# GEOLOGY OF THE EASTERN PART OF THE SAN JOSE HILLS, SOUTHERN CALIFORNIA

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# GEOLOGY OF THE EASTERN PART OF THE SAN JOSE HILLS, SOUTHERN CALIFORNIA

## INTRODUCTION

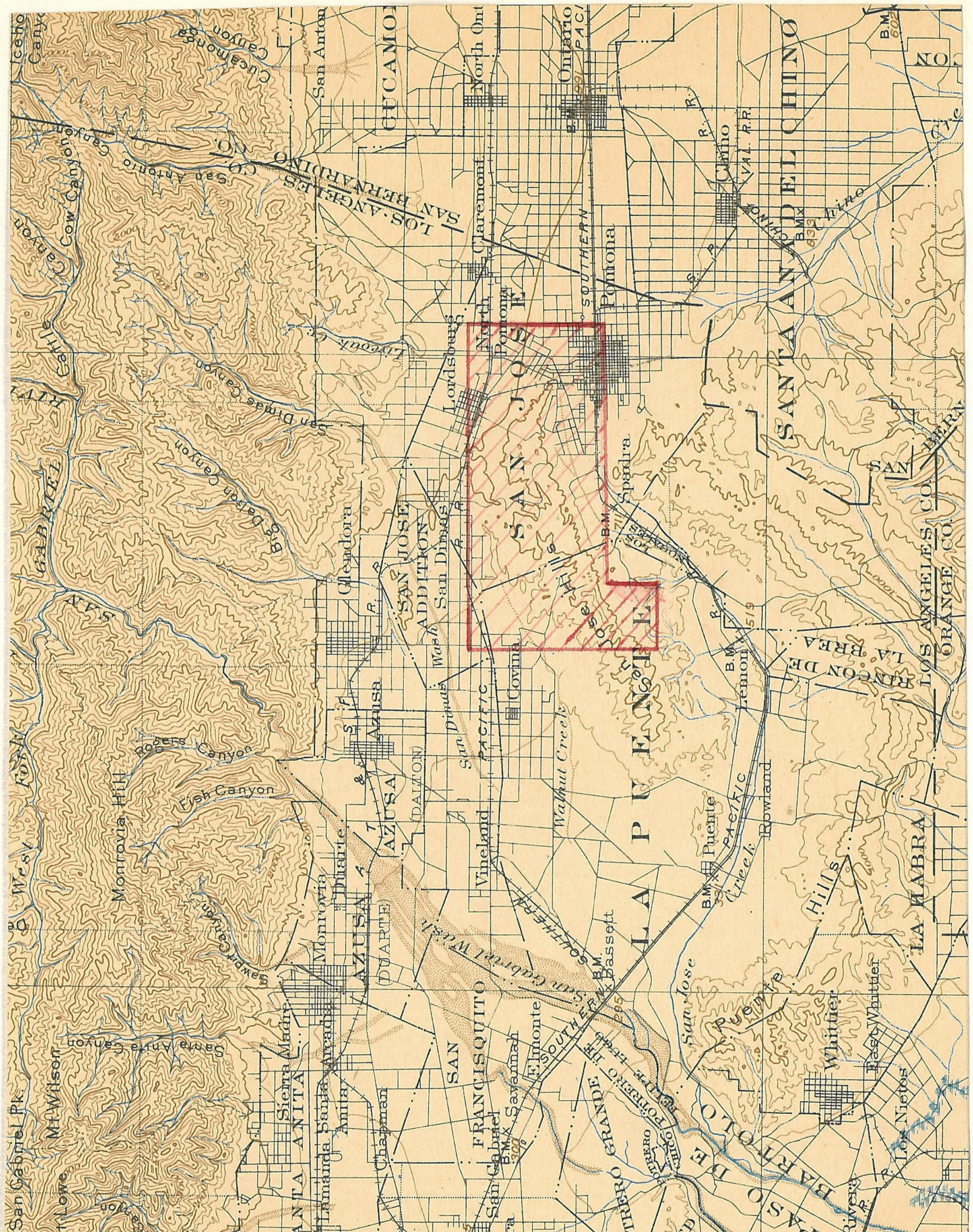
### AREA COVERED

The area described in this report occupies an irregular block comprising approximately thirteen square miles, the center of which is about 22 miles south east of the center of the city of Pasadena (see Fig.1). The hills which make up this area are known as the San Jose Hills. They extend from Puente on the south west to Pomona on the north east. The area covered extends from Ganesha Park in Pomona to a point slightly south east of the town of Covina. This area can be found on the Covina and Claremont Quadrangles as surveyed by the Los Angeles County.

### PURPOSE AND SCOPE OF EXAMINATION

A study of this district was undertaken as a thesis problem, a requirement for the degree of Bachelor of Science at the California Institute of Technology, Pasadena, California.

The problem was mainly a study of field relations and the related structure. Since the main object of this study was to become better acquainted with field work and field methods detailed mapping was carried on.




Index Map of a part of Los Angeles County

Shaded Area Discussed in this Report

Fig. 1

## METHODS OF FIELD WORK

As a base for recording field observations excellent Los Angeles County topographic maps, with a scale of an inch to every 2000 feet, were used. Locations for plotting geological data were determined by the intersection of Brunton compass sights taken to prominent topographic or cultural features. Due to the accuracy of the base maps, locations could in many places be made by simply noting the topography. This method of field work, tho less accurate than determinations of location and altitude with a plane table, permits fairly rapid work, and the geologists attention can be concentrated on problems of geology rather than of surveying.

## ACKNOWLEDGMENTS

The writer is indebted to K. E. Lohman for his assistance in determining the stratigraphic relations of certain diatomaceous shale beds.

## GEOGRAPHY

### Topography

Inasmuch as the character of most of the topographic features of this region can be seen by an examination of the topographic maps, the following description is confined to features not evident on the map.

The area as a whole can hardly be classed as more than hilly. The shale beds which characterize a large part of the hills are subject to much erosion and have become quite rounded and sloping. The most rugged territory is in the conglomerate beds in the vicinity of Buzzard Peak, where, especially on the south side, erosion has developed the typical bold, desert topography. The volcanics, of course, developed sharp features. However, in no part of the area is the relief very great. The highest point in the area, Buzzard Peak (1,380 feet), is about 700 feet above the nearest part of the valley, which gives a measure of the maximum relief of the hills. Every part of the hills can be reached on foot without hard climbing, and generally an automobile can be driven within a short distance of any point a vistor desires to reach.

Natural Vegetation

As a result of the semiarid climate this region has only a sparse growth of natural vegetation. What vegetation there is varies with the nature of the soil. The shale supports an abundant growth of short grass, mustard and wild flowers, in the spring. The rainless summers, however, change the vegetation to brown by the middle of June. The conglomerate and sandstone beds are covered by a small drought-resisting sage plant. The hardy cactus is very abundant in the volcanics and requires the hiker to be especially careful in choosing his path.

Culture

A small part of this area is under cultivation. Some of the fertile rolling hills are annually sowed with grain. The short heavy grass offers excellent pastorage for horses and cattle. There are several ranches in this area which use these grazing lands for their cattle and horses. In addition to this, large numbers of sheep have been recently introduced.

## PREVIOUS PUBLICATIONS

Walter A. English published in 1926 in Bulletin 768 of the United States Geological Survey "Geology and Oil Resources of the Puente Hills Region, Southern California". This report covers the entire San Jose Hills as well as the Puente Hills to the south. In addition to English's report Dr. Woodford and his class of senior geologists from Pomona College annually cover this portion of the San Jose Hills but as yet no report of this work has been published.

# GEOLOGY

## STRATIGRAPHY

### GENERAL CHARACTER OF FORMATIONS

The eastern portion of the San Jose Hills contains rather numerous mappable units. There is a small amount of Triassic slate; a considerable amount of basaltic extrusions part of which is older than the lowest sedimentary beds and part younger than the highest sedimentary beds; a small portion of tuffaceous sandstone; and a considerable thickness of sediments. The sediments while separated into several divisions are all considered a part of one paleontologic formation, the Puente. The Puente thus far has proven to be unfossiliferous so the exact position in the standard time scale is not known. English in his bulletin* has placed the Puente as middle and upper Miocene. He bases this "on the position of the Puente between the middle Miocene Topanga and the Pliocene Fernando and on such correlations as may be made on the basis of lithological character".# Since English has covered this area and can correlate and compare this

*English, U.S.G.S. Bul. 768, Geology and Oil Resources of the Puente Hills Region, Southern California.

#English, U.S.G.S. Bul. 768, p.39.

formation with better and more complete sections in the Puente Hills, his determinations will be used when comparing these beds with the standard time scale.

TRIASSIC SLATE AND GRANITE

The eastern end of the San Jose Hills are made up of a complex of metamorphic and partly metamorphosed sediments, together with granitic intrusives. English correlates these with some Triassic slates found in the Santa Ana Mountains. It is made up of a series of dark-grey slates with interbedded brown sandstone. The slates exhibit varying degrees of metamorphism. They usually have a well developed cleavage which, however, is not sufficiently perfect to obscure the original bedding planes.

In Ganesh Park, where several of the road cuts reach a depth of ten feet below the surface, there are good exposures of granite. Even this depth is not sufficient to expose any but a much weathered phase of granite, with the feldspars mostly decomposed. The rock is coarsely crystaline and locally shows a shistose tendency. English thinks that the granite might be older than the granitic intrusives in the Triassic slate of the Santa Ana Mountains and more closely allied to the granite present in the San Gabriel Range, which some beleive to be possibly Pre-Cambrian.

PUENTE FORMATION (MIDDLE AND UPPER MIOCENE)

General Characters

The sedimentary series is comprised of one formation, the Puente. Because of its great areal extent and the fact that it was probably the original source of the oil in the rich Puente Hills and Santa Fe Springs regions this formation is of importance. The name was given by Eldridge* and is derived from the Puente Hills, over which a greater part of the formation outcrops. A lithologically similar formation of approximately the same age found to the west, in Ventura and western Los Angeles counties, is called the Modelo formation.

The Puente formation crops out over the whole of the San Jose Hills with the exception of the extreme eastern portion where are found the extrusives and the small outcrop of Triassic slate and granite. Over most of the area the outcrops are fairly good, especially in the sandstone phases; however there are very few places where the sandstone is hard enough to form rugged outcrops. The shale outcrops are subject to considerable slumping and surface creep. These surface slumps render many of the dips observed on small outcrops so unreliable that a great percentage of such dips must be disregarded.

The Puente formation consists of an alternating succession of coarse and fine grained beds. The material from

*Eldridge, G.H., Arnold, Ralph, The Puente Hills oil district, southern California: U.S.G. S. Bull. 309. p103, 1907.

which they are composed is of all degrees of coarseness, ranging from boulders to clay and siliceous mud. The clay, tho made up mostly of clastic materials, consists in part of skeletons of diatoms. The sand, which is abundant, ranges from well-rounded and sorted quartz grains to angular and subangular grains of quartz and feldspar.

English in his report on the Puente Hills region divides the Puente formation into three parts, the lower shale, the middle sandstone and the upper member. The upper division he recognizes in the pòrtion of the San Jose Hills covered in this report. He did this by comparing this section with a more complete section in the Puente Hills.

From the evidence seen in the field there are only two major divisions present in this area: a sandstone and conglomerate member (middle sandstone), and a shale member (upper member). The sandstone and conglomerate member is the oldest sedimentary deposit in this area, it is overlain conformably by the higher shale member. In this report the shale has been divided into three parts, the shale proper which is predominating and into two conglomerate and sandstone zone. These sandstone zones appear to be interbedded with the shale but are large enough to be mapped as a separate unit.

Middle Sandstone

The massive conglomerate that forms Buzzard Peak has been mapped as middle sandstone because of its position beneath the upper member. It is very different lithologically from the upper shale. The conglomerate as exposed has a thickness of about 2500 feet. The total thickness must be greater as the conglomerate is cut off on the south by a fault. Perhaps a third of this thickness is coarse, poorly sorted sandstone. The rest is conglomerate, containing angular boulders of granite and schistose rocks. The conglomerate boulders vary from a half inch to eight inches in diameter. The average, however, is around two and one half inches. There are found in this conglomerate a few shale boulders, the predominating rock, however, is a subangular quartzite. Some of the boulders are rounded, but nearly all the finer material is angular and very poorly sorted.

On the south side of the fault which blocks out this conglomerate member there is a rather striking feature. This has been mapped, but the relations to the main mass are not very clear. This conglomerate is practically the same as the conglomerate to the north, there are shale boulders in both and in both the predominating boulder is a subangular quartzite cobble and pebble. The difference lies in the member on the south being much more consolidated; so much so that it stands out as a reef running almost east-west. This reef is at least 50 or 75 feet thick and more probably a 100 feet. It runs along the south side of the valley and in some places near the top of the ridge. Above this reef in at least one place vear the top of the ridge is another hard member. This apparently is a shale that is very well consolidated. It is very fine grained but the shaly texture is not very noticeable. This cannot be clearly explained as the field relations are not readily seen. It would appear, however, that it is a drag effect. When the main mass was raised this was dragged up with it. This explanation is based on the fact that the conglomerate in this small portion seems to dip to the south while the main mass dips toward the north. Because of some local effect either before faulting or as a result of the faulting this small zone became better cemented than the rest and stands out as a mappable unit.

The structural relations of the conglomerate are puzzling. It appears to be conformable beneath the overlying shale, yet it is absent at a only a slight distance to the east where the shale rests on a volcanic formation, and a few miles to the west the record of the Shell Company's Sentous well shows the conglomerate to be absent from that area, shale resting directly on volcanic rocks. It would seem that this is either a dome or an anticline that has been cut off on the south by a fault. It is more probable that this is a dome since this phenomona is not observed at any other place. The evidence upholding this theory is based on the change of attitude within the conglomerate member. On the west the strike is north-east, on the north it as almost east-west and on the east side the strike is north-west, indicating that the center of the dome has been cut off by the fault. Apparently then this is a dome that has been cut off on the south by fault. The shale was probably deposited before the doming took place. It may be that the smaller conglomerate member mentioned above is related to this phenomonon.

Upper Member

The beds mapped as the upper member of the Puente include a succession of alternating shale, sandstone, and conglomerate beds. The total thickness of this member as exposed in this area has an estimated thickness of 4800 feet, 4000 of which is shale, 300 feet is conglomerate and 500 feet of sandstone and conglomerate. The sandstone and conglomerate zones are interbedded in the predominating shale.

This upper member apparently rests conformably upon the middle sandstone member. The contact between these two members is gradational. A section thru the contact gives the unconsoledated conglomerate on the bottom followed by a small band of consoledated conglom rate, the pebbles of which are smaller than in the underlying conglomerate. Following this there is a massive sandstone member about 25 feet thick. This grades from a coarse sandstone on the bottom to a fine sandstone on top. Overlying this is a small zone of sandy shale and finally the shale proper. At one point a section was measured thru this contact. Here there were alternating sandstone and shale beds resting upon the conglomerate and under the shale.

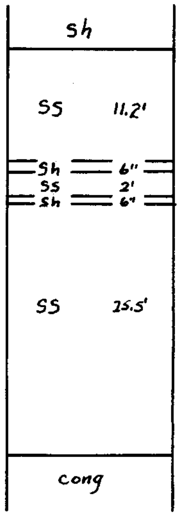



Fig. 2.

This exposure showed a buff colored, subangular sandstone. The sandstone is not uniform, in places it is compsed of fine grained sand and in other places there are many large pebbles of sandstone averaging about 3 to 5 mm. in diameter. These two bands alternate with each other, the thickness of each being about 6 inches. Near the top of the member there are several sandy shale beds interbedded with the sandstone. These beds are about 6 inches thick. There is one distinct bed of 6 inches and two more of one half inch each. At the top there are indications of more shale before the shale proper is reached. On the other side of the canon, but below the section described there is a 4 foot bed of very well consolidated conglomerate underlying the sandstone. The conglomerate pebbles vary from one half inch to eight inches in diameter. The average being about one and one half inches. This conglomerate contains shale as does the main conglomerate mass. Below this conglomerate there is a bed of very coarse sandstones. It is at least 5 feet thick. This section indicates that the conditions of deposition were not uniform during the time interval between these two divisions. However, it does show that there is no unconformity between the two and also that the change was gradual even if there were small fluctuations in the mode of deposition.

The massive sandstone member was very useful in determining the exact position of the contact between conglomerate and sandstone. Due to the softness of the shale and the gradational property of the contact, the exact position was at times difficult to determine. An outcrop of this massive sandstone was, therefore, very helpful and its pressence was eagerly looked for. This sandstone member was too thin and too inconsistant to be included in the areal geology map.

The main shale itself is very siliceous and with a wide range of hardness. Much of this shale is very diatomaceous. The finer varieties of diatomaceous shale are nearly white, are chalky, and have a light punky feeling. The shale as a whole consist of fine quartz grains, siliceous mud, and clay with which is mixed varying amounts of diatomaceous material. In the northwestern part of the area is found the most diatomaceous material. Much of the shale is very hard, almost flintlike, is very siliceous and is composed of very fine grained material. A few fish scales can be found. The rest of the shale is buff colored. Fairly well indurated but can be split along its bedding plane with the fingers. Interbedded with this somewhat sandy shale are sandstone members varying in thickness from one inch up to two feet. The narrow members are more consolidated than the wider ones, but they all can be crumpled with the fingers. At first it was thought that this sandy shale was of different age than the harder, better consolidated varieties, but K.E. Lohman, by comparing diatoms, thinks that it is all about the same age, and it has been mapped as such. The soft shale is badly contorted, so much so that it is difficult to obtain a good attitude in this material. The harder shale is not quite so distorted.

About a 1000 feet above the base of the upper shale member is a thin band of conglomerate. This is about 300 feet thick. The conglomerate is composed of gneissic, granitic, and basaltic boulders averaging about 3 inches in diameter. It is well cemented with sandstone. There are a few well cemented rather coarse sandstone members about 2 feet thick running thru the conglomerate. This conglomerate is merely interbedded with the shale, produced by a raising of the depositional basin until it was along the shore line. It might easily be that this conglomerate member is merely a lense that was deposited at the mouth of some river.

Considerably higher in the section is another sandstone and conglomerate member which is very similar to the one just described. This, however, is larger. While this is not so apparent in the area mapped the sandstone can be seen outcroping both to the west and to the south of this area. It has a thickness of greater than 500 feet. This member is composed mainly of a thick sandstone reef which stands out from the shale. Where it has been badly eroded, large sandstone boulders can be seen on the surface. Interbedded with this sandstone are very thin bands of contorted sandy shale, also there is found in this sandstone member, well consolidated conglomerate similar to that comglomerate described above. The presence of a greater amount of sandstone, however, is sufficient to make this a different zone. This member is a shore line deposit extending over a large area, and is not a local phenonona. It was formed by a small fluctuation of the wast line so that the basin was raised to sea level for a short time, long enough, tho, to deposit this conplomerate.

The entire thickness of the upper shale is by no means represented here. About 2 miles to the north there is a great thickness of the shale outcropping in the South Hills. From this it is apparent that the upper member of the Puente has a very great thickness.

The Puente Formation is the only deposit of Tertiary sediments in this area.

## TERRACE DEPOSITS

There are numerous river terraces on the north side of the hill, caused by rapid stream erosion due to a recent uplift of this area. These terraces are composed mostly of red unconsolidated conglomerate with a large amount of soil between the boulders. These conglomerate beds are horizontal. The terraces are probably about 200 feet thick.

## VALLEY FILL AND ALLUVIUM

The valleys are all underlain by soft sand and gravel, which is generally called valley fill. The surface soil or Alluvium is sandy near the hills but becomes finer and more clayey away from the hills, where the slope is not so great.

## IGNEOUS ROCKS

There are several recognizable igneous types present in this area. Most, but not all of the igneous rocks in this vicinity are flows. The granite west of Pomona has already been described (page 7). Resting on this and dipping west away from the granite are igneous flows. These flows on the whole are very basaltic and vesicular. For the most part these rocks are aphanitic, but in several places a fine grained rhyolite has been formed, probably due to a different flow or intrusion of some kind into the basalt. This basaltic flow is cut off by the fault that blocks out the middle sandstone and is therefore either the same age or older than this middle sandstone member. However, there has been at least one recent flow in this section, later than the faulting.

There is found resting against this basalt and cut off on the other side by the fault a small area of tuffaceous sandstone of about the same ages as the lava flow.

On the northern part of the area there is another basaltic flow. This is much younger than the other. It is an extrusive flow that rests upon the shale. The date of this flow is therefore placed as post upper Puente. This is a basaltic flow with considerably tuffaceous material intermined with it.

## STRUCTURE

### General Features

The structure of this area is very simple. There is one large fault and one smaller cross fault mapped. There are two short folds noted. While the structure itself is simple, the explanation of the structure is more difficult. It is probably connected in some way with the formation of the San Gabriel Range. The general structural trend is about N65E or nearly parallel to the San Gabriels. There seems to be a series of low hills in this vicinity, running parallel to the

San Gabriel Range. There are besides the San Jose Hills, the Puente Hills, the Coyote Hills, and several small hills in the vicinity of Monrovia and Glendora which all trend in nearly the same direction. This relation is probably due to the fact that the San Gabriel Range in its growth is exerting a force against the sediments of the valley and thus folding them. This is theoretically sound since the San Gabriels' are rising along a normal fault which is dipping south. This is causing a compressional force to be brought into play which is buckling the sediments, forming this series of small folded hills.

Faulting

At two places in this area large faults can be mapped. One can be traced into the aluvium and the other is covered on one end by a recent lava flow. If one of these faults was extended along its general trend it would meet and run parallel to the other. Because of this seemingly continuation of the two faults they have been connected and will be considered as one. It must be remembered, however, that they cannot be traced into each other and the assumption that they are continuous is only a hypothesis, there is no field evidence supporting this.

The western part of the fault has been treated as a fault for two reasons, (1)structural and (2) physiographic. The structural evidence in itself is fairly conclusive. The middle sandstone member is resting against the shale on the south along a contact which is dipping about 80 degrees to the north. This in itself is unusual, having a gradational rather flat contact on one side and a very abrupt, steep contact on the other, and in both cases the contact is between conglomerate and shale. Added to this is the fact the contact runs thru a series of saddles along its entire length of about three miles. This physiographic evidence is sufficient to call it a fault in which the north side moved up with respect to the south. When the two are put together the evidence is very clear that this contact is a fault. In no place can the fault plane be seen but by studying the nature of the contact it can be observed that the fault is striking about N60E and dipping about 80 degrees to the north. The total displacement along this fault can not be calculated due to the lack of data as to the thickness of the beds and the amount of subsequent erosion. A minimum estimate would give a displacement of approximately 1500 feet. The total displacement, however, would undoubtly be much greater than this. This portion of th e fault is cut off by a small cross fault causing a horizontal displacement of about 500 or 600 feet, the fault cuts two structural features so its presence is fairly evident. The main fault is displaced by this so the cross fault is younger than the main fault. Also this cross fault displaces a narrow sandstone member. The displacement of the sandstone member is greater than the displacement of the main fault, indicating that the cross fault has some rotational component. Evidently this fault continues both north and south much further than indicated, but evidence for this could not be seen in the area worked.

The eastern portion of the main fault has somewhat different characters than the western part. It is trending about N20E and dipping about 35 degrees to the west. The actual fault plane can not be seen in this fault but its attitude can be taken from its trace by the three point method. No idea of the total displacement along this fault can be assumed as nothing is known of the relation between the shale and lava. If the shale were deposited upon the lava a displacement of only several hundred feet would produce the same effect as a displacement of several thousand. This contact is quite evidently a fault because there are four beds abruptly cut off olong its trace. About half of this fault can not be accurately traced because of the alluvium covering it.

The age of this major fault is post Puente time since the movement along it has raised the upper part of the Puente Formation to its present position and has cut off several of the beds included in the Puente.

Folding

Probably during the time of the faulting there was a period of folding which formed two mappable synclines and produced numerous very small fold or contortions.

Neither of these folds can be seen but can only be recognized when a section is constructed thru them. The attitudes show that they are present.

The largest fold is in the north east portion of the sediments, this is mappable for about a half a mile. The other fold is in the north west portion of the sediments and is more a monocline than a syncline since the beds

beds flatten out after dipping to the north.

## GEOLOGIC HISTORY

The geologic history of this region is simple and can summed up in the following manner:

15. Deposition of valley fill and alluvium.
14. Formation of Quaternity river terraces.
13. General uplift.
12. Second basaltic lava flow.
11. Erosion.
10. Faulting and folding, raising the Puente Formation to its present position and producing existing folds.
9. Deposition of upper members of the Puente Formation on middle member and also on basaltic flow.
8. Deposition of middle sandstone member of the Puente Formation.
7. Long erosion interval.
6. First basaltic lava flow.
5. Erosion.
4. Intrusion of granitic rocks.
3. Metamorphism of Triassic sediments.
2. Erosion.
1. Deposition of Triassic sediments.

ECONOMIC RESOURCES

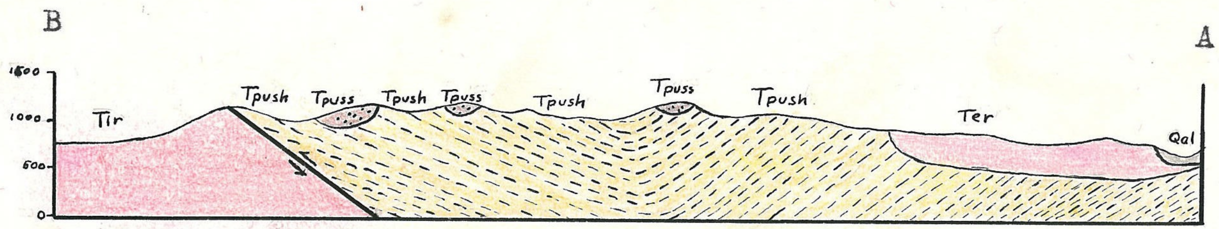
There is very little in this area which has any economic value. The Featherstone Quarry formerly quarried large amounts of diatomaceous earth. There are several quarries in the igneous rocks from which stone is taken for road foundations. This has never produced any oil even tho the structure is right. One well was sunk by the Shell Oil Company but they struck igneous rock at a depth of about 4000 feet. Other than that no attempt has been made to find oil in this region.

COLUMNAR SECTION

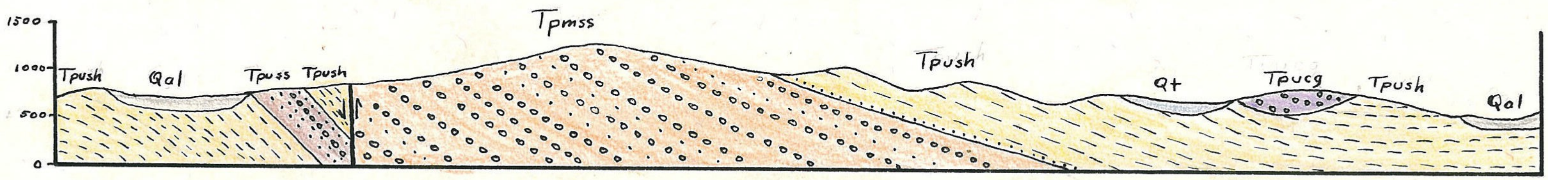
| Age | | | | Sym-bol | Sect-ion | Thick-ness | Description |
|---|---|---|---|---|---|---|---|
| Quaternary | Recent | | | Qal | | ? | Alluvium, valley fill sand, gravel |
| Quaternary | Pliestocene | | | Qt | | ? | |
| Tertiary | ? | | | Ter | | ? | River Terrace unconsol. cong, ss. |
| Tertiary | Miocene | Puente Formation | Upper | Tpush | | 500 | Extrusive basalt, tuff |
| Tertiary | Miocene | Puente Formation | Upper | Tpuss | | 500 | Massive buff ss., interbedded cong. |
| Tertiary | Miocene | Puente Formation | Upper | Tpush | | 2500 | White diatomaceous sh of varying hardness, sandy sh, buff ss. |
| Tertiary | Miocene | Puente Formation | Upper | Tpucg | | 300 | Well consolid. red cong., interbedded massive ss. |
| Tertiary | Miocene | Puente Formation | Upper | Tpush | | 1000 | |
| Tertiary | Miocene | Puente Formation | Middle | Tpmss | | 2500 | Middle ss., well consolid. red cong. interbedded massive ss. |
| Tertiary | ? | | | Tt | | ? | Tuff, tuffaceous ss. |
| Tertiary | ? | | | Tir | | ? | Extrusive basalt flows |
| Triassic | | | | Trsl | | ? | Triassic slates, intruded granites |

Plate II

# STRUCTURE SECTIONS OF THE EASTERN PART OF THE SAN JOSE HILLS




Section along line AB




Section along line CD

Scale 1/24,000
Vertical Scale = Horizontal Scale
1 inch = 2,000 feet