTIVITY TESTS

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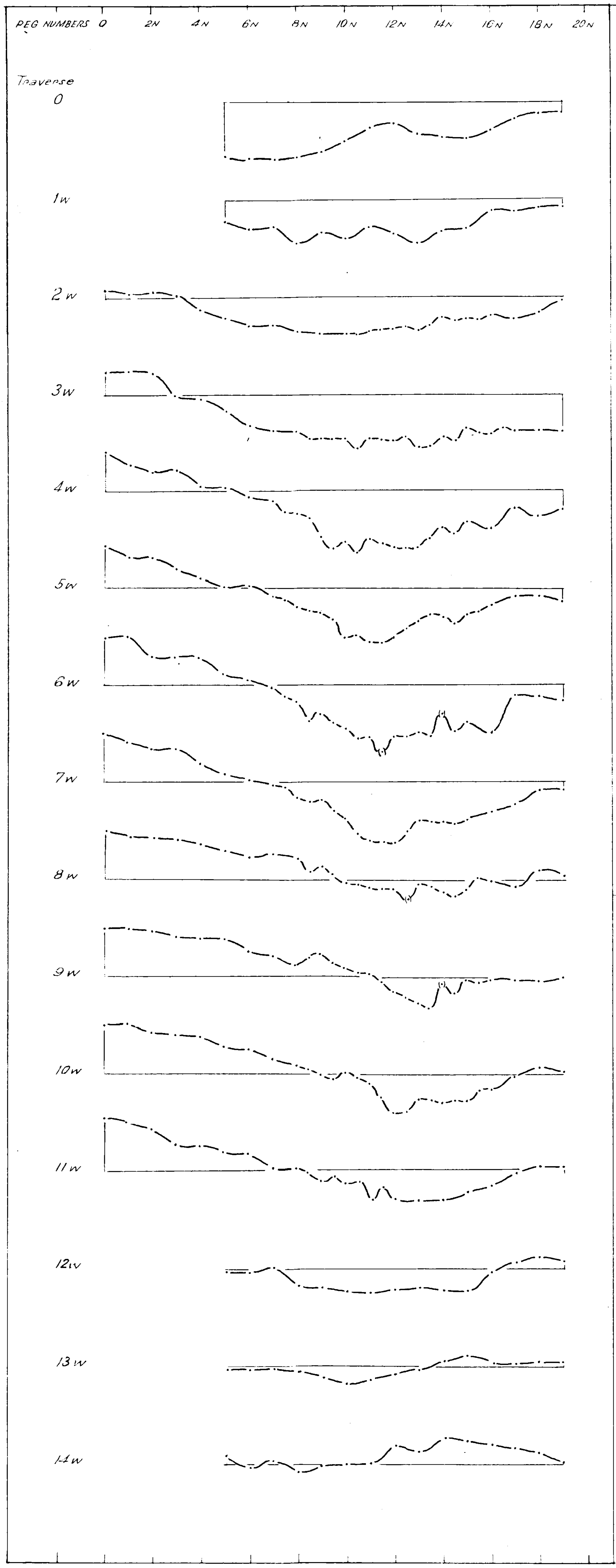


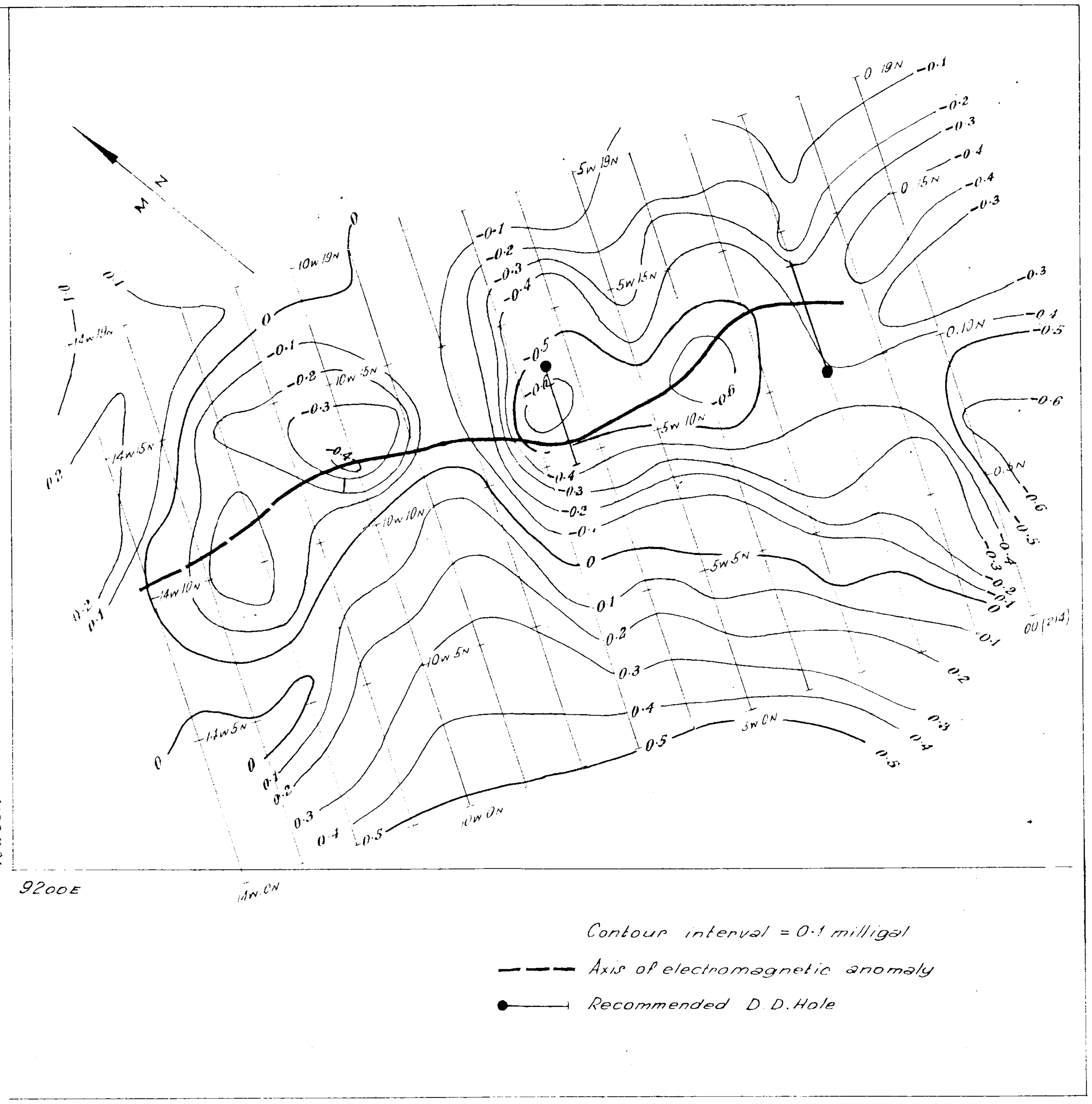


GEOPHYSICAL SURVEY AT CHILLAGOE - MUNGANA, QUEENSLAND

# REDCAP AREA

## GRAVITY PROFILES & CONTOURS
## ( RELATIVE BOUGUER VALUES )

SCALES

HORIZONTAL 200 0 200 400 600 FEET

VERTICAL 1·0 0 1·0 2·0 3·0 MILLIGALS

*W. J. Langron.*

Geophysicist

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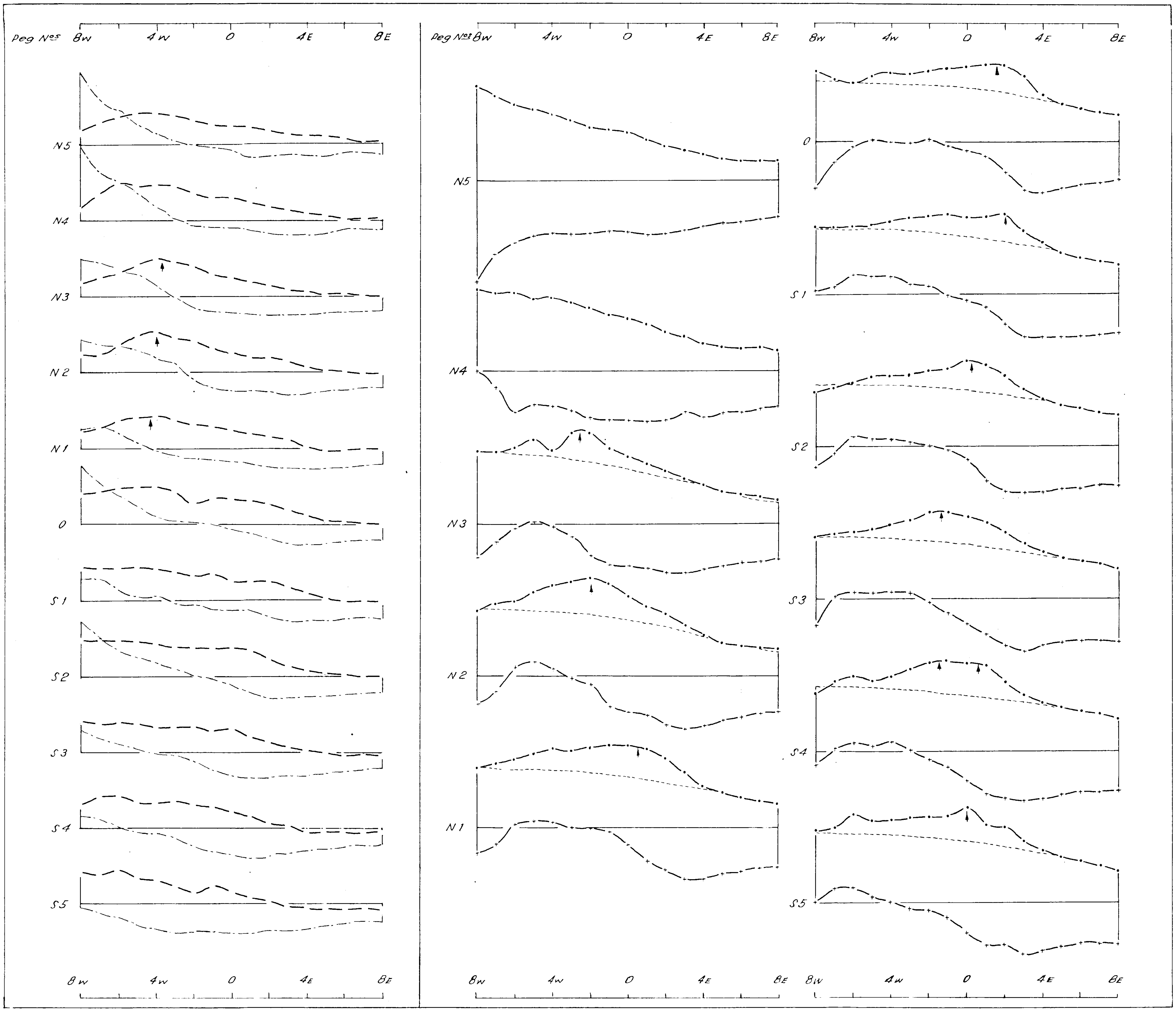
PLATE 15




**LEGEND**

Real Horizontal Component (R.H.C.)
Real Vertical " (R.V.C.)
Imaginary Horizontal Component (I.H.C.)
Imaginary Vertical " (I.V.C.)
Normal Ground Conductivity Curve
Position of Axis of E.M. Anomaly

**SCALES**

Horizontal 200 0 200 400 Feet
Vertical 10 0 10 20 Micro gauss per ampere of Primary Current

Geophysicist

GEOPHYSICAL SURVEY AT CHILLAGOE-MUNGANA, QUEENSLAND

# QUEENSLANDER AREA

# ELECTROMAGNETIC PROFILES OF REAL & IMAGINARY HORIZONTAL & VERTICAL COMPONENTS

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