California Institute of Technology

Senior Thesis

Geology of the NE 1/4 of The Humphreys Quadrangle, Los Angeles County, California

by

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Acknowledgments

In writing this report, U. S. G. S. Bulletin 753, "Geology and Oil Resources of a part of Los Angeles and Ventura Counties, California", 1924, by William S. W. Kew, was consulted for the regional stratigraphy and structure.

Introduction

Location of area

The area discussed in this report lies in the southernmost part of the California Coast Ranges, directly northeast of the San Gabriel Mountains and north of the Santa Monica Mountains. The area mapped is the NE 1/4 of the Humphreys Quadrangle.

The Humphreys Quadrangle, named after the station of Humphreys on the Southern Pacific Railroad in it's southern part, is located about 40 miles northwest of Los Angeles. It is in latitude 34° 30'N and longitude 118° 24'W. In the northern section is the southern part of the Sierra Pelona Hills, rising to a height of a little over 2700 feet in the Angeles National Forest. The southern section contains the narrow flat valley of the Santa Clara River. The San Andreas fault runs along the south side of Hughes Lake, which is about 15 miles due north. A branch of the San Andreas ends close to the eastern boundry of this area.

In the Humphreys Quadrangle, the area studied lies between

Bouquet and Mint Canyons, including a portion of Mint Canyon, and also Vasquez and Texas Canyons. By way of Bouquet Canyon, it is approximately 8 miles from the town of Saugus. From Pasadena it may be reached by taking Foothill Blvd. through the San Fernando Valley to Newhall, and then to Saugus. The road to Mojave is taken from Saugus, and either the Mint Canyon or Bouquet Canyon roads lead directly into the area.

Size of area

In shape, the region is rectangular, covering approximately 9 square miles. To some extent it has been put under culture by man. The main occupations are farming and cattle raising, and there is a small amount of tillable land. Numerous roads extend into the area in the main canyons, where there are several ranches and small mines. For example, in Vasquez Canyon are a ranch and a few gold diggings that are worked now and then, and from the Mint Canyon highway several accessible dirt roads lead to private ranches near the middle of the area. The high plateau in the southwestern section is under cultivation and is reached by either the Plum Canyon or Mint Canyon roads. Along the Mint Canyon highway are a few houses and stores.

Purpose of investigation

This area was investigated for the purposes of the senior thesis work in geology at the California Institute of Technology. The principal object was to map and determine the underlying structure, and to study the formations, so that the geologic history of the region could be learned.

Method of investigation

The field work was conducted by the writer from October 15,

1937 to May 21, 1938, the total time spent in the field being about 30 days. In general, the work consisted in the detailed mapping and study of the formations for the purpose of determining the structure of the area. This was done by the compass and clinometer method, using a Brunton Compass and it's clinometer attachment. Since the area is underlain by igneous and metamorphic rocks, and by sedimentary rocks which have dips of 5°or more, the above method was satisfactory for field mapping in this region. Also the limited time available for the work made the compass and clinometer method the most desirable. The field mapping was done with a U.S.G.S. topographic map of the Humphreys Quadrangle, of scale $\frac{1}{24,000}$, as a base map.

Summary

This area is between the San Gabriel Mountains and southernmost Coast Ranges. The topography is mature, exposures good, and climate semi-arid.

The northeast quarter of the Humphreys Quadrangle consists of a "basement complex" of granitic and metamorphic rocks of Jurassic and Pre-Jurassic age. Overlying it, in a steep fault contact, is the Escondido massive conglomerate, of Lower Miocene (?) age. Unconformably on the Escondido, and in both a depositional and fault contact on the "basement complex", is the Mint Canyon formation, of Upper Miocene age. The Mint Canyon-basement fault separates the Mint Canyon formation into two parts, since it does not extend into the Upper Mint Canyon beds.

The Mint Canyon formation is by far the most widespread, being well exposed here, and eroded to a bad land topography. It is chiefly interbedded with lenticular beds of coarse conglomerate, fine to coarse sandstone, and fine to coarse siltstone. The Escondido is a coarse conglomerate of granitic, metamorphic, and volcanic rocks.

Both Tertiary sediments are non-marine in origin, being fanglomerates, irregular stream deposits, and lake or playa deposits. The Escondido is steeply folded while the Mint Canyon is gently folded and faulted.

Physical Conditions

Relief and elevations

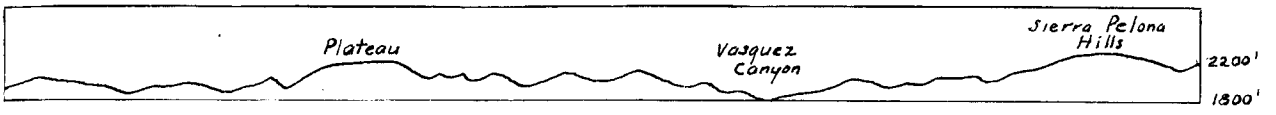


Fig. 1--Profile Section along meridian 118°26' West. Natural scale.

The relief in this area is in general sharp. Hills, ridges, peaks, and a large plateau are very prominent land forms. These forms are those characteristic of a region in the mature stage of erosion. The hills in the northern section, in the Escondido formation and the granitic basement complex, are fairly well rounded on top, but still have steep slopes. Here the main valleys have flat but narrow floors and the valleys running into them are narrow with steep sides. This makes the local relief sharp, as may be seen, for example, in Texas Canyon. In this particular canyon, the hill tops are from 300 to 500 feet above the bottom, and sometimes the relief is sharper than this. In the Mint Canyon formation immediately to the south, the relief is not so sharp, being composed of low peaks and cliffs in the hard conglomerate and interbedded sandstone. The valleys are here a little broader and the local relief is about 150 to 200 feet. Still farther south, on the edges of the high plateau which is very conspicuous in the SW corner, the relief increases

to from 350 to 400 feet. Sloping northeastward about 50 feet per mile, this plateau is bounded by foothills which are on the average about 100 feet above the valley floor.

The change in the relief in going from north to south may be seen in the profile section, Fig. 1. Considering the area as a whole, the maximum relief is 1350 feet. The lowest elevation is 1675 feet in the flat bottom of the mouth of Vasquez Canyon, while the gneiss and schist of the Sierra Pelona Hills rises to the greatest elevation of 3025 feet. In general, a plateau of a maximum elevation of 2250 feet in the Mint Canyon formation separates the low areas of Mint Canyon and Vasquez Canyons in the southern part, and the relief increases toward the north to 2716 feet in the Escondido and to 3025 feet in the basement complex.

Topography

A moderately rugged hilly topography is characteristic of this region. The topographic expression shows the work of erosion in a semi-arid climate, and consists chiefly of destructional land forms with a few high terraces and alluvium. In general appearance the area has steep, rolling hill-and-valley topography and a few sharp peaks that have not been eroded off, as seen in the profile section, Fig. 1. There is a high conspicuous plateau surrounded by low rounded hills and numerous long, relatively wide, canyons which control the drainage.

Considering the land forms more in detail , the plateau which rises from about 350 to 400 feet above the surrounding hills is the most outstanding feature in the southern and central regions. This is seen in Fig. 12, Plate II. It is on the average 500 yards wide and 1250 yards long, with a flat undulating

surface. The Mint Canyon formation here is composed of gently folded soft siltstone beds at the surface, succeeded by interbedded and interfingered conglomerate and sandstone beds, which outcrop on the sides of and in the hills at the base of the plateau. This plateau is surrounded on three sides by perpendicular erosian scarps (Plate 3, Fig. 16), and on the other side it leads up to the higher mountains toward the south. It is a remnant of the Upper Mint Canyon formation. Other cliffs in the Mint Canyon formation form a part of valley walls, and were caused by weathering assisted by basal undermining accomplished by intermittent streams. The outcrops of the hard conglomerate in this formation stand out as bold erosion scarps, as for example in Texas Canyon, where a 50 foot cliff of Pelona schist conglomerate forms the east rim of the canyon. This is seen in Plate I, Fig. 10. Also in the section near Texas Canyon, the tops of large assymmetrical anticlines have been eroded away, leaving steep cliffs in beds dipping about 25°.

Two thin resistant beds of pure white tuff, separated by interbedded siltstone and conglomerate are convenient marker beds in the Upper Mint Canyon formation. They form long hog - backs striking about east-west in the extreme west-central section. (Plate 2, Fig. 13- outcrop of white tuff)

Alluvial terraces of angular granitic boulders and pebbles are present in a few places. These are small and not very thick, and for this reason were not mapped. Their yellowish brown color makes them easily visible where they form flat tops over the Escondido and Mint Canyon formations. One terrace just outside of the eastern boundary and immediately south of the Pelona shist, is longer and much thicker than the others. It was probably

formed at a time when a stream started downcutting into thick alluvial gravels which it laid down during a period when it carried an excessive load. South of the area is the Santa Clara River, along which have been developed many terraces at different levels.

In the center of the plateau in the SW section is a low basin formed in the long syncline running the entire length of the plateau, and this is filled with water in the rainy season (PlateI , Fig. 9). The valleys vary from those with a V-shaped profile to those with flat floors and moderately sloping sides. Valleys of differential erosion at the contact between different formations are present, appearing as low saddles between the formations. A hanging valley, caused by a stream at the head of Vasquez Canyon capturing one flowing south from the basement complex is an interesting topographic form. It is shown in Fig. 8,Plate I.

The streams' valleys are in most places with flat floors and moderately steep walls, indicating the mature stage of the physiographic cycle. There is a more youthful appearance in the Middle Mint Canyon formation near the Escondido Contact, due to the typical bad land topography there. Many steep canyon walls and sharp peaks are present. This part of the formation is relatively hard, composed of Pelona schist conglomerate and some interbedded sandstone, and has weathered differently than the Upper Mint Canyon beds. The latter are chiefly pure siltstone and sandstone, and much interbedded conglomerate and sandstone. They have a tendency toward some hill and valley topography, with a few steep erosion scarps. The stage of development is in general about middle maturity.

The uplands of this area have round topped hills with steep sides and approximately V-shaped valleys (Plate I , Fig.8). In contrast to this, the lowlands have a bad land topography and some low hills and relatively wide valleys. With respect to rock distribution, most of the topographic forms are in the Mint Canyon formation. The surrounding country has topography of much the same type as this. The structural significance of this topography is that it shows soft beds that are gently folded, because there are many breached anticlines and cuestas.

Drainage

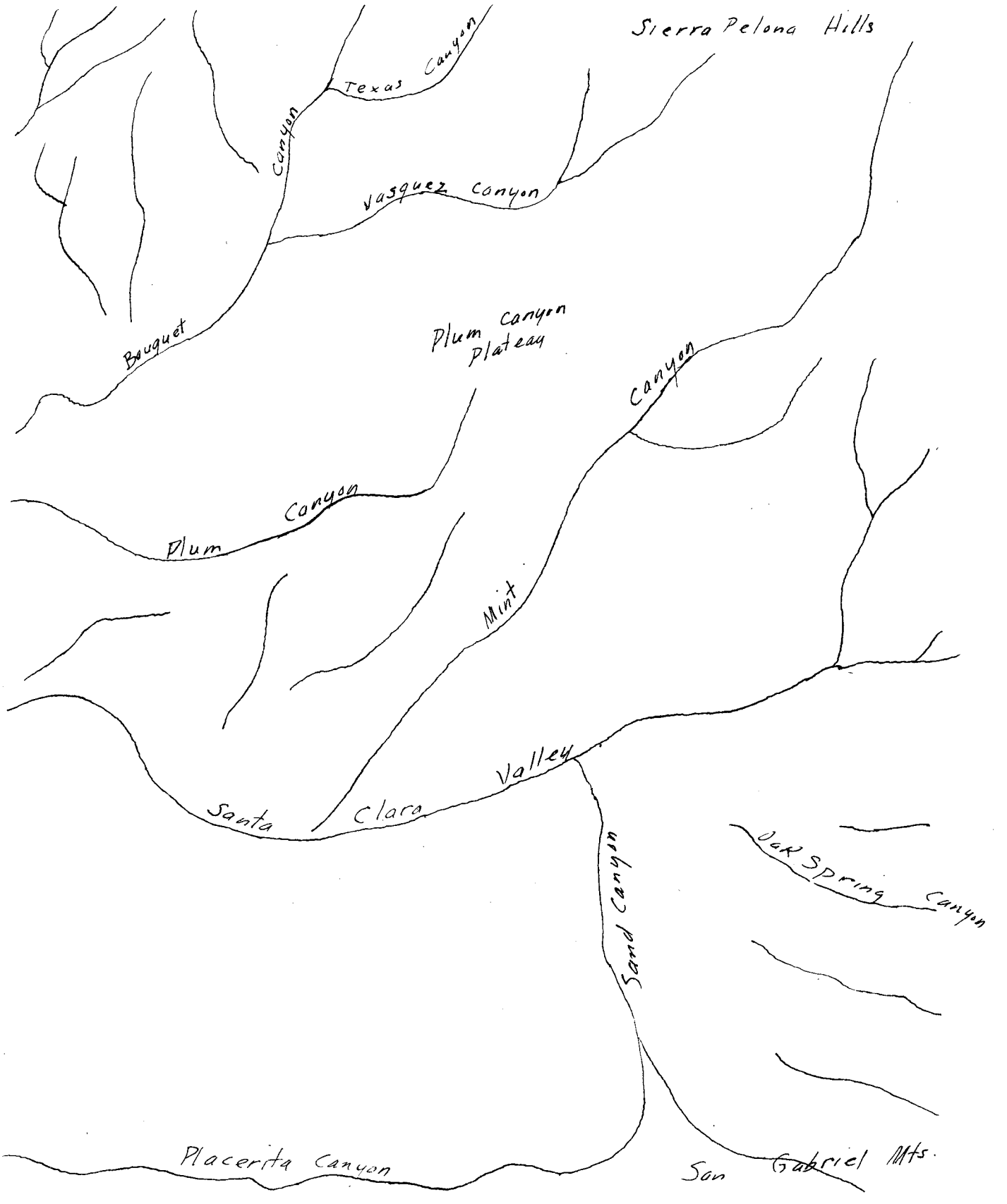
The drainage is in general south and west, from the Sierra Pelona Hills through Texas and Vasquez Canyons. From the south-western plateau there is some northward drainage. Sometimes during the winter the streams, such as the one in Texas Canyon, rise considerably and cause much damage. They are all intermittent and in general are not controlled by the underlying structure: they are insequent streams. They cut into the soft sediments at any convenient place, although some hard strata have a control in the drainage and some streams flow into the main ones nearly at right angles. However, the drainage pattern is principally dendritic, as seen in Fig.1a.

Climate and Vegetation

This area has a semi-arid type of climate. The temperature is slightly higher than on the coast, especially in summer, but there is usually a cool west wind, and the nights are cool.

The vegetation depends largely upon the kind of soil prevailing. In shade there is some grass vegetation, but the most general type is sparse sage brush and mesquite. Chaparral grows thickly in ravine bottoms. Trees are few except on some of the ravine

Fig. 1a--Drainage pattern of Humphreys Quadrangle.



bottoms, and here they are dense and small. Cottonwoods and live-oak trees are common along the principal streams. Except in ravines, vegetation is not thick, and is distributed about equally over all the formations.

Exposures and Distribution of Formations

The granitic and metamorphic rocks of the Los Angeles district are exposed in the Humphreys Quadrangle over a small area of approximately .9 square miles in extent. Outcrops are not very numerous, but in several small canyons streams have cut down into the gneiss and Pelona schist, forming steep cliffs. Pelona shist is exposed chiefly along the fault contact between the "basement complex" and the Mint Canyon formation. Here the old metamorphic sedimentary rocks have been faulted up against the sediments to the south. Exposures are few and not as conspicuous as those of the granite and gneiss. The schist contains quartz dikes which erosion has exposed in a few places. Along the rest of the Mint Canyon and basement contact, which is depositional, the basement is yellowish brown gneiss. Where the basement is exposed the hill slopes are the steepest and the topography mountainous. The highest elevation, 3025', is found in this section.

Exposed in the northernmost sections of the quadrangle is the Escondido formation, covering about 1.1 square miles. The poorly sorted conglomerate facies of the Escondido in this locality outcrops in only a few places near Texas Canyon. The outcrops are near the bottom of the canyon where streams have cut small cliffs in the Escondido. In a few other places a dip and strike cannot be taken, because the bedding is so poor. Local caliche deposits at the top of the Escondido, on the west side of Vasquez Canyon just north of the Baldwin mine, help in the location of the fault

contact between the Escondido formation and the "basement complex." The Escondido formation in this area has been eroded to long rounded ridges and round-topped hills, and is found at almost as high an elevation as the basement rocks. Outcrops of the Escondido formation are numerous farther north in Texas Canyon, where there is a better consolidated conglomerate and also a shale member. In the Los Angeles district, the Escondido, tentatively called the same age as the Sespe, occurs in Escondido Canyon, Sespe Creek, south of the Santa Clara Valley, Simi Valley and in the Santa Monica Mountains.

The Mint Canyon formation is very widespread and thick in this area, which is the type locality (Plate III, Fig. 16). It is the only other formation exposed here, and covers about seven square miles. A very fine section of Mint Canyon occurs here, especially the upper part, which is exposed along the sides of the Plum Canyon plateau. The complete change in lithology in one particular place, such as from pure siltstone and clay to coarse conglomerate with lenses of fine sandstone, and then back to siltstone, can be seen. And the gradual change toward the middle of the Mint Canyon formation into the well-rounded Pelona schist conglomerate with interbedded sandy conglomerate is easily observable. Where the change between the Upper and Lower Mint Canyon occurs is difficult to tell, and a separate study of the differentiation of the Mint Canyon formation would be necessary to determine this. The outcrops of the Mint Canyon are very numerous, forming many steep cliffs in soft beds and bold exposures in hard conglomerate beds (Plate II, Fig.12). The strata have

been eroded into much bad land topography, where most of the outcrops are found. In general, the Mint Canyon beds are much more eroded and contain many more exposures than in the Escondido or the "basement complex", and they are situated a a considerably lower elevation than the latter.

In summary, outcrops in the area are numerous and large, and related to topography in that they occur mostly in the "bad-lands", on top of ridges and on steep valley walls. There is rarely thick gravel covering the sediments, but the soil is very thin or absent, as would be expected in this type of region. Usually the soil is arkosic. Consequently, contacts are easily followed in most places, but since both the Escondido and Mint Canyon have a conglomerate member, some points in the contact are obscure.

The Mint Canyon formation is divided into three parts--Lower, Middle, and Upper--in this paper. This division was suggested by a fault which separates the Lower and Middle parts, and by the presence of the Pelona schist conglomerate only in the Middle part. The Lower part is thus practically absent from the area under discussion, being only a narrow strip on the Eastern Border. The Middle part covers about two square miles in the vicinity of Vasquez Canyon and east of Vasquez Canyon. The Upper part covers roughly one-half of the area, or about 4½ square miles.

Stratigraphy: Regional

The rocks of this region fall into three classes--a metamorphic and granitic "basement complex", a series of sedimentary rocks of many diverse types, and a series of igneous extrusive and intrusive rocks.

The metamorphic rocks are of sedimentary origin and are pre-Jurassic in age. They are chiefly quartzites, slates, limestones, and schists, intruded by granite of Late Jurassic or early Cretaceous age. Gneiss, of secondary origin, accompanies the granite.

Ranging from Upper Cretaceous continuously to the present, the sedimentary rocks are of many different types. Each formation is separated by different lithological characters and by an unconformity. Sandstone, shale and conglomerate predominate. The Upper Cretaceous is represented by the Chico formation, which is overlain unconformably by the Eocene Series, comprising the Martinez, Meganos, and Tejon formations. Succeeding these, and separated by an unconformity, is the Oligocene or Lower Miocene Sespe or Escondido formation. This is a non-marine deposit of thick coarse fanglomerate and sandstone of brown, yellow and red color, and interbedded with some shale. Grading into the Escondido formation is the partly marine Vaqueros. It is in some places conformable and in others non-conformable with the Escondido, and is determined by study of fauna to be Lower Miocene. The principal members are a coarse conglomerate interbedded with sandstone, and passing into variegated sandstone, conglomerate and clay. Unconformably upon the Vaqueros in this district is the Topanga, a well-bedded tan and brown sandstone containing large concretions

and minor thicknesses of conglomerate. Fossils of Middle Miocene age are common. The non-marine Upper Miocene Mint Canyon formation rests unconformably on the Topanga. This is not true in the Humphreys Quadrangle near Texas Canyon, where the Mint Canyon rests upon the Escondido. The Mint Canyon is a gray sandstone and shale with interbedded and interfingered sandy conglomerate in its upper part, and reddish and gray beds in the lower part. Some vertebrate mammals of Upper Miocene have been found in it. Over the Mint Canyon, in a striking unconformity, lies the Modello diatomaceous shale, clay, cherty beds, and fine sandstone, containing lenses of brown sandstone. It is marine in origin and Uppermost Miocene in age. Following the Modello shale unconformably, is the Pliocene series of the Pice and Saugus formations. The Pico is a hard, coarse conglomerate, and gray sandstone and shale, of marine origin. The Saugus is principally terrestrial, consisting of poorly sorted, conglomerate and sandstone, and some shale. Completing the generalized sedimentary section of the district are Pleistocene terrace gravels and sands forming dissected terraces at different elevations, and recent alluvium in the form of silt, sand, and gravel in the valley bottoms.

The igneous extrusive and intrusive rocks of the general region, which are not present in the Humphreys Quadrangle, are sills and flows of andesite, dacite, basalt, andesite breccia, and mud flows. They are Miocene in age, and associated with the Sespe formation.

Stratigraphy: Local

1. Jurassic(?) and Pre-Jurassic systems: Granitic and Metamorphic rocks.

The "basement complex" is made up of granite and

metamorphic rocks. The metamorphic rocks are the oldest in the area, and consist of Pelona schist and gneiss. Of sedimentary origin, the Pelona schist was probably a coarse sandstone in which feldspar predominated, judging from its appearance, but its original texture and structure have disappeared, due to intense matamorphism. It is not common in the basement in this locality as far as may be determined by the few exposures, being limited to a short strip along the Mint Canyon contact. The planes of schistosity are vertical or dip steeply south, and strike approximately parallel to the fault shown on the map in the "basement complex." A quartz dike about four feet wide cuts the schist, striking parallel to the schistosity. Part of the schist is included in the granite and gneiss, since some granite is found to the south of it, while some schist forms the contact between the Mint Canyon and the basement.

The gneiss is more common than the schist, and is found in the granite just north of the schist. It shows beautiful banded structure in places. In ravines in the Escondido formation, there are many large boulders of gneiss, indicating that the gneiss is common in the basement complex of the region. It is a highly metamorphosed sedimentary rock included in the granite. Evidences for a secondary origin are its association with mica schist and its highly contorted banding. There are wide bands of quartz and feldspar, and narrow ones of biotite. They are fairly distinct bands, but show no flow-like curves characteristic of primary gneiss and no original igneous texture. Quartz is very common in the gneiss, which tends to indicate sedimentary origin.

Another metamorphic rock found in the granite in this

locality is quartzite. This represents a finely laminated siliceous sandstone of the old Pre-Jurassic sedimentary series, and is found only near the fault contact between the "basement complex" and the Escondido. Its relation to the other metamorphic rocks is uncertain, but it may be interbedded with the schist. Like the schist and gneiss, it is an inclusion in the granite.

The granite in this area is the most abundant igneous rock. It is probably the same age as the Sierra Nevada intrusion, which is late Jurassic. In general it is highly fractured by faulting, and does not have a fresh appearance. That is, its original gray color is changed near the surface to a crumbly yellowish brown. There are different phases in the granite: some is coarse and equigranular, with a reddish color; some medium grained with a gray color, and some porphyritic.

In connection with the "basement complex" there is found a basal conglomerate in two places, along the Escondido granite contact and along the Mint Canyon granite contact. It is very angular, of pieces about 2 or 3 inches in diameter, fairly well consolidated, and resting on the granite. The fragments are granitic in composition, and are derived from the "basement complex."

2. Tertiary system.

a. Escondido formation (Lower Miocene ?)

In this area the Escondido formation is the oldest one exposed. Its exact relation to the Mint Canyon is somewhat uncertain, but it is probably Lower Miocene in age, separated from the Mint Canyon by an unconformity representing the time required for the removal of the Topanga and Vaqueros formations. This is evident from the geologic sections (Fig.7), assuming that the Topanga and Vaqueros were deposited here. The Escondido is a

typical fanglomerate deposit, consisting of coarse conglomerate with some coarse sandstone lenses.

It has many different lithological characters, but in this locality the chief outcrops are of massive gray conglomerate (Plate III, Fig. 14, and Fig. 15). One outcrop shows well-bedded and cemented conglomerate, and has a striking reddish brown color. Correcting for a mean dip of 58 degrees over a width of outcrop of .6 miles, the Escondido conglomerate is seen to be approximately 2500' thick. A picture of the Escondido unconformably below the Mint Canyon is shown in Plate I ,Fig.10 . This formation has been given the same age as the Escondido or Sespe, found in Escondido Canyon, in the Lang Quadrangle, due to its position in the geologic column. However, it cannot be traced into beds of known age, and no fossils have been found in it in the Texas Canyon locality. Since the lithology resembles that in Escondido Canyon, and it is unconformably below the Mint Canyon formation, while tending to be closely associated with the Vaqueros, which is Lower Miocene, the Escondido is probably Lower Miocene. Stratigraphically, the Escondido is isolated, being bounded by faults and sharp unconformites.

b. Mint Canyon formation (Upper Miocene).

Above the Escondido formation is the Upper Miocene Mint Canyon formation, named for the well developed beds in a large westward plunging syncline in the Upper Santa Clara Valley. They are overlapped unconformably by the Modello sandstone and shale. There is a constant difference in dip and strike between these formations.

The Mint Canyon is similar to the lower part of the Escondido. According to the main type of sediment and the lithology, it may be divided into three parts, a lower, middle, and upper,

which grade almost imperceptably into each other. The lower part consists of conglomerate, sandstone and clay of various colors, such as reddish gray, gray, and purplish gray. The dominant color is reddish gray. These reddish lower beds are not visible in the Humphreys Quadrangle, but are conspicuous in the Lang Quadrangle just east of Mint Canyon.

Faulting along the north side of the San Gabriel Mountains has cut out the lower beds of the Mint Canyon formation, and aids in dividing the Lower Mint Canyon beds from the Middle ones. In the Middle Mint Canyon are schist conglomerate beds which outcrop along the Escondido-Mint Canyon contact (Plate II, Fig. 11). One of these is shown in Fig. 2 . Besides the predominant schist pebbles it contains rounded pebbles of granite, quartz, andesite, andesite porphyry, quartzite, rhyolite, diorite, granite porphyry and basalt. This conglomerate is followed by sandstone, conglomeritic sandstone, and more pure conglomerate.

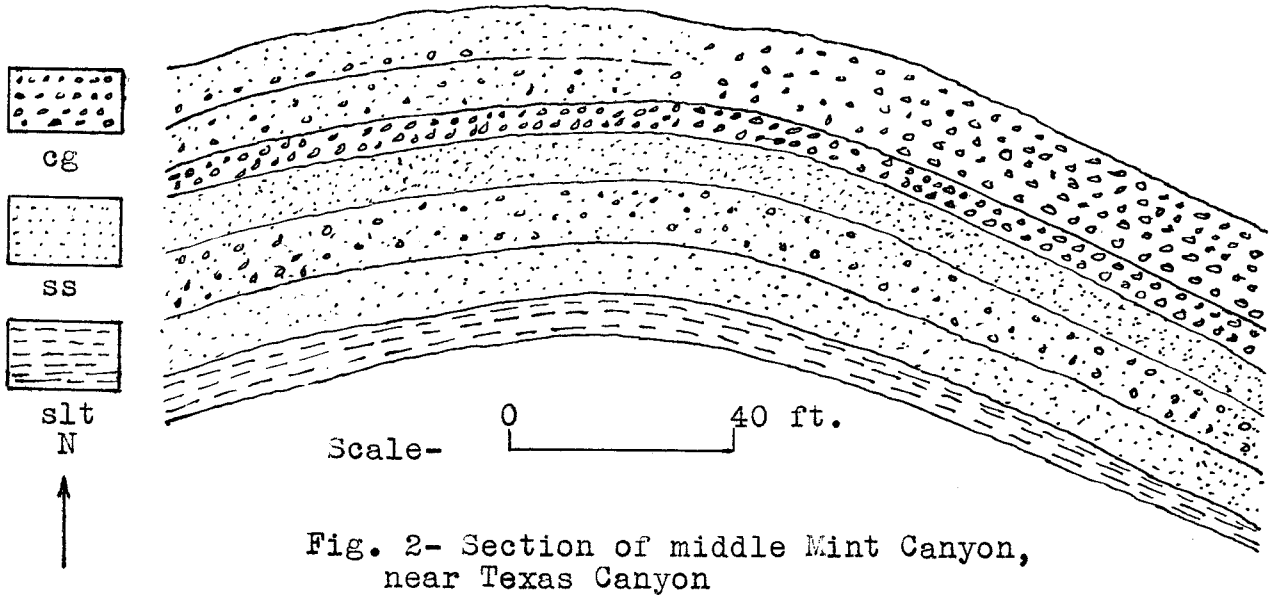


Fig. 2- Section of middle Mint Canyon, near Texas Canyon

As seen in Fig. 2 , the schist conglomerate beds are interbedded with fine sandstone, and a little higher in the section siltstone begins to appear with the conglomerate and sandstone. Siltstone

is brown in the Middle and gray in the Upper Mint Canyon. As we go up in the Mint Canyon column, siltstone increases in proportion to conglomerate, and near the top it is very common. For convenience in description, the Upper Mint Canyon is taken to begin where the typical schist conglomerate disappears. This point is practically impossible to tell on the map, since the schist conglomerate simply becomes less and less until it gradually is replaced by the conglomerate of the Upper Mint Canyon.

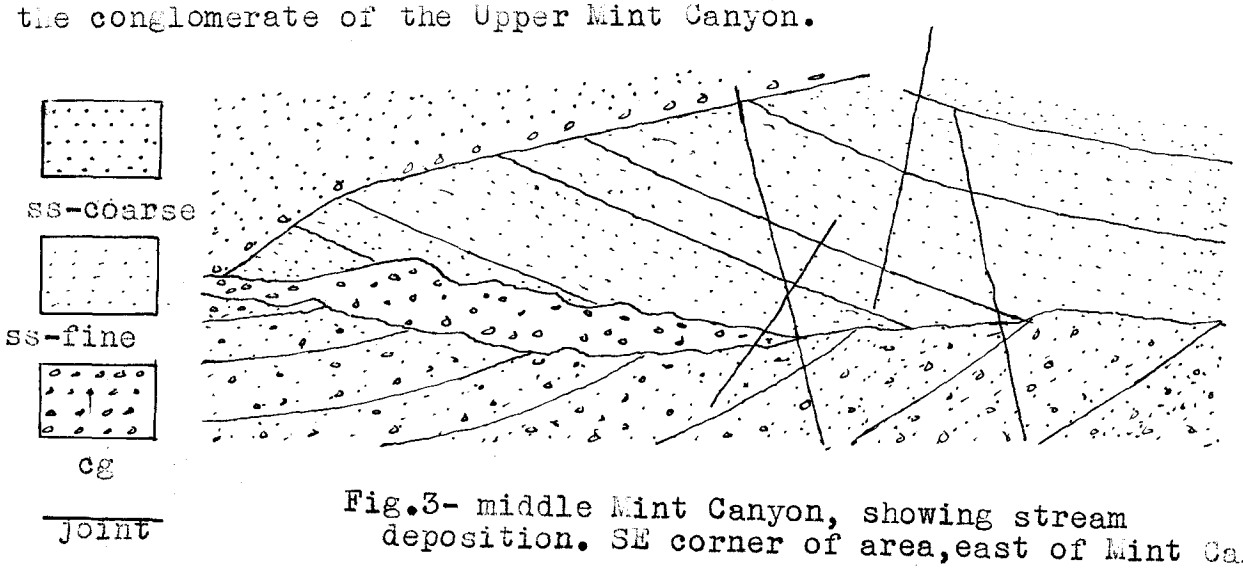


Fig.3- middle Mint Canyon, showing stream deposition. SE corner of area, east of Mint Canyon

Scale- 0 25 ft.

Near the contact with the "basement complex", the Middle Mint Canyon is a very coarse conglomerate, and looks much like the Escondido. It has a south dip of about 35°, rough bedding, and small lenses of coarse red sandy siltstone. The principal rocks are granite, gneiss, and schist.

In the Upper Mint Canyon, of larger extent than the Middle division, are light gray to nearly white gravels, interbedded with greenish and grayish clay or fine sand. These sediments were derived from igneous intrusive and extrusive rocks, and are entirely non-marine. Some impure sandy limestone is present in

the silty shale, and was probably deposited in small lake. Vertebrate remains are fairly common in the Middle and Upper divisions, a typical example being Upper Miocene horse teeth. The strata are soft and weathered into bad land topography.

Considering the Upper Mint Canyon of this area more in detail, it contains yellow, green, white, and reddish siltstone, sandstone, and conglomerate. The well stratified sandstone and clay beds or marls have lenses of conglomerate. The strata are lenticular and vary much from one locality to another. In the SW corner of the area, exposed on the sides of the plateau, there is interbedded conglomerate, sandstone and siltstone: a pure sandstone layer of 10' thickness is followed by 10' silstone beds for about 100', then a brown 20' shaly siltstone bed, then interbedded conglomerate and sandstone, then more pure siltstone layers, and finally more mixed conglomerate and sandstone. The total thickness of the cliff is 250'. Another example is shown in Fig. 4 .

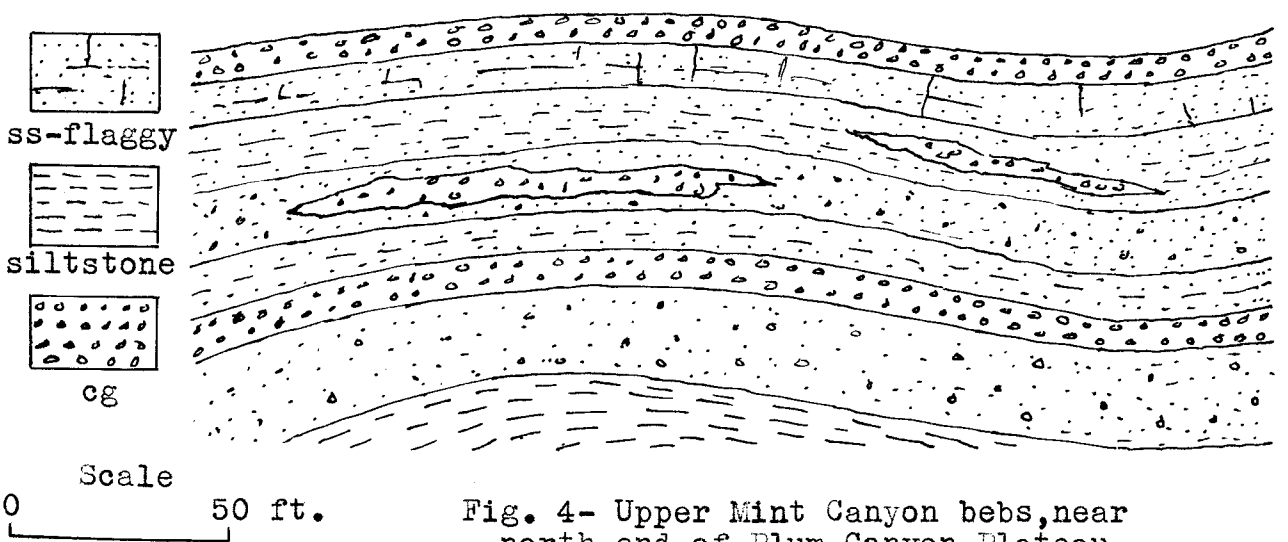


Fig. 4- Upper Mint Canyon bebs, near north end of Plum Canyon Plateau

In the southeastern part of Bouquet Canyon is coarse, light colored conglomerate, followed by soft sand and clay of gray, brown, and purplish color. Within these soft beds are thin layers of hard

brown, flaggy sandstone. Three distinct zones of white tuffaceous beds about 5' thick, separated by approximately 100' of soft clay and fine sand, form lenses near the top of the column which are easily recognized and are good marker beds. One of these is seen in Fig. 5 . Above the clay zones are light-colored conglomerate, pebbly sandstone, and intercolated siltstone series. The type locality for this is the head of Plum Canyon. These beds are much like the Saugus formation, which overlaps them in places in the los Angeles district, but the Mint Canyon beds are lighter and have softer clays and finer sands.

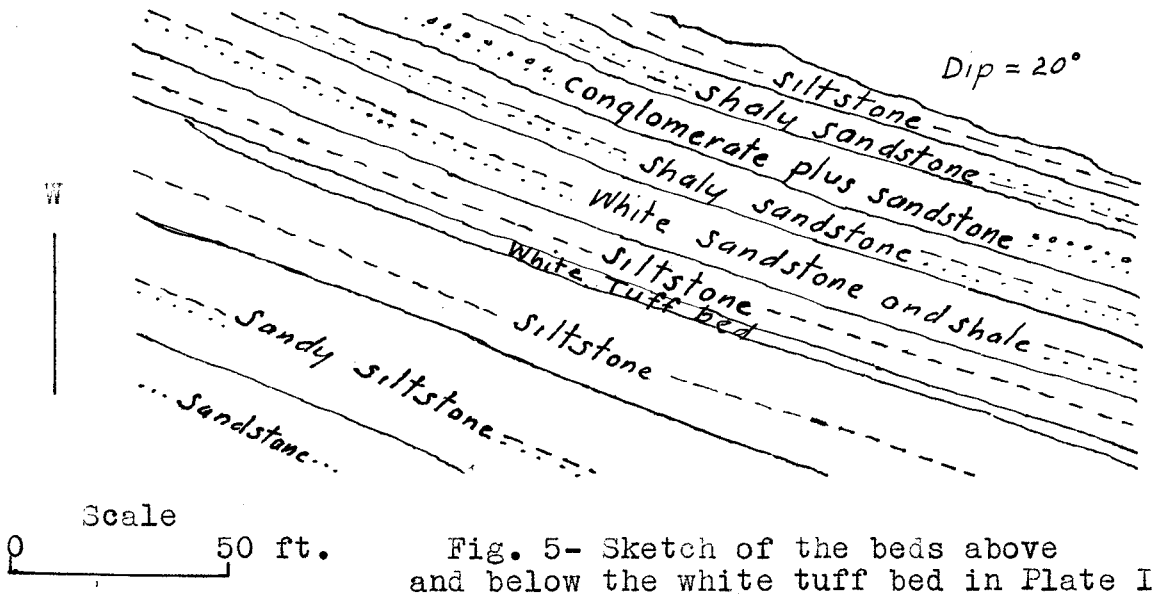


Fig. 5- Sketch of the beds above and below the white tuff bed in Plate II,Fig.

3. Quaternary system: Terrace deposits and alluvium.

The terraces in this area are very few and small and are Pleistocene in age. They are about 25' thick and near the 2000' elevation. Previous flood plains of the old Santa Clara River deposited them, thus leaving some trace of the time elapsed since the laying down of the Saugus formation. In form, they are flat, dissected, and unsorted deposits. The recent alluvium is found in the stream bottoms, and is composed of sand, gravel

and silt. It is not very thick.

Petrography: Local

1. Granitic and metamorphic rocks.

The Pelona schist is a dark, bluish gray and reddish gray micaceous schist, cut by white, coarse crystalline quartz dikes. It has pronounced schistosity developed parallel to muscovite grains, and the predominate mineral is grains of feldspar. There are also some quartz grains. All the grains are elongated and coarse. Other pieces of schist are gray, with feldspar and quartz abundant, and good schistosity.

The gneiss is brownish yellow and gray in color. It has well defined bands of feldspar and quartz, and thin bands of biotite. The texture is coarse, and the bands are usually highly folded.

The granite is coarse to fine grained, non-porphyrytic, equigranular, and brownish gray and gray in color. Feldspar is the most abundant mineral, quartz is about 10% or lesser amounts.

2. Escondido formation.

A typical outcrop of the Escondido (Plate III, Fig. 13) is of poorly sorted, rounded pebbles and boulders. The bedding is poor, but is shown by lenses of coarse grained arkosic sandstone. The average size of the pebbles is from 4" to 6", while many are larger, ranging up to 3' in diameter.

The Escondido conglomerate consists largely of granite, subangular and rounded, boulders. Some are coarse, equigranular, of reddish appearance due to the color of orthoclase, and having 80% feldspar (chiefly orthoclase), 15% quartz, and 5% biotite. Others are medium grained and gray in color, with feldspar 85%, quartz 10%, biotite 5%. Another type of granite is much weathered and

yellowish brown in color, coarse grained, equigranular, and with feldspar 80%, quartz 10%, biotite 10%. A granite of this last composition, but very hard and fresh, was also found. Some of the granite is porphritic. The largest boulders in the Escondido are gray, medium-grained granite.

Also common is banded, brownish colored gneiss, with predominating quartz, feldspar, and some gray biotite. Bands of alternating feldspar and quartz, and biotite, occur, and are well folded. This gneiss is coarse to fine grained, non-porphyritic and with a little weathering.

Quartzite ranges from small pebbles of about 1" in diameter to subangular boulders. It is rich in dark minerals, chiefly biotite, is banded, and brownish and pinkish gray in color.

Diorite is medium grained, equigranular, with about 80% calcic plagioclase and 20% biotite. The feldspar is much altered to kaolin, and this rock is not common.

Anorthosite is grayish white, of coarse grained, equigranular texture, and with bluish gray, fresh, plagioclase, probably labradorite, since it shows some play of colors. This rock is subangular, reaching from a few inches to about 1' in size, and is rather common.

Andesite is gray to lavender in color of very fine grained porphyritic texture, the phenocrysts being about 2% of the rock. They are small, elongated, and weathered to green and brown in places throughout the rock, and on the surface are weathered out, giving a vesicular appearance. Some andesite is not porphyritic, and is aphanitic in texture. The average size is about 6", well rounded.

Rhyolite is light gray, aphantic, porphyritic, slightly vesicular, and of 2% feldspar phenocrysts. Also it is finely banded, cream colored, and porphyritic.

Basalt is very fine grained, porphyritic, and much weathered. It is green, brown, purple, reddish gray, and dark gray in color. The boulders are about 6" to 1' in average size, and are well rounded and vesicular. Amygdules of calcite have been found in the basalt.

Quartz is coarse grained, white, and in small, subangular pebbles. It is not very common.

Arkose is a coarse, hard, approximately equigranular, white rock, and occurs as lenses in the conglomerate, similar to the sandstone lenses. It is made of subangular to rounded feldspar grains.

Volcanic breccia is a very hard brittle rock of gray to red volcanic fragments embedded in a red matrix. The fragments are angular, ranging in size from very small to several inches in diameter. There may be tuff in the Escondido, but none was found in this area.

On the west side of Texas Canyon, on the boundary of the area, the Escondido consists entirely of granite and gneiss, and appears to be granitic in places. The granite pebbles are angular, not well sorted or consolidated, and about 4" to 6" average size, although some are as large as 4' in diameter. The gneiss has a well-banded structure, and is composed principally of feldspar, quartz and a little biotite. It is gray and yellowish brown in color. It outcrops here in cliffs about 40' high. Besides the gneiss is an abundant black porphyritic igneous rock roughly

included ... with the gneiss. The phenocrysts are large, often several inches across. Some are chiefly of red orthoclase. They show flow structure. The ground mass is fine grained, composed of much biotite, feldspar and quartz. The phenocrysts are large, angular, elongated and of granite, and are of all sizes, grading into the ground mass. One piece was found in which there were highly contorted bands of feldspar and bands of dark minerals. The rock is a porphyritic gneiss, derived from the old "basement complex." Some of the phenocrysts are reddish, due to much orthoclase.

3. Mint Canyon formation.

Since only a very small part of the Lower Mint Canyon formation is present in this area along the fault contact with the "basement complex," and since this is only an arbitrary division, the rocks here being the same as those in the Middle division, these rocks will be described under the Middle Mint Canyon rocks.

Middle Mint Canyon has pebbles of about ½" to 3" in size, with some large boulders, and is well cemented with a coarse matrix of the same rocks. It alternates in the section with coarse mud, and the pebbles are sub-angular to well rounded, about 4" average size, and are well stratified. The Middle Mint Canyon conglomerate sonsists of Pelona schist, granite, granite porphyritic, gneiss, quartz, andesite, andesite porphyry, quartzite, rhyolite, diorite, and basalt. The Pelona schist is in small, flat, rounded pebbles, of gray and pink color, and composed of quartz, feldspar, and muscovite. The texture is coarse to medium and the schistosity is well developed. It is the most abundant rock in the conglomerate. The granite, granite porphyry, and gneiss pebbles are very similar to those of the Escondido formation, and derived from the same source.

They are on the average about 4" in diameter, subangular to well rounded, and quite common in the conglomerate. Some of the gneiss has ellipsoidal feldspar phenocrysts with flow structure around them. Andesite and andesite porphyry are red, gray, and brown, sometimes vesicular, and usually well weathered. Quartzite is much the same as in the Escondido, being dark colored, massive, and not very abundant. The rhyolite, diorite and basalt, are the same as in the Escondido formation.

The Middle Mint Canyon sandstone is coarse to medium grained, soft, and generally not well compacted, although in places it is hard and fine grained. The quartz grains are cemented by silty material in the impure sandstone, and by calcite in the pure sandstone. Calcareous sandstone is present in the Lower Mint Canyon beds. In the Middle Mint Canyon the sandstone is usually conglomeritic or is in the form of a lense itself. The grains are poorly rounded to well rounded. The rock is brown and gray in color, well stratified, and grades laterally and vertically into coarse conglomerat When associated with the conglomerate it is usually coarse grained and crumply, and is fine grained when interbedded with brown mud beds. A siliceous sandstone with quartz and granite pebbles, and other pebbles of the conglomerate, is common. Sandstone is more abundant than mudstone.

The mudstone of the Middle Mint Canyon is a dark brown, coarse, well compacted mud, overlain by pure sandstone, or by sandstone with pebbles of conglomerate, or by pure conglomerate. It is usually sandy, but is sometimes a fine soft mud. Sometimes it is more clayey, and becomes an impure siltstone. This mudstone changes gradually to gray siltstone in the Upper Mint Canyon. In it have been found Upper Miocene vertebrate fauna.

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In the Upper Mint Canyon beds, the conglomerate becomes less widespread, and is more interbedded with sandstone and siltstone. (Plate 3 ,Fig. 16). It is very hard and coarse in certain in certain beds, then outcrops on prominent ridges. The pebbles are about 3" to 4" in average size, subangular to well rounded, and often scattered through silty sandstone or sandy siltstone. They consist chiefly of granite, andesite, diorite, anorthosite, rhyolite, quartz, felsite, and basalt. No schist pebbles are present as in the Middle Mint Canyon conglomerate. The other rocks are the same as those in the conglomerate already described (Page26), and are derived from the same source. The felsite is a non-porphyritic andesite and rhyolite of light colors and aphanitic texture. The basalt and andesite are hard to distinguish, since they are both many shades of red, white, brown, and blue, and porphyritic. In general, the basalt is darker in color and more weathered.

The sandstone of the Upper Mint Canyon beds is usually a fine grained, siliceous rock, with well rounded grains, well consolidated, and cemented with calcareous and shaly material. It is almost always gray in color, and grades into conglomerate or siltstone, or is in definite beds. In places near the top of the section the sandstone is hard, white and flaggy, in beds of a thickness of about 10'. Near the same horizon are several long lenses of white tuff in the siltstone and sandstone. The most conspicuous one is shown in Fig.13 . This tuff is sure to be yellowish white with very fine black specks, and very fine in texture. The sandstone in some places shows cross bedding, formed by stream deposition. Spheres of black sand from $\frac{1}{2}$" dip to 4" in diameter are present in the sandstone, but not numerous.

The siltstone is more common than sandstone. It is a gray, very fine grained, soft, and in very thin layers. It is well consolidated and grades into fine sandstone and sandy conglomerate.

4. Terraces and alluvium.

The terraces of this area have angular to subangular granite, gneiss and quartz boulders. They are from a few feet up to 50' in thickness. They are a coarse detritus, usually of yellowish brown color, derived from the basement rock of the area.

The alluvium is coarse and fine unconsolidated sand, coarse gravel of granitic rocks, and some silt.

Fig. 6. Geologic Columns of the Los Angeles Region.

	Generalized		Humphreys Quadrangle
QUATERNARY	Recent.....	Alluvium	Alluvium
	Pleistocene...	Terrace Deposits	Terrace Deposits
	Pliocene.....	Saugus	
		Pico	
TERTIARY	Miocene.....	Modello	
		Mint Canyon	Mint Canyon (Tmc)
		Topanga	
		Vaqueros	
	Oligocene(?)..	Sespe	Escondido (Tes) (Lower Miocene?)
		Escondido(?)	
	Eocene.....	Tejon	
		Meganos	
		Martinez	
CRETACEOUS	Upper Cretaceous....	Chico	
JURASSIC	.....	Intrusive Granite	Intrusive Granite (bc)
PRE-JURASSIC	.....	Metamorphic Rocks	Metamorphic Rocks (bc)

Structure

Regional

The Los Angeles region comprises a series of more or less parallel folds, striking more nearly east than those in the coast ranges proper. This may be seen from a glance at the folds mapped in the Humphreys Quadrangle. The direction of the folds is seen well in the topography. The folds are much complicated by faulting. A large amount of deformation occurred in late geologic time, and Tertiary and Pleistocene beds were folded almost as much as the older ones. Deposits in general are largely separated by unconformities, representing the main periods of general deformation. The compressive forces acted approximately in a NS direction.

This region is a zone of soft Cretaceous, Tertiary, and Quaternary sediments which have been folded and faulted between the hard crystalline rocks in the Southern Coast Ranges and the rigid blocks of the Santa Monica and San Gabriel Mountains to the south.

Local

In the northeast quarter of the Humphreys Quadrangle the "basement complex" of the southernmost part of the California Coast Ranges is immediately overlaid in a fault contact by the Escondido formation. This contact is approximately straight and vertical, and ends where it strikes the Mint Canyon formation. It is therefore an old fault which brought the basement up against the Escondido formation sometime between the Late Jurassic and the Late Oligocene or Lower Miocene epochs.There is a basal conglomerate resting upon the granite along a short part of the length of this contact. This conglomerate is entirely of angular pieces of fresh granite derived directly from the "basement complex". There is a largely granitic conglomerate in the Escondido, but it has no resemblance to this.

Just up the slope and above the basal conglomerate, is a caliche deposit, which is common at the top of the sediments of this region. Also there is evidence of a basal conglomerate, of a different type, however, on the granite at the Mint Canyon contact. For these reasons, the basal conglomerate was included with the granite on the map, and the fault placed above it. The movement on this fault was about 2000 feet, or more.

The "basement complex" of the area is also overlaid farther to the southeast by the Mint Canyon formation, in a contact which is both depositional and a fault. The fault contact, as shown on the map, runs into the "basement complex" and disappears when it meets the depositional contact again. It cannot be found extended into the Mint Canyon formation to the west. Just to the east in the Lang Quadrangle, in cuts in the granite and gneiss near the sediments, much fractured granite and gauge zones may be seen. The contact may be traced in a straight line, and with steep dip, into the Lang Quadrangle, where it is definitely seen to be a steep reverse fault, with the red conglomerate beds of the Lower Mint Canyon dipping steeply into it. In the Humphreys Quadrangle, the contact is steep and fairly straight, and is just south of a very small outcrop of hard basal conglomerate, in a similar situation to that along the Escondido granite contact. The contact runs into the basement where there is very good evidence for a fault. To the south is the Pelona schist, which is much fractured and has approximately vertical planes of schistosity. To the north is the much fractured granite, and a definite change in lithology. Therefore, this is a fault between the Mint Canyon and the basement which ends in the basement. The movement on this fault was approximately 6000 feet.

Structure

The Middle and Upper Mint Canyon beds must have been deposited after the faulting occurred, which was in about the middle of Upper Miocene time. To substantiate this, the Mint Canyon formation shows a definite change in the character of the sediments where the depositional contact begins. Pelona schist in the basement was brought far enough up by the faulting so that the succeeding sediments forming the Middle Mint Canyon formation were made largely of schist and coarse muds brought down from steep uplands. Later in Upper Miocene time, the schist disappeared or the uplands were worn away and siltstone replaced the mudstone.

The depositional contact between the "basement complex" and the Mint Canyon formation is a typical contact of a series of sediments dipping about 35° and overlapping up on the granite. The contact runs far up the ridges in the granite and down the valleys, and is very irregular. In two places the granite outcrops again below the sediments, where there was a high spot in the basement, and where the sediments are fairly thin. Since the sediments dip away from these areas in all directions except north, they were folded into domes over these weak places in later disturbances. As shown on the map, the areas where the granite extends down under the sediments and outcrops below them are included in the granite. The dip of the sediments along the contact is definitely steeper than in all other places, and there is a coarse conglomerate at the base of the sediments, which represents the first deposition after the Upper Miocene uplift.

Overlying the Escondido formation in a steep unconformity is the Middle Mint Canyon formation. The Upper Mint Canyon beds lie conformably on this to the south, and are the youngest exposed in

this area. The Lower Mint Canyon is not exposed here, but lies down the dip of the upper beds shown in Fig. 10. The Mint Canyon beds thicken going westward. In Texas Canyon the Escondido-Mint Canyon contact runs up the side of the canyon in a wavy line and then straightens out a little for a short distance. Then the relief becomes more pronounced, and the large difference in dip between the formations causes the contact to be wavy. It tends to go up hillsides at a steep angle and not to be very far up on the ridges of the Escondido.

The structure of each formation will now be discussed without reference to the contacts. The"basement complex" is composed of granite, gneiss and schist of unknown extent. The granite has intruded the gneiss and schist, which have been exposed partly due to the uplift of the"basement complex." The gneiss is of sedimentary origin and probably lies on the schist. The schist is the oldest rock exposed. It is of sedimentary origin and of unknown extent vertically. In the schist are quartz dikes shot off from the granite, and parallel to the vertical plane of schistosity. The schist is included in the granite and is not merely to the south of it. The width of outcrop of the granite is about one mile from east to west, and it is of unknown vertical extent.

The Escondido formation is exposed in its upper part, and is dipping steeply south. It has been strongly folded and is now isolated in that it cannot be traced into any beds of known age. It is bounded by faults and unconformities. The width of outcrop of the Escondido here is about .6 miles from north to south, and the thickness exposed is roughly 2500'.

Structure

The Mint Canyon formation is in the eastern limb of the Santa Clara Valley synclinorium. The structure in general is numerous anticlines and synclines in beds of about 15° to 30° dip. A typical marker bed, such as that shown in Fig. 13 , dips 20° to south. The folds are short and plunge to the southwest. They have a northeast trend in general. There are a few which are major folds that extend across the Mint Canyon and which are easily visible in the topography. Most of the anticlines are assymmetrical and have been greatly eroded until only the remains of the limbs are visible. Part of a large fold is seen in Fig. 13 . In the process of folding, the soft sediments have in many places been faulted. The displacement ranges from 5' or less to about 500'. Fault $F_1 F_2$ has a displacement of about 250', while $F_3 F_4$ has a throw of at least 150' $F_5 F_6$ is of unknown displacement, but probably of the magnitude of 400'. Some of the faults are traceable as much as 700 yards, but in general are only 50 to 100 feet long. They are all almost vertical. The Mint Canyon formation outcrops over an area 2.7 miles wide from north to south, and is approximately 4000' thick.

In the Paleozoic era seas occasionally invaded the southern part of California, depositing the Cambrian, Ordovician, Silurian and Devonian rocks. Pre-Cambrian rocks are unknown in the Sierra Nevada and Southern Coast Ranges. Toward the close of the Paleozoic there was an intrusion of granitic rocks that is probably the same age as the Appalachian in the East. In the Triassic and Jurassic there was the marine deposition of the Franciscan series. Since the Southern Franciscan series does not extend up into the northern Los Angeles district, the oldest rocks in the Humphreys Quadrangle are the old Paleozoic sediments. These are now represented by the Pelona schist. The Pelona schist was a coarse grained sandstone probably of large extent and of fairly great thickness. The thickness of the Mint Canyon formation which has been derived from it is about 800'. Above and below this sandstone were other sediments of unknown character; the gneiss of the "basement complex" was derived from sediments immediately above the old sandstone. There was at least several thousand feet of sediments on top of what is now the Pelona schist. In early Mesozoic time seas extended over the site where the Sierra Nevada now stands, but in Southern California there was great erosion of the old Paleozoic sediments. At the close of the Mesozoic era, in late Jurassic or early Cretaceous time, the sediments were strongly folded in this area and intruded by granitic magmas. This occurred at the same time as the the formation of the "old Sierra". During the disturbance, the old sandstone was highly metamorphosed into a bluish micaceous schist. Almost all of the original character of the rock was lost, and good planes of schistosity were developed. Secondary gneiss was also formed at this time. After the intrusion, the fissures and joints of the granitic rocks and the altered sediments were

filled with veins of gold-bearing quartz--the same age as those of the Mother Lode system.

Following the Middle Mesozoic history of this region, was a peroid of erosion, invasion of the Upper Cretaceous seas, and widespread deposition of the Chico sandstone, shale, and conglomerate, of several thousand feet in thickness. It is uncertain whether the Chico was deposited in this area or not, but it may have overlapped on to the Pre-Jurassic sediments this far north. However, since there is no evidence of uplift between deposition of the Chico and deposition of the Escondido which would account for the Chico being eroded away from this area, it is assumed not to have been deposited here. The whole district is underlain by granitic and metamorphic rocks, and the highlands resulting from the Jurassic intrusion were probably in this area. The sediments of the Chico were derived from these mountains. In the early Tertiary there were more invasions by the sea of the land south of this area where the Eocene Tejon, Meganos, and Martinez formations were deposited. These do not outcrop in the Humphreys Quadrangle. Since the unconformity between the Escondido formation and the "basement complex" represents an unknown hiatus, it is uncertain whether or not any of the Eocene formations underlie the Escondido formation. If they do the vertical displacement on the fault between the Escondido and the "basement complex" must be very large, in the vicinity of 10,000', and all these sediments would have had to be eroded away. Therefore it is probable that, like the Chico, the early Tertiary sediments were not deposited here, and the first deposition after the Pre-Jurassic sediments was the Escondido formation.

In the early Tertiary, a great period of erosion took place in this area. This corresponds to the time when the "old Sierra" was being pleneplained. Some of the old sediments were by this time removed from this area. By the end of the Oligocene the area was surrounded by low country, and was in a large, flat valley. The conditions of depression were uniform and the climate was semi-arid. In this particular locality no non-marine deposition had been possible before this, and only erosion had taken place. But it is possible that other non-marine beds lie below the Escondido. Now, in early Miocene, deposition of clays and fine interbedded sandstone in playas began. This is the lower Escondido formation. After fairly thick deposits of these beds had been laid down, some volcanic activity in the form of rhyolite, andesite, and basalt flows took place. Following this, uplift occurred and the Upper Escondido was deposited. This is a coarse detritus accumulated under sub-aerial conditions in a semi-arid climate. There is coarse, reddish sandstone and alluvial fan conglomerate. The brownish red color is striking. The top of the Escondido is an ill-sorted fanglomerate. The Lower Miocene uplift was extensive, since about 4000' of sediments were deposited.

Following the Escondido formation was erosion, and deposition of the non-marine Vaqueroz formation, which in places in the Los Angeles district has been found to grade into the Escondido. Between the Lower and Upper Miocene, the first major faulting in this area occurred. The "basement complex" was brought up against the Escondido by at least a 4000' displacement, and probably larger. The Escondido was also steeply folded. Succeeding this was erosion until Upper Miocene. The Topanga formation was not deposited here.

Historical Geology

In Upper Miocene time, the Lower Mint Canyon formation was deposited unconformably on the Escondido formation and on the "basement complex." The conditions of deposition were sub-aerial, in a semi-arid climate. The land was relatively low, serving as a source of a fine sandstone and shale beds. There were local lakes in the broad valley in which calcareous sandstone was deposited. A reddish color is common. When about 1000' of lower Mint Canyon beds were laiddown faulting occurred in the "basement complex" again. This was about the time the present Sierra Nevada was formed as tilted fault block. After the faulting, the upper Mint Canyon beds were deposited. The valley of deposition was large and similar to the great valleys of California today. Mountains composed of granitic and metamorphic rocks surrounded it. The conglomerate and sandstone lenticular beds were laid down irregularly and alternating with mudstone beds. Early conglomerates were fanglomerates of the Santa Clara River, derived from sources to the north and east. As the highland wore down in Upper Miocene, fewer sediments were accumulated, but they still differed in different places. Following their deposition, the Mint Canyon beds were gently folded, faulted to some extent, and eroded to the present conditions of exposure. Pliocene sediments overlap the Mint Canyon, but are absent here. Deposition of Pleistocene terraces that have been dissected and left at different elevations, and of Recent alluvium completes the geologic history of the area.

Plate I

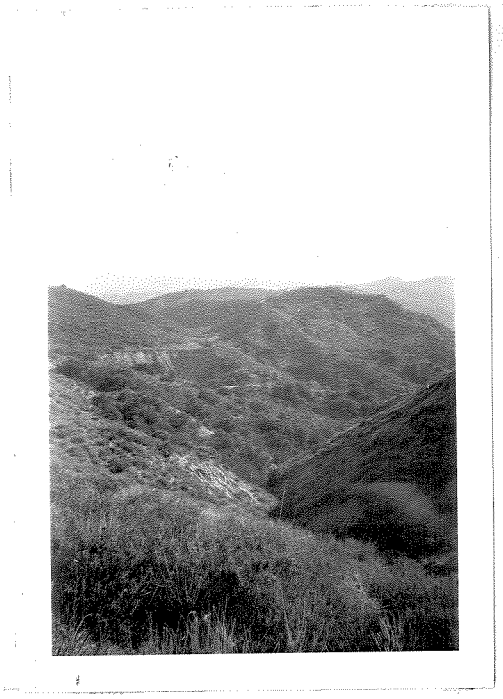

Fig. 8- View of captured stream in Vasquez Canyon

Fig. 9- Overlooking Plum Canyon Plateau

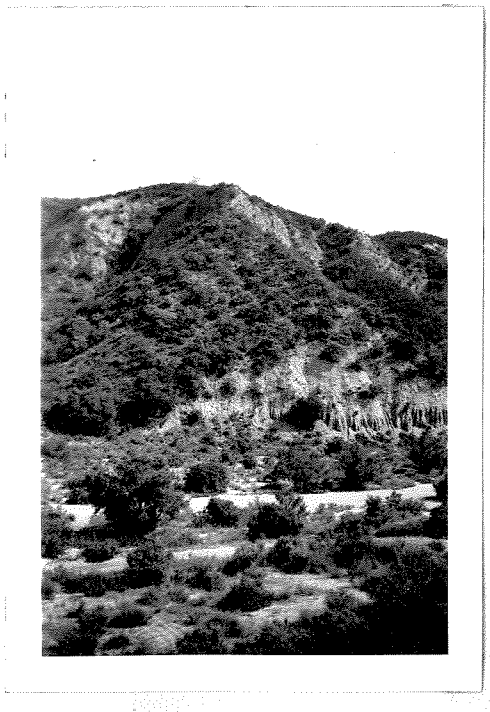

Fig. 10 The Mint Canyon formation overlying the Escondido formation, in Texas Canyon

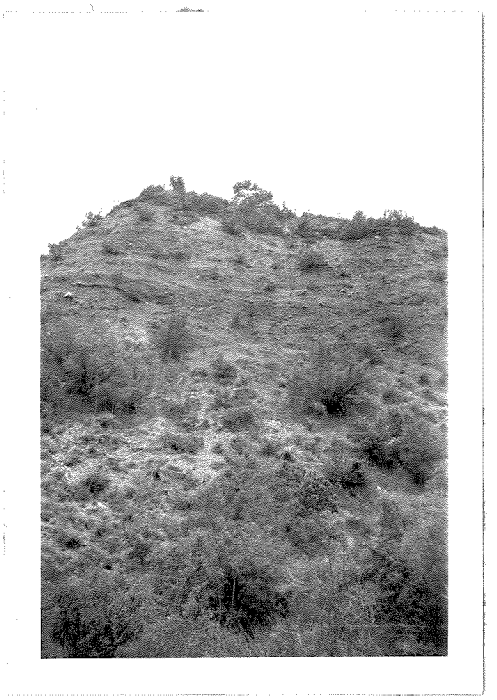

Fig.11-Outcrop of middle Mint Canyon formation in Texas Canyon

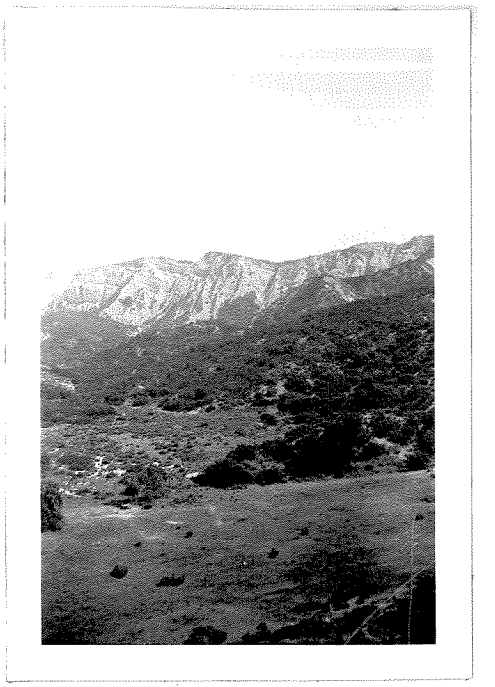

Fig.12-View of Plum Canyon Plateau from Bouquet Canyon

Fig.13-The edge of Plum Canyon Plateau showing tpyical white tuffaceous bed as a lense in the sediments

Plate III

Fig.14-An outcrop of the Escondido near Texas Canyon

Fig.15-Another outcrop of the Escondido formation

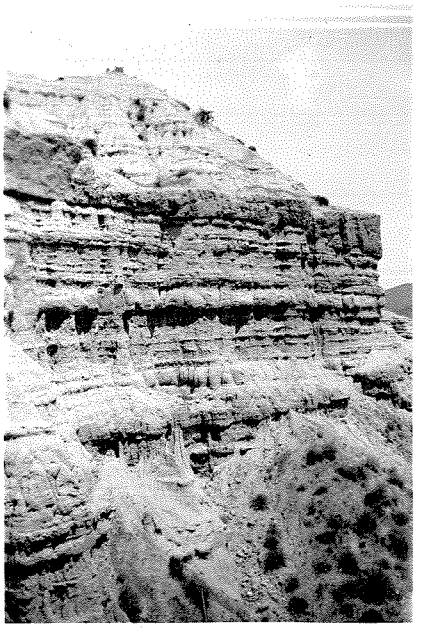

Fig.16-A typical exposure of the Mint Canyon formation