JOURNAL OF PALEONTOLOGY, VOL. 28, NO. 3, PP. 320–324, PLS. 34–35, MAY 1954

JURASSIC NAUTILOIDS FROM WESTERN NORTH AMERICA

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ABSTRACT—Three new species of nautiloids from western North America are figured and described: *Eutrephoceras montanensis*, *Bisiphytes* (*Cenoceras*) *imlayi*, and *B.* (*C.*) *lupheri*. The specimens came from the Rierdon formation of Montana, the Weburg formation of Oregon, and the Kialagvik formation of the Alaskan Peninsula. Only two species of Jurassic nautiloids have previously been reported from North America. *Cenoceras* Hyatt is placed as a subgenus of *Bisiphytes* Montfort.

INTRODUCTION

NAUTILOIDS from Jurassic formations are very uncommon fossils, especially so in North America. The richly fossiliferous Jurassic formations of Europe and Asia have yielded relatively few species and genera of nautiloids compared to the richness of the ammonite faunas. The nautiloids became almost extinct near the close of the Triassic. The evolutionary history of Triassic nautiloids can be summarized as a culmination of trends that began in the Carboniferous. The high degree of ornamentation attained in some stocks of Triassic nautiloids was never again repeated in the evolution of this group. Early in the Jurassic new stocks and evolutionary patterns were quickly established. There is no "break" in the evolutionary pattern of the nautiloids from the Jurassic to the Cretaceous.

Our knowledge of Jurassic nautiloids progresses very slowly. The only classification of post-Triassic nautiloids is that of Spath (1927). The literature on Jurassic nautiloids is sparse and is generally only a small part of larger faunal studies. Papers devoted entirely to Jurassic nautiloids include those by Parona (1897), Crick (1898), Tagliarini (1901), Prinz (1906), Pia (1914), and Loesch (1914).

The collection under study consists of only 15 specimens that include *Bisiphytes* (*Cenoceras*) *imlayi*, n. sp., from the Kialagvik formation of Alaska (lower Bajocian age); *Bisiphytes* (*Cenoceras*) *lupheri*, n. sp., from the Weburg formation of Oregon (lower Bajocian); *Eutrephoceras montanensis*, n. sp., from the Rierdon formation (Callovian) of Montana; and *Eutrephoceras* sp. indet. from the Twin Creek limestone (Bajocian) of Wyoming.

The only other described species of nautiloids from the Jurassic of North America are "*Nautilus*" *burkarti* Castillo and Aguilera (1895) and "*Nautilus*" *naufragus* Cragin from the Malone formation of Texas (Cragin, 1905). "*Nautilus*" *burkarti* belongs in *Eutrephoceras*. The proper generic assignment of "*Nautilus*" *naufragus* cannot be told from Cragin's description or illustrations.

All of the specimens have been collected by R. W. Imlay of the U. S. Geological Survey with various associates. The writer is indebted to Imlay for the opportunity to study these specimens. The holotype of *Bisiphytes* (*Cenoceras*) *imlayi*, n. sp., was photographed for the writer by A. K. Miller and C. Collinson at The State University of Iowa.

SYSTEMATIC DESCRIPTIONS

Family NAUTILIDAE d'Orbigny, 1840

Genus EUTREPHOCERAS Hyatt, 1894

EUTREPHOCERAS MONTANENSIS Kummel, n. sp.

Plate 34, figures 1, 2

Type species.—*Nautilus dekayi* Morton.

The Rierdon formation in Montana has

EXPLANATION OF PLATE 34

FIGS. *1, 2*—*Eutrephoceras montanensis* Kummel, n. sp. The holotype (USNM) from the Rierdon formation, Fergus County, Montana (U.S.G.S. loc. 19170), ×0.5. (p. 320)

3, 4—*Bisiphytes* (*Cenoceras*) *lupheri* Kummel, n. sp. The holotype (USNM) from the Weburg formation, Grants County, Oregon (U.S.G.S. loc. 21612), ×0.5. (p. 323)

Kummel, Jurassic nautiloids

Kummel, Jurassic nautiloids

yielded 10 specimens of nautiloids that are a new species of *Eutrephoceras*. The specimens are internal molds and for the most part partially crushed. The largest and best preserved specimen (U.S.G.S. loc. 19170, Pl. 34, figs. 1, 2) is designated the holotype. It measures 203 mm. in diameter and consists of a complete phragmocone plus a half whorl of living chamber. The most adoral part of the living chamber is 138 mm. wide and 188 mm. high. The conch is very involute and rapidly expanding. The whorl section is higher than wide on the phragmocone, but becomes depressed on the living chamber. The whorl sides are broadly rounded passing gradually onto a broadly rounded venter. The widest part of the whorl section is just above the umbilical shoulder. The umbilical shoulder is more sharply rounded and passes to a steep, high umbilical wall. On the internal mold there is a small umbilicus present. The suture is nearly straight across the venter and forms a very shallow lobe on the whorl sides. The siphuncle is located slightly below the center of the whorl.

Remarks.—Species of *Eutrephoceras* have long been recognized from the Cretaceous and the Cenozoic. However, there are several species in the Jurassic that properly belong in this genus. Spath (1927, p. 23) would include *Nautilus obesus* Sowerby from the Bajocian of Europe. Most certainly *N. cyclotus* Oppel (Zittel, 1868, pl. 3, figs. 2a, b) from the Upper Jurassic of central Europe belongs in *Eutrephoceras*. I would also include *N. rotundus* Crick (1898, p. 132) and *N. subrotundus* Crick (1898, p. 133) from the Inferior Oölite of England. *N. boissieri* Pictet (1867) and *N. bradfordensis* Crick (1898, p. 117) have more compressed conches, but can well be included within *Eutrephoceras*. *Nautilus waageni* Gemmellaro (1886), *N. lutati* Gemmellaro (1886), *N. mazzarensis* Tagliarini (1901) from the lower Dogger of Italy should also be placed in *Eutrephoceras*. *Nautilus burkarti* Castillo and Aguilera (1895, p. 12) from the Upper Jurassic of Mexico and the Malone Mountains of Texas (Cragin, 1905) also belong in *Eutrephoceras*.

Occurrence.—Upper Jurassic, Callovian, Ellis group, Rierdon formation, Montana.

U.S.G.S. loc. 19170, from lower 15 feet of Rierdon formation—*Gowericeras subitum* zone—slightly north of center of sec. 15, T. 14 N., R. 21 E., Fergus County; U.S.G.S. loc. 18758, *Kepplerites mclearni* zone, Section Creek, sec. 1, T. 28 N., R. 20 E., Blaine County; U.S.G.S. loc. 9662, NW¼ sec. 14, T. 7 S., R. 24 E., Bridger Canyon; U.S.G.S. loc. 18726, W.½ sec. 7, T. 24 N., R. 25 E., Morrison Butte, Little Rocky Mountains; U.S.G.S. 19180, from 30 ft. of shale and nodular limestone just above ledge of sandy limestone about 1 mile southeast of Piper in SE¼ sec. 9 and NE¼ sec. 16, T. 14 N., R. 20 E., Fergus County; U.S.G.S. loc. 19586, about 24 feet above base of Rierdon formation, Chalk Butte dome, sec. 7, T. 25 N., R. 26 E., Little Rocky Mountains, Phillips County; U.S.G.S. 21636, about 25 feet above base of Rierdon formation on divide about ½ mile west of Five Mile Creek, sec. 36, T. 5 S., R. 24 E., Pryor Mountains, Carbon County.

Repository.—U. S. National Museum.

EUTREPHOCERAS sp. indet.

One fragmentary and weathered specimen of one half volution of phragmocone from the Twin Creek limestone of Wyoming is specifically distinct from *E. montanensis*, but too incomplete to establish a new species. The specimen's value is in the recording of *Eutrephoceras* from the Twin Creek limestone.

Occurrence.—U.S.G.S. loc. 20981, Middle Jurassic, Bajocian, Twin Creek limestone, from upper 20 feet of member B, about 150 to 170 feet above base of formation. From head of Leed Canyon, secs. 1 and 2, T. 22 N., R. 119 W., Lincoln County, Wyoming.

Repository.—U. S. National Museum.

EXPLANATION OF PLATE 35

FIGS. *1, 2—Bisiphytes (Cenoceras) imlayi* Kummel, n. sp. The holotype (USNM) from the Kialagvik formation, Alaskan Peninsula (U.S.G.S. loc. 21251), ×0.5. (p. 322)

Genus BISIPHYTES Montfort, 1802
Subgenus CENOCERAS Hyatt, 1884
BISIPHYTES (CENOCERAS) IMLAYI
Kummel, n. sp.
Plate 35, figures 1, 2

Two large and well-preserved specimens form the basis of this species. The holotype (pl. 35, figs. 1, 2) is a nearly complete internal mold with isolated portions of the shell preserved. This specimen is by far the best preserved of the Jurassic nautiloids described in this report. The paratype is fragmentary consisting of approximately $\frac{1}{3}$ volution of living chamber and three camerae. It has much of the shell on the venter preserved.

The holotype measures 295 mm. in diameter and 185 mm. in width and 174 mm. in height of the most adoral part of the outer whorl. At the beginning of the living chamber the width-height measurements are 140 and 135 mm. respectively. The conch is large, robust, and very involute. The whorl sides are flattened to slightly arched and converge towards the venter. The venter is broadly arched on the phragmocone becoming more flattened adorally. The ventral shoulders are broadly rounded. The umbilical shoulders are likewise well rounded. The greatest width of the conch is just ventral of the umbilical shoulders. The umbilicus is very narrow.

The paratype (U.S.G.S. loc. 19757) is a much smaller specimen that probably had a diameter of 160 mm. It differs slightly from the holotype in that the whorl sides appear more flattened and the ventral shoulders more angularly rounded. The venter is flattened to broadly arched. The differences between the specimens are not thought to be of specific importance.

The suture forms a shallow ventral lobe and a wide shallow lateral lobe. The siphuncle is not observable on the holotype but on the paratype it is slightly ventral of the center of the whorl.

Only portions of the shell are preserved on both specimens but from these fragments, however, one can observe distinct growth lines and longitudinal striae. The striae on the holotype are approximately 1.5 mm. wide, as are also the interspaces between the striae. On the holotype there are patches of shell showing the striae on the venter, just below the ventral shoulder, and one just above the umbilical shoulder. Presumably the striae were on the whole shell, that is, on the whorl sides and venter. The striae are not noticeable on the internal mold. The venter of the paratype has about half of the shell preserved in a rather weathered condition; however, the longitudinal striae are very distinct and present over the ventral shoulder. Portions of the shell are preserved on one side of the conch just above the umbilical shoulder; the striae are not present on these shell fragments but strong growth lines are clearly shown.

Remarks.—There are differences in the shape of the conch and ornamentation between the two specimens described here. However, since they both come from the same formation and from very nearby localities and with no idea as to the range of variation that may be present, it is considered better to follow a more conservative course and place them in one species.

After a preliminary examination of this specimen I was inclined to place it in *Paracenoceras*; however, the presence of the longitudinal striae and the geologic age of the specimens suggest that it belongs in *Cenoceras*. The classification of Liassic and Bajocian nautiloids is at present very unsatisfactory. Most of the nautiloid species of these epochs are most conveniently placed in *Bisiphytes* or *Cenoceras*. *Bisiphytes* is typically involute and with a rounded whorl section and shell ornamentation consisting of growth lines and striations. *Cenoceras* is exactly like *Bisiphytes* in most morphologic features except for its more quadrate whorl sections. However, as Spath (1927, p. 20) has pointed out, Hyatt's genus *Cenoceras* has not been generally accepted. There are species which can be placed in either genus with about equal propriety. There are also species that agree with one or the other of these two genera in all features except they lack the longitudinal striae on any part of the shell. The variability in cross section of Liassic nautiloid species is well demonstrated in cross sectional outlines figured by Pia (1914, pls. 8–10). The gradational character of these two genera and the wide variation present suggest that they should be combined. However, phylogenetically there

are advantages in keeping separate the quadrate "*Bisiphytes*." For this reason it is proposed to make *Cenoceras* a subgenus of *Bisiphytes*.

The remaining species of Liassic nautiloids are included in *Sphaeronautilus*, *Digonioceras*, *Ophionautilus*, and *Hercoglossoceras*. These are aberrant genera that contain few species of limited distribution.

B. (*C.*) *imlayi* is similar to such early Jurassic species as *B.* (*C.*) *intermedium* (Sowerby), *B.* (*C.*) *jourdani* (Dumortier), *B.* (*C.*) *truncatus* (Sowerby), *B.* (*C.*) *quadrangularis* (Pia), *B.* (*C.*) *brancoi* Gemmellaro, *N. obstructus* Eudes-Deslongchamps. It differs from all of these species in details of whorl sections and involutions.

Occurrence.—Holotype, U.S.G.S. loc. 21251, Kialagvik formation—lower Bajocian age. From sandy sequence corresponding to *Hammatoceras kialagvikense* "subzone" of Kellum. Sea cliff on southeast shore of Wide Bay, 5.32 miles S. 46½°W. of the west end of Hartman Island. Grey siltstone containing many limestone concretions, about 500 feet below the top of the Kialagvik formation. Paratype, U.S.G.S. loc. 19757, from 975 to 800 feet below top of Kialagvik formation associated with *Erycites howelli* (White) and *Pseudolioceras whiteavesi* (White). Sea cliffs on northwest side of Wide Bay southwest of mouth of Pass Creek and about 3½ miles N. 50 W. of west end of Hartman Island, Alaskan Peninsula.

Repository.—U. S. National Museum.

BISIPHYTES (CENOCERAS) LUPHERI Kummel, n. sp.
Plate 34, figs. 3, 4

Two internal molds of rather coarse preservation from the Weburg formation of Oregon are in the collections under study. Lupher (1941, p. 248) mentions the occurrence of large nautiloids in the Weburg formation. The holotype (Pl. 34, figs. 3, 4) is a nearly complete specimen with a living chamber of ⅓ volution in length. The paratype is very poorly preserved and can add nothing to the description. The holotype measures 91 mm. in diameter, and the height and width of the most adoral part of the last volution are approximately 47 mm. and 67 mm. respectively. At the most adoral part of the phragmocone the height-width measurements are 37 mm. and 51 mm. The conch is very involute and somewhat compressed. The whorl sides are broadly convex to flattened and converge towards the venter which is broad and flattened. The ventral shoulders are broadly rounded. The umbilical shoulders are more abruptly rounded. The whorls are more rapidly expanding on the living chamber than on the phragmocone. The umbilicus measures approximately 16 mm. The suture is only moderately sinuous with a very shallow ventral lobe and a wide shallow lateral lobe that occupies the whole whorl side. The position of the siphuncle is not known.

No part of the shell is preserved.

Remarks.—This species is quite distinct from *B.* (*C.*) *imlayi* in the shape of the conch and its size. It is most similar to *B.* (*C.*) *intermedium* Sowerby and *B.* (*C.*) *orbignyi* Prinz (= *N. intermedius* d'Orbigny *non* Sowerby). The latter species was designated the type species of *Cenoceras* by Hyatt (1884, p. 301).

Occurrence.—U.S.G.S. loc. 21612, upper part of Middle Jurassic, Weburg formation, lower Bajocian age, just north of Colpitts Ranch in NE corner sec. 19, T. 18 S., R. 26 E., Grant County, Oregon.

Repository.—U.S. National Museum.

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MANUSCRIPT RECEIVED APRIL 9, 1953