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Upper Cretaceous Ammonites of California

Part I*

By

Tatsuro MATSUMOTO

Introduction

1. Historical review and purpose of study

The purpose of this paper is to describe the Upper Cretaceous ammonites of California which I studied during my visit to the United States in 1957-1958.

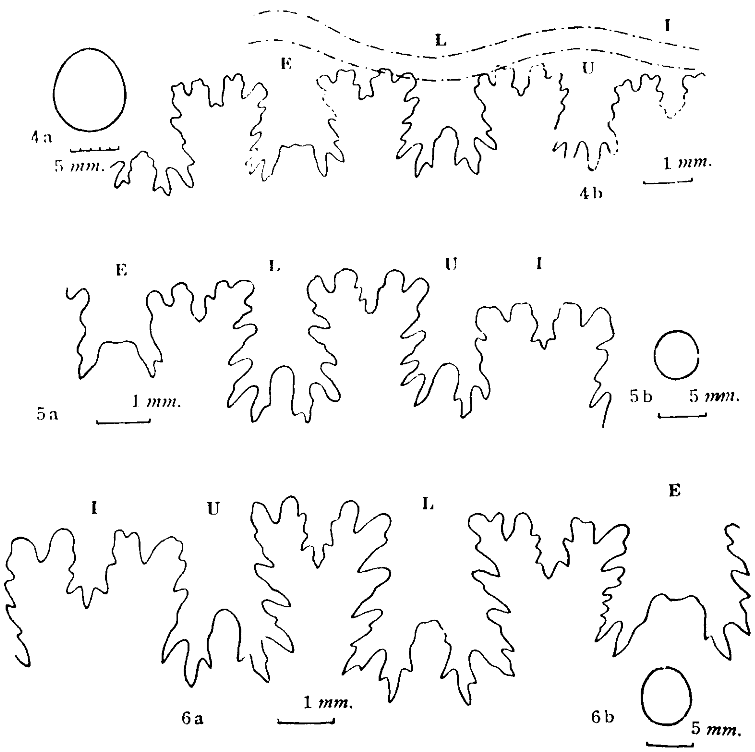
The history of the study of Cretaceous ammonites from this region goes back about a century, but for some reason the Californian ammonites have not been treated as adequately as they ought to have been.

The first governmental reconnaissance in the geology of California was taken in connection with the surveys for the railroad route from the Mississippi to the Pacific (NEWBERRY, 1856; BLAKE, 1858). While many of the collections on this occasion were described in appendices to the report, BLAKE (1858, p. 173) cited for the ammonites only a paper by TRASK (1856), which, however, strangely indicated that the ammonite bearing rocks of the Chico Creek were Tertiary.

The Geological Survey of the State of California was organized soon after the gold rush in 1849. WHITNEY (1865) edited the report of the geological field work and GABB (1864, 1869) was the author of a work on the Cretaceous fossils in two volumes, which contain descriptions of many species of the Ammonoidea. Immediately after the publication of the *Palaeontology of California*, Volume I, CONRAD (1865, 1866) criticised GABB's work, but with little mention of the ammonoid species. Still later STEWART (1927, 1930) published revised descriptions and illustrations of GABB's California Cretaceous and Tertiary type gastropods and lamellibranchs. For GABB's ammonites, however, no paper has been issued which is comparable with these useful and nomenclatorially accurate monographs of STEWART. Still worse is the situation that many of GABB's type ammonites are missing, although some of his illustrated specimens have been discovered in three institutions—the Museum of Paleontology, University of California, the Academy of Natural Sciences, Philadelphia, and the Museum of Comparative Zoölogy at Harvard College.

The United States Geological Survey was established in 1879 and, based on collections made in the course of its geological reconnaissance, WHITE (1885) and STANTON (1893, 1894, 1895, 1896) contributed papers on the paleontology of California. Very few ammonites, however, were described in those papers,

* Received October 31, 1958.



Figs. 4-6. *Sciponoceras kossmati* (NOWAK).

4. Cross section (a), with height=9.0, breadth=7.5 mm., and suture (b), at height=5.4, breadth=4.8 mm., of the holotype of *Cyrtochilus stylus* ANDERSON, from loc. CAS. 31097. Broken lines indicate the constriction.

5. Suture (a) and cross section (b) of an example, at height=5.1, breadth 4.5 mm., from loc. CAS. 33706, Arroyo del Valle.

6. Suture (a) and cross section (b) of another example, from loc. CAS. 33706, at height=6.2, breadth=4.9 mm. The same specimen is illustrated on Pl. 31, fig. 2a, b.

is uncertain, although it was presumed as the lower part of the Upper Cretaceous in this area (as understood from the writing on the label). Loc. CAS. 31097, the type locality of *Cyrtochilus stylus* ANDERSON, Dry Creek, Ono Quadrangle, northwest side of the Sacramento Valley; CAS. 33719, Garzas Creek, west side of the San Joaquin Valley, where Lower Turonian *Kanabiceras* cf. *K. septemseriatum* (CRAGIN) and *Inoceramus labiatus* SCHLOTHEIM are associated. Although further collection is needed, the existence of *S. kossmati* (NOWAK) in the Cretaceous of California is worth recording.

Sciponoceras aff. *S. bohemicum* (FRITSCH)

Pl. 30, figs. 2a-c, 3a, b; Pl. 31, fig. 4; Text-figs. 7a, b, 8-11

Compare.—

1872. *Baculites faujassi* LAMARCK var. *bohemica* FRITSCH *in* FRITSCH and SCHLOENBACH, *Ceph. der böhm. Kreideformat.*, p. 49, pl. 13, figs. 23-25, 29, 30.

1874. *Baculites baculoides*, GEINITZ (*non* MANTELL), *Palaeontographica*, vol. 20, p. 195, pl. 35, figs. 17-21.

1876. *Baculites* cf. *bohemicus*, SCHLÜTER, *Palaeontographica*, vol. 24, p. 140, pl. 39, figs. 1-5.

1895. *Baculites bohemicus*, JAHN, *Jahrb. K. K. geol. Reichsanst.*, vol. 45, p. 136, pl. 8, figs. 7, 8.

1896. *Baculites bohemicus*, WOODS, *Quart. Jour. Geol. Soc. London*, vol. 52, p. 76, pl. 2, figs. 9, 10.

1908. *Baculites* (*Lechites*) *bohemicus*, NOWAK, *Bull. Acad. Sci. Cracovie*, 1908, p. 348, 350.

1951. *Sciponoceras bohemicum*, WRIGHT and WRIGHT, *Palaeontogr. Soc.*, 1950, p. 16.

Types.—FRITSCH established the name *bohemica* on a number of syntypes. No subsequent authors have designated the lectotype. I have not seen the original specimens from Bohemia, but had an opportunity of studying the hypotypes of WOODS (1896) and WRIGHT and WRIGHT (1951) from the Chalk Rock of England.

Material.—The Californian specimens here described are as follows: UCLA. 28848 (Pl. 30, fig. 2a-c; Text-fig. 8), from loc. CIT. 1069; UCLA. 28849 (Text-fig. 7), from loc. CIT. 1069; UCLA. 28850-28852, from loc. CIT. 1062; UCLA. 28853 (Pl. 30, fig. 3a, b), from loc. CIT. 1070, representing a body whorl; UCLA. 28854 (Pl. 31, fig. 4; Text-fig. 9), from loc. CIT. 979; UCLA. 28855 (Text-fig. 11) and other fragments from loc. CIT. 79. All came from the upper sandy part of the Baker Canyon member, Santa Ana Mountains (Coll. W. P. POPENOE; W. P. POPENOE & G. H. ANDERSON; B. N. MORE).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
UCLA. 28848	7.6 6.5	5.8 5.0	(0.76) (0.71)	25.0
UCLA. 28849	5.9	4.5	(0.76)	
UCLA. 28851	7.4	5.5	(0.74)	
UCLA. 28853	16.1 13.8	11.5 9.0	(0.71) (0.65)	75.0
UCLA. 28854	5.5	4.4	(0.80)	
UCLA. 28855	12.4	9.2	(0.74)	

Description.—The shell is relatively small; the largest example of the body chamber is 16.1 mm. in height, but other specimens are smaller than that. Tapering is very slow. The section is almost elliptical. The periodic constrictions are very weak on all the examined specimens, being hardly discernible on the dorsal part. The ribs are generally weak, although variable in strength by individuals. They are more distinct on the ventral area and adjacent part of the flank than on the dorsal area. Those along the constrictions are slightly stronger than others. The ribs and constrictions are prorsiradiate on the flank,

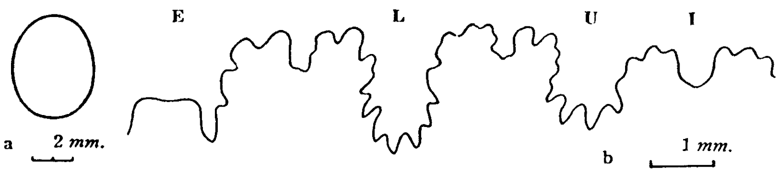
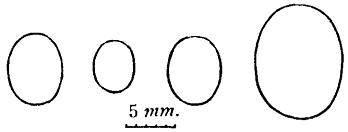


Fig. 7. *Scipononceras* aff. *S. bohemicum* (FRITSCH). Cross section (a) and suture (b) of an example, UCLA. 28819, from loc. CIT. 1069, top of Baker Canyon member, Santa Ana Mountains.



Figs. 8-11. *Sciponoceras* aff. *S. bohemicum* (FRITSCH). Cross sections of the four specimens: UCLA. 28818 (fig. 8) (see Pl. 30, fig. 2a-c), from loc. CIT. 1069; UCLA. 28854 (fig. 9), from loc. CIT. 979; UCLA. 28851 (fig.10), from loc. CIT. 1062; UCLA. 28855 (fig. 11), from loc. CIT. 79, all at or near top of Baker Canyon member. Santa Ana Mountains.

moderately but not strongly projected on the venter, and broadly curved forward on the dorsum, showing a shallow sinus on the dorsolateral part. No specimens before me are complete enough to show the aperture.

The suture is simple, having small and shallow dentation in addition to bifurcation. The saddles are much broader than the lobes; that between E and L is the broadest.

Remarks.—In all the characters the Californian specimens here described are almost certainly assigned to *Sciponoceras bohemicum* (FRITSCH). Among several species of *Sciponoceras*, *S. bohemicum* (FRITSCH) of the Upper Turonian is the closest to the Coniacian species of *Baculites* in the elliptical, instead of subcircular, section, weakness of ribs, slight forward curve of the ribs on the dorsal area, and simple (or simplified) suture. The fact was briefly mentioned by WRIGHT (*in* MOORE [Editor], 1957, p. L 218), who personally gave me further detailed information of the British species of *Sciponoceras*.

In the form represented by the Californian specimens the weakness of the constrictions is constant and diagnostic, just as in the one represented by the Japanese Upper Turonian specimens. Whereas in the European specimens, as was noticed by FRITSCH (1872) and WOODS (1896), the constrictions are sometimes fairly well-marked, but sometimes indistinct. WRIGHT (a letter to me dated Jan. 14, 1958) observes that "the constrictions are beginning to weaken in *S. bohemicum*." It may be suggested that the Californian and Japanese specimens, in which the constrictions are always very weak, could be separated at least subspecifically from the typical European examples of *S. bohemicum* (FRITSCH). Until the European specimen, especially the types from the Bohemian Cretaceous, are carefully examined, I temporarily call the Californian (and Japanese) specimens *Sciponoceras* aff. *S. bohemicum* (FRITSCH).

It should be noted here that *Baculites fairbanksi* ANDERSON (1902, p. 92, pl. 10, fig. 194; *non* pl. 7, figs. 152, 153) could possibly be a synonym of the present species, because the recorded type locality strongly suggests the Baker Canyon sandstone and the illustrated suture is as simple as that of the present species. Unfortunately ANDERSON's original specimens were lost (presumably in the fire of 1906) and two other figures (pl. 7, figs. 152, 153) indicated under his same specific name do not show the elliptical section, weak ribbing and simple suture of *Sciponoceras bohemicum*, but rather suggest *Baculites anceps* LAMARCK, the latter of which could be expected to be found in the higher level (*Metaplacenticeras*-bearing beds) of the same Santa Ana Mountains. In these circumstances we have to disregard the specific name *fairbanksi*, until we can confirm that its topotypes could be distinguished from either of *Sciponoceras bohemicum* (FRITSCH) and *Baculites anceps* LAMARCK.

Occurrence.—The described specimens came from the localities CIT. 1069, CIT. 1062, CIT. 1070, CIT, 979, and CIT. 79, all of which belong to the upper or uppermost part of the Baker Canyon member of the Santa Ana Mountains. The species is frequently associated with *Subprionocyclus neptuni* (GEINITZ).

In Japan the examples of the same species occur in the Upper Turonian, ranging from the subzone of *Subprionocyclus neptuni* (GEINITZ) to that of *Reesidites minimus* (HAYASAKA and FUKADA).

In Europe *Sciponoceras bohemicum* (FRITSCH) has been described as occurring in the Upper Turonian, frequently associated with *Subprionocyclus neptuni* (GEINITZ).

Genus *Baculites* LAMARCK, 1799

Type-species.—*Baculites vertebralis* DEFRANCE, 1830 (designated by MEEK, 1876).

Diagnosis.—WRIGHT's description (*in* MOORE [Editor] 1957, p. L 218) is adequate, but for a point about sutures. There are fairly great diversities in complexity of sutures in both *Sciponoceras* and *Baculites*.

Remarks.—A gradual transition occurs from Upper Turonian *Sciponoceras* to Coniacian *Baculites*. The situation is well exemplified by the Japanese material, between *Sciponoceras* aff. *S. bohemicum* (FRITSCH) and *Baculites yokoyamai* TOKUNAGA and SHIMIZU. The details should be described in the monographic descriptions of the Japanese species. In California there are examples of *Sciponoceras* aff. *S. bohemicum* (FRITSCH), as described above. *Baculites yokoyamai* is very rare in California, being represented by a few, poorly preserved specimens, but there is a closely allied species, *B. schencki* n. sp. to be described below.

In addition to the above two there are in the Lower Senonian of California two other allied Indo-Pacific species, *B. boulei* COLLIGNON and *B. capensis* WOODS.

These Lower Senonian species have simple sutures, with massive saddles and shallow minor incisions. They are not much apart from *Sciponoceras bohemicum* in sutures, size, and cross section. These Indo-Pacific species can be well distinguished from the Lower Senonian species of the Western Interior, but the differentiations in the two regions do not seem to be significant. The latter group of species may also be proved to be direct or indirect descendants of the world wide *Sciponoceras bohemicum* of the Upper Turonian.

In the Upper Senonian (Campanian and Maestrichtian) of California there are more diversities. A general evolutional trend can be recognized from a relatively simple to a complex suture. *Baculites chicoensis* TRASK of the Lower (to Middle ?) Campanian has a suture which is more complex than that of *B. yokoyamai* or its allies of the Lower Senonian. Its complexity is, however, moderate and the suture of *B. occidentalis* MEEK of the Upper Campanian is still more advanced. *B. rex* ANDERSON of the Maestrichtian (*plus* ? Uppermost Campanian) has the most complex suture among the Californian baculitid species, with deeply incised elements and a narrowed lateral lobe. The suture of the last species is nearly as complex as that of *B. complex* SAY. In fact a similar, but not identical, evolutional change of sutures are generally recognized in the species of the Western Interior province, as COBBAN (1951, 1958, and also oral communication) indicates. But the courses in the two provinces differ in detail and are probably parallel.

Even in the Pacific province the actual lineages of the species do not seem to be simply straight. Sometimes several species with sutures of dissimilar patterns occur in almost the same stage, if not at the same locality. Such a comparison can be done among *B. inornatus* MEEK, *B. occidentalis* MEEK, and *B. anceps* LAMARCK. Again, species with simple or simplified (?) sutures, e.g. *B. columna* MORTON, occur in the beds of late age. The situation is still more complicated, when size, tapering, cross section, ribbing, and keel are added to be taken into consideration. Thus, for instance, the keel or keel like siphonal elevation appears more than once, as seen in *B. kirki* n. sp. (Santonian), *B. chicoensis* TRASK, and *B. occidentalis* MEEK. These three species of successive geological ages do not necessarily show continuous change in all the morphological characters. *Eubaculites* is proved to have been derived from one of them, *B. occidentalis* MEEK.

So far as the available records are concerned, some of the Senonian species of California, e. g. *B. schencki* n. sp. and *B. chicoensis* TRASK, seem to be endemic, while others, e. g. *B. inornatus* MEEK and *B.* aff. *B. anceps* LAMARCK, are specifically indistinguishable from, or closely allied to, the European or other extra Californian species. Thus the faunal relations among different geographical provinces seem to be complicated too.

There is much to be done for correct understanding of the natural history of *Baculites*. There may be two or more main branches within *Baculites*, but it is at present rather difficult to state clearly what species belong to which subgroup. Until the whole picture can be figured out, and especially until the

position of *B. vertebralis* LAMARCK, the type species, in the whole group can be well settled, it is not advisable to subdivide subgenera within *Baculites* or to separate other new genera from *Baculites*. From the same reason I would not propose any new generic names for *Baculites columna* MORTON and *Baculites teres* FORBES, although they have peculiar features, as will be described below in detail.

Baculites schencki sp. nov.

Pl. 32, figs. 1a-c, 2a-c, 3a, b, 4a, b, 5a-c, 6a-c; Text-figs. 12a, b, 13a-c, 14a, b, 15-21, 22a, b, 23a-c, 24, 25

Material.—On examining a large number of specimens, I designated the types as follows:

Holotype, UCLA. 28830 (Pl. 32, fig. 2a-c; Text-fig. 12a, b), from loc. CIT. 1034, Member IV of the Redding area (Coll. W. P. POPENOE & D. SCHARF).

Paratypes, UCLA 28831 (Pl. 32, fig. 1a-c; Text-fig. 17) and UCLA. 28832 (Pl. 32, fig. 3a, b), from loc. CIT. 1244, Member VI (?) of the Redding area (Coll. W. P. POPENOE); USLA. 28828 (Pl. 32, fig. 4a, b; Text-fig. 13a-c), UCLA. 28829 (Pl. 32, fig. 5a-c; Text-fig. 14a, b), and UCLA. 28841 (Pl. 32, fig. 6a-c; Text-fig. 15) from the same locality as the holotype (Coll. W. P. POPENOE & SCHARF); UCLA. 28800 (Text-fig. 16) and UCLA. 28801, from loc. CIT. 1008, lower part of Member V of the Redding area (Coll. W. P. POPENOE & D. SCHARF); GK. H 7006 (Text-fig. 23a-c) and LSJU. 8576 (Text-fig. 24), from loc. LSJU. 3315 [=TM. 210], Lower Marlife formation of the Panoche group in Panoche Hills (Coll. M. B. PAYNE & T. MATSUMOTO); two better preserved specimens, UC. 35769 and UC. 35770, (Text-figs. 18, 19) among seven, from SOC. K-220, Member IV of the Redding area (Coll. M. V. KIRK, presented from SOC., Seattle, to UC., Berkeley); GK. H 7009 from TM. 1001 [=LSJU. 3310], basal member of the Chico formation in Chico Creek (Coll. S. CHUBER & T. MATSUMOTO); a specimen (UCLA.) from loc. CIT. 1014 and another (Text-fig. 20) from loc. UCLA. 3617, basal member of the Chico formation in Chico Creek (Coll. W. P. POPENOE & D. SCHARF; R. B. SAUL); a specimen from loc. UC. A-5179, Rumsey Hills (Coll. T. M. CROOK); LSJU. 8952 (Text-fig. 25) and LSJU. 8953 (Text-fig. 22a, b), from loc. LSJU. 2004, Funks shale of Rumsey Hills (Coll. J. M. KIRBY & T. M. CROOK); LSJU. 8954 and LSJU. 8955, from loc. LSJU. 2001, Funks shale of Rumsey Hills (Coll. J. M. KIRBY & T. M. CROOK); UC. 31506 (Text-fig. 21), from loc. UC. A-5179, Rumsey area (Coll. T. M. CROOK).

Associated with the above specimens there are many other less completely preserved ones which are comparable with the present species.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
UCLA. 28830	7.5	5.5	(0.73)	33.0
	5.1	3.8	(0.74)	

UCLA. 28828	8.9	7.2	(0.80)	30.0
	6.2	5.1	(0.82)	
UCLA. 28829	10.9	7.9	(0.72)	
UCLA. 28841	10.0	7.8	(0.70)	30.0
	8.2	6.2	(0.75)	
UCLA. 28800	11.7	9.0	(0.76)	50.0
	8.8	6.6	(0.75)	
UCLA. 28831	11.0	7.8	(0.70)	28.0
	8.5	6.2	(0.72)	
UCLA. 28832	9.2	6.7	(0.72)	26.0
	7.3	5.4	(0.73)	
GK. H 7006	15.0	10.0	(0.67)	60.0
	11.5	8.0	(0.69)	
LSJU. 8576	15.5	12.0	(0.77)	
Loc. CIT. 1014	16.0	10.8	(0.67)	
Loc. UCLA. 3617	12.5	9.0	(0.72)	30.0
	10.3	7.4	(0.71)	
UC. 35769	8.4	6.5	(0.77)	35.0
	6.4	4.7	(0.73)	
UC. 35770	11.4	8.8	(0.77)	30.0
	9.0	6.7	(0.74)	
UC. 31506	11.5	--		25.0
	9.0	6.2(+)	(0.68)	
	7.5	5.1	(0.68)	
LSJU. 8953	9.8	7.3	(0.74)	
LSJU. 8952	14.4	10.5	(0.72)	

Diagnosis.—The shell is relatively small, showing rapid tapering. The section is higher than broad and oval (i.e. egg-shaped), being much more narrowly rounded on the siphonal area than on the antisiphonal area and gently inflated on the flank.

In the typical examples short crescentic nodes are feebly developed on the dorsolateral part. They are moderately spaced, but the distance sometimes varies. The nodes are sometimes fairly strong but occasionally almost obsolete. From the nodes weak riblets run obliquely forward towards the venter, where they show prominent projection; the forward curve of the riblets on the dorsal part is broad and less pronounced. There are also several riblets and lirae on the untuberculate interspaces. On the body chamber the nodes and riblets are so much weakened that the surface is nearly smooth or only laevigate.

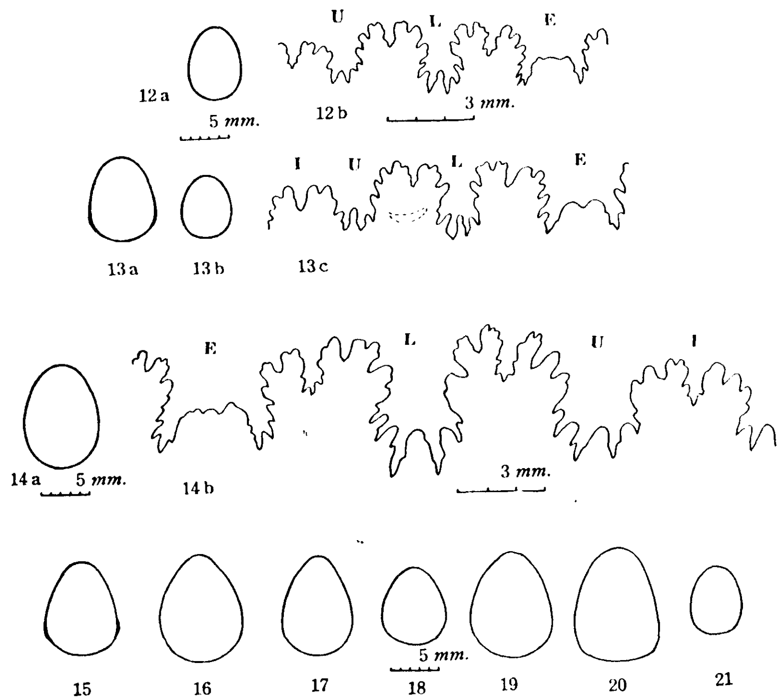
The suture is simple. The saddles are broad, subquadrate and subequally bifid; the saddle between E and L is slightly broader than or nearly as broad as the one between E and U; the antisiphonal saddle is smaller and lower than the other two. E is very wide and moderately deep; L is narrow, deep, and nearly symmetric; U is slightly wider but shallower than L and asymmetric; I is extremely small and narrow. The minor dentations are small and rather shallow.

Variation.—A considerable number of specimens from one and the same formation exemplifies a wide extent of variation of this species. Tapering is generally rapid, but is somewhat slowed in the adult body chamber. The slowed tapering occurs in a few specimens (e.g. UCLA. 28832, Pl. 32, fig. 3a, b) even in the septate part.

The cross section is typically oval but sometimes modified. In some specimens the flanks and antisiphonal side are more flattened than in the normal

ones, resulting in a subtrigonal whorl section, with the maximum breadth in the dorsal part. Other specimens tend to have an approximately elliptical cross section. Examples are shown in the Text-figures 12-25.

The ornament shows remarkable variation. In the typical form, as seen in the holotype and several of the paratypes, the dorsolateral nodes are weakly



Figs. 12-21. *Baculites schencki* n. sp.

12. Cross section (a) and the last suture (b), at height=7.5, breadth=5.5 mm., of the holotype, UCLA. 28830, from loc. CIT. 1034, Member IV of Redding area.

13. Cross sections (a, b), at height=8.9, breadth=7.2 mm. and height=6.2, breadth=5.1 mm., and the last third suture (c), at height=6.2, breadth=5.1 mm., of a paratype, UCLA. 28828, from loc. CIT. 1034. The dotted crescent indicates the dorsolateral tubercle.

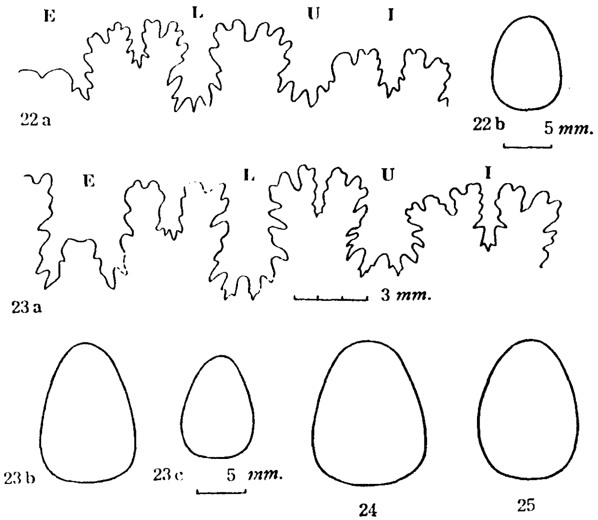
14. Cross section (a) and suture (b), at height=10.9, breadth=7.9 mm., of a paratype, UCLA. 28829, from loc. CIT. 1034.

15-21. Cross sections of various examples: ULCA. 28841 (fig. 15), from loc. CIT. 1034; UCLA. 28800 (fig. 16), from loc. CIT. 1008, lower part of Member V; UCLA. 28831 (fig. 17), from loc. CIT. 1244, Member VI (?); UCLA. 35769 (fig. 18), from loc. SOC. K-220; UCLA. 35770 (fig. 19), from loc. SOC. K-220, Member IV of the Redding area; an example (fig. 20), from loc. UCLA. 3617, basal member of the Chico formation, Chico Creek; UC. 31506 (fig. 21), from loc. UC. A-5179, Funks shale (?) of Rumsey Hills.

developed in the middle growth-stage, becoming still fainter on the late growth-stage. The early growth-stages, with heights below 5 mm., are nearly free from the nodes. Another paratype, UCLA. 28841, from the type locality, and several other examples have, however, moderately strong nodes, whereas still another set of specimens, e.g. UCLA. 28829, from the same type locality, and also several others, are only very faintly tuberculate or nearly smooth. There is gradation between the nearly smooth variant and the fairly strongly tuberculate ones. Some of the variants are illustrated on Plate 32.

The suture also shows variation in its minor details, such as the breadth and general outline of the saddles and the degree of slight asymmetry of the bifurcated saddles on both sides of L. As the shell grows, the relative height of the saddles and depth of the lobes increase. Again the Text-figures 12-14, 22, and 23 illustrate the facts.

Remarks.—This species is closely related to certain other Lower Senonian species of *Baculites* of the Indo-Pacific region. One is *Baculites yokoyamai* TOKUNAGA and SHIMIZU (1926, p. 195, pl. 22, fig. 5a, b, pl. 26, fig. 11), which is common in the Lower Senonian (especially Coniacian) of Japan, and another is *Baculites*



Figs. 22-25. *Baculites schencki* sp. nov.
22. Suture (a) and cross section (b), at height=9.8, breadth=7.3 mm., of a paratype, LSJU. 8953, from loc. LSJU. 2004, Funks shale of Rumsey Hills.
23. The last third suture (a), at height=13.5 mm., and cross sections (b, c), at height=15.0, breadth=10.0 and at height=11.5, breadth=8.0 mm., of a paratype, GK. H7006, representing a variety with a subtrigonal section, from loc. TM. 210 [=LSJU. 3315], Lower member of Marlife formation, Panoche group, Panoche Hills.
24. Cross section of another specimen, LSJU. 8576, from loc. LSJU. 3315.
25. Cross section of an example, LSJU. 8952, from loc. LSJU. 2004, Funks shale of Rumsey Hills.

besairiei COLLIGNON (1931, p. 37, pl. 5, figs. 6, 6a, 7, 7a, 8, 8a, 9; pl. 9, fig. 16), which occur abundantly in the Lower Senonian of Madagascar. These two are probably synonymous. They are distinguished from the present species by their very slow tapering, nearly elliptical cross section, and almost smooth to weakly semicostate surface, which has no tubercles at all. Among the species of *Baculites*, *B. yokoyamai-B. besairiei* is closest to the preceding species, *Sciponoceras* aff. *S. bohemicum* (FRITSCH). In the Japanese succession the former occurs just above the latter. In California the succession of species is not so perfectly recorded as in Japan. The uppermost part of the Baker Canyon member, in which *S.* aff. *S. bohemicum* occurs, is overlain by the poorly fossiliferous Holtz shale. No example of *B. yokoyamai* has been found in the latter member. Probable, but slightly doubtful, examples of *B. yokoyamai* in California are, in my observation, the one from loc. SOC. K-54, Member IV of the Redding area (Coll. KENNELL & ROBINS) and others from loc. UC. A-6621 of the Ortigalita Peak area (Text-fig. 26a, b). Their localities are too much isolated to inspect their relation to the specimens of *Sciponoceras* aff. *S. bohemicum*, while in the same Member IV of the Redding area and the approximately equivalent Lower Marlife formation of the Panoche group *Baculites schencki* occurs. Thus, *B. yokoyamai*, if existent, seems to be very rare in California. It should be noted, however, that the extreme variety of *B. schencki* approaches to *B. yokoyamai*. The example is a specimen, UC. 31506 (Text-fig. 21), from loc. UC. A-5179, in which tapering is relatively slow, the cross section tends to be relatively elliptical, and the dorsolateral nodes are very feebly developed on a limited portion of the whorl.

A variety of *B. schencki* with dorsolateral tubercles of moderate intensity, as represented by UCLA. 28828 (Pl. 32, fig. 4a, b; Text-fig. 13a-c) and UCLA. 28841 (Pl. 32, fig. 6a-c; Text-fig. 15), is allied to *Baculites boulei* COLLIGNON (to be described below) and *Baculites brevicosta* SCHLÜTER (1876, p. 141 [21], pl. 39, figs. 9, 10). The latter two have stronger dorsolateral tubercles and slower tapering than *B. schencki*. In *B. brevicosta* the nodes are crowded and the cross section is trigonal. A variety of *B. schencki* with subtrigonal section is fairly similar to *B. brevicosta*. Unfortunately the suture has not been illustrated for the typical examples of *B. brevicosta* from the upper part of the Emscher-Mergel of Germany. SCHLÜTER (1876, p. 141 [21] footnote, pl. 39, fig. 8) mentioned and illustrated an interesting specimen from the Emscher-Mergel, which has an oval cross section and smooth surface. This is close to a smoothish variety of *Baculites schencki*, as represented by LSJU. 8752 (Funks shale), LSJU. 3315, GK. H 7009, and others (basal member of the type Chico formation).

Occurrence.—Abundant at localities CIT. 1034 and SOC. K-220, Member IV of the Redding area; fairly common at loc. CIT. 1244, which is doubtfully referred by POPENOE to Member VI (?) of the Redding area, but possibly Member IV or V in my opinion; less common at loc. CIT. 1008, lower part of Member V of the same area. At the type locality (CIT. 1034) *Peroniceras shastense* ANDERSON and *Prionocycloceras californicum* (ANDERSON) are associated, indicating the Coniacian. Also found at localities LSJU. 3310 [=TM. 1001], CIT. 1014 and UCLA. 3617, basal member of the Chico formation in the type section of Chico Creek, east side of the Sacramento Valley; locs. LSJU. 2001, LSJU. 2004, and UC. A-5179, Funks shale of the Rumsey Hills, W. Sacramento Valley; LSJU. 3315 [=TM. 210], LSJU. 3316 [=TM. 31], and LSJU. 3136 [cf.], sandstone beds intercalated in the Lower Marlife shale of the Panoche group, Panoche Hills, west side of the San Joaquin Valley.

To sum up the species is common in the Lower Senonian, especially Coniacian, of California.

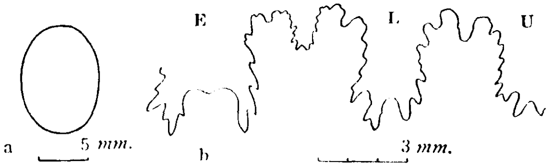


Fig. 26. *Baculites* aff. *B. yokoyamai* TOKUNAGA and SHIMIZU
Cross section (a), at height = 11.5, breadth = 8.1 mm., and suture (b) at height = 8.5 mm., of an example, from loc. UC. A-6621, Ortigalita Peak Quadrangle.

Baculites boulei COLLIGNON

Pl. 32, fig. 7a-c; Pl. 33, figs. 4a-c, 5a, b, 6a-d, 7a, b;
Text-figs. 27a, b, 28-32

1907. *Baculites vagina*, BOULE, LEMOINE, & THEVENIN (*non* FORBES), *Ann. Pal.*, vol. 2, p. 65, pl. 15, fig. 3, 3a.

1931. *Baculites boulei* COLLIGNON, *Ann. Géol. Serv. Mines, Madagascar*, fasc. 1, p. 35, pl. 5, fig. 2, 2a; pl. 9, fig. 14.

Type.—COLLIGNON established this species on nine syntypes. The illustrated one among them (COLLIGNON, 1931, pl. 5, fig. 2, 2a; pl. 9, fig. 14) is designated here as the lectotype. The type locality is, according to COLLIGNON, Mahagaga, northern part of Madagascar.

Material.—The Californian examples which I refer to this species are as follows:

UCLA. 28833 (Pl. 33, fig. 4a-c; Text-fig. 28) and UCLA. 28834 (Pl. 32, fig. 7a-c; Text-fig. 27a, b), from loc. CIT. 1008, lower part of Member V (Coll. W. P. POPENOE & D. SCHARF). Many other specimens from the same locality are referable to the present species.

UCLA. 28836 (Pl. 33, fig. 6a-d; Text-fig. 30) and UCLA. 28835 (Pl. 33, fig. 7a, b; Text-fig. 31), from loc. CIT 1007, Member IV (Coll. W. P. POPENOE & D. SCHARF). Many other specimens from the same locality are also referable to the present species.

UCLA. 28802 (Text-fig. 29)—UCLA. 28804, from loc. CIT. 1006, lower part of Member V of the Redding area (Coll. W. P. POPENOE & D. SCHARF).

UCLA. 28857, from loc. CIT. 1005, lower part of Member V (Coll. W. P. POPENOE & D. SCHARF); many other fragmentary specimens.

LSJU. 8577 (Pl. 33, fig. 5a, b; Text-fig. 32) and LSJU. 8578, from loc. LSJU. 3350, Holtz shale member of the Santa Ana Mountains (Coll. NISBELL).

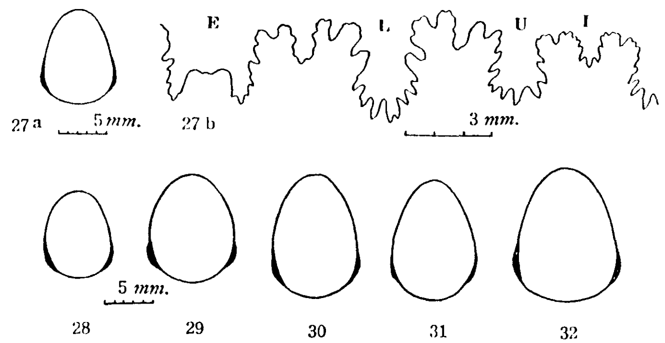
Other comparable specimens from loc. CIT. 1282 and CIT. 1285, Member V of the Redding area (Coll. L. NELSON & V. CHURCH; C. W. AHLROTH); loc. SOC. K-54, upper part of Member IV of the same area (Coll. KENNEL & ROBINS).

Measurements.—

Specimen	Height	Breadth Costal	;	Breadth Interc.	(B/H)	Distance
UCLA. 28833	9.6	7.5	;	7.0	(0.78 ; 0.73)	45.0
	7.3	5.5			(0.75)	
UCLA. 28834	10.2			7.5	(0.73)	30.0
	8.0			6.0	(0.75)	
UCLA. 28835	12.8			9.0	(0.70)	70.0
	8.6			6.3	(0.73)	
UCLA. 28836	16.0			11.2	(0.70)	45.0
	13.0			9.0	(0.69)	
UCLA. 28802	11.5			9.3	(0.80)	
UCLA. 28857	6.8			4.8	(0.70)	
LSJU. 8577	14.0	11.7	;	11.0	(0.83 ; 0.78)	50.0
	11.0			8.6	(0.78)	

Diagnosis.—The shell is relatively small, with slow tapering. The section is higher than broad, and oval to subelliptical, with the siphonal more narrowly rounded than the antisiphonal area. The maximum breadth is somewhat on the antisiphonal side of the mid-flank.

On the dorsolateral part there are normally strong crescentic nodes or short



Figs. 27–32. *Baculites boulei* COLLIGNON
27. Cross section (a) and the last suture (b), at height = 10.2, breadth = 7.5 mm., of an example, UCLA. 28834, from loc. CIT. 1008, lower part of Member V, Redding area.
28–32. Cross sections of various examples: UCLA. 28833 (fig. 28), from loc. CIT. 1008; UCLA. 28802 (fig. 29), from loc. CIT. 1006, Member V, Redding area; UCLA. 28836 (fig. 30) and UCLA. 28835 (fig. 31), from loc. CIT. 1007, Member IV, Redding area; LSJU. 8577 (fig. 32), from loc. LSJU. 3350, Holtz shale, Santa Ana Mountains.

but thick, arcuate ribs, which fade at the middle of the flank into the weak riblets. There are also intercalatory riblets. These riblets are developed on the siphonal half of the shell, being oblique on the flank and projected strongly on the venter. They are often so weak that they are only discernible under oblique lighting. The antisiphonal extensions of the major ribs quickly fade out, showing less pronounced forward curve on the dorsum. The tubercles or major, short ribs are moderately spaced, but the distance is occasionally irregular. Also the intensity of the tubercles varies irregularly. The nodes themselves are usually crescentic, but sometimes fairly rounded. The shells in the early growth-stage below 7-5 mm. in height are devoid of nodes.

The suture is simple. The saddles are broad, subquadrate to subrectangular in general outline, and subequally bifid. E is wide; L is narrow and deep; U is shallower than L; I is very small. The minor dentations are small and shallow.

Remarks.—*Baculites boulei* COLLIGNON is closely related to *Baculites schencki* n. sp., described just above. Typical examples of the two species are well distinguished. The former shows slower tapering and has thicker, stronger, and more distant dorsolateral nodes than the latter. Although the cross section is essentially oval in both species, it tends more frequently to be subelliptical in *B. boulei* than in *B. schencki*, while in the latter it tends often to be subtrigonal. There is, however, variation in these characters, and, accordingly, there are a few intermediate specimens. No significant difference is recognized in the sutures of the two species. Although the stratigraphical ranges of the two species overlap within the Lower Senonian, as represented by Member IV and V of the Redding area, *B. schencki* occurs abundantly in the lower part and is rare in the upper, while *B. boulei* is relatively common in the upper part. Even if the two species occur in the same member, their localities are usually isolated, the fossils being rarely intermingled.

As COLLIGNON (1931) already pointed out, *B. boulei* is closely allied to *B. besairiei* COLLIGNON [≑ *B. yokoyamai* TOKUNAGA & SHIMIZU]. The criteria for distinction are the dorsolateral tubercles in the former and comparatively elliptical section in the latter. Again there is variation in these features. The dorsolateral nodes are occasionally very weak and relatively elliptical section is also found in *B. boulei*. In slow tapering and in the characters of the suture, the two species are quite similar.

Baculites schencki is intimately related to *B. yokoyamai* [≑ *B. besairiei*], as has been already remarked.

Under these circumstances, it might be suggested that all the "species" in discussion could be ranked as subspecies within one species. The subspecies might be differentiated geographically and also in slight different stratigraphical levels. To prove clearly this possibility, however, the material at my disposal is not satisfactory. For the time being I treat *B. boulei* COLLIGNON as an allied but distinct species from *B. schencki* n. sp. and from *B. yokoyamai* TOKUNAGA and SHIMIZU or from *B. besairiei* COLLIGNON.

Baculites brevicosta SCHLÜTER (1876, p. 141 [21], pl. 39, figs. 9, 10) has short, crescentic ribs on the dorsolateral part, but its section is subtrigonal, having a subacute venter and its short ribs are more crowded than in *B. boulei* COLLIGNON.

Baculites asperoanceps LASSWITZ (1904, p. 16, pl. 3 [15], fig. 1a, 1b), from the Santonian (?) of Texas, likewise has crescentic ribs on the septate part, but its ribs are thicker, larger, and more numerous than in *B. boulei*, and on the adult body chamber become as strong and rounded as the tubercles of *B. asper* MORTON. Sutures were not illustrated for the original types of *B. asperoanceps* and *B. brevicosta*, and cannot at present be compared exactly with that of *B. boulei*.

The specimens from Zululand (South Africa) and Madagascar which were described under *Baculites* cf. *asperoanceps* LASSWITZ by SPATH (1921, p. 259, pl. 24, fig. 4, 4a) and by COLLIGNON (1931, p. 22, pl. 3, fig. 7, 7a) are probably better referable to *Baculites boulei* COLLIGNON, being, however, rather transitional between *B. boulei* and *B. capensis* WOODS (described below). In California too there are a few examples of such an intermediate form, as represented by UCLA. 28857, from loc. CIT. 1005.

Occurrence.—Localities CIT. 1008, CIT. 1006, CIT. 1005, CIT. 1282 and CIT. 1285, lower part of Member V of the Redding area; loc. CIT. 1007 and SOC. K-54, Member IV of the Redding area, northeast Sacramento Valley. Loc. LSJU. 3350, Holtz shale member of the Santa Ana Mountains.

The species is not rare in California, if not so abundant as *Baculites schencki*. In Madagascar it is represented by less numerous specimens than *Baculites besairiei* COLLIGNON (COLLIGNON, 1931), both occurring in the probable Lower Senonian.

Baculites capensis WOODS

Pl. 33, figs. 1a-d, 2a-c, 3a, b; Pl. 45, figs. 1a-d, 2a-d, 3a-d, 4a-d;
Text-figs. 33a, b, 34a, b.

1906. *Baculites capensis* WOODS, *Ann. South Afr. Mus.*, vol. 4, pt. 7, no. 12, p. 342, pl. 44, figs. 6a, b, 7a, b.
?1907. *Baculites vagina*, BOULE, LEMOINE, & THEVENIN (*non* FORBES), *Ann. Paléont.*, vol. 2, p. 65, pl. 15, fig. 3.
1921. *Baculites capensis*, SPATH, *Ann. South Afr. Mus.*, vol. 12, pt. 7, no. 16, p. 257, pl. 24, figs. 6, 7.
?1931. *Baculites* aff. *capensis*, COLLIGNON, *Ann. Géol. Serv. Mines, Madagascar*, fasc. 1, p. 22, pl. 3, fig. 6.
1936. *Baculites capensis*, VENZO, *Pal. Italica*, vol. 36, p. 116 [58].
1936. *Baculites capensis* var. *umsinensis* VENZO, *Pal. Italica*, vol. 36, p. 116 [58], pl. 10 [6], fig. 13a, b.
1958. *Baculites buttensis* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 191, pl. 49, fig. 6, 6a, 6b.
1958. *Baculites* aff. *capensis* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 192, pl. 48, fig. 8, 8a.

Types.—WOODS established this species on several syntypes. The one with septate part, if it exists, should be selected as the lectotype. As I have not seen the actual specimens of the syntypes, I hesitate to give here a designation. SPATH's (1921) hypotypes are considered reliable, since he had opportunities of comparing his specimens with WOODS'.

Material.—GK. H 7010 (Pl. 45, fig. 4a-d), GK. H 7011 (Text-fig. 33a, b), GK. H 7012 (Pl. 45, fig. 3a-d), GK. H 7013, GK. H 7014 (Pl. 45, fig. 2a-d), GK. H 7015 (Pl. 45, fig. 1a-d), and GK. H 7016-7019, from loc. TM. 14 [=LSJU. 3320] (Coll. T. MATSUMOTO); GK. H 7023-7026, from loc. TM. 11 [=LSJU. 3319] (Coll. H. G. SCHENCK, J. J. GRAHAM, M. B. PAYNE & T. MATSUMOTO); many other specimens from the same localities as above; GK. H 7020-7022, from loc. TM. 1007 [=LSJU. 3304] (Coll. S. CHUBER & T. MATSUMOTO), and many other fragmentary specimens from the same locality (Coll. S. CHUBER & T. MATSUMOTO); LSJU. 8565 (Pl. 33, fig. 1a-d), LSJU. 8564 (Pl. 33, fig. 2a-c; Text-fig. 34a, b) and several other fragmentary specimens, from loc. LSJU. 2880 (Coll. R. E. COOK); UCLA. 28838 (Pl. 33, fig. 3a, b), and other specimens from locs. UCLA. 3627, UCLA. 3630, and UCLA. 3633 (cf.) (Coll. L. E. & R. B. SAUL); a large number of specimens from locs. CIT. 1260 (Coll. W. P. POPENOE) and UCLA. 3784 (Coll. W. P. POPENOE and Victor CHURCH); specimens from loc. CAS. 31289 described by ANDERSON (1958, p. 192, pl. 48, fig. 8, 8a) as *Baculites* aff. *B. capensis* WOODS; holotype of *Baculites buttensis* ANDERSON (1958, p. 191, pl. 49, fig. 6, 6a, 6b) from loc. CAS. 27835 (Coll. J. A. TAFF, G. D. HANNA, & C. M. CROSS); ? several fragments comparable with the present species, from loc. UCLA. 3374 (Coll. W. P. POPENOE).

Measurements.—

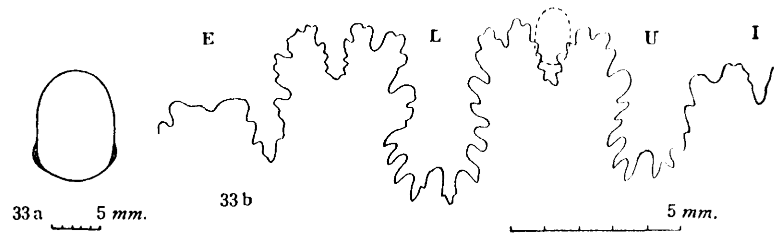
Specimen	Height	Breadth	(B/H)	Distance	Interval between tubercles ant. post.
GK. H 7010	15.1 14.4	11.0 10.3	(0.73) (0.71)	40.0	19.0/16.0/14.5/11.5
GK. H 7012	12.8 10.5	9.2 8.2	(0.71) (0.78)	30.0	10.7/12.5/10.5
GK. H 7013	9.7 8.7	7.7 6.7	(0.79) (0.77)	20.0	10.0/7.5/9.5
GK. H 7014	9.4 9.0	7.2 6.8	(0.76) (0.75)	25.0	10.0/9.8/7.5
GK. H 7015	8.4 7.8	6.2 5.4	(0.74) (0.70)	25.0	11.5
GK. H 7016	6.5	5.0	(0.77)		6.9/4.3/5.0
GK. H 7018	7.2 6.7	5.6 4.8	(0.78) (0.71)	20.0	7.8/6.7
GK. H 7020	10.5 9.4	8.0 6.7	(0.76) (0.71)	25.0	11.0/11.4
GK. H 7023	8.1 7.5	6.0 5.4	(0.74) (0.72)	20.0	10.5/10.0/8.5
GK. H 7026	7.0 6.0	5.3 4.5	(0.75) (0.75)	15.0	6.5/5.8/5.5
LSJU. 3565	10.0 8.5	7.4 6.0	(0.74) (0.70)	25.0	10.5/11.5/8.5
LSJU. 3564	9.5 7.0	7.0 5.3	(0.72) (0.75)	40.0	11.2/9.5/10.2/11.5
LSJU. 3566	7.0 5.1	5.5 3.8	(0.77) (0.74)	35.0	6.7/3.7/4.8/3.8/5.3/5.8/no tub.

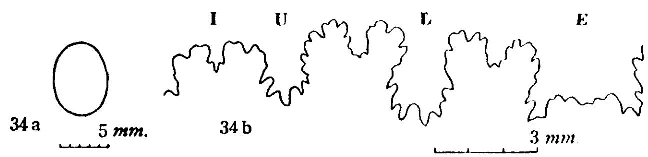
One from loc. UCLA. 3627	9.3 7.0	7.0 5.3	(0.75) (0.75)	50.0	8.0/14.5/12.2/13.9/7.8
Another from UCLA. 3627	9.0 6.0	7.5 --	(0.83) --	40.0	9.5/8.0/7.5/8.0
Another from UCLA. 3627	9.3 8.3	6.5 5.8	(0.69) (0.69)	22.0	13.4/10.0
One from loc. UCLA. 3784	19.5 17.0	-- 13.5	-- (0.79)	50.0	14+/17.0/20.0
One from loc. CIT. 1260	16.5 14.8	11.8 10.5	(0.71) (0.71)	40.0	12.7/11.9

Diagnosis.—The shell shows extremely slow tapering, having nearly parallel sided outline in lateral, siphonal and antisiphonal views. It is much higher than broad, elliptical in cross section, with only slightly convex, or flattened, nearly parallel, flanks, moderately rounded venter, and broadly rounded dorsum. In some cases even a shallow depression is discernible along the median line of the flank.

There is a row of tubercles along the dorsolateral shoulder. They are much apart from one another and typically, but not always, elongated in parallel to the elongated axis of the shell.

The suture is simple, with a number of relatively shallow incisions, which give rise to minute, roundish branches of saddles. The external and lateral saddles are almost equally broad, bifid, and subrectangular in general outline. The two lateral lobes are much narrower than the lateral saddle between them. The external lobe (E) is broad; the antisiphonal lobe (I) is very small; the first lateral lobe (L) is the deepest of all.





Figs. 33, 34. *Baculites capensis* WOODS.

33. Cross section (a) and the last suture (b) of an example, GK. H7011, from loc. TM. 14 [=LSJU. 3320], lower part of the Upper Marlife shale of Panoche Hills.

34. Cross section (a) and suture (b), at height 7.8, breadth 5.5 mm., of an example, LSJU. 8564, from loc. LSJU. 2880, upper part of the lower half of the Chico formation in Chico Creek.

Variation.—The species varies little in shell-form; thus the very slow tapering, elliptical cross section, with flattened sides, and the proportion of breadth and whorl, mostly ranging from 7/10 to 8/10, are characteristic of the species. The shallow depression on the mid-flank, which was regarded as a specific character by WOODS, are not always discernible, but may be a character which never occurs in many other species of *Baculites*. Anyhow, a number of Californian examples do show this character as WOODS' South African types do.

Another point of which WOODS stressed the importance is the elongation of the tubercles in parallel to the axis of the shell. Examining a great number of specimens from one and the same bed in California, I have noticed that this character is again inconstant. Even on the same individual some tubercles are elongated in parallel to the axis of the shell but others are not. In some specimens that kind of tubercle occurs more frequently than others. In an extreme example (e.g. GK. H 7012, Pl. 45, fig. 3a-d) the rounded, strong nodes like those of *Baculites asper* MORTON (1834, p. 43, pl. 1, figs. 12, 13; pl. 13, fig. 2) are developed, but that specimen cannot be specifically separable from other coexisting unmistakable examples of *B. capensis* WOODS.

Very faint riblets are sometimes discernible, extending from the tubercles or isolated on the ventral part. They never become as distinct as those of *Baculites asperiformis* MEEK (1876, p. 405, pl. 39, fig. 10a, d).

The young shell has no tubercles. The tubercle first appears where the height (i.e. the longer diameter of the section) is about 6 mm. in Californian examples before me, but about 8 mm. in South African examples (SPATH, 1921, p. 257).

The distance between the tubercles is variable, as the figures in the measurements clearly indicate. In many cases it is as long as, or somewhat longer than the height of the cross section, but there are many exceptions. It does not always increase regularly with growth, although in average it does so.

The simple suture as described above is characteristic of the species, but varies to some extent. For instance, the external saddle is sometimes slightly broader than the lateral one, but in some other cases as broad as, or even slightly narrower than the latter. The difference, however, is little. The rough outline of the elements is usually subrectangular, but on some specimens slightly trapezoidal or inverse trapezoidal.

Remarks.—*Baculites capensis* WOODS has close affinity with *Baculites yokoyamai* TOKUNAGA and SHIMIZU (1926, p. 195, pl. 22, fig. 5a, b; pl. 26, fig. 11) or *Baculites besairiei* COLLIGNON (1931, p. 37, pl. 5, figs. 6, 6a, 7, 7a, 8, 8a, 9; pl. 9, fig. 16) in its very slow tapering, elliptical cross section, and type of suture. Still closer is *B. boulei* COLLIGNON (1931, p. 35, pl. 5, fig. 2, 2a; pl. 9, fig. 14) (p. 118 of this paper), which has distant, arcuate tubercles. This is possibly an intermediate form between typical *B. yokoyamai-B. besairiei* and *B. capensis*. To trace the actual lineage, careful zonal collection (in some suitable place in South Africa) is necessary. In California there are very few examples of *B. yokoyamai* or *B. besairiei*, but its ally *B. schencki* n. sp. occurs abundantly. This species differs

from *B. besairiei* and *B. capensis* in its fairly distinct tapering and nonelliptical cross section, although it has a tendency to acquire dorsolateral tubercles, and includes an extremely rare variant of subelliptical cross section. *B. boulei* occurs also in California (see the preceding description). Here the three species, *B. schencki*, *B. boulei*, and *B. capensis* are nearly contemporary, but their stratigraphic positions of the maximum abundance are arranged in ascending order.

Similarity between *B. capensis* WOODS and the nearly contemporary *B. asper* MORTON is probably a parallelism between the entirely separated biogeographic provinces. The former has much more compressed whorl, thinner tubercles, and narrower saddles of sutures than the latter (see REESIDE, 1927a, p. 4, pl. 1, figs. 19-24; pl. 2, figs. 1-5; REESIDE, 1927b, p. 13, pl. 10, figs. 9-12; pl. 11, figs. 5-13; ? figs. 14-16).

A few body chambers of *B. capensis* WOODS from California are slightly arcuate. This may not be accidental, because the siphonal side is always convex. The feature, together with the distant dorsolateral tubercles, recalls to us *Euhomaloceras incurvatus* (DUJARDIN) (1837, p. 232, pl. 17, fig. 17; D'ORBIGNY, 1842, p. 564, pl. 139, figs. 8-10; SCHLÜTER, 1876, p. 142, pl. 39, figs. 6, 7; pl. 40, fig. 3; SPATH, 1926, p. 80). The suture of that species has broader lobes and more numerous minor incisions than that of *B. capensis*, but the difference is not so great as SPATH (1921, p. 258) considered. The resemblance between the two species, as already pointed out by WOODS (1906, p. 342), may not be superficial. To clarify the true relationship, we need better material of intermediate forms.

Occurrence.—Locs. TM. 14 [=LSJU. 3320] and TM. 11 [=LSJU. 3319], lower part of the Upper Marlife formation of Panoche group, Panoche Hills, west side of the San Joaquin Valley; locs. TM. 1007 [=LSJU. 3304], LSJU. 2880, CAS. 27835, UCLA. 3627, UCLA. 3630, and UCLA. 3666 (cf.), upper part of the lower half of the Chico formation in the type area, Chico Creek, east side of the Sacramento Valley (*Inoceramus naumanni* YOKOYAMA occurs in this unit). Locs. UCLA. 3374 and CIT. 1260, Redding area, which are referred to member IV of Popenoe. From another locality, UCLA. 3373, not far from UCLA. 3374, came a fragment of ammonite referable to *Texanites kawasaki* (KAWADA); also loc. UCLA. 3784, Member V (?) (possibly Member IV) of the Redding area. Loc. CAS. 31289, northwest of Rumsey, southwest side of the Sacramento Valley. Close to this locality, from loc. CAS. 31209, *Peroniceras* sp. is known.

WOODS' originals came from the 20 feet thick beds exposed in Pondoland, South Africa, in which *Texanites soutoni* (BAILY) and *T. stangeri* (BAILY) occur. Therefore they are most probably Santonian. SPATH's examples from Umtamvuna River, Natal and Umkwelane Hill, Zululand, South Africa were referred by him to the Upper Senonian, but his age assignment is doubtful, because *Texanites stangeri* (BAILY) was reported from the first area and *Pseudoschloenbachia umbulazi* (BAILY), *etc.* from the second. The association suggests rather Santonian and Lowest Campanian. BOULE, LEMOINE, and THEVENIN's comparable specimen from Madagascar may be late Coniacian, because "*Barroisiceras nicklesi* GROSSOUVRE" was described by them (1907, p. 45, pl. 11, fig. 2, 2a) from the same bed.

In Japan the species is rare, but a few examples were obtained from the probable Santonian of Hokkaido.

Baculites lomaensis ANDERSON

Pl. 34, figs. 1a-c, 2a-c; Text-figs. 35-38, 39-41.

?1941. *Baculites* sp., STEPHENSON, *Univ. Texas Pub.*, no. 4101, p. 407, pl. 76, figs. 7, 8.

1958. *Baculites lomaensis* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 191, pl. 48, figs. 5, 5a, 6.

Holotype.—CAS. type coll. (ANDERSON, 1958, pl. 48, fig. 5) (Text-fig. 39 of this paper) from loc. CAS. 2361, Joaquin Rock Quadrangle, west side of the San Joaquin Valley, as originally designated.

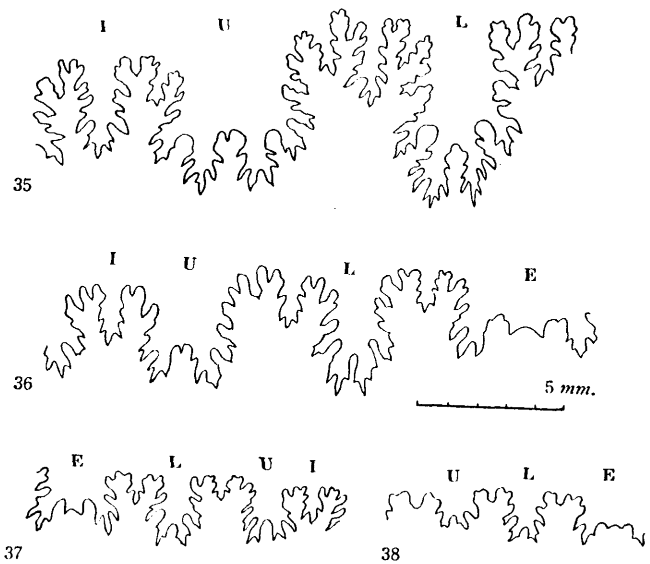
Material.—In addition to the holotype and paratypes of ANDERSON, the following is a list of examples of this species which I have examined:

LSJU. 8614 (Pl. 34, figs. 1a-c, 2a-c; Text-fig. 41), LSJU. 8615, LSJU. 8616 (Text-fig. 38), LSJU. 8617, LSJU. 8618 (Text-fig. 40), LSJU. 8619-8623, and a large number of specimens, from loc. LSJU. 1631 (Coll. S. W. MULLER & REINHARDT); LSJU. 8624 (Text-fig. 35), LSJU. 8625 (Text-fig. 36), LSJU. 8626 (Text-fig. 37), and a number of specimens, from loc. LSJU. 1629 (Coll. S. W. MULLER & REINHARDT); a large number of specimens from locs. CAS. 31593 [=CAS. 2361, the type locality] (Coll. C. C. CHURCH), CAS. 28304 (Coll. J. A. TAFF & C. M. CROSS), and CAS. 463 (Coll. F. M. ANDERSON). A probably referable specimens from loc. CAS. 1173 (Coll. L. G. HERTLEIN).

Measurements.—

Specimen	Height	Breadth (costal)	(B/H)	Breadth (intercostal)	(B′/H)	Distance
Holotype	13.0	9.3	(0.71)	8.5	(0.65)	
Paratype 1	10.2	7.9	(0.77)	6.5	(0.64)	27.5
	8.8	—		—		
Paratype 2	8.5	6.3	(0.74)	5.5	(0.65)	60.0
	5.0	4.0	(0.80)	—	—	
LSJU. 8614	10.5	7.8	(0.74)	7.1	(0.67)	30.0
	7.6	5.4	(0.71)			
LSJU. 8615	8.8	6.9	(0.78)	6.1	(0.69)	
LSJU. 8618	11.5	9.0	(0.78)	7.7	(0.67)	
LSJU. 8619	10.5	7.8	(0.74)	7.2	(0.68)	
LSJU. 8625	9.5	7.4	(0.78)	6.6		
LSJU. 8626	7.0			5.1	(0.72)	25.0
	4.4			3.7	(0.84)	

Diagnosis.—The shell is small, being about 15 mm. in height (i.e. longer diameter) in the probable adult stage. Tapering is rapid in the earlier growth-stages, gradually becoming slow in the later. The section is trigonal, higher than broad, broadest in the dorsal (i.e. antisiphonal) part, flattened on the dorsal area, subangular at the dorsolateral shoulder, slightly convex on the



Figs. 35-38. *Baculites lomaensis* ANDERSON. Sutures at different growth-stages.

35. Suture, at height=13.0 mm., of a probably adult shell, LSJU. 8624, from loc. LSJU. 1629, Coalinga area.

36. Suture, at height=9.5, breadth (costal)=7.4 mm., of a shell of probably middle growth-stage, LSJU. 8625, from loc. LSJU. 1629.

37. Suture, at height=5.5, breadth=4.5 mm., of a young shell, LSJU. 8626 from loc. LSJU. 1629.

38. Suture, at height=4.2mm., of a young shell, LSJU. 8616, from loc. LSJU. 1631, Coalinga area.

flanks, which are remarkably convergent, and very narrowly arched or almost fastigate on the siphonal area. In early growth-stages, with heights of 3-7 mm., the shell is relatively broad, inflated on the sides, rounded on the antisiphonal area, and subtrigonal in section.

The young shell is smooth up to a height of about 5 mm.; then widely spaced, weak nodes are developed on the flank near the dorsolateral shoulder; finally in the later growth-stages these nodes become strong and crescentic, extending to arcuate, short ribs on the flank and also sometimes to faint ribs on the dorsal area. The arcuate ribs fade out on the siphonal area, where very weak, numerous riblets or striae are sometimes discernible, forming sharp chevrons. On the dorsal area the weak ribs and growth-lines show very broad convexity and occasionally obtuse chevrons.

The suture is moderately incised; the saddles are broad and subrectangular in general outline. The saddle between L and U is somewhat broader than the one between L and E, except in the very young stage. The stem of L is much narrower than those of the adjacent saddles. At the bottom of L the secondary have described above under the heading of *Baculites* aff. *B. anceps* LAMARCK. That species, as is shown in the succession of Arroyo del Valle of the Bay area, occurs in the beds slightly below the level where *B. rex* is obtained. Morphologically, however, there is no gradual transition between the two, because *Baculits* aff. *B. anceps* has arcuate ribs of moderate intensity and evidently less complex type of suture. Although *Baculites hochstetteri* could be considered as a possible connecting form between the two, the paleontological and stratigraphical evidences available at present are not sufficient for leading a definite conclusion. The Californian example of *Baculites* aff. *anceps* has less acute siphonal area, where the ribs show less pronounced projection than the typical form of *B. anceps*. Some of the specimens of *B. rex*, as shown in the illustration (Pl. 40, fig. 1a-c), have reminiscent of the same feature, although the ribs themselves are extremely weak. Thus it is probably reasonable to search the origin of *B. rex* ANDERSON in the Californian subgroup of *B. anceps*, although the actual connecting form has not yet been perfectly confirmed. One would then conclude that *Baculites rex* had no direct connection with the stock of *Baculites gregoriensis-Baculites compressus* of the Western Interior Province, but was in parallel relation with that group, although the ultimate origin might be common.

Occurrence.—The type locality is CAS. 28325, Crow Creek, Stanislaus County, west side of the San Joaquin Valley; its stratigraphic position is not precisely recorded, but called "probably Joaquin formation". Other localities are LSJU. 3329 A [=TM. 204 A], and LSJU. 3327 [=TM. 3], type exposures of Marca shale of the Moreno formation, Panoche Hills, west side of the San Joaquin Valley; LSJU. 3345 [=TM. 507], Ragged Valley shale, slightly higher than the beds of *Baculites occidentalis* MEEK, and (?) LSJU. 3346 [=TM. 506], Brown Mountain sandstone, and also LSJU. 3369, of doubtful stratigraphic position, all in or adjacent to Los Gatos Creek, northwest of Coalinga, west side of the San Joaquin Valley; UC. A-4890, Reef Ridge, west side of the San Joaquin Valley; CAS. 31401 [=31567], LSJU. 3358, and UC. A-4959, shale unit, back of Antelope plain, southwest San Joaquin Valley; LSJU. 2227, in Cholame Quad., back in the range, west of San Joaquin Valley; LSJU. 2785, Debris Dam sandstone of the Santa Barbara Mountains; UCLA. 2415, *Pseudophyllites* bearing sandstone of the Santa Ana Mountains; LSJU. 3347, "Black Mountain" of a doubtful area, but possibly of Ragged Valley shale of Joaquin Ridge, west side of the San Joaquin Valley; LSJU. 3357, sandstone unit, top member of the Cretaceous in the succession of Arroyo del Valle, Bay area; UC. A-7234, west of Willows, far apart higher than the top of Guinda sandstone, west side of the Sacramento Valley.

The specimens from the Marca shale and Ragged Valley shale cannot be specifically separated, although no examples of this species have been found in Tierra Loma shale, in which *Eubaculites ootacodensis* was obtained. Therefore, *Baculites rex* is fairly long ranged. So far as available evidence is concerned, it occurs above *Baculites* aff. *B. anceps-Metaplacenticeras pacificus* in Arroyo del Valle and also above *Baculites occidentalis* MEEK in Los Gatos Creek. Its

geological range is probably all through the Maestrichtian and could possibly go down to the highest part of the Campanian.

Baculites kirki sp. nov.

Pl. 43, figs. 1a-c, 2a-c, 3a-c; Text-figs. 53a, b, 54-57, 58a, b

Material.—Holotype, UC. 35693, from loc. SOC. K-229 (Coll. M. V. KIRK) (Pl. 43, fig. 1a-c; Text-fig. 53a, b). Paratypes UC. 34871 (Pl. 43, fig. 2a-c) and UC. 34872 from the same locality as the holotype (Coll. M. V. KIRK); also UCLA. 28805 (Text-fig. 58a, b), 28806a (Text-fig. 55), 28806b (Text-fig. 56), 28809 (Text-fig. 57), 28813, 28814, and 28827 (Pl. 43, fig. 3a-c), from loc. CIT. 1006 (Coll. W. P. POPENOE & D. SCHARF, 1931). Many other comparable specimens from loc. CIT. 1006 are also available (UCLA.).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
Holotype (UC. 35693)	10.5	7.5	(0.71)	30.0
	9.2	6.6	(0.71)	
UC. 34871	10.7	7.5	(0.71)	
UCLA. 28805	11.3	7.0	(0.62)	—
	8.0	5.4	(0.67)	
UCLA. 28806	12.0	7.8	(0.65)	
UCLA. 28806 b	12.0	8.2	(0.68)	
UCLA. 28809	9.4	7.1	(0.75)	
UCLA. 28813	7.4	5.5	(0.74)	22
	6.2	4.2	(0.67)	
UCLA. 28814	6.9	4.9	(0.71)	28
	5.4	3.5	(0.64)	
UCLA. 28827	8.2	6.0	(0.73)	48
	5.5	3.7	(0.67)	
UCLA. —	10.0	7.0	(0.70)	
UCLA. —	9.5	6.5	(0.68)	

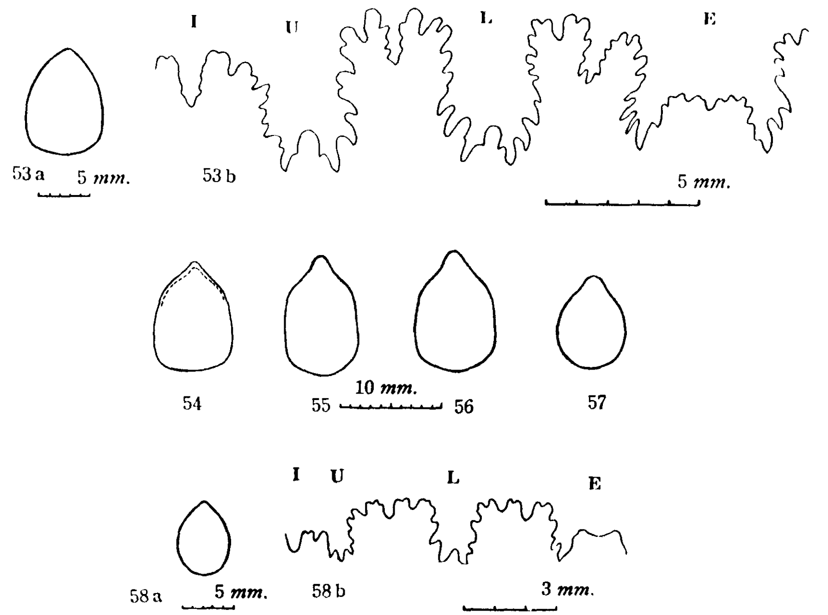
Diagnosis.—The shell is small, showing slow tapering. The section is higher than broad. A small, rounded keel is developed on the siphonal line of the shell. It is less distinct on the internal mould, sometimes resulting in fastigate venter. The main part of the flank is only slightly inflated on the body chamber, but somewhat inflated on the septate part. The dorsal part is rounded, but on the body whorl there are subangular shoulders between the dorsal part and the flattened flanks. Thus the adult section looks like an outline of a small boat in plane view.

The surface of the shell is nearly smooth, but with very weak riblets and indistinct striae, which show a sinus on the dorsolateral part, a broad convex curve on the dorsal part, and a prominent projection on the ventral part, forming chevrons on the mid-venter.

The suture has minute incisions of less acuteness, leaving roundish terminals to the subdivisions. The saddles and lobes are subrectangular in general outline. The former is relatively broad on the young shell, but becomes high on the adult whorl. The antisiphonal lobe (I) is extremely small. Thus the suture is as simple as in many Lower Senonian *Baculites*.

Variation.—A fairly large number of specimens from one stratigraphic units (lower part of Member V of the Redding area) show a certain extent of variation. The proportion of breadth and height varies from 6:10 to 8:10. Generally the flanks are more flattened on the adult shell than on the immature. Even in the immature stage, however, flanks are only gently inflated on some shells and moderately inflated on others. Also the keel varies in prominence by individuals, although it is rather small and rounded on the external surface of the shell.

The holotype and two other specimens, from loc. SOC. K-229, of the upper part of Member V have less rounded dorsal part than many specimens, from loc. CIT. 1006, of the lower part of Member V. If the difference would be confirmed to be constantly kept between the two different levels, subspecific speration could be justified. The available number of specimens from the higher



Figs. 53-58. *Baculites kirki* sp. nov.

53. Cross section (a) of the internal mould and suture (b), at height = 10.5, breadth = 7.5 mm., of the holotype, UC. 35693, from loc. SOC. K-229, upper part of Member V, Redding area. See Pl. 43, fig. 1a-c.

54-57. Cross sections of the paratypes: UC. 34871 (fig. 54) (internal mould shown by a dotted line), from loc. SOC. K-229 (see Pl. 43, fig. 2a-c); UCLA. 28806a (fig. 55), UCLA. 28806b (fig. 56) and UCLA. 28809 (fig. 57), from loc. CIT. 1006, lower part of Member V, Redding area.

58. Cross section (a) and suture (b), at height = 7.3, breadth = 5.0 mm., of a young shell, paratype, UCLA. 28805, from loc. CIT. 1006.

level is at present so small and the morphological difference is so slight, that for the time being I record the fact under the heading of variation.

Remarks.—At first sight this species resembles *Eubaculites* (?) *simplex* (KOSSMAT) [=*Baculites vagina* FORBES var. *simplex* KOSSMAT, 1895, p. 156 [60], pl. 19 [5], figs. 13a, b, 14a-c], from the Arialoor group of India, but has rounded antisiphonal area and no distinct ribs. KOSSMAT's original material consisted only of three fragments. Their sutures have not been illustrated nor described. SPATH (1953, p. 46) regarded this Indian species as intermediate between *Baculites* and *Eubaculites*. Similarly the present species could be regarded as another intermediate example. It never shows, however, the angular edges of the keel and strong ribs of the typical examples of *Eubaculites* [e.g. *E. vagina* (FORBES) and *E. ootacodensis* (STOLICZKA)]. Its simple suture is the same type as that of certain species of *Baculites* of the same and also the subjacent beds. From these facts I am inclined to conclude that the present species is more intimately related to the Lower Senonian species of *Baculites* than to the Maestrichtian species of *Eubaculites*.

Occurrence.—Loc. SOC. K-229, in a sandstone of Hooten Gulch, upper part of Member V of POPENOE in the Redding area; this is the type locality where the holotype and two paratypes were obtained along with *Pseudoschloenbachia* n. sp. (?) aff. *P. boulei* (BASSE). Another locality is CIT. 1006, in calcareous concretion of the lower part of Member V of POPENOE in the Redding area, where a large number of more or less fragmentary specimens, including several paratypes, were obtained along with *Baculites boulei* COLLIGNON and *Inoceramus* cf. *I. cordiformis* SOWERBY.

From the stratigraphic position and associated species, the geological age of the present species is best assigned to the Santonian (both the early and late parts). This is the earliest record of any keeled *Baculites*.

Baculites chicoensis TRASK

Pl. 36, fig. 2a-d; Pl. 37, fig. 1a-d; Text-fig. 59a-d, 60a, 61a, b, 62a, b, 63a, b

1856. *Baculites chicoensis* TRASK, *Calif. Acad. Nat. Sci., Pr.*, vol. 1, p. 92, pl. 2, fig. 2, 2A.

1864. *Baculites chicoensis*, GABB (*pro parte*), *Palaeont. Calif.*, vol. 1, p. 80, pl. 14, fig. 27b; ? pl. 17, fig. 27, 27a (*non* pl. 14, fig. 29, 29a).

1940. *Baculites chicoensis*, SCHENCK and KEEN, *Calif. Fossils for the Field Geologist*, p. 23, pl. 17, fig. 6A.

1940. *Baculites chicoensis*, TAFF, HANNA, and CROSS, *Bull. Geol. Soc. Amer.*, vol. 51, p. 1321, pl. 1, figs. 3, 4.

1958. *Baculites chicoensis*, ANDERSON, *Geol. Soc., Amer., Mem.* 71, p. 190, pl. 48, fig. 1, 1a, 1c (*non* 1b, 1d); Pl. 60, fig. 3, 3a, 3b.

Types.—TRASK's original specimen (specimens ?) is (are ?) lost (see TAFF, *et al*, 1940, p. 1321). TAFF, HANNA, and CROSS (1940, p. 1321) designated two specimens, CAS. 5786 and 5787, from loc. CAS. 27838, Chico Creek, as "neosyntypes". They are, however, unofficial neotypes and represent only body

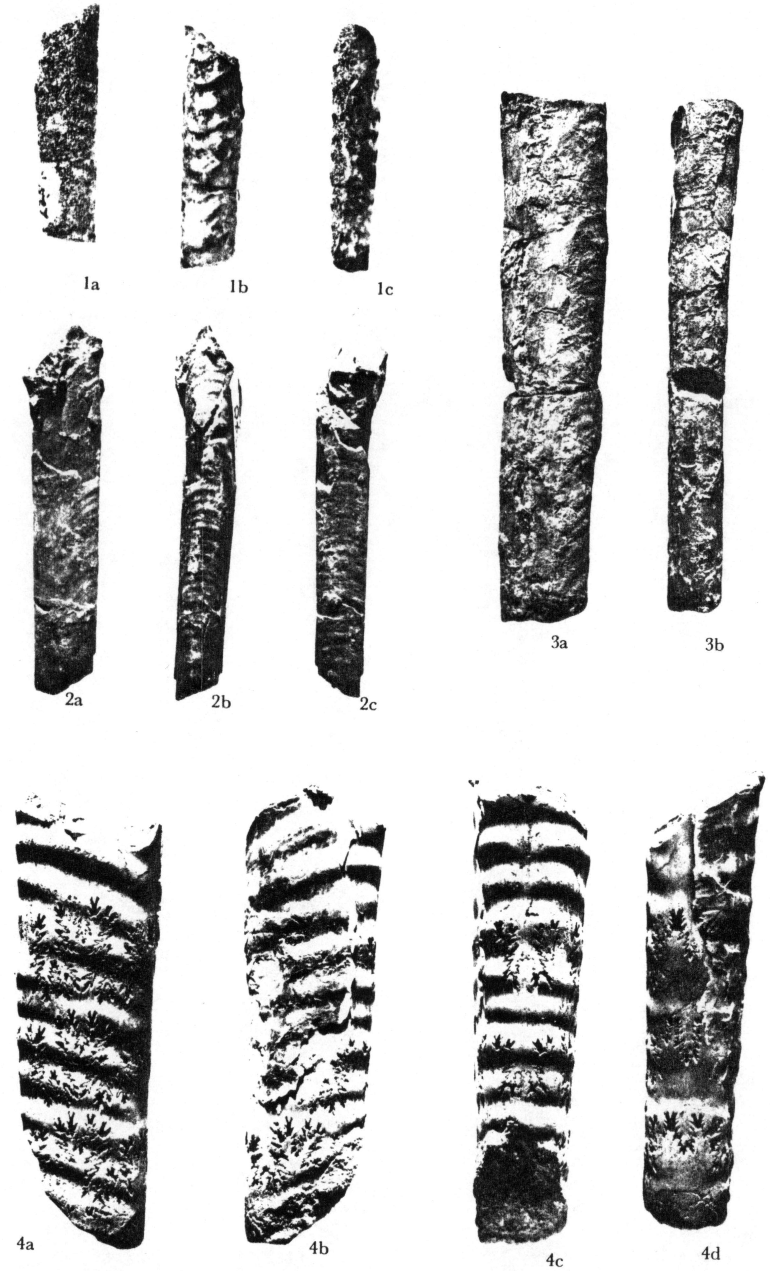
Explanation of Plate 30

Fig. 1. *Baculites columna* MORTON ....Page 161
Two lateral (a, b) and ventral (c) views, ×1. An example, LSJU. 8573, from loc. LSJU. 2251, top of the Panoche group in Panoche Hills (Coll. R. C. BROWN, S. W. MULLER, H. G. SCHENCK, and M. B. PAYNE). The right side (a) of the specimen is weathered.

Figs. 2, 3. *Sciponoceras* aff. *S. bohemicum* (FRITSCH)....................Page 109
2. Lateral (a), ventral (b), and dorsal (c) views, ×3/2. A specimen, UCLA. 28848, from loc. CIT. 1069, upper sandy part of the Baker Canyon member, Santa Ana Mountains (Coll. W. P. POPENOE).
3. Lateral (a) and ventral (b) views, ×1. A probably adult shell, UCLA. 28853, from loc. CIT. 1070, upper sandy part of the Baker Canyon member, Santa Ana Mountains (Coll. W. P. POPENOE).

Fig. 4. *Lechites* aff. *L. gaudini* (PICTET and CAMPICHE) ....Page 101
Two lateral (a, b), ventral (c), and dorsal (d) views, ×1. A specimen, UC. 37600, from loc. SOC. K-101, Huling Creek, One Quadrangle (Coll. M. V. KIRK).

Photos by Alexander TIHONRAVOV (1) and Takeo SUSUKI (2-4).



Explanation of Plate 31

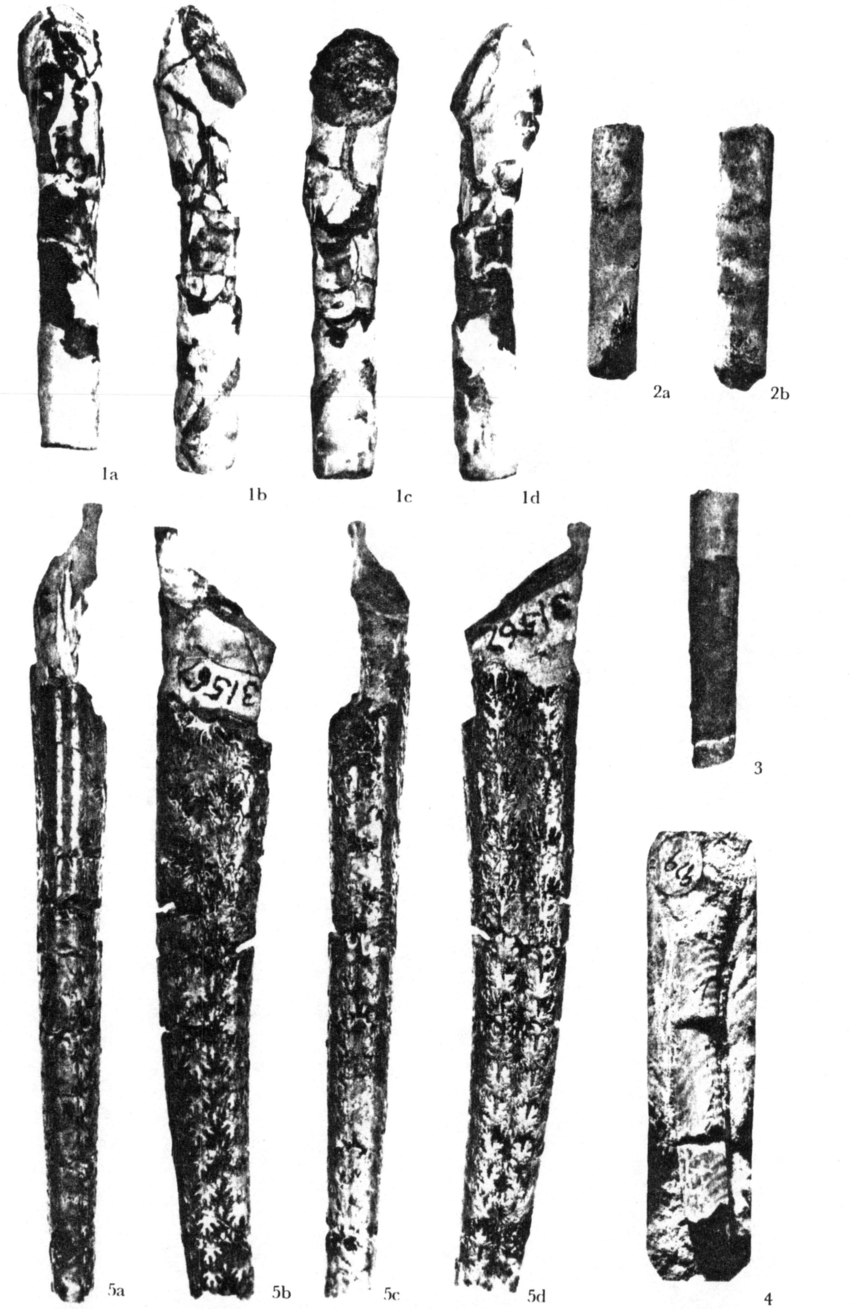
Fig. 1. *Sciponoceras baculoide* (MANTELL) ....Page 104
Ventral (a), two lateral (b, d), and dorsal (c) views, ×1. A crushed body chamber, from loc. CAS. 34405, "Hayes Gulch", 2 miles northwest of Gas Point, Ono Quadrangle, NW. Sacramento Valley.

Figs. 2, 3. *Sciponoceras kossmati* (NOWAK) ....Page 106
2. Dorsolateral (a) and right lateral (b) views, ×3/2. An example from loc. CAS. 33706, conglomerate in Arroyo del Valle, Alameda County (Coll. A. S. HUCY), ×3/2.
3. Lateral view of another example from the same locality as above.

Fig. 4. *Sciponoceras* aff. *S. bohemicum* (FRITSCH) ....Page 109
Lateral view of an example, UCLA. 28854, from loc. CIT. 979, upper sandy part of the Baker Canyon member, Santa Ana Mountains (Coll. W. P. POPENOE), ×3/2.

Fig. 5. *Baculites rex* ANDERSON ....Page 136
Ventral (a), two lateral (b, d), and dorsal (c) views, ×1. An example from loc. CAS. 31567 [=31401], back of Antelope plane, southwest San Joaquin Valley (Coll. W. S. KNOUSE).

Photos by Charles E. CROMPTON (1–3, 5), without whitening, and by Takeo SUSUKI (4), with whitening.



T. MATSUMOTO: Upper Cretaceous Ammonites of California

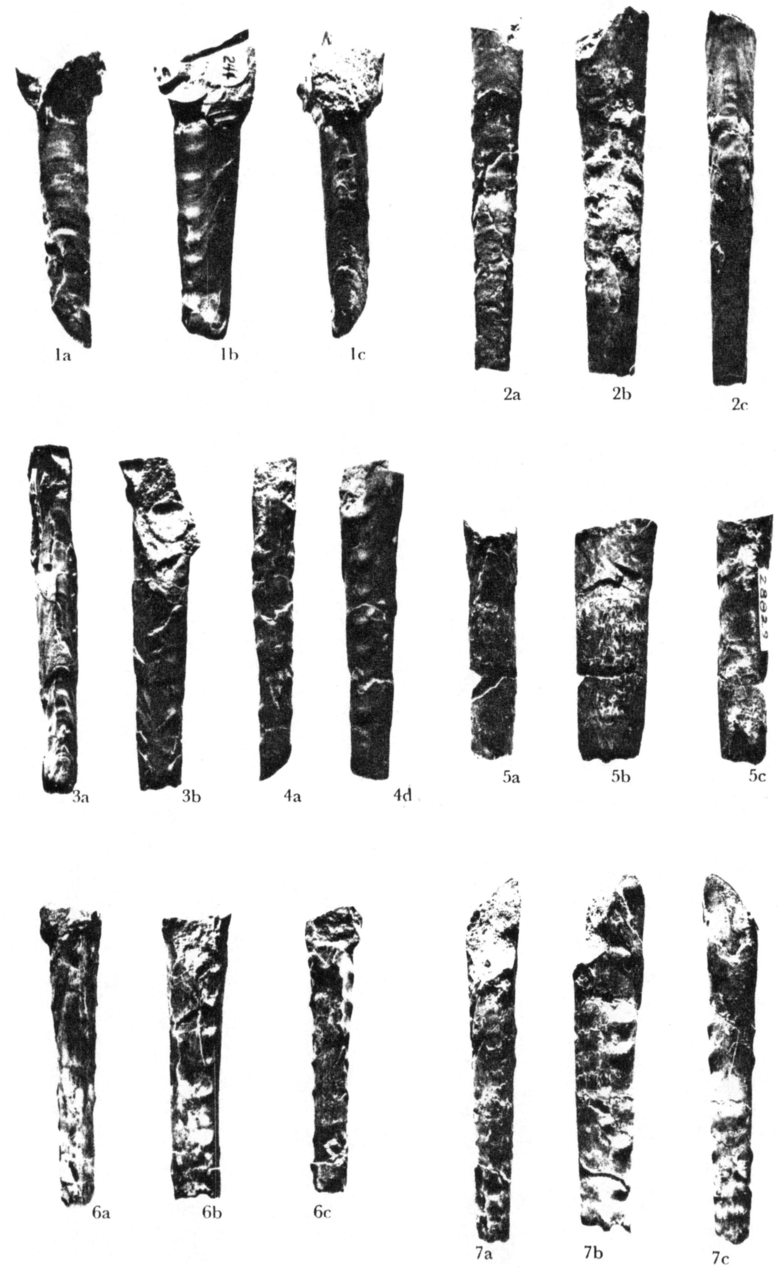
Explanation of Plate 32

Figs. 1–6. *Baculites schencki* sp. nov. ....Page 113

1. Dorsal (a), lateral (b), and ventral (c) views, ×1. One of the paratypes, UCLA. 28831, from loc. CIT. 1244 of the Redding area (Coll. W. P. POPENOE).
2. Dorsal (a), lateral (b), and ventral (c) views, ×3/2. Holotype, UCLA. 28830, from loc. CIT. 1034, Member IV of the Redding area (Coll. W. P. POPENOE and D. SCHARF).
3. Ventral (a) and lateral (b) views, ×1. A paratype, UCLA. 28832, from loc. CIT. 1244 of the Redding area (Coll. W. P. POPENOE).
4. Dorsal (a) and lateral (b) views, ×1. A paratype, UCLA. 28828 from loc. CIT. 1034, Member IV of the Redding area (Coll. W. P. POPENOE and D. SCHARF). Fairly prominent dorsolateral tubercles are shown under oblique light.
5. Ventral (a), lateral (b), and dorsal (c) views, ×1. A paratype, UCLA. 28829, from loc. CIT. 1034, Member IV of the Redding area (Coll. W. P. POPENOE and D. SCHARF).
6. Ventral (a), lateral (b), and dorsal (c) views, ×1. An example of a fairly strongly tuberculate variety, UCLA. 28841, from loc. CIT. 1034, Member IV of the Redding area (Coll. W. P. POPENOE and D. SCHARF).

Fig. 7. *Baculites boulei* COLLIGNON ....Page 118
Ventral (a), lateral (b), and dorsal (c) view, ×1. An example, UCLA. 28834, from loc. CIT. 1008, lower part of Member V of the Redding area (Coll. W. P. POPENOE and D. SCHARF).

Photos by Takeo SUSUKI.



Explanation of Plate 33

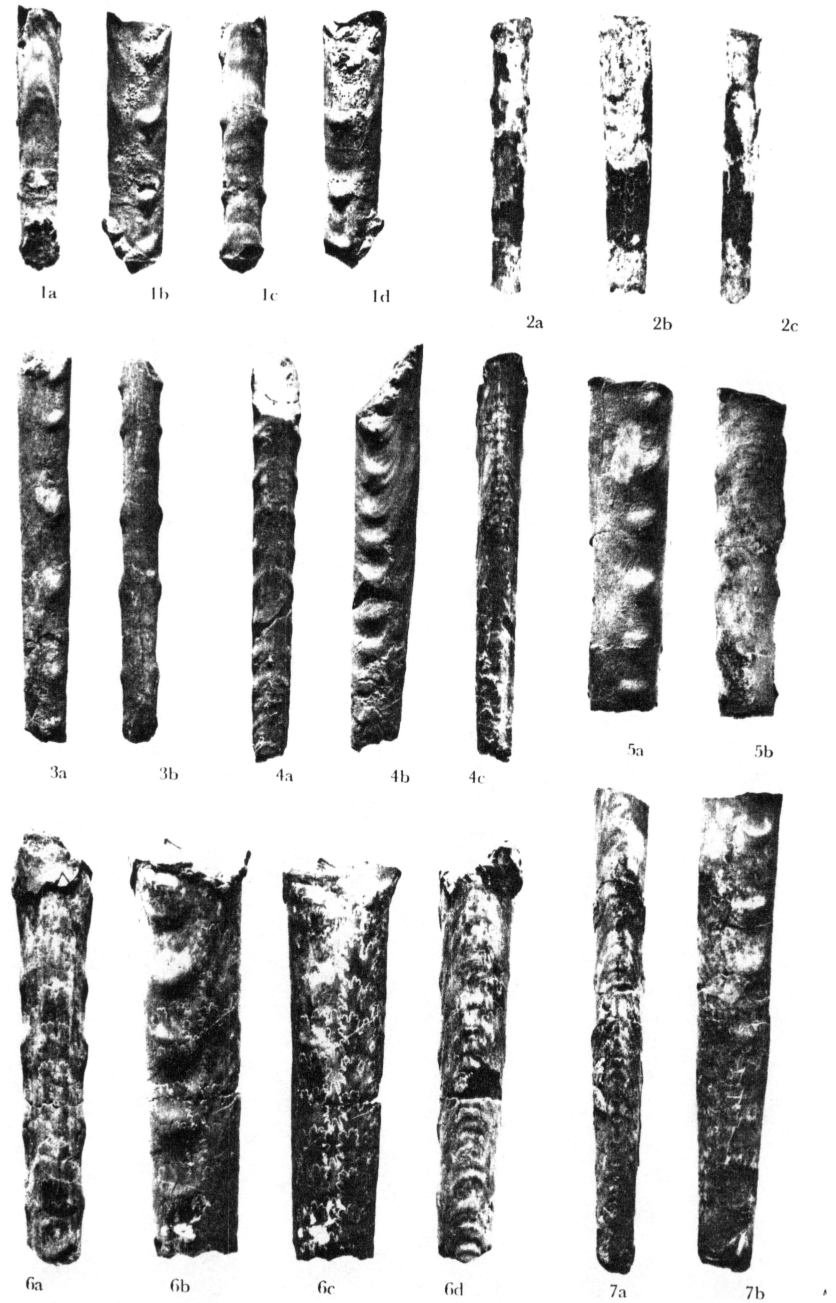
Figs. 1-3. *Baculites capensis* WOODS ....Page 121

1. Ventral (a), two lateral (b, d), and dorsal (c) views, ×1. An example LSJU. 8565, from loc. LSJU. 2880, upper part of the lower half of the Chico formation, Chico Creek (Coll. R. E. COOK).
2. Dorsal (a), lateral (b), and ventral (c) views, ×1. An example LSJU. 8564, from loc. LSJU. 2880, upper part of the lower half of the Chico formation, Chico Creek (Coll. R. E. COOK).
3. Lateral (a) and dorsal (b) views of an example, UCLA. 28838, from loc. UCLA. 3627, upper part of the lower half of the Chico formation, Chico Creek (Coll. L. E. and R. B. SAUL).

Figs. 4-7. *Baculites boulei* COLLIGNON ....Page 118

4. Dorsal (a), lateral (b), and ventral (c) views, ×1. An example, UCLA. 28833, from loc. CIT. 1008, lower part of Member V of the Redding area (Coll. W. P. POPENOE and D. SCHARF).
5. Lateral (a) and dorsal (b) views, ×1. An example, LSJU. 8577 from loc. LSJU. 3350, Holtz shale of the Santa Ana Mountains (Coll. NISBELL).
6. Dorsal (a), lateral (b, c), and ventral (d) views, ×1. An example UCLA. 28836, from loc. CIT. 1007, Member IV of the Redding area (Coll. W. P. POPENOE and D. SCHARF). One (c) of the lateral views is taken without whitening and oblique lighting to show the sutures.
7. Ventral (a) and lateral (b) views, ×1. An example, UCLA. 28835, from loc. CIT. 1007, Member IV of the Redding area (Coll. W. P. POPENOE and D. SCHARF).

Photos by Takeo SUSUKI (1, 3, 4, 6, 7) and Alexander TIHONRAVOV (2, 5).



T. MATSUMOTO: Upper Cretaceous Ammonites of California

Explanation of Plate 43

Figs. 1–3. *Baculites kirki* sp. nov. ....Page 143

1. Ventral (a), lateral (b), and dorsal (c) views, ×1. Holotype, UC. 35693, from loc. SOC. K-229, Hooten Gulch, upper part of Member V in the Redding area (Coll. M. V. KIRK).
2. Ventral (a), lateral, (b), and dorsal (c) views, ×2. One of the paratypes, UC. 34871, from the same loc. SOC. K-229 (Coll. M. V. KIRK).
3. Dorsal (a), lateral (b), and ventral (c) views, ×1. Another paratype, UCLA. 28827, from loc. CIT. 1006, lower part of Member V in the Redding area (Coll. W. P. POPENOE and D. SCHARF).

Fig. 4. *Baculites columna* MORTON ....Page 161
Dorsal (a), lateral (b), and ventral (c) views, ×2. A fragmentary specimen from loc. UC. A-4684, "Garzas sandstone" of Volta Quadrangle, west side of the San Joaquin Valley (Coll. University of California, Paleontology 103 class, 1948).

Fig. 5. *Baculites inornatus* MEEK ....Page 155
Dorsal (a), lateral (b), and ventral (c) views, ×1. Lectotype, USNM. 1259, from Sucia Island, Washington.

Fig. 6. *Eubaculites ootacodensis* (STOLICZKA) ....Page 166
Lateral view of a specimen from loc. LSJU. 3186, Mira marl, West Australia (see Pl. 44, fig. 1a, b), ×1.

Photos by David H. MASSIE (1, 2, 4), Takeo SUSUKI (3), Nelson W. SHUPE (5), and Alexander TIHONRAVOV (6).