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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1962/45

DUNDAS METALLIFEROUS GEOPHYSICAL SURVEYS, TASMANIA 1960

by

W. J. LANGRON and J. HORVATH

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SUMMARY

Geophysical surveys were made in three adjoining areas - the Razorback, Grand Prize and Intermediate areas - in the Dundas Mineral Field near Zeehan, Tasmania.

The aim of the surveys was to assist in the search for tin, which in this region occurs in association with sulphides. Electromagnetic, self-potential (S-P.) and magnetic methods were used.

In the Razorback area strong electromagnetic and S-P. anomalies were observed over known mineralization in the main open-cut, but elsewhere the anomalies are weaker and indicate zones of only relatively weak mineralization. The magnetic results show some correlation with the known sulphides but it was concluded that, in general, there is considerable variation in the magnetic properties of the sulphides, owing to the irregular distribution of pyrrhotite. Strong magnetic anomalies observed over the serpentine are considered to be caused by concentrations of magnetite.

In the Grand Prize area a strong magnetic anomaly was found associated with gossan near the serpentine/slate contact and coinciding in part with a strong electromagnetic anomaly. These anomalies provide a suitable target for testing. No useful results were obtained with the S-P. method.

The electromagnetic survey of the Intermediate area showed several anomalies, some of which are considered to warrant testing. The S-P. results were of no interest. The magnetic survey showed anomalies which to some extent correlate with the electromagnetic results, but in the main are associated with the serpentine. The serpentine/slate contact was clearly indicated by the magnetic results.

A list of recommended sites is given for drilling and trenching to test the geophysical results.

1. INTRODUCTION

In March 1959 the Tasmanian Department of Mines requested the Bureau to undertake a geophysical survey to assist in the search for tin-bearing sulphides in the Dundas mineral field, near Zeehan. It was proposed that the geophysical survey should investigate a narrow strip of country which included the Razorback and Grand Prize mines and, if possible, should be extended beyond the Grand Prize mine towards the Melba Prospect and Renison Bell. Subsequently, following an inspection by Dr J. Horvath (Senior Geophysicist of the Bureau), in company with Messrs T. Hughes (Chief Geologist, Department of Mines) and A.H. Blissett (Regional Geologist, Department of Mines) the area shown on Plate 1 was selected for the geophysical survey. It was decided that three sets of traverses would be necessary to cover the area; these are referred to as the Razorback and Grand Prize grids (about the mines of these names) and the Intermediate grid. The topography and geology of the area, and the location of the geophysical grids, are shown on Plate 1.

The Razorback mine has been a small tin producer for many years and the Grand Prize mine has been worked by a small local syndicate for some time. Three holes drilled by the Department of Mines near the Razorback mine (Plate 2) gave promising results suggesting the possible existence of economic tin deposits in the Razorback/Grand Prize area. The locus of the tin and associated sulphide mineralization was considered to be the boundary between the Cambrian sediments and the ultrabasic complex, but the geological mapping of this boundary was difficult because of the presence of soil and vegetation.

Because of the intimate association of the tin with the sulphides, it was considered that geophysical methods suitable for the detection of sulphides would prove useful in the search for further tin deposits. This view was supported by the results of an earlier geophysical survey in the Renison Bell field, where magnetic and self-potential anomalies were found to be associated with mineralization of a similar type. In the present survey, the magnetic and self-potential methods were used to some extent but the main method used was the electromagnetic (Turam) method.

The geophysical party, consisting of W.J. Langron (party leader), R.C. Stubbs and F.F. de Castillejo (geophysicists), R. Smith and J. Sparrow (university students) and one field hand, arrived at Zeehan on 7th January 1960. Traverse clearing had commenced in December 1959, but because of adverse weather and shortage of axemen this work had not proceeded very far by the time the geophysical party arrived. As a consequence much time was spent initially in assisting with traverse clearing before geophysical work could commence. Messrs Smith and Sparrow returned to Melbourne on 19th February 1960 and two additional field hands were engaged for the remainder of the survey. The field work ended on 7th April 1960 when the Bureau personnel returned to Melbourne.

The surveying of the geophysical grids was done by Mr B. Lynch, Department of the Interior, and one chainman. A team of two to ten axemen was provided by the Department of Mines for clearing the traverses.

The area of the geophysical survey is largely covered by dense rain forest and this, together with the rugged topography, slowed the progress of the work considerably. Tracks, suitable at all times for 4-wheel-drive vehicles, gave access to the Razorback and Grand Prize mines. Foot tracks were cleared to give access to the Intermediate area.

2. GEOLOGY

The earliest descriptions of the geology of the Dundas region were given by Montgomery (1890, 1896), Twelvetrees (1900), Ward (1909), and Condor (1918). Reid (1925) gives a more specific description of the geology and history of mining operations in the Razorback area since tin was discovered there in 1909. Taylor (1955) discusses the geology of the Dundas region with particular reference to the ultrabasic rocks.

Since 1958, the Department of Mines has undertaken a programme of detailed mapping in the Zeehan/Dundas region. The geological information shown on Plates 1, 2, 6, and 8 has been supplied by the Department of Mines, and follows from an examination of mine records and old workings and from surface mapping facilitated by the clearing of the geophysical grids. The following description of the Grand Prize/ Razorback area also includes information received by personal communication from A.H. Blissett.

In the Razorback/Grand Prize area, the mineralization occurs in the form of fissure veins striking approximately north-north-west. The host rocks are a thick series of Middle Cambrian slate, greywacke, breccia conglomerate, and also a distinctive chert conglomerate which serves as an important marker horizon.

In late Cambrian time the sediments were intruded by a pyroxenite mass which was later serpentinized. Near the Razorback mine the serpentine is faulted against the Cambrian sediments and mineralization took place along the line of faulting. At the Grand Prize mine the mineralization is wholly within the sediments. The serpentine contains magnetite in the form of irregular veins of variable thickness and as larger concentrations in some localities.

At the Razorback mine the tin is found as fine-grained cassiterite intimately associated with marcasite, pyrite, pyrrhotite, and arsenopyrite in a quartz gangue. Galena occurs sporadically in small quantities both here and in the Grand Prize mine. Near the orebody, fluids accompanying the mineralization impregnated and altered the serpentine to talc and dolomite, and some silicification took place. The sulphide orebody is oxidised down to about 100 feet into a limonitic and haematitic gossan up to 15 feet wide and containing fine disseminated cassiterite, associated in places with fine, rather gritty, quartz. Minor quantities of cassiterite are also found disseminated through the talcose and dolomitic zones. The lode is almost vertical, with a steep westerly dip in the northern part of the workings.

Similar gossan is found at the Grand Prize mine and on the western slope of Black Hill. At the Grand Prize the lode is nearly vertical. There are no mine plans of the Grand Prize available, but some old records show that the shaft was sunk to a depth of 240 feet.

The lode at Razorback has been worked by open-cut (in which pyrite, pyrrhotite, and other sulphides are exposed) and a system of adits and drives, some of which are at present being worked. The workings at the Grand Prize consist of adits and drives on several different levels. Each mine has a small treatment plant operated by a local syndicate.

3. GEOPHYSICAL METHODS

The electromagnetic, magnetic, and self-potential (S-P.) methods were employed. The principles of these methods are described in standard geophysical textbooks, and the following discussion deals only with their particular application in the present survey.

Electromagnetic (Turam) method

Because of the steep topography and thick vegetation it was not practicable to use closed loops for the primary field or to survey from both the hangingwall and footwall sides of the lodes. The primary layout used in each area consisted of a long grounded cable placed along the grid baseline. The resistance of the primary circuit was about 200 ohms.

Two primary layouts were used in the Intermediate area, the first with cable laid along the baseline and the second with the cable along 5000S. The two layouts were necessary because of the presence and shielding effect of a highly conductive zone at about 500S in the southern portion of the grid.

In using the Turam method, measurements along the traverses were made of the amplitude ratios and phase differences of currents induced in two horizontal search coils kept at a fixed separation of 100 feet. Frequencies of 440 and 880 c/s were used. In general, it was found that the anomalies were clearer when operating with 880 c/s.

The results of the Turam survey are shown on the plans of the areas by plotting the axes of the Turam anomalies. Profiles and ratio/phase diagrams for a few selected traverses are also presented. The ratio/phase diagrams are useful in interpretation as they have a characteristic shape depending on the conductivity, dip, and shape of the conducting bodies. A greater conductivity or thickness of a conductor is indicated by a steeper slope of the ratio/phase diagram. Wait (1951) has given a theoretical explanation of this effect.

Self-potential (S-P.) method

Measurements were made with a transistorized millivoltmeter designed and constructed in the Bureau's Geophysical Laboratory. It was not possible to survey all the traverses with this method. Although good agreement with the other geophysical methods and with the known mineralization was found in the Razorback open-cut, no confirmation was found of the strong Turam anomalies in the Intermediate area; in both the Intermediate and Grand Prize areas the S-P. results were of little interest.

Magnetic method

Variations in the vertical component of the Earth's magnetic field were measured with an Askania torsion magnetometer (No. 581649). The magnetic survey included several traverses in the Razorback area, most of the traverses in the Grand Prize area, and all the traverses in the Intermediate area.

4. DISCUSSION OF RESULTS

Razorback area

Turam method. The results of the Turam survey showed several anomalies indicating the presence of conducting bodies. The axes of the anomalies are shown on Plate 2. The anomalies have been graded in terms of strength - strong, medium, weak, and very weak. Plate 3 shows selected ratio/phase diagrams and a comparison between results using frequencies of 440 c/s and 880 c/s (Figs. 5 and 6).

A definite Turam anomaly, shown as "A" on the plan, was observed over the known mineralization in the open-cut area. The ratio/phase diagram (Plate 3, Fig. 7) for Traverse 22N, which crosses the open-cut where sulphides are exposed, shows a pronounced indication of a good conductor. Anomaly "A" can be traced for a distance of about 500 ft in the direction of the strike of the lode. The anomaly weakens rapidly north of Traverse 24N. It is possible that the lode has been displaced to the west by a fault near Traverse 26N, and the Turam anomaly through 28N/725W and 30N/750W may represent the continuation of "A" on the northern side of the fault.

Another Turam anomaly, "E", about 200 ft east of "A" has been traced from Traverse 26N to Traverse 34N. It is clearly defined on Traverse 28N to 32N and coincides with a magnetic anomaly on these traverses.

Three drill holes have been put down by the Tasmanian Department of Mines in the positions shown on Plate 2. All three holes passed first through weathered serpentine and then through dolomite, which in part carried sulphide mineralization. Core assays from DDH No. 1 gave 1.16 per cent tin between 195 and 206 ft, and sludge assays from DDH No. 2 gave over 2% Sn in several sections in the dolomite. DDH No. 3 gave values of 0.46 per cent tin over six feet before it passed out of dolomite into talc. The tin values in DDH No. 2 seem to correspond to the Turam anomaly "E". The anomaly suggests that the mineralization continues north of DDH No. 2. It would therefore be worth while to test the anomaly between 28N and 34N by at least one more drill hole.

Anomaly "D", which extends from 36N to42N, is caused by a body of fairly high conductivity. The anomaly was also observed in the survey of the Intermediate area, which here overlaps the Grand Prize area, and will be discussed when considering the results in the Intermediate area.

South of the open-cut area, Turam anomaly "B" was traced from 20N/840W to 6N/750W. The anomaly arises from a fairly shallow depth and does not suggest a body of very high conductivity. The anomaly is considered to be caused by a zone of weak sulphide mineralization. This view is supported by information from earlier drilling, which recorded no tin values greater than 0.1 per cent in the area south of Traverse 12N. (Blissett, personal communication).

A prominent Turam anomaly ("C") was observed in the south-western part of the area, extending from 6N/1130W to 18N/1420W. From the ratio/phase diagrams, an example of which is given in Plate 3, Fig.2, the anomaly appears to be due to a body of low conductivity which, over most of its length, is wide and thick but becomes considerably narrower towards its northern end. The conductor is situated some distance away from the boundary between the serpentine and the sediments, and is in a geologically unfavourable area for sulphide mineralization. The anomaly is probably caused by graphitic and carbonaceous slates, which are known to be present in the area. The only recommendation that can be made with regard to anomaly "C" is that the northern end, where the conducting body appears to be narrow, should be examined geologically for any signs of mineralisation.

The ratio/phase diagrams for Traverse 20N from the measurements with 440 c/s and 880 c/s are shown in Figs. 5 and 6 of plate 3. The axis of the Turam anomaly is at 650W with 440 c/s and at 625 with 880 c/s. This displacement is mainly due to the dip of the conductor and to the current concentration closer to the surface when using the higher frequency. Under favourable conditions, and particularly when an insulated loop is used to provide the primary field, this displacement can be used to estimate the dip of the conductor. Examination of the Turam results with two frequencies on Traverses 18N to 36N shows some evidence for a steep westerly dip of the conductors, but the evidence is not clear on several traverses. North of Traverse 36N the Turam results, when plotted in the form of profiles, suggest that the dip of the conductor causing anomaly "D" is steeply to the east and continues thus, with slight flattening, to the Intermediate area.

The results of the Turam survey of the Razorback area may be summarized as follows:-

Anomaly "A" represents the effect due to the known mineralization.

Anomaly "B" is considered to represent mineralization of generally poor quality at fairly shallow depth, but some testing would be recommended if it is found that the old workings did not extend far enough to test the conducting zone.

Anomaly "C" is probably not associated with mineralization, but a geological examination along parts of the anomaly zone is considered desirable.

Anomaly "D" may be associated with mineralization forming an extension of the sulphide orebody of the Razorback mine, and some testing is recommended.

The results of DDH No. 2 suggest that Anomaly "E" is associated with mineralization. The other anomalies shown on Plate 2 are considered to be of little importance.

Self-Potential method. Traverses 12N to 24N were surveyed with this method, and the results are shown in the form of profiles on Plate 4. Plate 2 shows the axes of the S-P. anomalies on the plan of the area.

In general there is good agreement between the S-P. and Turam results. The strong S-P. anomaly on Traverses 21N to 23N coincides with the known orebody. From 12N to 21N there is a second S-P. anomaly which follows closely the Turam anomaly "B". The S-P. profiles support the conclusion drawn from the Turam results that the conducting body responsible for anomaly "B" lies at a fairly shallow depth. Both the S-P. and Turam anomalies lie within the slates but are not far from the contact with the serpentine and run roughly parallel to the contact. Although the anomalies are not as strong as those near the open-cut, their position is geologically favourable. The S-P. results support the suggestion made above with regard to the testing of Turam Anomaly "B".

The broad S-P. anomaly that appears towards the western ends of Traverses 12N to 20N is considered to originate from the graphitic slate and to be of no economic interest.

Magnetic method. Traverses 21N to 42N were surveyed with the magnetic method. The contours of magnetic vertical force are shown on Plate 5, and the axes of the magnetic anomalies on Plate 2.

The magnetic readings along Traverse 22N revealed a distinct but not very strong anomaly over the sulphides exposed in the open-cut. Inspection of the underground workings showed that there was a body of compact sulphide at least 12 ft wide located almost immediately beneath Traverse 23N and covered by no more than 40 or 50 ft of overburden. However, this sulphide body gives very little magnetic effect along Traverse 23N. This suggests that the sulphide mineralization has a considerable variation in magnetic properties along the line of lode.

Samples of ore and other rocks in the surveyed areas were collected for susceptibility determinations, the results of which are given in the Appendix. These results show large variations in the magnetic properties of ore from the Razorback mines, the susceptibility ranging from 0.1×10^{-3} c.g.s. units for gossan to 21.2×10^{-3} c.g.s. units for pyrrhotite ore from the Razorback open-cut. The pyrrhotite, which has a high magnetic susceptibility, does not seem to be widely distributed. It is considered that the magnetic effects due to the sulphides in general are only weak and only detectable when the sulphide body is near the surface.

The magnetic contour map (Plate 5) shows a belt of magnetic anomalies over the serpentine. The contact between the serpentine and the sediments is clearly shown by the transition from disturbed to relatively uniform magnetic values. Whereas the highest magnetic reading obtained over known sulphides (in the main open-cut) was only slightly greater than 1500 gammas, several closures greater than 4000 gammas were located over the serpentine, and it is assumed that most of these magnetic anomalies are due to concentrations of magnetite within the serpentine. One such anomaly centred at 23N/300W indicates a body of high magnetic susceptibility close to the surface, and the above assumption could be easily checked by trenching at this anomaly.

Another localized anomaly was observed at 28N/530W. The nearby drill hole DDH No. 2 revealed over 2 per cent tin in several sections. The magnetic anomaly coincides with Turam anomaly "E" and it is possible, in this case, that the magnetic anomaly actually arises from sulphides.

Grand Prize area

The plan of the area on Plate 6 shows the geophysical grid, the principal survey results, and the geology. The surveyed area is situated mainly south of the Grand Prize mine and therefore does not include the Grand Prize lode.

Turam method. Only Traverses 10S to 24S were surveyed with this method because of the very difficult terrain in the area. Frequencies of 440 and 880 c/s were used for the primary field.

The Turam results are in general of poor quality, and only on Traverses 16S, 18S, and 20S were anomalies located that are worthy of note. The ratio/phase diagrams (using a frequency of 880 c/s) for these traverses are included on Plate 7. The anomaly at 20S/700E is weak and originates from a near-surface body that has a relatively low conductivity. The anomalies at 18S/660E and 16S/640E are more distinct but also originate from a body of relatively low conductivity. The ratio/phase diagram for Traverse 12S, included on Plate 7, shows only a very weak anomaly. The remaining traverses surveyed are devoid of Turam anomalies. The Turam results on Traverses 16S, 18S, and 20S bear a close relation to the results of the magnetic survey and are further discussed below.

Self-potential method. Traverses 00 to 3S and 16S to 20S were surveyed with this method. Except for Traverses 0 and 2S, which are in the vicinity of the Grand Prize mine and where a weak S-P. anomaly of about 100 millivolts was obtained, the profiles for the most part are smooth and devoid of anomalies. These results contrast with the strong S-P. anomalies in the Razorback area, although it must be pointed out that the worked portion of the Grand Prize lode has not been covered by the S-P. survey.

Magnetic method. The results of the magnetic survey, in the form of magnetic profiles, are shown on Plate 7. The higher intensities in the south-western portion of the grid are due to serpentine which is found in this area, and many of the irregularities on the western portions of the traverses are probably due to segregations of magnetite within the serpentine.

The profiles show a pronounced magnetic anomaly whose axis continues from 16S/575E to 24S/850E. The position of the anomaly coincides with some sparse outcrops of cherty gossan and is not far from the contact of serpentine with conglomerate and greywacke. The anomaly is due to a narrow body with a steep westerly dip situated at a fairly shallow depth, but the depth appears to be increasing toward Traverse 24S. It is possible that the anomaly is due to a segregation of magnetite near the eastern boundary of the serpentine, but the length, narrow width, and regular shape are points in favour of it being due to a sulphide lode. The associated Turam anomaly is not as pronounced as the magnetic anomaly and is distinct only on Traverses 16S and 18S, while on Traverses 20S and 22S the Turam results point to relatively low conductivity of the conducting zone. Geologically, a lode with the disposition suggested by the geophysical results could be a shear-zone type of deposit, similar to that at the Grand Prize.

It is considered that the Turam and magnetic results on Traverses 16S and 18S offer a suitable target for testing, and recommendations are made for this in Chapter 5.

Intermediate area

Plate 8 shows the geophysical grid, the principal survey results, and the geology of the Intermediate Area.

Turam method. All traverses were surveyed with this method using a frequency of 880 c/s per second for the primary field. The use of this frequency was decided upon following the results of electromagnetic work at Razorback and Grand Prize.

It was not possible to read to the limits of the traverses with this frequency, so that after reading traverses to 1000S with the primary cable along 00S, the cable was relaid along 500 S and readings were repeated over about [illegible] of the first layout and continued to 1500S. The overlapping profiles did not agree very well and had to be corrected to obtain a composite profile along each traverse. The lack of agreement between the results with the two layouts was due to the use of a grounded cable to provide the primary field and also due to the primary cable along 500S being partly over or near a highly conductive and magnetic zone. Selected results from the first layout (i.e. with primary cable along 00S) are shown as ratio/phase diagrams and profiles on Plates 9 and 10.

Several Turam anomalies were recorded and are shown on Plate 8. The readings along Traverses 46E to 38E confirm the results on the northern traverses of the Razorback grid and show the continuation of anomaly "D" as far as 40E. They also show another anomaly ("F") from 42E to 38E. The geological environment of anomalies "D" and "F" is favourable, as they lie close to the contact between the serpentine and the sediments. However, the area is covered by scree, which impedes geological observations.

The Turam anomaly "D" is most pronounced on Traverse 44E; the ratio/phase diagram is shown in Plate 9, Fig. 1. Figs. 2 to 4 of the same plate show that the anomaly becomes weaker to the north-west. Anomaly "F" appears to be derived from a greater depth than "D" or from a wide zone of medium conductivity. There were no S-P. anomalies associated with the Turam anomalies in this area and this could point to the Turam anomalies being caused by shearing. The magnetic contours (Plate 11) show a zone of high values between 42E and 32E with a general trend similar to that of the Turam anomalies, but there is not a very close correlation between the magnetic and the Turam results. The Turam results on Traverses 36S to 30S show only weak and indistinct anomalies.

Anomaly "G", which in general is weakly defined, is strongest at 28E/815S (See Plate 9 Fig. 5), but diminishes rapidly both east and west of this traverse. However, testing of this anomaly is recommended, as it is in a position geologically favourable for sulphide occurrence.

Anomaly "H", which extends from Traverse 22E to Traverse 12E, appears prominently on the ratio and phase profiles (Plate 10) and in the ratio/phase diagrams (Plate 9, Fig. 6, 7, and 8). The ratio/phase diagrams suggest a marked increase in the conductivity of the body between Traverses 16E and 14E. This Turam anomaly coincides with a magnetic anomaly (Plate 11). As the magnetic and Turam anomalies are in good agreement and occur in a geologically favourable location, it is considered that they should be tested, preferably by a drill hole on Traverse 14E.

A Turam anomaly ("J") was observed between Traverses 10E and 0. The character of the anomaly varies rapidly from traverse to traverse, but in general it seems to arise from a shallow, flat-lying body not only with a high conductivity but also with a high magnetic permeability. The magnetic results on Traverses 10E and 8E show a magnetic anomaly coinciding approximately with Turam anomaly "J". Some old asbestos diggings are situated nearby, and it is recommended that they should be investigated, as they may provide information as to the cause of the geophysical anomalies in this particular locality.

<u>Self-potential method</u> Traverses 46E to 22E were surveyed with this method but no promising results were obtained and the profiles are not presented in this report. Of particular interest is the fact that no confirmation was obtained of the Turam anomalies, even in the area where the Turam results suggest a body at fairly shallow depth. Several possibilities could account for the absence of S-P. anomalies. Either there are no sulphides or graphite present to cause an S-P. anomaly, or the ore has its oxidized portion below the water-table in the area and thus the conditions for the generation of the potentials are not present. Similar conditions may exist in the Grand Prize area. On both these areas, S-P. measurements were made during and after heavy rain, and it is probable that at these times the level of the water-table had risen above the level of the depth of weathering.

In the Razorback area, however, further S-P. readings, made after the work in the Grand Prize and the Intermediate areas, showed that strong anomalies were still present over the known mineralization. The explanation for this behaviour seems to be that water from the steep hillside at Razorback is drained by a series of adits and old workings to the valley below and that this allows sufficient active oxidation of the orebody to continue. There is no such drainage on the Grand Prize or Intermediate areas, but whether improved S-P. response would be obtained, say in mid-summer, is still open to question.

Magnetic method. All traverses were surveyed with this method. The results, in the form of magnetic contours, are shown on Plate 11. The axes of the principal magnetic anomalies are shown on Plate 8. Values of the magnetic susceptibilities of samples collected on Traverse 10E are included in the Appendix.

One of the clearest features of the contour plan is a line of steep magnetic gradients, extending from near the south-eastern corner of the grid towards the north-western corner. This line represents the boundary between serpentine (to the north-east) and sediments (to the south-west). The contours suggest that in the north-western portion of the grid the serpentine is terminated abruptly, probably by a fault striking roughly west.

Most of the magnetic anomalies occurring over the serpentine are considered to be caused by concentrations of magnetite within the serpentine. However, some of the magnetic anomalies appear to be associated with the Turam anomalies and could be due to sulphide mineralization. The axis of the magnetic anomaly associated with Turam anomalies "D" and "F" changes from down-dip to up-dip and again to down-dip of the conducting body between Traverses 46E and 36E. The axis of another magnetic anomaly closely follows anomaly "H" between 20E and 12E. The Turam results are considered to be more significant as regards sulphide mineralization. The drill hole recommended to test Turam anomalies "D" and "H" should also serve to test the associated magnetic anomalies, and it is important that the magnetic properties of the cores from these holes should be measured.

The intense magnetic anomaly at 10E/460S is due to a highly magnetic body but the relation between this body and the flat-lying conductor causing Turam anomaly "J" is not clear. As the magnetic body appears to come close to the surface, it could be tested by a costean.

Another intense magnetic anomaly (with readings greater than 26,000 gamma) is centred near 850E/250S and is also due to a highly magnetic body close to the surface. Whilst this anomaly does not coincide with an electromagnetic anomaly and is not likely to be due to sulphide mineralization, it could be easily tested by costeaning. An adit on Traverse 10E leads to some old asbestos workings, where samples of relatively fresh rock were obtained for susceptibility tests. The tests showed that the rock is only weakly magnetic, and they did not provide any evidence as to the cause of the magnetic anomaly.

It is considered that none of the remaining magnetic anomalies is significant as regards tin-bearing sulphide ore, and that they are probably due to concentrations of magnetite in the serpentine. Bands of magnetite up to three inches thick have been noted in the serpentine. It is understood that trenching of some of the magnetic anomalies in the serpentine was done by Rio Tinto Australian Exploration Pty Ltd and that samples taken from trenches in this and the Grand Prize area showed relatively high nickel values (0.4 per cent nickel) associated with magnetite. The nickel values seem to coincide with the magnetic anomalies, and point to an affinity of the nickel with the magnetite. It is not known in what mineralogical form the nickel occurs, but its close association with magnetite suggests the possibility of using the magnetic method in the search for nickel.

5. CONCLUSIONS AND RECOMMENDATIONS

The geophysical work was done with the aim of locating deposits of tin associated with sulphides. Therefore the geophysical methods applied were those mainly used in the search for sulphide bodies. However, whilst the interpretation of much of the geophysical data is fairly clear over most of the surveyed areas, the meaning of some of the results is not yet clear and it is hoped that further geological examination and some initial testing may enable the geophysical data to be more fully analysed.

At Razorback, for example, distinct Turam and S-P. anomalies were obtained over sulphide mineralization in the region of the main open-cut; the magnetic profile over the open-cut also exhibits a definite anomaly, but away from this traverse there is in general no definite relation between magnetic results and sulphide mineralization. In the southern part of the Grand Prize area, strong magnetic anomalies are associated with rather weak Turam indications in a favourable geological environment. It is believed that the magnetic results are associated with sulphide mineralization. Both in the Grand Prize and the Intermediate areas, the S-P. method did not give anomalies where the Turam anomalies were found. In the Intermediate area some strong Turam and magnetic anomalies were recorded, and it is believed that some of these could represent mineralization although no confirmation was obtained from the S-P. method. However, even in this last group of results there are several instances of a divergence in the axes of the Turam and the magnetic anomalies.

Throughout the work most reliance has been placed on the Turam method of investigation. The S-P. method, though successful in the vicinity of the Razorback open-cut, has not been regarded as more than an ancillary method of investigation.

Bearing in mind the results over similar mineralization at Renison Bell, where strong magnetic anomalies were recorded, it was thought that the magnetic method would provide a convenient means of locating the sulphide mineralization. The magnetic results in the region of the known mineralization at Razorback are not regarded as conclusive. Laboratory tests of several samples of sulphide from the Razorback area showed that the ore has a fairly low magnetic susceptibility, and that there is a considerable variation in susceptibility within the sulphides.

Where the magnetic anomalies occur in serpentine and are not accompanied by Turam anomalies, it can be assumed that most of them are due to concentrations of magnetite within the serpentine.

In the Razorback area, the results show that the orebody causing Turam anomaly "A" is limited in extent and is probably terminated at both ends by cross faults. Tunnels No. 1 and 2 and drill holes No. 1 and 3 have tested this anomaly and have shown mineralization of economic interest.

Tunnels No. 3, 4, 5, and 6 have been driven in the area of anomaly "B", but with the exception of tunnels No. 3 and 4 have probably not reached the proper target. The information available from these workings would need to be considered before drilling of anomaly "B" could be recommended. Drill holes might be warranted in order to reach the target at a greater depth.

The northern end of anomaly "C" should be examined geologically to see if there is any sign of mineralization in this section where the conducting body narrows considerably. A recommendation for testing anomaly "D" is made in a later paragraph. The results of DDH No. 2 are encouraging and suggest that the magnetic and Turam anomalies near 28N/500W are due to the tin-bearing sulphides.

In the Grand Prize area one drill hole is recommended to test the magnetic and Turam anomalies at 18S/650E. Although the Turam results point to a steep easterly dip of the conductor, the selected collar site is on the western side of the anomaly, and this is downhill from the target. The hole should be sited at 18S/500E or 18S/550E, drilled in the direction of the traverse, with a depression of 45 degrees and length at least 200 to 250 ft in order to test the ground at a depth of 150 to 200 ft below the axis of the Turam anomaly. The magnetic and Turam anomalies extend to Traverse 16 at 625E and the drill site could be moved to that traverse if it is found more convenient, but the site on Traverse 18S would be preferable.

In the Intermediate area three drill holes are recommended to test the Turam anomalies. The holes should be drilled from the northern side of the anomalies, and in the azimuth of the traverse, and each should be depressed at 45 degrees. The holes are planned to test the ground at a depth of about 100 to 150 ft below the surface. The holes should be drilled to about 200 ft in length. It is considered that with a depression of 45 or 50 degrees, and taking into account the dip of the conductor and the topography, the holes should intersect the target. The holes should be collared at 44E/850S, 28E/750S and 14E/540S. Two costeans are recommended to test magnetic indications. One costean on Traverse 8E between 270S and 330S would investigate the near-surface body responsible for the intense magnetic anomaly there. The other costean on Traverse 10E between 425S and 550S would investigate the Turam and magnetic results, which point to a shallow, flat-lying body of high electrical conductivity and high magnetic susceptibility. In addition, it is recommended that the area in which Turam anomaly "J" occurs be examined geologically, and special attention should be paid to the old asbestos diggings.

The testing which has been recommended can be summarized as follows:

Area	Test	Coordinates	True Azimuth	Length (ft)	Inclination
Grand Prize	DDH 1	18S/500E or	70°	250	45°
		16S/500E	70°	250	45°
Inter-mediate	DDH 2	44E/850S	208°30'	150	45°
	DDH 3	28E/750S	" "	150	45°
	DDH 4	14E/540S	" "	150	45°
	Costean T3	8E/270S-8E/330S	" "	60	
	Costean T4	10E/425S-10E/550S	" "	100	

6. REFERENCES

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REID, A.M.	1925	The Dundas Mineral Field. Bull. geol. Surv. Tasm. 36
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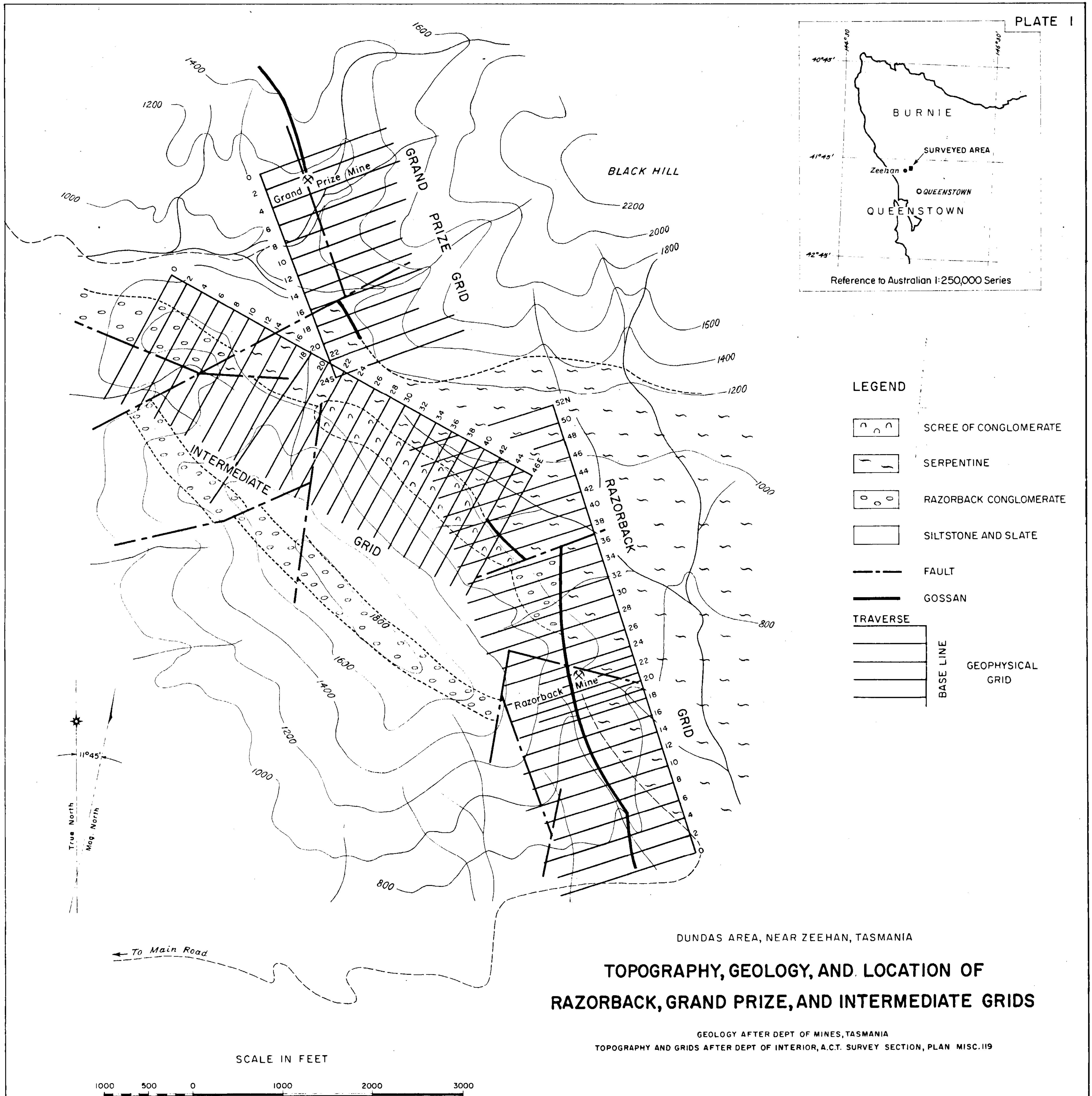
WARD, L.K.	1909	Tin Field of North Dundas. Bull. geol. Surv. Tasm. 6

APPENDIX

SUSCEPTIBILITIES OF ROCK SAMPLES FROM THE DUNDAS AREA

determined by J. Horvath.

Sample	Locality	Geological Description	K in c.g.s. units x 10^{-3}
379	Razorback Open-Cut	pyrrhotite partly oxidized	5.10
380	Hodges tunnel 60 ft from entrance	ironstone	0.254
381	Razorback	gossan	0.154
382	Razorback Brocks tunnel	gossan	0.100
383	Open-Cut	pyritic ore	1.22
384	Razorback in crosscut from Open Cut	pyritic ore	0.205
385	Razorback shaft at south end of Open-Cut	pyrrhotite	21.2
386	Razorback Brocks tunnel	gossan	0.216
387	Razorback	gossan	0.236
388	Razorback	gossan	0.112
389	Grand Prize Bottom tunnel	gossan	0.130
390	Grand Prize Main tunnel dump	tin ore	0.140
486	Intermediate Grid 1000E/400S	serpentine	0.680
487	" 1000E/430S	serpentinized pyroxenite	1.05
488	" 1000E/450S	sheared serpentine	5.42
489	" 1000E/475S	"	0.680
490	" 1000E/500S	serpentinized pyroxenite	0.515
491	" 993E/550S	serpentine	5.78



DUNDAS AREA, NEAR ZEEHAN, TASMANIA

TOPOGRAPHY, GEOLOGY, AND LOCATION OF RAZORBACK, GRAND PRIZE, AND INTERMEDIATE GRIDS

GEOLOGY AFTER DEPT OF MINES, TASMANIA

TOPOGRAPHY AND GRIDS AFTER DEPT OF INTERIOR, A.C.T. SURVEY SECTION, PLAN MISC. 119

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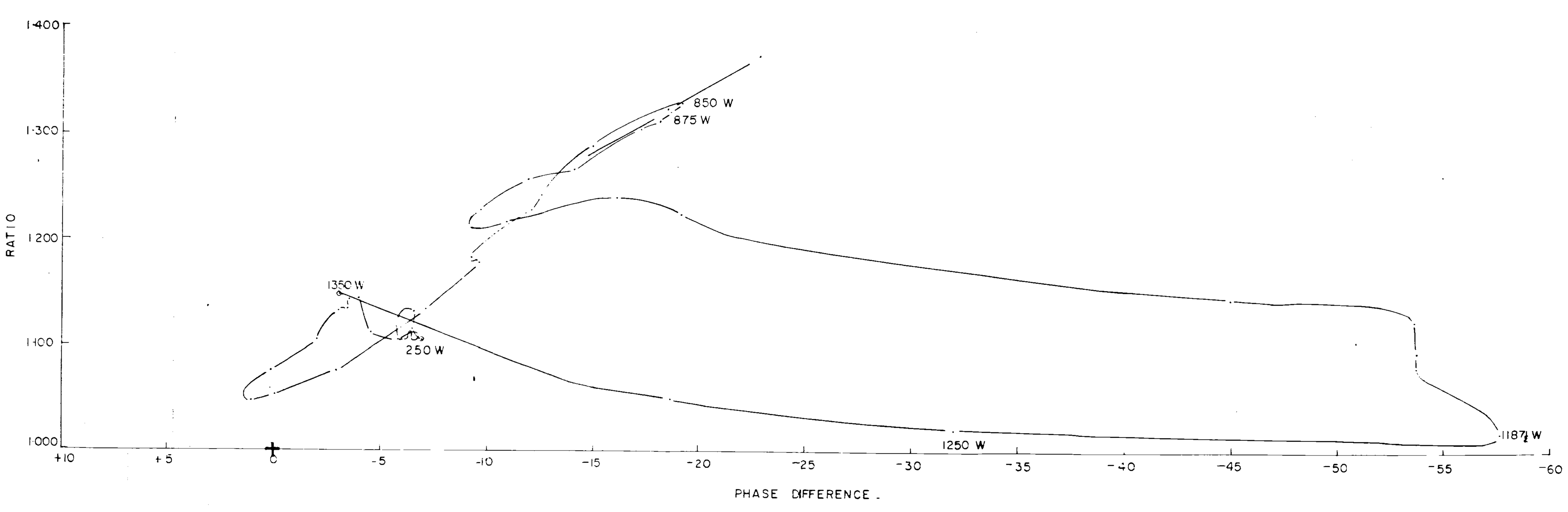

FIGURE 1. 4 N 440 c/s

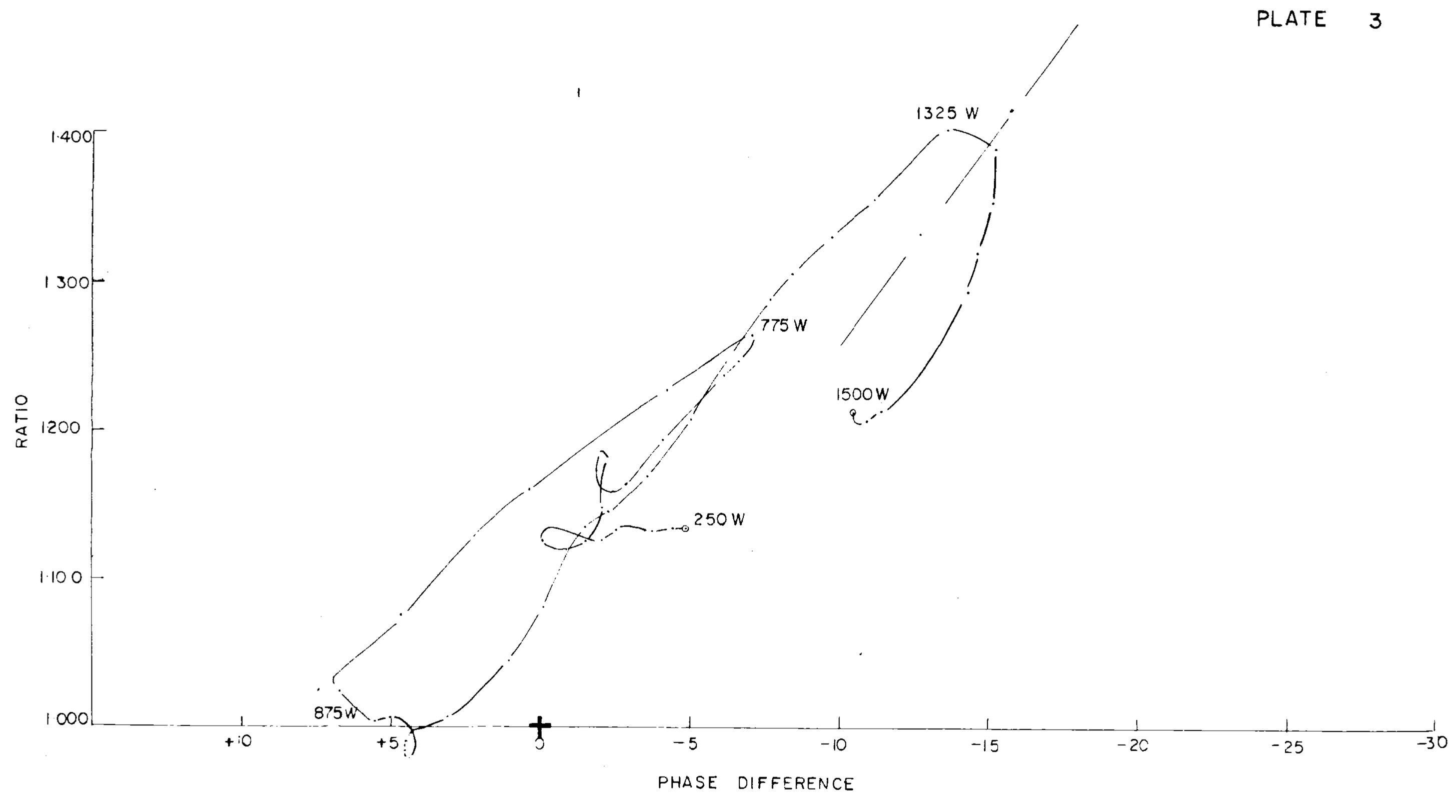

FIGURE 2. 12N 440 c/s

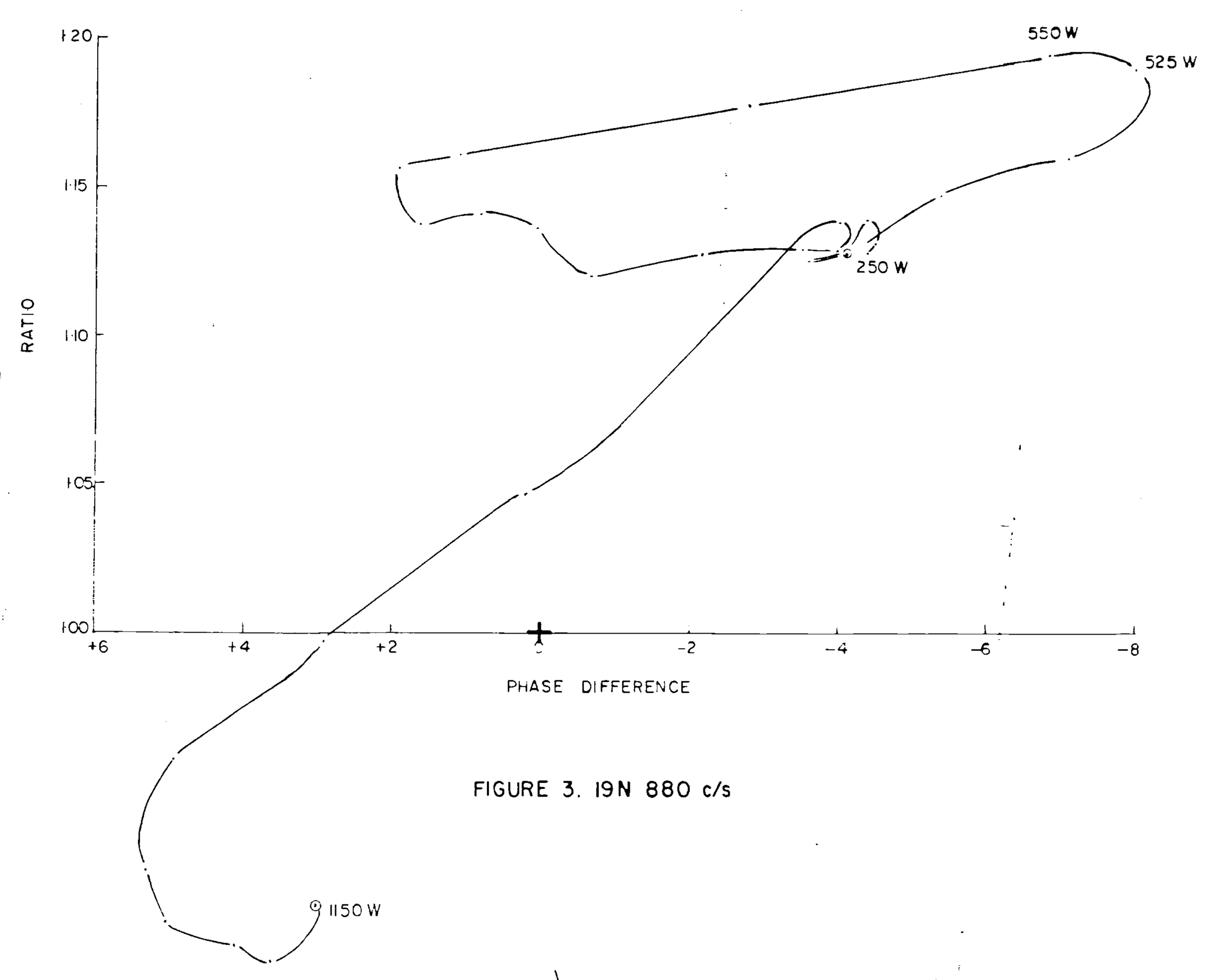

FIGURE 3. 19N 880 c/s

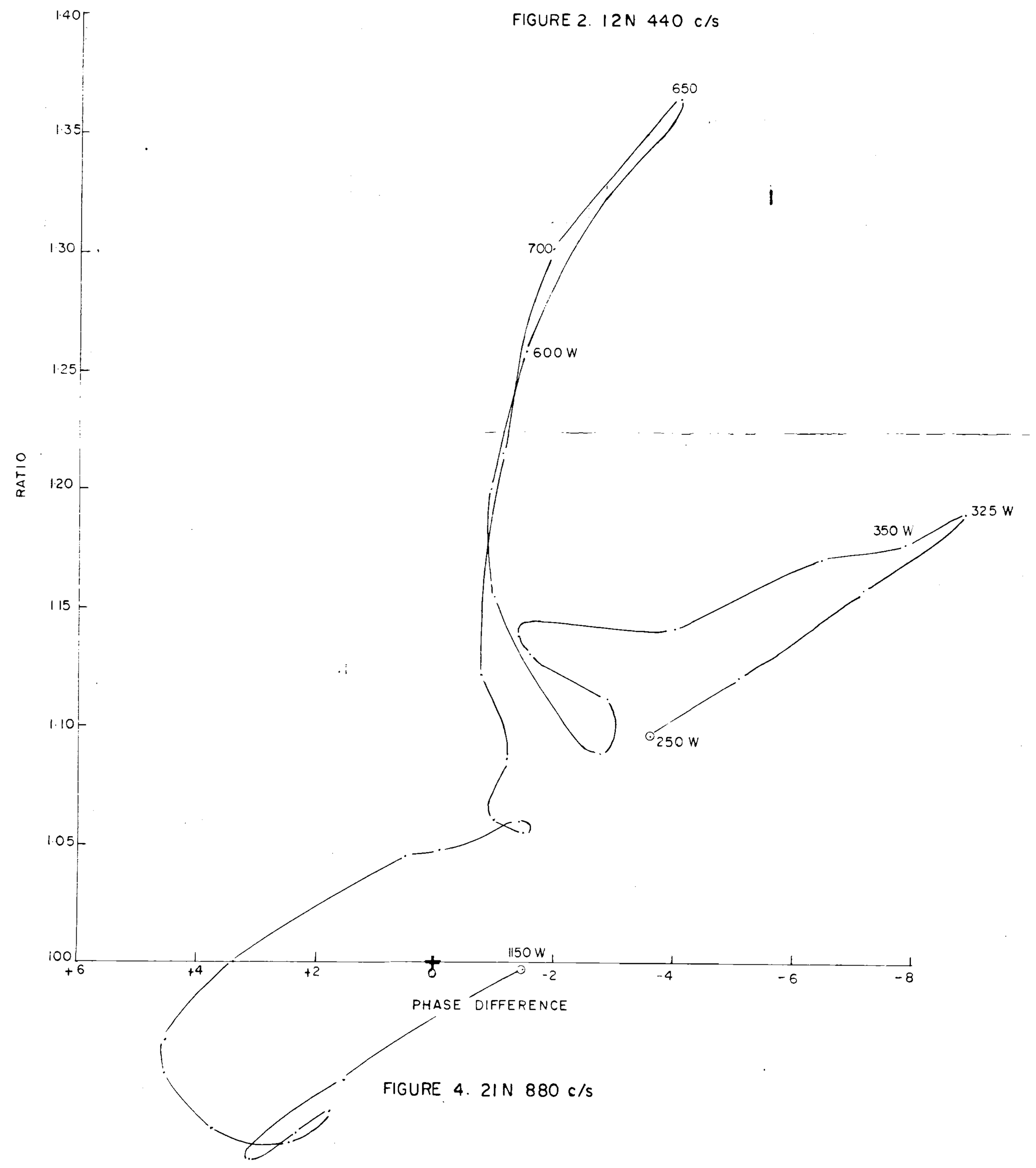

FIGURE 4. 21N 880 c/s

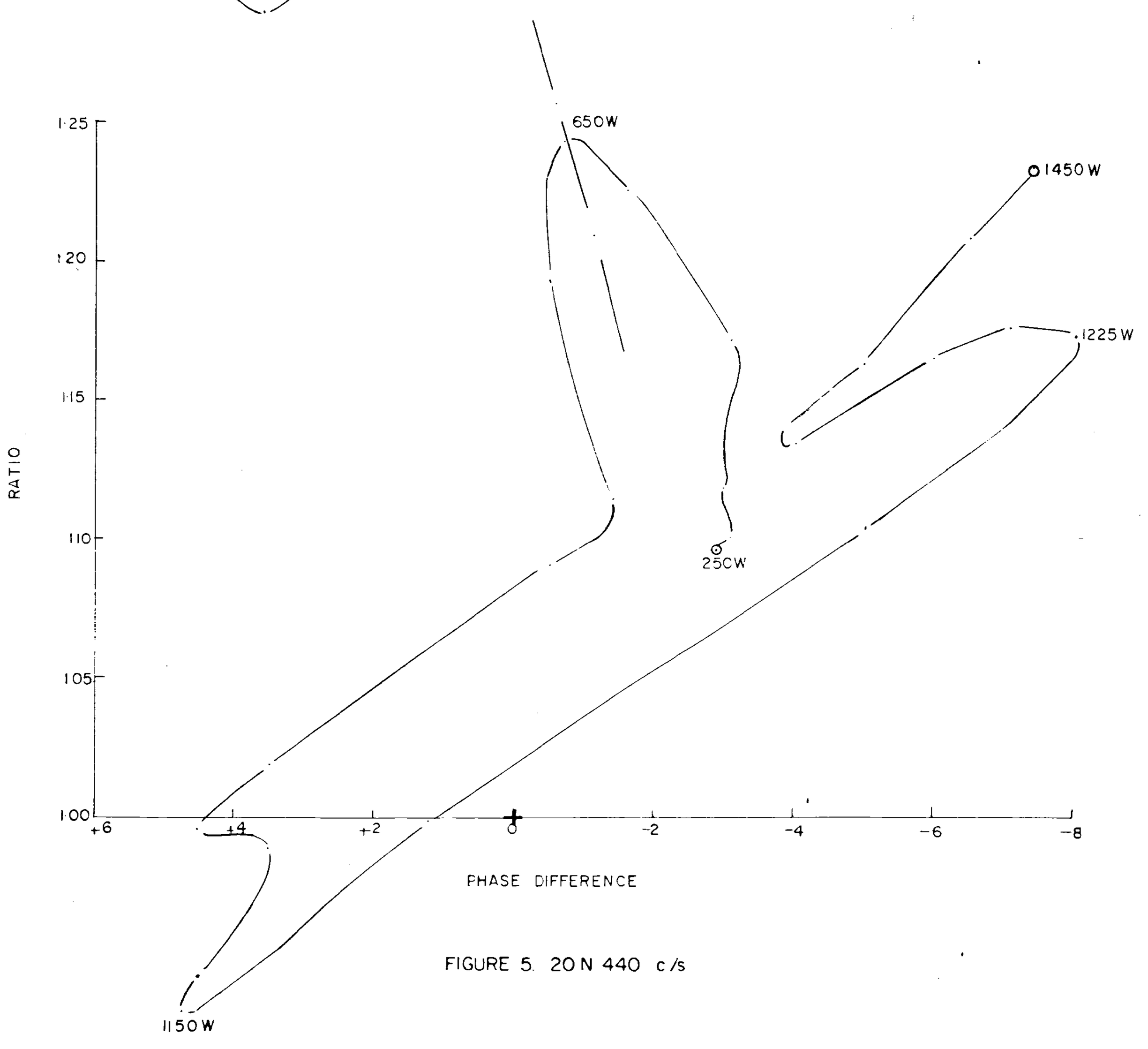

FIGURE 5. 20N 440 c/s

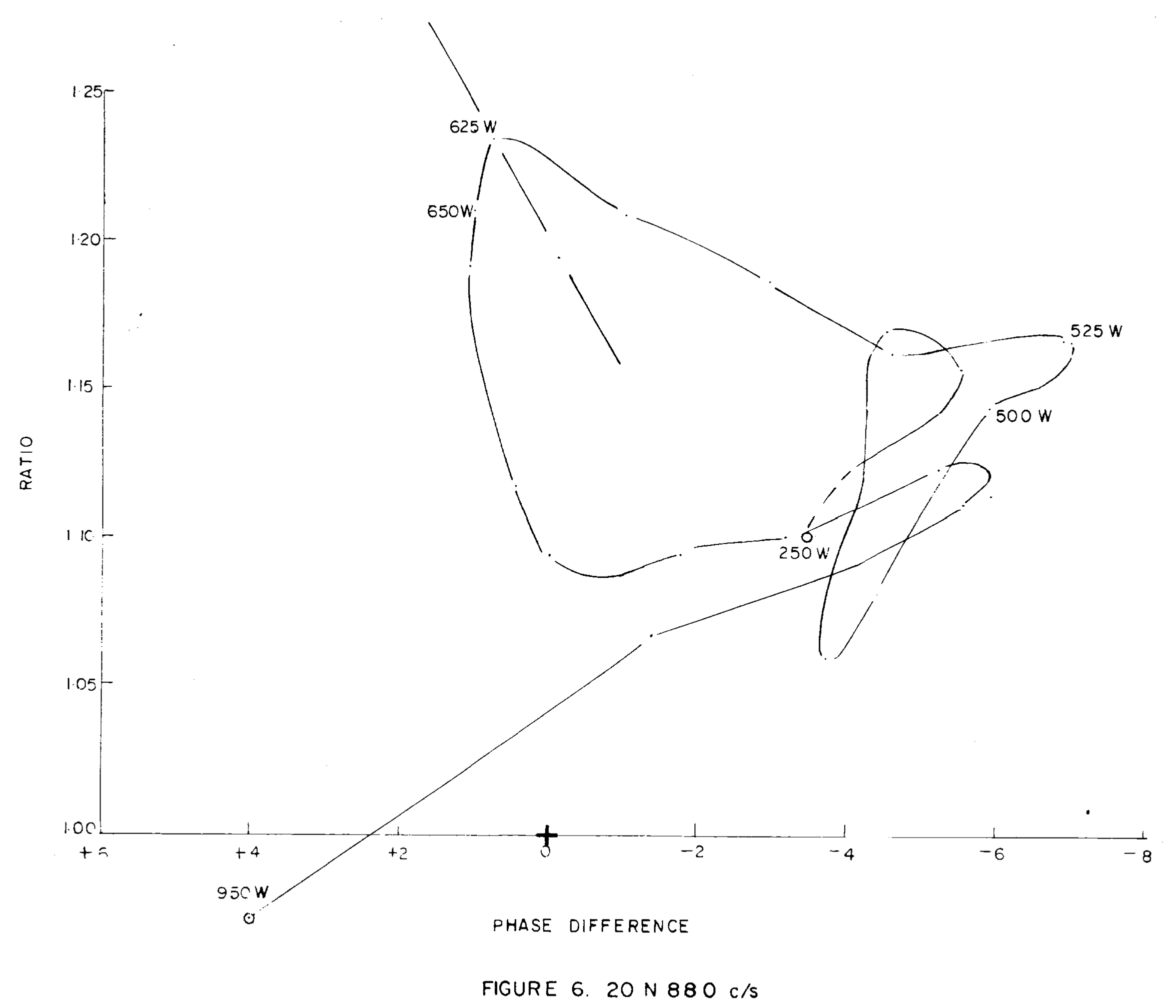

FIGURE 6. 20 N 880 c/s

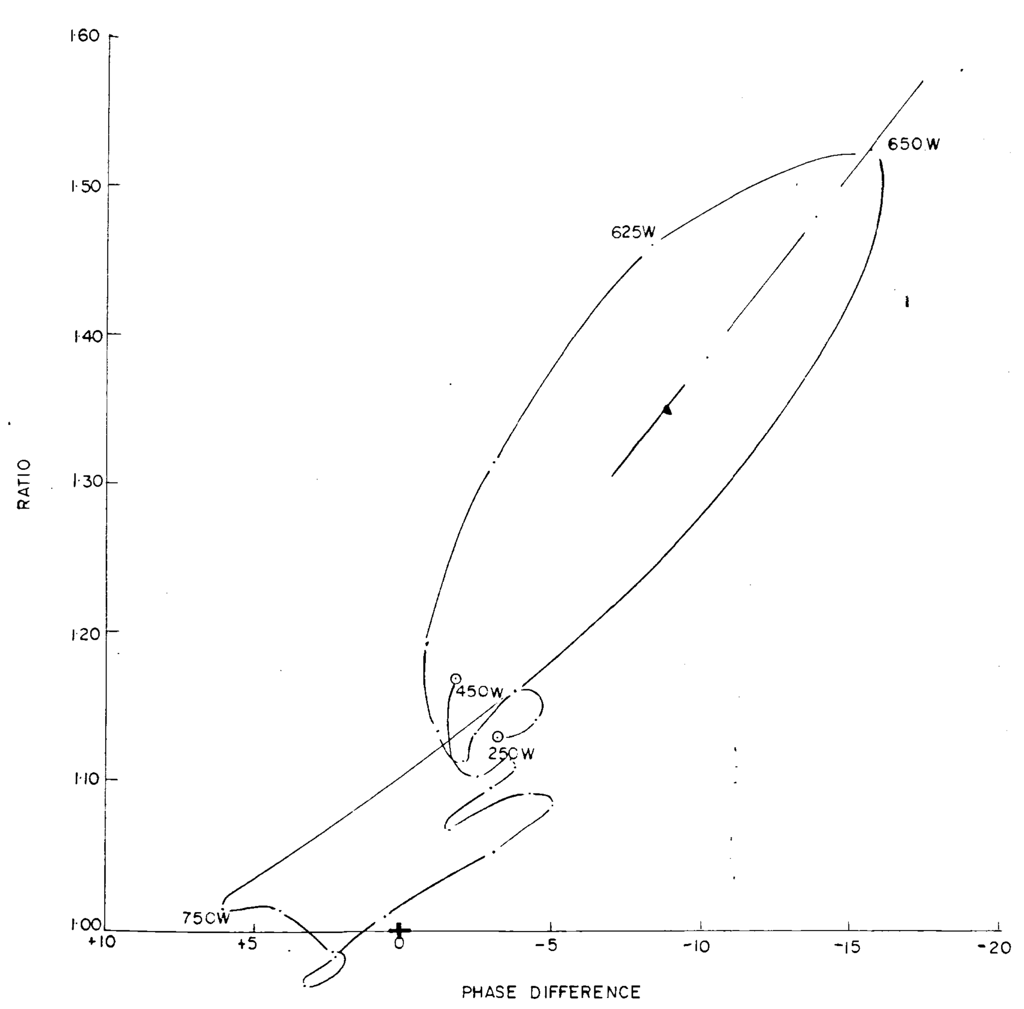

FIGURE 7. 22 N 440 c/s

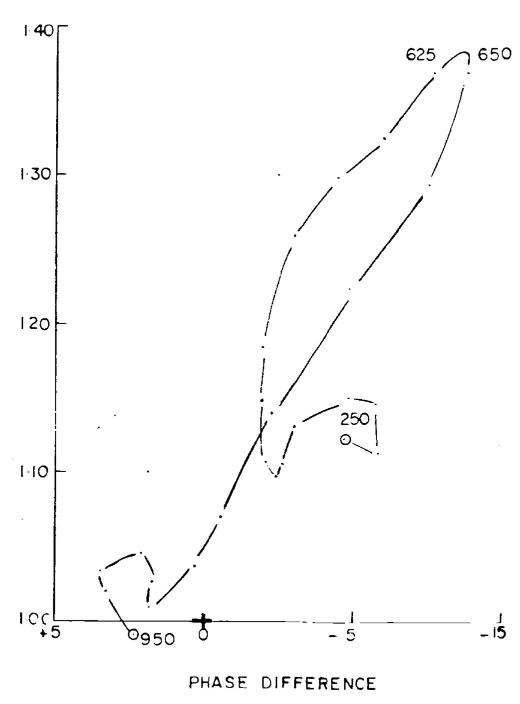

FIGURE 8. 23N 880 c/s

RAZORBACK GRID

SELECTED TURAM RATIO/PHASE DIAGRAMS

SCALES: AS SHOWN

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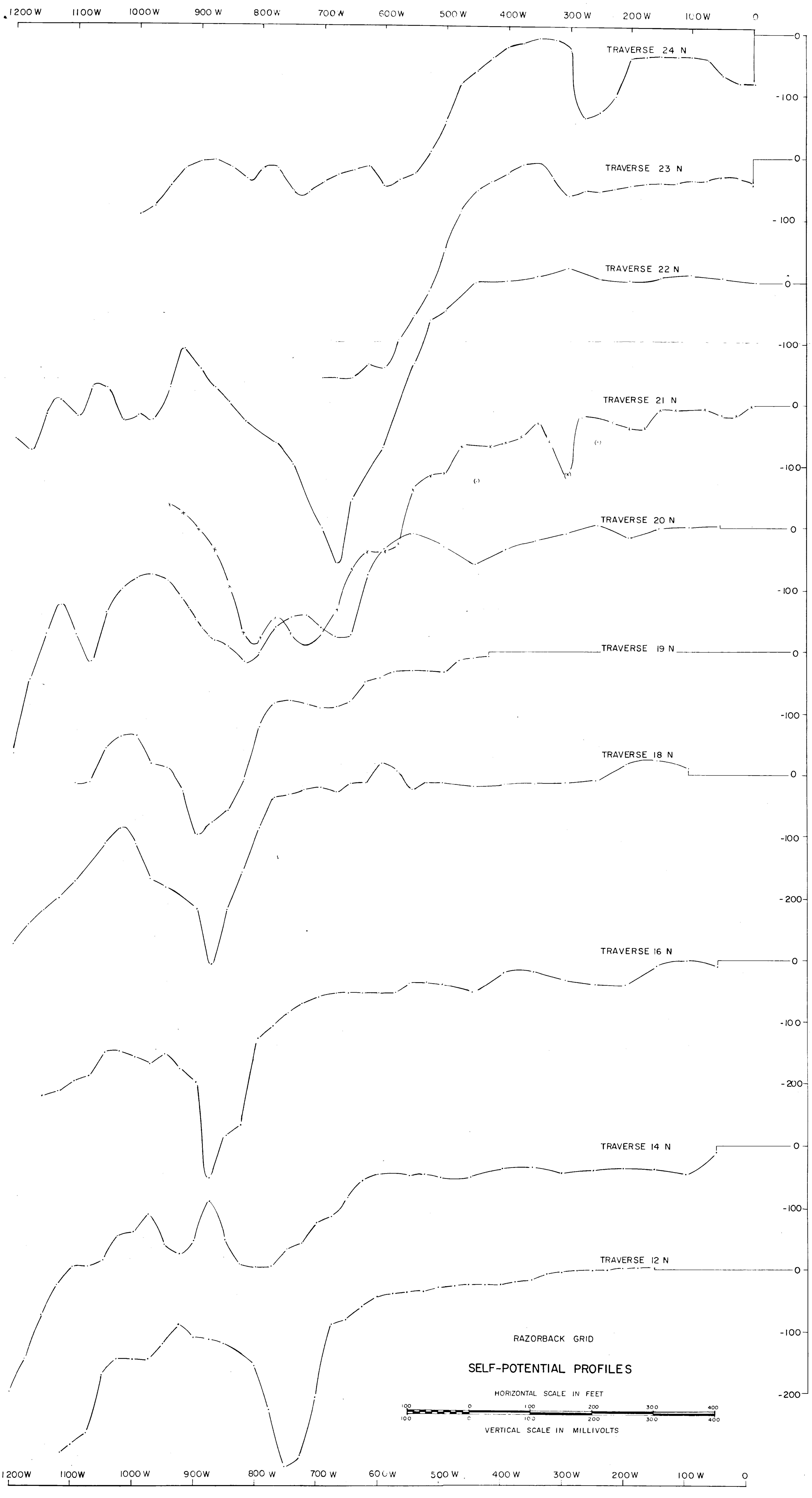

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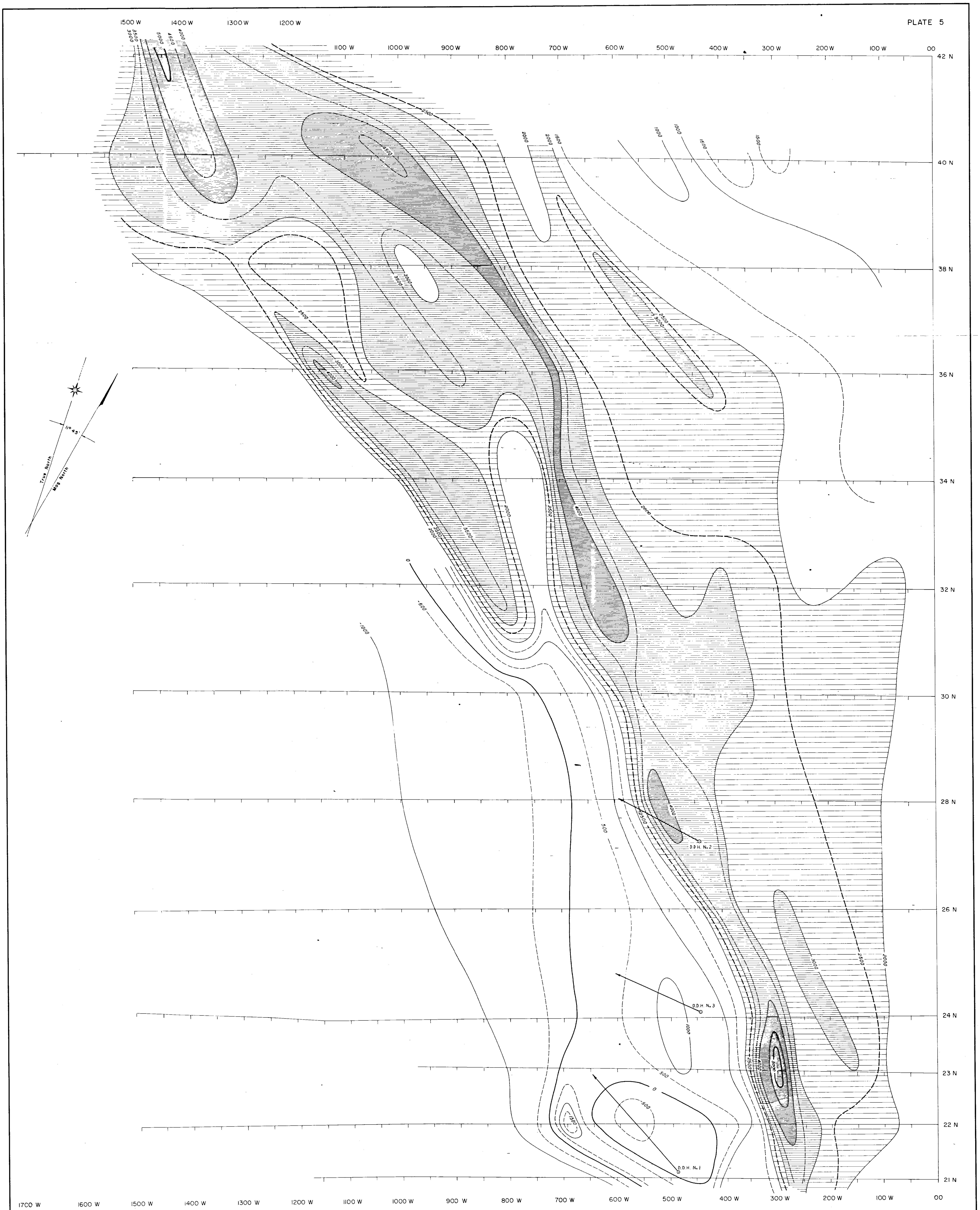

RAZORBACK GRID

MAGNETIC VERTICAL FORCE CONTOURS

LEGEND

- 2000 γ - 3000 γ
- 3000 γ - 4000 γ
- 4000 γ - 5000 γ
- > 5000 γ

SCALE IN FEET

100 0 100 200 300

CONTOUR INTERVAL 500 γ

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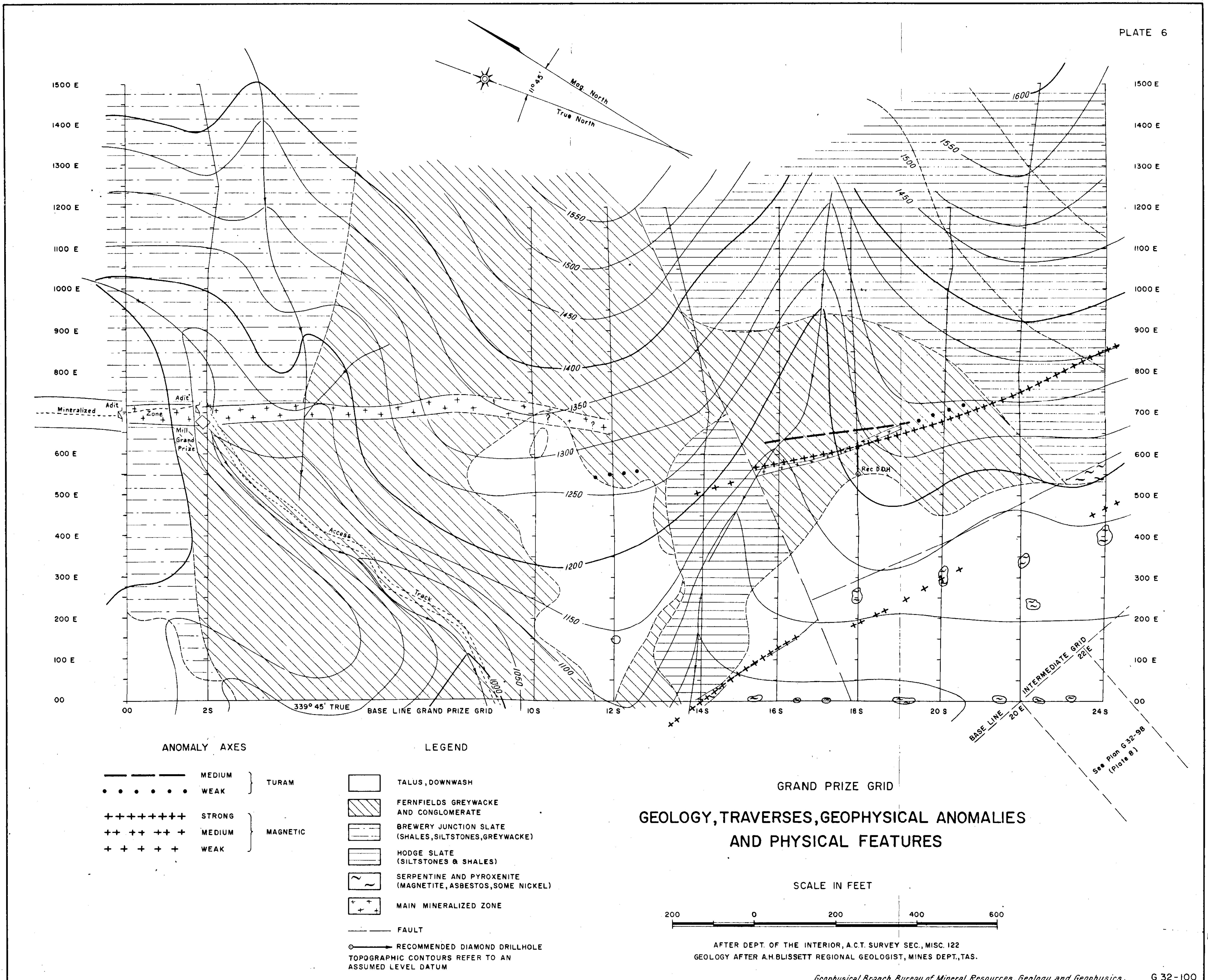

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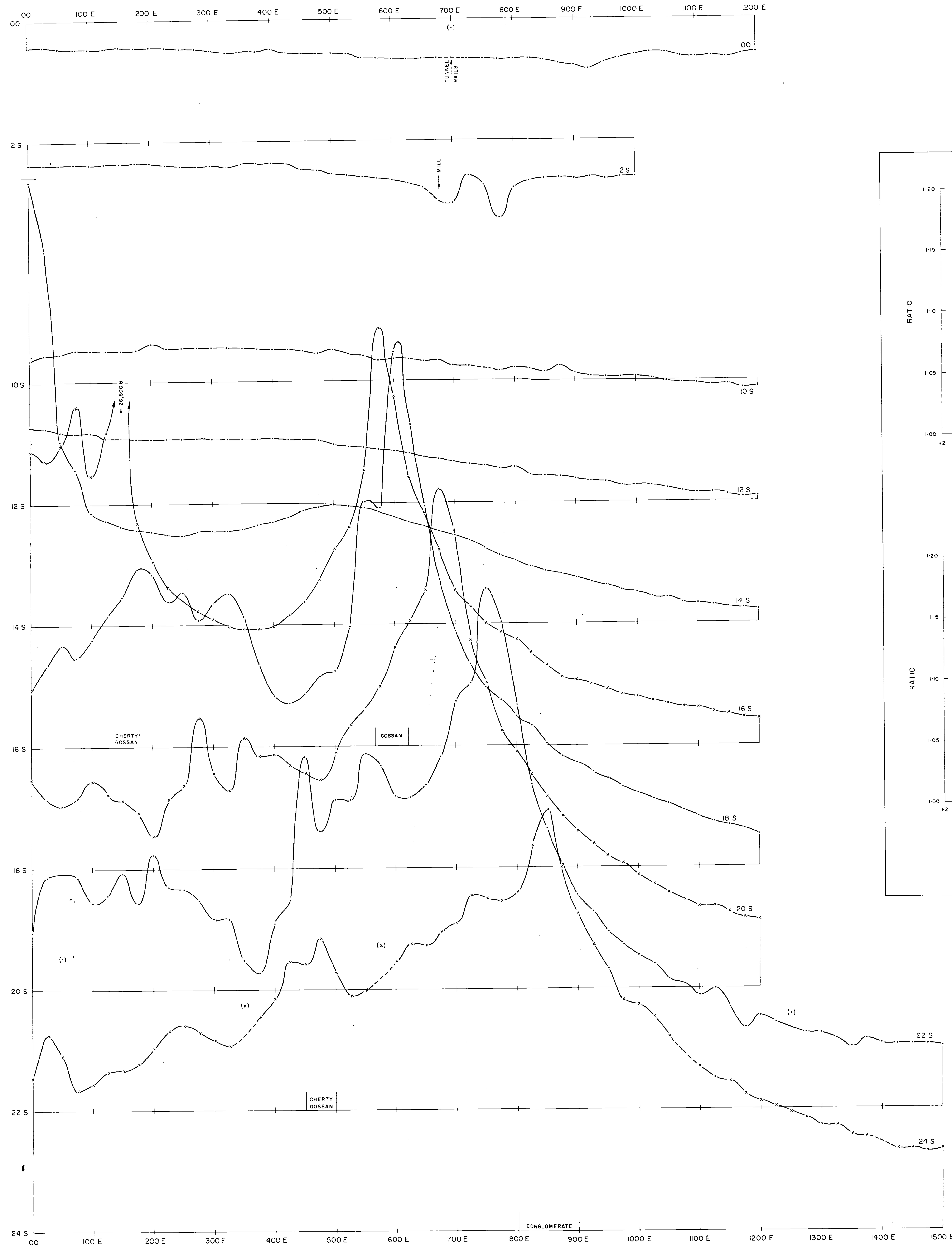
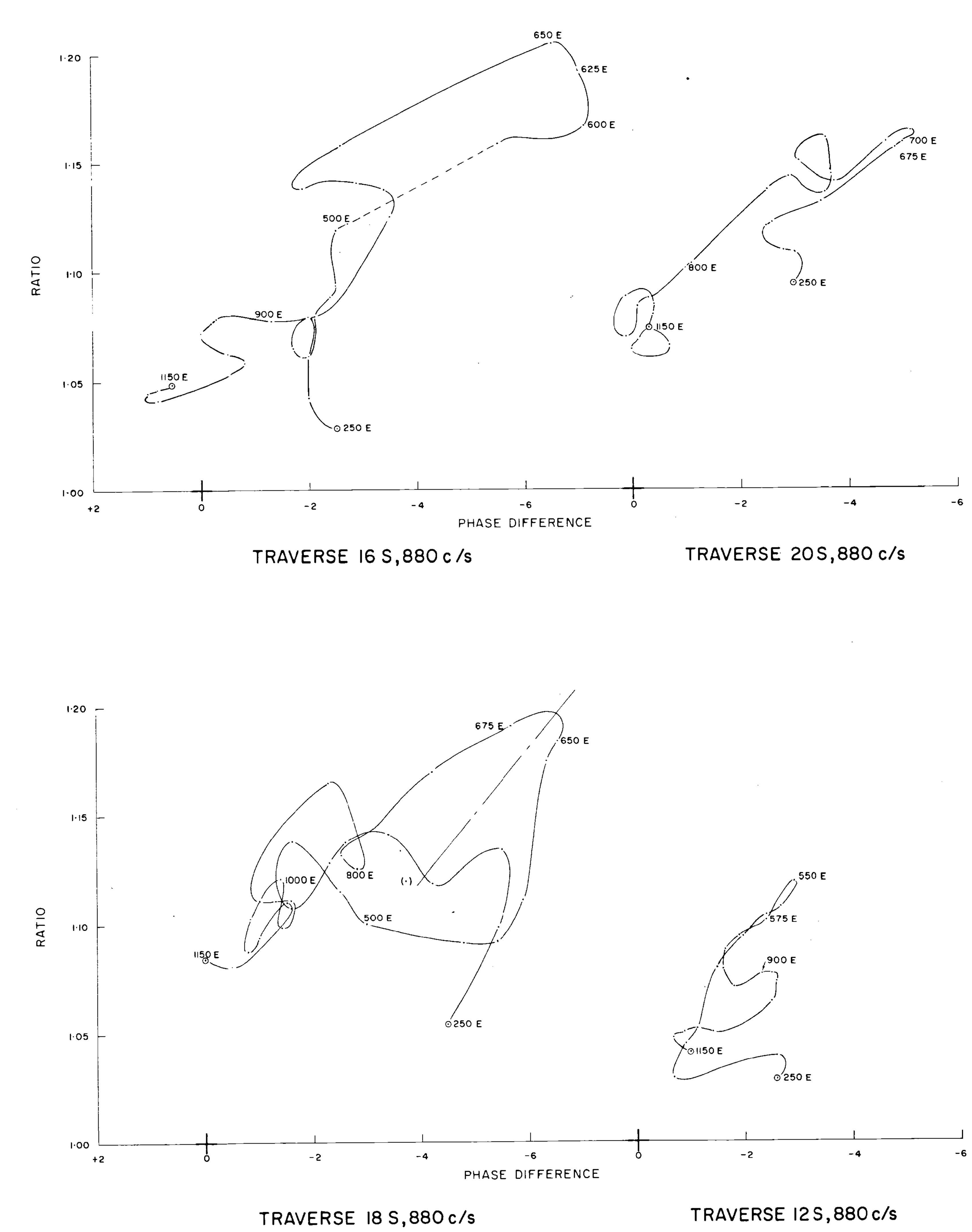




FOR 100 FT COIL SEPARATION
SCALES AS SHOWN

GRAND PRIZE GRID

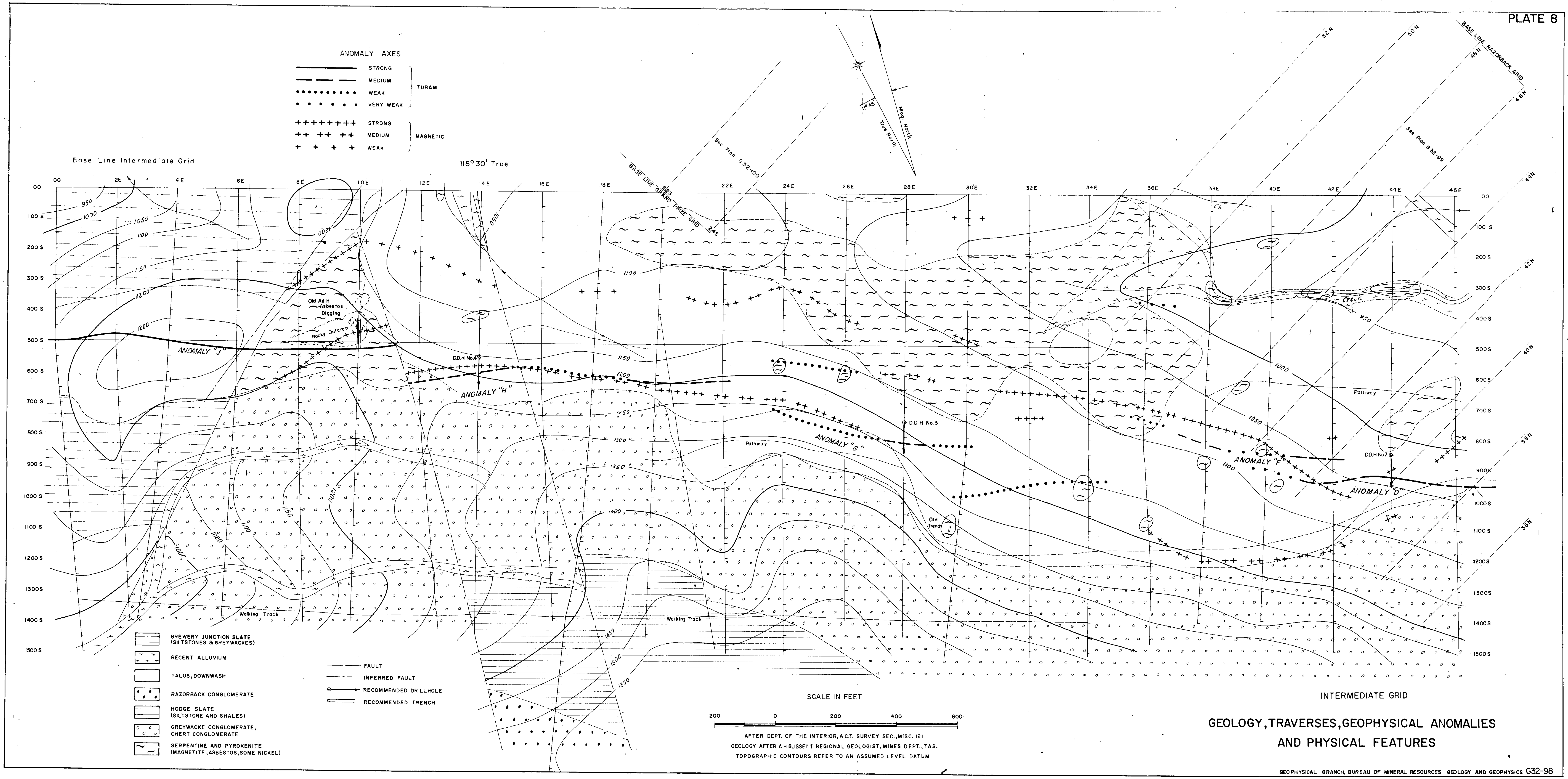
MAGNETIC VERTICAL FORCE PROFILES AND TURAM RATIO PHASE/PROFILES (INSET)

HORIZONTAL SCALE IN FEET

100 0 100 200 300

1000 0 1000 2000 3000

VERTICAL SCALE IN GAMMAS



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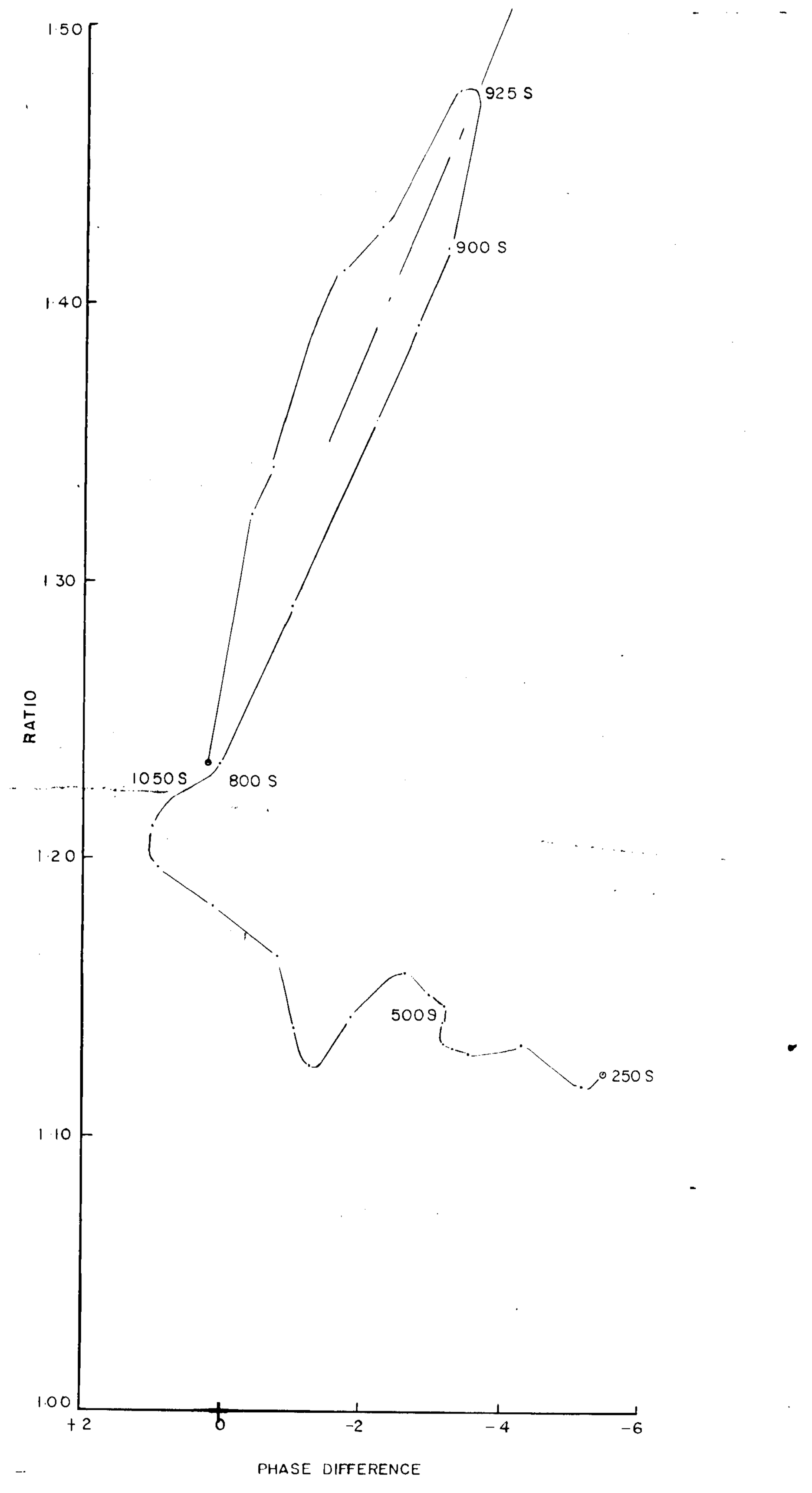


fig. 1— TRAVERSE 44 E, 880 c/s

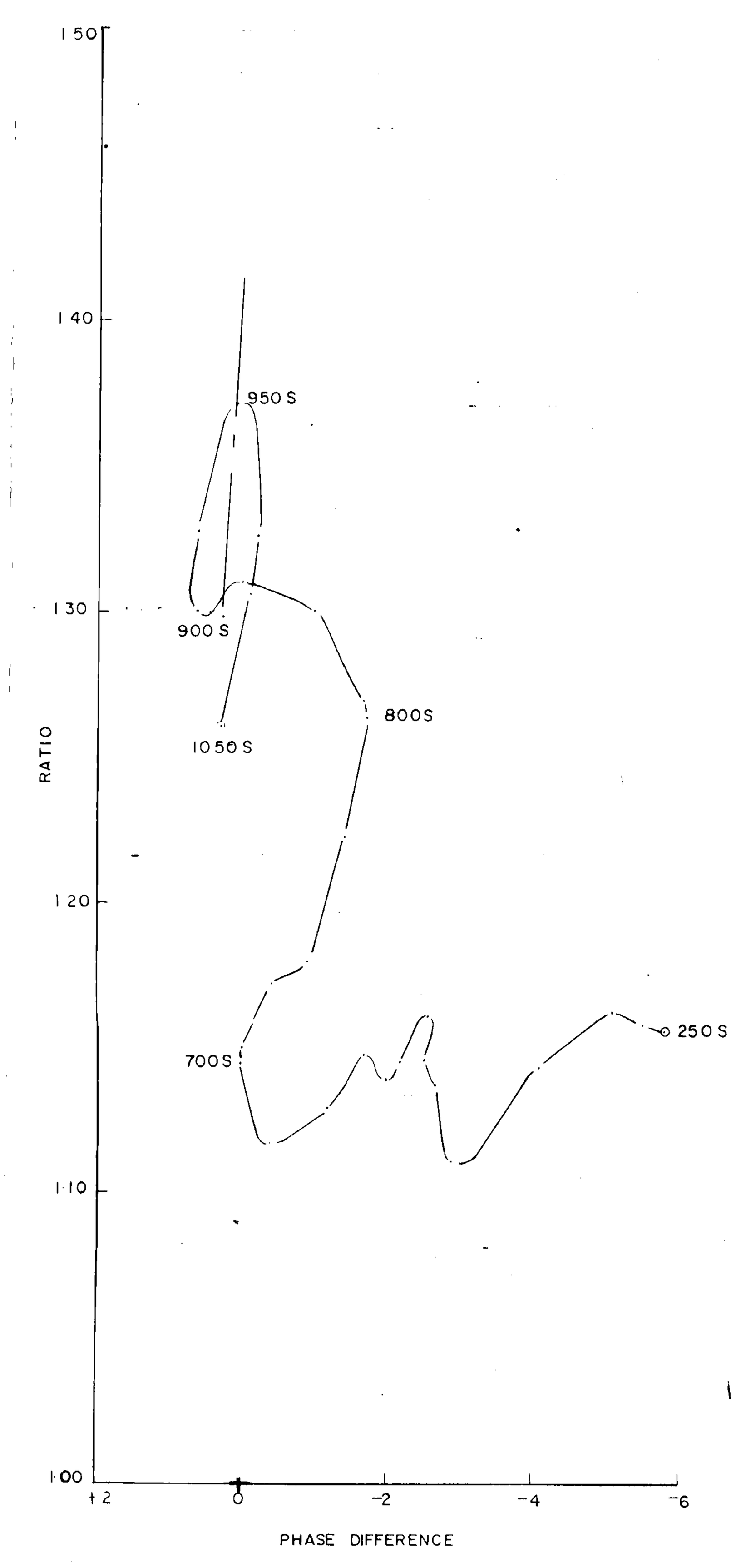


fig. 2 —TRAVERSE 42 E, 880 c/s

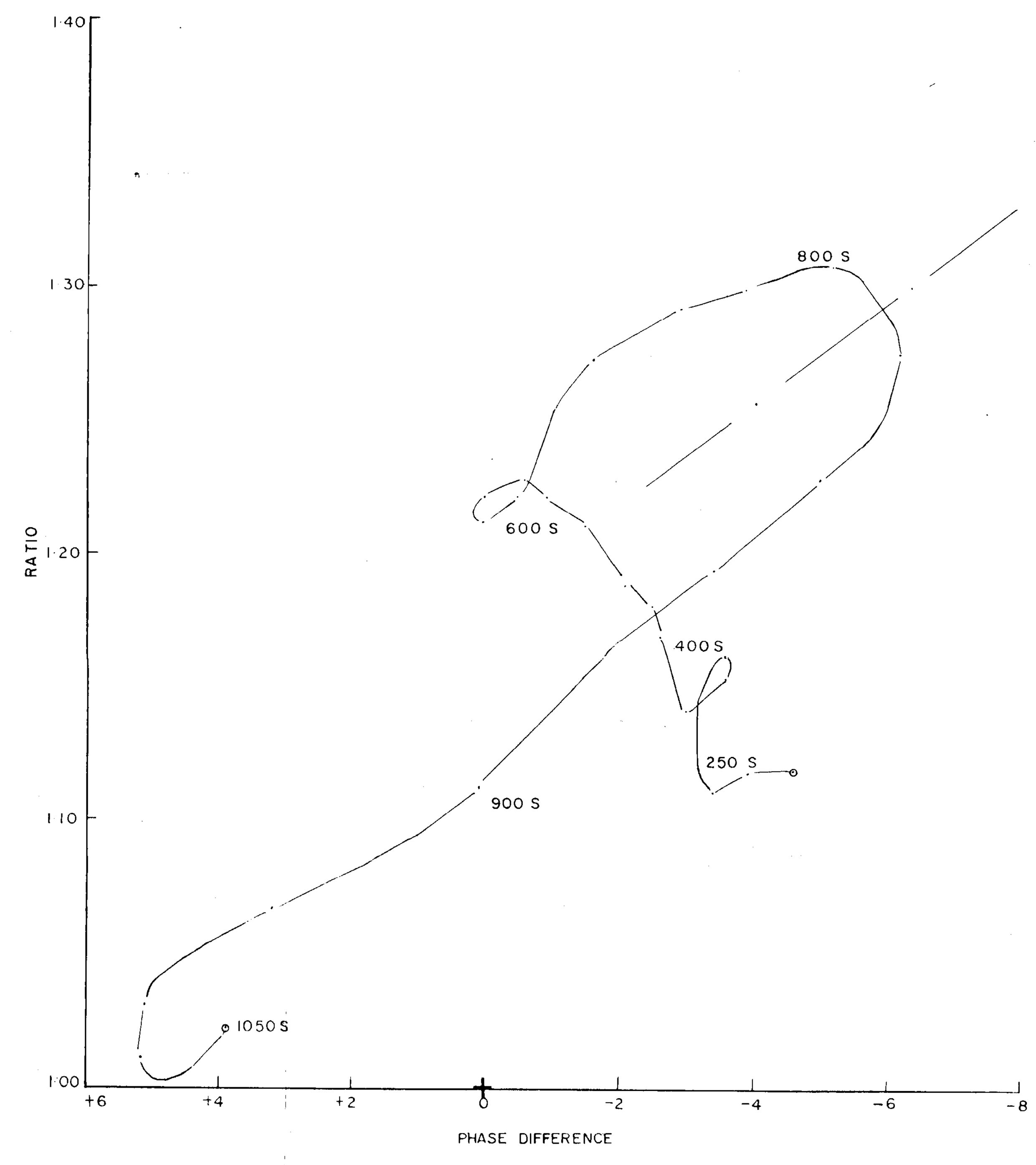


fig. 5— TRAVERSE 28 E, 880 c/s

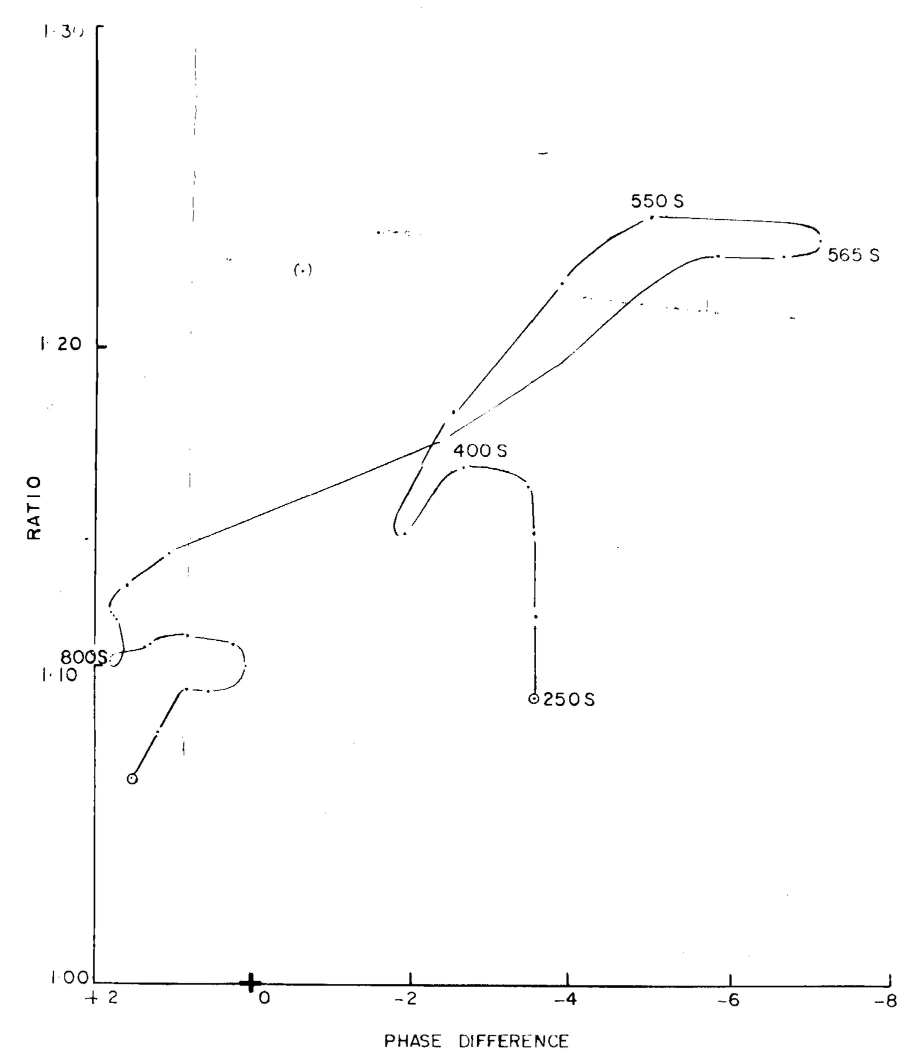


fig. 6— TRAVERSE 16 E, 880 c/s

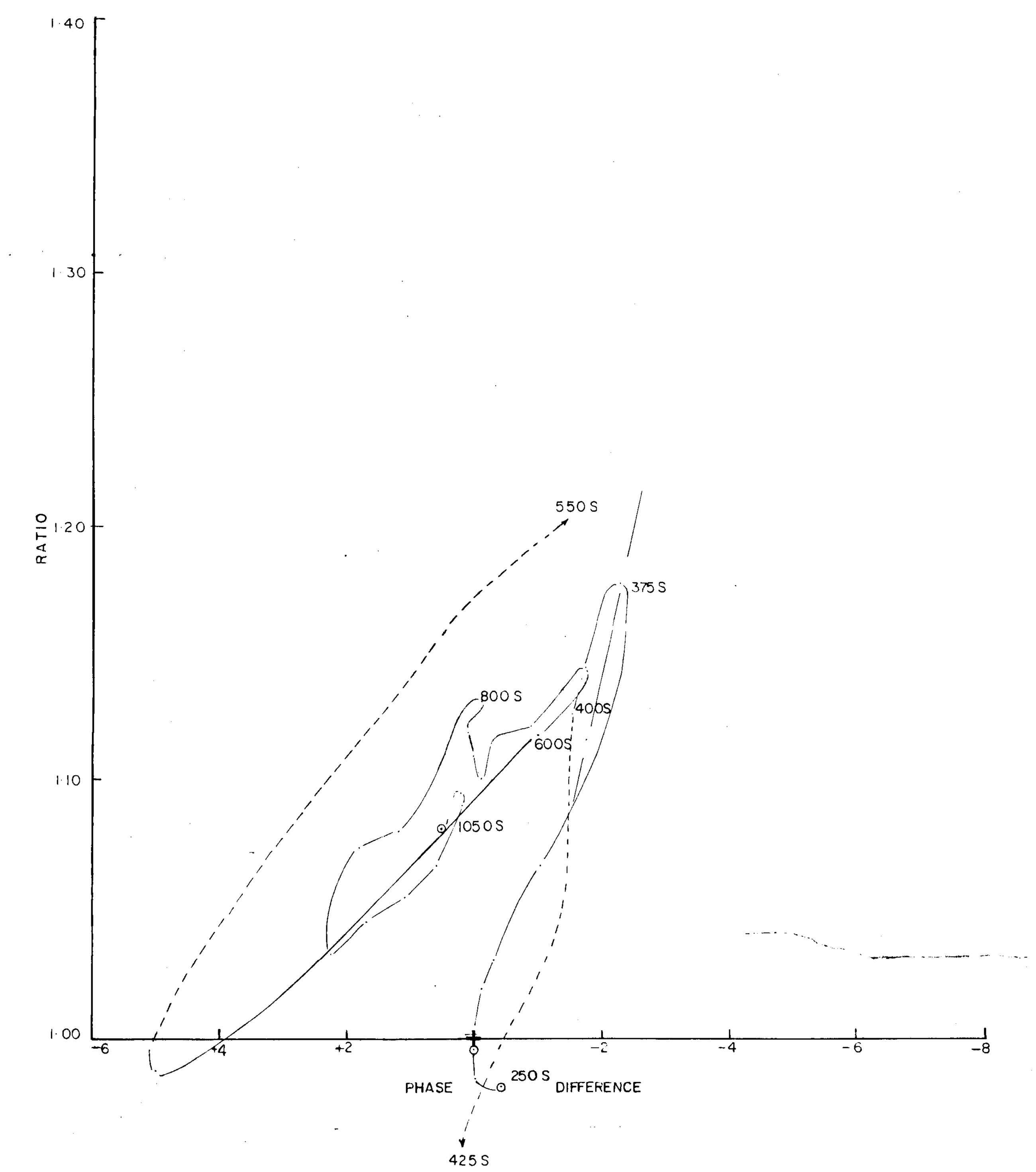


fig. 9— TRAVERSE 10 E, 880 c/s

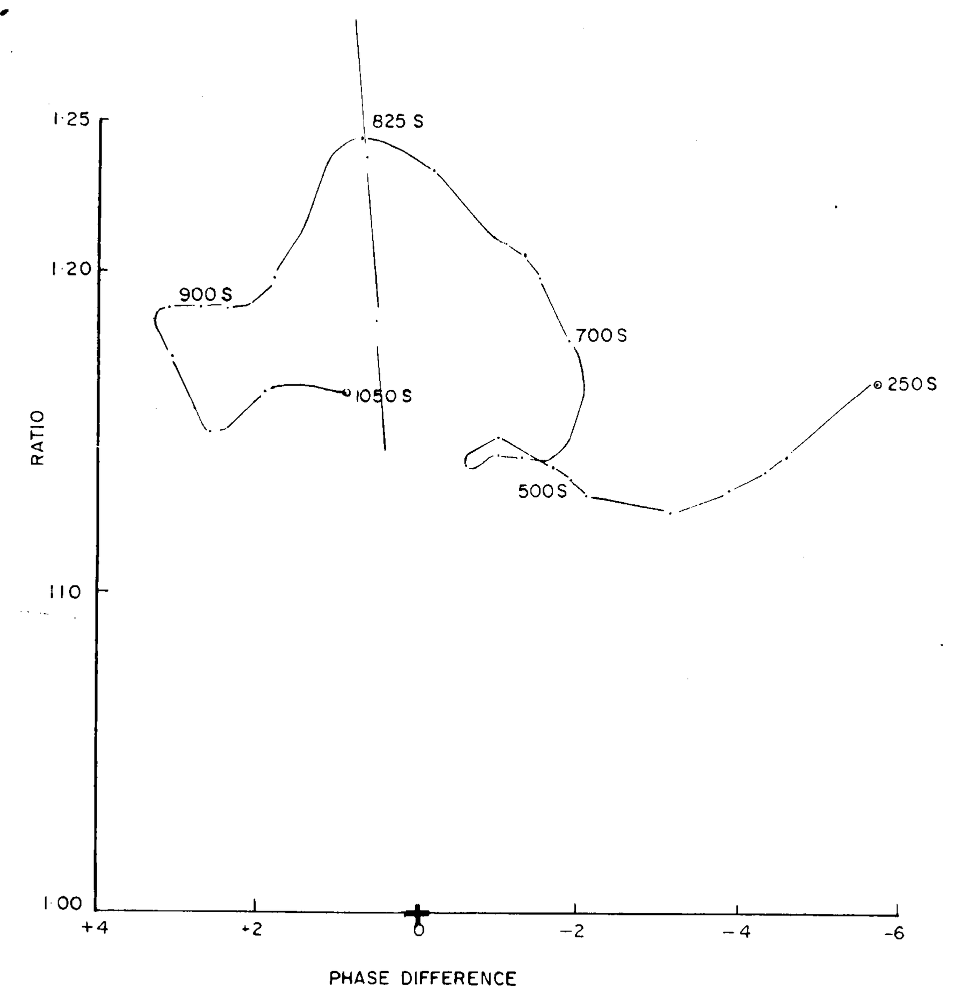


fig. 3— TRAVERSE 38 E, 880 c/s

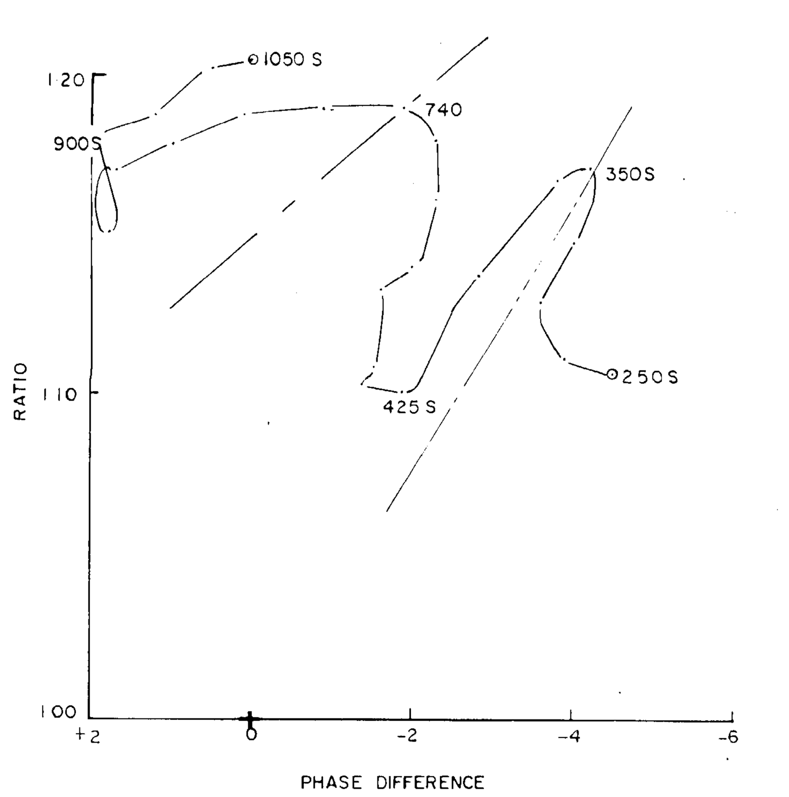


fig. 4—TRAVERSE 36 E, 880 c/s

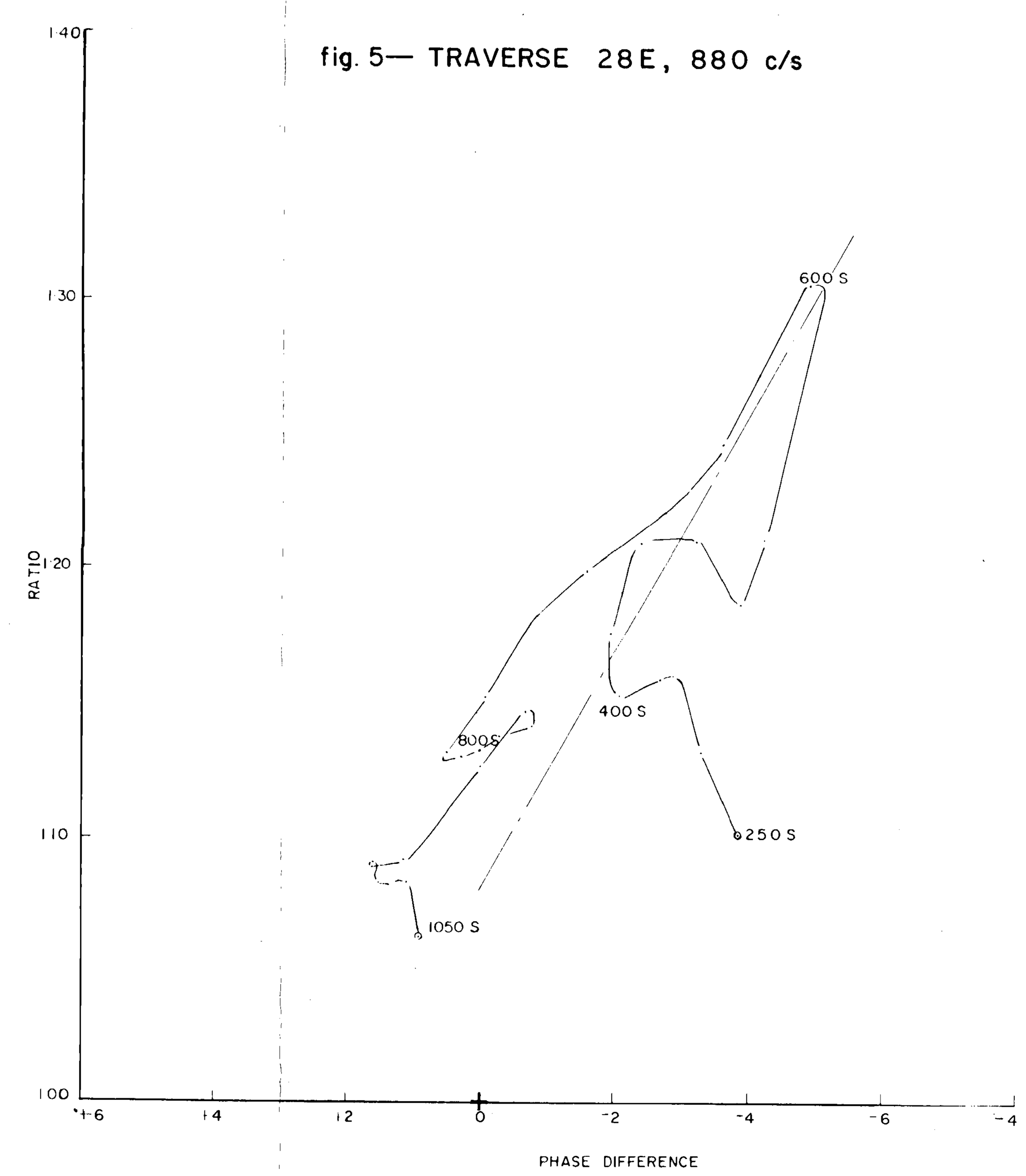


fig. 7— TRAVERSE 14 E, 880 c/s

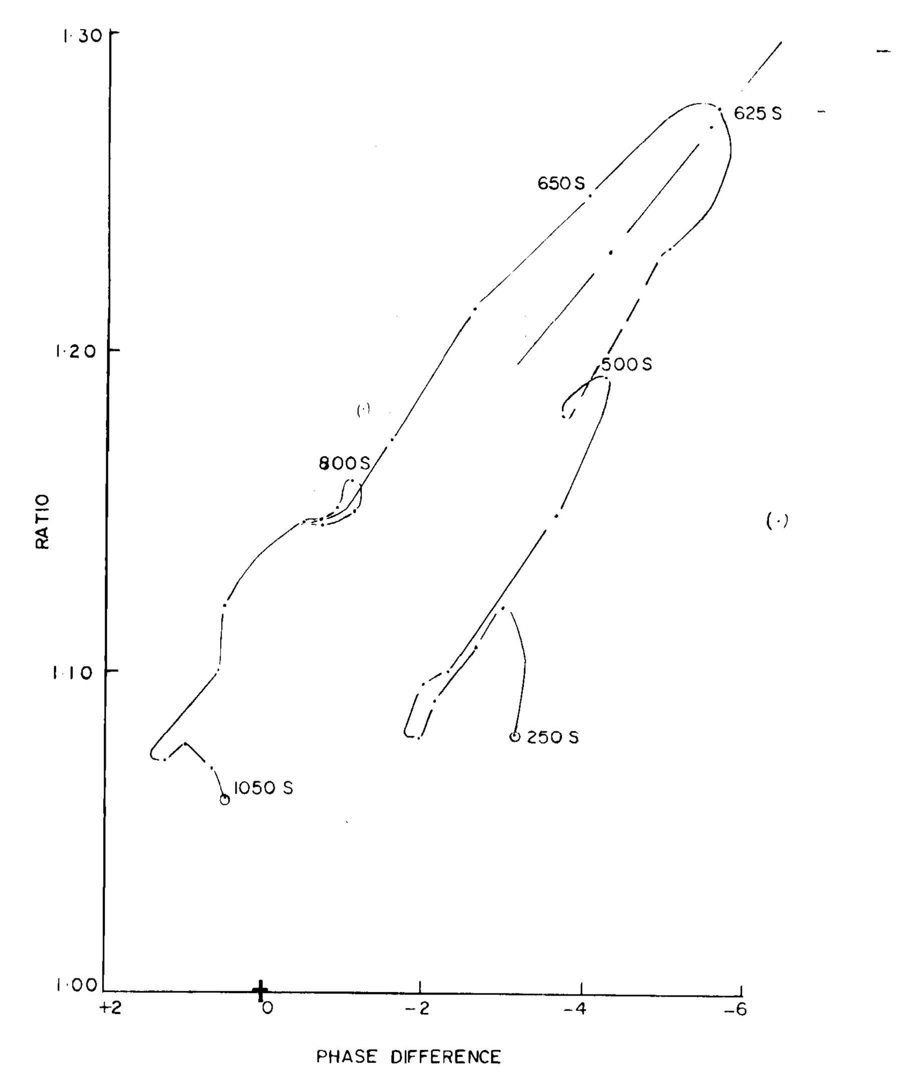


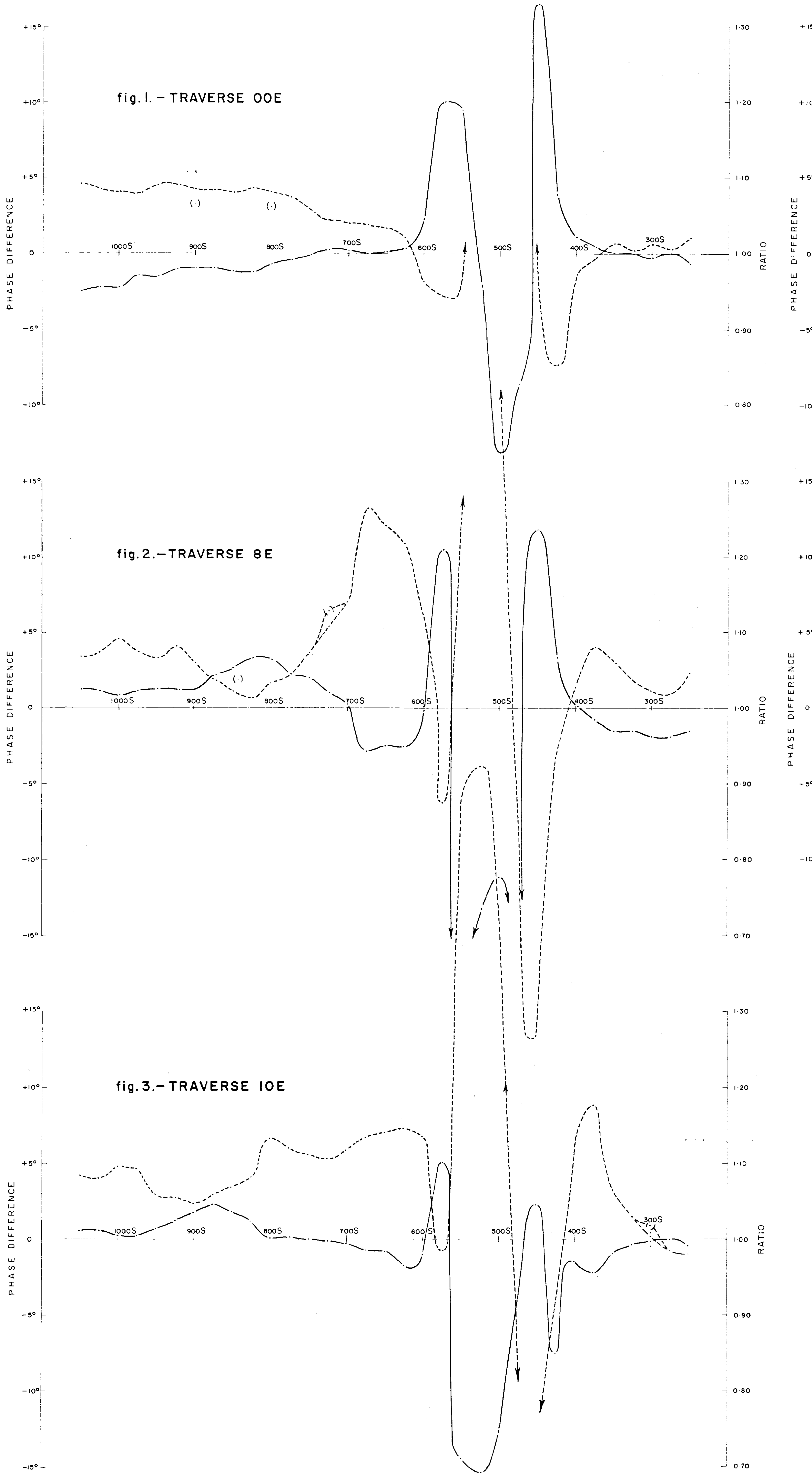
fig. 8— TRAVERSE 12 E, 880 c/s

INTERMEDIATE GRID

SELECTED TURAM RATIO/PHASE DIAGRAMS

SCALES: AS SHOWN

PLATE 10



INTERMEDIATE GRID

SELECTED TURAM RATIO AND PHASE PROFILES

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PLATE II

INTERMEDIATE GRID

MAGNETIC VERTICAL FORCE CONTOURS

LEGEND

- 2000 γ – 4000 γ
- 4000 γ – 6000 γ
- 6000 γ – 8000 γ
- > 8000 γ

SCALE IN FEET

100 0 100 200 300

CONTOUR INTERVAL 500 γ

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