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THE FERNANDO FORMATION NEAR NEWHALL, CALIFORNIA

by

Walter A. Athelin English

Thesis for M.S. degree

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INTRODUCTION

The age of certain fossiliferous sandstones overlying the granite in Ellsmere Canyon, near the San Fernando Pass, has been in doubt for some years. This formation has ~~They have~~ been determined at different times as Vaqueros, Monterey, and Fernando. It was with the hope of obtaining additional information on the age and relationships of these beds that the writer undertook a study of them. This subject was suggested for investigation by Doctor J. C. Merriam, and the work has been carried out under his direction. The writer's field work was done during parts of the months of January and June, 1912.

LOCATION.

The work done by the writer was limited to an area around Ellsmere Canyon, near Newhall, California, about thirty miles northwest of Los Angeles on the line of the Southern Pacific Railroad. Ellsmere Canyon lies on the extreme northwest flank of the San Gabriel Range, just east of the San Fernando Pass, which separates the San Gabriel from its westward continuation in the Santa Susan Range. The canyon is about three miles long, and runs in a northwest direction toward Ellsmere Ridge, at which point it enters a broad southwest extension of the broad alluvium floored Santa Clara Valley. The general elevation of the Santa Clara Valley is about twelve hundred feet, while the highest point in the San Gabriel Range of this immediate area is thirty five hundred feet.

INTRODUCTION

The age of certain fossiliferous sandstones overlying the granite in Kilamere Canyon, near the San Fernando Pass, has been in doubt for some years. They have been determined at different times as Vaqueros, Monterey, and Fernando. It was with the hope of obtaining additional information on the age and relationships of the beds that the writer undertook a study of them. This subject was suggested for investigation by Doctor J. C. Merriam, and the work has been carried out under his direction. The writer's field work was done during parts of the months of January and June, 1912.

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HISTORICAL REVIEW.

George H. Ashley[1] who visited the locality of the San Fernando Pass in 1894, says of this region: "At the San Fernando tunnel in Los Angeles county the beds that have been considered as Niocene of the Monterey Series are overlaid conformably by a series of calcareous sandstones and conglomerates which are quite fossiliferous." He made a collection of twenty three determined species, of which fourteen, or sixty per cent. are living. He considered the formation as of the same age as the Lower Purissima.

[1] Ashley, G.H., The Neocene Stratigraphy of the Santa Cruz Mts. Proc. Cal. Acad. of Sci., Ser. 2, vol. 5, p. 337, 1895.

In 1900 Ellsmere Canyon was visited by W. L. Watts,[2] who called the oil yielding sandstones the lower portion of the Middle Niocene. He also found a point where the sandstones of the Middle Niocene were resting unconformably on "hard sandstones resembling the Neocene sandstones of the Sespe district." This particular locality was not found by the present writer.

[2] Watts, W. L., Bull. Cal. State Min. Bureau, 1900, no. 19, p. 56.

During the years 1901-2 the region of the Santa Clara valley was investigated by G. H. Eldridge,[3] who mapped the lower sandstone beds of Ellsmere Canyon as Vaqueros, and in the text speaks of their having a typical fauna of the Vaqueros. His age determination was, however, more probably based on the lithologic similarity to the beds in the eastern end of the Santa Susana Range, which he called Vaqueros. He speaks of a structural unconformity, with difference of dip and strike between the Fernando gravels and the underlying

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STRATIGRAPHY.

The chief formation of the San Gabriel Range is the San Gabriel Granite, a complex of granitic rocks and schists which makes up the whole central part of the range. Arnold[4] divides the San Gabriel

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The Fernando formation of this area is not less than three to four thousand feet thick, and was laid down upon an eroded surface of the San Gabriel Granite. The upper surface of the granite is generally somewhat decomposed. The basal ten to fifteen feet consists of subangular to rounded fragments of granite, with comminuted

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Stratigraphically above the fine sandstones and shales is a series of cross bedded alternating coarse sandstones and conglomerates. These strata are well exposed on the sides of Ellsmere Ridge, in Whitney Canyon just north of Ellsmere, in Placerita Canyon, and they extend for an unknown distance eastward along the northern flank of the San Gabriel Range. In Ellsmere Canyon the conglomerate consists of well rounded pebbles and boulders up to twelve inches in diameter of granitic, and less commonly of volcanic rocks. The pebbles are of all sizes, and grade down into the sand which fills the interspaces. The induration is slight, most samples can be broken between the fingers. The color is a light buff.

The lower sandstone and shale beds were called Vaqueros by Eldridge, and the two were considered to be structurally unconformable by him. The writer believes the entire series to be conformable. The relations of the two lithologic units are well shown on

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the ridge to the north of Ellsmere Canyon. There is here an abrupt and striking change from a medium grained sandstone to an overlying very coarse conglomerate. The conglomerate is more resistant than the underlying sandstone which weathers out from under it, and causes it to stand out very prominently on the otherwise even slope of the ridge. On examining the actual contact, the conglomerate is seen to rest on the sandstone without any irregularity of the contact plane, and the sandstone grades up into the sandy matrix of the conglomerate. Farther west the conglomerate pinches out, and the change in lithology is not so abrupt. On Ellsmere Ridge strata typical of both the upper and lower divisions are interstratified.

The conglomerate has a strike of North 50° West, and dip 12° North, while the lower part of the sandstone, and the granitic surface on which it was deposited have strike North 65° West, dip 20° North. No difference in dip or strike was observed at the actual point of contact.

Along with the difference in strike there is a thinning out of the shaly beds toward the East, and the conglomerate comes to rest directly on the granite at the head of Whitney Canyon. The presence of such an overlap does not however preclude conformity. The lithologic character of the sandstones and shales indicates that they are probably of estuarine origin, and the conglomerates are fluviatile delta deposits. In deposits of this character some irregularity is to be expected. The two different lithologic units are therefore considered to be conformable in this area.

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Fauna

The principal fossil localities examined are within one hundred feet of the base of the sandy shale in Ellsmere Canyon.[5]

[5] U. C. Loc. No. 1601 N.W. quarter N.E. quarter S.E. quarter sec. 7 T. 3 north R. 15 west Mt. San Bernardino. In bed of canyon about hundred yards downstream from the granite contact.
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U.C. Loc. 1603 Pico canyon one quarter mile to N.W. of Superintendent's house, near tank on top of ridge.

Many of the fossil layers are only a few feet above the granite. Small collections of some of the species were made on Ellsmere Ridge, and in Grapevine Canyon on the south side of the San Fernando Pass. No fossils were found in the conglomerates.

The following species were collected by the writer.

Of the fifty five species there are twenty three or 44 per cent. living. Some of the other forms show only slight differences from the living forms, and are evidently nearly related to them. The literature on the fauna of the Fernando formation is rather scanty, and there are a large number of forms which have not been found so far from any other locality than the present one.

Arnold divides the Fernando of the Santa Clara valley into three horizons.The lower Fernando fauna as given by him comes from five different localities and consists of thirty three species, of which seventeen are specifically identified, and of the latter there are ten found also in Ellsmere Canyon. The writer examined a collection in the California Academy of Sciences from a locality five miles north-east of Camulos, which is one of the five localities mentioned above. This collection contains twenty four species, of which thirteen are common to Ellsmere Canyon, and comes from a

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Arnold's middle Fernando collection comes from Ellsmere Canyon, the same locality as the writer's collection. He collected thirty three species, of which thirty were identified, and of these seventeen are found in the Ellsmere Canyon faunal list of the writer. His collection localities probably included one somewhat higher horizon than the others, where he found Pecten caurinus and Pecten parmleei. He regards the fauna as equivalent in age to the "typical fossiliferous portion of the Purissima and the lower part of the San Diego formation."

From the upper Fernando he gives lists from three localities. The first locality is north-west of Santa Paula, and is of a lower horizon than the other two; it has thirteen species which are found also at Ellsmere Canyon. The third locality is at Barlow's Ranch, and is from a Pleistocene horizon. There are only five species from the latter locality which are found also at Ellsmere Canyon.

Arnold's[6] work in the Santa Maria district led him to believe that "at least five, and probably six distinct horizons are recognizable in the Fernando by means of characteristic fossil faunas." His faunal list gives all the horizons together, although they extend from the miocene to the Pleistocene. There are seventy species, of which thirteen are found in Ellsmere Canyon. Most of the species which he gives are from the upper or Pleistocene horizon.

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Arnold's[7] faunal list from the Etchegoin contains 84 recognizable species, of which twelve are common to Ellsmere Canyon, besides other very closely related species. The Purissima in its lower faunal zone has eight species common to Ellsmere Canyon. The characteristic form Pecten healyi is found in both the Etchegoin and Lower Purissima, and is believed to be characteristic of this horizon. The form of Pecten healyi found in the Upper Purissima, and in the San Diego formation is somewhat thinner, and has the ribs less raised. The Lower Purissima, and the Etchegoin are taken to be the Northern California equivalents in age of the Ellsmere Canyon fauna.

In conclusion it may be stated that there is a characteristic fauna developed in the lower part of the Fernando, of which Ellsmere Canyon, Pico Canyon, the locality northwest of Camulos, and Mt. San Cayetano are examples. In the standard time scale this horizon is near the line between the uppermost Niocene and the lower Pliocene.

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Echinoidae

Astrodapsis fernandoensis Pack

Echinarachinus excentricus Esch.
var. minor new variety

Pelecypoda

Amiantis callosa Cpr.

Arca trilineata Conrad

Cardium quadrigenarium Conrad
var. fernandoensis Arnold

Cardium sp.?

Chione ellsmerensis new speices

Chione fernandoensis new species

Cryptomya californica Conrad

Dosinea ponderosa Gray

Leda taphria Dall

Macoma indentata Cpr.

Macoma sp.?

Marcia subdiaphana Cpr.

Metis alta Conrad

Modiolus rectus Conrad

Mytilus sp.?

Nucula castrensis Hinds

Panopea generosa Gould

Pecten ashleyi Arnold

Pecten healyi Arnold

Pecten cerrosensis Gabb

Pecten sp.? small

Phacoides acutilineatus Conrad

Phacoides nuttali Conrad

Phacoides richthofeni Gabb

Phacoides santaecrucis Arnold

Solen sicarius Gould

Tellina idae Dall

Venericardia californica Dall

Casteropoda

Amphissa sp.?

Dathytoma carpenteriana Gabb
var. fernandoana Arnold

Bittium cf. asperum Gabb

Calyptrae filosa Gabb

Cancellaria ellsmerensis new sp.

Cancellaria tritonidae Gabb
var. ellsmerensis new var.

Cancellaria sp.? near fernandoensis
Arnold

Chrysodomus arnoldi Rivers

Chrysodomus sp.?

Conus californicus Hinds

Crepidula princeps Conrad

Cypraea fernandoensis Arnold

Drillia fernandoensis new sp.

Ficus nodiferus Gabb

Gyrineum ellsmerensis new sp.

Mangilia sp.?

Mitra idae Dall

Nassa perpinguis Hinds

Neverita recluziana Petit

Pachypoma biangulata? Gabb

Polynices galianoi Dall

Siphonalia kelletti Forbes

Trophon sp.?

Turitella cooperi Carpenter

Turris fernandoensis new sp.

Nothoidae

Astrodapsis fernandoensis Pack

Echinarachnius excentricus Mack.
var. minor new variety

Pelecypoda

Amiantis callosa Cpr.

Area trilineata Conrad

Cardium quadrigenarium Conrad
var. fernandoensis Arnold

Cardium sp.?

Chione ellamerensis new species

Chione fernandoensis new species

Cryptomya californica Conrad

Donaxes pondersae Gray

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Venericardia californica Dall

Gasteropoda

Amphissa sp.?

Baltytoma carpenteriana Gabb
var. fernandoana Arnold

Bittium cf. asperum Gabb

Calyptrae filosa Gabb

Cancellaria ellamerensis new sp.

Cancellaria trittonidae Gabb
var. ellamerensis new var.

Cancellaria sp.? near fernandoen

Arnold

Chrysodomus arnoldi Rivers

Chrysodomus sp.?

Conus californicus Hinds

Crepidula princeps Conrad

Cypraea fernandoensis Arnold

Drillia fernandoensis new sp.

Ficus modifera Gabb

Gyrineum ellamerensis new sp.

Mangilia sp.?

Mitra idae Dall

Nassa perplexata Hinds

Nevertia reclusiana Petit

Pachypoma biangulata? Gabb

Polynices gaitanoi Dall

Siphonalia kellettii Forbes

Trophon sp.?

Turritella cooperi Carpenter

Pico Canyon Area.

Introduction.

Although the area of Pico Canyon was one of the first oil producing localities in the state, the only account of the geology of the area is that of Eldridge. He mapped the beds near the centre of the Pico anticline as Vaqueros, which was seemingly conformably overlain by Fernando gravels. From a hasty examination of the Santa Susana mountains from Pico canyon to San Fernando pass the writer has come to the conclusion that the beds which form the axis of the Pico anticline are part of the Fernando series, and are not Vaqueros.

Stratigraphy.

Lithologically the strata is the axis of the Pico anticline are fine grained, chocolate colored, oil stained and slightly indurated sandstones and sandy shales, which have in places been affected by pressure so as to become spheroidal and jointed. These beds are only 400 or 500 feet thick, above which the finer beds are interstratified with gravels and conglomerates, which latter become gradually more abundant, until about 2500 feet above where they first appeared the coarse beds entirely replace the fine sandy shales and sandstones.

On the north limb of the anticline the beds dip to the north at angles of from 20° to 70°, the steeper dips being near the axis of the anticline and the lesser ones at the edge of the valley. At no place was any structural evidence of uncomformity found, although the section is well exposed, due to the steep slopes, and the absence of vegetation.

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The lithologic succession is the same in Pico Canyon as in Ellsmere Canyon, where the sandy shales are fossiliferous. The two areas are only a few miles apart, and the beds can be traced as practically continuous between the two areas. It is thus very probable that the Pico Canyon sandy shales are of the same age as those in Ellsmere Canyon, and are of Fernando and not Vaqueros age.

Fauna

The following collection was made from a fine grained sandstone interstratified with gravels, near the upper limit of the fine grained beds

Pelecypoda

Cardium quadrigenarium Conrad

Cardium, sp.?

Chione fernandoensis, new sp.

Leda taphria Dall

Pecten sp.? like pabloensis

Solen sicarius Gould

Gasteropoda

Bulla, sp.?

Calyptraea filosa Gabb

Chrysodomus arnoldi Rivens

Fusus cf. portolaensis

Nassa perpinguis Hinds

Neverita sp.?

Polynices gallianoia Dall

Sigaretus scopulosus Conrad

Turitella cooperi Cpr.

This fauna is essentially of the same age as that collected from Ellsmere canyon, although it is from beds which appear to be about 1500 feet stratigraphically above the latter horizon.

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Echinarachinus excentricus Esch. var. minor new var.
Pl. 2. fig. 7.

Similar in general to the recent Echinarachinus excentricus from which it differs as follows:--size smaller, and test thinner; tumid area in center of abactinal surface absent, the thickness decreasing gradually from the center to the edges which are very thin; excentricity of apical system varies from 1:1 to 1:2.4 and averages 1:2.0, which is somewhat greater than in the living E. excentricus. In this respect the present form is somewhat similar to E. gibbsi, which, however, is more excentric, and which has the relative lengths, and the angles between the petals different.

This variety resembles immature specimens of E. excentricus. Specimens similar to the present form in the University of California collection are marked from Burn's Ranch (Santa Clara valley), and from the Tenth Street Well, San Diego.

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Chione ellsmerensis new sp.

Pl. 1, fig. 1 and 2.

Shell large, outline rather rounded; dental formula L.010101, second cardinal tooth bifid; shell ornamented by concentric lamellae which disappear on eroded specimens; radial sculpture of flat ribs developed by weathering; escutcheon a distinct flattened area, the radial sculpture absent from the escutcheon, and for a distance of about ten millimeters below the escutcheon; ligament deep seated; lunule lanceolate, bounded by impressed line.

Compared to Chione securis this species is longer anteriorly, the escutcheon is narrower, and the lunule is of the same width but twice as long. It appears similar to a specimen from the lower Miocene at Calabasas, figured by Ralph Arnold as C. temblorensis, and which he says is similar to, or possibly identical with a form found in the upper Miocene.

Altitude 75 mm.; latitude 95mm., of which two thirds is posterior to the beak; diameter 45 mm.; lunule length 20 mm., width 12 mm.

Chione effamerenata new sp.

Pl. 1, fig. 1 and 2.

Shell large, outline rather rounded; dental formula L.0101O1, second cardinal tooth bifid; shell ornamented by concentric lamellae which disappear on eroded specimens; radial sculpture of flat ribs developed by weathering; escutcheon a distinct flattened area, the radial sculpture absent from the escutcheon, and for a distance of about ten millimeters below the escutcheon; ligament deep seated; lunule lanceolate, bounded by impressed line.

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Altitude 75 mm.; latitude 95mm., of which two thirds is posterior to the beak; diameter 45 mm.; lunule length 20 mm., width 12 mm.

Chione fernandoensis, new sp.

Pl. 1, fig. 4 and 5.

Shell small, sub-triangular, thick; lunule large, cordate, distinct, bounded by an impressed line; anterior dorsal slope short, posterior dorsal slipe long and only very slightly convex; escutcheon broad and flat or slightly concave; ligamental channel equal in length to one third of posterior dorsal slope; base roundly arcuate; shell marked by concentric lamellae which become more prominent upon erosion of specimen, when they give it a corrugated appearance; radially marked by numerous fine ribs.

This species is common from the lower part of the Fernando formation. It was probably included under Chione succincta by Gabb, who lists the latter from the Fernando Pliocene. This species differs from other chiones by its small size, large broad lunule, lamellar structure, and broad escutcheon.

Altitude 18 mm.; length 22mm.; thickness 10.5 mm.; lunule length 6 mm., width 4 mm.

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Ficus nodiferus, Gabb.

Pl. 1, fig. 5 and 8.

Shell pear shaped, with large body whorl; spire low, body whorl forms two thirds width of spire; an upper and lower angulation present, the former the more distinct; shell ornamented with twelve very prominent nodes to each whorl, these consist of two spiral rows of vertically elongated nodes, the upper row being so spaced as to alternate with the lower; both the lower and upper nodes are elongated and have from one to three cusps which are formed where the heavy spiral lines cross the raised area of the node; shell marked by twelve to fifteen spiral lines, between each of which are three finer lines of which the middle one is the wider; spiral lines crossed by numerous very fine longitudinal lines; mouth opening semi-circular to sub-triangular; outer lip thin; canal medium length, recurved.

This species is quite close to F. kernianum, cooper, of the Temblor formation, from which it differs as follows:--larger size, the maximum lengths being 120 and 60 mm., respectively; the spiral lines on F. nodiferus vary in width and show a tendency to be wavy, while those on F. kernianum

Ficus modiferus, Gabb.

Pl. 1, fig. 5 and 8.

Shell pear shaped, with large body whorl; spire low, body whorl forms two thirds width of spire; an upper and lower angulation present, the former the more distinct; shell ornamented with twelve very prominent nodes to each whorl, these consist of two spiral rows of vertically elongated nodes, the upper row being so spaced as to alternate with the lower; both the lower and upper nodes are elongated and have from one to three cusps which are formed where the heavy spiral lines cross the raised area of the node; shell marked by twelve to fifteen spiral lines, between each of which are three finer lines of which the middle one is the wider; spiral lines crossed by numerous very fine longitudinal lines; mouth opening semi-circular to sub-triangular; outer lip thin; canal medium length, recurved.

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are very uniform; the former has generally only one point to each node on the upper angle, and two on each node of the lower angle, while the latter has two on the upper and two or three on the lower; in general the latter's nodes are vertically longer, and the cusps are more acutely pointed especially on the larger whorls.

Some specimens, especially the earlier whorls have the nodes small or nearly absent, and an oval outline replaces the normal angulation of the body whorl. These resemble F. pyriformis, Gabb, very closely. As the shell grows larger the nodes and angulation increase in prominence until the mature shell shows only slight resemblance to F. pyriformis.

F. stanfordensis and Ficus sp.? from the Lower Miocene of Contra Costa County, both represented only by casts, appear similar to F. nodiferus as far as could be told from casts.

This species is listed by Gabb as from both Ellsmere and Pico Canyons.

Altitude 36 mm.; width 25mm.; altitude of spire 10mm.; mouth opening length 32 mm., width 15mm.; largest specimen altitude 120 mm.

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This species is listed by Gabb as from both Killamere and Pico Canyons.

Altitude 36 mm.; width 25mm.; altitude of spire 10mm.; mouth opening length 32 mm., width 15mm.; Largest specimen altitude 120 mm.

Gyrineum ellsmerensis, new sp.

Pl. 2, fig. 1.

Shell bucciniform, spire high, apex broken, whorls two present; suture deeply impressed, whorls rounding out below suture; varices prominent; two or three low rounded nodes on angle of whorl between each two successive varices; shell cancellated, marked by fourteen flat spiral lines on outer lip, and twenty on the inner lip of body whorl; these are crossed by numerous fine longitudinal lines; mouth opening oval equal in height to half the total height of restored shell; outer lip greatly thickened, spiral lines showing on the inner surface of lip; inner lip thinly encrusted, and showing spiral lines; canal short.

This species appears to be close to Ranella mathewsoni, Gabb. It differs from Gabb's figure in smaller size, slightly more deeply impressed suture, and presence of nodes on angle.

Altitude 28 mm.; width 20 mm.; thickness 14 mm.; mouth opening height 15 mm., width 8 mm.

Gyrineum ellamerensis, new sp.

Pl. 2, fig. 1.

Shell buccinitorm, spire high, apex broken, whorls two present; suture deeply impressed, whorls rounding out below suture; varices prominent; two or three low rounded nodes on angle of whorl between each two successive varices; shell obscurely marked by fourteen flat spiral lines on outer lip, and twenty on the inner lip of body whorl; these are crossed by numerous fine longitudinal lines; mouth opening oval equal in height to half the total height of restored shell; outer lip greatly thickened, spiral lines showing on the inner surface of lip; inner lip thinly encrusted, and showing spiral lines; canal short.

This species appears to be close to Ranella matthewsoni, Gabb. It differs from Gabb's figure in smaller size, slight more deeply impressed suture, and presence of nodes on angle

Altitude 28 mm.; width 20 mm.; thickness 14 mm.; mouth opening height 15 mm., width 8 mm.

Cancellaria ellsmerensis, new sp.

Pl. 2, fig. 2.

Shell fusiform, spire elevated, whorls five to six, slightly angulated below the suture; suture impressed, angulation absent on the body whorl; mouth opening narrow equal to half the height of shell; whorls ornamented with ten to twelve longitudinal ridges, on body whorl these become irregular in shape, and the angulation is absent; whorls show three or four extremely faint radial lines, which are absent in body whorl except for small area on posterior part of columella; outer lip thin, columella encrusted, smooth except for two acute plications anteriorly; canal short straight.

This species is similar to C. cooperi, Gabb, from which it differs by smaller size, absence of angulation on body whorl, and the irregular growth lines on body whorl.

Altitude 25 mm.; width 12mm.; mouth opening length equal to about half total height of shell, width 5 mm.

Cancellaria ellamerensis, new sp.

Pl. 2, fig. 2.

Shell fusiform, spire elevated, whorls five to six, slightly angulated below the suture; suture impressed, angulation absent on the body whorl; mouth opening narrow equal to half the height of shell; whorls ornamented with ten to twelve longitudinal ridges, on body whorl these become irregular in shape, and the angulation is absent; whorls show three or four extremely faint radial lines, which are absent in body whorl except for small area on posterior part of columella; outer lip thin, columella encurved, smooth except for two acute plications anteriorly; canal short straight.

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Cancellaria tritonidae, Gabb, var. angulata new var.
Pl. 1, fig. 3.

Size medium, spire elevated, apex absent, three whorls present1 whorls angulated below suture; ornamented by twleve transverse ribs on each whorl, the ribs forming nodes along the shoulder; lower part of the body whorl concave outwardly in outline, and the vertical ridges are absent from this part; shell spirally ornamented by alternating coarse and fine lines; outer lip smooth, inner lip encrusted; canal short and straight.

This variety differs from C. tritonidae in smaller prominence of the vertical ridges, and greater angulation. In the angulation this variety resembles the earlier whorls of C. tritonidae.

Altitude 20 mm.; width 17 mm.; height of mouth opening equal to half total height of shell.

Cancellaria tritonidea, Gabb, var.
angulata new var.
Pl. I, fig. 3.

Size medium, spire elevated, apex absent, three whorls preserved whorls angulated below suture; ornamented by twelve transverse ribs on each whorl, the ribs forming nodes along the shoulder; lower part of the body whorl concave outwardly in outline, and the vertical ridges are absent from this part; shell spirally ornamented by alternating coarse and fine lines; outer lip smooth, inner lip encrusted; canal short and straight.

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Altitude 20 mm.; width 17 mm.; height of mouth opening equal to half total height of shell.

Turris ellsmerensis, new sp.

Pl. 2 Fig. 3 and 4.

Shell small, fusiform, spire high, apex unknown, whorls four to five present; angulated near suture, shoulder concave, whorls slightly convex below angle, body whorl evenly convex; longitudinal sculpture eleven to twelve prominent rounded ridges which slope slightly to the left, and are most prominent on upper part of whorl near angle, but are not present on the shoulder; shell spirally marked by two to three lines above and seven to eight lines below angle; body whorl and columella ornamented by twenty five spiral lines which are sometimes subequal and alternating; aperture narrow, outer lip thin and smooth, prominently reflected; posterior sinus deep along suture, anterior edge of the sinus parallel to the line of angulation; canal short curved slightly backwards from the aperture; columella smooth.

This species is close to Turris coalingensis, from which it differs by having spiral lines infer and more numerous, and no difference in coarseness of sculpture on body whorl and on columella. It differs from Mangilia tabulatus as figured by Arnold[1] from Bath-House Beach, Santa Barbara, by finer spiral ribbing and shorter canal.

[1] Arnold, Ralph. U.S.Nat. Mus. Paper 1781, pl. 57, fig. 4.

Altitude 29mm.; width 11mm.; mouth opening height 17 mm., width 5mm.; posterior canal width 2 mm., depth 3 mm.

Turritia ellamerensis, new sp.

Pl. 2 Fig. 3 and 4.

Shell small, fusiform, spire high, apex unknown, whorls four to five present; angulated near suture, shoulder concave, whorls slightly convex below angle, body whorl evenly convex; longitudinal sculpture eleven to twelve prominent rounded ridges which slope slightly to the left, and are most prominent on upper part of whorl near angle, but are not present on the shoulder; shell spirally marked by two to three lines above and seven to eight lines below angle; body whorl and columella ornamented by twenty five spiral lines which are sometimes subequal and alternating; aperture narrow, outer lip thin and smooth, prominently reflected; posterior sinus deep along suture, anterior edge of the sinus parallel to the line of angulation; canal short curved slightly backwards from the aperture; columella smooth.

This species is close to *Turritia cosatingensis*, from which it differs by having spiral lines finer and more numerous, and no difference in coarseness of sculpture on body whorl and on columella. It differs from *Mangilia tabulatus* as figured by Arnold[1] from Bath-House Beach, Santa Barbara, by finer spiral ribbing and shorter canal.

Arnold, Ralph. U.S.Nat. Mus. Paper 1781, pl. 57, fig. 4.

Altitude 29mm.; width 11mm.; mouth opening height 17 mm.; width 5mm.; posterior canal width 2 mm., depth 3 mm.

Turris fernandoensis, new sp.

Pl. 2, fig. 6.

Shell small fusiform, spire high, equal in height to the mouth opening; whorls five, roundly angulated, suture following line of angulation of preceding whorl; posterior canal on upper slope of body whorl, prominent, wide, triangular with angle of 135° between sides; lower part of body whorl and canal ornamented by faint spiral lines which may have been worn off of rest of whorl; mouth opening narrow; outer lip broken; columella simple; canal medium length, straight.

This species is similar in shape and size to Astyris richthofeni, but is longer anteriorly, and is distinguishable by the presence of anterior sinus.

Altitude 21 mm.; width 9 mm.; mouth opening height 11.5 mm., width 3.5 mm.

Turris tetranodosaria, new sp.

Pl. 2, fig. 6.

Shell small fusiform, spire high, equal in height to the mouth opening; whorls five, roundly angulated, suture following line of angulation of preceding whorl; posterior canal on upper slope of body whorl, prominent, wide, triangular with angle of 135° between sides; lower part of body whorl and canal ornamented by faint spiral lines which may have been worn off of rest of whorl; mouth opening narrow, outer lip broken; columella simple; canal medium length, straight.

This species is similar in shape and size to Aetyrris richthofeni, but is longer anteriorly, and is distinguishable by the presence of anterior sinus.

Altitude 21 mm.; width 9 mm.; mouth opening height 11.5 mm., width 3.5 mm.

Explanation of Plate 1.

All figures natural size.

Fig. 1. Chione ellsmerensis, n. sp.

Fig. 2. Same as fig. 1., showing hinge.

Fig. 3. Cancellaria tritonidae, Gabb, var. angulata, new var.

Fig. 4. Chione fernandoensis, n. sp. anterior view.

Fig. 5. Same as fig. 4, view of left valve.

Explanation of Plate 2.

All figures natural size.

Fig. 1. Gyrineum ellsmerensis, n. sp.

Fig. 2. Cancellaria ellsmerensis, n. sp.

Fig. 3. Turris ellsmerensis, n. sp.

Fig. 4. Turris ellsmerensis, n. sp. side view.

Fig. 5. Ficus nodiferus, Gabb.

Fig. 6. Turris fernandoensis, n. sp.

Fig. 7. Echinarachinus excentricus, Esch. var. minor, n. var.

Fig. 8. Ficus nodiferus, Gabb. larger specimen showing the more prominent nodes and angulation.

Fig. 9. Astrodapsis fernandoensis, Pack.

Explanation of Plate 1.

All figures natural size.

Fig. 1. Chione ellamerenais, n. sp.

Fig. 2. Same as fig. 1., showing hinge.

Fig. 3. Cancellaria trittonidea, Gabb, var. ampulata, new v

Fig. 4. Chione fernandoensis, n. sp. anterior view.

Fig. 5. Same as fig. 4, view of left valve.

Explanation of Plate 2.

All figures natural size.

Fig. 1. Pyrinoma ellamerenais, n. sp.

Fig. 2. Cancellaria ellamerenais, n. sp.

Fig. 3. Turris ellamerenais, n. sp.

Fig. 4. Turris ellamerenais, n. sp. side view.

Fig. 5. Ficus modiferus, Gabb.

Fig. 6. Turris fernandoensis, n. sp.

Fig. 7. Mohtmarschinus excentricus, Mesk. var. minor, N.var

Fig. 8. Ficus modiferus, Gabb. larger specimen showing the more prominent nodes and ampulation.

Fig. 9. Astrodapsis fernandoensis, Pack.