GEOLOGY OF THE TUJUNGA AREA, SOUTHWESTERN SAN GABRIEL MOUNTAINS, CALIFORNIA

by

R. P. Sharp

1934

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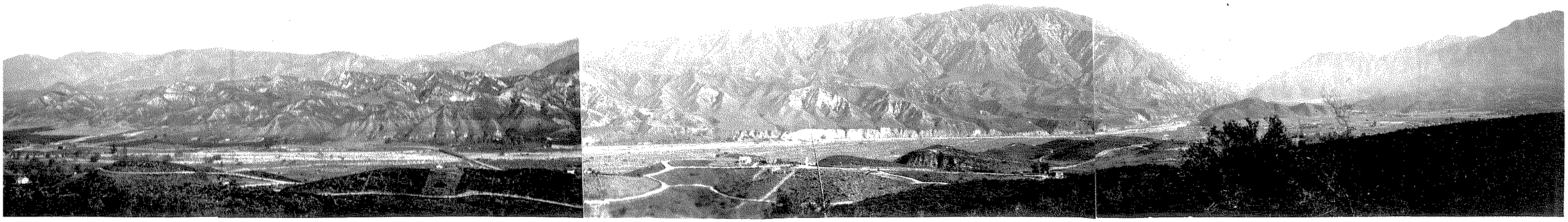


Panorama of Tujunga Area
Tertiary sediments in mid-distance
basement scarp in background
view nearly due north photos by
courtesy of Mr. J. Judson

SUMMARY

The Tujunga area offers a wide variety of rocks, igneous plutonics, lavas, metamorphics, and Tertiary and Quaternary marine and terestrial sediments from middle Miocene up to Recent in age. The entire span of all the rocks of the area ranges quite certainly from Jurassic up to Recent and possibly from Pre-Cambrian(?) up to Recent.

The Tertiary sediments have all been deformed and are folded into a medium large syncline, the Merrick Syncline, with several smaller attendant folds. Faulting has uplifted the underlying basement to the north. The Tertiary sediments abut sharply against this basement scarp.

The faulting of the Tujunga area is of two types, reverse and normal, with the normal faulting being younger than the reverse faulting. This idea differs from the ideas generally held about the Tujunga area and is the most important contribution of this paper. The faulting has all occurred in late Pleistocene or Recent time and evidence of movements are fresh.

Collections and determinations of fossils from the so called Topanga of the Tujunga area have definitely fixed the age of this series of beds as middle Miocene.

INTRODUCTION

LOCATION

The Tujunga area is located on the south flanks of the San Gabriel Mountains in central Los Angeles County, California. This region is shown in the middle southern portion of the San Fernando Quadrangle, U.S.G.S. map, 118°20' longtitude and 34°20' north latitude. More specifically, the area lies between the mouths of the Little Tujunga and Big Tujunga Rivers, northwest of the town of Sunland. Pasadena lies 17 miles to the east, and Los Angeles is located 18 miles to the southeast.

Excellent highways lead to the area from Los Angeles, Pasadena, and San Fernando. The best route is along Foothill Boulevard from either Pasadena or San Fernando. The best route for reaching the region from Los Angeles is via Glendale, Verdugo Canyon, and Foothill Boulevard.

SHAPE AND SIZE

The general shape of the area is that of an irregular rectangle. Approximately six to seven square miles were covered in the work.

CULTURE

The Tujunga area lies along the borders of the metropolitan Los Angeles area. Despite this, it is penetrated by only a few roads and inhabited by a very limited number of people. Most of the roads are not open to the ordinary traveler but are kept under lock and key by the owners of the land. Excellent roads are found in Big Tujunga Canyon, Little Tujunga Canyon, and Kagel Canyon; all of which have greatly facilitated the field work. A few old trails are to be found, but none ~~which~~ are of any particular importance.

The scattered population is found principally on the terraces fronting either on Big Tujunga or Little Tujunga Rivers, or near the heads of the canyons near the north boundary of the area. At the mouth of Kagel Canyon a large group of cabins are huddled in the oak and sycamore trees. This group of habitations forms a small resort.

A few rather meager attempts have been made to exploit the area economically. Agriculture pursuits are carried on upon the terraces, principally truck farming. One oil well has been drilled, apparently without sucess, along the Sunland Fault in the east fork of Sycamore Canyon. Several deserted mining shafts are scattered through the area, both in the sediments and in the basement complex.

Just to the south of the area proper on the alluvium a number of thriving farms of citrus and avocado trees and some flower gardens are to be found. The city of Sunland which lies about a mile south of the area proper is a sleepy little village noted particularly as a health resort.

METHOD OF WORK

The work on this area has been carried on by daily excursions from the city of Pasadena. These trips were made on the week-ends of the months of January to May inclusive during the year 1934.

The mapping has been done entirely on airplane photos obtained from the Fairchild Aerial Surveys of Los Angeles. These photos have made for a greater degree of accuracy in location and plotting of contacts and have on the whole greatly facilitated the field work. The writer has taken the privilege of giving names to many of the smaller unnamed canyons of the area in order to help in the location and description of certain phenomena.

The labatory work and the preparation of this report have been carried out at the California Institute of Technology, Pasadena, Calif.

PURPOSE

The purpose of this work was to fulfill the requirement of a Senior Thesis for graduation from the California Institute of Technology. Particular attention has been paid to stratigraphy and structure.

PREVIOUS WORK

A great deal of work has been done on this area by a number of workers, usually as a part of a much larger area. The work of Mason L. Hill, Structure of the San Gabriel Mountains, north of Los Angeles, California; Univ. of Calif. Pub., Bull. of Dept. of Geology, vol. 19, no. 6, pp 137-170, 1930; deals more intimately with the area than any other published work.

W.S.W. Kew has mapped the area as a small part of a much larger area. His work is published as U.S.G.S. Bull. 753, Geology and Oil Resources of a part of Los Angeles and Ventura Counties California.

W.J. Miller published in 1928 a paper on the "Geomorphology of the southwestern San Gabriel Mountains of California" Univ. of Calif. Pub., Bull. Dept. of Geology, vol 17, pp.193-240. This same author has just published, 1934, a new paper, The Geology of the Western San Gabriel Mountains of California: Pub. of the Univ. of Calif. at L.A. in Math. and Phy. Sc., vol. 1, pp. 1-114.

For a number of years the California Institute of Technology has been conducting field classes in the eastern portion of the area, and detailed reports of this work are on file at the Institute.

ACKNOWLEDGEMENT

I wish to acknowledge the kind assistance of Dr. J.H. Maxson, Instructor in Geology at the California Institute of Technology, under whose direction this work has been carried on. Mr. Popenoe of the Institute has also very kindly collected and classified invertebrate material from this area and has kindly consented to allow the writer to use the results in this report. Mr. Jack Judson has aided with numerous discussions and observations and several photographs.

PHYSICAL CONDITIONS

RELIEF

The Tujunga area exhibits only moderate relief. The elevations of the region vary from about 1,350' up to 3,000'. Moderate, rather broad valleys with rounded ridges and general subdued relief are the general features of the area. The region as a whole may be considered to be in an early stage of maturity, though certain areas along the southern margin are distinctly youthful. Both differential erosion and tectonic deformations have been active in determining the relief of the Tujunga area.

DRAINAGE

The Little and Big Tujunga Rivers are the main systems of drainage of the area. The Big Tujunga plays a more important role than does the Little Tujunga which drains only a limited area on the west portion of the region. The Big Tujunga River follows a southwest course along the eastern boundary of the area until it comes to the southeast corner where it swings sharply west and forms the southern boundary of the Tujunga area. The Little Tujunga River follows a southwest course along the western edge of the area and empties into the Big Tujunga River. Kagel Canyon, the western boundary of the area, and Herrick Canyon drain the extreme western portion of the region. The general pattern of drainage is dendritic.

Both of the Tujunga Rivers are intermittent, in their lower reaches, drying up during the summer months. However, both these streams sometimes become raging torents in the winter. Near their sources the Little Tujunga and Big Tujunga Rivers run moderate streams of water the year round. Many of the smaller side canyons of both these streams have small springs which flow the entire year. Most of these springs are tapped for domestic use.

TOPOGRAPHY

The San Gabriel Mountains as a whole ~~is~~ are a commanding range towering over the San Fernando and Tujunga Valleys to the south. However, the south flank in the vicinity of the Tujunga area is made up of a group of low, rather irregular hills.

In these foothills the Saugus, Pico, and Modelo formations are found. The differences in resistance to erosion of these formations makes for an unevenness of topography. The Pico formation forms a prominent strike ridge from east to west across the area. Behind this strike ridge are located the highly dissected Saugus badlands, while in front, to the south, of this ridge lie the subdued and grassy slopes of the Modelo. Hanging valleys are often formed at the Pico-Modelo contact as shown in figure 3. These little hanging valleys are due to the difference in resistance to erosion of the two formations.

This difference of erosion between the Pico and Saugus Formations gives rise to an interesting bit of topography on the east side of the Little Tujunga River where it cuts through the Saugus Formation. At an earlier stage the Little Tujunga River has cut a broad valley in the Suagus Formation. This valley extended about one half mile

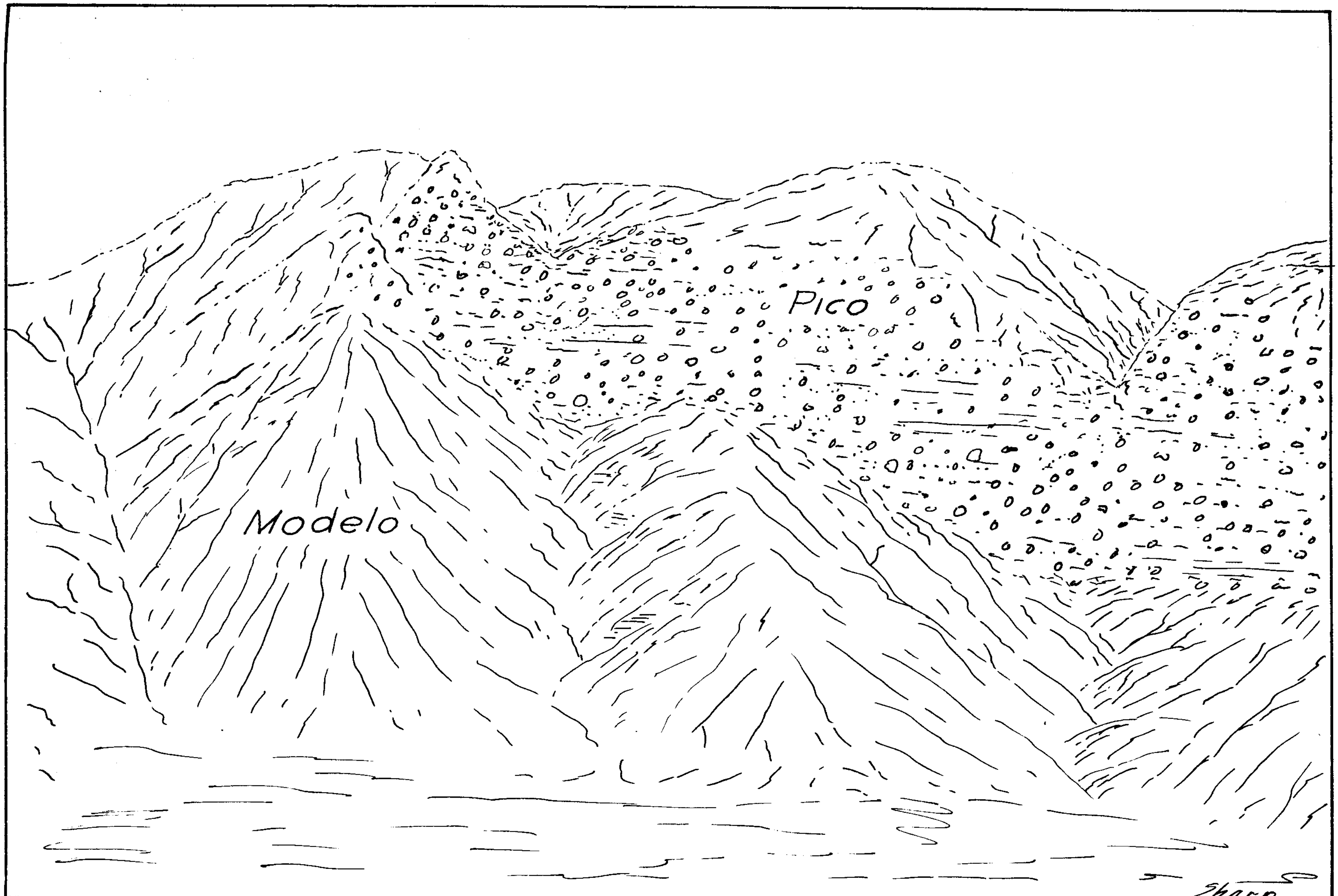


Fig. #3
Hanging Valleys - Modelo-Pico Contact

east of the present course of the river. Although the river has been able to cut a broad valley in the soft Suagus gravels,it has only cut narrow passages in the resistant basement rock to the north and the resistant Pico to the south. Since this broad valley stage uplift has occurred, and the Little Tujunga River has intrenched itself along the western margin of this broad valley, thus isolating the former valley floor as terrace deposits. On traveling up the Little Tujunga Canyon one recieves a rather startling effect in passing from the narrow canyon in the Pico into the broad, terrace flanked valley in the Saugus.

The course of Gold Creek in the northwestern corner of the area also offers an interesting bit of topography. Gold Creek flows east a bit south through Saugus sediments apparently on its way to join the Little Tujunga River. However, when it gets to within about one-third of a mile of the Little Tujunga, instead of flowing on east through the soft Saugus sediments it swings almost at right angles to its former course and cuts off through the hard basement complex. About three-fourths of a mile farther south Gold Creek joins the Little Tujunga River after having cut entirely through the neck of basement complex.

This sudden divergence in the course of Gold Creek is due to the Sunland Fault which has so broken up the rock that erosion has quickly cleaned out the canyon in which Gold Creek now flows. In short, Gold Creek found an easier path through the basement complex along the fault zone than through the Saugus sediments. This canyon is extremely straight and narrow.

VEGETATION

Like most of the hills of Southern California the Tujunga area is covered by brush which at times becomes quite thick and almost impenetrable. The Modelo shales quite commonly support the growth of grass and in the spring time are beautifully covered by wild flowers, lupines, wild onions, and mustard being the most common. The brush of the area is for the most part made up of common sagebrush and grease-wood. Scrub oak and scattered holly, lilac, and manzanita bushes also occur. In the canyons grow oaks and sycamore trees of credible size. As a general rule the vegetation on the north slopes of the ridges is more luxuriant than else-where.

CLIMATE

The climate of the Tujunga area is mild and quite enjoyable during the winter and spring months. However, during the summer the weather becomes hot enough to make field work rather distasteful. The average rainfall is from 16 to 20 inches per year, seldom over the latter figure. During the winter months snow caps the higher peaks of the San Gabriel Mountains. On the whole it may be said that the Tujunga area enjoys a semi-arid climate.

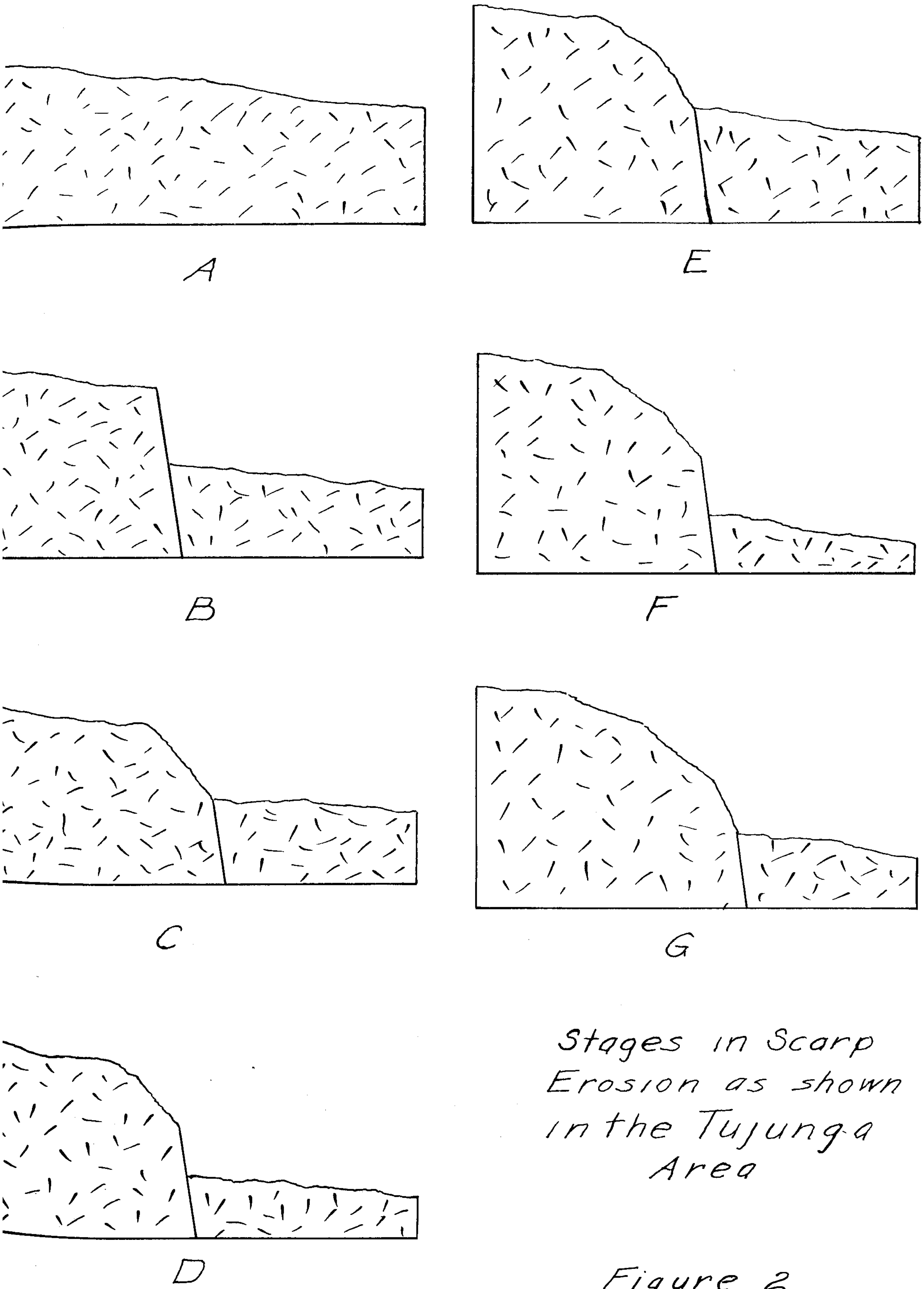
GEOMORPHOLOGY

The geomorphology of the Tujunga region is not particularly outstanding, but some interesting developments in scarp erosion are shown.

Sometime in late Pleistocene time the general Tujunga area was subjected to a more or less moderate deformation with some folding and faulting and general uplift. After this erosion set in and an erosion surface of moderate relief was developed. To the north of the Tujunga area proper there were some rather resistant but low hills of igneous rock. In early Recent or late Pleistocene time there was a recurrence of deformation with faulting and uplift of the igneous mass. This uplift was not a continuous process but passed through at least three epochs with development of eroded scarps as depicted by the following diagrams, figure 2.

Remnants of the old surface are now to be seen on the top of the igneous mass to the north of the area. This surface has moderate relief at present and was apparently never reduced to the state of a peneplain. The more strongly dissected counterpart of this surface is found about 1700' lower on the Tertiary sediments. Moderately broad valley stages had been developed on this surface.

Following the cessation of uplift the Tujunga River cut a series of terraces and deposited stream gravels upon them. This was followed by more or less general uplift of the entire area and the cutting of new terraces. The area was uplifted again and the various terraces were incised with the development of superimposed streams in the underlying Tertiary sediments. Thus we find the area at the present day.



Stages in Scarp Erosion as shown in the Tujunga Area

Figure 2

Foreground, typical Saugus terrain, middle distance, extensive terraces cut in soft Saugus to east of Little Tujunga River. Photo looking northeast.

Three stages of scarp erosion as shown in diagrams of section on Geomorphology. Photo looking east toward Big Tujunga Canyon.

STRATIGRAPHY

SEDIMENTS

1. Topanga Formation (Mid-Miocene)

This formation represents the oldest of the sedimentary units in the area, omitting from consideration the metamorphics in the basement complex. Collections of fossils by Mr. Popenoe and the writer definitely fix the age of the Topanga as middle Miocene. A statement of this determination, furnished through the kindness of Mr. Popenoe, will be found in the petrographic description of the Topanga formation.

No definite figure on the thickness of the Topanga formation can here be given, since the only exposures are those brought up along the Sunland Fault and scattered remnants lying on the basement. A maximum thickness of 750 feet has been found, though this only represents a small part of the true section. The Topanga as brought up along the Sunland Fault is either in a vertical position or overturned to the south.

2. Modelo (Upper Miocene)

The Modelo Formation overlies the Topanga with apparently conformable relationship. The Modelo is upper Miocene in age. This unit has two distinct areas of occurrence in this region. The first is along the south boundary of the area where it occurs in its natural stratigraphic relationship. The second outcrop of the Modelo Formation is along the Sunland Fault where the Modelo underlies the Topanga, the section here having been overturned and thrust up over the Saugus Formation.

The maximum thickness of the Modelo as exposed in this area is 1485 feet, though this does not represent the entire thickness of the section, since some has been cut off along the Tujunga Wash. Except where it has been overturned north of the Sunland Fault, the Modelo Formation generally dips north at angles varying from about 30° up to 45°. The average strike of the formation is westta bit north.

3. Pico Formation (Lower Pliocene)

The Pico Formation overlies the Modelo Formation with apparently conformable relations in this area, though in other regions an unconformity has been reported.[1] The Pico Formation is considered to be lower Pliocene in age[2,3], though the writer has no other evidence for this than stratigraphic relations.

The Pico has in this area a maximum thickness of 1575 feet, thinning to the east to a minimum thickness of 450 feet. The Pico dips north at angles ranging from 35° to 45° with an average strike of west a bit north.

4. Saugus Formation (Upper Pliocene?)

Mason L. Hill[4] considers the Saugus to be upper Pliocene in this area. The Saugus as a whole is

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[1] Kew, W.S.W., Geology and Oil Resources of a part of Los Angeles and Ventura Counties California; U. S. Geol. Survey Bull. 753, p. 70, 1924

[2] Kew, W.S.W., same as above, p. 77

[3] Hill, Mason L., Structure of the San Gabriel Mountains, north of Los Angeles, California; Univ. of Calif. Pub. Bull. Dept.of Geol., vol.19, no. 6. p. 143, 1930

[4] Hill, Mason L., same as above, p. 144

usually considered to be upper Pliocene and Pliestocene[1]. In this particular area there is no way of telling whether the Saugus is Pliocene or Pleistocene; however, the lack of any unconformity between the Pico and the Saugus, as noted elsewhere[2], tends to indicate that here the Saugus may be Pliocene.

In this area the Saugus has a maximum thickness of 2580 feet, though like the Pico it thins to the east to an approximate thickness of 1645 feet. The dips of the Saugus vary widely, being both north and south due to the folding along the Merrick Syncline.

5. Terrace Deposits (Quaternary)

These deposits occur in scattered spots throughout the area and are roughly placed as Quaternary. A good many of these deposits are Recent while some may be Pleistocene. The terrace deposits never occur in thicknesses of greater than 50 feet; many are much thinner.

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[1] Kew, W.S.W., U.S.G.S. Bull. 753, p. 81

[2] Kew W.S.W., U.S.G.S. Bull. 753, p. 82

Columnar Section

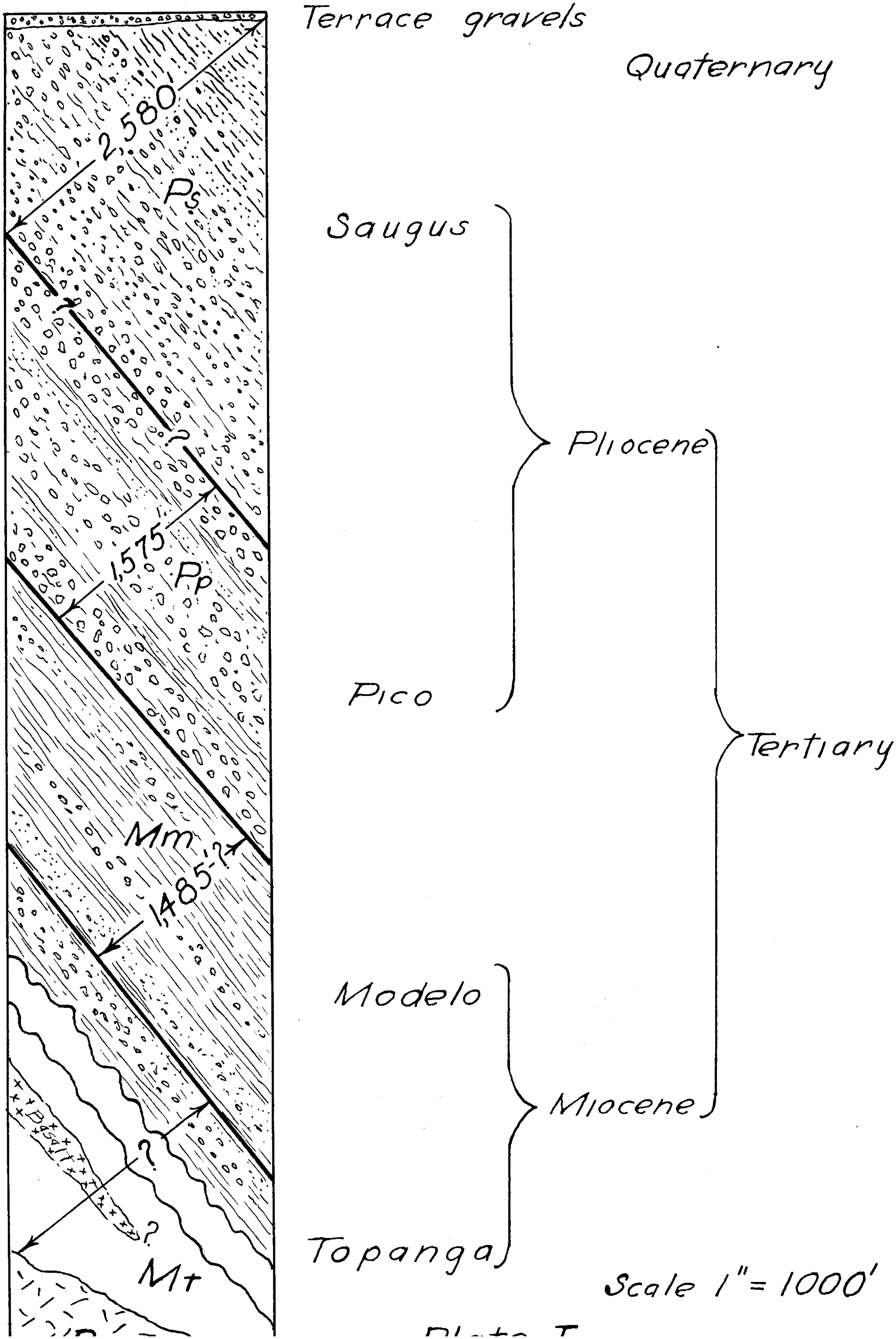

Plate I

IGNEOUS AND METAMORPHICS

1. Basement Complex

The basement complex is made up of a large igneous mass with scattered metamorphic remnants included in the igneous mass. These metamorphic remnants may be Pre-Cambrian[1] and are at least older than Cretaceous, since the igneous mass which includes them is correlated with the Sierra Nevadan intrusion,[2,3] which is supposedly of the Cretaceous Jurassic interval in age. As far as can be told from this area this basement complex is older than middle Miocene.

2. Sunland Basalts (Middle Miocene)

These basalts are placed as middle Miocene in age due to their relation to the middle Miocene Topanga Formation in which they are reported to be interbedded.[4,5] As nearly as can be determined these basalts have a thickness of 200 plus feet.

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[1] Miller, W.J., Anorthosite in Los Angeles County, California: J. of Geol., No. 39, p. 336, 1931.

[2] Miller, W.J., Geomorphology of the Southwestern San Gabriel Mountains of California: U. of Calif. Pub., Dept. of Geol., vol. 17, No. 6, p. 198, 1928.

[3] Kew, W.S.W., Geology and oil Resources of a part of Los Angeles and Ventura Counties, California: U.S.G.S. Bull. 753, p. 10, 1924.

[4] Hill, Mason L., Structure of the San Gabriel Mountains, north of Los Angeles, California: U. of Calif. Pub., Bull. Dept. of Geol., Vol. 19, No. 6, Pl. 15, section A A', 1930.

[5] Judson, J., personal conversation.

PETROGRAPHY

SEDIMENTARY

1. Topanga Formation

The Topanga Formation is the whole a well consolidated sedimentary series varying from conglomerate through sandstone to a poorly bedded, soft, sandy siltstone. Sandstone beds of a thickness of from ½' up to 4' are common, while massive conglomerates are frequently to be found. The sandstones are composed of medium sized grains of quartz and biotite moderately well consolidated. Specimen S 5 is a sample of the typical Topanga Sandstone.

S 5

Degree of consolidation:- moderate, friable in part.

Minerals:- quartz, biotite, kaolin

Size:- fine sand Shape:- sub-angular

Color:- gray to brown

Alteration:- to loose, sandy, silty soil

Cementation:- kaolin and in some places iron oxides

Name:- silty sandstone

The conglomerate varies from a medium gravel,throught a medium conglomerate of well rounded pebbles,up to a coarse conglomerate with cobbles up to six inches in diameter. The pebbles and cobbles are made up for the most part of rather acid igneous rocks. Some pebbles of metamorphic rocks also occur in these conglomerates. The sandstones and conglomerates are often well oxidized to a brown tan color.

The sandy siltstones mentioned above seem to be found more in the vicinity of Little Tujunga Canyon. Both the sandstones and siltstones are abundantly concretionary. These concretions are often filled with numerous lamellibranch and gastropod shells and are quite quartzitic in lithologic character. These concretions have preserved the shells which are inclosed in them, but they in turn owe their existence to the presence of these shells which have furnished the cement for the concretion.

This formation as a whole is prolifically fossiliferous, and many specimens have been collected at various outcrops of the Topanga Formation by Mr. Popenoe and the writer. The following is a statement furnished through the kindness of Mr. Popenoe.

The Topanga Formation is clearly marine and in this particular area seems to have been laid down directly upon the basement. It outcrops in an east-west strip near the north boundary of the area where it has been brought up along the Sunland Fault. Scattered outcrops and remnants of this unit are found farther west in Little Tujunga Canyon.

Topanga sandstone and conglomerate as exposed in ~~Barn~~ Doane Canyon.

Reef beds in Topanga Formation as found in ~~Barn~~ Doane Canyon.

The Topanga Formation is well consolidated and quite resistant to erosion. It generally stands out in bold relief over the softer Modelo which it overlies, the section here being overturned. Reef beds and strike ridges are quite characteristic of the Topanga.

The Topanga Formation weathers to a rocky or silty soil as the case may be. The silty soil often supports the growth of grass while the remainder of the formation is characteristically covered by sagebrush.

2. Modelo Formation

The Modelo Formation is made up principally of thinly bedded, oxidized, gypsiferous mud shales. Numerous variations in the lithology of this formation occur, to be sure. Sandstone lenses and beds are quite common, and about half way up in the section as exposed in this area a series of quite massive sandstone beds occur, aggregating in all about 85 feet in thickness. These sandstones are nearly always quartz mica sandstones, which become conglomeratic on occasions.

Conglomerate lenses are not at all uncommon. These lenses tend to occur in zones of coarser deposition which may have lateral extents of ½ mile along the strike. Most of the lenses are from five to ten feet in thickness and are made up of well rounded boulders and cobbles of predominately granitic compostition. The surrounding matrix of sand is often highly oxidized to a dark brown color.

The shales themselves, which, as mentioned previously, make up the greater part of the section are also quite variant in lithology. Brown, thinly bedded, incompetent mud shales are most common. Diatomaceous paper shales and siliceous, cherty shales are also to be found. The siliceous shales are prominent near the base of the formation as exposed along the southern margin of the area and form an excellent marker bed of about 100 feet in thickness. This series of beds can be traced cross country with ease due to the white color of the rock. All the shales are concretionary in part, but the diatomaceous and cherty shales more so than the mud shales.

The shales are quite incompetent and in numerous outcrops are complexly folded and contorted. The formation as a whole is undoubtedly marine, though the only fossils found by the writer were some fish scales, which are known to be rather common in the Modelo. The mode of deposition was rather subdued, only rarely are ripple marks or such structures found.

The Modelo Formation is not at all resistant to weathering and on the whole is marked by a more subdued topography than the other formations of the area. The shales weather into a fine silty soil which slides and slumps quite easily. Grass grows upon the soil derived from the Modelo, and often times the contacts can be mapped with a fair degree of accuracy by the foliage. In the spring beautiful fields of blue lupine cover the grassy Modelo slopes.

Areally the Modelo Formation occurs at three locations. First, there is a strip running roughly east-west starting

Blue lupines growing on Modelo shales
in early spring.

Coarse conglomerate interbed in Modelo
shales.

at the Tujunga Wash bridge and running west into Little Tujunga Canyon and Kagel Canyon. This strip is approximately 2,500 feet wide. The second outcrop of Modelo is also an east-west strip which has been brought up along the Sunland Fault. It has a maximum thickness of about 700 feet and extends from Big Tujunga Canyon west to within 3/4 of a mile of Little Tujunga Canyon. The third exposure of Modelo shales occurs to the east and south of the Big Tujunga Canyon, just where it leaves its southward course and swings west. This exposure is very irregular since it is covered by terrace and fan deposits for the most part.

To recapitulate briefly, the Modelo Formation is here made up of a series of mud shales with variations ranging from diatomaceous shales and siliceous cherts up to sandstones and conglomerates. The formation is highly gypsiferous, marine, greatly oxidized, and quite incompetent.

3. Pico Formation

The Pico Formation is most characteristically a conglomerate but like the other formations of the area varies quite widely from a conglomerate being frequently a sandstone and often a shale.

The Pico conglomerate is made up of well rounded pebbles, cobbles, and boulders of gneisses, schists, lava, feldsites, granodiorite, quartz, granite, and pegmatite. These boulders, pebbles, and cobbles are cemented by a medium grained quartz sandstone, which is often well oxidized and cemented by iron oxides. Often the pebbles and cobbles carry a thick coating of iron oxide. These conglomerates become much coarser to the east where boulders from one foot up to one and a half feet in diameter are common. The average conglomerate seldom has boulders over six inches to one foot in size. The bedding of the Pico conglomerates is poor and indistinct. Scour channels and cross beds are not common.

The Pico Formation passes into a medium grained quartz sandstone at various intervals throughout the section; sandstone lenses are common in the conglomerates. Often, however, the sandstones occur in thick beds, six to ten feet, which are marked by numerous concretions. These sandstones are well oxidized and often, though not always, are cemented by iron oxides.

Shales are also fairly common in the Pico. Sandy mud shales and siltstones quite well oxidized are rather common. These shales are generally poorly bedded for shales, though near the base of the Pico there is a hundred feet of well bedded mud shales quite similar to the Modelo shales. The fine sandstones and coarse siltstones frequently contain a good deal of clastic biotite.

In the western part of the section the Pico Formation in its upper reaches is a rather fine grained muddy sandstone with quite shaley characteristics. However, on the east the uppermost Pico is a coarse, well cemented conglomerate. This apparent gradation of the sediments from coarser on the east to finer on the west is characteristic of the section as a whole. The Pico is clearly marine in its western extremity. Some marine fossils have been found just to the west of Little Tujunga River by Mason L. Hill[1] The writer has found some small pelecypods in concretions in the Pico as far east as the west side of Oil Canyon, about one-third mile southeast of the southwest corner of Sec. 2, T. 2 N., R. 14 W.; San Fernando Quadrangle, U.S.G.S. map. Farther to the east, the general impression gained is that the Pico passes into a terrestrial mode of deposition. This is shown by the general lithologic character of the formation and seems to hold only for the uppermost part of the Pico section. Mason L. Hill[2] also holds somewhat the same view.

The Pico Formation occupies an east-west strip in this area just to the north of the Modelo Formation which it overlies. Topographically the Pico is represented by bold and frowning cliffs and long strike ridges. It is quite resistant to erosion and stands out in bold relief between the softer Modelo and Saugus which bound it on the south and north respectively.

As a general rule the Pico weathers into a rocky soil which supports the growth of sagebrush.

The high degree of oxidization of the Pico is evidently secondary. The formation as a whole contains more iron compounds and iron containing minerals than the other formations of the area. The oxidization of these materials has occurred since the Pico has been exposed to terrestrial

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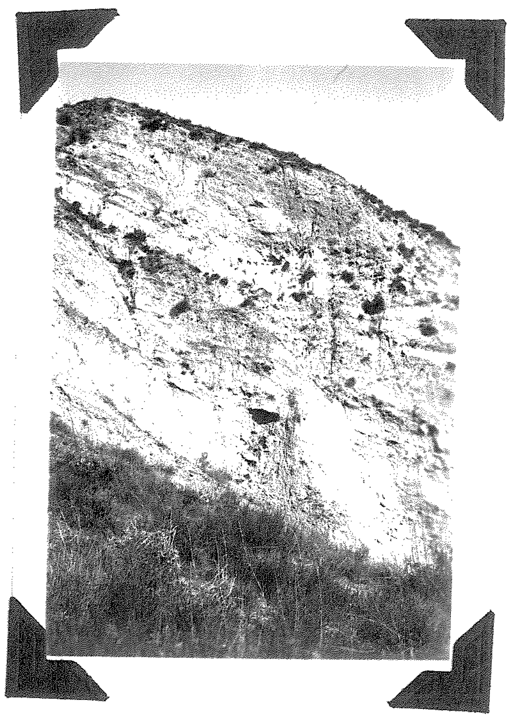
1 Hill, Mason L., Structure of the San Gabriel Mountains, north of Los Angeles, California: U. of Calif. Pub., Bull. Dept. of Geol., vol. 19, no. 6, p. 143, 1930

2 Hill, Mason L., same as above, p. 145

A

B



C

Typical exposures of Pico Formation: A--Big Tujunga Canyon, B--Tujunga Wash, C--Modelo contact north of Tujunga Wash.

conditions.

4. <u>Saugus Formation</u>

The Saugus Formation is most typically a medium grained, white, arkosic, unconsolidated gravel, though it often varies from this general character. The Saugus Formation on a whole shows a more sedate mode of deposition as one goes up in the section. Near the bottom of the formation just above the Pico, the Saugus is predominately a fine conglomerate with an average size of boulders of from ¼'' up to 2'' in diameter, though there are scattered boulders up to 6'' in diameter. These boulders are nearly all made up of acid igneous rocks with a few scattered gneisses and schists. Frequently anorthosite boulders are found and once in a while some lava boulders. The presence of anorthosite is a marked difference from the underlying Pico which never seems to carry anorthosite, at least in this particular region.

Farther up in the section the Saugus passes into its typical character of a medium grained, inconsolidated, arkosic gravel with occasional conglomerate lenses and beds. Even farther up in the section the formation becomes quite sandy, and in places even rather massive, blue, mud clay lenses are not uncommon.

On the whole the Saugus is not oxidized to any great degree, though quite frequent thin beds of pink and brick-red color are to be found. This coloring is evidently due to a degree of oxidation but is confined to thin beds of rather fine material and local extent.

The bedding of the Saugus Formation is poor, though in places, particularly in Little Tujunga Canyon, thick beds up to ten or fifteen feet in thickness are easily recognized. Scour channels and lenses showing a varied and unsettled mode of deposition are common and quite characteristic.

The Saugus Formation is distinctly less resistant to weathering and erosion than the better consolidated and firmly cemented Pico. The weathering and erosion of the Saugus produces typical bad land topography, which is in marked contrast with the bluff, stike ridge topography of the Pico. On the whole the Saugus weathers to a gravelly soil which is most always covered by an abundant growth of sagebrush and greasewood and such varied brush-like types of vegetation.

The Saugus Formation is terrestrial in its mode of deposition in this area and as far as the writer knows is unfossiliferous, though else where the formation is known to be both marine and fossiliferous.[1] Terrestrial deposition is shown in this area by the sub-angularity of the boulders, by the arkosic character of the gravels, by the scour channels and lenses, by the lack of bedding, by absence of fossils, by the general lack of constancy of any one characteristic throughout the entire formation, and

[1] Kew, W.S.W., Geology and Oil resources of a part of Los Angeles and Ventura Counties California: U.S.G.S. Bull., 753, p. 82, 1924

by the lack of any characters common to marine sediments.

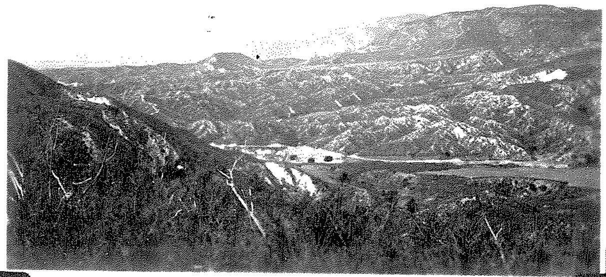
Areally the Saugus occupies a wide, roughly east-west strip in this region, and it is the thickest of all the sedimentary formations of the area as shown on the columnar section.

To recapitulate briefly, the Saugus is an ill-sorted, white, loose, arkosic gravel with numerous conglomerates and sandstones. It is of terrestrial origin and gives rise to characteritic bad land topography.

The writer has at various times experienced some difficulty in distinguishing the contact between the Pico and the Saugus and in view of this has attempted to set up a few diagnostic criteria which may held in separating the two formations. These criteria are, of course, generalized in part and are not to be considered as infallible and are not always apparent.

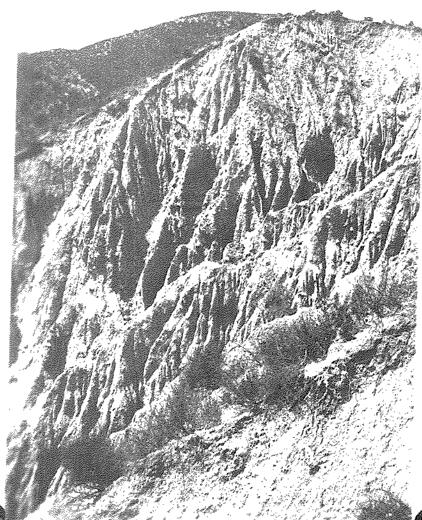
CRITERIA FOR DISTINCTION BETWEEN SAUGUS AND PICO

PICO	SAUGUS
1. Well oxidized, boulders often covered with thick layer of brown oxides, sandstones often very well oxidized.	1. Degree of oxidation slight, no place comparable to that of Pico.
2. Large boulders fairly frequent, 1½' up to 2' in diameter.	2. No boulders as those of Pico, possible maximum of 1', on the whole much smaller.
3. Quite resistant to erosion and weathering, giving rise to to strike ridges and bluffs.	3. Not resistant to weathering and erosion, giving rise to bad land topography.



A

B



C

Saugus Formation

A--Typical Saugus terrain as exposed west of Little Tujunga River. Photo looking west.

B--Saugus bad lands as exposed east of Little Tujunga River.

C-- Saugus conglomerate strongly eroded, east of Little Tujunga River.

PICO	SAUGUS
4. Boulders and pebbles deeply decomposed.	4. Boulders and pebbles generally fresh.
5. Pebbles and boulders on the whole sub-angular to well rounded.	5. Boulders and pebbles all sub-angular.
6. Cementation rather good.	6. Poorly cemented.
7. Never a loose arkosic gravel.	7. Typically a loose arkosic gravel.
8. Never contains anorthosite.	8. Anorthosite common though not over abundant.
9. Thick (100') section of shales.	9. Shales not common and when present not at all constant and lens out quickly.
10. Sandstone with large concretions common.	10. Concretions rare.
11. Occasionally fossiliferous.	11. Never fossiliferous.

5. <u>Terrace and Fan Deposits</u>

These terrace and fan deposits are typical river gravels and fanglomerates. They are made up for the most part of gravels and angular cobbles and boulders. The entire mass is generally ill-sorted and poorly consolidated. Faint horizontal bedding is generally discernible.

There are at least two separate ages of terrace river gravels. Remnants of the older terrace series are found along the front of the south bounding slope of the area between the Big Tujunga bridge and the mouth of Little Tujunga. These deposits also occur in other scattered localities in the area. They are generally made up of large cobbles, and boulders up to 4' in diameter are not rare. The cobbles and boulders are usually of acid igneous rock, though numerous schists and gneisses are also present. Large boulders of anorthosite, 3' in diameter, are found as are also scattered boulders of lava.

The younger terraces are found along the Big and Little Tujunga Rivers and along the walls of some of the larger canyons. These deposits are similar to the older river gravels described above, though they occur at lower levels.

The fan deposits found in the area are also apparently of two ages corresponding roughly to the ages of the two terrace deposits. These fan deposits are made up of typical fanglomerates, though they are often quite rich in soil. In some places the fans seem to grade into the river terraces. This is particularly true east of Big Tujunga River. The later fans seem to be a bit younger than the youngest terraces, since they often occur intrenched in these terraces. All these Quaternary deposits, except the youngest fans, are intrenched by gullies and canyons indicating uplift and rejuvination.

These deposits range in thickness from a few up to fifty feet in thickness. They lie with angular unconformity on the Tertiary sediments of the area.

Older terrace deposits unconformably overlying Modelo sandstone as exposed along south slope of Tujunga area, just north of Tujunga Wash.

Same as above

IGNEOUS

1. Sunland Basalts

The Sunland Basalts are made up of a series of at least two basaltic flows and possibly three. The total aggregate thickness of these flows seesm to be in plus of 200' with no indications of any great interval of time between flows. Much of this unit is made up of a lava braccia with angular boulders of lava. Near the top of the section the basalts become quite vesicular and in places amygdaloidal with amygdules of quartz and calcite.

The formation weathers to a loose brown-red soil often quite clay-like in character. On the whole the basalts are not very resistant to weathering and do not withstand any great deal of transportation. The lavas outcrop in a series of red, black, and brown cliffs along the northern boundary of the area, in the east central portion, just south of the basement complex. They also occur in scattered remnants on ridges in the western portion of the area.

From what can be seen of the basalts in this area, they seems to have been extruded upon the basement complex surface and only rest upon the Topanga as slides, which will be found more fully discussed under the section dealing with land slides. Mason L. Hill[1] apparently thought that these basalts were extruded during Topanga time, middle

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[1]Hill, Mason L., Structure of the San Gabriel Mountains, North of Los Angeles, California: U. of Calif. Pub. Bull. Dept. of Geol., vo. 19, no. 6, Geologic Section A A'.

Cliffs of Sunland Basalt as exposed in West Olive Canyon. Photo looking north.

Miocene, and that these basalts are interbedded in the Topanga. Mr. J. Judson[1] has told me that the basalts in the Verdugo Hills occur interbedded in the Topanga Formation though they do, at least in part, lie also on the basement. There is no direct evidence of such interbedding of the basalts in the Topanga as exposed in this area. However, it seems quite certain that the basalts are middle Miocene in age and have been extruded in part upon the middle Miocene surface of the basement complex.

The source of these basalts has in all probability been of a fissure type, though there is no direct evidence to justify this conclusion. The writer has taken the privilege of calling these the Sunland Basalts for this particular discussion. Olive Canyon near the east boundary of the area, Sec. 1, T. 2 N., R. 14 W.; San Fernando Quadrangle map, offers a good type locality for this unit.

2. Basement Complex

The basement complex is made up mostly of igneous rocks with remnants of gneisses and schists. These metamorphic remnants are rather few and scattered in this area. They seem originally to have been sediments, though they are now so greatly metamorphosed as to almost

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[1] Judson, J., personal conversation.

defy identification. It seems quite plausible to correlate these metamorphics with the other metamorphic rocks found in the San Gabriel Mountains, which are considered to be possibly Pre-Cambrian[1].

The igneous mass is correlated with the Sierra Nevadan intrusion of Jura-Cretaceous time. In this particular region there is no evidence for making the igneous rock anything other than pre-middle Miocene. Several writers[2,3] consider the igneous mass to be of the Sierra Nevadan interval, and the writer sees no good reason for not accepting this idea.

The facts, however, seem to point to two different periods of intrusion. The first was one of coarse grained rock, which is now deeply weathered. Specimen S 6 is a sample of this rock, and the following is a determination and description resulting from both megascopic and microscopic studies.

I. Hand Specimen:-
   1. Texture:- Coarse(medium) phaneric, equigranular, rather sub-euhedral
   2. Major Minerals:- Plagioclase, quartz, orthoclase, biotite, hornblende
   3. Minor Minerals:- Titanite
   4. Alteration:- Kaolin

II. Thin Section

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[1] Miller, W.J., Anorthosite in Los Angeles County, California: J. of Geol., No. 39, p 336, 1931.

[2] Miller, W.J., Geomorphology of the Southwestern San Gabriel Mountains of California: U. of Calif. Pub., Dept. of Geol., Vol. 17, No. 6, p. 198, 1928.

[3] Kew, W.S.W., Geology and Oil Resources of a part of Los Angeles and Ventura Counties California: U.S.G.S. Bull. 753, p. 10, 1924.

1. Mineral Composition
   (a) Essential:- Quartz, orthoclase, andesine
   (b) Varietal:- Biotite, hornblende
   (c) Accessory:- Apatite, titanite, magnetite
   (d) Alteration Products:- Sericite on andesine, chlorite on biotite, kaolin on feldspars

2. Amounts
   Quartz--20%, orthoclase--20%, andesine--43%, biotite--5%, hornblende--10%, accessory--2%

3. Texture
   Coarse phaneric, hypautomorphic

4. Name

   Biotite Hornblende Granodiorite

The second intrusion was of a moderately fine grained rock of which S 4 is a sample.

I. Hand Specimen
   1. Texture:- Fine medium phaneric, equigranular
   2. Major Minerals:- Quartz, plagioclase, biotite, orthoclase
   3. Minor Minerals:- Magnetite
   4. Alteration:- Chlorite, epidote

II. Thin Section
   1. Mineral Composition
      (a) Essential:- Quartz, oligoclase, orthoclase
      (b) Varietal:- Biotite
      (c) Accessory:- Magnetite, apatite, zircon
      (d) Alteration Products:- Chlorite on biotite, sericite on oligoclase

   2. Amounts
      Quartz--20%, orthoclase--35%, oligoclase--38%, biotite--5%, accessory--2%

   3. Texture
      Fine medium phaneric, hypautomorphic granular

   4. Name
      Biotite Quartz Monzonite

There is a great deal of positive untwinned feldspar in this rock which might be albite, thus making the rock an albitized quartz monzonite. However, such features as a variable optic angle, perthitic texture, apparent unalbitized condition of other orthoclase and plagioclase crystals in the rock, and other minor features suggest that this may be some of the positive orthoclase, which is now worrying students of igneous petrography.

Numerous aplites and a few pegmatites have been found but no melanocratic dikes. The later fine grained intrusions stand out prominently against the older, more deeply weathered igneous mass.

The basement complex occupies a large area to the north of the area proper as described in this report. It has been brought up along the Sierra Madre Fault system. The igneous mass weathers into a loose gravelly soil which supports the growth of scrub sagebrush.

GEOLOGIC STRUCTURE

CONTACTS

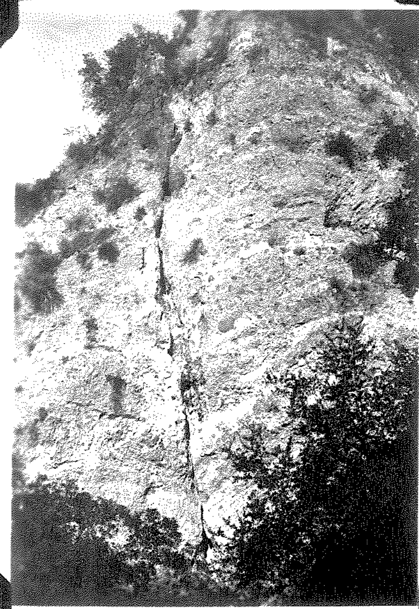
(a) Topanga-Modelo Contact

The Topanga-Modelo contact is a gradational, depositional contact. The succession is from conglomerates in the middle Miocene Topanga Formation, through sandstones into shales in the upper Miocene Modelo. One of the best criteria for the determination of this contact is found in the coarser character of the upper Topanga Formation as compared with the Modelo shales, and by the fact that this upper Topanga is often concretionary; frequently these concretions are fossiliferous.

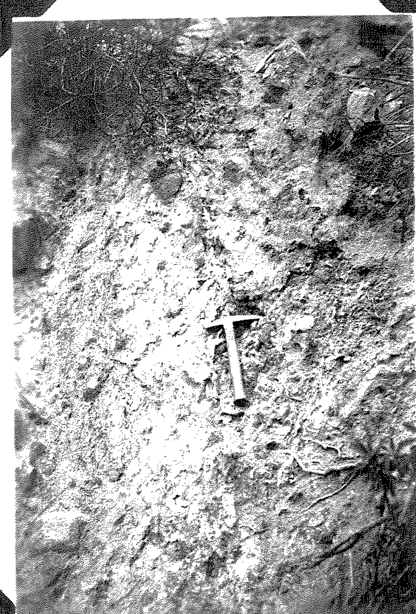
This contact is very steep, being often nearly vertical or overturned slightly so as to dip north at high angles. The contact strikes, on the average, about north 70 degrees west.

(b) Modelo-Pico Contact

This contact also seems to be a conformable, in places gradational, depositional contact. The writer found some localities where the upper Miocene Modelo passed into the lower Pliocene Pico quite abruptly but with no apparent erosional break. The usual contacting sediments seemed to be a silty shale for the Modelo and a coarse marine conglomerate for the Pico. At other localities there seemed to be a greater gradation in the contact, with numerous interbeds and lenses of conglomerate interpolated in the Modelo shales. This is particularly true just north of the Tujunga Wash bridge, where the contact is determined with



Small fault displacing Modelo-Pico contact as exposed in Pico cliff. Photo looking north.



Brecciated zone of small fault displacing Modelo-Pico contact.

a good deal of difficulty. On the whole this contact dips rather shallowly, 30 to 35 degrees, north and strikes about north 70 degrees west.

(c) Pico- Saugus Contact

This contact, as far as known to the writer, is a conformable one in the Tujunga area. The gradation from a marine to a terrestrial mode of deposition apparently took place without any break in sedimentation.

The contact between these two formations is hard to plot accurately on the basis of lithology; but on the overall work the topography is a great help, since there is usually a noticeable break between the resistant Pico and the soft, easily eroded Saugus. A few criteria for the determination of the contact will be found in the section dealing with the petrography of the Saugus Formation.

The Pico-Saugus contact dips approximately 40 degrees north and strikes roughly north 70 degrees west.

(d) Terrace-Tertiary Contacts

The terrace deposits of the Tujunga area lie with angular unconformity over the underlying Tertiary sediments. These Quaternary deposits lie in a horizontal position on the planed off edges of the upturned beds of the older sediments.

(e) Sunland Basalt-Basement Complex Contact

The lava has been extruded out onto the rather uneven middle Miocene erosion surface of the basement complex.

Along the north boundary of the lava the igneous mass has been lifted above the lavas by normal faulting.

(f) Fault Contacts

The Modelo Formation is brought into juxtaposition with the Saugus Formation by uplift along the Sunland Fault, a steeply dipping reverse fault which strikes roughly north 60 degrees west and dips as much as 80 degrees north.

In places the Topanga Formation is brought into contact with the Basement Complex. This is accomplished by normal faulting in the east part of the Tujunga area, but by reverse faulting in the west part near the Little Tujunga River.

The Saugus Formation is also treated in somewhat a similar manner, being brought into contact with the basement by normal faulting in the east and by reverse faulting in the west. The same is true of the Topanga and Saugus Formations, which are brought into juxtaposition by reverse faulting in some places and by normal faulting in other places.

(g) Other Contacts

At times both the Saugus and the Topanga Formations lie directly in depositional contact upon the basement. This is particularly true of the Saugus which overlaps to the north in the vicinity of Little Tujunga Canyon.

FOLDING

The Merrick Syncline is the major fold of the area. This structural feature involves the Tertiary sediments lying along the south flanks of the San Gabriel Mountains and extends in a north 70 degrees west direction across almost the entire Tujunga area. This syncline has been cut off along the north limb by the Sunland Fault, and only Saugus sediments are exposed on this limb of the fold. On the south limb, Saugus, Pico, and Modelo sediments are exposed.

The axis of this structure lies entirely within the Saugus sediments and in places is covered by Quaternary sediments(Terrace deposits), thus definitely fixing the time of folding sometime between the end of the Saugus deposition(early Pleistocene?) and the deposition of the terraces(late Pleistocene or Recent). As far as the writer could determine, this syncline exhibits no constant plunge of any great dimension.

The north limb of this fold is more sharply folded and in places overturned, though the writer is convinced that this overturning is due to dragging along the Sunland Fault. That the entire structure is not a phenomenon due to drag is shown by its size and distance from the large faults, and by its trend, which, although similar to the general trend of faulting, does not follow the large configurations in the faults in Little Tujunga Canyon. The steepness of dip on the north limb compared with that on the south limb bespeaks a force from the north.

A structure, of the magnitude of the Merrick Syncline, implies some sort of adjustment in the underlying basement complex. Just what this adjustment may have been is a matter of conjecture. Mason L. Hill[1] offers one possible explanation in his paper.

Several smaller folds are also found in the Tertiary sediments. Two of these smaller folds are found in the Modelo Formation at the mouth of Kagel Canyon. Here a small syncline and a small anticline, both trending approximately north 80 degrees west and plunging about 35 degrees west, are found. In a small canyon to the east of Kagel Canyon the character of the syncline is clearly shown by a conglomerate interbed in the Modelo.

Mason L. Hill[2] shows these folds as involving the Pico-Modelo contact and, due to subsequent erosion, producing a configuration of that contact. Such a structure as shown on Mr. Hill's map increases the thickness of the Pico Formation by nearly 1,000 feet. Mr. Hill has thus included in the Pico Formation a large section of shales, in places cherty which is characteristic of the Miocene. The writer sees no reason for including these apparently Modelo shales in the Pico Formation. A large conglomerate interbed, which has been nearly doubled in thickness by the folding mentioned above has been the cause of this apparent error on Mr. Hill's part. However, Mr. Kew[3] also shows a similar displacement of the contact, but he attributes it

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[1] Hill, Mason L., Structure of the San Gabriel Mountains, North of Los Angeles, California: U. of Calif. Pub., Bull. of Dept. of Geol., Vol. 19, No. 6, pp. 158-159, 1930.

[2] Hill, Mason L., same as above, Geologic Map.

[3] Kew, W.S.W., U.S.G.S. Bull. 753, Geologic Map.

~~it~~ to faulting. The writer hesitates to abandon the ideas of these two men because of the very limited time which was at his disposal to study this particular problem. Studies of the contacts and sections farther west might give additional data which would held solve the problem. However, let it be said that from what the writer has seen at this locality; he feels that a correct interpretation of this problem has not been given, and that the Pico-Modelo contact has not been displaced as shown in the works of the two men mentioned above.

A small, very shallow anticline and syncline are found to the west of Little Tujunga Canyon a bit to the south of the mouth of Gold Canyon. Both of these folds plunge northwest at about 24 degrees.

All of the above folds seem to be more or less contemporaneous and similar in character, thus it appears to be a fairly safe assumption that they were caused by the same deformation.

Numerous other localized minor folds occur in the area particularly along faults. Some of the Topanga sediments just to the east of the Little Tujunga River are severely dragged up by the Sunland Fault. The Modelo Formation to the east of Big Tujunga Canyon is severely deformed and complexly folded, a rather common characteristic of the Modelo shales.

In brief, the folding of the Tujunga area is simple and apparently due, for the most part, to a single deformation. The Merrick Syncline and minor attendant folds are the results of this deformation.

SLIDING

Landslides are a rather common phenomena in the Tujunga area and in several places play an important part in the interpretation of the structure. The Modelo Formation is more liable to landsliding than the other formations of the area. This is due, chiefly, to the muddy, silty soil which is derived from the Modelo shales, and which, when soaked with water, slumps and slides quite easily. The slides in the Modelo Formation are probably as much slumping phenomena as sliding phenomena. Numerous small slumps and slides of very recent origin are to be seen at the present day on the Modelo slopes. As a general rule these slides give rise to a bench or terrace topography frequently backed by a cirque-like amphitheatre. Sliding also occurs sparsely in the other units of the area, principally the lavas where the sliding plays a very important role.

Just to the north and a bit east of the Tujunga Wash bridge, one of the oldest slides of the area is to be found. This slide has occurred in a small canyon which crossed the Modelo-Pico contact. The softer underlying Modelo has evidently been cut away to such an extent that finally a large part of the Pico cliff broke away and slid down the canyon carrying a good deal of shale with it. This mass of fractured, intermixed shales and conglomerates came to rest in the canyon and remnants of this mass are to be found there at the present day. This slide complicated the mapping of the Modelo-Pico contact and proved a troublesome problem until the sliding was recognized.

A somewhat similar, though younger, slide involving the Modelo-Saugus contact along the Sunland Fault occurs in the first canyon to the east of Olive Canyon. This slide has carried a good deal of the overlying Modelo and Topanga Formations down onto the Saugus gravels.

A smaller slide involving the Saugus-Modelo contact along the Sunland Fault has occurred on the west slope of Olive Canyon. Here, the slide has been almost directly along the contact instead of across it as in the two preceeding cases.

Possibly the most important slides of all are those involving the Sunland Basalts. On the ridge just to the east of Barn Canyon a mass of lava overlies the Modelo and Topanga Formations. This mass of lava is finely ground up and in places intimately mixed with Modelo shale giving a reddish-brown clay-like mass. Mason L. Hill[1] postulates a fault to the east of ~~Barn~~ Doane Canyon to explain this anomalous situation. If the fault hypothesis were correct the plane of the fault would have to be nearly horizontal, something not found anyplace in the area.

The fault hypothesis seems to the writer to be quite impossible. Mr. Hill's map shows an anomalous situation. He has the lava mass bounded by a fault on the east side, but on the west side it overlies the Modelo Formation in a regular contact. The lava never contacts the Modelo in natural

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[1]Hill, Mason L., Structure of the San Gabriel Mountains, North of Los Angeles, California: U. of Calif. Pub., Bull. Dept. of Geol., Geologic Map, 1930.

contact. The Modelo is upper Miocene, and the lava is no younger than middle Miocene. The lava mass lies almost horizontally over the ends of the steeply dipping Topanga and Modelo beds. The beds have apparently been planed off to some extent by the sliding mass.

On the east slope of Olive Canyon occurs another lava slide of much smaller dimensions than the one just discussed. This small slide has carried a mass of lava down onto the surface of the Topanga conglomerates. This mass is finely fractured, and numerous cobbles and pebbles of the underlying conglomerate are intimately intermixed with the lava.

In brief, sliding of recent date has played an important role in the Tujunga area, not only topographically but also structurally.

FAULTING

The faulting of the west San Gabriel Mountains has been for a number of years a question invoking a great deal of discussion and difference of opinion.

W.J. Miller[1] states that the "larger faults of the San Gabriel Mountains are, so far as known to the writer, of the normal type. The fault surfaces dip at high angles, seldom if ever less than 60 degrees and often nearly 90 degrees". Kew[2] also shows normal faulting in this area. Mason L. Hill[3] claims, however, that reverse faulting is the predominate structure of the southwestern portion of the San Gabriel Mountains.

From the work which has been done in the Tujunga area the writer has come to the conclusion that both normal and reverse faulting have played a very active part in uplifting the range. Normal faulting seems to predominate more toward the east while reverse faulting becomes paramount toward the west. The normal faulting of the Tujunga area is younger than the reverse faulting.

Sunland Fault

The Sunland Fault is the representative of reverse faulting in the Tujunga area. This is the southernmost

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[1] Miller, W.J., Geomorphology of the Southwestern San Gabriel Mountains of California; U. of Calif. Pub., Dept. of Geol., Vol. 17, No. 6, p. 203, 1928.

[2] Kew, W.S.W., Geology and Oil Resources of a part of Los Angeles and Ventura Counties California: U.S.G.S. Bull. 753, cross-section M M', 1924.

[3] Hill, Mason L., Structure of the San Gabriel Mountains, North of Los Angeles, California: U. of Calif. Pub., Bull. Dept. of Geol., Vol. 19, No. 6, p. 140, 1930

of the major faults of the region and for the most part lies in the Tertiary sedimenta. Mason L. Hill[1] has apparently named the fault from the town of Sunland and gives a short description of it in his paper.

The Sunland Fault takes an approximate east-west course across the central portion of the Tujunga area from a small canyon just west of Big Tujunga Canyon, where it is terminated by a small cross fault, to Little Tujunga Canyon, where it curves and swings up the canyon, determines the course of Gold Creek, and then apparently dies out in the Saugus sediments to the north.

From its eastern termination until it starts to curve into Little Tujunga Canyon, the Sunland Fault has brought into contact the Pliocene Saugus and the Miocene Modelo or Topanga. The fault has cut off the north limb of the Merrick Syncline and entirely cut out the Pico Formation. Where the fault starts to curve into the Little Tujunga Canyon, the contacting bodies are either Saugus and basement or Topanga and basement. As the fault goes farther up the canyon the Saugus Formation and the basement become the contacting bodies.

The Sunland Fault shows a variety of dips along its exposures, in the eastern and central parts of the area northward dips of about 80 degrees plus being common, while farther west dips as low as 45 degrees are seen. In Little Tujunga Canyon the Sunland Fault is fairly steep and

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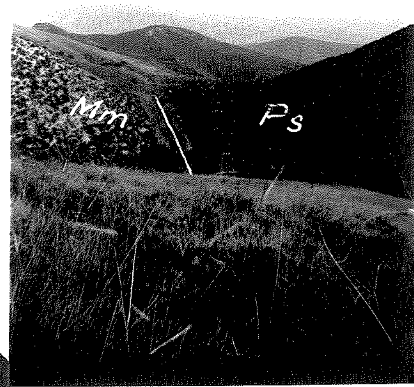
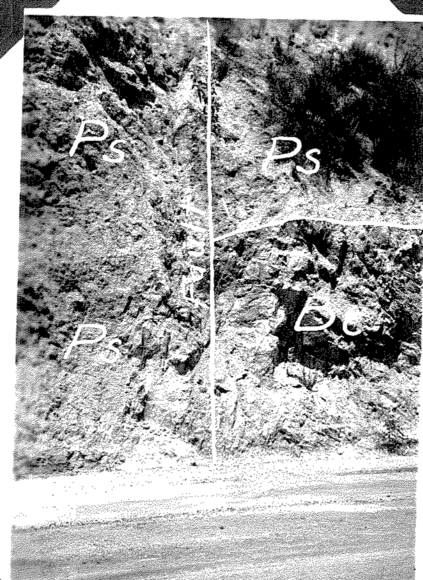
[1] Hill, Mason L., Structure of the San Gabriel Mountains, North of Los Angeles, California: U. of Calif. Pub., Bull. of Dept. of Geol., Vol. 19, No. 6, pp. 150-151, 1930.



Small fault gap on Sunland Fault east
of East Oil Canyon. Mm--Modelo
Ps--Saugus



Exposure on road cut west of Little
Tujunga River. Saugus(Ps) lying with
depositional contact on Basement Complex
(Bc) brought into contact by fault with
Saugus. Block to right has gone up.

shows dips ranging from 70 to 80 degrees, always in such a manner that the fault is reverse. This wide variety of dips brings home once again the fact that a fault can not be conceived of as a simple plane of fracture, but on the contrary must be considered as a zone of fracturing. Such a wide variance in dips is probably due to differences of material involved in the fracturing and upon the difference in trend of the contact which would give rise to varying components of force.

The Sunland Fault is predominately of the reverse dip-slip type with a minimum dip-slip component of 2500 feet plus. The fact that there has not been any great strike slip component is shown by the general trend of the fault, and by the lack of any evidence supporting such a movement.

In places, the Saugus sediments are strongly dragged and at times even overturned. Breccia along the fault zone is not very great and is in no place clearly shown. As a general rule, the Sunland Fault exhibits outstanding topographic expression wherever the basement is one of the contacting bodies. This topographic expression is due, at least in part to erosion of the softer sediments lying to the south of the fault. Where the Sunland Fault cuts through the sediments, it is marked by a number of small fault gaps and such attendant features.

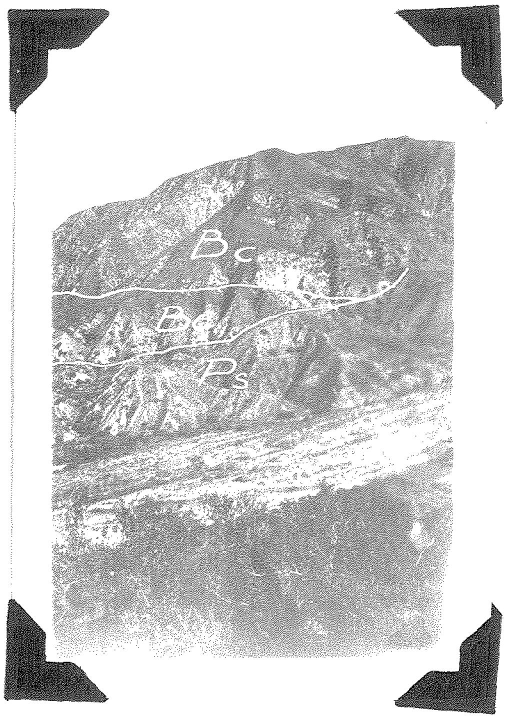
Doane Fault

The Doane Fault is one of the major normal faults to be found in the area. This fault has uplifted the basement to the north and is clearly shown by the contact between the Sunland Basalts, which have been cut off and abut~~s~~ abruptly against the uplifted block of basement.

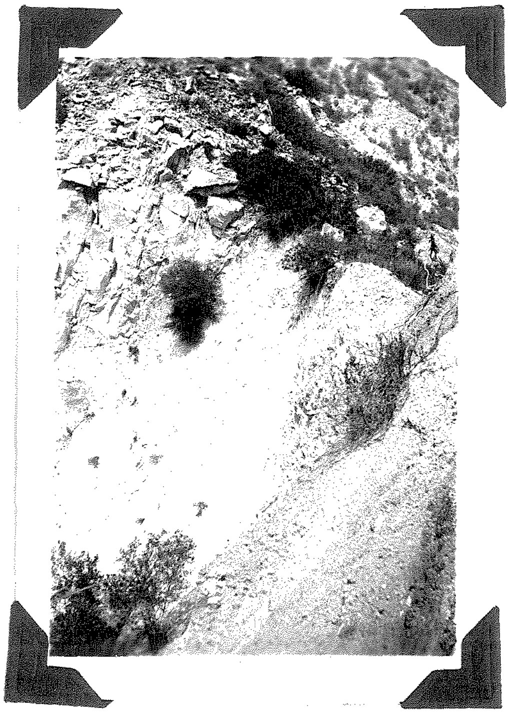
The fact that this contact is a fault contact and not a flow contact as mapped in all previous published works, is shown by the abruptness and sharpness of contact between the basement and the lava, by the fact that there are absolutely no inclusions of the basement in the lava at the contact as would be expected in the case of a flow contact, by termination of some overlying Quaternary deposits, and most decisively by a lava remnant found on a ridge to the north of the Doane Fault. This single lava remnant clearly fixes the structure as one of faulting and precludes the possibility of a flow contact.

The Doane Fault comes down the west side of Big Tujunga Canyon and then curves and follows an east-west course across the north central part of the Tujunga area. The fault dies out to the west before reaching Little Tujunga Canyon. In Big Tujunga Canyon the Doane Fault brings the basement up above the Saugus, while through the central portion of the area, the basement has been raised up above the Sunland Basalts.

The Doane Fault takes its name from Doane Canyon, a prominent topographic feature in the eastern portion of the Tujunga area. The fault itself is particularly well exposed in Olive and Doane Canyons. In this locality the fault plane dips about 70 degrees south. The Doane Fault is a normal dip-slip fault, no evidence of a stike-slip component being found. An approximate minimum figure for the dip-slip component would be 1000 feet plus.



Normal faulting as shown north of Tujunga Wash, Basement Complex(Bc) lifted above Saugus sediments(Ps). Photo looking north.



Zone of brecciation on normal fault in igneous block. As exposed on ridge east of West Olive Canyon.

Olive Fault

The Olive Fault is another normal fault, which runs south of and parallel to the Doane Fault. The Olive Fault takes its name from Olive Canyon, where the fault is clearly exposed near the point of junction between the east and west branchs of Olive Canyon. This fault joins the Doane Fault where the latter swings up into Big Tujunga Canyon. These two faults are apparently contemporaneous or nearly so.

To the east of Olive Canyon the Olive Fault brings the basement up above the Saugus sediments; as the fault continues west, however, the contact is between Topanga and basement. The Olive Fault is responsible for the small window of basement exposed in a small tributary canyon to the west of Olive Canyon. This fault curves a bit northward before reaching Doane Canyon and apparently dies out. Some Quaternary deposits complicate the relations at this locality in such a manner that the fault can not be accurately traced.

This fault is a steeply dipping normal fault with a predominance of dip-slip displacement. It is impossible to give any figure as to the magnitude of this dip-slip component, but it seems that the displacement may have been in the neighborhood of 1000 feet (?).

Other Faults

Other smaller faults are to be found in the Tujunga area. For the most part these small faults are at variance with the other major structural trends of the region. Not all of these small faults are of the same age; some are older than the reverse faulting, and some are dated between the normal and reverse faulting.

In the southern portion of the area these small cross faults have displaced the Modelo-Pico contact in several places. In the north portion of the area these faults have greatly complicated the structure. This is particularly true to the west of Herbert Canyon. Here the situation is further complicated by a layer of rough fanglomerates which covers the fault between the Topanga and Saugus Formations. The Sunland Fault also has a small subsidiary fault at this locality, which adds to the complication.

The igneous mass to the north of the Doane Fault is cut by a number of faults of which the predominate type seems to be normal. These faults are entirely within the basement and are very difficult to trace. However, zones of breccia and some topographic expression are of aid in locating them. The writer has not worked the region north of the Doane Fault and has only located one of these faults provisionally.

Tujunga Fault(?)

From what the writer knows of the stratigraphy to the south of the Tujunga area, it seems probable that a fault, now buried, runs up the Tujunga Wash and cuts under the Alluvium just to the north of the town of Sunland. Mason L. Hill also has noted the possibility of such a fault and discussed it briefly in his paper.[1]

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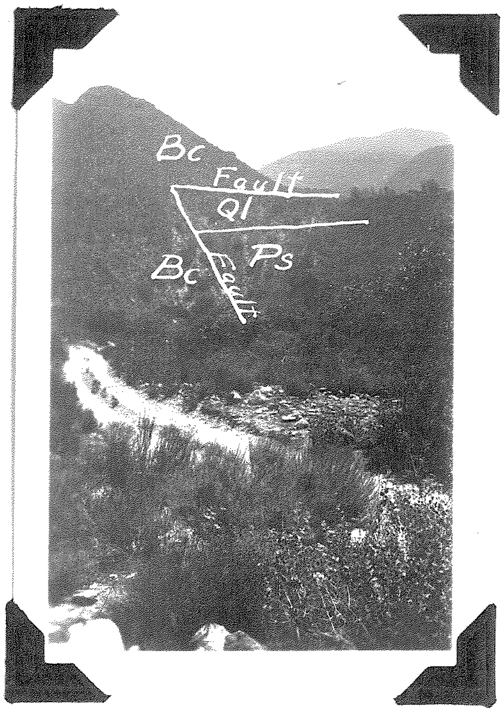
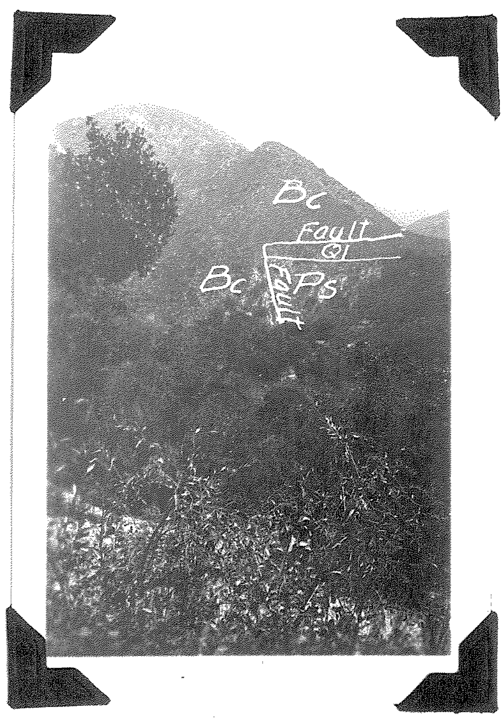
[1]Hill, Mason L., Structure of the San Gabriel Mountains, North of Los Angeles, California: U. of Calif. Pub., Dept. of Geol., Vol. 19, No. 6, p 153, 1930.



Small normal cross fault between Saugus (Ps) and basement (Bc) cut off by Sunland Fault near mouth of Gold Creek. Photo looking east.



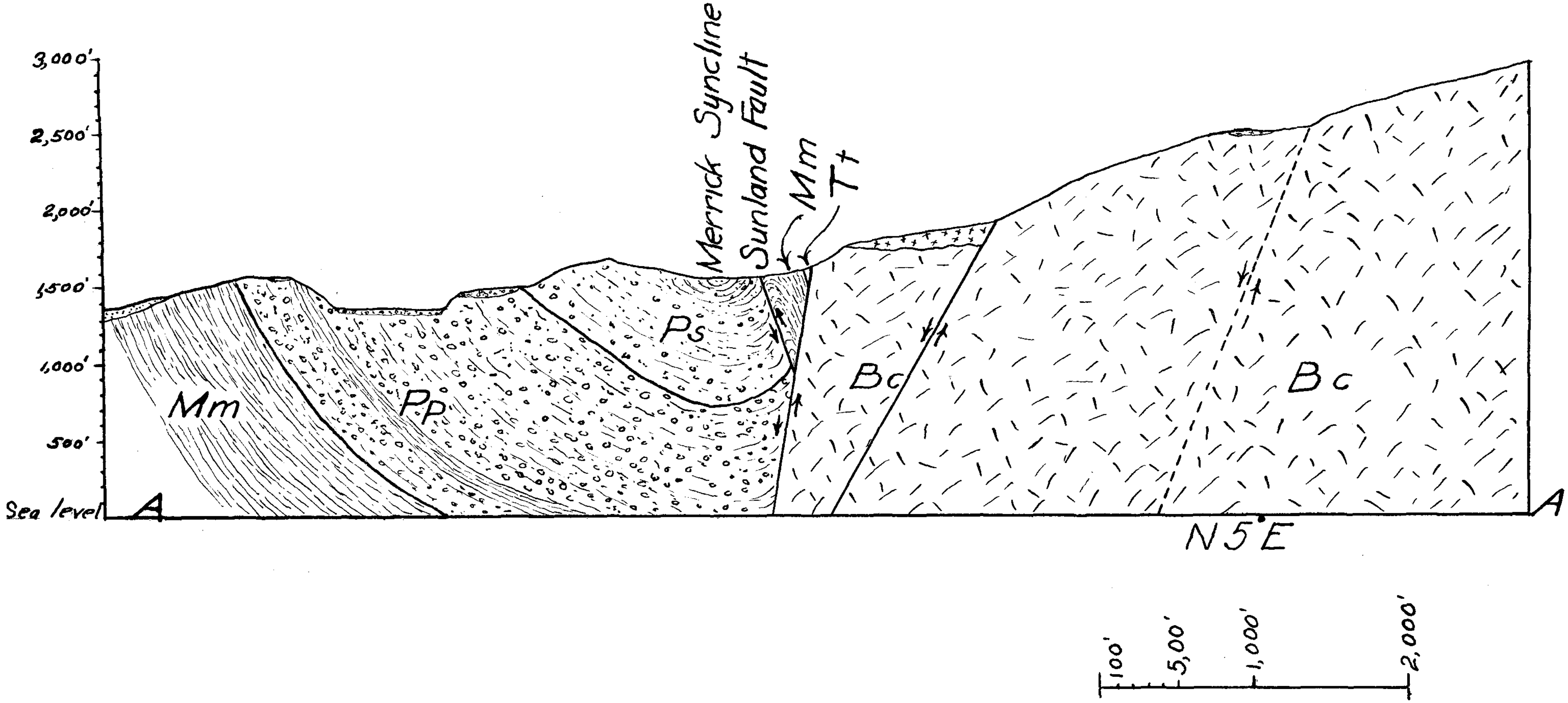
Same as above at slightly different angle.

FORCES

The forces of the two periods of deformation which have acted upon the Tujunga area since Tertiary time have been, first, compressive and, second, tensional. The probable reason for a predominance of faulting over folding is, as Mr. Hill[1] suggests, because of the underlying rigid basement rock.

The compressive force came from the north and was responsible for the Merrick Syncline and the Sunland Fault. The second deformation gave rise to the normal faulting. Both of these periods of deformation are reflected locally in the Tujunga area, but undoubtedly the deformations as a whole were much larger and effected a good deal of Southern California. The first deformation might be correlated with the period of thrusting of the Santa Susana and San Cayetano faults. The second period of deformation is probably correlative to the normal faulting noted throughout the San Gabriel Range.

Minor shearing stresses have been set up at least at two different periods, but that major shearing forces have not played a part in the Tujunga area is shown by the lack of large shearing structures. The Merrick Syncline shows no tendancy toward an _en enchelon_ arrangement and coupled with the Sunland Fault is a typical compresional structure. None of the major faults have a recognizable strike-slip component. The above facts indicate that shearing stresses have not been prominent in the Tujunga area in later geologic time.

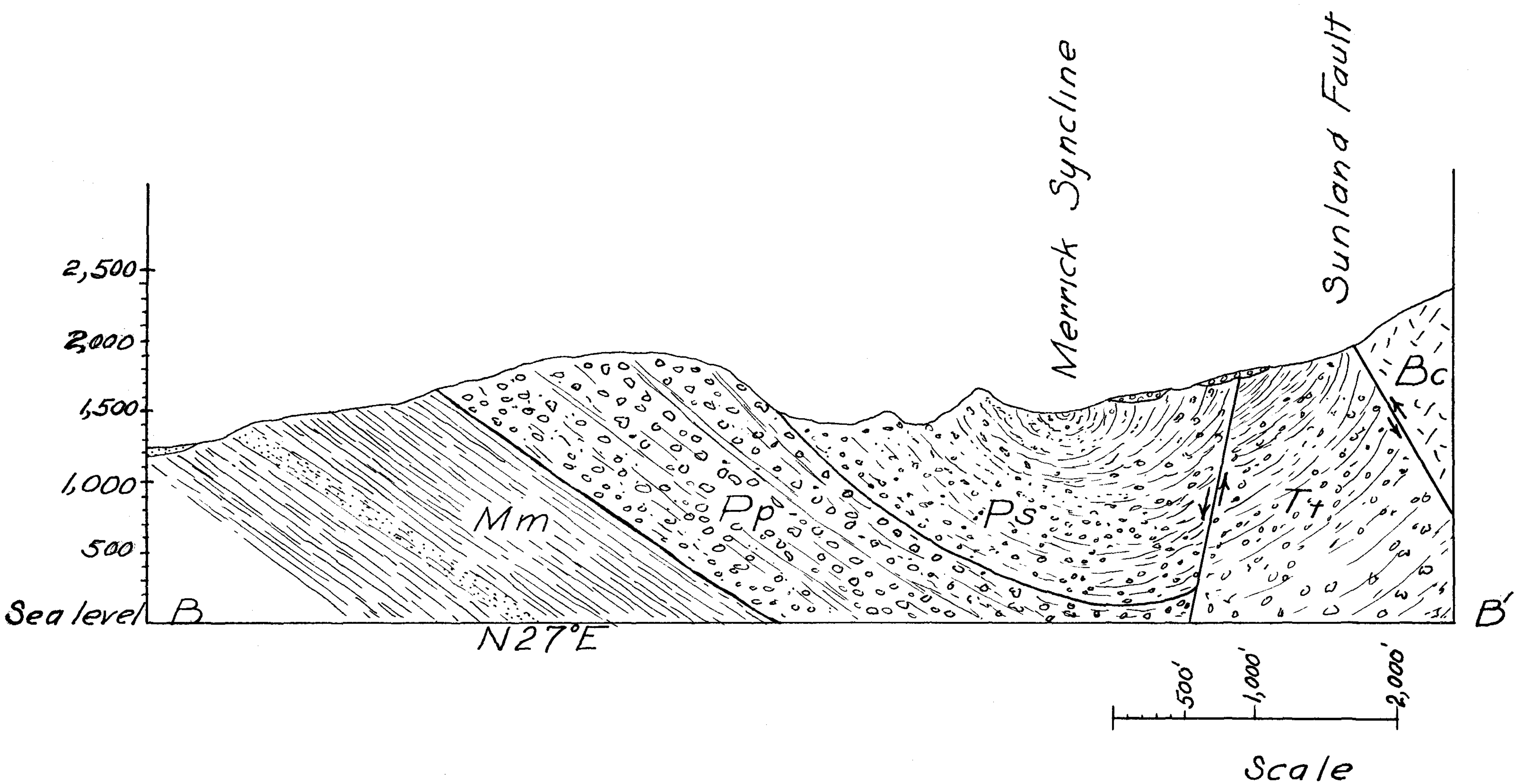


Scale
1 inch = 1,000'

Cross-Section Tujunga Area

Senior Thesis, R.P. Sharp

Plate II



Cross-Section Tujunga Area

Senior Thesis, R.P. Sharp

Plate III

HISTORICAL GEOLOGY

In Pre-Cambrian times(?) a thick series of sediments, probably marine, was laid down in the Tujunga area. But from Pre-Cambrian time up to the Jura-Cretaceous interval, there is no indication of activity in this area with the exception of some deformations which served to metamorphose the Pre-Cambrian sediments. The area may have been undergoing erosion during this time; or, perhaps, sedimentation was carried on during at least a part of this time, record of this sedimentation having been removed by subsequent erosion.

In the Jurassic-Cretaceous interval a large batholith was intruded into these metamorphics with a good deal of stoping, deformation, and further metamorphism. From this time up until the middle Miocene, erosion was active, and the region was reduced to one of moderate relief.

Upon this surface the Sunland Basalts were extruded in a series of at least two and possibly three flows. This was followed by a general down warping of the area and invasion by the sea with deposition of the Topanga Formation with its prolific fauna of marine invertebrates. The sea remained in this general area from middle Miocene time up to and including lower Pliocene time. The mode of deposition became more sedate in upper Miocene time, and the Modelo shales were laid down.

However, between Pliocene and Miocene time a general rejuvination of surrounding areas was reflected in the coarse character of the Pico Formation, which was laid down by the sea during lower Pliocene time. By middle Pliocene the sea had started to retire from the area, and a short time after this the terrestrial Saugus Formation was being deposited.

It is interesting to note that during lower Pliocene and middle Pliocene time the site of the present Big Tujunga Canyon was marked by a re-entrant along the margin of the area of deposition. In upper Pliocene the Little Tujunga Canyon was apparently marked by a somewhat similar feature.

The deposition of the Saugus Formation may have extended a bit into the Pleistocene. Then apparently the entire region suffered a general upwarping with subsequent erosion. Sometime later, still in the Pleistocene, the area was subjected to a deformation which developed the Merrick Syncline and apparently gave birth to a number of small cross faults, which seem to be principally of the shear type. Next, reverse faulting along the Sunland Fault was produced by a deformation similar to the deformation which produced the Merrick Syncline, quite possibly a later phase of the same deformation. This faulting cut off the north limb of the Merrick Syncline and thrust the Modelo and Topanga Formations over the Saugus, overturning the section at certain localities as shown on cross-section A A'. This faulting entirely blocked out the Pico section exposed on the north limb of the Merrick Syncline.

A period of quiet followed with attendant erosion. However, in late Pleistocene or early Recent times this region was again subjected to severe deformation with uplift of the igneous block along normal faults. This faulting took place in at least three separate periods with short periods of quiescence in between each epoch of faulting.

Various erosive agencies were busily at work during this time carving out a great deal of the present topography. The Big and Little Tujunga Rivers were busy cutting stream beds and depositing stream gravels. Sometime, apparently after the cessation of faulting the entire area suffered an upwarping, and the various streams of the region were rejuvenated. These rejuvenated streams cut through their deposited gravels and down into the bed rock, thus isolating their former beds, which remained as terraces. This was followed by more erosion and the carving of new stream channels, then uplift and isolation of a second group of terraces.

At the present day the earlier terraces have nearly all been striped off by erosion, and only remnants of them are to be found here and there. At present the younger terraces are being dissected. The entire region seems to be enjoying a period of quite, erosion is actively at work reducing the topography of the area to a more subdued condition. Numerous slides have occurred in fairly late geologic time with the development of the peculiar topography characteristic of slides.