Structural Study of a Portion of the Lang and Humphreys Quadrangles, Los Angles Co., California.

by

L.F.Uhrig

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Introduction

In this report the area mapped north of the San Gabriel Mountains in the Lang and Humphreys Quadrangles is considered primarily from the structural point of view. A portion of this area at the head of Tick Canyon was mapped by Y. Bonillaas in 1933.During the year 1934-5, Mr. C Dawson and the writer extended this work independent of the other.

W.S.Kew in Bulletin 753 of the U.S.G.S. has described much of the geology of the area. O.H.Hershey has described the Escondido formation outcropping in Tick Canyon, in the Amer. Geol. Vol.29,p356. Brief descriptions of the borax deposits in Tick Canyon are found in Econ. Geol. Vol.16,1921 and U.S.G.S. Prof. Paper 158,1931.

Geography

Location and General Features

The area covers approximately 30 square miles and lies north of the San Gabriel Montains between Long. 118°20' and 118°23' W and Lat. 34°30' and 34°27' N. It is approximately 50 miles north of Paadena and Los Angles and is accessible by roads. From Pasadena one may drive to the area by taking H Harrison Ave from Devils Gate Dam to San Fernando and thence to Saugus. From Saugus one may take roads leading into

Soledad, Bouquet Canyons from which one may get to most of the area over roads that vary from fair to almost impassable. Many of the roads shown on the map are completely washed out.

Topography and Drainage

The relief in the area ranges from 500 feet to 1000 feet. The portion underlain by the soft Mint Canyon is bad land in character. In many places it forms steep cliffs 200 feet or so in height. The maximum elevation of 2875 feet west of Mint Canyon Spring is underlain by the more resistant Basement Complex. The cycle of erosion is probably early maturity as flat remnants of an older erosion cyle may be noted West and east of Mint Canyon and are well developed west of Bouquet Canyon. These older surfaces are probable terraces of an older cycle of erosion as they consist almost entirely of basement complex detritus.

Drainage is predominantly southwest to the westward flowing Santa Clara River. The streams are intermittent, and parallel the strike of the Mint Canyon Beds for the most part. A few of the streams cut across the strike of the beds suggesting superpostion. Spring Canyon is parallel to the strike of the beds to the west and heads in a fault.

Climate and Vegetation

The region is semiarid. Rainfall at Newhall has a mean annual average of 17". The rainy season occurs between November and March.

Vegetation is scanty, the type depending somewhat on the soil. The most luxurious growth is found on the north side of the hills. Chapperal grows plentiful on the sandy soils and those derived from the lavas, Tree growth is low and the trees are mostly scrubby and dwarfed. Sage brush and other types of the hardy desert plants grow in small quantities in all parts.

Culture

The area in general is thinnly populated. There are a number of small settlements, hot dog stands, etc. along Mint Canyon road. Many of the settlements are a result of some enterprising real estate company who have parcelled the land for those who like the desert sunshine and heat minus the scenery. The region is too dry for any extensive farming but a few optimistic people are doing some grazing and hog raising.

A few of the stream channels show traces of gold as does the Texas & Soledad and Vasquez Canyons. Most of the gravels are so poor for dry placering that this phase is only a avocation for many who want a little thrill that comes with hunting for gold.

Geology

Stratigraphy and Petrography

General

The rocks exposed in this area are a metamorphic and granitic complex or the Basement complex, a series of terrestrial sediments and a series of extrusive and intrusive rocks in sediments. The petrography of these rocks will not be described in detail. Only the general field relations and appearance will be considered. The rock types of the Basement Complex have not been differentiated as they were too numerous for the number of outcrops available. The rocks range in age from Jurrassic to Recent.

Jurrassic or Earlier

Basement Complex

The Basement Complex is typically exposed west and east of Mint Canyon in the northern part of the area. It consists of metamorphic rocks of schist and gneiss types intruded by granite. The large masses of complex are faulted against the Mint Canyon for the most part. The complex has been highly fractured and faulted. A few of these fault zones are mineralized and carry small quantities of gold. Mr . Dawson, I believe, has studied some thin sections of parts of the complex. Basic dikes near Tick Canyon may have been roots of some volcanoes.

Oligocene

Sespe

This formation might be divided into 2 series, both similar in lithologic character but differ in the presence of lavas in one and not the other. This formation is exposed at the head of Tick and Aqua Dulce Canyon. A formation similar in character to this is exposed in Texas Canyon west of the complex in the northwest part of the area.

Sespe

Tick Canyon Series

This series has been fully described by O. Hershey for the first 5,000 feet of the canyon. Briefly the series may be summarized as:

1- 500 feet of coarse breccia- conglome rate of angular and subangular blocksof granite gneiss, well cementee and in planes clearly stratified resting unconformably on the schist-gneiss-granite complex.

2. 2000 feet of dark brown basic lava which in part is very vesicular and amygdaloidal abounding in secondary chalcedony.

3- 200 feet of red and yellow andstones and coarse breccia conglomerate of "complex" materiial.

4-3000 feet of dull red and yellow coarse sandstones and coarse conglomerate breccia.in lower part are present some white to gray shales, impregnated with gypsum and containing the borax minerals.

5-200 feet of dark red brown lava capped with about 20 to 30 feet of agglomerate upon which the Mint Canyon rests unconformably.

The sandstones and conglomerates contain little to no lava pebbles but are mostly angular to subangular "complex material". They are baked by some of the lava flows and intrusions. The character of the lavas suggest that these in the east of Tick Canyon must have been intruded while those to the west suggest, in part, extrusion. The lack of lava in the sediments and the good stratification suggest that the series was deposited under static water conditons with most of the sediments being derived from the surrounding highlands of complex.

Texas Canyon Series

The Texas series differ from those in Tick Canyon in having no lava flows, at least in this area, and the sediments lithologically are much coarser and less consolidated and less stratified. The sediments which are just west of the complex I have called Sespe as they seem to be unconformable with the material that is Mint Canyon in character. The lack of good exposures in this section has made it difficult to differentiate between the formations. If one uses the criteria of predominance of lava in the Mint Canyon and of Complex in the Sespe, the contacts may be traced to some extent.

In the canyons draining into the Vasquez Canyon, the Sespe is characterized by large(20') "complex" blocks and unconsolidated fanglomerate material. The unconformable Mint Canyon farther south is characterized by much smaller sized material containing lava boulders. In Texas Canyon near the Ward Canyon there is a thick bed of breccia complex that resembles the Basement Complex and must be differentiated from this. In the extreme northern part of the area there are the consolidated, stratified, red conglomerate and sandstones that resemble the Tick Canyon Series.

To tie in the true relations in this section would require considerable work with the Quadrangle to the north. Mr. J . Judson has mapped this but I have been anable to continue or pick up some of the features and formations that he has mapped. Such correlations is made difficult by the lack of good outcrops

What I have been able to pick up from the surface shows that Sespe is the only formation in Texas Canyon and west of the complex and it lies unconformably beneath that to the south. The Sespe seems to dip at angles greater then 40° while the Mint Canyon is less then 30°. Both vary slightly in strike.

Upper Miocene

Mint Canyon Series

These beds are typically exposed in Mint Canyon and make up more than 50% of the area mapped. They have been described by Kew and others who have described vertebrate remains found in this formation. The Mint Canyon rests with a large unconformity on the Sespe or Escondido series and is faulted against the complex for some distance. Although there seems to be no well marked break in the lithology of the sediments, one finds certain characteristics in different parts of the area. As a rule the beds of reddish tinge predominate in the lower part while beds of brown and gray are present in the upper part.

The Mint Canyon is characterised by its poor stratification and consolidation. Beds are discontinous and may lense out in a very short distance. There are a few conglomerate beds that are better consolidated and so form striking ridges and cliffs. Lava boulders of varying degree of angularity predominate in the lower part of the formation while the upper parts contains a greater percentage of complex material. The ~~is true~~ Latter occur west of Mint Canyon.

West of Spring Canyon in Bee Canyon and Aqua Dulce. the foramtion is characterized by a very coarse fanglomerate consisting of subangular to angular blocks of lava and complex. Resting on top of these there are about 300 feet of sandy shales and sandstones which form continous beds for some distance and pinch out. On top of this there are typical fanglomerates interbedde with lenticular masses of stratified sandstones and gravels. West of the fault there is a great thickness of conglomerates and gravels that form continous beds that pinch out. Northward , near the contact of the Escondido the gravels are underlain by red, brown, green, sandstones, ash and marl beds which are supposed to contain fresh water fossils. These pinch out to the west as the coarser fanglomerates ~~are~~ come in contact with the basement. Just north of Vasquaz Canyon a series of ash beds helped to interpret the structure as found.

In short, one might summarize the Mint Canyon as found in this area as follows: The base of the formation consists of a great thickness of very coarse conglomerate. This is overlain by a series of finer conglomerates and fanglomerates with interbeds of red, gray, green, sandstones and shales and ash beds which form lenticles in a greater thickness of coarser fanglomerate. The upper part is characterized by gray colored ~~sediments~~ fanglomerate, + sands that have a coarse texture.

These lithologic characters suggest that the Mint Canyon was deposted under subaerial conditions. The region at that time was probably a large valley surrounded by mountains of complex. The beds of conglomerate and sandstone all of which are more or less unsorted are lenticular and appear to have been deposited as large alluvial fans. At different stages and at different places lakes existed as shown by the aboundance fresh water mollusks and of the finer lenticles of sediment.

Pliocene

The Modello and Saugus formations which are present to the south of the area were not mapped.

Quaternary Terraces

Small patches of unsorted angular gravels of basement complex were found in varoious parts of the area suggesting that they may be at an old terrace level. These are all at about 2200'. Most of these were so small that they were not mapped.

Quaternary Recent Alluvium

This is found in most of the canyons and stream beds. The wide portion at the head of Aqua Dulce Canyon is made up of alluvium which hides most of the structure beneath.

Structural Geology

For convenience in description the structure of the area may be divided into three parts. The first part entails the folds and faults at the head of Tick Canyon. The second considers the faults in the Basement Complex and its contact relations with the sediments. The third gives the structure of the Mint Canyon and its contact Relations with the overlying and underlying sediments.

Tick Canyon Section

In this section the Escondido is cut by three major north south faults. The Tick Canyon fault displaces the lavas and drops a small syncline of Mint Canyon into contact with the Escondido. This fault extends down Tick Canyon a short distance where it seems to die out. East of this fault there is another that seems to be continous in the Escondido and the complex only. Both of these faults seem to be cut off by the large northeast fault in the Basement. The Spring Canyon fault seems to have the most displacement and drops Mint Canyon against the Escondido. Along this fault the Escondido is drag folded suggesting strike slip movement.

Near Skyline Ranch the Escondido has been folded into a syncline and anticline which has been displaced by the north south vertical faults.

A possible interpretation of the structural history that is here might be:

1- Folding of the Escondido with development of North south faulting

2- Deposition of the Mint Canyon followed by folding of Escondido and Mint Canyon. Possibly accompanied by recurrent movement along the old fault system causing displacement of the Mint Canyon to a lesser extent then the Escondido.

Basement Complex Section

The basement complex in this area has been highly deformed and fractured with many fault zones. The largest is plotted on the map. It is characterized by considerable fault gauge and is mineralized. As one approaches Mint Canyon along the fault one finds that it completly disappears.

This has been interpreted as a cross fault which seems to be part of the system of north south faults that are present in the area. The Escondido sediments in this locality have been cut off by this fault and are highly distorted. The same sandstone beds, impregnated with gypsum, are found in the little patch just west of the fault. Here the lava and sandstones seem to be in direct contact with the Mint Canyon and not separated by a fault. This type of relation suggests a very great unconformity between the Escondi do and the Mint Canyon.

The large fault zone may be followed westward across the canyon by the associated quartz ledge and mineralized zone. Farther west this is cut by another cross fault west of which the conatact relations are not at all clear. In some parts the Mint Canyon seem to lie directly on the complex and in others there is definite evidence of faulting. This contact may be interpreted as depositional with recurrent faulting along some of the faults that were formed in the complex due or post Escondido and pre Mint Canyon. The notthern boundary of Complex is not clear. What outcrops could be found and the general distribution seem to indicate a depositional contact.

One might summarize the structural history as:

1. Development of the Northeast to east faults in the complex, possible accompaning the volxcanic activity or preceeding it.

2. Depositionaof the Escondido and subsequent faulting and folding with stress conditions favorable for the development of the north south faulting and east west folds.

Mint Canyon Section

The structure found in the Mint Canyon for most of the area is simple. In Tick Canyon the Mint Canyon is dipping westawrd with an average dip of 20° to 30° with some faint suggestions of minor undulations. Cutting southward across the Mint Canyon there is a small anticline which may be a reflection of the cross fault found in the Basement Complex to the north.

West of Mint Canyon the prevailing dip of the formation is in a southerly direction. At the head of Plum Canyon and to the east there is an anticline and syncline of short length which strikes in a southerly direction. In the vicinity of the mouth of Vasquez Canyon there are two more anticlines. The presence of the fault and the overturned beds was determined quite accurately in the field as they are exposed clearly.

Most of the faults and folds occuring in the Mint Canyon seem to be short in length and displacement. The cause of this distribution would be difficult to give. The trends of the faults and folds seem to be of the same pattern as those in the Basement Complex and Tick Canyon sections. and possible hypothesis may be that the present structure of the Mint Canyon is the reflection of some older structure beneath that has since been rejuvenated.

Historical Geology

During the Jusrassic and Post Jurrassic epochs, the deeply buried sediments and lavas were intruded by granodiorite and granite forming the present Basement Complex. Following this there was probably a period of faulting after which the Escondidao was laid down in basins. The climate was arid so that a variety of lake, playa, and fan deposits were laid down by streams flowing into these basins. Following this there came a period of volcanic activity with its intrusion of the series with sills of andesite and deposition of ash and extrusions of lava upon the sediments. After a short period of quiet the beds were faulted and folded under stress conditions favorable for the north-south fault pattern and the east-west fold pattern.

In upper Miocene time the Mint Canyon formation was deposited unconformably upon the Escondida and Basement Complex under subaerial conditions. Region was again a large basin surrounded by mountains of the complex and Escondido. Beds of unsorted conglomerate and sandstone in lenticular bodies appear to have been deposited as large alluvial fans. At different stages of deposition lake existed in various parts of the area and deposits of stratified muds, andstones were formed. Volcanic activity in the region resulted in the deposition of ash beds in various parts of the area. In lower Mint Canyon time a period of slight faulting and folding took place near Tick Canyon and resulted in the syncline of Mint Canyon in the Escondido. Later the Mint Canyon was folded and faulted more and the overlying Saugus was deposited unconformably upon the Mint Canyon series.

In recent times (Pleistocene) the region was eroded to late maturity as denoted by the remants of wide valleys at elevations of approxiamtely 2200'. Since then uplift has interrupted the older cycle and the younger cycle of erosion is vigoursly attacking the softer Mint Canyon sediments and converting the region into a typical badland.

Part I

Improvements on a Pendulum of the Holweck-Lejay Type

Part II

Some Theoretical Considerations of the Magnetic Field in the Los Angles Basin

Thesis by

L.F.Uhrig

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

California Institute of Technology Pasadena, California

Part I

Improvements on a Pendulum of the Holweck-Lejay Type

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Part I

Improvements on a Pendulum of the Holweck-Lejay Type

Introduction

A pendulum of the Holweck-Lejay type was constructed by Dr. R.A.Peterson during the years of 1934-35. He found that due to thermal hysteresis in the spring the measurements of gravity required a temperature correction. He estimated that every degree change in temperature at 15° C. was equivalent to - 19 mgal change in gravity. Since the temperature of the spring could not be accurately determined many of the measurements were probably in error of 10 mgal or more. Dr. Peterson attempted to insulate the instrument, but this was not satisfactory so it was thought desireable to insulate and thermostat the instrument in order to keep the temperature constant within a few tenths of a degree centigrade.

During the course of this work it was found that the thermostating was just one problem as certain other phases gave rise to considerable trouble. As a result,at the time of writing this report, no rigorous field tests havo been made with the thermostated and insulated instrument.

Description of Improvements

General

The main features of the rebuilt instrument are illustrated in the drawings at the end of the report. As much as possible of the materials of the old instrument were utilized.

The base in which the pendulum is fastened is bolted tightly within a $3\frac{1}{4}$" length of $2\frac{1}{2}$" Shelby tubing which is fastened firmly to $\frac{1}{2}$" steel plate. This is screwed to a 11" diameter block of wood consisting of three 2" thicknesses of oak. The wood has been treated with stain to help prevent checking.

Two levels are mounted on the $\frac{1}{2}$" steel plate. The leveling screws are mounted on a $\frac{1}{4}$" steel plate screwed to the bottom of the oak block.

The microscope has been modified to accomadate the new position of the pendulum. It is mounted firmly on the $\frac{1}{2}$" steel plate.

The clamp mechanism has been altered. The clamp rod within the bell jar is kept from rotating by a guiding slot in the base. Before, this tended to move to one side and leave the pendulum unclamped. The lever that is fastened to the clamp is attached to an eccentric that is operated from the outside. The clamp is held in "fest" position by an automatic locking action of the eccentric and stiff spring.

A galvanized iron case surrounds the whole instrument and extends about 7" above the $\frac{1}{2}$" steel plate. This required the construction of wells for levels. This may seem a little clumsy in leveling but the arrangement preserves the rigidity required for the proper operation of pendulum and levels. The top of the case is capped by a fiber board on which the relay and control board are mounted. This is firmly fastened by hexagonal nuts on threaded rods extending from the wooden base.

Thermostating and Insulation

The instrument is insulated by a combination of wood and wool. There are other materials that are better insulators but the material on which the pendulum rests must be rigid and firm. Oak seemed to satisfy this requirement in addition to being a good insulator. The portion of the case above the wood is filled with wool which is as good an insulator as sawdust and is easier to handle.

Heat is furnished thru a resistance by a 6 volt storage battery. Since the effect of temperature is due to the differential temperature in the spring as a result of a sudden change in the temperature of the base, the heating and temperature control is designed to keep the base at constant temperature. For this reason the heater is mounted directly beneath the pendulum base.

The temperature is controlled by a mercury thermostat that activates a relay which in turn controls the flow of current thru the heater. The mercury thermostat consists of a capillary tube of 1mm. bore mounted in a threaded steel plug. The whole screws into another plug which is firmly cemented into a pyrex tubing filled with mercury. This design enables one to use the thermostat for any range of temperature desired. To get the sensitivity of one tenth of a degree, a nine inch length of $\frac{1}{8}$" pyrex tubing is filled with mercury. This was bent into a U-shape and inserted in the well next to the base. The relay is activated by completion of the electric circuit witha nichrome wire in contact with the mercury in the capillary. In this manner the temperature of the air surrounding the base is kept constant. A thermometer is inserted in the base of the pendulum and is read at regular intervals.

This temperature does not vary more then a tenth of a degree, indicating that conduction of the heat upward thru the metal is neglible and that the base remains at constant temperature.

The effectiveness of this system in the field has not been tested rigorously so it is not known what effect travel will have on the constancy of temperature. If it varys one can blame it on the crudness with which the thermostat was made and it would probably pay to have one carefully machined or buy one for $30 or so.

Tests were made on the instrument indoors and outdoors. It was found that for a 20° difference in temperature from outside to inside of the instrument that the temperature stayed constantly within one tenth of a degree for a few days inside and half day outdoors. At the beginning of the experiment it required approximately three hours for the system to reach equilibrium. It generally requires about 20 to 30 seconds to furnish the heat that radiates in 2½ to 3 minutes, which gives a measure of the efficiency of the insulation.

I believe that under any change of temperature that one would encounter in the field the instrument will stay at constant temperature provided that one can furnish the required current. The heater draws approximately 2 amperes so that it may be necessary to use a special 200 ampere hour storage battery instead of the average 90 ampere hour car battery.

Photocell

The photocell used by Dr. Peterson deteriorated so that a new cell had to be installed. A number of different cells and circuits were tried out. The gas filled Westinghouse SK-60 Phototube with the circuit shown in the wiring diagram was found to have the maximum sensitivity. Essentially this is the same as before except the circuit constants have changed.

To get sharp response the pointer on the pendulum was machined into a small cylinder. A westinghouse 2.5 ampere galvanometer lamp is used for a light source as one can get a very sharp image of the narrow filament. In this way one gets complete extinction of the light beam so that two impulses from the cell are recorded. There is one for the extinction and one for the return of the light. The time factor due to the larger coupling is greater then that of Dr. Petersons arrangement but it was needed to get the required sensitivity as the present light source does not give sufficient illumination for operation on the older circuit with the smaller condenser. However, the present impulse is sharp enough to pick out the period with the same accuracy as before.

The operation of the cell seems to depend more on the area of the light impinging on the cathode rather then the intensity so that the light beam must be made long and narrow. This involves special care in making a mask that satisfies these requirments and yet eliminates all ghosts from the light source.

Shielding

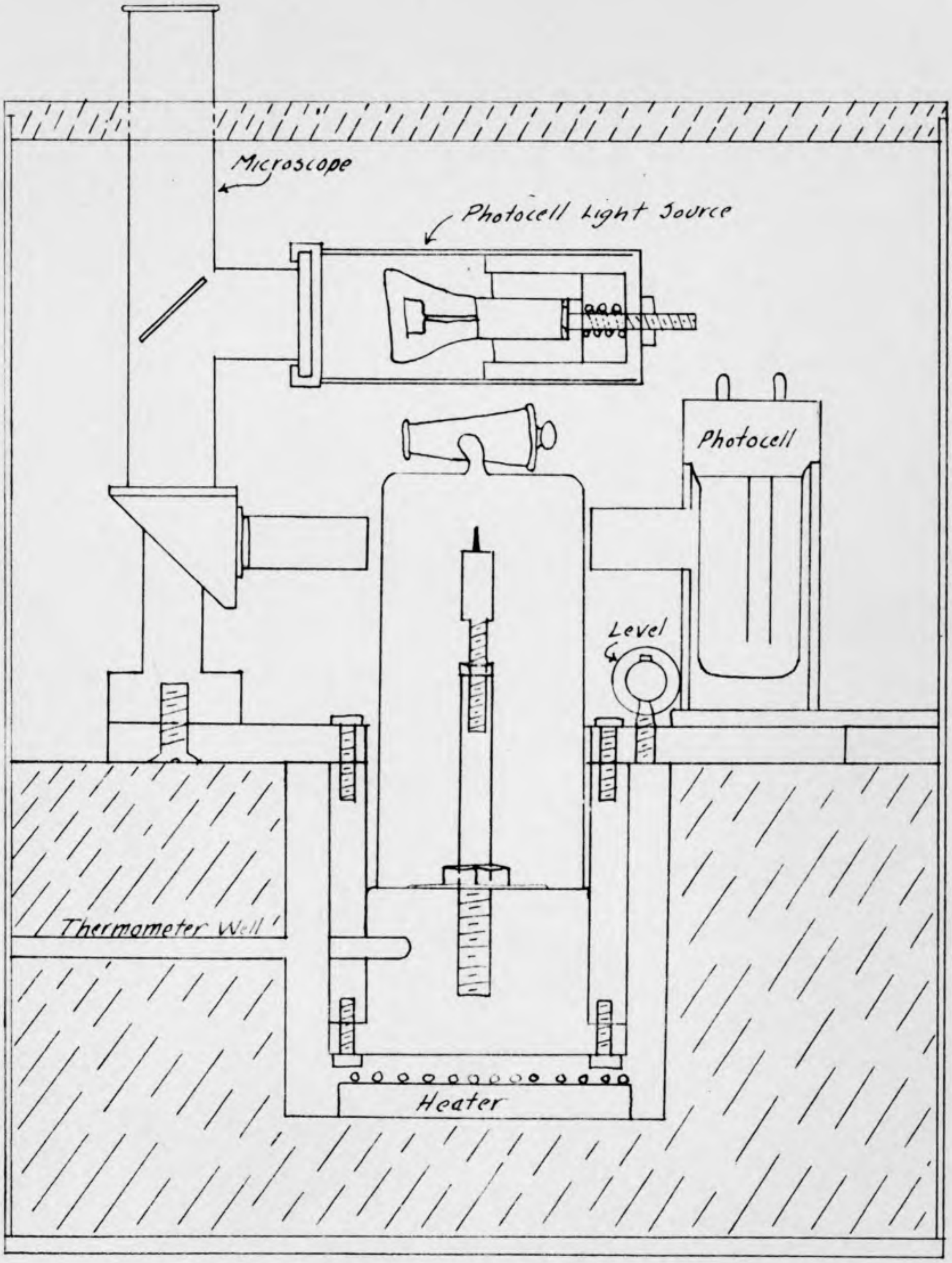
A source of trouble and cause of inaccurate records is the pick up of stray magnetic fields by the amplifier and phototube circuit. All cables leading into the intrument were shielded and grounded. The amplifier case and the instrument case are grounded. The B batteries used to operate the phototube are placed in a galvanized iron box that is also grounded. In this way most of the stray fields were eliminated under the worse possible conditions so that very little trouble from this should arise in the future.

Period Changes of the Instrument

A peculiar property of the Elinvar used in the pendulum spring is one of "aging". That is, over a period of time the spring gets stiffer and causes the sensitivity to decrease. The sensitivity may be raised by adjusting th bob and heat treating the spring for a week or so at 150°C to relieve any stresses that might have been set up during the operation.

Between April 20 and May 25 a series of measurements were made with the instrument. Most of these were made at Pasadena and a few made on Mount Wilson in order to calibrate the instrument. During this interval the period dropped from 74.6 sec. to 72.2 sec. for 15 swings. These were timed made with a stop watch calibrated to a tenth of a second. The measurements were made at 33.3°C so that any temperature effects were completly elliminated. The values determined from the records made under field conditions were very erratic which is in part due to the method of recording and unfamiliarity with field technique. From about June the first, when Dr. Peterson completed his measurements, to about January the first, when the writer wished to use the instrument, the period for 15 swings dropped from approximately 61. sec. to 45 sec. This is about 15 sec. in 6 months which is about the same rate that th period is drifting at the present time. The cause of this drift has not been determined. It may be the result of recrystallization of the Elinvar or in the composition of that used in the pendulum. At the present time the drift has stopped altogether, so the material may have reached equilibrium. Continued measurements may give some clue as to the cause.

Pendulum Assembly

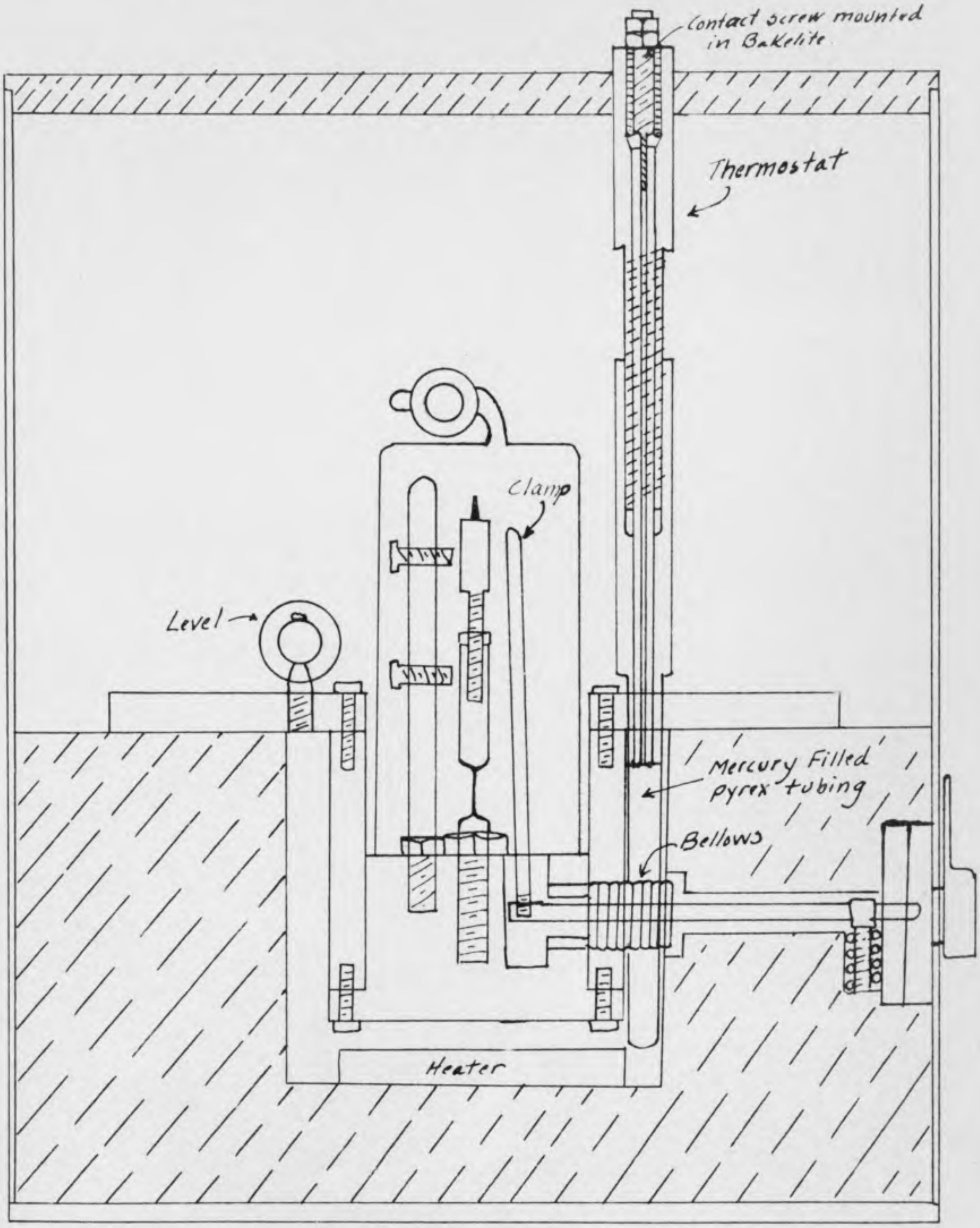


Section Drawn Perpindicular

to Plane of Vibration

Scale ½" = 1"

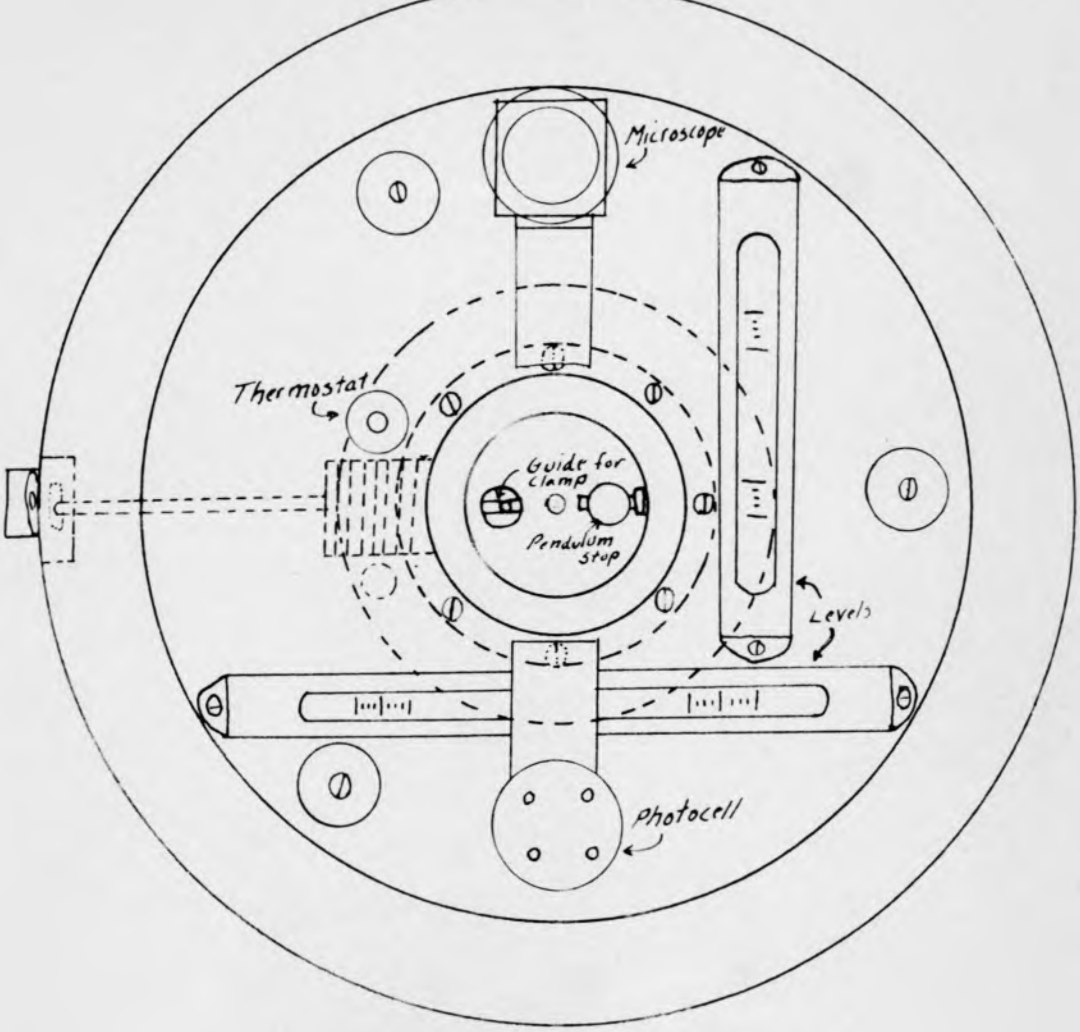
Pendulum Assembly



Section Drawn Parallel
to Plane of Vibration

Scale $\frac{1}{2}''$ – 1''

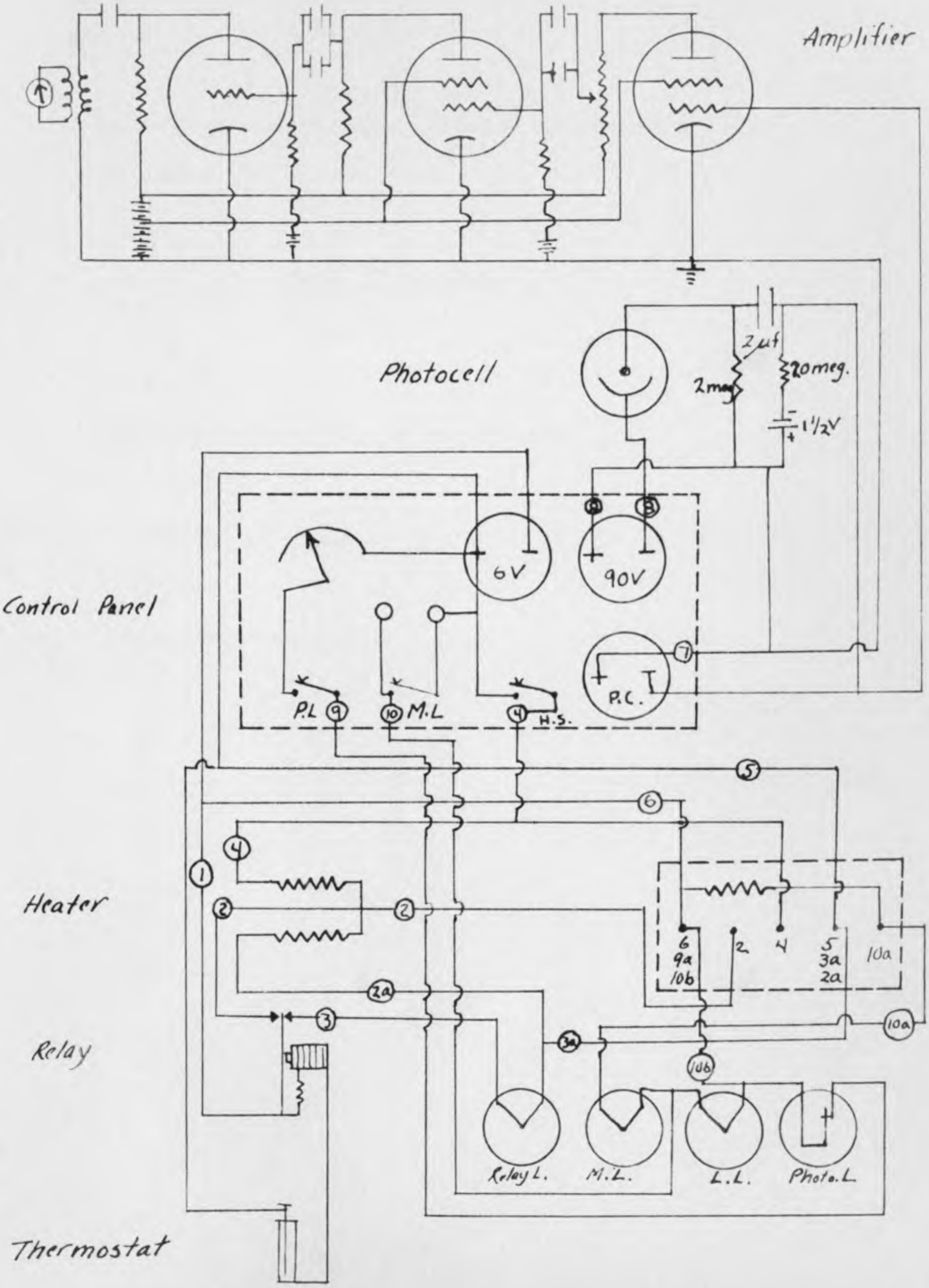
Pendulum Assembly



Plan View

Scale $\frac{1}{2}'' = 1''$

Wiring Diagram



Part II

Some Theoretical Considerations of the Magnetic Field in the Los Angles Basin

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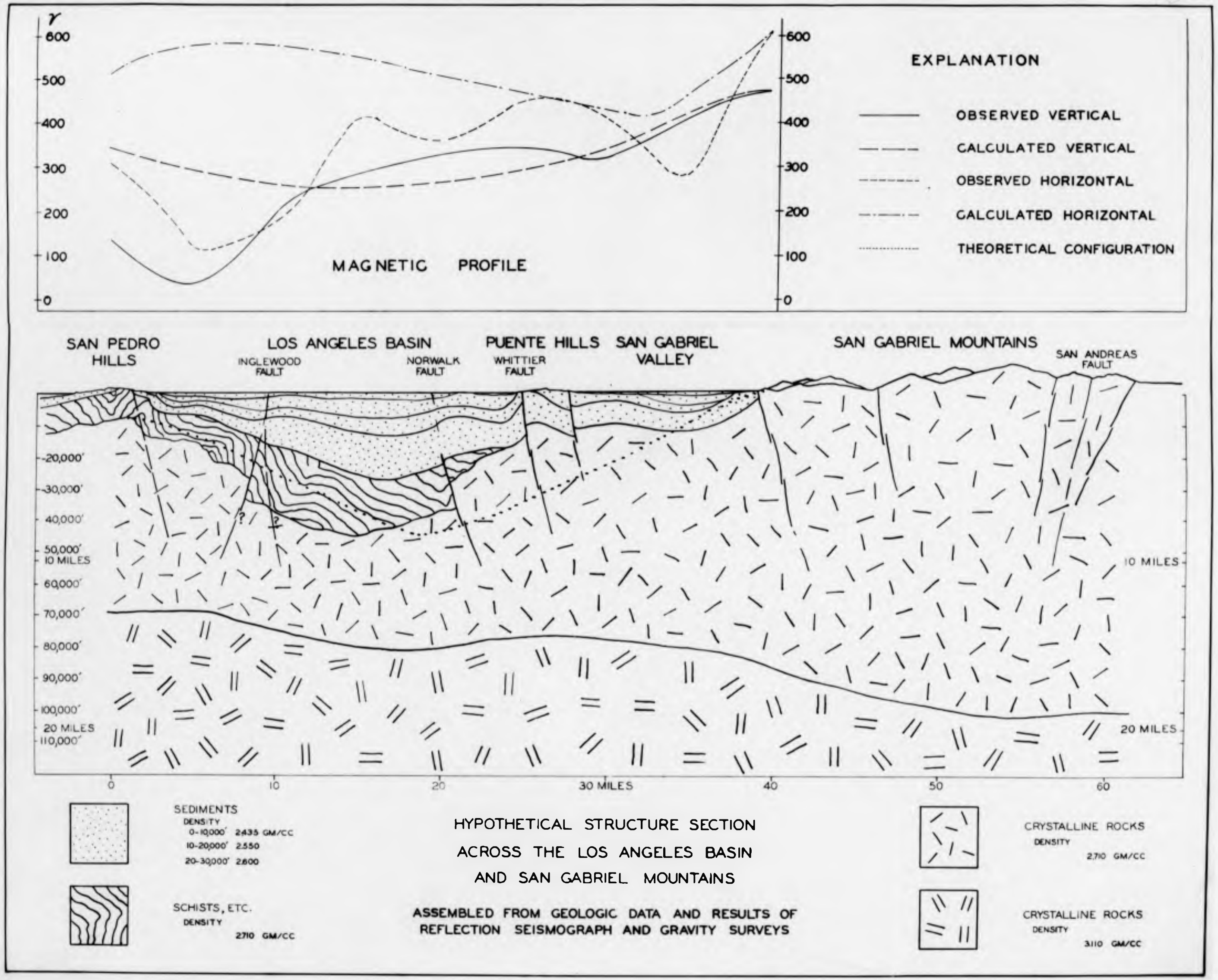


HYPOTHETICAL STRUCTURE SECTION ACROSS THE LOS ANGELES BASIN AND SAN GABRIEL MOUNTAINS

ASSEMBLED FROM GEOLOGIC DATA AND RESULTS OF REFLECTION SEISMOGRAPH AND GRAVITY SURVEYS

Part II

Some Theoretical Considerations of the Magnetic Field in the Los Angles Basin

Introduction

A magnetic profile across the Los Angles Basin from the San Gabriel Mountains to the San Pedro Hills was made by Mr. S. Schaffer in 1936 with a vertical magnetometer. The cause of the anomaly could be intrepreted in a number of ways so in order to get a better idea of the distortion of the magnetic field by the Los Angles Basin an attempt was made to calculate the field.

The method of solution followed is that outlined by Dr. Smythe of the Physics department.

Statement and Solution of the Problem

From the structural crossection of the Los Angles Basin (Fig.1) one sees that the problem may be reduced to that of two semi-infinite blocks of different permiabilities, separated by a sinous boundary and placed in an inclined uniform field.(Fig.2)

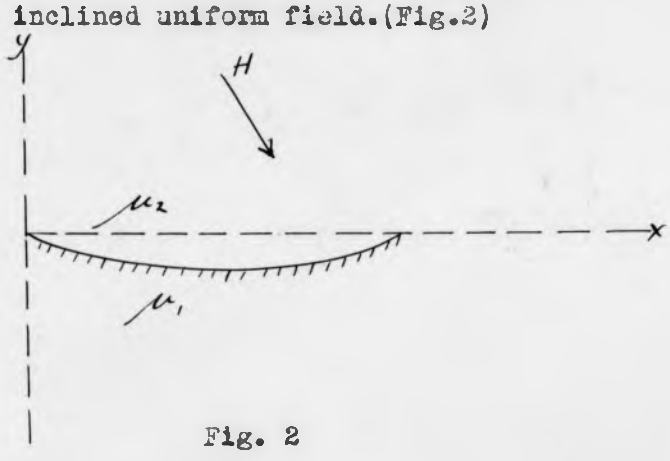
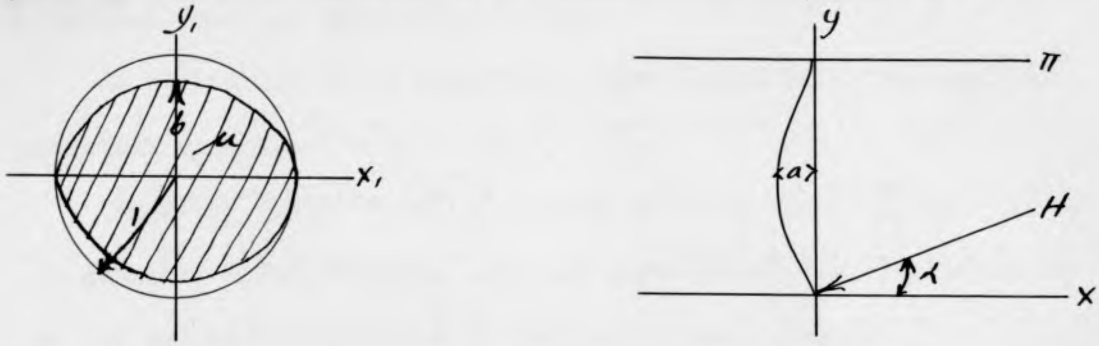


Fig. 2

This assumes that the permeability of the sediments and the air is the same as compared with the permeability of the granite.

The problem then reduces to finding some simple transformation that

that will transform a field about a known body into a configuration as shown above. A very close transformation to the actual conditions would be given by the transformation of an ellipse in the z_1 plane by $z = \ln z_1$



z_1 plane　　　　z plane

Fig.3

$$x_1^2 + \frac{y_1^2}{b^2} = 1$$

$$z = \ln z_1$$

$$x_1 = e^x \cos y \quad , y_1 = e^x \sin y$$

$$e^{2x}\cos^2 y + \frac{e^{2x}\sin^2 y}{b^2} = 1$$

$$e^{2x} = \frac{1}{1+\left(1+\frac{1-b^2}{b^2}\sin^2 y\right)}$$

$$y = \frac{\pi}{2} \ , \ x = -a \quad , e^{-2a} = b^2$$

$$\therefore \ x = -\frac{1}{2}\ln\left(1+(e^{-2a}-1)\sin^2 y\right)$$

Now any field in the z plane is $W = Hz = H \ln z$,

A vertical field H_1 in the z plane is given by taking V as the potential function in $W_1 = Hz = H_1 \ln z$, 5

A horizontal field H_2 in the z plane is given by taking U as the potential function $W = Hz = H_2 \ln z$, 6

Then any field $H = \sqrt{H_1^2 + H_2^2}$ making an angle $\tan\alpha = \frac{H_1}{H_2}$ with the x axis is obtained by superposing the real part of (5) and the imaginary part of (6) and may be combined by taking the real part of

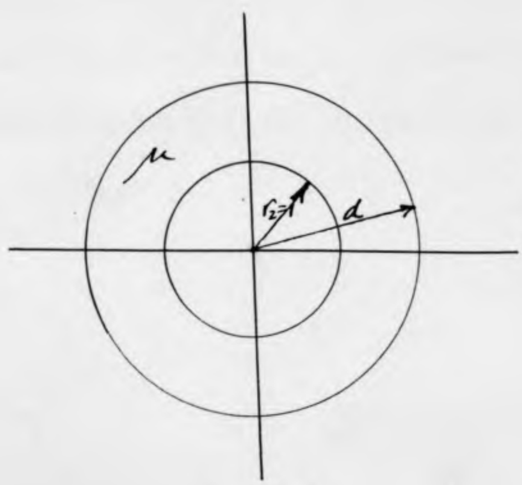
$$W_4 = W_1 + W_2 = H e^{-j\alpha} \ln z,$$

The boundary conditions on the x axis in the z plane are:

$$\text{Imag. part. of } \left.\frac{\partial W_1}{\partial z_1}\right|_{y=0} = j\frac{\partial V_1}{\partial x_1} = 0 \qquad 7$$

$$\text{Imag. part of } \left.\frac{\partial W_2}{\partial z_2}\right|_{y=0} = -j\frac{\partial U_2}{\partial y_1} = 0 \qquad 8$$

Since the vertical field transforms into concentric circles which intersect at the axis normally and the horizontal field gives radial lines which are tangential to the axis, the transformation $z_1 = \frac{c}{2}\left(\frac{1+z_2^2}{z_2}\right)$ of elliptical into circular boundary enables one to use circular harmonics but requires from (7) and (8) that the circles $r_2 = 1$ which comes from the line ,2c, between the foci in the z plane, be for V_1, an equipotential and for U_2 a line of force.



z_2 plane

$$z_1 = \frac{c}{2}\left(\frac{1+z_2^2}{z_2}\right)$$

Equations 5 and 6 now take the form

$$W = -A\ln\frac{1+z_2^2}{z_2^2} + AB = -A\ln\left(1+\frac{1}{z_2^2}\right) - A\ln z_2 + AB$$

On expanding

$$W = A\left\{\sum_1^\infty \frac{(-1)^n}{n z_2^{2n}} - \ln z_2 + B\right\}$$

$$= A\left\{\sum_1^\infty \frac{(-1)^n}{n r_2^{2n}} e^{-j2n\theta_2} - \ln z_2\right\}$$

where $1 < r_2 < d$, superpose potential of the form

$$W' = A\left\{\sum_1^\infty \frac{(-1)^n}{n}\left(\frac{C_n}{r_2^{2n}} e^{-j2n\theta_2} + D_n r^{2n} e^{j2n\theta_2}\right)\right\}$$

where $r_2 > d$, take potential of form

$$W'' = A\left\{\sum_1^\infty \frac{(-1)^n}{n}\left(\frac{E_n}{r^{2n}} e^{-j2n\theta_2} + M\ln z_2\right)\right\}$$

at $r_2 = 1$, imag. part $\frac{\partial W'}{\partial r_2} = 0$

so $C_n = D_n$

at $r_2 = \infty$, $W'' = H_0 e^{-j\alpha} \ln z_2 + \text{const.}$

so that the expression becomes

$$W = H_\infty N\left\{\sum_{n=1}^\infty \frac{(-1)^n}{n}\left(r_2^{-2n} e^{-2jn\theta_2} - \ln z_2\right\} + HB'\right.$$

$$W' = H_\infty\left\{\sum_{n=1}^\infty \frac{(-1)^n}{n} N_n'\left(r_2^{-2n} e^{-2jn\theta_2} - r^{2n} e^{j2n\theta_2}\right\}\right.$$

$$W'' = H_\infty\left\{\sum_{n=1}^\infty \frac{(-1)^n}{n} N_n''\left(r^{-2n} e^{-2jn\theta_2} + e^{-j\alpha}\ln z_2\right\}\right.$$

The real part represents the potential function.

All constants are complex, where the subscript R is used this refers to the real part of the constant and where the subscript I is used this refers to the imaginary part of the constant as:

$$N_n = N_{nR} + jN_{nI}$$

Now at $r_2 = d$

$$U_1 + U' = U'' \qquad \mu \frac{\partial (U_1 + U')}{\partial r_2} = \frac{\partial U''}{\partial r_2}$$

Taking the real and imaginary parts of the coefficients of the $e^{j2n\theta_2}$ and $\cos 2n\theta$ and $\sin 2n\theta$ terms, we get the following equations.

$$-N_R \ln d + B_R = \cos\alpha \ln d$$

$$-N_I \ln d + B_I = \sin\alpha \ln d$$

$$-\mu N_R = \cos\alpha$$

$$-\mu N_I = \sin\alpha$$

$$\frac{-\cos\alpha}{\mu} + N'_{nR}(1-d^{4n}) = N''_{nR}$$

$$-\cos\alpha + \mu N'_{nR}(1+d^{4n}) = N''_{nR}$$

$$\frac{-\sin\alpha}{\mu} - N'_{nI}(1+d^{4n}) = -N''_{nI}$$

$$-\sin\alpha - \mu N'_{nI}(1-d^{4n}) = -N''_{nI}$$

$$B_R = \frac{\mu-1}{\mu}\cos\alpha \ln d \qquad B = \frac{\mu-1}{\mu} e^{-j\alpha} \ln d$$

$$B_I = -\frac{\mu-1}{\mu}\sin\alpha \ln d \qquad N = -\frac{1}{\mu} e^{-j\alpha}$$

$$N'_{nR} = \frac{(\mu-1)\cos\alpha}{\mu[(\mu-1)+(\mu+1)d^{4n}]} \qquad N'_{nI} = \frac{-(\mu-1)\sin\alpha}{\mu[(\mu-1)-(1+\mu)d^{4n}]}$$

$$N'_n = \frac{\mu-1}{\mu}\left\{\frac{\cos\alpha}{(\mu-1)+(\mu+1)d^{4n}} - j\frac{\sin\alpha}{(\mu-1)-(\mu+1)d^{4n}}\right\}$$

$$N''_{nR} = \frac{-2d^{4n}\cos\alpha}{(\mu-1)+(\mu+1)d^{4n}} \qquad N''_{nI} = \frac{-2d^{4n}\sin\alpha}{(\mu-1)-(\mu+1)d^{4n}}$$

$$N''_n = -2d^{4n}\left\{\frac{\cos\alpha}{(\mu-1)+(\mu+1)d^{4n}} + j\frac{\sin\alpha}{(\mu-1)-(\mu+1)d^{4n}}\right\}$$

$\frac{\partial w''}{\partial z}$ gives the field at any point

$$w'' = H_\infty \left\{ \sum_{n=1}^{\infty} \frac{(-1)^n}{n} N_n'' \left(r_2^{-2n} e^{-2jn\theta_2} + e^{-j\alpha} \ln z_2 \right) \right\}$$

$$\frac{\partial w''}{\partial z} = \frac{\partial w''}{\partial z_2} \cdot \frac{\partial z_2}{\partial z}$$

$$z_1 = e^z$$

$$z_1 = \frac{c}{2}\left(\frac{1+z_2^2}{z_2} \right)$$

$$\frac{\partial z_2}{\partial z} = \frac{\partial z_2}{\partial z_1} \cdot \frac{\partial z_1}{\partial z} = \frac{2z_2^2 e^z}{\sqrt{1-e^{-2a}}(z_2^2-1)}$$

$$\frac{\partial w''}{\partial z_2} = H_\infty \left\{ \sum_{n=1}^{\infty} \frac{(-1)^n}{n} N_n'' \left(\frac{-2}{z_2^{2n+1}} + \frac{e^{-j\alpha}}{z_2} \right) \right\}$$

$$\frac{\partial w''}{\partial z} = H_\infty \left\{ \sum_{n=1}^{\infty} \frac{(-1)^n (-2N_n'')}{z_2^{2n+1}} + \frac{e^{-j\alpha}}{z_2} \right\} \left\{ \frac{2z_2^2 e^z}{\sqrt{1-e^{-2a}}(z_2^2-1)} \right\}$$

$$= \frac{2H_\infty e^x}{\sqrt{1-e^{-2a}}} \left\{ \sum_{n=1}^{\infty} \frac{(-1)^n(-2N_n'') e^{jy}}{z_2^{2n+1}(z_2^2-1)} + \frac{e^{-j\alpha} e^{jy} z_2}{(z_2^2-1)} \right\}$$

The real part of this solution is the vertical field and the imaginary part is the horizontal field.

Therefore after seperating real and imaginary parts,

$$H_x = \frac{8H_\infty e^x r_2}{\sqrt{1-e^{-2a}}\left(r_2^4 - 2r_2^2\cos 2\theta_2 + 1\right)} \left\{ \sum_{n=1}^{\infty} (-1)^n d^{4n} \frac{\left[(\mu-1)\left[r_2^2\cos(\alpha+y-(2n+1)\theta_2) - \cos(y-(2n+1)\theta_2-\alpha)\right] - (\mu+1)d^{4n}\left[r_2^2\cos(y-\alpha-(2n+1)\theta_2) - \cos(y-(2n-1)\theta_2+\alpha)\right]\right]}{r_2^{2n}\left((\mu-1)^2-(\mu+1)^2 d^{8n}\right)} + \frac{r_2^2\cos(y-\theta_2+\alpha) - \cos(\alpha-y-\theta_2)}{4} \right\}$$

$$H_y = \frac{2H_\infty e^x r_2}{\sqrt{1-e^{-2a}}\left(r_2^4 - 2r_2^2\cos 2\theta_2 + 1\right)} \left\{ \sum_{n=1}^{\infty} (-1)^n d^{4n} \frac{\left[(\mu-1)\left[\sin(y-\theta_2+\alpha-2n\theta_2) - \sin(y+\theta_2-\alpha-2n\theta_2)\right] - (\mu+1)d^{4n}\left[r_2^2\cos(y-\theta_2-\alpha-2n\theta_2) - \sin(y+\theta_2-\alpha-2n\theta_2)\right]\right]}{r_2^{2n}\left((\mu-1)^2-(\mu+1)^2 d^{4n}\right)} + r_2^2\sin(y-\theta_2-\alpha) + \sin(\alpha-y-\theta_2) \right\}$$

where

$$r_2 = \left[\frac{e^{2x} + r_0^2 + 2e^x r_0\cos(\theta_0 - y)}{1-e^{-2a}}\right]^{1/2}.$$

$$\theta_2 = \tan^{-1}\frac{e^x\sin y + r_0\sin\theta_0}{e^x\cos y + r_0\cos\theta_0}$$

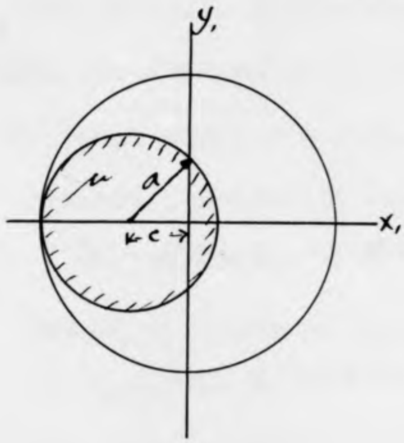
and

$$r_0 = \left[\left(e^{2x}\cos 2y - 1 + e^{2a}\right)^2 + \left(e^{2x}\sin 2y\right)^2\right]^{1/4}$$

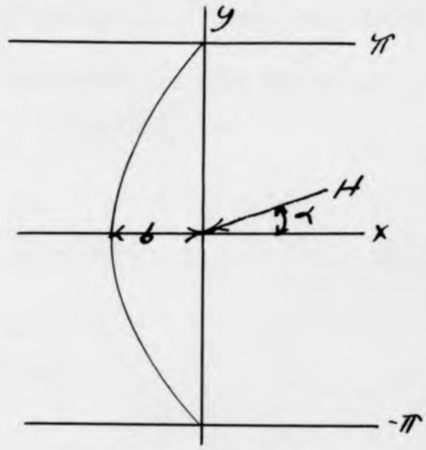
$$\theta_0 = \frac{1}{2}\tan^{-1}\frac{e^{2x}\sin 2y}{e^{2x}\cos 2y - 1 + e^{-2a}}$$

The solution of this problem is so cumbersome to evaluate accurately that another solution was derived of a configuration that is not as good an approximation but serves to give one an idea of the distortion of the field.

In this case a circle was transformed into the z plane



z, plane



z plane

$$Z = \ln z_1$$

$$x_1 = e^x \cos y$$

$$y_1 = e^x \sin y$$

$$(x_1 + c)^2 + y_1^2 = a^2 = (1-c)^2$$

$$e^{2x}\cos^2 y + 2ce^x \cos y + c^2 + e^{2x}\sin^2 y = 1 - 2c + c^2$$

$$e^{2x} + 2ce^x \cos y = 1 - 2c$$

$$z_1 = a - c, \quad z = -b$$

$$c = \frac{1 - e^{-b}}{2}$$

$$y = \cos^{-1} \frac{e^{-b} - e^{2x}}{e^x(1 - e^{-b})}$$

$$x = \ln\left\{\sqrt{e^{-b} + \frac{(1-e^{-b})}{4}\cos^2 y} - \frac{(1-e^{-b})}{2}\cos y\right\}$$

In the z plane the potential is given by:

$$W = xH\cos\alpha - jyH\sin\alpha$$
or $W = He^{-j\alpha}Z = He^{-j\alpha}\ln z_1 = HE\ln z_1$, where E is complex

In the z_1 plane we have the potentials given by a line charge at $z_1 = 0$ where c is the distance of the center of the cylinder from the origin. Thus, there is a line charge at a distance of $\frac{a^2}{c}$ from the center as an image. In addition there is one at the center of the cylinder to keep the total charge the same. Then we find that the

Potential outside of the cylinder is

$$W_1 = HE\ln z_1 + HA\ln(z_1 + c) \text{ and the}$$

Potential inside of the cylinder is

$$W_2 = HB\ln z_1 + HC\ln\left(z_1 + c - \frac{a^2}{c}\right) + D$$

put $z_2 = z_1 + c$

$$W_1 = H\left\{E\ln\left(1 - \frac{c}{z_2}\right) + (A+E)\ln z_2\right\}$$

$$W_2 = H\left\{B\ln\left(1 - \frac{c}{z_2}\right) + C\ln\left(1 - \frac{cz_2}{a^2}\right) + B\ln z_2 - C\ln\frac{a^2}{c} + D\right\}$$

Expanding the ln terms

$$W_1 = H\left\{\sum_1^\infty \frac{(-1)^n c^n}{n r_2^n} E e^{-in\theta_2} + (A+E)\ln r_2 e^{i\theta_2}\right\}$$

$$= H\left\{\sum_1^\infty \frac{(-1)^n c^n}{n r_2^n} E(\cos n\theta_2 - j\sin n\theta_2) + (A+E)\ln r_2 + (A+E)i\theta_2\right\}$$

$$W_2 = H\left\{\sum_1^\infty \frac{(-1)^n c^n}{n r_2^n} B(\cos n\theta_2 - j\sin n\theta_2) + \frac{Cc^n r^n}{a^{2n}}(\cos n\theta_2 + j\sin n\theta_2) + B\ln r_2 + Bi\theta_2 - C\ln\frac{a^2}{c} - C\pi i + D\right\}$$

Then

$$U_1 = H\left\{\sum_1^\infty \frac{(-1)^n c^n}{n r_2}(E_R\cos n\theta_2 + E_I\sin n\theta_2) + (E_R + A_R)\ln r_2 - (A_I + E_I)\theta_2\right\}$$

$$U_2 = H\left\{\sum_1^\infty \frac{(-1)^n}{n}\left[\frac{c^n}{r_2^n}(B_R\cos n\theta_2 + B_I\sin n\theta_2) + \frac{c^n r^n}{a^{2n}}(C_R\cos n\theta_2 - C_I\sin n\theta_2)\right] + B_R\ln r_2 + C_I\ln\frac{a^2}{c} - B_I\theta_2 - C\pi + D\right\}$$

The boundary conditions are:

$$r_2 = a \qquad U_1 = U_2 \qquad \frac{\partial U_1}{\partial r} = \mu \frac{\partial U_2}{\partial r}$$

giving the equations

$$A_I + B_I = E_I \qquad (A_R + E_R)\ln a = B_R \ln a + C_R \ln\frac{a^2}{c} - C\pi + D$$

$$E_I + C_I = B_I \qquad E_R = B_R + C_R$$

$$E_I = \mu(B_I + C_I) \qquad E_R = \mu(B_R - C_R)$$

$$A_R + E_R = \mu B_R.$$

and solving we get

$$B = \frac{\mu+1}{2\mu}\left(E_R + jE_I\right)$$

$$C = \frac{\mu-1}{2\mu}\left(E_R + jE_I\right)$$

$$A = \frac{\mu-1}{2}\left(E_R - \frac{j}{\mu}E_I\right)$$

Now

$$W_1 = H\left\{(E_R + jE_I)\ln z_1 + \frac{\mu-1}{2}\left(E_R - \frac{j}{\mu}E_I\right)\ln(z_1 + c)\right\}$$

Let $z \rightarrow \infty$

$$W_1 = H\left\{E_R\left(\frac{\mu+1}{2}\right)\ln z_1 + jE_I\left(\frac{\mu+1}{2\mu}\right)\ln z_1\right\}$$

then

$$E_R = \frac{2\cos\alpha}{\mu+1}, \quad E_I = \frac{-2\mu\sin\alpha}{\mu+1}$$

and

$$W_1 = H\left\{(E_R + jE_I)z + \frac{(\mu-1)}{2}\left(E_R - \frac{j}{\mu}E_I\right)\ln\left(e^z + \frac{(1-e^{-s})}{2}\right)\right\}$$

Then $\frac{\partial W_1}{\partial Z} = H\left\{E_R + jE_I + \frac{\mu-1}{2}\left(E_R - \frac{j}{\mu}E_I\right)\frac{e^z}{e^z + \frac{(1-e^{-s})}{2}}\right\}$

Now $$\frac{e^{x+iy}}{e^{x+iy} + \left(\frac{1-e^{-s}}{2}\right)} \cdot \frac{e^{x-iy} + \left(\frac{1-e^{-s}}{2}\right)}{e^{x-iy} + \left(\frac{1-e^{-s}}{2}\right)} = \frac{e^{2x} + \left(\frac{1-e^{-s}}{2}\right)e^x\cos y + j\left(\frac{1-e^{-s}}{2}\right)e^x\sin y}{e^{2x} + (1-e^{-s})\cos y + \left(\frac{1-e^{-s}}{2}\right)^2}$$

So $$\frac{\partial W_1}{\partial Z} = H\left\{E_R + jE_I + \frac{\mu-1}{2}\left(E_R - \frac{j}{\mu}E_I\right)\left(\frac{e^{2x} + \left(\frac{1-e^{-s}}{2}\right)e^x\cos y + j\left(\frac{1-e^{-s}}{2}\right)e^x\sin y}{e^{2x} + (1-e^{-s})\cos y + \left(\frac{1-e^{-s}}{2}\right)^2}\right)\right\}$$

The real part of this solution is the vertical field and the imaginary part is the horizontal field

thus:

$$H_x = \frac{H}{\mu+1}\left\{2\cos\alpha + \frac{(\mu-1)e^x}{e^{2x} + (1-e^{-s})\cos y + \left(\frac{1-e^{-s}}{2}\right)^2}\left(\cos\alpha\left(e^x + \left(\frac{1-e^{-s}}{2}\right)\cos y\right) - \sin\alpha\left(\frac{1-e^{-s}}{2}\right)\sin y\right)\right\}$$

$$H_y = \frac{H}{\mu+1}\left\{2\mu\sin\alpha + \frac{(\mu-1)e^x}{e^{2x} + (1-e^{-s})\cos y + \left(\frac{1-e^{-s}}{2}\right)^2}\left(\cos\alpha\left(\frac{1-e^{-s}}{2}\right)\sin y + \sin\alpha\left(e^x + \left(\frac{1-e^{-s}}{2}\right)\cos y\right)\right)\right\}$$

Calculations

The basin was assumed to be 40 miles wide and 40,000 feet deep at the center. A field of 0.5 gauss inclined 30° tothe vertical was used. Susceptibilities of the granite and sediments were taken from Dr. Soskes determinations.

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The permeablities calculated from these gave a value of 1.012 for the granite and a value of 1.0004. Thus the permeability of the sediments can be assumed to be one, the same as air.

$$\mu + 1 = 1.012 \qquad \delta = 1.2$$

$$\mu - 1 = 0.012 \qquad e^{-\delta} = 0.301$$

$$\cos\alpha = .866 \qquad 1 - e^{-\delta} = 0.70$$

$$\sin\alpha = .500 \qquad H = 0.5 \text{ gauss.}$$

The equations of the x and y components of the field intensities then are:

$$H_x = 0.5\left\{0.8650 + \frac{0.006e^x}{(e^{2x} + 0.70\cos y + 0.12)}\left(0.86(e^x + 0.35\cos y) - 0.175\sin y\right)\right\}$$

$$H_y = 0.5\left\{0.505 + \frac{0.006e^x}{e^{2x} + 0.70\cos y + 0.12}\left(0.50(e^x + 0.35\cos y) + 0.310\sin y\right)\right\}$$

The fiålds are calculated for x = 0 and for a traverse line of definåte slope which approximates the actual field relations with the granite more closely. For such a traverse, one would have for the horizontal and vertical fields measured, contributions from the x and y components given in the formula. That is.

$$Z = H_x\cos\phi + H_y\sin\phi$$

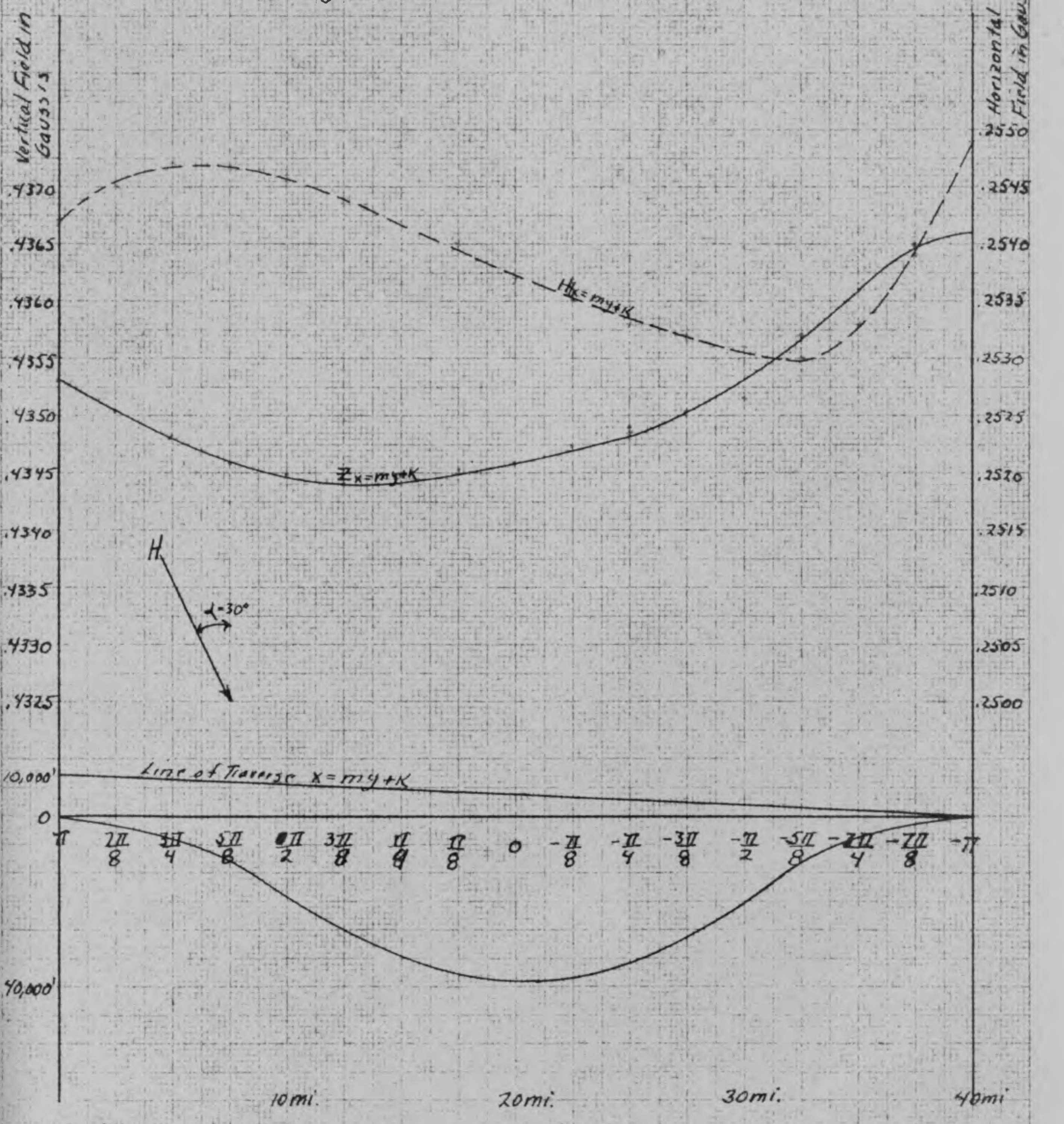
$$H = H_x\sin\phi + H_y\cos\phi$$

where ϕ is the angle that the line of traverse makes with the line x = o

Calculations

y	sin y	cos y	.35 cos y	.31 sin y	.175 sin y	x	e^x	e^{2x}	$e^{2x}+.70\cos y+0.12$	$e^x+.35\cos y$	$\{.8650+\frac{.006e^x}{(\ )}(\ )\}^{.5}$	H_x .4325+	$\{.5050+\frac{.006e^x}{(\ )}(\ )\}^{.5}$	H_y .2580+	
$-\pi$	0	-1	-.35	0	0	0	1	1	.42	.65	$\frac{.006}{.42}(.87\times.65)=.0081$	.0041	$\frac{.006}{.42}(.54\cdot.65)=.00465$	.0049	
$-\frac{7\pi}{8}$	-.38	-.92	-.32	-.118	-.066	.02	1.02	1.04	.52	.70	$\frac{.006\times1.02}{.52}(.87\times.70+.07)=.0080$	.0040	$\frac{.006\times1.02}{.52}(-.118+.35)=.0028$	.0034	
$-\frac{3\pi}{4}$	-.70	-.70	-.25	-.217	-.122	.04	1.04	1.08	.70	.79	$\frac{.006\times1.04}{.70}(.87\times.79+.125)=.0072$	.0036	$\frac{.006\times1.04}{.70}(-.217+.39)=.0035$	.0033	
$-\frac{5\pi}{8}$	-.92	-.38	-.13	-.285	-.161	.06	1.06	1.13	.99	.93	$\frac{.006\times1.06}{.99}(.87\times.93+.161)=.0063$	.0032	$\frac{.006\times1.06}{.99}(-.285+.46)=.0011$	.0030	
$-\frac{\pi}{2}$	-1	0	0	-.31	-.175	.08	1.08	1.17	1.29	1.08	$\frac{.006\times1.08}{1.29}(.87\times1.08+.175)=.0055$	.00265	$\frac{.006\times1.08}{1.29}(-.31+.54)=.0012$	.0031	
$-\frac{3\pi}{8}$	-.92	.38	.13	-.285	-.161	.10	1.11	1.22	1.60	1.24	$\frac{.006\times1.11}{1.60}(.87\times1.24+.161)=.0051$	.00255	$\frac{.006\times1.11}{1.60}(-.285+.62)=.0013$	.0032	
$-\frac{\pi}{4}$	-.70	.70	.25	-.217	-.122	.12	1.13	1.27	1.89	1.38	$\frac{.006\times1.13}{1.89}(.87\times1.38+.122)=.0047$	.00235	$\frac{.006\times1.13}{1.89}(-.217+.68)=.0016$	.0033	
$-\frac{\pi}{8}$	-.38	.92	.32	-.118	-.066	.13	1.14	1.30	2.06	1.46	$\frac{.006\times1.14}{2.06}(.87\times1.46+.07)=.0045$	.00225	$\frac{.006\times1.14}{2.06}(-.118+.73)=.0020$	.0035	
0	0	1	.35	0	0	.15	1.16	1.35	2.17	1.51	$\frac{.006\times1.16}{2.17}(.87\times1.51)=.0042$	.00210	$\frac{.006\times1.16}{2.17}(.75)=.0024$	.0037	
$\frac{\pi}{8}$	.38	.92	.32	.118	.066	.17	1.19	1.40	2.16	1.51	$\frac{.006\times1.19}{2.16}(.87\times1.51-.07)=.0041$	.00205	$\frac{.006\times1.19}{2.16}(.118+.75)=.0030$	.0040	
$\frac{\pi}{4}$	.70	.70	.25	.217	.122	.19	1.21	1.46	2.08	1.46	$\frac{.006\times1.21}{2.08}(.87\times1.46-.122)=.0040$	.00200	$\frac{.006\times1.21}{2.08}(.217+.73)=.0033$	.0042	
$\frac{3\pi}{8}$	.92	.38	.13	.285	.161	.20	1.22	1.49	1.87	1.35	$\frac{.006\times1.22}{1.87}(.87\times1.35-.161)=.0039$	.00195	$\frac{.006\times1.22}{1.87}(.285+.67)=.0038$	.0044	
$\frac{\pi}{2}$	1	0	0	.31	.175	.22	1.25	1.55	1.67	1.25	$\frac{.006\times1.25}{1.67}(.87\times1.25-.175)=.0040$	.00200	$\frac{.006\times1.25}{1.67}(.31+.62)=.0042$	.0046	
$\frac{5\pi}{8}$	-.92	-.38	-.13	.285	.161	.24	1.27	1.62	1.48	1.14	$\frac{.006\times1.27}{1.48}(.87\times1.14-.161)=.0042$	.00210	$\frac{.006\times1.27}{1.48}(.285+.57)=.0044$	.0047	
$\frac{3\pi}{4}$	.70	-.70	-.25	.217	.122	.26	1.29	1.68	1.30	1.04	$\frac{.006\times1.29}{1.30}(.87\times1-.122)=.0047$	.00233	$\frac{.006\times1.29}{1.30}(.217+.52)=.0044$	.0047	
$\frac{7\pi}{8}$	.38	-.92	-.32	.118	.066	.28	1.32	1.75	1.23	1.00	$\frac{.006\times1.32}{1.23}(.87\times1-.07)=.0051$	.00255	$\frac{.006\times1.32}{1.23}(.118+.5)=.0040$	.0045	
π	0	-1	-.35	0	0	.30	1.35	1.82	1.24	1.00	$\frac{.006\times1.35}{1.24}(.87)=.0057$	.00285	$\frac{.006\times1.35}{1.24}(.5)=.0033$	.0042	

Calculated Horizontal and Vertical Components of the Magnetic Field Across a Structural Basin



Discussion of Results

The calculated horizontal and vertical magnetic fields are plotted on the graph andnstructure section together with the shape of the basin that was transformed from the circle. In this case the formula derived were used directly as the angle ϕ is approximatelt 2° so that the contributions of H_x and H_y in the respective cases could be neglected.

From the structure section one sees that the trend of the computed and observed fields are similar from the San Gabriel Mountains to the Inglewood fault. Here the discrepancy in anomalies may be accounted for by the excess granite shown above the theoretical configuration. From the Inglwwood fault to the San Pedro Hills tha anomalies vary 200 and 300 gammas from those calculated. One can then say that the assumptions of the problem for this part of the profile are wrong and consequently the hypothetical structure section here does not give the whole story.

Available seismic data indicates that the material beneath the San Pedro Hills is of lower velocity then granite. Gravity measurements seem to indicate thet the density of the material should approxiamtely 2.71. This limits the material to the metamorphics which have the same density.

One could postulate from these computations that the magnetic field in the Los Angles Basin are determined for the most part by the shape of the underlying granite rather than by some anomalous distribution of magnetite in the sediments. Also the granite in the San Pedro Hills as shown by the hypothetical section is much too thick and should be replaced by a greater thickness of metamorphics or a material of lower permeability and same density as granite.

The field relations and observations are discussed in more detail by Mr. S. Schaffer in his Master's Thesis for 1936.