GEOLOGY OF THE RAVENNA QUADRANGLE.

---- Richard H. Jahns.

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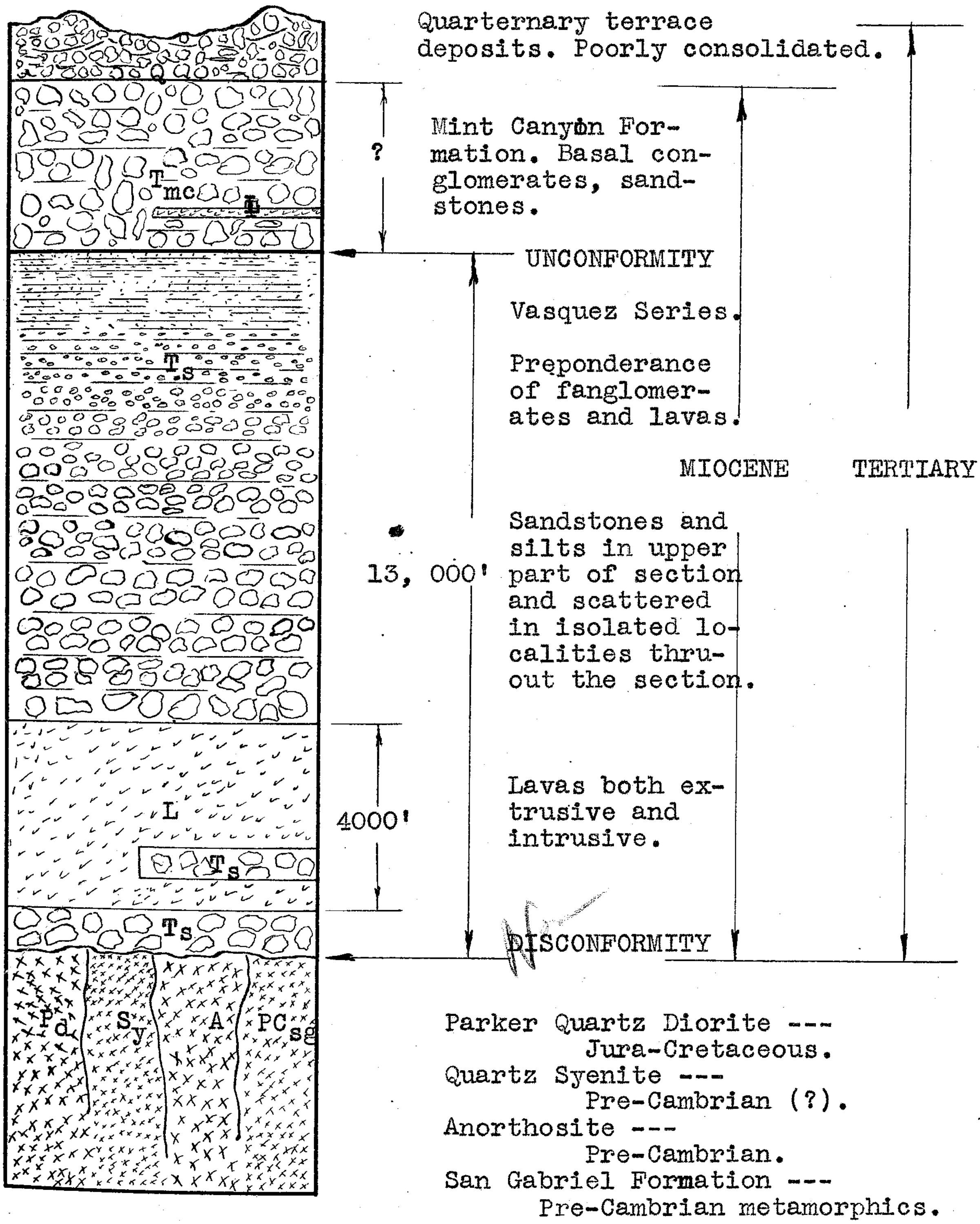

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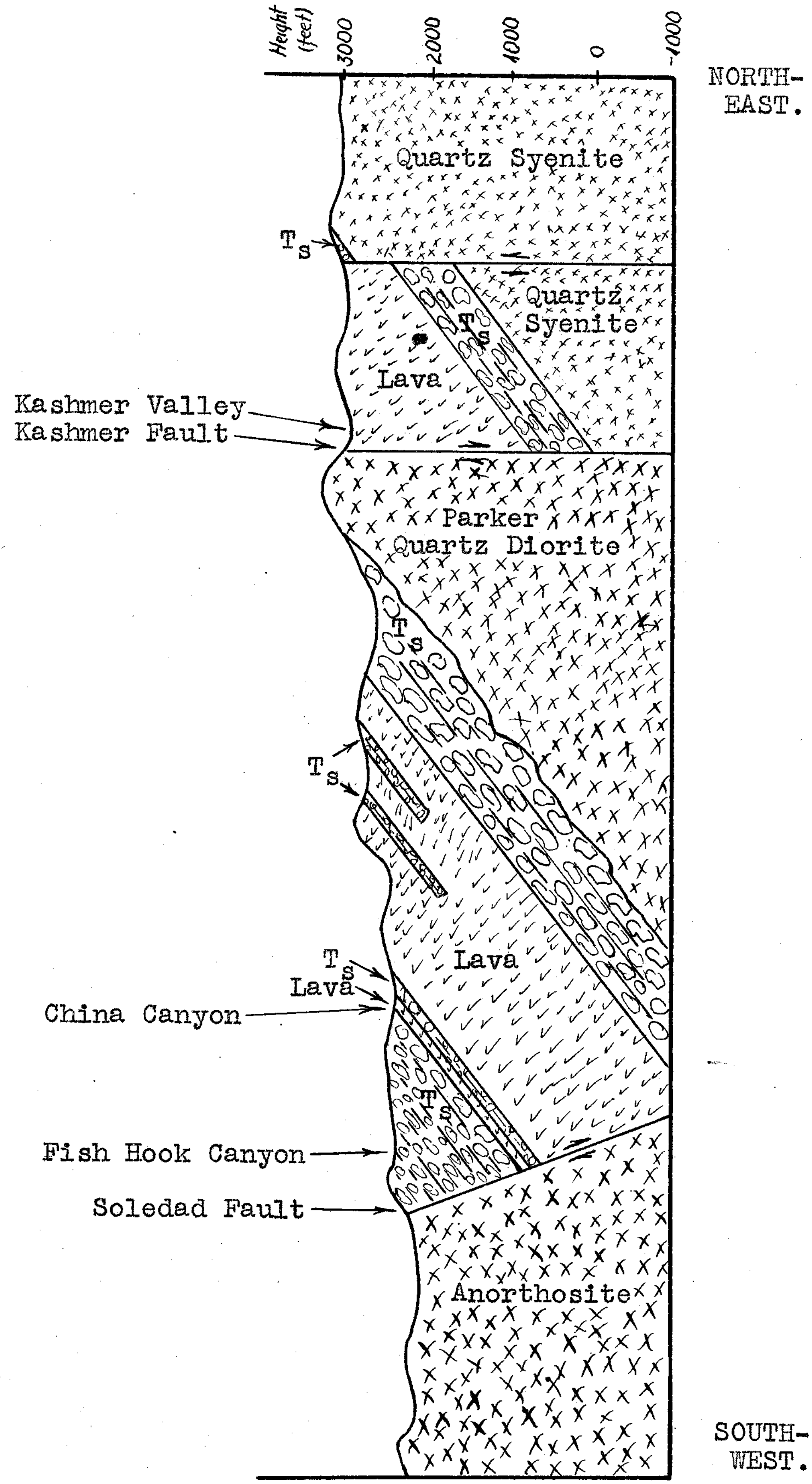

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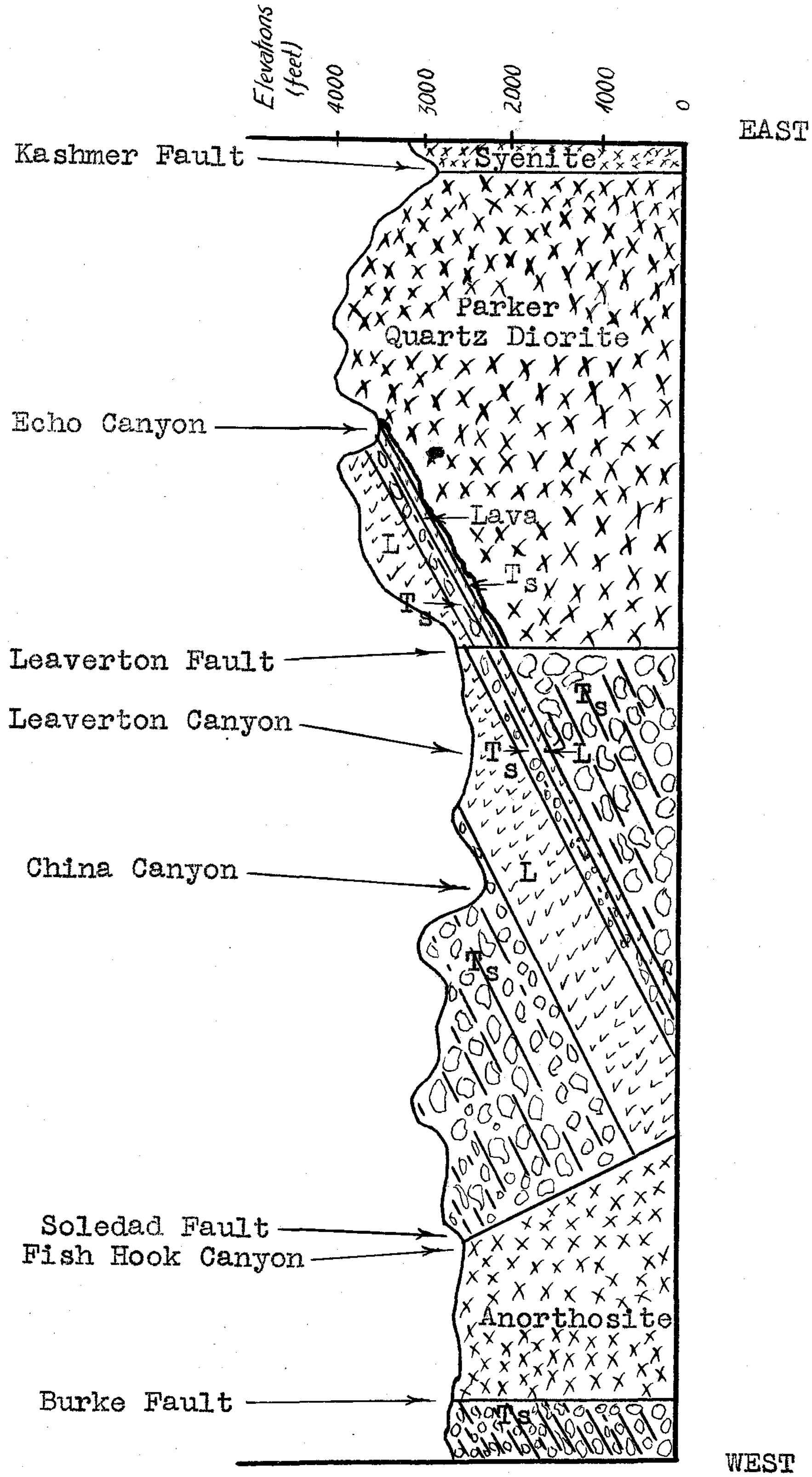

ABSTRACT.

The Vasquez Series, composed of coarse fanglomerates, finer sandstones, and lavas, represents sub-areal deposition in the form of a series of rapidly coalescing alluvial fans. These fans were formed in a basin entirely local in character (confined to the Ravenna and Lang Quadrangles) which was probably caused by faulting, either in late Oligocene or very early Miocenr time.

The sediments are early or early middle Miocene in age, are very well consolidated, poorly sorted, and broadly stratified. They occur associated with intrusions of quartz diorite, syenite, and anorthosite, contacting these formations either depositionally or by means of faults.

The lavas are of both intrusive and extrusive origin. The extrusive type is both vesicular and amygdaloidal, while the intrusive type is massive.

The section is broken by two major fault systems. The older of these, trending northwest-southeast, is represented by normal faults, whose movement is primarily vertical, while the younger system, trending nearly at right angles to the other, consists of steep strike-slip faults.

INTRODUCTION

LOCATION OF AREA:

The Ravenna Quadrangle is located in the north-central part of Los Angeles County, California, occupying a position on the northwestern fringe of the San Gabriel Mountains. (See Index Map). Ravenna, the town itself, is eighteen miles east of Saugus and an equal distance southwest of Palmdale.

Soledad Canyon, which runs east and west through the area, was once the principal traffic route between Antelope Valley and the Los Angeles region, but has since been supplanted by Mint Canyon to the north, through which a well-paved road (the Sierra Highway) has been constructed. The main line of the Southern Pacific Railroad still traverses Soledad Canyon, however, although it has been relocated on a minor scale several times.

Well-graded gravel roads cover much of the area itself, although some very poor private ways must be used in order to reach the more inaccessable localities. In addition to the Southern Pacific Railroad, the Sierra Highway, and the gravel road in Soledad Canyon, there is one other means of egress into the Ravenna Quadrangle. United States Forest Service Roads extend directly over the San Gabriel Mountains from the Los Angeles region to the area here discussed, entering via Aliso Canyon or Indian Canyon. Such roads, while affording splendid views of the Ravenna region (see Fig. 1), are not to be recommended for comfortable travel.

SHAPE AND SIZE OF AREA:

The mapped area, which corresponds exactly to the quadrangle itself, is approximately square in plan, with an area of forty-six to forty-eight square miles. The northern two-thirds of the area was intensively mapped, while the southern one-third, which comprises the north slope of the San Gabriel Mountains, was merely glanced over. Such an action was felt to be justifiable, inasmuch as but one type of rock (anorthosite) outcrops over that area. Furthermore, it is not connected in any significant geological manner with the phenomena appearing in the northern two-thirds of the quadrangle, as will be shown later.

PURPOSE OF INVESTIGATION:

Under the research program of the California Institute of Technology, the general region just north of the San Gabriel Mountains is being geologically mapped. The foregoing geologic map of the Ravenna

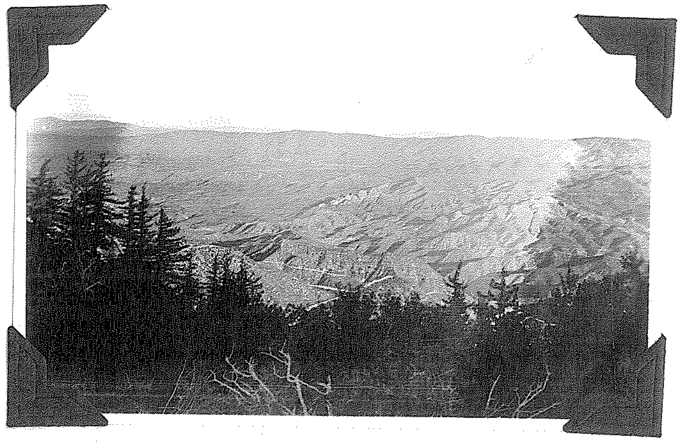

Fig. 1 --- A general view of the Ravenna area, from a point in the San Gabriel Mountains near the head of Indian Canyon. Vasquez Rocks appear in the middle distance, while Sierra Pelona Ridge is prominent in the background. Although the floor of Soledad Canyon cannot be seen, its approximate location at the base of the slope in the foreground can be inferred.

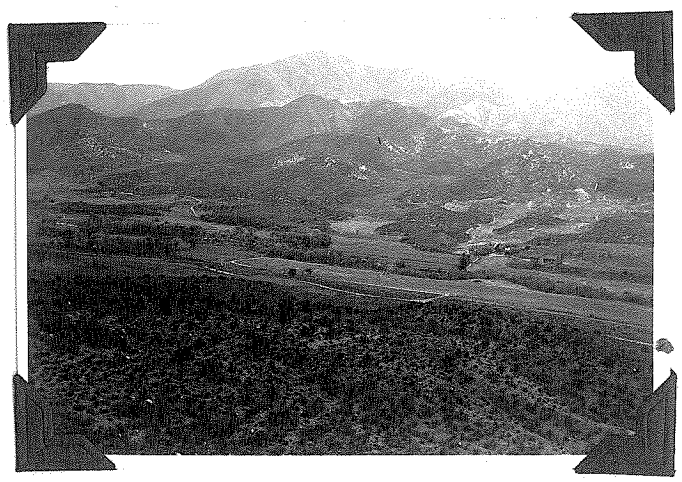

Fig. 2 --- View across Soledad Canyon, with the San Gabriel Mountains in background. White outcrops of anorthosite can be plainly distinguished on the slopes.

Quadrangle is a part of a series of such maps encompassing this region.

METHOD OF INVESTIGATION:

Field work necessary for the fabrication of the geological map of this quadrangle was done on week-ends from September, 1934 to May, 1935. The trips from Pasadena to the area were made by automobile, the drive taking about an hour and a half each way. Overnight camps were made in the United States Forest Service public camp situated in Indian Canyon two miles above its mouth.

All actual field mapping was done afoot, although automobiles were used in reaching the localities. No plane table or barometer work was necessary, inasmuch as the topographic maps of the region are very accurate and the various outcrops lend themselves to easy location on these maps.

Use was made of the library facilities of the California Institute of Technology in research into the available literature on the area, and the photographic dark rooms of the same institution were employed in the making of the illustrations in this report.

ACKNOWLEDGEMENTS:

Dr. John H. Maxson of the California Institute of Technology was very helpful with suggestions, both in the classroom and in the field.

Mr. Robert P. Sharp was an ideal combination of teacher and field companion. His suggestions concerning available literature on the area, his help with the photography involved, his instructive criticism in the field, and his ever-present humor and good nature were indispensible and unforgettable.

Mr. Ygnacio Bonillas kindly offered important information on the lavas found in the section, as well as some good suggestions as to the age of the Vasquez Series.

Miss Frances M. Hodapp was especially helpful in the mounting of photographs and copying of maps, as well as being a very able assistant in the general technical work.

REVIEW OF LITERATURE.

Probably the first mention of Soledad Canyon (then called Williamson's Pass) was made in 1853 by William P. Blake, geologist and mineralogist of the expedition which made explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean.* He speaks of the pass:

> "----- The pass extends from the Great Basin to the Rancho of San Francisquito, which is one of the valleys of the Pacific Slope. Its entrance on the Great Basin is near the meridian of 118 degrees and latitude 34 degrees 30 minutes, and its direction a little south of west; the distance through the mountains from the Great Basin side to the open valley of the Santa Clara River is about twenty miles. The altitude of the summit level is 3,164 feet above the sea."

He goes on to describe the pass in more detail:

> "----- At the summit of the pass the hills on each side are of granite, which is nearly white and of a fine grain. The mass is compact and tough, and has a sub-crystalline, vitrified appearance, as if it had been partly fused. Some of the surfaces of broken fragments were observed to be drusy with minute quartz crystals. ------------ The same formation skirts the foot of the opposite high hills, extending at their base in a long terrace. The terrace has an even, sloping outline, and is evidently the remnant of a slope that originally extended throughout the valley between the mountains ------"

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* U. S. Explorations and Surveys for a Railroad to the Pacific -- Vol. V.

Blake speaks of a copper vein found near the present site of Acton:

"----- A vein of copper ore appears on the surface. Its presence is indicated by the green color of the carbonate, and it has been prospected by parties from Los Angeles, who have broken off some of the surface rock, and accumulated several hundred weight of ore."

Then, proceeding with the description of the canyon:

" The mountains on the left part of the pass are high rugged peaks, composed of light colored granite (now known to be anorthosite) , in which hornblende is seldom present. The decomposition of this granite seems to be rapid, and its surface becomes white as chalk, so that wherever it is visible between the thick growth of dwarf oaks it looks like patches of snow. When a high wind blows over these hills it raises a cloud of white dust, formed by the disintegrating feldspar. The granite seems to be almost wholly formed of white feldspar or albite; and both quartz and mica are in small proportion, and also white."

A short distance below the copper vein, the upraised and uneven edges of stratified sandstones and conglomerate become visible on the right side of the pass, beyond the low foothills of granite. The dark-colored ridge of volcanic rock also shows its summit at several places. These formations appear to extend nearly parallel with the valley, and the intrusive rock comes down to the bed of the stream. Below this the outcrops of upraised strata were nearer the trail and more distinct, and are seen to be worn into fantastic shapes. A mass of one of the outlying beds on the top of a hill had an outline bearing a close resemblance to the features of a man. (Haystack Rocks)------------"

" There was not a good opportunity to examine the lithological character of these strata; but they had the appearance of being nearly identical in their nature with the sediments seen in the lower parts of the Pass of San Francisquito. The colors presented, were varying shades of gray, red, and brown; the materials were coarse, and, so far as I observed, were not accompanied by beds of shale."

The series attains a great thickness, but it could not be determined with any accuracy. The uplifts and disturbances seem to be produced by the dyke or ridge of intruded porphyritic rock, which extends from the summit nearly half way down to the plains, but appears to be broken in several places. --------- It is very probable that several intrusions would be found. A short distance below the edge of the ridge of the erupted rock, a long valley was seen extending off towards the east, and the dry bed of a stream, very broad, and lined with large boulders, indicated the existence of a powerful current there at some seasons of the year. The rocks thus transported along this creek were mostly granitic and metamorphic, much white granite being found. I picked up several masses, which had a delicate purple or lilac tint, produced by the feldspar. This, however, was a syenite, no mica being visible, but an abundance of hornblende of an olive green color. The crystals were so disposed throughout the rock that the surface looked as if it had been written upon. The rock in fact is a beautiful graphic syenite."

He then describes masses of ore found in the bed of the stream:

" The size of some of the masses of ore, and the number of fragments of this peculiar rock, indicated the existence of very considerable quantities up the valley, and we may expect to discover a valuable bed of iron ore in that region."

This "iron ore" which Blake describes is in reality ilmenite, $FeTiO_3$, which is valueless as a commercial source of iron. He states further:

" The lower part of the pass is narrow, and bounded on each side by the ridges of white granite, the sandstone being beyond. About sixteen miles from the summit, the granite hills become higher, and the stream wends in a circuitous course around projecting points of the ridges. Here the granites no longer have the peculiar whiteness, but are highly laminated and micaceous, becoming gneissose, and have the usual dark color. The planes of lamination are bent and contorted, and veins of feldspar and quartz traverse the rock in various directions. These rocks are in all probability metamorphic, and in appearance they present a great contrast to the white and chalk-like granite which forms the hills along a great part of the pass."

" About nineteen miles from the summit, the granitic hills disappear, and the valley is bounded by low hills of sandstone and conglomerate. The country opens, and a view is presented for long distances in various directions. The strata are exposed all along the stream, and dip, at small angles, in different directions; but as we proceeded further from the igneous rocks of the pass, the flexures became more and more gentle, until the strata were nearly horizontal."

Thus, in a clear and interesting manner, does Blake describe Soledad Canyon from its source at the summit of the pass to the point where it broadens out and meets the valley of the Santa Clara River.

O. H. Hershey described in 1902 the anorthosite found in the region.* He assigns it to what he terms the Ravenna Plutonic Series, specimens of which were collected in Pole Canyon, which enters Soledad Canyon near Lang, in the quadrangle just to the west. Concerning the anorthosite he says:

" Another member of the series is an aggregate of feldspar of the clear, lilac variety. By the appearance and increase of the green hornblende, this grades into the normal variety. By the continued decrease of the feldspar, the series grades into the most basic which has scarcely any feldspar. Bluish iron oxide (probably in part ilmenite) occurs abundantly in the more basic varieties as a primary constituent. All are related -- a complementary series. They are bound together by a common feldspar, andesine."

" This plutonic series is unique for Southern California, if not for the state at large, judging from its appearance in the field. Its relation to

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* Oscar H. Hershey --- Am. Geol. Vol.29 pp 273-290, 1902

the granite on the north was not determined and remains one of the interesting problems of California historical geology. I predict that it will be found to be Mesozoic in age and just a little older than the granitic series."

Hershey's prediction apparently has not worked out, because the anorthosites have been determined to be Pre-Cambrian in age.

In a publication of the same year, Hershey describes the Escondido Series of sediments.* This Escondido Series has since been named the Vasquez Series by R. P. Sharp.** Hershey assigns Tick Canyon as the type locality, and goes on to state:

" The Tertiary formations in this region have the structure of a trough trending northeast to southwest and closed on the northwest end. They dip towards the axis of the trough and curve around the northeast end in a very beautiful and instructive manner. Each successive series laps past the next older, so that the older series are in forms of crescent or horseshoe-shaped areas, having their greatest width at the northeastern end of the trough and rapidly thinning out and disappearing on its sides."

" ------ It is a characteristic of this sandstone and conglomerate series that although overlying and newer than the vast mass of lava, the material is essentially all debris from the schist-gneiss-granite complex. The material grows finer to the westward, and at the valley of the Agua Dulce, the very coarse breccia-conglomerates have been reduced to ordinary conglomerates. A local source of much of the material is indicated by the abundance of Ravenna diorytes in the conglomerates on the south side of the trough and their rarity on the north side."

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* Oscar H. Hershey --- Am. Geol. - Vol. 29 - pp 349-372, 1902.

** Robert P. Sharp --- Oral communication.

" The Escondido Series was deposited under static water conditions and apparently in the sea. The bedding is regular and the pebbles in most layers are well rounded."

This statement is now known to be definitely incorrect, inasmuch as evidence of a sub-areal deposition for the series is absolutely definite.

Concerning the lavas in the section, Hershey says:

" The lava flows were contemporaneous with the sediments and not later intrusions. In places the sandstone is reddened and hardened under a lava sheet, but the sandstone over it is unaltered."

The lava is now believed to be intrusive in some cases, on the basis of different lithological character and the baking of conglomerate beds above the lava.

" The lava is local in its heavy development. Through its resistant properties it gives rise to a range of rugged black mountains. ------- "

" East of the main Escondido Canyon, the lava spreads out to a width in places of several miles and continues east to a valley trending north from Acton. But in this belt of mainly dark reddish brown lava hills, there are irregular areas of granite. Apparently, the region abounds in faults, and by them the lava (which here lies at a comparatively low angle,) has been in places carried up high, removed by erosion and the underlying granite rock laid bare. Conglomerate and sandstone appear with the lava as far as a prominent elevation south of the South Escondido Canyon, but eastward there is apparently little of it present in the series which is mainly lava and tuff."

"The lava bends south to the railroad at Acton, and one small area of it lies south of that village on the south side of Soledad Canyon. A narrow belt of lava crosses the summit about two miles north of the railroad, but just north of the summit, it bends around to the southeast, spreads out to quite a belt and reaches the railroad about one and one half miles northeast of Vincent Station.

Here on both sides of the railroad are low hills of dark red and purple color, composed of a massive bed of coarse tuff, much like that in Tick Canyon, but containing a greater variety of lava fragments. A rugged purple mountain just west of this, near the summit is probably also of this tuff."

W. S. W. Kew in his paper on the geology of the Los Angeles and Venture Counties* correllates the Vasquez with the Sespe, thus considering it of questionable Oligocene age. This correllation is made largely on the basis of lithology, and on that basis alone seems quite justifiable.

Kew determined that the Vasquez is sub-areal in origin, on the basis of the presence of gypsum and borax deposits, the angularity of conglomerate fragments, etc.

He also states that the Escondido lavas are both intrusive and extrusive, and are for the most part basic andesites. These lavas he terms Miocene in age.

Included with Kew's paper is a geologic map of the areas discussed. This map includes about one half (the western half) of the Ravenna Quadrangle, and is fairly accurate as to large phenomena, but necessarily neglectful of details.

W. J. Miller, in his paper on the geomorphology of the Western San Gabriel Mountains,** includes a part of

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* W. S. W. Kew -- U. S. G. S. Bull. 753, 1924.

** William J. Miller -- U. of Calif. Pub. Bull. Dept. of Geol. Vol. 17, No. 6, pp 193-240, 1928.

the Ravenna Quadrangle in his extensive map of faults of the region. In a later publication* he has mapped the mountain area geologically, and has again included the southeastern part of the Ravenna Quadrangle. As far as the latter area is concerned, the map is quite accurate.

Again in 1931, Miller gives a very complete and exhaustive account of the anorthosite section in the northern San Gabriel Mountains.** He describes the rock thus:

> " The anorthosite proper is so called because it consists very largely of plagioclase feldspar, that is to say, 90 percent or more of plagioclase. In most cases the plagioclase content is more than 95 per cent. The color is white, bluish-gray, or light gray. Most of the rock is medium to coarse grained with crystals commonly ranging in size from 1/8 to ½ inch, and less commonly from 1 to 3 inches long. Most of the specimens examined show little or no grannulation, but some bear considerable evidence of this texture. A foliated structure of even a moderate degree is rarely observable in the anorthosite proper."
>
> "A study of the feldspar in a dozen thin sections of the anorthosite proper from widely scattered localities revealed two facts; first, that it is all plagioclase ranging from oligoclase to labradorite, with andesine greatly predominant; and, second, that the plagioclase of the white variety is in general somewhat more acidic than that of the bluish-gray variety."

He goes on to say that in several localities large bodies of titaniferous magnetite and even ilmenite it-

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* William J. Miller --- Pub. U. of Calif. at L.A. Vol. 1, No. 1, pp 1-114, 1934.

** William J. Miller --- Jour. Geol. Vol. 39 pp 331-344, 1931.

self are found, said bodies representing differentiations in the original magma. He also postulates a gabbroic magma for the anorthosite as a whole, and has determined the body to be a true intrusion, probably a laccolith or cone-shaped batholith.

Additional references may be found in the bibliography at the end of this report.

PHYSICAL CONDITIONS.

RELIEF AND ELEVATIONS:

That portion of the quadrangle which was intensively mapped has a moderate to high relief. The maximum difference in elevations is approximately 2,000 feet. The southern part of the area is very mountainous, while the remaining territory is hilly, but very rough.

Parker Mountain (Elevation: 4127 feet), situated a mile directly west of acton, is the highest point in the mapped area, while that point in Soledad Canyon at the extreme western edge of the quadrangle is the lowest. There are over twenty prominences with elevations of about 3,000 feet.

TOPOGRAPHY:

The general topography of the area is that of a mature stage in the erosion cycle, although there are a few isolated points that definitely represent a much later stage.

Soledad Canyon is an alluvium-filled valley whose walls vary markedly in steepness at different localities. In the eastern part of the area, it is a broad, gentle valley, whose sides are low, smooth-appearing hills. As one proceeds westward, however, the sides of the valley become more steeply inclined, until finally the canyon, for it has now become a true canyon, winds and twists its way between nearly vertical walls of anorthosite in the tortuous manner of which Blake speaks in his report. (See Review of Literature).

Kashmer valley, trending southeastward into Soledad Canyon, is another broad, detritus-filled feature whose course is largely determined by the Kashmer Fault. Little Escondido Canyon is a similar feature.

All the other canyons in the region are sharp and narrow, containing alluvial deposits near their mouths only. Most of these canyons trend in surprisingly straight courses, some because of the presence of faults and others merely as a result of their relations to the strike of the sedimentary rocks.

DRAINAGE:

The drainage of the quadrangle as a whole represents a very regular pattern. The streams in all the major canyons form a trellis, rather than a dendrytic pattern, this phenomenon being due in all probability to the uniform north-south strike of the sediments. This theory is substantiated when one views the pattern formed by the tributaries of the main streams, which is typically dendrytic, since there is no longer control by the strike of the Vasquez sediments.

An interesting point to note is the similarity between the stream pattern on the north side of Soledad canyon, where the water courses trend through sediments, and the pattern of the streams running through the anorthosite of the San Gabriel Mountains on the opposite side of the canyon. As may be seen from a map, the canyons on both sides strike Soledad Canyon, the main drainage artery, nearly at right angles, except where their courses are influenced by the presence of faults. Such a situation lends credence to the supposition that the present north slope of the San Gabriel Mountains, which was also the north slope of the basin in which the Vasquez sediments were deposited, was once covered with sediments also. It then seems logical that the streams were influenced by the strike of the sediments, and continued in their courses even after all the sediments were eroded away.

Rainfall in the area is very slight, and there is no water course in the northern two-thirds of the area which supports a year-round stream. Consequently, stream erosion is but a minor factor, except in very rare instances. Occasionally, a very severe cloudburst will completely alter the superficial appearance of Soledad Canyon, as did the torrential rain of 1923, which completely washed out the tracks of the Southern Pacific Railroad for a distance of over twenty miles.

CLIMATE AND CULTURE:

The climate of the Ravenna district leaves much to be desired. With an average yearly rainfall of but 10 or 12 inches, the region falls into the semi-arid class. Temperatures are uncomfortably high in the summer, while raw, biting winds, sudden drops in temperature, and occasional driving rains lash the unfortunate natives during the winter months.

The two towns in the area can only be termed villages on the basis of population. Both are railroad stations and little more. Numerous settlers have located in the various side canyons, however, homesteading wherever there is an available supply of water. The water supply of the region is apparently decreasing, because the inhabitants are quite consistent in their stories concerning the sizes of streams ten and twenty years ago. One old fellow, in pointing out the dry, barren creek bed lying before him, told of the days when he caught small trout on that very spot.

The principal occupation of the homesteaders is the raising of sheep, goats, and turkeys. There are a few large alfalfa farms in Soledad Canyon near Ravenna, as well as one large poultry farm.

VEGETATION:

Typical semi-arid vegetation is found throughout the northern two-thirds of the quadrangle. White sage, sugar bush, buckthorn, and manzanita are common shrubs, while juniper is the only tree which occurs in more than a few scattered localities. Cottonwoods, alders, and sycamores are found in Soledad Canyon, in addition to a few oaks.

Yucca occurs nearly everywhere in the region, while such wild flowers as scarlet penstemons, scarlet buglers, cactus blooms, and blue lupines make their appearance in the spring.

The slopes of the San Gabriels in the southern part of the area are covered with a dense growth of manzanita, yucca, sage, buckthorn, and scrub oak, with isolated groups of big cone spruce trees in the higher altitudes.

In general, vegetation is not sufficiently dense to impair progress through the area on foot, or even by automobile in some cases. In this respect, the region is ideal for field work.

EXPOSURES:

Exposures of the various formations are widespread and of excellent magnitude, as might be expected from a region of mature topography. In addition, many of the formations are well exposed because of their lithologic character. (See Figs. 6-14 and 21-24).

Nearly all the streams in the side canyons flow directly on bedrock, so that sections can be easily traced out simply by travelling up or down canyons. (See Fig. 41). There is but little soil in the region, and, as has been previously explained, only a very few of the canyons and valleys are heavily alluviated, so that recognition of bedrock is usually a simple matter.

GEOLOGIC CONDITIONS.

STRATIGRAPHY AND PETROGRAPHY:

SEDIMENTARY ROCKS.

THE VASQUEZ SERIES:

4000 feet of lavas.

9000 feet of fanglomerates and sandstones.

Age: Lower or middle Miocene.

This series, formerly called the Escondido by O. H. Hershey*, has since been renamed the Vasquez by R. P. Sharp**, inasmuch as the name Escondido is preoccupied.

Constituents:

The Vasquez Series is composed for the most part of coarse fanglomerates, although the section grades into coarse sandstones and a few silts in the uppermost part. These fanglomerates represent rapid deposition over a series of gradually coalescing alluvial fans, and have the properties which one might suspect

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* Hershey -- Am. Geol. Vol. 29, pp. 349-512, 1902.

** R. P. Sharp -- Proc. G.S.A. Stanford meeting, 1935.

of such deposits. The sedimentary members of this series will be discussed in the following pages, while the lavas are treated under igneous rocks.

Sorting and Consolidation:

Without exception, the fanglomerates are very poorly sorted. Deposition was so rapid that the fragments had but little chance to be laid down in anything but haphazard fashion.

Consolidation, on the other hand, is excellent. Even the finer grained members of the series are often so well consolidated that thin sections can be made of them with perfect ease. The series as a whole forms very competent beds.

Stratification:

Bedding in the fanglomerates is best seen from a distance. (See Fig. 7). When viewed in such a manner, it is seen to be very regular and coarse. Often such bedding is best distinguished through the effects of differential erosion, as shown in the figure referred to above. To the observer in close proximity, the fanglomerate often appears quite massive; this is especially true of the lower members of the series.

Composition of Fragments:

The fragments in the fanglomerates vary tremendously in composition from place to place, depending upon their source. This might be expected from a formation of an alluvial fan origin. In one locality west of Parker Mountain (See Fig. 5), the formation is composed almost entirely of fragments of quartz diorite, while in another, an outcrop in upper Escondido Canyon (see Fig. 4), the fragments and cementing material are very nearly completely anorthosite. From the latter instance, it might be inferred that the formation lies very close to basement, and such is the case, for a small patch of primary anorthosite outcrops not far away. (See geologic map).

To summarize, the fanglomerates present a very great array of various types of rock fragments, among them shists, Parker Quartz Diorite, syenite, anorthosite, gabbro, quartz, and various vein minerals. It is significant, however, that no fragments of lava or of Pelona shist have been observed at any locality.

A thin section study of a part of the finer phase of the Vasquez revealed the following composition: Orthoclase and microcline, 30%; albite, 15%; calcite (cementing material), 15%; iron oxides, 20%; with the remainder of heavy minerals.

<u>Size and Rounding of Fragments</u>:

As great a range in size as could sensibly be imagined is presented by the fragments in the Vasquez.

The largest boulders found are about three feet across (see Figs. 5 and 6), while the smallest particles are of the order of one or two millimeters. An average size is approximately four or five centimeters.

The fragments as a general rule are strikingly angular (see Figs. 3, 5, and 6), again indicating a short distance of transportation. The lower members of the series are never better than sub-rounded, and are far more often highly angular. Were this angularity of fragments more widespread, the Vasquez might be said to contain lavas and breccias instead of lavas and fanglomerates.

Cementing Material:

In all cases, the fanglomerates are extremely well cemented, as may be readily guessed from their topographic expression (see Fig. 7). They are as a consequence much more resistant to erosion than the lavas with which they are associated.

The cementing material is composed of roughly equal amounts of secondary calcite and iron oxides, which often make up sizeable proportions of the rock as a whole. This material is well-oxidized, but is never friable.

Color:

The Vasquez fanglomerates present an amazing array of reddish and pinkish tints, due principally to the presence of large amounts of iron oxides. These colors contrast sharply with the brilliant white of the adjacent anorthosites.

Lithologic Characters:

Such features as ripple marks and mud cracks have been found in interbeds of coarse sandstones in the lavas. The fanglomerates show nothing of this sort. The small beds of sandstone are thought to have been formed in small isolated playas or ponds throughout the region.

As far as is known up to the present time, the Vasquez series is totally unfossiliferous. The sandstone beds, however, offer ideal horizons for mammalian fossils, and it is not too much to expect that such fossils will be found in the not too distant future.

The fanglomerates weather in two major ways. Primarily, they form large talus blocks, which gradually disintegrate into finer and finer material. Secondarily, they are subject to differential erosion because of their stratified nature. The effects of this latter type of erosion can be plainly seen on Haystack Rocks.

Areal Extent, Thickness, and Trends:

The fanglomerates and sandstones are bounded on the south by the Soledad Fault, which brings them into contact with the anorthosites (see Fig. 25), and end in a depositional contact against quartz syenite to the north, as well as to the east. On the west they disappear under the more recent Mint Canyon Formation in an unconformable contact. From these data, it may be calculated that the original basin of deposition had an area not exceeding eighty square miles.

As accurately as can be determined, the fanglomerates and sandstones have a combined thickness of about 9,000 feet.

There is a total absence of flexures in the Vasquez, the beds lying in the same gentle synclinal position as that in which they were deposited. They dip to the west at an average angle of thirty degrees, and strike nearly north and south.

Nature of Outcrops:

Outcrops may be found almost anywhere in the area, inasmuch as there is but little soil. Stream beds offer almost continuous sections, as do the tops of many of the ridges. Cliffs occur, but are not common. The usual outcrop is a slope covered with a thin layer of detritus, but with the bedrock appearing in places.

Topographic Expression:

Haystack Rocks is an ideal example of the usual topographic expression of the Vasquez fanglomerates. They form numerous nubbins on the ridges and hard, resistant chutes in the bottoms of canyons, through which the water flows with great rapidity during storms.

The features formed by isolated sections of the formation which are very well cemented form the most spectacular physiographic phenomena in the area.

Type Section:

R. P. Sharp has designated Vasquez Rocks as the type section for the Vasquez sediments. (See Figs. 10, 11, and 12). At this locality, the sediments are more fine in grain, but in other respects resemble the fanglomerates.

Vasquez Rocks, the nature of which can best be determined by examination of the photographs referred to above, were once the stronghold of the bandit, Vasquez, in the early days of California. They now are a scenic attraction for curious tourists.

Age:

The age of the Vasquez series is a much debated question. It is definitely known that they cannot be younger than Miocene on the basis of the interbedded lavas, which are known to be of that age. On the other hand, they are certainly no later than middle Miocene, which is the age of the unconformably overlying Mint Canyon Series (see section following on Mint Canyon Series). Whether they are middle or early Miocene is the question.

Fig. 3 --- Typical exposure of Vasquez fanglomerate, in upper Escondido Canyon. Fragments are Parker Quartz Diorite, Anorthosite, and Quartz Syenite. Cementing material is chiefly calcite and iron oxides.

Fig. 4 --- Large exposure of anorthosite-rich facies of Vasquez fanglomerate. Formation very near to the anorthosite basement at this point. Cementing material mostly anorthosite grains.

Fig. 5 --- Facies of the Vasquez sediments in which fragments are nearly all Parker Quartz Diorite. Cementing material mostly calcite. Note large size of boulders.

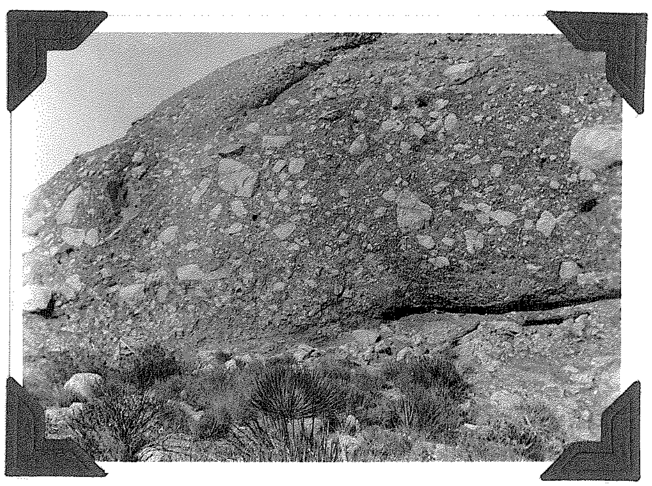

Fig. 6 --- Very well-consolidated, well-oxidized Vasquez fanglomerate. The color is bright red. Note angularity of fragments, pointing to short distance of transportation.

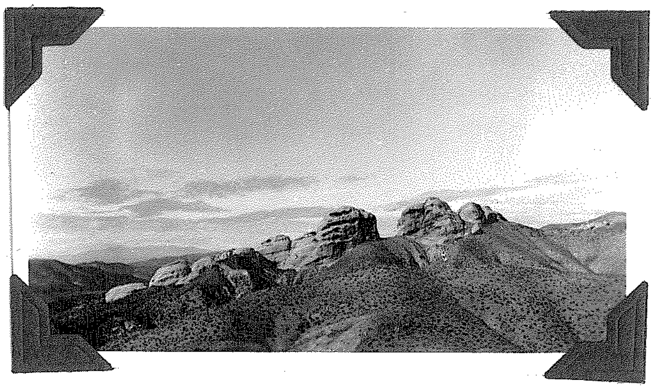

Fig. 7 --- Haystack Rocks, a very resistant portion of the Vasquez Series. This very unusual physiographic feature is mentioned in literature as early as 1853 (see Review of Literature). Wind erosion has undoubtedly played a great part in carving out the peculiar notches in the formation.

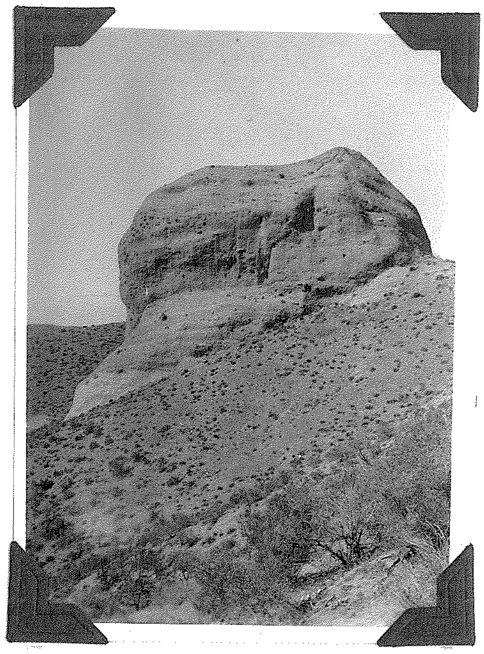

Fig. 8 --- A nubbin of fanglomerate formed by differential erosion. The resistant nature of this rock is due in all probability to the preponderance of fine matrix material.

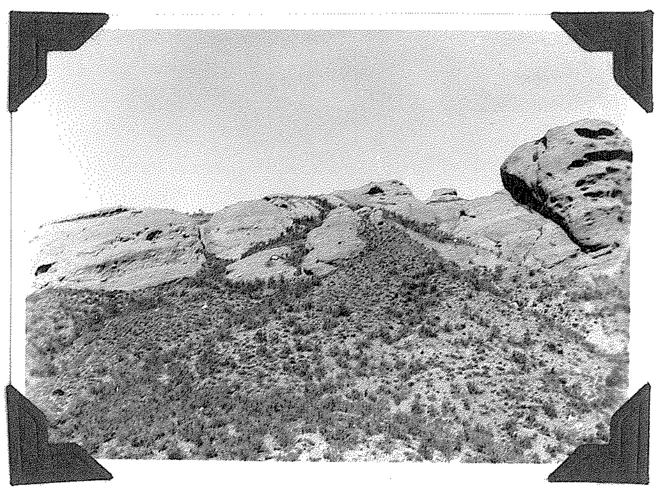

Fig. 9 --- Closeup of Haystack Rocks, showing clearly the cavities hollowed out by wind and rain. Products of weathering appear as detritus in the foreground.

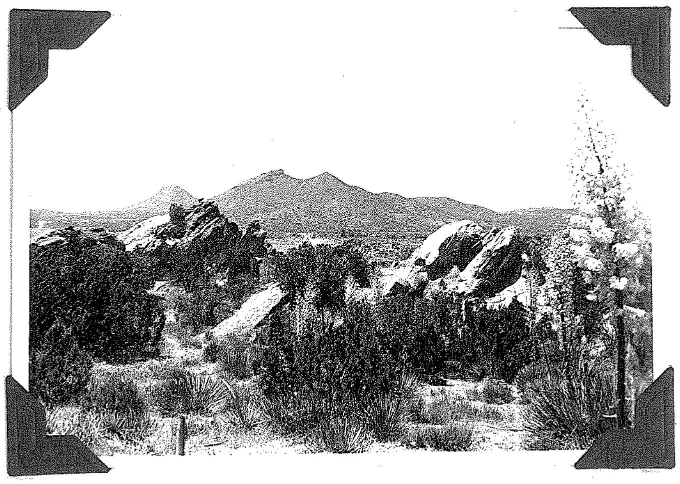

Fig. 10 --- Exposure of Vasquez sediments in the type locality, Vasquez Rocks. This represents the upper portion of the section, in which the Vasquez is composed of much finer material.

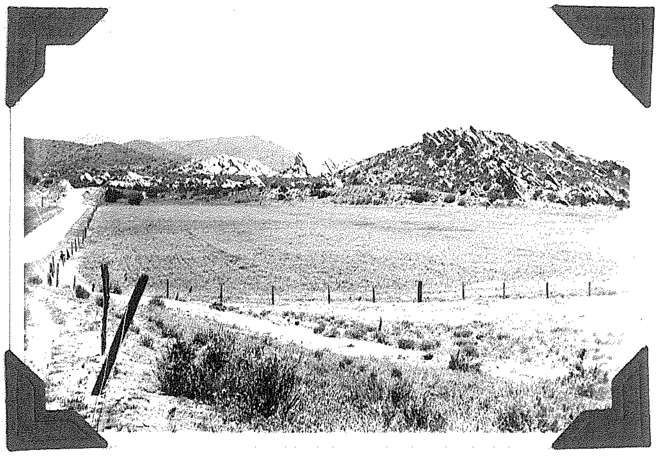

Fig. 11 --- Vasquez Rocks, designated as the type locality for the Vasquez series by R, P. Sharp.

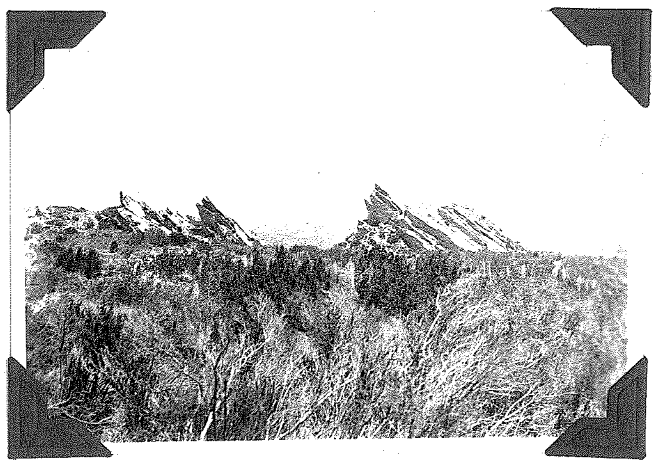

Fig. 12 --- Typical exposure of Vasquez Rocks. The up-tilted strata weather into very peculiar jagged forms, which project out of the surrounding plateau.

Fig. 13 --- Dip-slopes formed by upper members of the Vasquez series in Aqua Dulce Canyon. (In the Lang Quadrangle). Haystack Rocks are plainly visible in the background.

Fig. 14 --- Bed of anorthosite fanglomerate in upper Escondido Canyon. Note the typical shallow-dipping contacts on the slopes in the background.

Fig. 15 --- Typical Vasquez fanglomerate, with fragments of Parker Quartz Diorite in various stages of decomposition.

Fig. 16 --- Lower Mint Canyon Formation, which immediately overlies the Vasquez.

Although an unconformity has been shown to represent a long period of geologic time, such a thing is not necessarily always the case. If conditions are right, an unconformity may be formed in a small fraction of a geologic period. However, it is certain that the Vasquez Series must be early middle Miocene at the latest.

It is useless to attempt to correlate the Vasquez with any other Southern California formation on a lithologic basis, because the Vasquez was deposited under extremely local conditions, which conditions might not have existed at all a few tens of miles away.

Therefore, it seems that a closed case exists for the assigning of the Vasquez to the early or early middle Miocene, but which of these two it really is, I believe it impossible to state. Until definite evidence comes in through the channels of paleontology, we can but offer conjectures.

THE MINT CANYON SERIES:

Basal conglomerates.

Sandstones and silts.

Age: Upper middle Miocene.

Although the Mint Canyon Series does not outcrop in the Ravenna Quadrangle, a short description of it would not be amiss, because of its interesting relations to the Vasquez Series. It rests with an angular unconformity of some twenty to thirty degrees upon the upper members of the Vasquez, and its lower members are thick basal boulder conglomerates.

Its fragments are much better rounded than those of the Vasquez, and it is far less oxidized and reddish in color.

The age of the Mint Canyon, as determined by Maxson on the basis of a vertebrate fauna*, is upper middle Miocene, although some more recent fossil evidence may lead to its being assigned to the lower middle Miocene.

QUARTERNARY DEPOSITS:

Quarternary deposits occur in Sierra Pelona Valley, Kashmer Valley, and in various isolated localities throughout the area.

As a rule, these quaternary deposits are old stream terraces, and are but rudely stratified. They are made up of angular fragments of gneiss, shists, acidic igneous rocks, and occasionally fragments of fanglomerate. (See Figs. 44 and 45).

* * * * *

* John H. Maxson -- Carnegie Inst. Wash. Publ. No. 404, 1930.

Fig. 17 --- Lower Mint Canyon formation exposure in Agua Dulce Canyon. Note that the fragments are more rounded than those in the Vasquez fanglomerates.

Fig. 18 --- Mint Canyon Formation outcropping west of Bee Canyon. Note that the sediments here are finer than those in the picture just above, which are lower in the section.

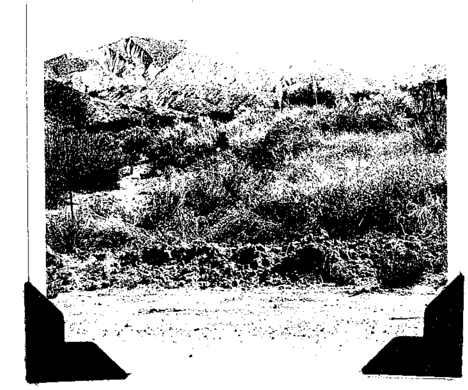

Fig. 19 --- Mint Canyon Formation outcropping off lower Soledad Canyon. Note general dip of beds.

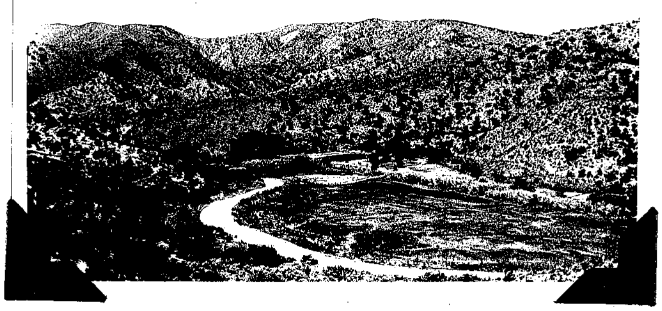

Fig. 20 --- Typical alluvium-filled canyon. (Agua Dulce Canyon) Bee Canyon Fault comes thru the saddle in the left background.

Fig. 21 --- View of Haystack Rocks from the mouth of Indian Canyon. Soledad Canyon in the foreground. Note typical canyon vegetation.

Fig. 22 --- Vasquez outcrops above Soledad Canyon, as viewed from mouth of Indian Canyon.

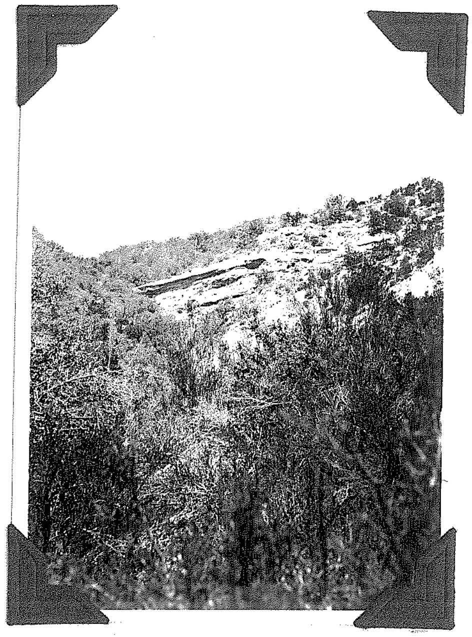

Fig. 23 --- Fine-bedded Vasquez outcropping just off Agua Dulce Canyon.

Fig. 24 --- Another view of the fine phase of the Vasquez. Lower Escondido Canyon.

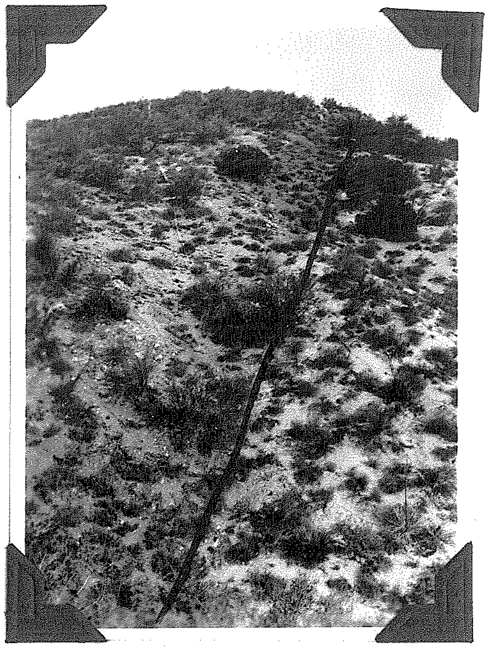

Fig. 25 --- Fault contact between Vasquez sediments and Anorthosite basement. The latter has been uplifted into contact with the more recent formation. Soledad Fault.

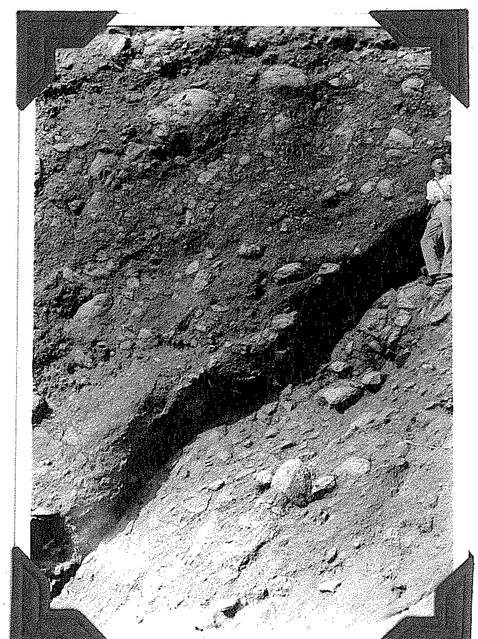

Fig. 26 --- Another view of Vasquez fanglomerate. Note large size of several of the fragments,

ALLUVIUM:

Soledad Canyon is the principal alluvium-filled valley in the area, although many small canyons contain such deposits throughout part of their lengths. (See geologic map). (See also Fig. 20).

The alluvium is of course related to the various formations which are now present in the area, and is a Recent feature. Deposits are being constantly changed, especially during cloudbursts, but such changes are necessarily slight.

IGNEOUS ROCKS.

LAVAS:

Composition:

According to Bonillas*, an average thin section of Vasquez lava shows the phenocryst feldspars to be median labradorite, pigeonite, and sometimes bytownite, with an average of An_{61}. Hypersthene, but no augite was also noted.

The feldspars as a rule are quite fresh, although sometimes corroded around the edges by the last phases of the solidifying magma.

W. J. Miller** reports olivine basalt from a locality northwest of Ravenna, but does not state definitely the location of same. As shown by their composition, the Ravenna lavas are basic andesites, with perhaps a few basalts.

Lithologic Characters:

There are two distinct types of lavas present in the area on the basis of lithology. One is definitely

* * * * *

** W. J. Miller -- Geology of West. San Gab. Mts. U. C. L. A. Pubs. Vol I, No. 1, 1934.

* Y. Bonillas -- Oral communication.

extrusive, whith a vesicular structure, and the other is intrusive, as shown by the baking of fanglomerates both above and below the lava sheet.

The extrusive type is usually amygdaloidal, with amygdules ranging in size from a millimeter or so up to ten centimeters (see Fig. 33). These amygdules are usually composed of chalcedony and quartz, although they often contain calcite and chloritic material. This lava also shows flow structure in places, as well as cooling fractubes. (See Figs. 36 and 37).

The intrusive type is very massive, and never vesicular..It has baked the sediments both above and below to a brilliant reddish material because of its intrusion. Also, the fact that no fragments of lava are found in the fanglomerates lends support to the intrusion theory.

Color:

The lavas are usually dark greenish black, but sometimes grade off into bright greens or browns. The amygdules are white or light greenish.

Areal Extent, Thickness, and Trends:

The lavas have roughly the same areal extent as the fanglomerates (see geologic map), as they occur in the same serbes more or less contemporaneoulsly. Their thickness is approximately 4,000 feet.

Fig. 27 --- Hand specimen of Parker Quartz Diorite. The dark masses are hornblende crystals, while the light-colored material is mostly albite and quartz. The albite is usually untwinned.

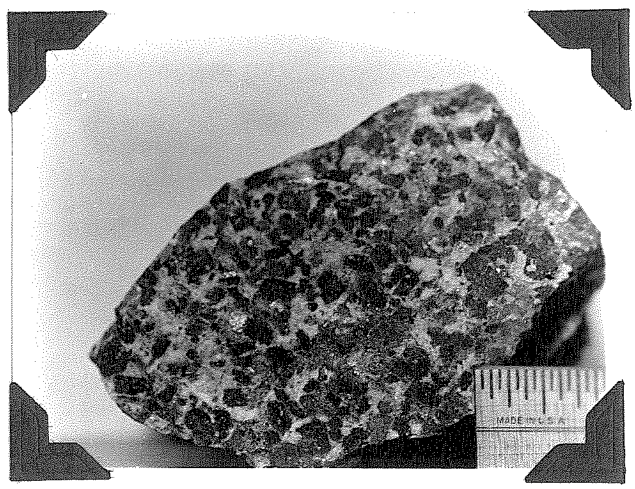

Fig. 28 --- Hornblende-rich phase of Parker Quartz Diorite.

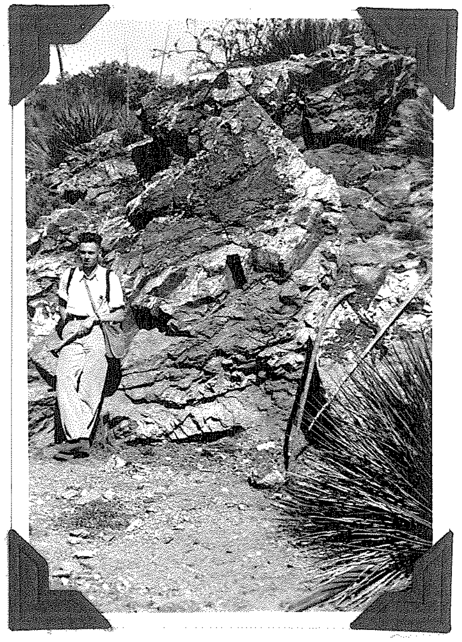

Fig. 29 --- Mineralized quartz vein intruding Parker Quartz Diorite in Leaverton Canyon.

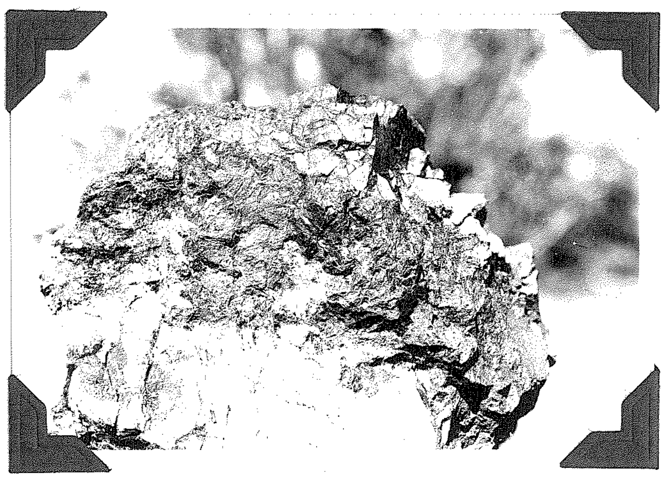

Fig. 30 --- Specimen taken from the above quartz vein. The quartz is easily recognizable, while the dark mineral is magnetite.

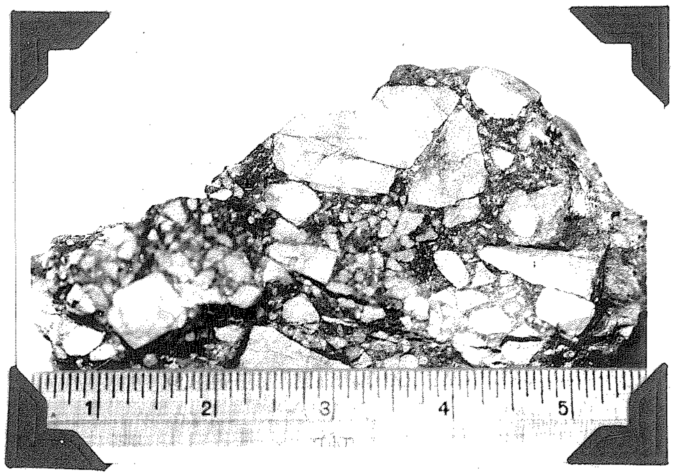

Fig. 31 --- Hand specimen taken from a brecciated quartz vein. The cementing material is approximately 50% calcite, 50% iron oxides. This material makes a very well-consolidated aggregate.

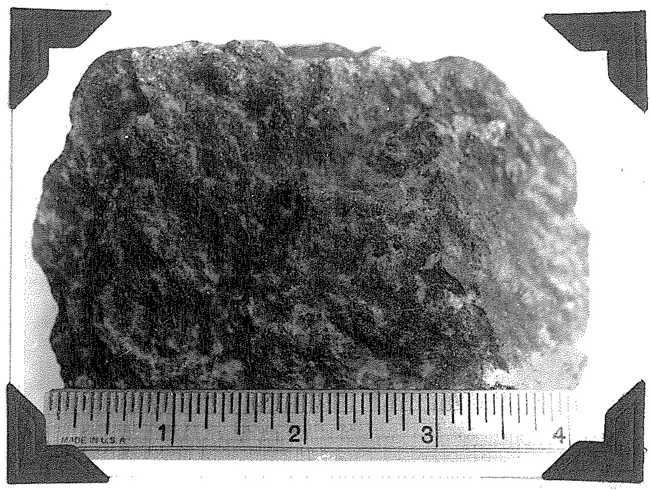

Fig. 32 --- Hand specimen of Quartz Syenite. The light material is mostly orthoclase and microcline, with varying amounts of quartz, while the dark is biotite and augite. (No hornblende)

Fig. 33 --- Amygdaloidal lava, of the type which is undeniably extrusive. The amygdules are composed of chalcedony. Note the reaction zones around the amygdules and the vesicular nature of the rock.

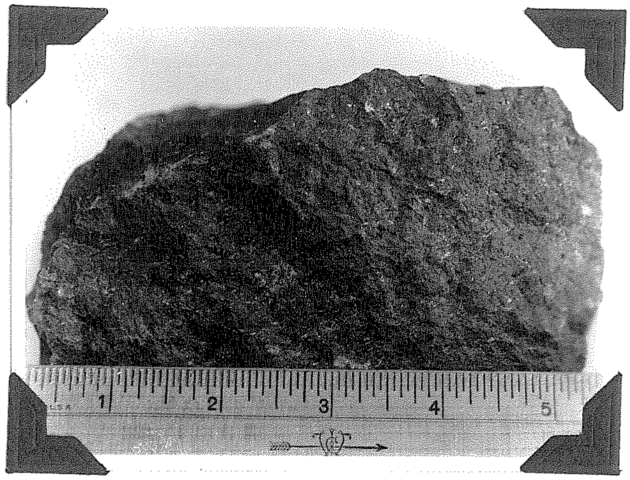

Fig. 34 --- Typical lava specimen.

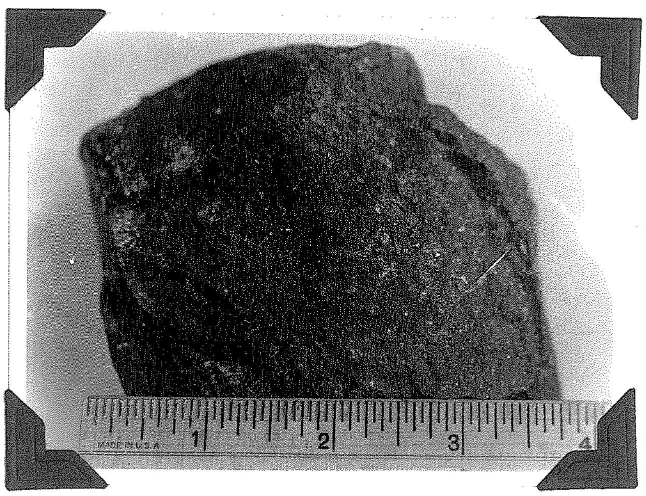

Fig. 35 --- Lava of the intrusive type. It was injected as a sill-like body. The phenocrysts are of andesine.

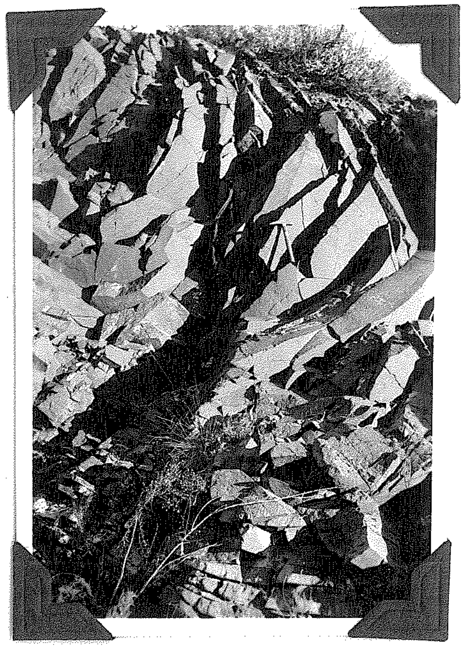

Fig. 36 --- Cooling cracks in lava. This type of rock is not very vesicular.

Fig. 37 --- Spheroidal weathering in lava. This locality is but a few rods removed from that of the above picture.

Fig. 38 --- Interesting outcrops on west slope of East Echo Canyon. The rock on the skyline is lava, while interbeds of light-colored fanglomerates can be distinguished. The slopes in the foreground are typical exposures of Parker Quartz Diorite.

Fig. 39 --- The coarse nature of the fanglomerates can be easily distinguished in this closeup of the above location. They can also be seen to be more resistant to erosion.

Fig. 40 --- Fault contact between Anorthosite basement (on the left) and lava. Soledad Canyon. This is but a minor fault, however.

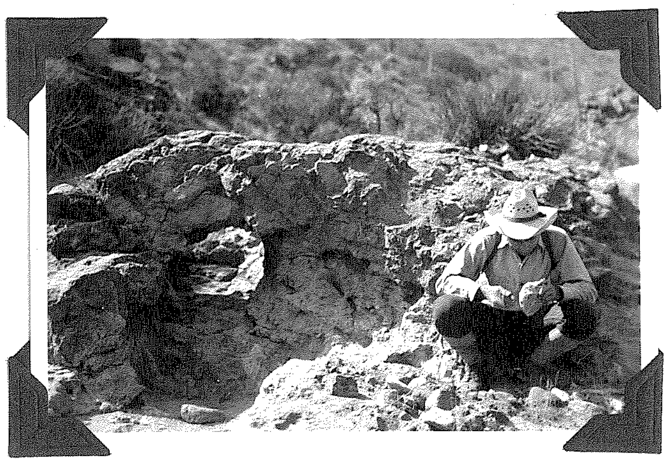

Fig. 41 --- Lava forming a natural bridge in Leaverton Canyon.

The lavas are perfectly conformable with the sediments, and, although they are not stratified, the beds are thin enough to be considered along with the fanglomerates as regards dip and strike.

Nature of Outcrops:

The lavas, being less resistant to erosion, usually form rubble-strewn slopes, although cliffs are sometimes found (see Figs. 38 and 39). If the general topography were younger, there is no doubt that there would be a marked tendency for the lavas and fanglomerates to form a cliff-bence topography.

Age:

The age of these lavas was determined by Miller to be Miocene (see Review of Literature and section on age of the Vasquez).

PARKER QUARTZ DIORITE:

Composition:

The Parker quartz diorite contains as its principal minerals quartz, untwinned albite, and hornblende. Small quantities of orthoclase, titanite, apatite, and magnetite were also found, with a trace of augite.

The diorite is intruded in several places with quartz veins, which are in turn slightly mineralized with magnetite, copper, and gold deposits.

Color:

The rock has a light gray color in the field, and does not contrast greatly with the pure white anorthosite.

Lithologic Characters:

The rock bears a strongly gneissic texture in some places, pointing to some sort of strain. To substantiate this, the thin section studies show the rock to be full of strain fissures,in the feldspars especially.

The early crystallizing minerals are found in beautiful euhedrons in certain facies of the diorite mass, notably on the north side of Soledad Canyon near Acton.

The rock is usually pretty badly weathered and jointed, so that the obtaining of a hand specimen is very difficult.

EXTENT AND Thickness:

The diorite is of course an intrusive, which has been raised by fault action before the deposition of the Vasquez Series. Bounded on all sides by faults, it outcrops over an area only a few square miles in extent. (See geologic map).

Outcrops and Topographic Expression:

The rock forms typical igneous outcrops, with talus slopes. There is little or no soil. The general topographic expression is rounded peaks and sharp canyons. Parker Mountain, the highest point in the quadrangle, is composed entirely of Parker quartz diorite.

Age:

Miller (see Review of Literature) has determined the Parker quartz diorite to be of Jura-Cretaceous age. No conflicting evidence was found.

QUARTZ SYENITE:

Composition:

The principal minerals found in the quartz syenite are orthoclase, quartz, biotite, augite, and some hornblende in places. Apatite, titanite, zircon, and magnetite also occur.

Color:

The average color of the syenite is much darker than that of the Parker quartz diorite. It appears fairly dark gray in outcrop.

Lithologic Characters:

The early crystallizing minerals (especially titanite) form well defined euhedrons. At certain facies along the edges of the exposed syenite, pegmatitic occurrences are found. Here the quartz and feldspars are abnormal in size and very well crystallized.

The rock as a whole is not gneissic, but certain facies are.

Extent and Thickness:

The syenite outcrops in scattered localities in the north and northeastern parts of the area. Its one well-defined contact is a depositional one, with the Vasquez sediments to the north. In addition, its contact with the Parker quartz diorite is a typical intrusive one, with a pronounced zone of metamorphism present. (See geologic map for location).

Topographic Expression and Outcrops:

These features are nearly the same as those for the Parker quartz diorite, except that the hills are more rounded.

Age:

These rocks are apparently much older than the Parker quartz diorite, largely on the basis of appearance. Their texture is markedly gneissic in places, and the rock as a whole "looks" old. It is probably

Pre-Cambrian in age.

ANORTHOSITE:

The nature of the anorthosite has already been rather exhaustively explained, so a few words here are sufficient.

The rock is nearly pure white in color, with a very simple composition. A usual analysis shows andesine, 95%; muscovite, 3%; and other minerals, 2%. The rock as a whole often shows good cleavage as a result of the feldspars which it contains.

The anorthosite outcrops over the entire southern one-third of the area, coming into contact with the other formations along the Soledad Fault.

The age of the anorthosite is Pre-Cambrian.

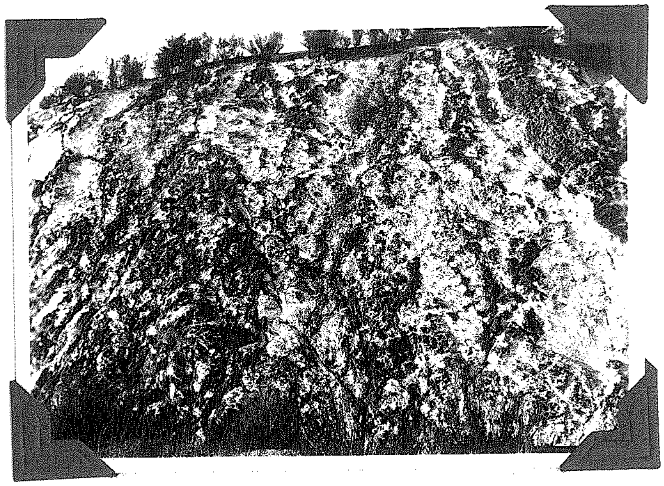

Fig. 42 --- Metamorphosed Anorthosite in lower Soledad Canyon, in the Lang Quadrangle.

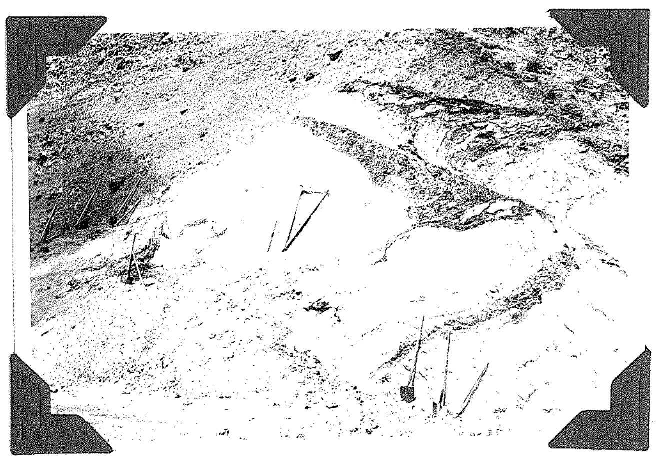

Fig. 43 --- Anorthosite, with brecciated and drag-folded material. Quarternary stream deposits are clearly shown in the upper part of the picture.

Fig. 44 --- The Arrastre Canyon Quarternary fan, truncated in the foreground by Soledad Creek. San Gabriel Mountains in the background.

Fig. 45 --- A typical exposure of Quarternary stream gravels in Soledad Canyon. Note the rude stratification.

GEOLOGIC STRUCTURE:

As might be expected in a region of highly competent rocks, strains in the rocks were removed by means of faulting rather than folding.

There are two main trends of faulting in the region, as may be seen from the geologic map. The older system is represented by the Soledad Fault, a normal fault with an average dip of 65 degrees. This fault has dropped the Vasquez Series down into contact with the anorthosite.

Contrary to opinion, Soledad Canyon is not determined by any one fault, but is rather determined by a whole series of faults, most of which are subsidiary to the Soledad Fault, whose displacement may be measured in a few thousands of feet.

In contrast to the northwest-southeast trend of the Soledad Fault, the second system runs northeast-southwest. This system is characterized by the Indian Canyon Fault, the Burke Fault, and the Leaverton Fault, as well as the Little Escondido Fault.

These faults are ver steep, most of them nearly vertical. They are definitely younger than the other system, offsetting the older normal faults in several places. They are strike-slip affairs, with nearly negligible vertical movement. The Leaverton and Escondido

Faults show movements of approximately one quarter of a mile.

As to the age of these faults, they cannot be older than Miocene, because they offset the Vasquez sediments. On the other hand, they must be older than Quarternary, because Quarternary stream deposits are undisturbed by faulting in all observable cases.

Numerous minor faults occur throughout the region, offsetting the various strata a matter of some tens of feet, but these faults could go into either major system.

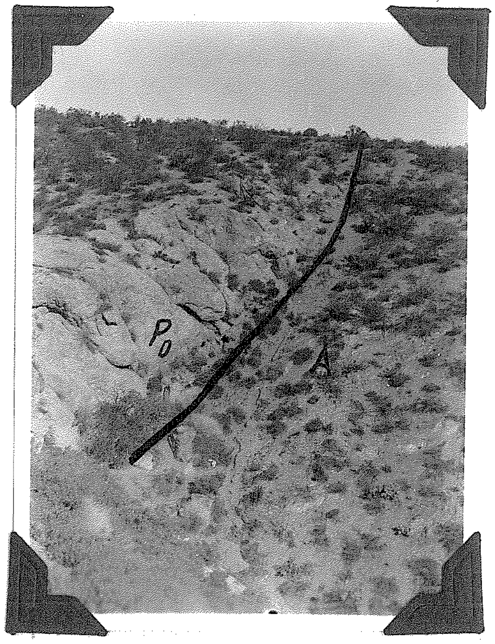

Fig. 46 --- Fault contact between Parker Quartz Diorite (P_d) and Anorthosite (A). Soledad fault. Note that the diorite is obviously more resistant to erosion than the anorthosite.

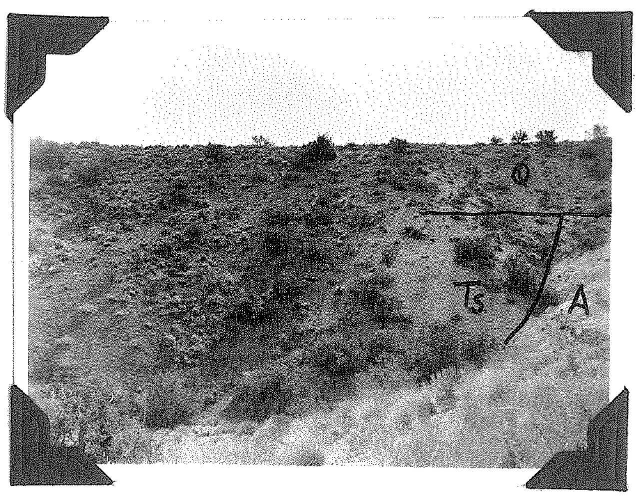

Fig. 47 --- The Soledad Fault contact between Vasquez fanglomerates (T_s) and Anorthosite (A). Note that the Quarternary stream terrace is unbroken by the fault, thus establishing the faulting as pre-Quaternary.

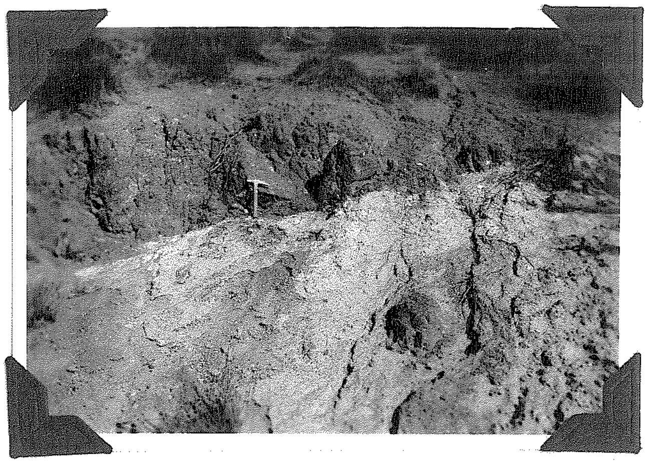

Fig. 48 --- Contact between Vasquez (brown above) and Anorthosite basement (white below). This is a normal fault contact. (Soledad Fault). Note the absence of brecciation.

Fig. 49 --- Small patch of Vasquez anorthosite fanglomerate truncated by the Kashmer Fault. Lava (L) above and Quartz Syenite (S_y) below. See map for full explanation of details.

Fig. 50 --- Exposure of Vasquez fanglomerates in Soledad Canyon. The white material in the center middle distance is gouge formed by the Soledad Fault.

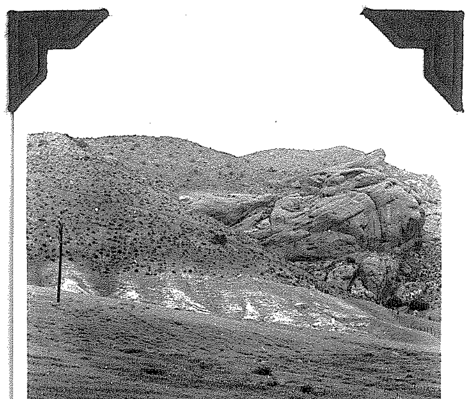

Fig. 51 --- Soledad Fault gouge in Soledad Canyon near Ravenna.

Fig. 52 --- Fault gouge in Soledad Canyon. This gouge has been prospected extensively, although a more barren spot for minerals could not be imagined.

Fig. 53 --- Additional gouge from a north-south trending fault which is supplementary to the Leaverton Fault. Note the typical skyline physiographic forms of lava in the distance to the left.

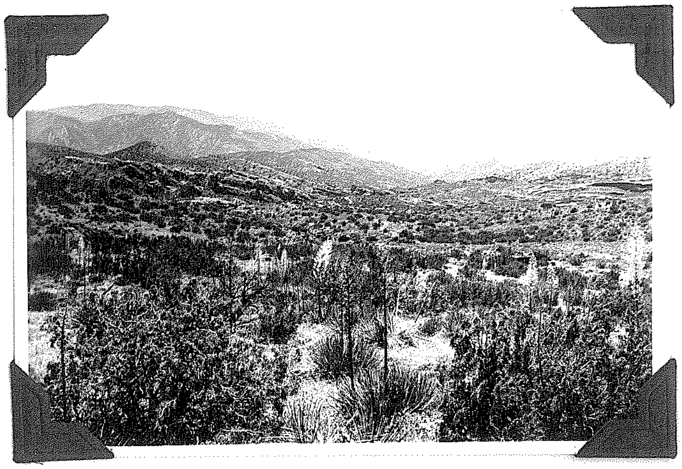

Fig. 54 --- Escondido Canyon. At this locality, the position of the canyon is governed by the presence of a large fault.

Fig. 55 --- View across Soledad Canyon, showing the anomalous saddles in the middle distance, which are caused by the Indian Canyon Fault. The trace of this fault can be accurately located for a distance of several miles on the basis of physiographic evidence alone.

HISTORICAL GEOLOGY:

In Pre-Cambrian time, the sediments which extended over the area were regionally metamorphosed into what is now known as the Pelona schists. The syenites to the north and the anorthosites to the south were then intruded.

Between Pre-Cambrian and Jurassic time the happenings do not immediately concern us. In Jura-Cretaceous time, however, the Parker quartz diorite was intruded.

At the start of Miocene time, a local basin was formed in the area, largely as the result of faulting, into which the surrounding highlands discharged material very rapidly during early Miocene (?) time. Small playas and ponds existed at scattered localities, but deposition on the whole was sub-aerial.

Probably soon after early middle Miocene time, deposition ceased, to be resumed again on a large scale as a result of further uplift, the Mint Canyon Series being deposited.

Subsequently, the present faults in the area became active, resulting in the down-dropping of the Vasquez against the anorthosite, etc. (See cross-sections).

Quarternary deposits were laid down by streams, and were later dissected as a result of rejuvenation through fault action. The present alluvium-filled canyons then formed their present outlines.

ECONOMIC GEOLOGY:

The Ravenna area does not present a very inviting prospect for the economic geologist. The mineral resources are very limited.

There has been some mining of quartz veins in the Parker quartz diorite for copper, with rather indifferent success. The copper mineral is for the most part chrysocolla.

No gold mines of any note exist in the area, although there are several large establishments in the quartz syenite in adjacent quadrangles.

A mica mine is located on the side of Soledad Canyon near Acton, but has long ago been abandoned.

The Southern Pacific Railroad took large quantities of lava from a huge quarry in the hills immediately behind Acton, which rock was used for track ballast.

The boulders of ilmenite which are found scattered over the anorthosite and the fanglomerates are valueless from an economic standpoint.

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