THE GEOLOGY OF THE WILEY CANYON AREA,

Oak Ridge Anticline,

T 3-4 N, R 18-19 W, VENTURA COUNTY,

CALIFORNIA

A thesis submitted in fulfillment of
partial requirements for the degree
of Master of Science in Geology.

by

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June, 1941

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SUMMARY

The accompanying map and thesis comprise a report on the geology of an area lying on the Oak Ridge anticline about six miles southeast of the town of Fillmore, California.

The Oligocene Sespe is the oldest formation exposed. The other formations found are Vaqueros, Modelo, Pico, Saugus, and finally, Recent terrace gravels and alluvium. The Sespe-Vaqueros and the Vaqueros-Modelo contacts appear to be conformable and are differentiated by a transition in lithology. A marked unconformity exists between the Modelo shale and Pico sandstone; this is not as pronounced on the west end as on the east end. The Saugus appears to overlap the Pico progressively from west to east.

The main structural features are the Oak Ridge fault, the Oak Ridge anticline, and the Eureka anticline and the Baker fault. Other subsidiary folds are present. The trend of the large structures is, on the whole, east and west; that of the lesser ones is mostly southeast and northwest.

The Oak Ridge fault is down-thrown on the north side; its plane is vertical at Torrey Canyon but is overturned at Wiley Canyon.

The Oak Ridge anticline consists of a series of small, connected domes. Oil production has been estab-

lished on several of these domes. A new wildcat is now drilling on a small surface closure in Wiley Canyon.

The Eureka anticline plunges westward towards the Baker fault. The evidence found in the field indicates that this is an unusual structure. It forms a part of a large, recumbent fold which has been further folded into an assymmetrical anticline. It is terminated on the west end by what is here called the Baker fault (after the Baker Ranch). Competent beds are conglomerates and sandstones; fossil evidence indicates their age to be late Pico (probably San Diego). Modelo sandstones and shales make up the remainder of the exposed rocks.

The Baker fault runs southwest from the Santa Clara River through the first canyon west of Torrey Canyon. Two interpretations can be placed on the relationship of the rocks: the Baker fault may have originated with, and therefore can be terminated against, the Oak Ridge fault; or it may possibly represent a different period of faulting, cutting the Oak Ridge fault and eventually joining up with the western end of the Santa Susana fault. Because of lack of sufficient evidence to the contrary, the first possibility is used.

INTRODUCTION

Because of previous work done in 1934 in the nearby Santa Clara River valley by means of the reflection seismograph, the writer was interested in the general geology of the Oak Ridge Anticline. Therefore, the problem of mapping a portion of the anticline was chosen in order to complete requirements for the degree of Master of Science in Geology. The field work was conducted at intervals from April, 1940, to May, 1941.

ACKNOWLEDGEMENTS

The writer is indebted to Mr. Albert Gregersen of The Texas Company of California for his assistance in the choice of an area, to Mr. L. Snedden of The Texas Company for his discussion of some of the geologic features of the region, and to the staff of the California Institute of Technology, with special emphasis on the help tendered by Dr. F. D. Bode, both in the field and on the finished report and map.

Further thanks are due the many ranchers who kindly allowed access to their property and who cooperated in many ways to help the writer complete his work.

LOCATION OF AREA

The Wiley Canyon area is located on the south side of the Santa Clara River valley, in all or part of Sections 31, 32, T 4 N, R 18 W, Sections 5, 6, 7, 8, T 3 N, R 18 W, Sections 34, 35, 36, T 4 N, R 19 W, and Sections 1, 2, 3, 10, 11, 12, T 3 N, R 19 W, Ventura County, California. It is bounded roughly by the Happy Camp Syncline and valley on the south, by Eureka Canyon on the east, Guiberson Canyon on the west, and Santa Clara River valley on the north. The town of Fillmore lies across the Santa Clara valley to the northwest, and the town of Piru is also across the valley, on the northeast. The location is approximately 60 miles northwest of Pasadena, California.

Procedure of Investigation

Aerial photographs of the region were obtained and all mapping was done on them. The U.S.G.S. quadrangle sheet Piru was useful only in obtaining elevations for the cross sections. Its small scale and large contour interval showed only the major features and substantially neglected smaller features.

The aerial photographs were initially obtained from Fairchild Aerial Surveys, Inc., Los Angeles, California (flown 1929). Later, other photographs were obtained for a mosaic from the Agriculture Adjustment Administration, Salt Lake City, Utah (flown 1938). These proved superior due to the improvement in the entire method of photographing from 1929 to 1938. In making the mosaic, it was found that an error in matching had to be overcome. Fortunately, the error caused a repetition of a small portion of the map (indicated on the map in the southeast and southwest corners), rather than a cutting out of any of it. The distortion is not considered to be serious.

Previous Geological Surveys

The first geologic report on the Los Angeles and Ventura counties was by W. L. Watts of the California State Mining Bureau.[1] G. H. Eldridge, in 1901-2, made a study of the Santa Clara River valley, Los Angeles and Ventura counties, and later a detailed map was published.[2] In 1914, the University of California published a paper covering the stratigraphy of the Fernando Group in an area near Newhall, California, several miles east of the town of Piru.[3] W. S. W. Kew published a report on the oil resources of the Simi valley (about eight miles south of Torrey Canyon field) in 1919.[4] In 1924, the U.S.G.S. published a report by Kew on the oil resources of parts

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[1]Watts, W. L., Oil and gas yielding formations of Los Angeles, Ventura, and Santa Barbara counties: California State Min. Bur. Bull. 11, 1897.
[2]Eldridge, G. H. and Arnold, Ralph, The Santa Clara Valley, Puento Hills, and Los Angeles districts, southern California: U.S.G.S. Bull. 309, 00. 1-101, 1907.
[3]English, W. A., The San Fernando Group near Newhall, Calif: California Univ. Dept. Geol. Bull., vol. 8, pp. 204-219, 1914.
[4]Kew, W.S.W., Structure and oil resources of the Simi Valley, southern California: U.S.G.S. Bull., 691, pp. 323-349.

of Los Angeles and Ventura counties.[5] In it, Kew described the geology and stratigraphy of the Wiley Canyon area. A Master's thesis was prepared by W. D. Lewis in 1940 covering the Upper Las Llajas Canyon area, eight miles southeast of Torrey Canyon field.[6] Numerous unpublished reports have been made for various oil companies interested in the oil possibilities of the region.

GEOGRAPHY

The Wiley Canyon area lies on the north flank of Oak Ridge which trends east from the Oxnard plains along the south side of Santa Clara River to the Santa Susana Mountains. The Happy Camp Syncline parallels Oak Ridge immediately to the south; farther south lie the Simi Anticline, Simi valley, and the Simi Hills, in the order named. North of the Santa Clara River valley lies the southern extremity of the Santa Ynez Mountains; in particular, Sespe Creek, Oat Mountain, Hopper Canyon, and Piru Creek are immediately north of the Wiley Canyon area.

The general location is in the southern part of the California Coast Ranges or Transverse Ranges, as they are sometimes called. The trend of these mountain ranges is in general east and west.

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[5]Kew, W.S.W., Geology and oil resources of a part of Los Angeles and Ventura counties, California: U.S.G.S. Bull. 753, 1924.

[6]Lewis, W. D., The Geology of the Upper Las Llajas Canyon Area, Santa Susana Mountains, California: California Institute of Technology, 1940.

Vegetation consists of sagebrush, chaparral, yucca plant, occasional oak trees, and grass and wild oats. The sandy soil supports the chaparral, yucca, and similar plants. Sagebrush and grass grow on the shale, especially on the protected, north-facing slopes.

Drainage is effected either to the north to the Santa Clara River or to the south to the Happy Camp valley. The elevation is roughly in three levels: the Santa Clara River lies at about 600 feet above sea level; Happy Camp valley is about 1500 feet above sea level, while Oak Ridge lies in between at an elevation of about 2500 feet. The drainage to the south is easily accomplished because most of the stream beds lie in the loosely consolidated Pico or Saugus sandstone. To the north, the elevation difference is greater, and more resistant beds are exposed; consequently, the valleys head up into ampitheaters with nearly vertical walls, and stream cutting is very rapid during rainy seasons. The relief and drainage have been controlled largely by folding and faulting.

Slumping and large landslides are common, particularly in Vaqueros rocks.

STRATIGRAPHY

General Character

Exposures of the rocks throughout the area mapped

COLUMNAR SECTION

Scale: 1" = 500'

(Guiberson Canyon and Happy Camp Valley)

EPOCH	FORMATION	SYMBOL	THICKNESS (in feet)	SECTION	CHARACTER OF ROCKS
Quat.	Gravels, alluvium	Qal	0-50		Terrace sands, gravels; alluvium.
PLIOCENE	Saugus	Ts	1170		Clean sands and gravels - contains soft gray thin sandstone layers. Mostly barren of fossils except for coquina bed. Outcrops usually light-colored.
					Unconformity (Transgression)
	Pico	Tp	350		Light gray to brown marine sands and shales with conglomerate or shale usually at base. Quite fossiliferous near base.
					Marked unconformity
MIOCENE	Modelo	Tms Tmsh	610		Upper part[1] is cherty laminated shales (brown or gray); then follows red or brown soft laminated sandstones; lower part is white or cream diatomaceous shales with chert layers. No fossils.
	Vaqueros	Tv	385		Mixture of brown shale and gray to brown shaly sandstones. Contains numerous shell reefs. Green-gray sandstone at base.
OLIGOCENE	Sespe	Tsp	900 (Max. = 5000+)		Brown massive sandstones at top; contains vertebrates. Also gray, red or white soft sands and shales.

[1] Seen in Torrey Canyon

are generally quite good, although either land sliding or dense brush provided complications. All the rocks are of sedimentary origin, ranging in age from Oligocene through Pliocene. Recent river gravels and alluvium lie in the valleys.

The Oligocene Sespe formation occurs in the eroded crests of the anticlines, with Vaqueros, Modelo shale, Pico, and Saugus appearing in that sequence from the Sespe out towards the flanks. The Sespe maintains essentially the same lithologic characteristics throughout the area. The Vaqueros formation likewise is similar in all of its outcrops. The Modelo shale is, for the most part, upper Modelo and is composed of interbedded, diatomaceous shale and layers of hard, cherty shale. However, in the area east of Torrey Canyon and north of Oak Ridge fault, are found massive upper Modelo sandstones and conglomerates interbedded with brown shale layers. A characteristic view of these beds is shown in figure 1. This set of pictures was taken at a point (P-1) just north of Torrey Canyon field looking northeast.

The formations named each very greatly in lithology, being comprised of all types of shale, sandstones, and conglomerate. They form both the source and the reservoir rocks for the oil found in the area. No igneous rocks were found in the region mapped, although an exposure of a basaltic sill in the Vaqueros lies about five miles

FIGURE 1. MASSIVE UPPER MODELO SANDSTONE BEDS; LOOKING NORTHEAST FROM TORRY CANYON (LOCATION AT P-1).

FIGURE 2. SESPE AND VAQUEROS FORMATIONS; IN FIRST CANYON EAST OF WILEY CANYON (FROM P-2 LOOKING SOUTH).

southwest of Torrey Canyon field on the north side of Simi valley.

Sespe Formation

The best exposures of the Sespe occur in Guiberson Canyon at the west end of the area mapped. Other limited exposures are found in the eroded portions of the crest of the Oak Ridge anticlinal axis.

The Sespe formation in Guiberson Canyon consists of massive brown or buff sandstones interbedded with layers of softer sandstone and clay. Below these lie clays and sands of variegated colors, mostly reds, purples, greens, and grays. The massive layers protect the weaker sands by prominent cliffs or faces below which the sands and clays weather into miniature badlands topography. Above the massive layers is a layer of gray to light brown, medium-grained sandstone which appears to be gradational from Sespe into Vaqueros. Its thickness is about 50 feet. The full thickness of the Sespe is not exposed; however, oil well data in nearby areas show it to be more than 5000 feet thick. At places, small wedges of medium-size conglomerate can be found, a very good example occurring in a canyon tributary to, and west of Wiley Canyon. Thin lenses of finer conglomerate are also distributed throughout the exposures. Much gypsum is present in the rocks.

In many places, the exposures at the Sespe-Vaqueros contact show fragments of bones of mammals; these occur mostly at the top of the massive brown sandstones and just below the gray, transitional sandstone bed. Collections by field parties of the California Institute of Technology Vertebrate Paleontology Department indicate that the sediments were deposited under sub-aerial conditions. The age of the Sespe in this locality has been shown by these collections to be Oligocene.[7] The description as given in the report by Kew[8] has been used by the writer in the correlation and mapping of the formation. Since the change between the Sespe and the Vaqueros is lithologic, with no apparent angular unconformity, the contact is thought to be conformable and has been mapped as being just above the massive brown sandstones. Figure 2 is a view of the Sespe and Vaqueros formations in the first canyon east of Wiley Canyon (from P-2 looking south).

The Sespe formation serves as a reservoir for petroleum; most of the Oak Ridge Anticline oil comes from the lower and middle Sespe. According to Kew, minor faulting is common in the oil fields of South Mountain[9]; and this

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[7] Stock, Chester, Oral Communication.

[8] Kew, W.S.W., Geology and oil resources of a part of Los Angeles and Ventura counties, California: U.S.G.S. Bull. 753, pp. 30-34, 1924.

[9] Idem, p. 38.

fact, coupled with the resemblance of the oil to the Eocene production of Simi valley, leads to a belief that the oil in the Sespe originated in Eocene shales.

Vaqueros formation

The Vaqueros consists, for the most part, of tan-colored, shaly sandstone or dark brown shales. There are numerous layers of calcareous sandstone reefs which are full of such fossils as Ostrea eldridgi, Turitella ineziana, Scutella fairbanksi, and numerous pectens.

The Vaqueros formation is about 400 feet thick at a maximum. Near the top of the Vaqueros occurs several layers of massive brown sandstone, with softer brown, shaly sandstone in between. The uppermost bed weathers into large, spheroidal boulders. In some places, one can find remains of vertebrates imbedded in the sandstone. This layer has been taken as the top of the Vaqueros, although the soft, sandy beds above may be a transitional zone into Modelo. Figure 2, which is referred to on page 8, gives a typical view of the Vaqueros.

As stated earlier, the bottom of the Vaqueros has been taken to be the gray sandstone immediately above the brown beds which had Sespe mammalian remains. A point of interest is that these brown beds occur in a steeply dipping position at the mouth of Guiberson Canyon and that here the rocks appear to have been worked on by boring animals. This may be an indication of nonconformity between the two formations.

Modelo formation

Two distinctly different exposures of the Modelo are to be found in the region under discussion. One lies in the northeast corner of the area. It is mostly upper Modelo and consists of laminated, hard, fine-grained, siliceous sandstones and shales and coarser, rather massive, well-bedded sandstones. The latter beds contain considerable gypsum and are frequently stained a dark brown by impregnated oil. This is well illustrated in Smith Canyon and Eureka Canyon, both of which lie at the northeastern edge of the area mapped (see figure 1). Also in this area can be found patches of fine-grained sandstones stained yellow by sulphur. One such locality occurs immediately west of the Eureka Canyon field on the ridge above the first well at the mouth of the canyon. The stream action in the massive sandstones has cut narrow, steep canyons with knife-like ridges separating them. Numerous waterfalls, or steps, which sometimes make progress in the canyons nearly impossible, are carved in the rock. The presence of conglomerates, gypsum, nodules, and oil staining gives these Modelo beds an appearance not unlike some of the Sespe beds in which similar canyons are cut. Heavy brush growth is supported on the sandstones. The laminated, cherty beds are mostly present as fragmentary remains on the hillsides. The low hills lying between Torrey, Smith, and Eureka Canyons are more or less covered with these fragments, and they serve as a method of delineating the contact between the Pico and the Modelo.

In the rest of the area, Modelo outcrops consist of the lower chalky shales. The exposures vary in color from light tan, cream, or even pinkish to a chalky white. Occasionally, there are thin layers of interbedded volcanic ash of a light gray color. On the crests of the hills, especially in the western portion of the area, the organic shales have been burned and fused into a red or brown, extremely hard mass. In a side-canyon on the west flank of Wiley Canyon, near the Modelo-Pico contact, the fusing and burning is well illustrated. There seems to be no particular pattern to the burned areas with respect to structure other than being confined to the lower Modelo diatomaceous shales.

The typical sequence of the shales can be seen to advantage in the upper part of Guiberson Canyon. Here, one finds a sandy, tan-colored member at the base with a gradual transition to a tan or brown, punky shale. Progressing farther south, up the section, the punky shales grade into the chalky white diatomaceous shales. The color separation is fairly distinct here. As one progresses eastward, the tan shales become less predominant, probably due to folding and to the presence of much more grass and brush. The shales tend to weather into a rich, black soil. Throughout all of the punky and chalky shales occur thin beds of very resistant, white to gray chert. These chert layers are more prominent, however, in the chalky section, sometimes being two or three feet thick. Fish scales are abundant in both sections. Figure 3 was taken on the fireroad nearly east of Wiley Lake (from P-3, looking northeast at the roadcut). It shows a typical white chalky cliff and rounded topography.

Oil seeps are present in places and have been shown on the map. Correlation of the lower Modelo has been made on the basis of lithology. A rather thick, brown sandstone layer, containing vertebrate remains and forming large, spheroidal boulders, has been taken as the top of the Vaqueros. The contact appears to be gradational and conformable.

The upper Modelo in the Eureka Canyon area was distinguished from the Pico by means of the fragments of siliceous shale on the one side of the contact and the sand grains on the other side. This contact is unconformable.

In the southern part of the area the contact between the Modelo and the Pliocene beds extends completely across the map from east to west and is unconformable. On the east end, the Pliocene beds were laid down on nearly

FIGURE 3. WHITE, CHALKY, DIATOMACEOUS SHALE CLIFF ON FIRE ROAD EAST OF WILEY LAKE; LOOKING NORTHEAST FROM P-3.

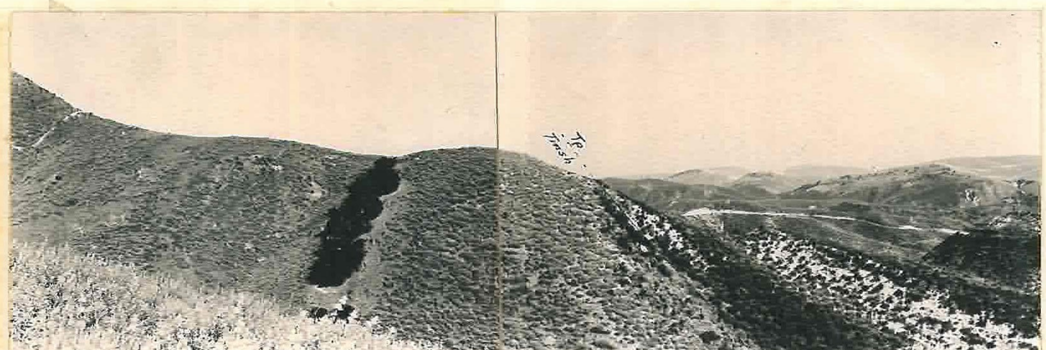

FIGURE 4. VIEW OF ANGULAR UNCONFORMITY BETWEEN PICO SANDSTONE AND MODELO SHALE; TAKEN NEAR LOCATION FOR FIGURE 3, FROM P-4 LOOKING EAST.

vertical Modelo beds. Figure 4 was taken near the location for figure 3. The view was east from P-4, and it shows the angular unconformity between the Modelo and Pico formations. This relationship changes towards the west, however, so that the Pico and Modelo tend to have nearly the same strike and dip. The distinction between the beds west of Wiley Canyon is therefore based on color and on shale and sand fragments.

Pico formation

The Pico sandstones and conglomerates lie along both the north edge and the south edge of the mapped area. They occur in a relatively narrow strip at the head of Guiberson Canyon, apparently nearly conformable at this point with the Modelo shales. The contact is traceable as a fairly distinct change of color from the grayish, shaley soil of the Modelo to the sandy, brown or tan soil of the Pico. As the contact is traced to the east, the brown shale immediately above it gives way to a moderately-resistant, thick bed of conglomerate. This is well shown immediately above Wiley Lake; at this locality, many large pectens can be found. Farther east, the contact is such that the Pico sandstones dip off at nearly right angles from the dip of the Modelo in a very distinct unconformity. Some relatively thin layers of fine-grained, gray sandstone persist in the outcrop east of Wiley Canyon.

The contact between the Saugus and Pico has been taken at the base of a rather loosely-consolidated white sandstone. The Pico is, apparently, gradually overlapped from west to east, although within the confines of the map, the Pico has not been altogether covered up by the Saugus.

Pico sands and conglomerate are found also in the northeast sector of the map, and a small outcrop of coquina occurs in the first canyon west of Torrey Canyon. The strata have been sharply folded and are flanked by Modelo sandstone and shale on either side. The fold plunges westerly. Differentiation of Modelo and Pico has been accomplished by the lithologic character of the two formations. One limb of the fold is vertical, and its outcrop supports a growth of oak trees which forms a distinctive band across the hills. This is shown in figure 5 (looking southwest from P-5 in Smith Canyon).

The lower portion of the Pico, as exposed in this area, contains a characteristic Pliocene fauna.[10]

Saugus formation

With the exception of one small, isolated patch of Saugus which occurs in the first canyon west of Torrey

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[10] Popenoe, W. P., Determined age by comparison of fossils from this area with collections at California Institute of Technology.

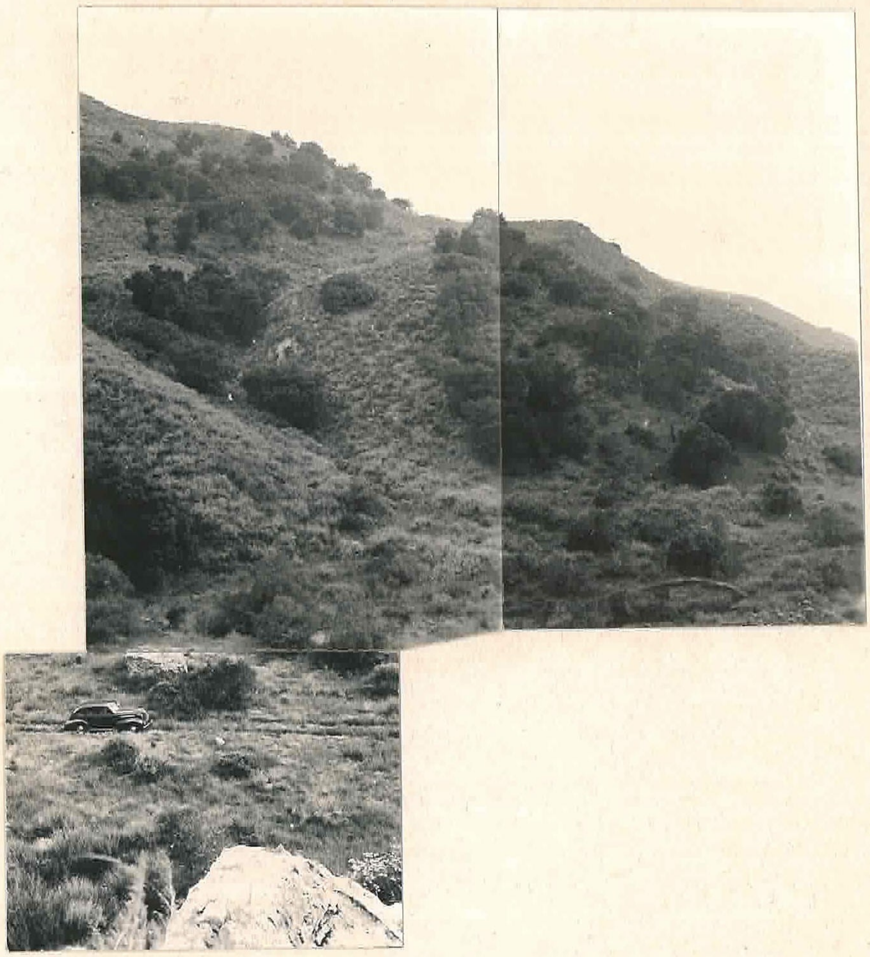

FIGURE 5. DISTINCTIVE BAND OF OAK TREES FOLLOWING THE OUTCROP OF THE VERTICAL FOLDING OF THE PICO SANDSTONES AND CONGLOMERATES, (LOOKING SOUTH-WEST FROM P-5 IN SMITH CANYON).

Canyon, the rest of the Saugus is confined to the southern margin of the area mapped. It is a poorly-consolidated, white sandstone which has been washed clean and which contains numerous large boulders. These boulders have been left in place on the ridges after the sand was washed away, and the resulting surface is now characteristically boulder-strewn.

One of the distinctive features of the Saugus is the presence of a bed of small fragments of shells which are loosely cemented. This bed of coquina occurs in the southeast corner of the map.

The Saugus gradually overlaps the Pico to the east. It is characteristic in that it forms low, rounded hills which have clean, steep faces eroded out by water action. The sands are frequently iron-stained. No fossils have been found by the writer.

Terrace Gravels

A gravel terrace lies along the edge of the Santa Clara River about fifty feet above the present river level. This alluvium extends up into most of the larger canyons. It has probably been deposited in Recent times, and represents a former flood plain of the river. One gravel terrace lies in the same canyon as the Baker fault trace, and it is at a considerably higher elevation than the river benches (possibly 500 feet higher). It may represent another flood plain.

Unidentified

Along the new Torrey Canyon road, which begins half a mile from the canyon mouth and runs directly southeast to the field, an unusual outcrop of rock was found. It was composed of fragments of Vaqueros and Modelo rocks; some of the Modelo cherts were brecciated and re-cemented. In places the material resembled a breccia and in other places it had bedding planes and seemed intact as an original rock. It has not been colored as a formation nor given a formation name.

STRUCTURE

Landslides

Guiberson Canyon lies in the saddle between the Wiley Canyon structural high and the Shields Canyon oil fields (just west of the margin of the map). On the west flank of Guiberson Canyon a large section of land has evidently slumped along a fairly flat-lying fault plane. Possibly 300 feet of vertical displacement and about 1000 feet of horizontal displacement took place.

Another area of large-scale slumping or landsliding is found in Wiley Canyon. The platform on which Wiley

Lake lies is apparently a landslide similar to the one in Guiberson Canyon.

A third landslide lies east of Guiberson Canyon where steeply-dipping Modelo shale remnants rest unconformably on Vaqueros beds of a gentler dip.

Folding

Just south of the Torrey Canyon oil field, a series of tight folds occur in the Modelo diatomaceous shales. The resistant chert layers serve as a good index to the folding. The folds trend southeast and northwest; they apparently run together on their northwest ends and die out before reaching the Oak Ridge fault. At places, small oil seeps are found.

The southern part of the region mapped forms the north limb of the Happy Camp syncline. Although the axis lies too far south to appear on the map, the dip-strike data show it to trend in an east-west direction. The dips are comparatively gentle, seldom exceeding 20 degrees.

The Torrey Canyon oil field, which is one of the oldest fields in California, is a closed anticline located on the Oak Ridge anticlinal axis. The eroded crest of the anticline exposes a small portion of the upper Sespe brown sandstones, the Vaqueros, and the Modelo shale. On the west side of the field, the thick brown sandstone used as the marker bed between Vaqueros and Modelo is seen gradually to change its dip from the west to the north until the Oak Ridge fault is reached; here it is abruptly dragged down into the fault zone. Oil-stained sandstone is found in Torrey Canyon in this zone.

Just east of Wiley Canyon, about one-half a mile in from the mouth, there appears to be a slight amount of closure on the Oak Ridge anticlinal axis. The dips and strikes which showed the closure were obtained mostly from the Sespe sandstones. A well is currently drilling there (see map for location), and it is reported to be about 1500 feet deep at this time. Structure section C-C' illustrates the relationships of the formations in this locality.

The Eureka anticline crosses Torrey and Smith canyons in a northwest direction. This structure is very unusual because the evidence points to a sharply-folded, assymmetrical anticline which has Modelo shales overlying Pico sandstone and conglomerate. The anticline plunges westward and ends against the Baker fault. On the ridge immediately west of Torrey Canyon, the Modelo fine-grained, laminated sandstones and shales extend over the fold without being displaced. Immediately adjacent to the laminated shales is found a white, coarse sandstone; this outcrops at various places along the fold and serves to

FIGURE 6. OAK RIDGE FAULT ZONE, TORREY CANYON; LOOKING WEST FROM P-6.

demonstrate that no displacement has occurred in the beds, at least none in the vicinity of Torrey Canyon. Structure sections A-A' and B-B' afford the best explanation of the relations found in the field. Section B-B' shows that deformation produced a large, recumbent fold which then was further folded to form an anticline. Section A-A', taken nearly parallel to the anticlinal axis, demonstrates the westward plunge of the anticline in Torrey Canyon.

Faulting

One of the main structural features in this area is the Oak Ridge fault. It trends about S 80° E from the Santa Clara River, passing along the north edge of the Torrey Canyon oil field. In the vicinity of Torrey Canyon, the fault plane appears to be nearly vertical; the up-throw side is on the south so that Sespe, Vaqueros, and Modelo are exposed. Figure 6 shows the fault zone as it appears on the west side of Torrey Canyon. This view is from P-6 looking west. North of the fault, Modelo sandstones and shales and Pico sandstones and conglomerates are present between Torrey Canyon and the point where the fault trace first runs under the Santa Clara alluvium. The trace apparently bends back from under the alluvium very quickly, curving in and out of Wiley Canyon. The fault plane is overturned here, dipping at an average angle of about 45 degrees to the south. Figure 7 (taken at P-7 looking west) shows the overturned, massive Pico sandstones and conglomerates at Wiley Canyon. The trace finally passes under the river deposits again about three-fourths of a mile west of Wiley Canyon, and remains in this position at least to the edge of the mapped area. At the mouth of Wiley Canyon, where the Oak Ridge Fault is overturned, Pico is exposed at the base of the first hills; then a thin wedge of the diatomaceous and cherty Modelo shale appears, and lastly the characteristic shales and shell reefs of the Vaqueros formation occur at the top of the hills. Figure 8 is a panoramic view taken at P-8 near the mouth of Wiley Canyon looking generally east. It shows the relationship of several of the formations as they appear near structure section line C-C'.

The Baker fault lies just west of Torrey Canyon. It runs from the Baker ranch (whence the name was derived) southeast until it meets the Oak Ridge fault. The evidence for the fault is based on the crescent-shaped outcrop of Vaqueros rocks which appears to make up the western half of a circular, anticlinal outcrop. The exact location of the fault trace is not known. Two interpretations are possible with the data at hand: (1) if the Baker fault and the Oak Ridge fault are the same age, then the Baker fault probably is terminated

FIGURE 7. MASSIVE OVERTURNED PICO SANDSTONES AT THE MOUTH OF WILEY CANYON (LOOKING WEST FROM P-7).

FIGURE 8. PANORAMIC VIEW TAKEN AT P-8 NEAR THE MOUTH OF WILEY CANYON LOOKING GENERALLY EAST.

by the other fault; and (2) if the two faults are not the same age, there is a strong possibility that the Baker fault may cross the Oak Ridge fault and eventually connect with the Santa Susana fault (which, according to Kew[11], terminates at the southeast corner of the map). The first interpretation has been used.

It is to be noted here that the field evidence, which was carefully collected, has given an unusual structural picture of the Eureka anticline and the Baker fault. A further examination of the area with better facilities may well yield evidence that would allow a different interpretation. However, the author feels that the structural picture shown is the best for the data at hand.

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[11]Kew, W.S.W., Geology and oil resources of a part of Los Angeles and Ventura counties, California: U.S. G.S. Bull. 753, pp. 56-57, 1924.

GEOLOGIC HISTORY

1. Deposition of Sespe.

2. Deposition of Vaqueros.

3. Deposition of Modelo conformably on Vaqueros; sequence of diatomaceous shales, massive sandstones, and cherty, laminated shales indicate oscillating but gradually retreating sea.

4. Major folding and faulting with attendant erosion.

5. Encroachment of sea with deposition of Pico sandstones, shale, and conglomerate on eroded Modelo surface.

6. Transgression of Saugus seas, with Saugus formation overlapping Pico and Modelo.

7. Second major folding and faulting.

    a. This period of deformation probably was responsible for the major structural features of this region; activity may have been confined to old zones of weakness or may have created entirely new faulting and folding.

8. Present cycle of erosion and deposition of alluvium.