GEOLOGY OF THE ELYSIAN PARK-SILVER LAKE DISTRICT,

LOS ANGELES COUNTY,

CALIFORNIA

By Harry W. Carlson

1945

ABSTRACT

This is a report on the general geology of the Elysian Park-Silver lake district; a six square mile tract of hilly country lying just north of the city of Los Angeles.

The rock units present are granitic bedrock of Jurassic(?) age, sediments of Tertiary age and Quaternary alluvium. The bedrock is a granodiorite; the Tertiary beds which are divided into the Topanga of middle Miocene and Modelo of upper Miocene ages are made up of sandstone and shale; and the Quaternary alluvium consists of reworked Tertiary and granitic bedrock detritus.

The main structural feature over most of the area is a wide east-west anticline. A few extensive faults and a great many minor faults occur, all of which dip at a high angle.

The geologic history of the area began with the intrusion of the granitic bedrock. The area was then extensively eroded exposing the bedrock to the surface. Then followed the unconformable deposition of the Topanga formation, followed by folding and faulting. Later unconformable deposition of the Modelo occurred, followed by more folding and faulting. There is a time break between upper Miocene and upper Pleistocene in sedimentation. In upper Pleistocene time alluvial fans were deposited over the northern part but later partially eroded off to give present landscape.

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GEOLOGY OF THE ELYSIAN PARK-SILVER LAKE DISTRICT, LOS ANGELES, COUNTY, CALIFORNIA

INTRODUCTION

Location of Area

The Elysian Park-Silver Lake district is made up of a group of hills lying between the cities of Los Angeles and Glendale, California. They form an oblong, upland area trending northwest-southeast, parallel to the Los Angeles River which lies along the east side.

The hills extend northward into Griffith Park, where with gradual increase in relief they pass into the eastern tip of the Santa Monica Mountains.

The district is named after the two main geographic features in the area. Elysian Park covers most of the south half and Silver Lake is the most notable geographic feature in the north half of the area.

Size and Bounds of Area

The Elysian Park-Silver Lake district is roughly 4-25 miles long by 1.50 miles wide making an area of approximately 6.50 square miles. In its long dimension, it extends from the Southern Pacific railroad yards on the south to Los Feliz Boulevard on the north. Sunset Boulevard forms the southwest boundary and Riverside Drive forms the northeast boundary.

Purpose of Investigation

The investigation was undertaken to record and interpret the general geology of the region. More specifically, it was to map formational contacts, faults, folds and dip and strike of beds; to prepare cross-sectional profiles and a geologic column; and to write a report supplementing and interpreting the data collected.

Method of Investigation

Base maps of the area were made from United States Geological Survey Topographic Maps by photo enlargement to double size. The Los Angeles Quadrangle and Glendale Quadrangle surveyed in 1925, were used for this purpose.

Points were located by topography and Brunton Compass intersection. Each point established was numbered and represented an outcrop. As many data as possible were plotted on the map in the field. The rest, being mostly descriptive, were recorded opposite a corresponding number in the field note book. The stratigraphic section was measured by pace along the traverse shown on the geologic map at the south end of Elysian Park. The distances obtained were checked by scaling on the map distances between located points along the traverse. Strikes and dips of strata and directions and slopes of traverse were recorded along with the paced distances. The true thicknesses were obtained later by trigonometric calculations.

Before beginning the field work, some time was spent looking over published reports on the geology of the Los Angeles area.* The information obtained from these papers, especially concerning stratigraphy and nomenclature, is noteworthy. There has been no

* A list of publication used as references is given on page 20.

report published, however, covering the Elysian Park-Silver Lake district in recent years.

Geography

Except for Elysian Park this area is entirely residential and has shown by the many new houses great increase in population in the last 25 years.

The several main boulevards and trolley lines together with a complete network of streets give excellent accessibility to all points in the area.

Plant ana soil coverage and the general soft nature of the rocks preclude any natural outcropping of formations. However, many exposures are found along road cuts and some in clay pits and landslide areas in the southern part of the area.

Elevations above sea-level range from 315 to 800 feet; the average and the most common elevation in the region is about 600 feet. The greatest relief is about 500 feet but the average is close to 300 feet.

The topography is rolling and hilly and is contrasted to the flat valley of the Los Angeles River which lies to the east. The southern part is more hilly and presents the greatest relief. Towards the north it gradually decreases to about 300 feet in the north end.

A stream divide is located close to the east edge of the area, parallel to its long dimension. About 20 percent of the area drains to the east directly into the Los Angeles River and about 80 percent drains to the southwest and joins the Los Angeles River farther downstream. East of the divide the drainage slope is very steep whereas west of the divide it is more gentle. Owing to the semi-arid climate, all the streams in the area are intermittent, flowing only when it rains.

STRATIGRAPHY

General

The formations underlying the Elysian Park-Silver Lake district can be classed in three major groups: the granitic bedrock of Jurassic(?) age, the sediments of Tertiary age and the alluvial and terrace deposits of Quaternary age. These groups are separated by faults or major unconformities.

Granitic Bedrock

The oldest rocks in the area are part of the granitic intrusive body located at the extreme north end of the area. It is believed to be of Jurassic age, although that has not been determined definitely. It underlies all the later sediments and probably is the bedrock for the whole or a great part of the Los Angeles Basin. It is brought to the surface in this region both by faulting and by erosion.

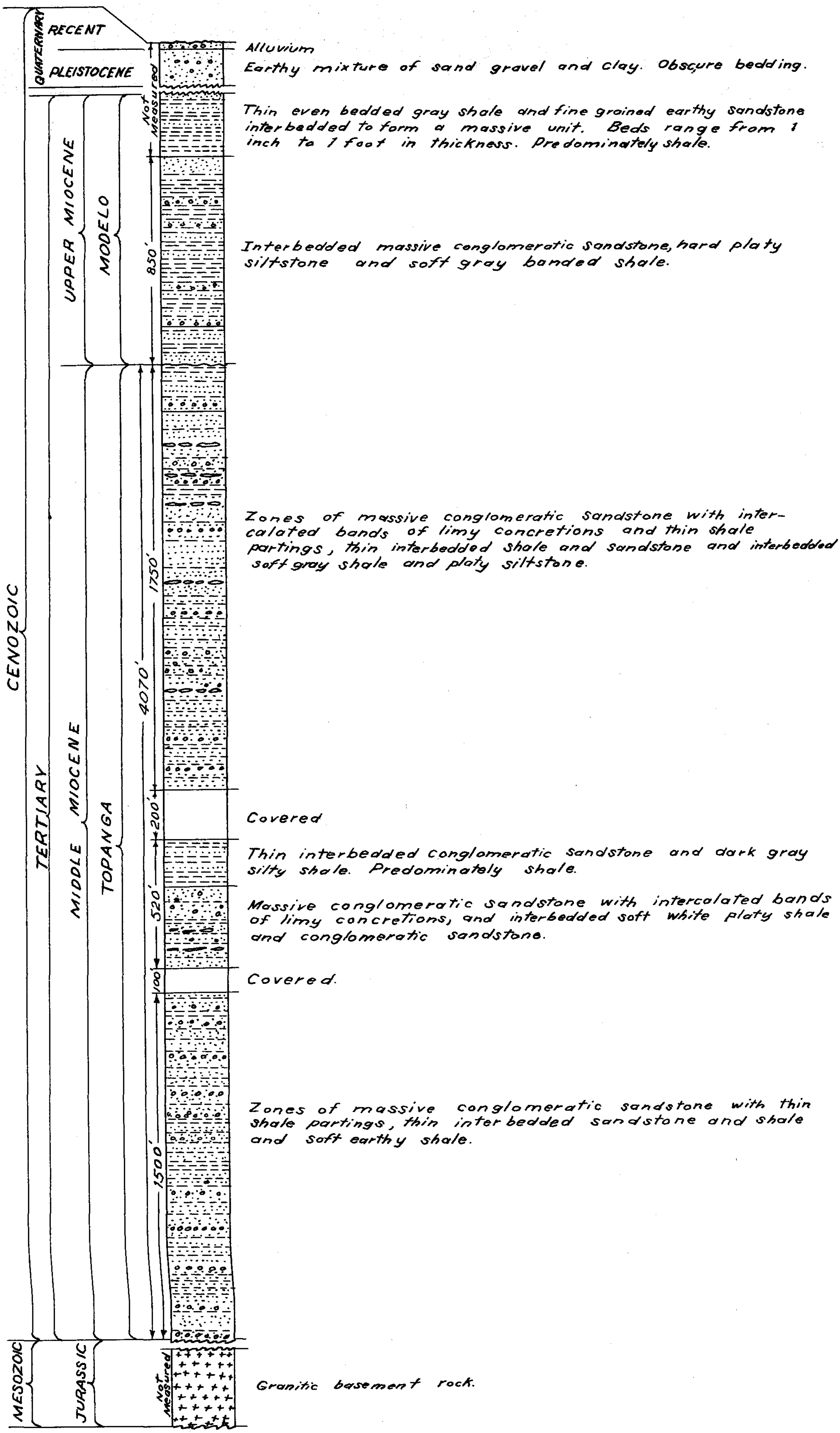
In general, the granitic rock in this region is variable in character grading from granites to granodiorites to diorites. In the area mapped the weathering is so extensive as to make exact determination difficult. However, to the north where better exposures are present, there is a high percentage of plagioclase feldspar and it is not unlikely that the rock is a granodiorite in this vicinity.

The weathered rock is soft and crumbles easily. Freshly broken surfaces exhibit a preponderance of milky white plagioclase grains, some orthoclase grains, a minor amount of quartz, numerous soft weathered biotite flakes and an overall iron staining. The iron staining is the result of hydration of hematite to limonite and may have come from the granitic rock or from overlying sediments. It gives the rock a yellowish brown color.

COMPOSITE GEOLOGIC COLUMN OF THE ELYSIAN PARK - SILVER LAKE DISTRICT

Scale : 1" = 500'

By Harry W. Carlson
1945



A good exposure of the granitic bedrock and the Miocene sediment contact can be seen a few blocks north of Los Feliz Boulevard on Amesbury Road. Here the granodiorite shows a greater amount of weathering than the overlying sediments. The reason for this may be twofold: 1) the sediments contain more quartz, 2) the surface of the granodiorite intrusive was weathered before the sediments were deposited.

Tertiary Sediments

The Tertiary sediments are confined to the middle and upper series of the Miocene epoch. The Topanga formation of middle Miocene age and the Modelo formation of upper Miocene age are the main geologic formations present in this area. About 90 percent of the land surface is underlain by these formations.

Topanga Formation

The Topanga formation is the oldest sedimentary formation in the Elysian Park-Silver Lake district. It forms the core of a great east-west anticline as illustrated at the north end of the geologic map.

The section was measured for some 4000 feet of thickness from the top contact downward to the axis of the anticline and the bottom contact was not reached. Hoots divides the Topanga into three separable units: the lower unit consisting of gray conglomerate and loose granitic sandstone; a middle unit of massive more indurated beds of conglomeratic sandstone, shale and a thick body of basalt of both intrusive and extrusive origin; and an upper unit of soft shale and sandstone. Only the middle and upper members of the Topanga formation are exposed in this area.

The formation here consists essentially of conglomeratic sandstone and shale with the conglomeratic sandstone greatly predominating. Little change is noted in the lithology throughout the exposed section.

The beds are divided into zones of massive conglomeratic sandstone with thin shale partings, zones of interbedded shale and sandstone and zones of shale with a minor amount of intercalated sandstone.

In the massive conglomeratic sandstone zones which average about 500 feet across individual beds as thick as 30 feet are present. The thin shale partings range from several inches to several feet in thickness. Limestone concretions are present in many of the sandstone beds in the upper half of the section. They are oval shaped measuring about three feet long by one foot wide and occur in bands laying end to end as exposed on cliffs and cuts.

The grain size in the sandstone ranges from very fine to 6 or 7 millimeters in diameter. There are two preferred grain sizes: a small size with diameters ranging from 0.1 to 0.3 millimeters and a large size with diameters ranging from 3 to 6 millimeters. The small grains are yellow, opaque and cherty and the large grains are of transparent quartz, with a pitted surface suggesting a granitic origin not far removed.

Soft gray earthy sandstone is present in the thinner sandstone and shale series. The gray color is due to a greater amount of biotite flakes and the softness is due both to biotite and an increased amount of arkose.

About 300 feet of harder somewhat more compacted sandstone is exposed on the cliff near the juncture of Riverside Drive and the Arroyo Seco Parkway. The sandstone both above and below is softer.

Throughout most of the section shales are found as thin partings between more massive sandstones. Thicknesses of individual beds vary from very thin to about 15 feet. All the shale is thinly laminated and in some places thin seams of gypsum are found.

The shale throughout the section is soft and clayey and may be diatomaceous in many places. In the upper part close to the contact the shale is whiter and more powdery and contains a small amount of silty shale and siltstone.

Near the center of the section about 2000 feet below the Topanga-Modelo contact is a shale zone close to 200 feet thick. It differs from the other shale zones in that it is much thicker and contains different mineral constituents. It is made up of thin bedded gray to brown shale with a minor amount of interbedded sandstone. The sandstone percentage increases towards the bottom of the zone. The shale fragments weather into flattened concentric discs averaging one inch in diameter. The shale is thinly laminated and has a schistose structure. It is composed of minute angular grains of obsidian, small rounded quartz grains, chlorite grains and some partially kaolinized feldspar particles in a fine grained ground mass probably of chlorite and clay mixture.

A similar type of material was noted in a much thicker bed in Griffith Park. But there the rock is blacker and harder than the shale described above. It contains less chlorite, feldspar and quartz but more obsidian fragments. This would indicate that Griffith Park was closer to the source of lava, which made the obsidian fragments, than was the Elysian Park-Silver Lake district.

Modelo Formation

The Modelo formation flanks the Elysian Park-Silver Lake district on the northwest and southwest sides exposing only about the lower 1000 feet of section. In the Los Angeles region the Modelo is said to lie unconformably on the Topanga formation; the Topanga everywhere showing a decidedly greater angle of dip. However, in this region the angle of unconformity is not very great.

Detailed foraminiferal studies have been made of the Miocene formations and have served as useful criteria for locating formational contacts. However, in this report the contacts are established by purely stratigraphic and structural differentiation.

The siltstone and shale of the upper Topanga grade into the siltstone and shale of the Modelo but the amount increases noticeably at the base of the Modelo and serves as a marker for the contact between the formations. Like the Topanga, the Modelo contains conglomeratic sandstone but in much lesser amounts. There are only a few massive sandstone beds and they are near the base.

In the lower 850 feet the lithology is not unlike that of the upper Topanga formation where the zones of thin bedded sandstone and shale predominate. The sandstone is variable in hardness grading from hard calcareous, conglomeratic type to soft fine grained gray sandstone rich in biotite fragments.

A massive sandstone lens appears at the base of the Modelo and shows up in the raad cuts of Sunset Boulevard between Silver Lake Drive and Glendale Boulevard. It is exceptionally soft and loosely consolidated, reaching a thickness of about 50 feet. Intercalated in the bed are bands of shale, conglomerate and concretions.

For a great thickness above the sandstone lens the formation is made up of interbedded thin sandstone beds and shale beds; the average thickness of the individual beds is about 6 inches. The shale is gray and spongy and the sandstone is fine grained to silty.

Terrace and Alluvial Deposits

The terrace and alluvial deposits were all layed down in the Quaternary period from late Pleistocene to the present. In mapping no attempt was made to differentiate between the Pleistocene and Recent deposits. However, several distinct types of beds were observed and a brief description will be given for each. The dating of the beds is hypothetical, based on physiographic position and degree of consolidation.

Physiographically, the Quaternary deposits may be divided into three types: an alluvial fan deposit, valley terrace deposits and valley alluvium.

The alluvial fan deposit appears at the northwest corner of the area where it covers a considerable portion of the Tertiary rock, as can be seen on the geologic map. The bulk of this deposit is late Pleistocene in age and derives its material from the granites and basalts of the Santa Monica Mountains which lie to the north. The Quaternary deposit east of the alluvial fan is similar to the fan deposit and was probably connected to it prior to a recent uplift. A good exposure of the Pleistocene alluvium outcrops in a road cut on Monon Street about a block north of Hyperion Boulevard. Here the formation is horizontally bedded and made up of a mixture of conglomeratic arkosic and quartz grains, clay, biotite and limonite to form a rather well cemented deposit. Concentrations of the conglomeratic grains give rise to rough obscure banding.

Stream bench or terrace deposits are located in some of the valleys in the north end of the area. They occur along the sides of the valleys and are usually rounded off due to vegetal growth. Their tops are not over 25 feet from the valley floor and serve as excellent building sites. The bottoms of most of the valleys are covered with a thin layer of alluvium derived from the terraces and older rocks above. The materials in the valley terrace and alluvium deposits are much the same, both containing reworked detritus from the older Tertiary beds. The terrace deposits which are of late Pleistocene age contain some fossil organic plant remains but the Recent valley alluvium contains a great deal of organic substance or humus.

STRUCTURE

Folds

The older and the main structural feature of the Elysian Park-Silver Lake district is the east-west anticline, the axis of which passes through the middle of Silver Lake. The general dip of the strata indicates a westward plunge of the anticline and a somewhat steeper south limb than north limb. The top of the anticline has a gentle dip but the dip becomes progressively steeper away from the axis.

There are several secondary anticlines and associated synclines in the area that parallel the main anticline. They are gentle folds with low dips and, like the major anticline, have a westward plunge. In a sense the major anticline could be considered an anticlinorium since it includes secondary anticlines and synclines; however, they are few in number.

Locally, fault blocks have been tilted so as to obscure the presence of the anticline. Its presence becomes evident, however, when the dips of all the beds in the area are considered as a whole.

In the south, around Elysian Park, the strata are squeezed to a more east-west strike to parallel the structure of the Los Angeles oil field.

Faults

Owing to the pervasive plant coverage and soft character of the rock, the task of tracing fault exposures in the Elysian Park-Silver Lake district is a difficult one. To further confuse the geologist is the great number of insipient adjustment faults of indeterminable displacement or extent. It was necessary, therefore, to qualify all the faults extending beyond actual outcrop of the fault as hidden or suggested faults.

GEOLOGIC SECTIONS THROUGH THE ELYSIAN PARK-SILVER LAKE DISTRICT

Horizontal and vertical scale
1" = 1000'

By Harry W. Carlson
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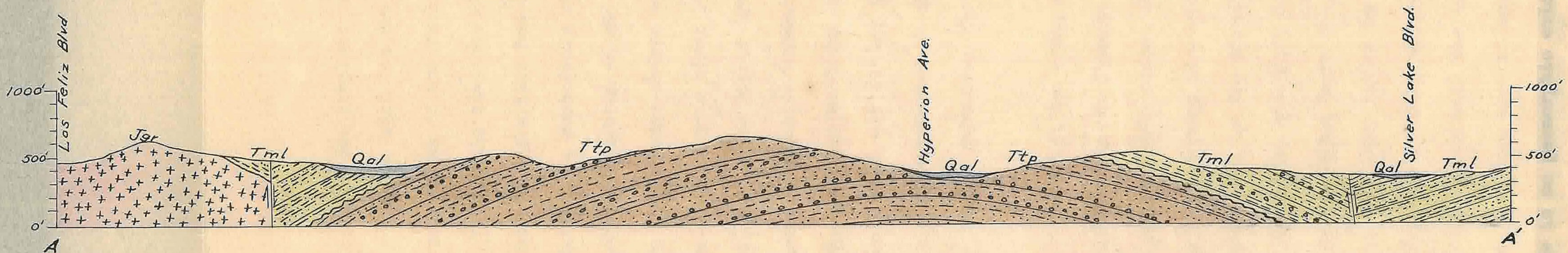
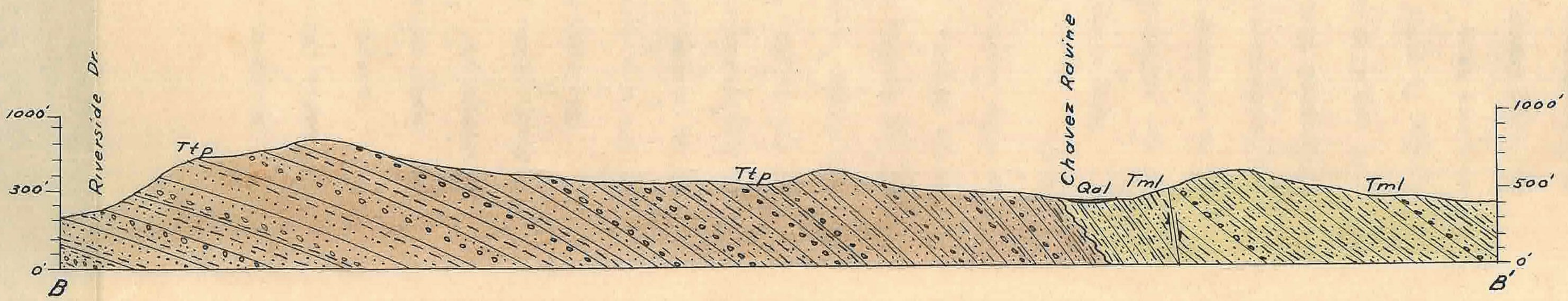
EXPLANATION

Qal - Quaternary alluvium
Tml - Tertiary Modelo formation
Ttp - Tertiary Topanga formation
Jgr - Jurassic granodiorite



Section west of Silver Lake



Section through Elysian Park

In the north end a fault lifts the granitic bedrock up against the Modelo formation of upper Miocene age. On the east end of the fault, Modelo is present on both sides of the fault and does not show any great change in facies. This would indicate that the fault displacement is not very great and that granitic bedrock underlies the Tertiary beds south of the fault at a reasonably shallow depth.

The long fault in the Modelo formation on the southwest edge of the area parallels roughly the Topanga-Modelo contact. Whether it is a reverse or normal fault is unknown since the only indication of its presence is the difference in the dip of the beds on each side of the fault. Through the Modelo formation between Glendale Boulevard and Silver Lake Drive no suggestion can be found of a continuation of the fault, and it is assumed to be cut off and pass into transverse faults. This anomaly may be attributed to the presence of the massive sandstone lens of the Modelo formation that underlies this area.

Many minor faults occur throughout the area, more particularly in the softer Modelo formation than in the Topanga formation. There is no discernable pattern of these faults except that some occur along joint fractures which would give them some consistency of strike, but in general the strike and dip as well as the direction of displacement are diverse. They were caused by secondary dispersed stresses acting in many directions from the major force direction. The dispersed stresses were set up when thin weak beds failed by rupture from some directed force. All the faults of secondary nature occurred either contemporaneously with early folding or with the later major faulting. It is not unlikely that there have been several successive stress reversals in the area. There is no geomorphic evidence of any recent faulting.

Unconformities

Unconformities exist between each of the three major geologic groups present in this area and between the individual units in the Tertiary and Quaternary systems.

There is a nonconformity between the Tertiary rocks and the granitic bedrock. An exposed contact between the bedrock and the Modelo formation found on Amesbury Road just north of Los Feliz Boulevard is tilted at a high angle and the overlying sediments lie parallel to the contact. This would indicate that the bedrock has been tilted to that high angle since the Modelo was deposited in Late Miocene time.

The Modelo just above the contact is made up chiefly of arkose or reworked bedrock. In view of Hoots' observation that most of the granitics in this region are brought to the surface by faults it may be concluded that this is a fault contact, and the arkose is merely the gouge. However, the continued parallelism between the contact and the sediments higher up and the absence of shearing planes strongly suggest a sedimentary contact.

In most of the Los Angeles region the Modelo formation lies with an angular unconformity on the Topanga formation. In the Elysian Park-Silver Lake district no direct evidence could be found of an angular unconformity between the two formations. Hoots substantiates this somewhat in his statement that there are "local exceptions" to this generality. This contact then is a disconformity.

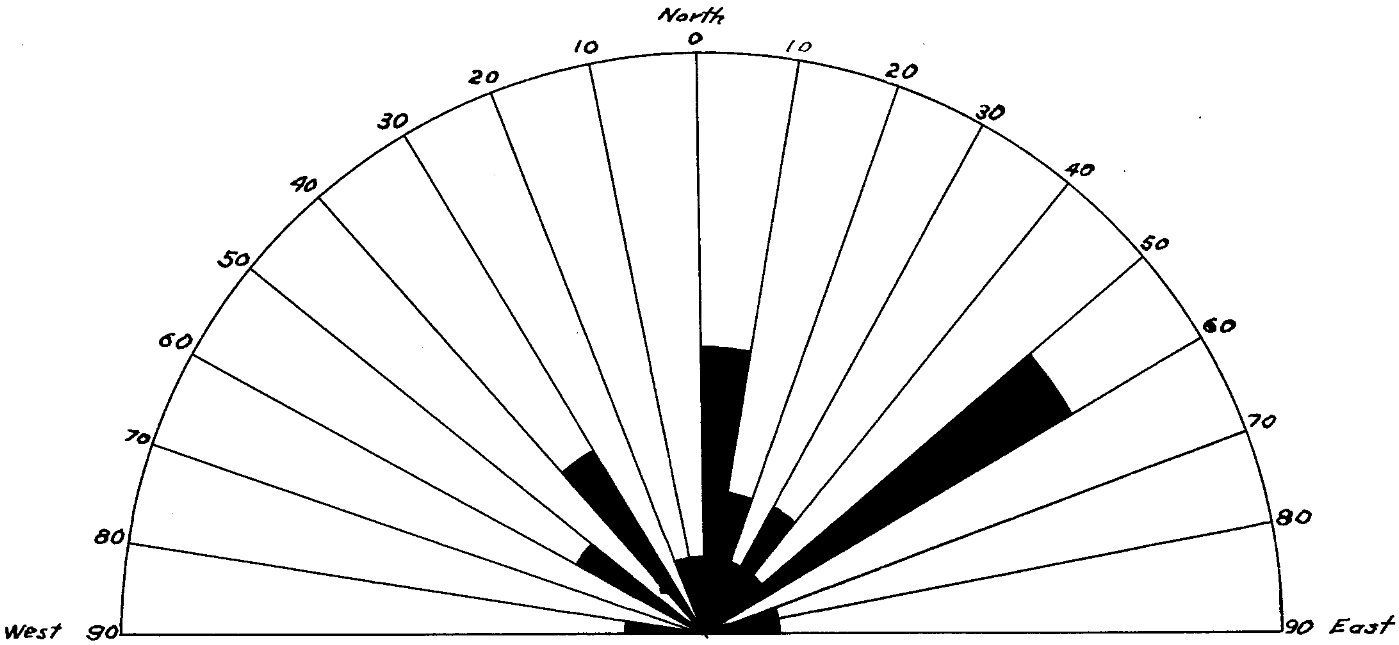
The Quaternary alluvium overlies all older formations unconformably in this region since there is a time lapse from upper Miocene to late Pleistocene. Also there is little doubt that an unconformity exists in some places between the Pleistocene and Recent deposits where they come in contact.

Joints

Except for the massive sandstone beds all the Tertiary beds are jointed. The joint spacing depends on the thickness; the thinnest beds contain the greatest number of joints; the spacing in some beds such as the thin Modelo shale may be as close as three joint fractures per inch. A total of 26 bearings were taken for the better, more clearly defined joint sets. These are plotted on the chart on page 16. Actually each joint bearing taken represents a great number of individual joints that were aligned to make a set. All degrees of joint orientation are to be found; in some instances the direction of joint orientation was unmistakable, in others, it was doubtful. The dips of all the joints were very steep and no record was made of them.

From the joint diagram it can be seen that the long wedges are oriented roughly at 45 degrees apart; one north-south, one northeast-southwest and one northwest-southeast. The north-south wedge is perpendicular to the east-west trend of the major anticline and may be considered to represent the longitudinal extension joints of the anticline. They are caused by slight elongation parallel to the axis of the fold. The northwest-southeast wedge and the northeast-southwest wedge may be considered as the shear fractures set 45 degrees apart from the north-south compressive force that raised the anticline. The gradual increase in wedge length from the northwest around to the northeast shows that the northeast was the direction of greatest relief for the stresses set up.

Thus it may be summarized that the forces causing the anticline were compressive and acting in a north-south direction.



JOINT DIAGRAM

Showing strike orientation of joints in the Elysian Park - Silver Lake District.

Scale

Each division equals one joint.

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GEOLOGIC HISTORY

The geologic history of the Elysian Park-Silver Lake district began with the intrusion of the granitic bedrock with subsequent erosion exposing the bedrock to the surface. Then followed the unconformable deposition of the Topanga formation of middle Miocene age over the lower Miocene sediments and probably over some of the granitic bedrock. Owing to widespread volcanism in the headlands area during middle Topanga time a mixture of detrital volcanic glass, tuff, sand and clay was deposited.

Then came a period of diastrophism in which the area was uplifted from its marine surroundings and subjected to degradation. The uplift was accompanied by folding and faulting forming the east-west anticline, but in a more subdued form. At the beginning of upper Miocene the area was again inundated and the Modelo sandstone and shale was deposited unconformably on the Topanga formation.

From late Miocene time to late Pleistocene time there is no geologic record of events in this region. All that is known is that the beds were further folded and faulted after the deposition of the upper Miocene to give the structure now present in the Tertiary formations. At the same time the area was uplifted and eroded.

In late Pleistocene time there was a still-stand while alluvial fan deposits spread over the northern part of the area and the streams were aggrading. The final uplift that marked the end of Pleistocene time is still in effect. It has eroded off much of the detrital fan deposits and also the Pleistocene valley alluvium forming the valley terraces. With the final uplift the area has come to its present land form.

GEOMORPHOLOGY

The land form of this region differs from the typical semi-arid type only by the modifications brought about by very mild winters affording continuous year around plant growth. The plants hold the soil in place giving the surface a more rounded subdued form typical of a more humid climate.

The hill slopes are rounded concave upwards at the base and convex upwards at the summits. There is no evidence of an "old land" on the hill tops so the region has reached or passed its greates measure of relief. The streams are intermittent carrying water only during heavy rains. They are excavating at the headlands and depositing the material farther down. These evidences indicate a mature or late mature stage in the geomorphic cycle.

A striking feature is the through-going character of the main valleys which extend across the uplift forming a stream divide in the valley. Most evident of these is the valley below Silver Lake that extends through Silver Lake in a straight line, passes over the divide and continues on into the Los Angeles River basin. The next valley south presents the same peculiarity. Before the early Pleistocene uplifts the streams all flowed in one direction - towards the Los Angeles River. When the land was uplifted the Los Angeles River remained antecedent cutting through the rising formations while the smaller tributary streams extending across the Elysian Park-Silver Lake area were without sufficient cutting power to keep pace with the uplift and were bowed up in the middle causing a stream reversal. But this hypothesis may be questioned by the observation that these valleys lie at an oblique or "unnatural" angle to the Los Angeles River. However, this may be explained in this way: when the streams flowed into the Los Angeles River they were flowing in a more east-west direction, then with the uplift the streams gradually rotated and migrated, as they cut down, to a more north-south direction to conform with the slopes of the anticline. By the law of least work, it is evident that it is easier for a stream to cut perpendicularly across an anticline than to cut it at any other angle.

The structure and the rock hardness has little effect on the land forms in this area. The rocks can be considered uniformly soft throughout the whole area because everywhere there is a covering of mantle and plant growth. Structure has no effect since it depends on rock hardness and differences in rock hardness to express itself in the shape of the land. The streams are consequent to the slope paying no heed either to rock hardness or to structure.

As a matter of academic interest an example of stream piracy is seen close to the Topanga-Modelo formational contact just east of Glendale Boulevard.

REFERENCES

Hoots, H. W., Geology of the Eastern Part of the Santa Monica Mountains, Los Angeles County, California: U. S. Geol. Survey Prof. Paper 165, p. 83, 1930.

Kew, William S. W., Geology and Oil Reserves of a Part of Los Angeles and Ventura Counties, California: U. S. Geol. Survey Bull. 753, 1924.

Arnold, Ralph, The Los Angeles Oil District, Southern California: U. S. Geol. Survey Bull. 309, p. 138, 1907.

Reed, R. D. and Hollister, J. S., Structural Evolution of Southern California: Bull. of the A. A. P. G., Vol. 20, part 2, p. 1530, 1936