

Please do not destroy or throw away this publication. If you have no further use for it write to the Geological Survey at Washington and ask for a frank to return it

UNITED STATES DEPARTMENT OF THE INTERIOR

Ray Lyman Wilbur, Secretary

GEOLOGICAL SURVEY

W. C. Mendenhall, Director

Professional Paper 175—B

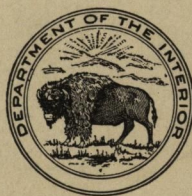
SOME OF ALPHEUS HYATT'S UNFIGURED TYPES FROM THE JURASSIC OF CALIFORNIA

BY

C. H. CRICKMAY

Shorter contributions to general geology, 1932-33

(Pages 51-64)



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1933

For sale by the Superintendent of Documents, Washington, D. C. - - - - - Price 5 cents

CONTENTS

Abstract.....	Page 51
Introduction.....	51
Description and discussion of species.....	52
Missing types.....	58

ILLUSTRATIONS

PLATES 14-18. Figures of Hyatt's type specimens.....	Page 59-64
--	---------------

SOME OF ALPHEUS HYATT'S UNFIGURED TYPES FROM THE JURASSIC OF CALIFORNIA

By C. H. CRICKMAY

ABSTRACT

Alpheus Hyatt named a considerable number of Jurassic fossils from California. Only a few of these were described, and none were illustrated. In this paper 16 of these species are evaluated in terms of present-day nomenclature, figures of the type specimens are shown, and their probable age significance is given. Included are *Monotis semiplicata* (= *Entolium semiplicata*), *Monotis symmetrica* (= *Entolium symmetrica*), *Daonella? subjecta* (= "*Daonella*" *subjecta*), *Daonella böchiformis* (= "*Daonella*" *böchiformis*), *Daonella cardinoides* (= "*Daonella*" *cardinoides*), *Aucella erringtoni* var. *arcuata* (= *Buchia arcuata*), *Aucella elongata* (= *Buchia elongata*), *Aucella* var. *elongata orbicularis* (= *Buchia sinzovi*), *Aucella aviculaeformis* (= *Buchia erringtoni* var. *aviculaeformis*), *Aucella aviculaeformis* var. *acuta* (= *Buchia erringtoni* var. *orbicularis*), *Aucella orbicularis* (= *Buchia erringtoni* var. *orbicularis*), *Cardioceras dubium* (= *Amoeboceras dubium*), *Perisphinctes virgulatiformis* (= *Virgatosphinctes virgulatiformis*), *Perisphinctes mühlbachi* (= *Dichotomoceras mühlbachi*), *Olcostephanus lindgreni* (= "*Galilaeiceras*" *lindgreni*), *Oecotraustes denticulata* (= "*Oecotraustes*" *denticulata*).

INTRODUCTION

Of all the Jurassic species of fossils from California named by Alpheus Hyatt not one was ever illustrated by its author, and only a few of them were described. None are yet adequately known. The writer, encouraged by the late S. S. Buckman's commendations, undertook some years ago to remedy this lamentable state of things. He attempted first to find Hyatt's lost types but was successful only in a very small degree. Only one, "*Vermiceras*" *crossmani*, was found.¹

Spath's recent selection of *V. spiratissimum* as genotype excludes *crossmani* from *Vermiceras*. This was hardly Hyatt's intention, but Spath's selection is perfectly valid. *Crossmani* would then be expected to fall into *Metophioceras* Spath, but this is open to doubt, as neither the young stages nor the septal line of *crossmani* is known, and without these details there is nothing to distinguish *Metophioceras* from the homeomorphic series *Arniotites*.

The writer turned next to the United States National Museum, at Washington, where many of Hyatt's unfigured types were repositied. Here he found both

the large collections from Mount Jura² and the various small collections from other places scattered through the Sierra Nevada.³ All of these have been studied. The Mount Jura types are to be treated in the writer's forthcoming monograph on that famed locality. The other types can not well be included in that monograph and are therefore made the subject of this article, the chief purpose of which is to illustrate and revise these species.

The writer's thanks are due to Dr. T. W. Stanton for his kindness in making available not only the collections themselves but space in which to study them in the National Museum during the summer of 1930; also for having illustrations prepared by members of the staff of the Geological Survey, for providing access to the excellent libraries of the Smithsonian Institution and the Geological Survey, and for numerous other favors.

Hyatt was very indefinite, and even careless of consequence to some extent, in regard to his types. His failure to indicate types in his original descriptions is thus explained in a letter to the curator of the National Museum dated at Cambridge, Mass., February 21, 1896:

I have been thinking lately that the other types of species described in Trias and Jura better not be definitely settled upon yet. Most of them will eventually be figured, and if I pick out the exact types now I shall not be able to change, and if I do there will be confusion.

Hyatt's work came to its close without his having selected the types, either in published reports or on labels. The writer has therefore been obliged to regard all the material bearing Hyatt's labels as cotypes. But Hyatt labeled considerable numbers of rather various specimens of some of his species. Of these the writer has selected those to be illustrated by excluding specimens which came from other than the type localities, which did not accord closely with the description, or which were too poorly preserved to be accurately compared.

² Hyatt, Alpheus, Jura and Trias at Taylorville, Calif.: Geol. Soc. America Bull., vol. 3, pp. 395-412, 1892.

³ Hyatt, Alpheus, Trias and Jura in the Western States: Geol. Soc. America Bull., vol. 5, pp. 395-434, 1894.

¹ Crickmay, C. H., A note on two of Hyatt's Liassic ammonites: California Acad. Sci. Proc., 4th ser., vol. 14, No. 3, 1925.

DESCRIPTION AND DISCUSSION OF SPECIES

"Monotis semiplicata" Hyatt, 1894

Plate 14, Figures 4-7

Geol. Soc. America Bull., vol. 5, p. 414, 1894.

This shell has a more elongated form than *Monotis subcircularis*, being narrow anteriorly and then widening out posteriorly. There are concentric lines over the whole valve, but only the umbonal ridges and posterior parts of the valves are adorned by radiating ridges. These consist of coarse, linear, straight ridges or costae widely separated and with finer lines between them. The extreme border of the posterior part of the shell in the vicinity of the hinge is also destitute of radial lines. There is a distinct but very small posterior wing, and the anterior edge has also a very slight extension, just enough to make it appear straight. The anterior or oral region is short, the umbo varying from nearly terminal to about one-fifth of the anteroposterior diameter from the oral end. The posterior end is much broader, the shape being an extended oval, narrower anteriorly than posteriorly. The umbo is situated nearer the center in young specimens, but always well toward the anterior end, and the shape of the valve does not change materially with growth. The species is gregarious, thickly crowded on the slabs, having had similar habits in this respect with *Monotis salinaria* and *subcircularis*. It is obviously either a Triassic or Rhetic species.

Remarks: Hyatt's description is accurate, but his main distinction on the basis of shell contour and position of umbo is worthless, because the differences in these are too much the result of diastrophic distortion. Hyatt seems to have failed completely to realize how much of the present shape of the shells of this species (as well as the four following, and also the species of *Aucella* described farther on) is the result of diastrophic changes. The connection of some of Hyatt's specific distinctions with diastrophism is undoubted, for all the specimens of one "species" have a common relationship with the direction of compression, those of another "species" have a different relationship with the fundamental directions of strain, usually at right angles to the first species. Some specimens having other orientations puzzled Hyatt, so he left them unidentified or marked them "sp. indet."

The species now under consideration is hardly a *Monotis* in any strict sense, but rather a primitive pectinid allied to *Entolium*: witness the reentrant hinge and the upturned "ears." It differs from *Entolium balteatum* Crickmay by its stronger and more numerous radial striae and its weaker concentric plicae.

Hyatt's positive opinion about the date is open to grave doubt in the light of modern knowledge. The ammonites associated with this species are early Liassic. In British Columbia, also, the closely related *Entolium balteatum* occurs with Lower Lias (Lower Jurassic) ammonites.⁴

Result: *Entolium semiplicatum* (Hyatt). Cotypes, U. S. Nat. Mus. No. 30192, from black argillites

(Sailor Canyon formation), American Canyon, Eldorado County, Calif.

Date: Lower Jurassic, Deroceratan(?).

"Monotis symmetrica" Hyatt, 1894

Plate 14, Figures 1-3

Geol. Soc. America Bull., vol. 5, p. 414, 1894.

The shells of this species, although found at the same locality in the canyon, differ from those of *M. semiplicatus* most markedly in outline and the position of the umbones. These are almost central in young shells, and about one-third of the anteroposterior diameter distant from the anterior oral edge in adults. The shape is irregularly elliptical, the long hinge line forming the upper, flattened part of the outline. The anterior end is narrower than the posterior and the branchial edges evenly rounded and gibbous. There are regular concentric ridges and some radial folds along the umbonal ridges much slighter than in *M. semiplicata* and apparently absent in one adult and one young specimen. It is much rarer than its companion species, only seven specimens having been found on the slabs with *Monotis semiplicatus*. The aspect is that of a species of *Daonella*, but the evident affinity with *Monotis semiplicata* is vouched for by the presence of similar posterior and slight anterior wings.

Remarks: This may possibly be only a variant of the preceding species. It shows some minor differences, such as radial striae, fewer and confined largely to postumbonal slope; concentric plicae, stronger. Distinct from *Entolium balteatum* Crickmay by the postumbonal position of the radial striae.

Result: *Entolium symmetricum* (Hyatt). Cotypes, U. S. Nat. Mus. No. 30193, from black argillite (Sailor Canyon formation) of American Canyon, Eldorado County, Calif.

Date: Lower Jurassic, Deroceratan(?).

"Daonella? subjecta" Hyatt, 1894

Plate 14, Figures 14-17

Geol. Soc. America Bull., vol. 5, p. 415, 1894.

The fossils of this species are much compressed and not well preserved, but they are probably referable to the genus *Daonella*. The outline varies from an ellipse, the anteroposterior axis considerably longer than the dorsoventral, which is evidently the normal form, to an oval, with the longest axis dorsoventral. How much of the last is distortion due to fossilization it is impossible to say, the material being very limited. The shell is marked by coarse concentric ridges near the umbo, becoming finer outwardly, as in *Daonella* and *Monotis*; the radiating lines are coarser than in any other species of *Daonella* from Sailors Canyon, with a finer line between each pair of coarse ones. The hinge line is certainly that of a *Daonella*, but I have used a query after the generic name on account of the state of preservation of the specimens on hand, only two of which are whole. The radiating lines are distributed about equally over the entire surface, but are more prominent near the centers of the valves. These fossils were regarded by Doctor Curtice as lying above the *Monotis* shales, and this agrees with the paleontology. There were no associated species in the single small slab of black shale collected.

Remarks: Hyatt's description is sufficient. He distinguished the species by its "coarser" (and it may be added, fewer) "radiating lines." This and the two following species are hardly *Daonella* in the strict

⁴ Crickmay, C. H., The stratigraphy of Parson Bay, British Columbia: California Univ. Dept. Geol. Sci. Bull., vol. 18, pp. 51-70, 1928.

sense—a Middle Triassic genus. However, until separation can be made on the basis of well-preserved fossils these will be referred to "*Daonella*," the quotation marks indicating that we include not simply *Daonella* in a broad sense but anything closely resembling *Daonella*, whether related or not.

Hyatt gives some stratigraphic information in the phrase "above the *Monotis* shales" which is a rough clue as to date. The "*Monotis* shales" were the uppermost Triassic beds with *Pseudomonotis subcircularis*, hence these "*Daonella* beds" may be presumed to be early Jurassic.

Result: "*Daonella*" *subjecta* Hyatt. Cotypes, U. S. Nat. Mus. No. 30190, from black argillites (Sailor Canyon formation) of Sailor Canyon, Placer County, Calif.

Date: Not certain. Probably early Lower Jurassic.

"*Daonella böchiformis*" Hyatt, 1894

Plate 14, Figures 8–13

Geol. Soc. America Bull., vol. 5, p. 415, 1894.

This shell, as the name indicates, is a close approximation to the European *D. böchi* of Mojsisovics, from the passage beds between the Muschelkalk and Noric series. The umbones are nearer the center than in that species, the concentric ridges more linear, and the radial marking more distinct and closely crowded. It, however, belongs to the primitive type of the group, which approximates closely to the ancestral genus, *Posidonia*. The American species is, however, evidently more distant from *Posidonia* in the genetic series and nearer the typical, heavily striated forms of the genus than the European forms. Our species is also probably smaller as a rule than the *D. böchi*. The outline is that of a flattened ellipse, the lower edge being gibbous and the hinge line flattened, the longest dorsoventral diameter being near the center. The young shells are radiately ridged at a comparatively early stage of growth, and the Posidonian stage is not strongly marked. A fragment of this species was found associated with a species of Ammonitinae from the Ammonites bed of Sailors Canyon. These were for the most part found below the Ammonitinae and were accompanied by a few poorly preserved Pelecypoda of several other genera.

Remarks: Two good distinctions may be added to Hyatt's description. The radial striae are finer than in "*Daonella*" *subjecta*. The concentric striae cover the whole shell.

The associated Ammonitinae mentioned by Hyatt have been found in the National Museum collections. They comprise unnamed species of "*Dactylioceras*" and "*Protogrammoceras*." This suggests at first sight a Harpoceratan date, but the species is probably earlier—Liparoceratan or Amaltheian.

Result: "*Daonella*" *böchiformis* Hyatt. Cotypes, U. S. Nat. Mus. No. 30189, from black argillites (Sailor Canyon formation) of Sailor Canyon, Placer County, Calif.

Date: Lower Jurassic, Amaltheian (?).

"*Daonella cardinoides*" Hyatt, 1894

Plate 14, Figures 18–23

Geol. Soc. America Bull., vol. 5, p. 416, 1894.

The valve of this shell often has an outline like some species of *Cardinia*, and the longitudinal striae are correspondingly curved toward the anterior and posterior ends; otherwise it is similar to *D. böchiformis*. A specimen of this species was found associated with the cephalopods of the Ammonites bed of Sailors Canyon, but the bulk of the specimens were found in the bed below this.

In company with the species of *Daonella* there are several specimens of other species of Pelecypoda, but none of them sufficiently well preserved to be of any value for the determination of age. Some of these last are also associated with the Ammonitinae.

Remarks: Hyatt's distinction of this species was based on such characters as outline of shell and curve of striae. But these have been altered by metamorphism and hence have no taxonomic value. However, this species, though highly similar to "*Daonella böchiformis*," may well be distinct; the striae are certainly somewhat coarser.

As Hyatt cites it from the "*Ammonites* bed of Sailors Canyon," its date may be safely assumed to be early Lower Jurassic.

Result: "*Daonella*" *cardinoides* Hyatt. Cotypes, U. S. Nat. Mus. No. 30191, from black argillites (Sailor Canyon formation) of Sailor Canyon, Placer County, Calif.

Date: Early Lower Jurassic.

"*Aucella erringtoni* var. *arcuata*" Hyatt, 1894

Plate 15, Figures 8–11

Geol. Soc. America Bull., vol. 5, pp. 430–431, 1894.

This variety represents the extreme form and is arcuate in the left valve, with a very prominent umbo. The striations are less decided than in *Aucella elongata*. There are a few shells which are apparently smooth, while most are striated as in *Aucella elongata*. The task of separating this from other varieties by the characteristics of the relative proportions of the left valve to the right and other characters, such as the relative prominence of the umbones in both valves, shape of the hinge line in the right valve, and so on, is impracticable on account of the compressed and more or less distorted condition of every fossil. It is obviously a near affine of *Aucella pallasi*, sp. Keyserling, as figured and described by Lahusen from the zone of *Cardioceras alternans* in Russia, in so far as the general shape and striations are concerned, and Keyserling's original drawings and descriptions of *Aucella pallasi* give longitudinal striations and a form of shell so close to this that without the right valve and hinge line they would be considered identical. With the complete information given by the drawings of the latter, however, it becomes apparent that they are not both referable to the same species. The hinge line of the right valve of the *arcuata* is more like that of *mosquensis*, while the general shape of the shell alone is like that of *pallasi mosquensis*, from the Volgian or middle part of the Upper Jura in Russia.

Remarks: Hyatt's description of this species was derived partly from specimens which have no connection with his types. The types, which came from the Moffat's Bridge locality, are very distinct. They are much too strongly arcuate to have any close relationship with "*Aucella*" *erringtoni*. Moreover, the ornament consists only of concentric striae and plicae. Hyatt's remark that this variety is striate as in "*Aucella*" *elongata* (that is, radially) is not borne out by the type specimens. One of the types shows faint striae, which are interpreted as an individual reversion. Probably Hyatt's statement was founded partly on other things from other localities. It is to be noted that the posterior ear is notably low—that is, not prominent.

In view of all these differences, this must be regarded as an independent species. It may be designated by the name which Hyatt used for the variety. It is most closely related to "*Aucella*" *terebratuloides* and "*Aucella*" *andersoni* of the Tithonian of Russia and California.

The age of the species is undoubtedly Tithonian. This is confirmed by its association with fragments of Tithonian ammonites. This is immensely interesting and important, because formerly no Mesozoic rocks younger than Kimmeridgian have been known to occur in the Sierra Nevada. The slabs of rock containing "*Aucella*" *arcuata* are composed of green sandstone and shale, very different from the slate of the Mariposa formation, in which most of the Upper Jurassic fossils of the Sierra Nevada are found. Evidently these slabs came from beds which have been included in the Mariposa formation of many authors but which, in the writer's opinion, would be better separated as a younger formation. This unit has, of course, remained unnamed and, indeed, hitherto unrecognized as a distinct unit. A host of problems arise at once: Have these beds of latest Jurassic age correlatives in California or in the regions immediately beyond? What is their relationship to the great batholiths and to the high-angled structure of the Sierra Nevada? These questions are of fundamental importance. They bear directly upon late Jurassic history, not only of California but of the whole Cordillera. Their solution will answer in some measure the outstanding problem: Did the Nevadan orogeny take place at one time? If so, when? Or did it come as several successive steps? Again, if so when? Finally, how was the deformation related to the great intrusions?

These are all field problems and must be turned over to the field geologist. However, on one of them the paleontologist has a word to say. The problem of correlation, though by no means solved, at least yields some clues. In the northern Coast Ranges of California rocks that have been called Knoxville shale, bearing so-called Portlandian and Aquilonian species of "*Au-*

cella,"⁵ are probably of Tithonian age and therefore roughly correlative with the "*Aucella*" *arcuata* zone. In the middle Coast Ranges, from a locality near Nipomo, San Luis Obispo County, the writer has collections which include *Berriasella* cf. *B. calisto* D'Orbigny, *Substeueroceras* sp., *Buchia terebratuloides* Lahusen, *Protothurmannia rezanoffiana* Crickmay, etc. These, there can be no doubt, are of late Tithonian age.⁶ The Mount Jura locality of northern California, which is described in a forthcoming monograph by the writer, also includes a fossiliferous formation of Tithonian age. The species are mostly new. They include *Aulacosphinctoides* sp. No other beds of this age have yet been identified in western Canada or in Alaska. However, in Mexico, from the Sierra Ramirez and elsewhere, such typical Tithonian fossils as *Berriasella* cf. *B. calisto* and *Substeueroceras* sp. are reported.⁷

Result: *Buchia arcuata* Hyatt.⁸ Cotypes, U. S. Nat. Mus. No. 30200, from green sandstone and shale formerly included in the Mariposa slate on the south bank of the Tuolumne River at Moffat's Bridge, about 6 miles south of Sonora, Tuolumne County, Calif.

Date: Late Upper Jurassic, Tithonian.

"*Aucella elongata*" Hyatt, 1894

Plate 15, Figures 1-3

Geol. Soc. America Bull., vol. 5, p. 431, 1894.

This species has an excessively elongated shell, but the outline of umbonal ridge is apparently straight or only very slightly curved. The shell is heavily striated in all specimens, the striations being generally distributed. The striae being much lighter and therefore easily obliterated by pressure on the extreme anterior and posterior areas, they may be absent upon either or both of these in large specimens. This accounts for the discrepancy in the descriptions of Meek and Gabb, one finding them more strongly developed on the anterior and the other on the posterior region, but they are apparently, as stated by Meek, usually lighter on the posterior region. It is to be noted, however, that none of the specimens here described have such bare posterior regions as some of those figured by Meek. They are all more similar to his Figure 5 than to 5 *a-e*. The hinge line of the right valve rounds out anteriorly more than in *Aucella erringtoni* var. *arcuata*; the oral region is more protuberant. The wing is of about the same size but is straight. The posterior wing is broader and more distinctly marked than is usual in var. *arcuata* in both valves, and especially long and prominent in the left valve. The umbo is apparently less prominent in the left valve than in *arcuata*, and that of the right valve is possibly less acute, but these characters are rendered somewhat doubtful by the compressed condition of the fossils.

⁵ Pavlov, A. P., Enchaînement des Aucelles et Aucellines du Crétacé russe: Soc. imp. naturalistes Moscou Nouv. Mém., vol. 17, 1907.

⁶ These latest of Jurassic deposits are to be distinguished from the "Knoxville sandstone" of the Coast Ranges, which bears "*Aucella*" *piochii*, "*A.*" *crassa*, "*A.*" *crassicolis*, etc., of early Cretaceous age.

⁷ Burckhardt, Carlos, Faunas jurásicas de Symon (Zacatecas): Inst. geol. Mexico Bol. 33, pp. 56-58, 1919.

⁸ This and other species formerly referred to *Aucella* are to be placed in the genus *Buchia* Rouillier, 1845, type *B. mosquensis*, which antedates and therefore invalidates *Aucella* Keyserling, 1846.

Remarks: The important points in Hyatt's description may be summarized as follows: Concentric plicae, strong and regular; radial striae, strong and covering the whole shell. The excessive elongation which Hyatt noted as a distinction is mainly distortional.

The relationships of the form are with "*Aucella*" *erringtoni* and other Kimmeridgian species, and it is perhaps hair-splitting to regard this as more than a variety of Gabb's species. (Compare with the figures of the types of *erringtoni*, pl. 16.) However, Hyatt separated it, and there may be some advantage in not interfering with the established status of the name.

Hyatt was in error in reporting this from Bostwicks Bar. The museum labels and the numbers on the specimens all indicate that the material came from the locality on the Stanislaus River opposite the mouth of Bear Creek. Moreover, the matrix, a dark argillite, is characteristic of that locality and very different from that of Bostwicks Bar.

Result: *Buchia elongata* Hyatt. Cotypes, U. S. Nat. Mus. No. 30197, from black argillite (Mariposa slate) on the Stanislaus River opposite the mouth of Bear Creek, about 2 miles south of Reynolds Ferry, which is the stage road crossing between Copperopolis and Sonora, Calaveras County, Calif.

Date: Mid Upper Jurassic, Kimmeridgian.

"*Aucella* var. *elongata orbicularis*" Hyatt, 1894

[Probably intended for *Aucella elongata* var. *orbicularis*]

Plate 15, Figures 4-7

Geol. Soc. America Bull., vol. 5, p. 432, 1894.

This differs merely in being more circular in outline and approximates toward *Aucella orbicularis*.

Remarks: To Hyatt's description, which is rather incomplete, may be added the following details: Concentric striae fine and irregular; radial striae variable, weak to obsolete. The outline of the shell is different from all the others, as may be seen in the plates.

This is very unlike *elongata* and *erringtoni*. It ought to rank as an independent species. Hyatt's varietal name, having been used by him for another "*Aucella*," can not be elevated to specific rank for this. It would, therefore, be necessary to supply a new name were it not for the fact that this form seems to be identical with "*Aucella*" *sinzovi* from the Kimmeridgian of Russia.

Result: *Buchia sinzovi* Pavlov. Plesiotypes, U. S. Nat. Mus. No. 30195, are from the pale weathered argillite (?Mariposa slate) on the Stanislaus River opposite Bostwicks Bar, near Reynolds Ferry, Tuolumne (?) County,⁹ Calif.; associated with "*Perisphinctes*" *virgulatiformis* Hyatt, etc.

Date: Mid Upper Jurassic, late Kimmeridgian.

⁹ In a footnote Hyatt says "south side of the river," which would suggest Tuolumne County, but the river makes a sharp turn at this place, so it is uncertain in which county this locality falls. It is about 7 miles east of Copperopolis.

"*Aucella aviculaeformis*" Hyatt, 1894

Plate 16, Figures 13-16

Geol. Soc. America Bull., vol. 5, p. 433, 1894.

This has an outline similar to that of some species of the genus *Avicula*. The young are similar to *Aucella orbicularis* but become more elongated in adults, without, however, entirely losing the orbicular form. The posterior wing is large, and the posterior outline like that of an *Avicula* in some specimens; in others it is similar to *Posidonia*. The oral region is very protuberant and more rounded than that of var. *elongata* but does not project so far anteriorly, especially in the right valve, as does the same region in *orbicularis*. The hinge region is broad and straight, the valve in outline being similar to the right valve of *orbicularis*; but the diameter from the umbo to the border of the dorsoventral edge is longer in proportion to the anteroposterior or transverse diameter. In fact it is just intermediate between *elongata* and *orbicularis* in many characters but differs from both by its peculiar form and outline. The striae are persistent and about the same as in *elongata* and *orbicularis*. There is nothing similar in European faunas, so far as I know.

Remarks: Here again Hyatt's reliance on shell outline led him astray. He appears merely to have chosen those specimens which were distorted diastrophically in a certain peculiar way and erected this species for them. His types are very similar to *Buchia erringtoni* in having strong concentric plicae and weak radial striae. They differ from *Buchia erringtoni* in that the plicae are less regular and the radial striae considerably less faint. It seems well to regard them as a variety.

Of the two localities given by Hyatt, the second only is correct, according to the labels on the specimens. Probably the first locality was given on the basis of material which was not included by Hyatt with the types.

Result: *Buchia erringtoni* var. *aviculaeformis* Hyatt. Cotypes, U. S. Nat. Mus. No. 30198, from black argillite (Mariposa slate) by the Sonora road 6 miles east of Copperopolis, Calaveras County, Calif.

Date: Mid Upper Jurassic, Kimmeridgian.

"*Aucella aviculaeformis* var. *acuta*" Hyatt, 1894

Plate 16, Figures 17-20

Geol. Soc. America Bull., vol. 5, p. 433, 1894.

This may be merely a noteworthy form of *aviculaeformis*, or it may indicate another series between *elongata* and *aviculaeformis*. I think it is simply an extreme form of *aviculaeformis*, having, however, a subacute angle in the lines of growth on the umbonal ridge and a correspondingly subacute outline at the posterior extremity.

Remarks: Hyatt's suggestion that this "is simply an extreme form of *aviculaeformis*" may be taken to mean that he would hardly give it varietal rank. There is some reason to agree with this and indeed to regard the form as a gerontic brephomorph. Its extremely small size, together with evidence of maturity in the crowding of the latest-formed growth lines and in the incurving of the inferior margins of the shells, as if growth had come to an end, points strongly to gerontic brephomorphism or cretinism. The outline and radial lines are highly similar to those of

certain varieties of *Buchia erringtoni*, such as var. *aviculaeformis* or even more so to var. *orbicularis*.

Result: *Buchia erringtoni* var. *orbicularis*, gerontically bryomorph individuals. Cotypes of "var. *acuta*," U. S. Nat. Mus. No. 30199, from black argillite (Mariposa slate) on road to Sonora 6 miles from Copperopolis, Calaveras County, Calif.

Date: Mid Upper Jurassic, Kimmeridgian.

"*Aucella orbicularis*" Hyatt, 1894

Plate 16, Figures 21-23

Geol. Soc. America Bull., vol. 5, p. 434, 1894.

This variety, as the name indicates, has a remarkably circular outline, and the oral region is exceedingly gibbous and projects anteriorly as in Meek's figure; but his figure is certainly an extreme form, resembling, except in size, the young shells of the specimens from which this description is taken. All the good specimens examined by me are also right valves, so that it is quite possible that Meek's extraordinary form may be another variety, if not a distinct species. Right valves of this variety can be easily mistaken for slightly distorted specimens of *Amusium aurarium* in which the anterior wing has been lost, so closely do they approximate in outline to Meek's figure of that form, and the shell also, though usually marked by prominent lines of growth and striae, is sometimes quite smooth.

The unequal umbo having the characteristic anterior reentrant curve and wing of *Aucella* is, however, usually sufficiently well marked to prevent an observer from making this mistake. This variety is certainly very similar to the *Aucella crassicollis* var. *solida* in the shape of the younger part of the right valve but differs materially in having striations and in the shape of the adult.

Remarks: This form also is so similar to *Buchia erringtoni* in all essential respects that to regard it as of higher rank than a variety seems a mistake. It differs from the typical species in that both the concentric plicae and radial striae are weak and irregular. The orbicular outline, which Hyatt supposed to be characteristic, is the result of diastrophic distortion. Some of the orbicular specimens which he ranged here are different from the types in other respects and plainly belong to other varieties which have been made to resemble this by similar distortion to a roundish shape.

Hyatt's locality is at fault—apparently a mere accident in transcription on his part. The museum labels say "6 miles from Copperopolis on road to Sonora."

Result: *Buchia erringtoni* var. *orbicularis* Hyatt. Cotypes, U. S. Nat. Mus. No. 30194, from black argillite (Mariposa slate), on road to Sonora, 6 miles from Copperopolis, Calaveras County, Calif.

Date: Mid Upper Jurassic, Kimmeridgian.

"*Cardioceras dubium*" Hyatt, 1894

Geol. Soc. America Bull., vol. 5, p. 402, 1894.

Remarks: This species has already been revised and illustrated by Reeside.^{9a} However, there is still the troublesome question of the name of the species being

^{9a} Reeside, J. B., jr., Some American Jurassic ammonites of the genera *Quenstedticeras*, *Cardioceras*, and *Amoeboceras*, family *Cardiocerata*: U. S. Geol. Survey Prof. Paper 118, p. 38, 1919.

invalidated through the page priority of *Cardioceras whitneyi* Smith,¹⁰ which, though not illustrated, was undoubtedly intended for this species. However, Smith describes his specimens as *Cardioceras alternans* Von Buch. He mentions no character by which his specimens differ from *Cardioceras alternans*. Even though he does compare them with other species, he does not actually contrast them with any and suggests the name *whitneyi* merely in case the Californian form should prove distinct. He founded no types. His name is therefore a true nomen nudum. Hence it had only temporary status and must be considered to have lapsed through the appearance of Hyatt's description and naming of *Cardioceras dubium*.

Result: *Amoeboceras dubium* (Hyatt); synonym, *Amoeboceras whitneyi* (Smith). Cotypes, U. S. Nat. Mus. No. 30201, from black argillite (Mariposa slate) at Texas ranch, Calaveras County, Calif.

Date: Upper Jurassic, Rasenian.

"*Perisphinctes virgulatiformis*" Hyatt, 1894

Plate 16, Figures 24-25; Plate 17, Figures 1-8

Geol. Soc. America Bull., vol. 5, p. 422, 1894.

P. virgulatiformis has the peculiar closely approximated linear costae of a group of *Perisphinctes* which occurs only in the Upper Jura throughout western Europe. This species is not a typical discoidal form of *Perisphinctes*. The whorls are decidedly involute, the inclusion being about one-third, and although the inner whorls are discoidal until a late stage and the umbilicus is what one would term open, still the outer whorl broadens rapidly.

There are several close allies in the Upper Jura of Europe. One of these is *Ammonites virgulatus* Quenstedt, of the Oxfordian; another and perhaps even closer form is his *Ammonites planulatus siliceus*, which occurs in the Solenhofen schists. All of these differ from our species in the regularity with which the plicae bifurcate, and probably the whorls of our species may differ somewhat in outline of a transverse section, but this can not be ascertained on account of the compression of the specimens in hand. The sutures agree closely and show that these forms are all allied species of the same group.

C. jeremejevi Nikitin of the Russian fauna is a similar form, and only every alternate costation is bifurcated, so that it comes very near to the American shell, in which the bifurcation is irregular. Some of our examples have hardly any of the costae bifurcated; others have only a few with bifurcations, but in some specimens every alternate costa is bifurcated on parts of the whorl. It seems probable that the American species had rounder whorls than *P. jeremejevi*.

Remarks: To Hyatt's description may be added: The species is a compressed planulate with round and slightly flattened venter. Ribbing fine, close, slightly flexuous, simple and biplicate (in a very few specimens zigzag), crossing venter uninterrupted and almost straight. Septal line is perisphinctean but reduced; external lobe (EL) very slightly shorter than the first lateral (L1); auxiliaries dependent. All specimens more or less crushed. Cotype No. 1, diameter 33(?) millimeters, thickness 17(?) per cent, width of umbilicus 30(?) per cent.

¹⁰ Smith, J. P., Age of the auriferous slates of the Sierra Nevada: Geol. Soc. America Bull., vol. 5, p. 254, 1894.

By its septal line this species is close to *Virgatosphinctoides* Neaverson, with which it is now ranged. The ribbing is simpler—rather of the *pectinatus* type; but this is a minor difference.

The types are from the Bostwicks Bar locality. The specimens from the Bear Creek locality are not of this species and, moreover, are indeterminate.

Result: *Virgatosphinctoides virgulatiformis* (Hyatt). Cotypes, U. S. Nat. Mus. No. 30204, from the pale weathered argillite (? Mariposa slate) of the Stanislaus River opposite Bostwicks Bar, near Reynolds Ferry, Tuolumne (?) County, Calif.

Date: Mid Upper Jurassic, late Kimmeridgian, Paravirgatitan.

"Perisphinctes mühlbachi" Hyatt, 1894

Plate 18, Figures 1-2

Geol. Soc. America Bull., vol. 5, p. 426, 1894.

The young are discoidal, but the increase in dorsoventral diameters is by no means so slow as in the normal forms of *Perisphinctes*. In the large specimen which served as type of this description there were about seven whorls, as estimated, in a diameter for the whole shell of about 125 millimeters.

The lateral costae are single, much coarser than in *P. virgulatiformis* and very closely set. There were about 47 on the seventh whorl and as many on the sixth. This gives the costae a more crowded aspect on the inner whorls than on the outer one, the costations being wider apart proportionately in the older stages than in the younger whorls. The lateral costae are slightly arched forward, single, sharply defined, and prominent. The bifurcations are regular and set well upon the abdomen, so that they are concealed, as in most of the species described in this paper, by the involution of the whorls. The absence of straight, unbifurcated costae is noticeable in this species and *P. filiplex*?, but the latter has fewer costae, and the bifurcations are not wholly hidden by the involution of the whorls.

Remarks: The illustrations add all that is needed to Hyatt's description. Further, they amend his description in one respect—it is uncertain whether "the bifurcations" of the ribs are "regular." They are certainly not "set well upon the abdomen," according to the modern use of these terms. EL is longer than L1. The furcation of ribs comes just off the external side of L1.

This form might be connected on the basis of its ribbing with any of the lower Kimmeridgian and even the Corallian perisphinctids. The fragment of septal line preserved is not that of *Perisphinctes* but shows rather a connection with *Dichotomoceras*, under which the species is tentatively ranged, it being understood that this assignment is provisional.

Result: *Dichotomoceras mühlbachi* (Hyatt). Holotype, U. S. Nat. Mus. No. 30202, from black slate (Mariposa slate) near Greenwood, Eldorado County, Calif.

Date: Mid Upper Jurassic, early Kimmeridgian, Prionodoceratan.

"Olcostephanus lindgreni" Hyatt, 1894

Plate 17, Figures 9-10

Geol. Soc. America Bull., vol. 5, p. 427, 1894.

The specimen representing this species is unluckily so much altered by compression that some of its characteristics become doubtful. The tubercular aspect of certain of the lateral costae is probably due to flexures, occasioned by pressure in the direction of the dorsoventral diameters of the whorl. The lateral costae are divided upon the sides into numerous smaller costae, which cross the abdomen continuously; that is to say, the costae have the aspect of a species of *Olcostephanus* of the *virgatus* group of that genus, which has been so finely described by Michalski in the Russian fauna of the Upper Jura. So much depends upon the development of the young in this genus that I can not compare it with any species yet described. That it is not probably identical with the adult stage of any one described by Michalski seems to be plain, even in this imperfect specimen.

Remarks: Hyatt mistook the relationships of this form. It has no connection with *Olcostephanus* nor with the *virgatus* group but is a gowericeratine kosmoceratid. It has the typical cross-sectional outline and robust form and the characteristic type of fasciculate secondary ribs. The septal line is unfortunately not well preserved, though it is apparently straight and of medium elaboration. The one side of the specimen is almost complete and shows the crowding of the costae, which marks the end of the last whorl. The last septum is half a whorl back, hence the living chamber was half a whorl in length. The last half whorl has 22 primary ribs and 110 secondaries. The young stages show a costate (tuberculate?) serpentine; there is a faint suggestion of tubercles, the faintness of which may be the result of poor preservation rather than weak development.

The dimensions are as follows:

Millimeters		Millimeters	
Diameter.....	a 103	Width of umbilicus 180°	
Diameter 90° back.....	a 56	back.....	20
Diameter 180° back.....	a 76	Thickness.....	a 28
Width of umbilicus.....	36	Thickness 180° back.....	a 20
Width of umbilicus 90°		Height of whorl.....	a 33
back.....	15	Height of whorl 180° back.....	a 32

Though it is not possible to make an exact generic determination, this form agrees most closely with *Galilaeiceras*.

Result: "*Galilaeiceras*" *lindgreni* (Hyatt). Holotype, U. S. Nat. Mus. No. 30205, from deeply weathered argillite and sandstone (Mariposa slate) half a mile south of Colfax, Placer County, Calif., and a quarter of a mile west of the railroad (according to the field label), where it is associated with "*Catacephalites*" sp.

Date: Early Upper Jurassic, Callovian, Proplanulitan, *fracidus*?

* These dimensions depend upon reconstructions. The irregularity of dimensions is, of course, the result of diastrophic distortion.

"Oecotraustes denticulata" Hyatt, 1894

Plate 17, Figures 11-13

Geol. Soc. America Bull., vol. 5, p. 427, 1894.

This is a species belonging to the smooth-whorled, denticulated section of the genus which occurs in the Upper Jura. The specimens, although only fragments considerably compressed, show the denticulations, the aperture in part and the sutures. The characteristics of all of these indicate plainly that it is a species of *Oecotraustes*, allied to such forms as *Oecotraustes* (*Ammonites*) *lochensis*, sp. Oppel., of the Oxfordian. It may be that its nearest congener is in the Solenhofen slates, but in order to make such a close diagnosis better specimens must be procured.

The sutures have a short abdominal lobe, with large siphonal saddles, large first lateral lobes, with three long, slender terminal lobes and other parts of the outline, as in the section of the genus to which it is referred. This genus is sometimes confused with *Amaltheus* of the Lower Jura, but the resemblances are very slight and do not need discussion.

Remarks: Magnification shows that the end of the last whorl is broken and hence does not show the aperture as Hyatt thought. Further, Hyatt speaks of a "short abdominal lobe." This is hardly correct: The external lobe is very long for an oppelid. The shell is small and compressed, oxyconic(?). The ornament consists of median ventral denticulations and faint, weakly flexuous plicae on the flanks.

Dimensions: Diameter, 35 millimeters (reconstructed); height of whorl, 68 per cent or 20 millimeters; width of umbilicus, 7 per cent or 2.5 millimeters.

Result: "*Oecotraustes*" *denticulata* Hyatt. Cotypes, U. S. Nat. Mus. No. 30206, from the pale, deeply weathered argillite (? Mariposa slate) on the Stanislaus River opposite Bostwicks Bar, near Reynolds Ferry, Tuolumne (?) County, Calif. It is associated with *Virgatosphinctoides virgulatiformis* (Hyatt).

Date: Mid Upper Jurassic, late Kimmeridgian, Paravirgatitan.

MISSING TYPES

Information is earnestly requested with regard to the types of the following species which the author has not been able to find:

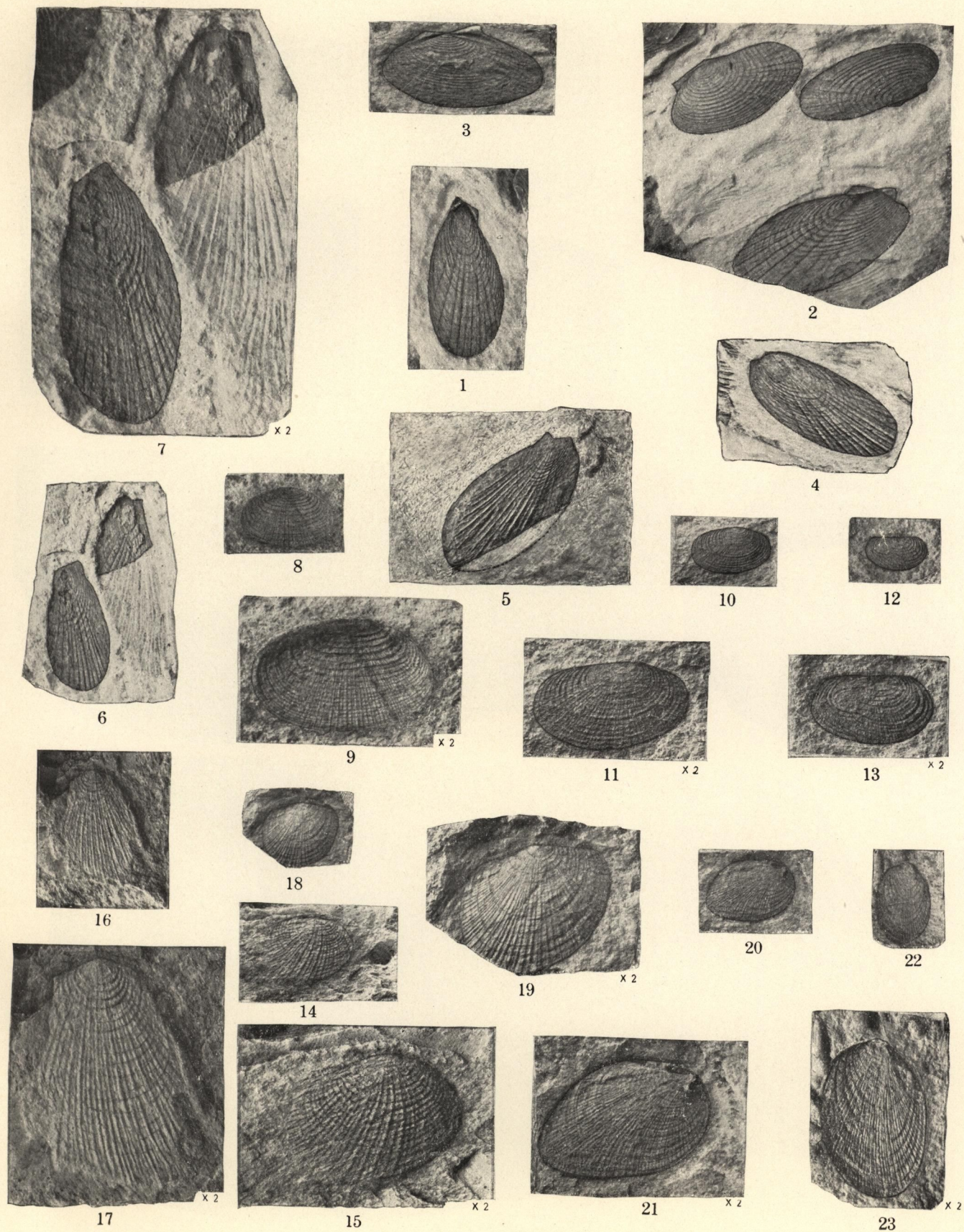
Coroniceras claytoni Hyatt.	Pecten acutiplicatus Meek.
Pleuromya concentrica Hyatt.	Inoceramus obliquus Meek.
Perisphinctes colfaxii Gabb.	Inoceramus rectangulus Meek.
Aucella piochii Gabb.	Trigonia pandicosta Meek.
Rhynchonella gnathophora Meek.	Mytilus multistriatus Meek.
Lima sinuata Meek.	Astarte ventricosa Meek.
Lima reticostata Meek.	Unicardium gibbosum Meek.
Lima cuneata Meek.	Myacites depressus Meek.

These were described long ago from California (and one from Nevada) and probably lie unrecognized in some American museum. The directors of museums ought to regard this loss as a challenge to the integrity of their stewardship. Such a loss is a smirch which can be removed only by finding the specimens or discovering their fate.

PLATES 14-18

PLATE 14

	Page
FIGURES 1-3. <i>Entolium symmetricum</i> (Hyatt), Lower Jurassic, American Canyon, Eldorado County, Calif. Five cotypes, all left valves-----	52
1. A natural mold.	
2. Upper figures are casts, lower a mold.	
3. A natural cast.	
FIGURES 4-7. <i>Entolium semiplicatum</i> (Hyatt), Lower Jurassic, American Canyon, Eldorado County, Calif. Four cotypes--	52
4. A left valve.	
5. A right valve.	
6. Molds of right and left valves.	
7. Same specimen as Figure 6.	
FIGURES 8-13. " <i>Daonella</i> " <i>böchiiformis</i> Hyatt, Jurassic, probably Lower, Sailor Canyon, Placer County, Calif. Three cotypes, each natural size and twice enlarged-----	53
8-11. Natural casts.	
12-13. A natural mold.	
FIGURES 14-17. " <i>Daonella</i> " <i>subjecta</i> Hyatt, Jurassic, probably Lower, Sailor Canyon, Placer County, Calif. Two cotypes, each natural size and twice enlarged-----	52
16-17. A fragmentary specimen showing predominant radial ribbing. The outlines are not true shell margins.	
FIGURES 18-23. " <i>Daonella</i> " <i>cardinoides</i> Hyatt, Lower Jurassic, Sailor Canyon, Placer County, Calif. Three cotypes, each natural size and twice enlarged-----	53



FIGURES OF HYATT'S TYPE SPECIMENS



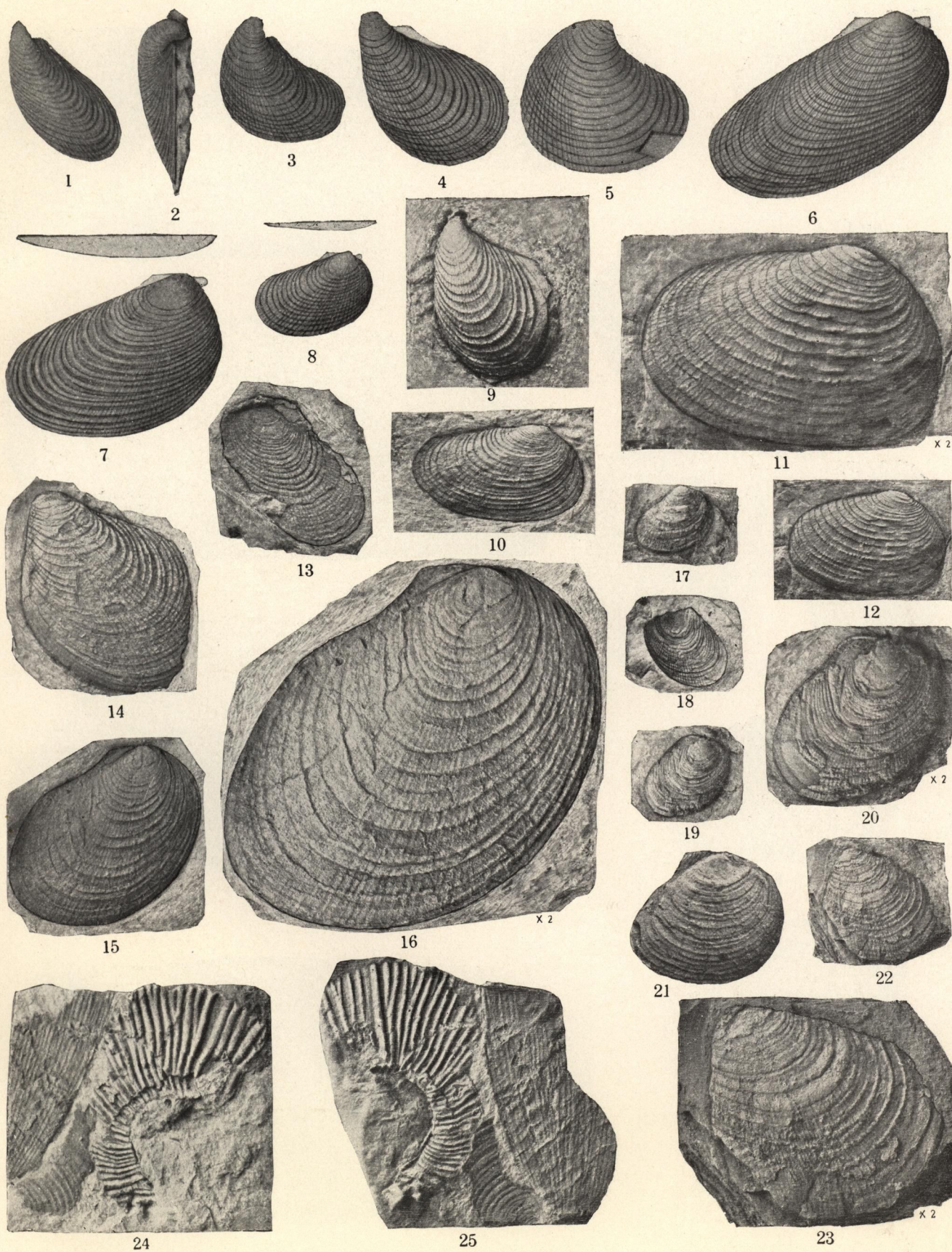
11
FIGURES OF HYATT'S TYPE SPECIMENS

PLATE 15

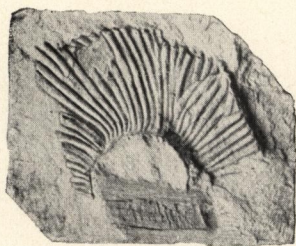
	Page
FIGURES 1-3. <i>Buchia elongata</i> Hyatt, Kimmeridgian, Stanislaus River opposite mouth of Bear Creek, Calaveras County, Calif. Three cotypes, all left valves.....	54
FIGURES 4-7. <i>Buchia sinzovi</i> Pavlov (= <i>Aucella elongata</i> var. <i>orbicularis</i> Hyatt), upper Kimmeridgian, Stanislaus River opposite Bostwicks Ber, near Reynolds Ferry, Tuolumne (?) County, Calif. Three cotypes of Hyatt's variety----	55
4, 5. A right valve.	
6. A right valve.	
7. A left valve.	
FIGURES 8-11. <i>Buchia arcuata</i> Hyatt, Tithonian, south bank of Tuolumne River at Moffat's Bridge, Tuolumne County, Calif., cotypes.....	54
8. Left valve, enlarged. Same specimen is seen on the slab in Figure 10.	
9. A valve enlarged, showing faint traces of radial striae. Same specimen is seen on the slab in Figure 10. Striae are not typical but are an individual reversion.	
10. The originals of Figures 8 and 9, and others, on a slab.	
11. A slab containing other cotypes. Large specimen to right of center is an internal mold of a right valve.	

PLATE 16

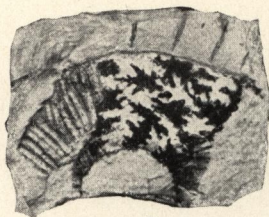
- FIGURES 1-2. *Buchia erringtoni* var. *linguiformis* Meek, copies of protographs shown for comparison, from California Geological Survey, Geology, vol. 1, Appendix B, pl. 1, figs. 1, 1a.
- FIGURES 3-8. *Buchia erringtoni* (Gabb) Meek, copies of protographs shown for comparison, from California Geological Survey, Geology, vol. 1, Appendix B, pl. 1, figs. 2, 2a, 3, 5a-d. [These numbers have been taken from Meek's description, the incorrect reference at the head of the description having been noted. This error, seemingly typographic, has been copied unnoted by some later authors.]
- FIGURES 9-12. *Buchia erringtoni* (Gabb) Meek, Kimmeridgian, Mariposa Estate, Calif. Plesiotypes. Shown here for comparison. U. S. Nat. Mus. No. 7831.
9. A left valve. The history of this specimen is unknown, but its similarity to Meek's Figure 2 (fig. 3 of this plate) is so great as to suggest the probability of its being one of the cotypes, one of the Gabb collection which was sent to Meek. It is listed in the catalog of type specimens, U. S. Nat. Mus. Bull. 53, pt. 1, as a plesiotype.
10. A right valve, plesiotype.
- 11-12. A right valve, natural size and twice enlarged, plesiotype.
- FIGURES 13-16. *Buchia erringtoni* var. *aviculaeformis* Hyatt, Kimmeridgian, Sonora road 6 miles east of Copperopolis, Calaveras County, Calif. Three cotypes----- 55
13. A left valve.
14. A left valve, somewhat distorted so as to appear unusually umbonate.
- 15 and 16. A right valve natural size and twice enlarged.
- FIGURES 17-20. *Buchia erringtoni* var. *orbicularis* Hyatt (= *Aucella aviculaeformis* var. *acuta* Hyatt), upper Kimmeridgian, Sonora road, 6 miles east of Copperopolis, Calaveras County, Calif. Three cotypes of Hyatt's variety, all gerontic brephomorphs----- 55
- 17 and 18. Natural size.
- 19 and 20. The same specimen, natural size and twice enlarged.
- FIGURES 21-23. *Buchia erringtoni* var. *orbicularis* Hyatt, Kimmeridgian, Sonora road 6 miles east of Copperopolis, Calaveras County, Calif. Two cotypes----- 56
21. A right valve, slightly distorted. The specimen does not show the radial striae as strongly as it should.
- 22 and 23. A left valve natural size and twice enlarged.
- FIGURES 24-25. *Virgatosphinctoides virgulatiformis* (Hyatt), late Kimmeridgian, Stanislaus River opposite Bostwicks Bar, near Reynolds Ferry, Tuolumne (?) County, Calif.----- 56
24. Cotype No. 3, a fragmentary mold of the exterior. The slab also shows a shell of *Buchia sinzovi* Pavlov and a leaf of *Zamia* sp.
25. A wax cast of the mold, Figure 24, showing the ribbing and one varix.



FIGURES OF HYATT'S TYPE SPECIMENS



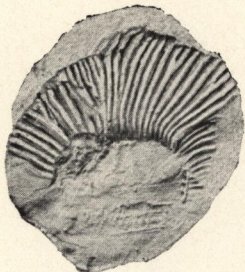
1



3



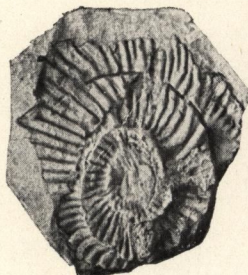
4



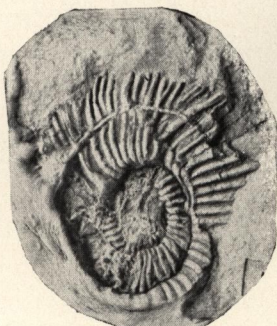
2



5



6



7



9



8



10



11



12



13

FIGURES OF HYATT'S TYPE SPECIMENS

PLATE 17

	Page
FIGURES 1-8. <i>Virgatosphinctoides virgulatiformis</i> (Hyatt), late Kimmeridgian, Stanislaus River opposite Bostwicks Bar, near Reynolds Ferry, Tuolumne (?) County, Calif.-----	56
1. Cotype No. 1, a fragmentary natural mold of the exterior.	
2. A wax cast of specimen shown in Figure 1.	
3. Cotype No. 1, a natural internal mold, retaining the septa. The four scratches in the matrix near the periphery indicate the locations of the apices of the external lobe (EL).	
4. Same as Figure 3 but twice enlarged.	
5. Cotype No. 2, showing the second lateral lobe (L2) and the dependent auxiliaries.	
6. Cotype No. 4, a fragmentary mold of the exterior.	
7. A wax cast of specimen shown in Figure 6.	
8. Cotype No. 4, a fragmentary natural mold of the interior, twice enlarged.	
FIGURES 9-10. " <i>Galilaeiceras</i> " <i>lindgreni</i> (Hyatt), Upper Jurassic, half a mile south of Colfax, Placer County, Calif. Holotype. Shows traces of lateral tubercles on the last half-whorl, the body chamber.-----	57
9. Ventrolateral aspect.	
10. Lateral aspect.	
FIGURES 11-13. " <i>Oecotraustes</i> " <i>denticulata</i> Hyatt, late Kimmeridgian, Stanislaus River opposite Bostwicks Bar, near Reynolds Ferry, Tuolumne (?) County, Calif. Holotype.-----	58
11. This specimen preserved part of the natural mold of the interior, and the external mold of the right-hand side of the shell.	
12. Part of natural mold of the interior retaining the septa of the right-hand side, and an external mold of the left-hand side. The counterpart of the specimen shown in Figure 11.	
13. Same as Figure 12 but three times enlarged. Shows flexuous, lateral plicae and peripheral denticulations.	
	63

PLATE 18

- FIGURES 1-2. *Dichotomoceras mühlbachi* (Hyatt), early Kimmeridgian, Greenwood, Eldorado, Calif. Holotype----- Page 57
1. A natural mold of the exterior with a small fragment of internal mold showing part of the septal line, EL to L2, and its relation to the ribbing.
 2. A plaster cast of the holotype, showing traces of the secondary ribs.
- 64





FIGURES OF HYATT'S TYPE SPECIMENS