MOLLUSKS FROM THE ASPEN SHALE (CRETACEOUS) OF SOUTHWESTERN WYOMING

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INTRODUCTION

The Aspen shale of southwestern Wyoming has yielded few fossils except the abundant fish remains noted by everyone who has dealt with the formation, consequently a collection containing ammonites and a variety of pelecypods is worthy of special record in spite of the fact that their state of preservation leaves much to be desired. This material was secured by Mr. Weymouth during the course of field work for the California Co., and is derived from two localities on the Meridian anticline southeast of Kemmerer, Wyo. Interesting features of the collection are that it contains the genus *Acompsoceras*, not previously described from North America; the genus *Epengonoceras*, not previously described from the interior province, though its presence at a distant locality has been noted;[1] and a third genus, here named *Kanabiceras*, whose geographic range is much extended over that shown by previous records.

The photographs of specimens shown in the accompanying plates were made by W. O. Hazard and the photographs were retouched and the plates assembled by Miss Frances Wieser.

THE ASPEN SHALE

The Aspen shale of southwestern Wyoming was named in 1907 by Veatch,[2] the typical locality being the exposures near old Aspen

[1] Stanton, T. W., unpublished data.

[2] Veatch, A. C., Geography and geology of a portion of southwestern Wyoming: U. S. Geol. Survey Prof. Paper 56, p. 64, 1907.

station in T. 14 N., R. 118 W., Uinta County, on a part of the Union Pacific Railroad, since abandoned in favor of a shorter route lying some miles farther north. Veatch described the formation as "dark-colored, splintery, somewhat arenaceous shales containing abundant fish scales," and ascribed to it a thickness of 1,600 to 2,200 feet, with the average at 1,800 feet.

The beds comprised in the Aspen formation at the type locality had been clearly noted, however, by most of the earlier students of the region,[3] the references extending at least as far back as 1870. Stanton[4] in 1892 recorded near old Bear River City from "several hundred feet of bluish and brownish shales," that are undoubtedly part of the present Aspen shale, "teleost fish scales and crushed specimens of a *Prionocyclus* (perhaps *P. woolgari*)." These ammonites are now recognized as belonging to some species of *Metoicoceras*[5] and agree therefore with the fauna described below. Schultz has in several papers[6] described the Aspen shale of the same general region. He records it as composed of black shale, dark drab arenaceous shale and gray sandstone, 1,200 to 1,800 feet thick but averaging 1,600 feet, at places weathering into small splintery fragments and producing long rounded hills of peculiar silver-gray color, and containing abundant fish scales. In sec. 19, T. 24 N., R. 115 W., Lincoln County, it yielded specimens of *Lingula* species.

The most notable lithologic feature of the Aspen shale is the presence of zones of a very hard, very fine-grained rock which weathers to a platy, very light gray, resistant material and causes the formation of conspicuous and very characteristic ridges along the outcrop. Identical material constitutes most of the Mowry shale of central and eastern Wyoming, recently studied by W. W. Rubey,[7] who concluded that its peculiarities are due to an unusual content of silica, and that this was derived from the alteration of volcanic ash. The fossils described in the present paper are all preserved in this hard siliceous rock. Mr. Rubey has studied specimens of this matrix and has very kindly contributed the following note:

The three samples from the Aspen formation are all very hard, light to medium gray, fine-grained rocks. The sample reported as most representative is somewhat coarser grained than the others and distinctly light gray, both on the weathered surface and in fresh fracture. Its weathered surface is con-

[3] For references see Veatch, footnote 2.

[4] Stanton, T. W., The stratigraphic position of the Bear River formation: Amer. Journ. Sci., ser. 3, vol. 43, p. 104, 1892.

[5] Stanton, T. W., personal communication.

[6] Schultz, A. R., Coal fields in a portion of central Uinta County, Wyo.: U. S. Geol. Survey Bull. 316, p. 215, 1907; Geology and geography of a portion of Lincoln County, Wyo.: U. S. Geol. Survey Bull. 543, pp. 30, 59, 1914; A geologic reconnaissance for phosphate and coal in southeastern Idaho and western Wyoming: U. S. Geol. Survey Bull. 680, pp. 13, 28, 1918.

[7] Rubey, W. W., Origin of the siliceous Mowry shale of the Black Hills region: U. S. Geol. Survey Prof. Paper 154, pp. 153–170, 1929.

spicuously marked by abundant white spots from ⅓ to 1 or 2 millimeters in diameter. The other two samples are nearly alike—both are very light gray on the weathered surface and medium gray on fresh fracture.

Microscopic examination shows that the white-spotted sample is a rhyolitic tuff that consists of volcanic glass, angular quartz grains, and calcite. The glass, which constitutes about 75 per cent of the rock, is very pale brownish gray and minutely porous. Its refractive index is slightly less than 1.50 and corresponds to that of a highly silicic glass. Numerous and well-preserved curving plates and cuspate shards of this glass show clearly the vitroclastic texture of the rock. A very small amount of cryptocrystalline material in the glass indicates that it has been slightly devitrified. The white spots so noticeable in the hand specimen are the larger masses of this porous glass. The crystalline grains, about 10 per cent of the rock, are exceedingly angular fragments and very thin flakes from less than 0.01 to 0.18 (commonly about 0.06) millimeter in diameter. Quartz predominates but mixed with it is some sanidine or orthoclase and a few crystals or fragments of zircon, magnetite(?), biotite, plagioclase, and hornblende(?). The rock is distinctly laminated with layers about 0.2 millimeter thick of these crystalline grains alternating with thick and thin layers of the glass. These crystalline grains afford no evidence that they are clastic sand grains, and, although possibly entirely clastic, it seems more probable that they are largely fragments of phenocrysts crystallized before the explosions or of shattered wall rock blown from the sides of the volcanoes. The calcite, about 15 per cent of the rock, occurs as large anhedral crystals concentrated chiefly near the quartz grains, but also distributed here and there throughout the glass. No clay minerals were recognized in this sample.

The two darker gray samples might be termed argillaceous tuffs or tuffaceous mudstones. Both contain volcanic glass and angular quartz grains, but they also contain clay and organic matter and a considerable amount of cryptocrystalline material (in part at least devitrified glass). In neither of them was any calcite recognized. The sample from 80 feet below the top of the formation contains more clay and organic matter and less glass than the one from 300 feet below the top. However, in both there is approximately 50 per cent or more of glass, the vitroclastic texture of which is still preserved. The angular quartz grains in both specimens range from less than 0.01 to 0.08 (commonly about 0.02) millimeter in diameter. These samples are not distinctly laminated, but the small lenses of organic matter and the clay crystals all have a parallel orientation.

In general appearance in the hand specimen, these two dark gray samples from the Aspen formation greatly resemble the Mowry shale of northeastern Wyoming, and in thin section there is a striking similarity in the constituents, in the size of grain, and especially in the presence of more or less altered rhyolitic ash in both formations. But the relative proportions of these constituents are very different—even the more clayey and organic sample of the Aspen contains far less clay and organic matter and much more fresh volcanic glass than samples of the Mowry. Furthermore, the angular quartz grains, though of approximately the same size in both formations, are distinctly more numerous in the Aspen. That is, the two formations appear to be made up of the same constituents, but the Mowry shale contains much less volcanic débris or else the volcanic glass originally in it is now much more thoroughly devitrified.

Under the Aspen shale lies conformably the thick Bear River formation of dark shales containing thin beds of sandstone and

limestone and beds of carbonaceous material, and yielding a large fauna of chiefly nonmarine species, together with a few marine forms that indicate Upper Cretaceous age.[8] Above the Aspen shale lies conformably the Frontier formation,[9] a group of sandstones inclosing shales and beds of coal, the whole several thousand feet thick. Parts of the formation have yielded a marine fauna which includes the following species as identified by T. W. Stanton: *Barbatia* species, *Inoceramus labiatus* Schlotheim, *I.* aff. *I. erectus* Meek, *Pteria* species, *Ostrea soleniscus* Meek, *O. sannionis* White, *Lima* species, *Anomia* species, *Anatina* species, *Modiola* species, *Pholadomya* species, *Cardium curtum* Meek and Hayden, *C. pauperculum* Meek?, *Tellina modesta* Meek, *T.* (*?*) *isonema* Meek, *Donax cuneata* Stanton, *Mactra emmonsi* Meek, *Corbula mematophora* Meek, *Gyrodes* species, *Turritella* species, *Glauconia coalvillensis* Meek, *Pugnellus fusiformis* (Meek), *Fusus utahensis* Meek?, *Admetopsis subfusiformis* Meek.

THE ASPEN FAUNA AND ITS RELATIONS

As noted previously there have been reported from the Aspen formation to date only scales and other remains of fishes, *Metoicoceras* species and *Lingula* species. To these the present paper adds:

Pteria (*Oxytoma*) species.
Ostrea species.
Anomia species.
Periplomya? aspenana Reeside and Weymouth, new species.
Thracia? wyomingensis Reeside and Weymouth, new species.
Tancredia? lincolniana Reeside and Weymouth, new species.
Aphrodina? aspenana Reeside and Weymouth, new species.
Lincaria? species.
Tellina? species.
Mactra? incompta (White)?
Mactra? aspenana Reeside and Weymouth, new species.
Kanabiceras wyomingense Reeside and Weymouth, new genus and species.
Epengonoceras aspenanum Reeside and Weymouth, new species.
Metoicoceras whitei Hyatt.
Metoicoceras species.
Acompsoceras americanum Reeside and Weymouth, new species.

[8] White, C. A., The Bear River formation and its characteristic fauna: U. S. Geol. Survey Bull. 128, 1895. A. C. Veatch, U. S. Geol. Survey, Prof Paper 56, pp. 60–64.
[9] Veatch, A. C., U. S. Geol. Survey, Prof. Paper 56, pp. 65–69.

Besides the mollusks, in the matrix of the specimens described in this paper the fish scales *Leucichthyops vagans* Cockerell [10] and *Erythrinolepis mowriensis* Cockerell [11] were noted.

All of these species except some of the specimens of *Metoicoceras whitei* came from the NW. ¼ sec. 32, T. 21 N., R. 115 W., at horizons 70 to 100 feet below the top of the formation, which is there 670 feet thick. Some of the specimens of *Metoicoceras whitei* Hyatt came from sec. 17, T. 16 N., R. 117 W., at a horizon 350 feet below the top of the formation, which is there 820 feet thick.

The pelecypods help but little in the correlation of the fauna. The ammonites, on the contrary, assist materially. *Kanabiceras* occurs in the middle Eagle Ford shale of Texas, in the Greenhorn limestone of eastern Colorado, in the lower part of the Colorado group in southern Utah, and in the Mowry shale of southern Wyoming, in all these in association with species of lower Turonian age, such as *Inoceramus labiatus*. *Epengonoceras* occurs in the middle part of the Eagle Ford shale of Texas and in the Mowry shale of the Black Hills of eastern Wyoming, in both regions in association with lower Turonian species; and in somewhat older beds elsewhere, as the upper Cenomanian of France. *Metoicoceras* is widespread in America, chiefly in beds of lower Turonian age—middle Eagle Ford shale, Greenhorn limestone, lower part of the Mancos shale, Mowry shale, Mosby sandstone member of Warm Creek shale, etc.—though in Texas it occurs also in somewhat older beds (lower Eagle Ford or upper Woodbine),[12] and in Europe is said to range from upper Cenomanian to lower Turonian. The species found in the Aspen shale is Turonian. *Acompsoceras* has been reported from the Cenomanian of Europe and north Africa, but not yet from the Turonian. The writes consider the Aspen fauna to be of lower Turonian age and equivalent to that of the lithologically similar Mowry shale, though it has some similarity to that of the Greenhorn limestone, which in the Black Hills region lies as much as 1,000 feet above the Mowry shale. The relations of the Aspen shale to the lower part of the Colorado group at various other places can be determined in only a general way—that is, it is equivalent in age to a very early part.

[10] Cockerell, T. D. A., Some American Cretaceous fish scales, with notes on the classification and distribution of Cretaceous fishes: U. S. Geol. Survey, Prof. Paper 120, p. 180, pl. 34, fig. 13; pl. 35, figs. 1–15, 1919.

[11] U. S. Geol. Survey, Prof. Paper 120, p. 182, pl. 36, figs. 3–6.

[12] Stephenson, L. W., unpublished data.

DESCRIPTION OF SPECIES

Family PTERIIDAE Meek

Genus PTERIA Scopoli

Subgenus Oxytoma Meek

PTERIA (OXYTOMA) species undetermined

Plate 1, Figure 5

A single small external mold of a species of *Pteria* (*Oxytoma*), preserved in the living chamber of *Acompsoceras americanum*, presents features that mark it as an unnamed form. In the absence of other material it is not possible to tell whether this single individual is juvenile or mature, and the writers have therefore left it unnamed.

The specimen represents a left valve with a width of 3 millimeters parallel to the hinge margin and a height of 2 millimeters. The posterior wing is proportionately large and the body of the shell stout and well rounded. The ribs, about 30 in number, are of even size and rather closely spaced on the anterior and posterior parts of the valve, but are more distant and alternate in height on the middle section. The posterior wing is ribbed, relatively large, and shallowly emarginate.

No comparable species has been recorded from beds in the Interior Province as old as the Aspen shale except a large undescribed individual from the Thermopolis shale of the Crow Indian Reservation in southern Montana. *Pteria* (*Oxytoma*) *nebrascana* (Evans and Shumard)[13] and *P.* (*O.?*) *haydeni* Hall and Meek[14] are both much larger and come from much higher horizons.

Cat. No. 73763, U.S.N.M.

Family OSTREIDAE Lamarck

Genus OSTREA Linnaeus

OSTREA species

Plate 2, Figure 3

Several of the specimens of *Epengonoceras aspenanum* were overgrown by a small oyster with subcircular valves, almost unsculptured and lacking in features which would serve to differentiate it from similar simple forms occurring at many horizons. It is recorded here for the sake of completeness. These specimens might be the

[13] Meek, F. B., Invertebrate Cretaceous and Tertiary fossils of the Upper Missouri country: U. S. Geol. Survey Terr. Rept., vol. 9, p. 34, pl. 16, fig. 3; pl. 28, fig. 11, 1876.
[14] Idem, p. 33, pl. 16, fig. 2.

young of *Ostrea prudentia* White, but it is not possible to be sure of their identity.

Family ANOMIIDAE Gray

Genus ANOMIA Linnaeus

ANOMIA species

Plate 1, Figures 2, 3

Two moulds of the exterior of valves represent a species of *Anomia* with but little sculpture.

Valve subcircular in outline, with cardinal margin nearly straight, however; umbones marginal or almost so, inconspicuous. Surface ornamented by concentric lines of growth and a few distant and rather faint radial lines. Internal characters entirely unknown.

Length of larger specimen, 19 millimeters; height, 18 millimeters.

Such forms as this are much alike at widely separated horizons, and in the absence of better material it seems of little value to apply a specific name or attempt comparisons.

Cat. No. 73764, U.S.N.M.

Family ANATINIDAE Dall

Genus PERIPLOMYA Conrad

PERIPLOMYA? ASPENANA, new species

Plate 1, Figure 1

A single natural cast of the exterior of a left valve is similar to *Periplomya applicata* Conrad.[15] As noted by Wade, some of the European forms assigned to *Thracia* are not very strikingly different from Conrad's species or the present one, and the status of the genus *Periplomya* and its species should not be considered settled until more is known about them. Though the material in hand is scant foundation for a new species the shell is sufficiently characterized to deserve a name.

Valve depressed, elongate-oval in outline and nearly symmetrical, with an oblique carination extending posteriorly from the beak. No fissure visible in the beak of the type, though shell is entirely absent. Sculpture is even over entire valve, consisting of rather distant concentric lines parallel to the margin. Internal characters entirely unknown. Length, 44 millimeters; height, 25 millimeters; depth of valve, as preserved, about 5 millimeters.

[15] Wade, Bruce, The fauna of the Ripley formation on Coon Creek, Tenn.: U. S. Geol. Survey Prof. Paper 137, p. 75, pl. 24, fig. 3, 1926. Wade erroneously designates this species *Periploma*, but it is the genotype of *Periplomya* Conrad (Amer. Journ. Conchology, vol. 3, p. 15, 1867; vol. 6, p. 76, 1870).

No species recorded from the interior province is sufficiently close to *Periplomya? aspenana* to deserve comparison. *P. applicata*, from the later Upper Cretaceous of the Coastal Plain, tapers more posteriorly and has finer sculpture but is very similar in gross form.

Holotype.—Cat. No. 73765, U.S.N.M.

Family THRACIIDAE Dall

Genus THRACIA Leach

THRACIA? WYOMINGENSIS, new species

Plate 1, Figure 10

Two natural casts of the exterior of right valves have the form of some shells generally assigned to *Thracia*, except that as here preserved they are not as inflated. Few details are preserved, but the writers have ventured to apply a specific name in the belief that the species will be recognizable in future collections. The specimens are compressed, ovate in general outline, rostrate posteriorly; beak not prominent, subcentral, with a diagonal depression extending posteriorly from it. Anterior and basal margins evenly convex; posterior margin nearly straight, vertical; dorsal margin nearly straight anteriorly, emarginate posteriorly, angle at the beaks 90°. Only sculpture shown is distant concentric lines. Internal characters entirely unknown.

Length, 21 millimeters; height, 18 millimeters; depth, as preserved, 2 millimeters.

No described form in the American Cretaceous known to the writers is much like *Thracia? wyomingensis*.

Holotype.—Cat. No. 73766, U.S.N.M.

Family TANCREDIIDAE Fischer

Genus TANCREDIA Lycett

TANCREDIA? LINCOLNIANA, new species

Plate 1, Figure 6

A single mold of the exterior represents a left valve with the form of some species of the genus *Tancredia*. It is compressed; the dorsal margin nearly horizontal for a distance of about 6 millimeters behind the beak, very slightly emarginate in front of the beak, angle at the beak about 150°; ventral margin gently and evenly convex; the anterior margin tapered, the posterior rather sharply truncated in an oblique direction and apparently permitting a gape. Beak inconspicuous; two faint depressions, possibly accidental, diverging

at an angle of about 70° from the beak. Sculpture of fine concentric lines with a few low obscure folds parallel to them. Internal characters entirely unknown. Length, 23 millimeters; height, 14 millimeters; depth of valve, as preserved, about 2.5 millimeters.

No species in the American cretaceous deposits, known to the writers, seems near enough to *Tancredia? lincolniana* to require comparison.

Holotype.—Cat. No. 73767, U.S.N.M.

Family VENERIDAE Leach

Genus APHRODINA Conrad

APHRODINA? ASPENANA, new species

Plate 1, Figures 7, 8

A mold of the exterior of a right valve retaining the central part of the shell and therefore showing some internal characters and a second, incomplete mold of the exterior represent this species. The outline of the valve is round-oval with all the margins evenly convex; valve rather shallow for the genus; angle at the beak about 120°. Sculpture of unequal concentric lines. Pallial line shows deep but blunt sinus; muscle scars not prominent. Hinge and other characters unknown.

Length, 27 millimeters; height, 23 millimeters; depth as preserved, 5 millimeters.

Of the seemingly related forms of comparable age, "*Callista*" *orbiculata* (Hall and Meek)[16] is higher and stouter; "*Callista*" *tenuis* (Hall and Meek)[17] is smaller and stouter. The much later species "*Callista*" *deweyi* Meek and Hayden[18] has some resemblance, but the outline of the valve is less orbicular.

Holotype and paratype.—Cat. No. 73768, U.S.N.M.

Family TELLINIDAE Deshayes

Genus LINEARIA Conrad

LINEARIA? species

Plate 1, Figure 9

A single natural cast of the exterior of a valve suggests *Linearia* in its general appearance, but so few details are available that no further assignment is warranted. The specimen is depressed, sym-

[16] Meek, F. B., Invertebrate Cretaceous and Tertiary fossils of the upper Missouri country: U. S. Geol. Survey Terr. Rept., vol. 9, p. 186, pl. 5, fig. 2, 1876.

[17] Idem, pl. 5, fig. 1.

[18] Idem, p. 182, pl. 17, fig. 15.

metrically oval, transversely elongated, and shows traces of concentric lines. Other characters obliterated.

Length, 25 millimeters; height, 16 millimeters; depth of crest, 2.5 millimeters.

Various forms resemble this, but comparisons seem of little value. No species of similar age is known in the interior region, however.

Cat. No. 73769, U.S.N.M.

Genus TELLINA Linnaeus

TELLINA? species

Plate 1, Figure 4

A single specimen constituting a mold of the interior of a left valve and preserving a little of the shell seems to belong to the genus *Tellina* but preserves so few details as to make a definite assignment difficult.

Valve depressed, in general transversely elongate-oval, with a posterior basal angle, to which a faint ray extends from the low beak. Anterior dorsal margin shorter than posterior dorsal margin, both nearly straight; basal margin gently convex; anterior margin evenly rounded; posterior margin oblique, straight. Sculpture visible is of fine concentric lines. Other characters not shown.

Length, 19 millimeters; height, 12 millimeters; depth, 2 millimeters.

No form much like this and of comparable age has been described from the interior region.

Cat. No. 73770, U.S.N.M.

Family MACTRIDAE Gray

Genus MACTRA Linnaeus

MACTRA? INCOMPTA (White)?

Plate 1, Figures 12, 13

Three molds of the exterior of valves are very much like *Mactra? incompta* (White)[19] in size and form, differing only on the finer and less regular concentric sculpture. Though this difference may be due only to the manner of preservation it seems best to question the identification of the material in hand until better specimens are available.

The valves are ovate-subtrigonal in outline, moderately convex; beaks about one-third the length behind the anterior margin, only moderately prominent as preserved; angle at the beaks a trifle more

[19] White, C. A., The invertebrate fossils collected in portions of Nevada, Utah, Colorado, New Mexico, and Arizona: U. S. Geog. Surveys W. 100th Mer. Rept., vol. 4, pt. 1, p. 185, pl. 17, fig. 6, 1877.

than 90°; anterior margin broadly convex, basal margin very gently convex, posterior margin narrowly convex; posterior umbonal ridge poorly defined. Surface shows only fine concentric lines of unequal elevation. Internal characters entirely unknown.

Length, 18 millimeters; height, 16 millimeters; depth of valve, 4 millimeters.

The original *Mactra? incompta* came from a locality 5 miles above Pueblo, Colo., probably in the Carlile shale, though possibly older.

Plesiotypes.—Cat. No. 73771, U.S.N.M.

MACTRA? ASPENANA, new species

Plate 1, Figure 11

A single mold of the exterior of a valve represents a species similar in general expression to *Mactra? incompta* White? but differing enough in outline to deserve record as a different species. It is much longer proportionately and shallower though also a small species with a sculpture of fine unequal concentric lines. None of the species of similar age is near it, though it suggests the much younger *Mactra? canonensis* Meek.[20] Internal characters entirely unknown.

Length, 20 millimeters; height, 14 millimeters; depth of valve, 3 millimeters.

Holotype.—Cat. No. 73772, U.S.N.M.

Family ACANTHOCERATIDAE Douvillé

KANABICERAS, new genus

Stanton[21] in 1894 described from a lower Turonian horizon near the base of the local Cretaceous section at Upper Kanab, Utah, the ammonite *Acanthoceras? kanabense.* It was not figured again until 1927, when Moreman[22] published a figure of a specimen from the Turonian part of the Eagle Ford shale of north Texas that shows features not present in the type of the species. Adkins[23] has suggested that Moreman's species is not Stanton's species and that the latter may belong to *Protacanthoceras* Spath.[24] A comparison of the

[20] White, C. A., Contributions to invertebrate paleontology, No. 1: Cretaceous fossils of the Western States and Territories: U. S. Geol. Geog. Survey Terr., Eleventh Ann. Rept. (1877), p. 297, pl. 9, fig. 11, 1879.

[21] Stanton, T. W., The Colorado formation and its invertebrate fauna: U. S. Geol. Survey Bull. 106, p. 181, pl. 36, figs. 6–8, 1894.

[22] Moreman, W. L., Fossil zones of the Eagle Ford of north Texas: Journ. Paleontology, vol. 1, p. 95, pl. 13, fig. 5, 1927.

[23] Adkins, W. S., Handbook of Texas Cretaceous fossils: Texas Univ. Bull. 2838, p. 245, 1928.

[24] Spath, L. F., On the ammonite horizons of the Gault and contiguous deposits: Geol. Survey Great Britain Mem., Summary Progress for 1922, p. 144, 1923.

Sharpe, Daniel, Description of the fossil remains of Mollusca found in the chalk of England, Part I, Cephalopoda: Palæontographical Soc. Mon., p. 25, pl. 9, fig. 3, 1853.

two figured specimens has convinced the writers, however, that the forms are inseparable specifically and that they have little in common with *Protacanthoceras*. The associates of *A.? kanabense* in Utah include "*Helicoceras*" *pariense* Stanton, *Baculites gracilis* Shumard, *Metoicoceras whitei* Hyatt (as *Buchiceras swallowi* Hyatt), and *Placenticeras* sp.[25] The associates listed by Moreman in Texas include *M. whitei*, *M. whitei* var. (as *M. swallowi* Shumard), *Scaphites* aff. *warreni* M. and H. (as *S. vermiformis* Meek), *Placenticeras pseudoplacenta* Hyatt, *Romaniceras* species (as *Acanthoceras* species), *Baculites gracilis* Shumard, *Inoceramus fragilis* Hall and Meek (as *I. labiatus* Schlotheim).

In the material from the Aspen shale a single external mold of the flank of an ammonite shows features so similar to those of *Acanthoceras? kanabense* that the writers have little doubt of their being congeneric though specifically distinct. To receive these two species the writers propose the genus *Kanabiceras* with *A.? kanabense* Stanton as genotype. The following characters may be noted:

Shell fairly stout; whorls somewhat depressed. Sculpture irregular, coarse, consisting of three rows of small, uneven nodes on the venter, the median row at places forming a rough keel; a row of rather distant, long marginal spines which appear to be hollow at the base and on the internal moulds appear as rounded or truncated, heavy, blunt nodes; between the marginal nodes faint uneven ribs; a row of uneven umbilical nodes. The suture only moderately dissected, with first lateral saddle narrow, first lateral lobe wide, bifid; other elements small.

The described characters of *Acanthoceras eschi* Solger[26] from the Mungo chalk of Kamerun, Africa, suggest strongly that it also may belong to *Kanabiceras*, but the writers prefer at this time to make this assignment only tentative.

KANABICERAS WYOMINGENSE, new species

Plate 1, Figure 14

Shell evidently stout-whorled, with relatively small umbilicus—about one-fifth the diameter; umbilical shoulder rounded. Aperture unknown. The type specimen shows a single whorl. There are six or seven blunt irregular nodes near the umbilicus, increasing much in height from the earlier to the later part. There would be 16 marginal nodes, if the complete margin were present, also increasing in height from the earlier to the later part, somewhat irregular, in part

[25] Stanton, T. W., U. S. Geol. Survey Bull. 106, p. 35.

[26] Solger, Friedrich, Die Fossilen der Mungokreide in Kamerun und ihre geologische Bedeutung, in Esch, Ernst, and others: Beiträge zur Geologie von Kamerun, pt. 2, p. 124, pl. 4, figs. 1–4, text fig. 21, 1904.

truncated. Poorly defined and irregular ribs show between the tubercles. Ventral part of shell unknown. Suture unknown.

This species is characterized by its small umbilicus and strong umbilical tubercles and differs in these characters from *Kanabiceras kanabense*. A specimen in hand from the Mowry shale of central Wyoming is very much like *K. wyomingense* and may be identical, though it is not as well preserved. The writers know of no other species which could well be brought into comparison here.

Holotype.—Cat. No. 73773, U.S.N.M.

Family ENGONOCERATIDAE Hyatt

Eight specimens of an engonoceratid ammonite are contained in the collection. The family Engonoceratidae Hyatt has been variously interpreted but is probably best viewed as containing the genera *Protengonoceras* Hyatt, 1903, *Engonoceras* Neumayr and Uhlig, 1881, *Hypengonoceras* Spath, 1922, *Parengonoceras* Spath, 1924, *Metengonoceras* Hyatt, 1903, and *Epengonoceras* Spath, 1924. At one time or another there have also been included, probably because of the possession of relatively simple, rounded saddles, *Neolobites* Fischer, *Hoplitoides* Von Koenen, *Indoceras* Noetling, *Sphenodiscus* Meek, and *Flickia* Pervinquière, but they would seem better placed in other families.

As thus constituted the family may be characterized as follows:

Shell much compressed, discoid, narrowly umbilicate. Venter truncated, though very narrow in several genera, becoming rounded in old age. Flanks smooth or with broad low falcate folds. Septa gently curved, not deeply incised, containing in the adult many lobes and saddles; lobes only moderately serrated, saddles often rounded, entire; ventral lobes short, simple, spreading, usually with pointed short, entire siphonal saddle.

The constituent genera may be briefly characterized as follows:

Protengonoceras Hyatt,[27] genotype *P. gabbi* (Böhm). Albian-?Turonian. Shell smooth except in late stages where folds appear. Venter concave, bordered by sharp, smooth ridges. Saddles usually very broad and short, lobes with few marginals.

Engonoceras Neumayr and Uhlig,[28] genotype *E. pierdenale* (Von Buch). Albian-?Cenomanian. Three distinct lines of nodes. Venter flat with nodose edges in earlier stages; broad, often with zigzag outline in later stages. Saddles deeper than in *Protengonoceras* and

[27] Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, p. 153, 1903.

[28] Neumayr, Melchior, and Uhlig, Victor, Cephalopoden der Hilsbildungen Norddeutschlands: Palaeontographica, vol. 27, p. 12, 1881.

Böhm, Johannes, Über *Ammonites pedernalis* Von Buch: Zeitschr. Deutsch. geol. Gesell., vol. 50, pp. 183–201, pls. 5–6, 1898.

more rounded; lobes with more and deeper marginals; principal saddles sometimes bifid.

Hypengonoceras Spath,[29] genotype *H. warthi* (Kossmatt).[30] Albian. Shell with low folds, elongate marginal nodes, alternating in position along the margins of the flattened venter. Ribs terminating at both ends in small tubercles (according to Stoliczka, but none shows in his figures). Suture relatively complex, with all saddles rounded, bifid and with smaller marginals suggested; lobes with numerous small, pointed marginals.

Parengonoceras Spath,[31] genotype *P. ebrayi* (De Loriol).[32] Albian. Shell with apparently smooth flanks in early stages and with venter truncated and bordered by elongated marginal tubercles; in later stages shows ribs and three rows of lateral nodes. Suture relatively complex, with saddles rounded, bifid, and dissected by many small marginals; lobes with many small blunt marginals.

Metengonoceras Hyatt, genotype *M. inscriptum* Hyatt.[33] Albian. Shell with broad folds in some species; very rarely faint nodes also; usually smooth. Venter in early stages comparatively broad and concave; later narrow but distinctly truncate; still later becomes first acute and then rounded (according to Hyatt, but see below). Suture much like that of some species of *Engonoceras* but rarely has divided saddles.

Epengonoceras Spath,[34] genotype *E. dumbli* (Cragin).[35] Cenomanian-Turonian. Shell with nearly smooth flanks, only low broad flolds showing on some shells; venter relatively broad, slightly concave in early stages, becoming narrow (1 to 2 millimeters) but still concave or flat in later stages, and in old age rounded. The sheli is not acute at any stage of growth, though the internal molds often are narrowly rounded (see below) in the adult stages and show no reflection of the truncation of the shell. Suture, in general, has the lobes more deeply dissected than in *Metengonoceras*, but the saddles are usually simple as in that genus.

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[29] Spath, L. F., On Cretaceous Ammonoidea from Angola: Roy. Soc. Edinburgh Trans., vol. 53, pt. 1, p. 112, 1922.

[30] Kossmatt, Franz, Untersuchungen über die südindische Kreideformation: Beltr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 9, p. 176, pl. 20, fig. 8, 1895. Stoliczka, Ferdinand, The fossil Cephalopoda of the Cretaceous rocks of southern India, Ammonitidae: Palaeontologia Indica, vol. 1, p. 92, pl. 48, fig. 2, 1865.

[31] Spath, L. F., On a new ammonite (*Engonoceras iris*, sp. n.) from the Gault of Folkstone: Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 508, 1924.

[32] De Loriol, P., Études sur la faune des couches du Gault de Cosne: Soc. paleont. Suisse Mém., vol. 9, p. 7, pl. 1, fig. 1, 1882.

[33] Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, pp. 179–182, pl. 25, figs. 5–9; pl. 26, figs. 1–4, 1903.

[34] Spath, L. F., On a new ammonite (*Engonoceras iris*, sp. n.) from the Gault of Folkstone: Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 508, 1924.

[35] Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, p. 185, pl. 27, figs. 3–14, 1903.

Four of the genera may be instantly excluded from consideration here, but *Metengonoceras* and *Epengonoceras* must be taken into account. The original description of *Metengonoceras* brought forth as its chief characteristic the sharpening of the venter in the middle stages of growth, preceded by a stage with truncated venter and succeeded by a final stage with rounded venter. *Epengonoceras* was separated by Spath for Cenomanian and Turonian species from *Metengonoceras* apparently in the main because of its younger age, for citation of Hyatt's figure and description of the Turonian species "*Metengonoceras*" *dumbli* (Cragin) Hyatt was the only characterization given. These fit in every respect the characterization of the typical Albian *Metengonoceras*. However, Hyatt's description of *dumbli* is in error in the important respect that the venter is not at any stage acute but retains a narrow truncation to a late stage and then becomes rounded. An examination of the specimen figured by Hyatt and cited by Spath is sufficient to convince that it is only the inner mold of the shell that is narrowly rounded, whereas the exterior of the shell itself was channeled or flat on the periphery. Hyatt interpreted a truncation of the latest part of the type preserved as due to injury to the shell, but it appears to the writers as a normal feature. The writers have in hand about a dozen other specimens from the Eagle Ford shale of Texas, which yielded the type, and these show the feature even better than Hyatt's specimen, for much more of the shell is retained, and some specimens even in the internal mold show a distinct ventral facet. The generic description given above is drawn up in accordance with these observations.

The writers have in hand also four specimens figured by Hyatt as *Metengonoceras inscriptum*, including the type of the species and genus, and one, the type, of *M. ambiguum*. All are more or less corroded and deformed, and there is no trace of the shell on any of them. It is not possible to say from these specimens whether the sharp venter of the middle stages is an accident of preservation or an original feature, nor whether the shell was flattened on the venter or sharp. The suggestion is very strong, however, that the shell of these Albian forms also had a narrow, flattened, or concave venter, even though the molds may have been more or less acute. In fact, the front view [36] of the type of *M. inscriptum* given by Hyatt is much restored and the specimen does not show any such straight, sharp ventral edge as his figure presents. On the contrary the venter is irregular, and one part lying between sharpened parts shows a distinct truncation, suggesting that the sharp parts are deformed and the flattened part normal. The writers feel that questions as to *Metengonoceras* must remain unsettled until some one is fortunate

[36] Hyatt, Alpheus, U. S. Geol. Survey Mon. 44, pl. 25, fig. 9.

enough to find good specimens. If it really has, as the writters suggest, a truncated venter the distinction from *Epengonoceras* is very tenuous.

In the meanwhile the writers have accepted *Epengonoceras* as distinct and have referred to it the specimens from the Aspen shale here in question. Spath placed in his genus, beside the genotype, *Sphenodiscus* cf. *pedernalis* (Von Buch) of Grossouvre[37] from the Cenomanian of St. Croix, later named *Metengonoceras douvillei* by Grossouvre.[38] Here probably belong also the Cenomanian form named by Grossouvre[39] *Metengonoceras arnaudi* and the Turonian *M. tolveiense*, both from France. Here would go also Hyatt's *M. acutum*[40] from the Eagle Ford shale of Texas. The range of the genus in Texas appears to be from beds containing true *Acanthoceras* and other Cenomanian forms up into beds containing Turonian species of *Metoicoceras* and other lower Turonian forms.

EPENGONOCERAS ASPENANUM, new species

Plate 1, Figure 15; Plate 2, Figures 2–5; Plate 3, Figures 5–7

This species is based on eight specimens, six of them flattened and somewhat distorted molds of the exterior, one a free fragment of a whorl, and the eighth, chosen as type, a flattened internal mold preserving the beginning of the living chamber and showing the sutures.

The shell was in all probability a much compressed disk as in other species of the genus, though the specimens in hand were so much flattened in preservation that it is not possible to compare the form with that of undistorted material from Texas and elsewhere. The venter of the type at about 40 millimeters diameter is 1.5 millimeters broad and flat with sharp margins; at 60 millimeters it is 1.75 millimeters broad and still flat; at 73 millimeters diameter, the maximum preserved, it is still evidently flattened but the distortion of the specimen makes a measurement valueless. The umbilicus is 5 millimeters wide at the diameter of 70 millimeters and as shown on several paratypes had a rounded shoulder and gently sloping inner wall. Living chamber and aperture not seen.

The surface of the shell, as shown in the type and plaster casts made from the paratypes, was nearly smooth. No nodes are shown and no folds, a few exaggerated growth lines of falcate form being the only ornament. The type and one of the paratypes bore an

[37] De Grossouvre, Albert, Les ammonites de la Craie supérieure: Carte géol. France Mém., Recherches sur la Craie supérieure, pt. 2, Paléontologie, p. 140, text fig. 58, 1894.

[38] De Grosseuvre, Albert, Le Crétacé da la Loire-Inférieure et de la Vendée: Soc. sci. nat. Ouest France Bull., ser. 3, vol. 2, pp. 34–35, pl. 3, fig. 2, text fig. 6, 1912.

[39] De Grossouvre, Albert, idem, pp. 35–37, pl. 3, fig. 4, text figs. 7–8, 1912.

[40] Hyatt, Alpheus, U. S. Geol. Survey Mon. 44, p. 184, pl. 26, fig. 8; pl. 27, figs. 1–2.

overgrowth of oysters, but these seem to have grown upon the shell and not upon an internal mold as in the case of some of the specimens of *Metengonoceras* studied by Hyatt.

The external suture has broad, rather flattened saddles with the first four indented by a tiny marginal lobe. The lobes, on the other hand, are relatively simple, more like those of Albian *Metengonoceras* than like those of *Epengonoceras dumbli.*

The characteristic features of the species in *Epengonoceras* lie largely in the sutures, for form and ornament are so nearly uniform that they offer little assistsance. *E. aspenanum* differs from other American forms in the greater width of the saddles, the small marginals dividing the first four saddles, and in the lesser dissection of the lobes—this is true with respect to species recorded from Texas and several unpublished specimens from the Mowry shale of Wyoming. From the French species noted above it may be separated also by the same features of the suture.

Holotype and paratypes.—Cat. No. 73774, U.S.N.M.

Family SCHLOENBACHIIDAE

Genus ACOMPSOCERAS Hyatt, 1903

Acompsoceras was proposed by Hyatt [41] to receive the genotype *Ammonites bochumensis* Schlüter,[42] *Ammonites essendiensis* Schlüter,[43] and *Ammonites rencvieri* Sharpe.[44] Pervinquière [45] included in the genus, besides the species named, *Ammonites sarthensis* Guéranger [46] (including *A. inconstans* Schlüter) [47] and proposed two varieties of *A. essendiensis.*, var. *nurhilense* and var. *madjeurense*, which perhaps are better named as independent species. Spath [48] separated from *Acompsoceras* as *Pseudacompsoceras* Schlüter's *Ammonites inconstans* and *Ammonites coupei* var. Sharpe [49] (not Brongniart), renaming the latter *vectense* and making it the genotype. The conspicuous differences between the genera seem to be in

[41] Hyatt, Alpheus, U. S. Geol. Survey Mon. 44, p. 111.

[42] Schlüter, Clemens, Cephalopoden der oberen deutschen Kreide: Palaeontographica, vol. 21, p. 1, pl. 1, figs. 1–4; pl. 2, fig. 1, 1871.

[43] Idem, p. 3, pl. 1, figs. 5–7; pl. 2, fig. 2.

[44] Sharpe, Daniel, Description of the fossil remains of Mollusca found in the chalk of England, part 1, Cephalopoda: Paleontographical Soc. Mon., p. 44, pl. 20, figs. 2 *a, b, c,* 1855.

[45] Pervinquière, Léon, Études de paléontologie tunisienne, pt. 1, Céphalopodes des terrains secondaires, pp. 303–308, pl. 17, 1907.

[46] Guéranger, E., Album palèontologique du département de la Sarthe (Le Mans), p. 5, pl. 4, fig. 1; pl. 8, fig. 2, 1867.

[47] Schlüter, Clemens, Paleontographica, vol. 21, p. 7, pl. 3, figs. 1–5.

[48] Spath, L. F., On upper Albian Ammonoidea from Portuguese East Africa, with an appendix on Upper Cretaceous ammonites from Maputoland: Annals Transvaal Mus., vol. 11, pt. 3, p. 197, 1925.

[49] Sharpe, Daniel, Paleontographical Soc. Mon., pl. 19, figs. 1 *a–c.*

the presence of several additional rows of nodes on the flanks of *Pseudacompsoceras* and greater curvature of the ribs.

Hyatt placed *Acompsoceras* in the family Mantelliceratidæ. Pervinquière placed it between *Acanthoceras* (*Sharpeiceras*) and *Mammites*, in his discussion suggesting that both *Acompsoceras* and *Mammites* were derived from *Acanthoceras*. Spath assigned both *Acompsoceras* and *Pseudacompsoceras* tentatively to the Schloenbachiidæ.

The genus may be characterized as follows:

Discoidal ammonites with moderately wide umbilicus; large, fold-like costae; marginal and umbilical rows of nodes; venter flattened or somewhat convex, bearing a raised line or "nascent keel." In later stages the flanks became smooth and the venter rounded, the nodes disappear. The external suture has five or six lobes and shows a curvature with the second lateral saddle high; saddles bifid, lobes bifid; siphonal lobe notably shorter than the first lateral lobe.

ACOMPSOCERAS AMERICANUM, new species

Plate 3, figures 1–4

This species is based on a single internal mold, a fragment constituting a little more than one-fourth whorl, accidentally compressed and somewhat distorted but preserving essential characters sufficiently well to deserve a definite assignment and a specific name.

Shell apparently a compressed disk; maximum diameter of type now remaining estimated at 75 millimeters, with part of living chamber preserved. Umbilical shoulder rounded; width of umbilicus not known, but evidently small. Aperture unknown.

Sculpture on septate part of the type consists of fairly sharp primary ribs forking to form low rounded secondary ribs, between which lie intercalated secondary ribs. All these end at the ventral margin in elongated transverse nodes. No umbilical nodes are visible on type. The unseptate part shows only faint growth lines. The ribs and growth lines are gently falcate. The venter was probably gently convex with a low but distinct raised line, rounded on the internal mold. The width of the venter at the maximum diameter of the type (estimated at 75 millimeters) is 9 millimeters, but it may have been reduced a little by the distortion of the shell.

The suture shows bifid lobes and saddles, moderately dissected, short siphonal lobe; first lateral saddle and first lateral lobe subequal in width; second lateral saddle high.

Acompsoceras americanum is characterized by its numerous ribs on the early part, its lack of distinct umbilical nodes, and the lesser dissection of the suture as compared with other species. From *A. bochumense* (Schlüter) it differs in its more numerous ribs, lack of

umbilical nodes, proportions of the suture, and stouter sutural elements, though the degree of dissection is nearly the same; from *A. essendiense* (Schlüter) also by its more numerous ribs and by its less dissected suture; from *A. renevieri* (Sharpe) by its more numerous ribs, shorter siphonal lobe, and stouter sutural elements; from *A. mrhilense* Pervinquière by its less rounded sutural elements and lack of umbilical nodes; from *A. madjeurense* Pervinquière by its coarser ribs, earlier loss of the ribs, and less rounded sutural elements.

This occurrence of *Acompsoceras* does not accord with the current assignment of the genus solely to the Cenomanian. The stratigraphic relations and the associated fossils argue for the lower Turonian age of the present fauna. It is the first record, so far as the writers are aware, of the genus in the United States.

Holotype.—Cat. No. 73775, U.S.N.M.

Family METOICOCERATIDAE Hyatt, 1903

Genus METOICOCERAS Hyatt, 1903

Metoicoceras was instituted by Hyatt [50] in 1903 with *Ammonites swallowi* Shumard [51] as the first species described under the genus and therefore usually considered the genotype. In addition Hyatt described as new *M. gibbosum*, *M. whitei*, and *M. acceleratum*. Hyatt also figured and named *M. kanabense* without description. The genotype species was recorded from the Turonian Eagle Ford shale of Texas, *gibbosum* from Texas, *whitei* from Texas and Utah, *acceleratum* from Texas, and *kanabense* from Utah.

Leriche [52] described *Metoicoceras pontieri* from the base of the Turonian in the north of France, and Grossouvre [53] described, as species of *Mammites*, *Metoicoceras pervinquieri*, *M. gourdoni*, *M. petraschecki*, *M. bureaui*, *M. dumasi*, and with these referred to *Mammites* (*Metoicoceras*) D'Orbigny's *Ammonites geslinianus*.[54] These are assigned to the lower Turonian of western France. Spath [55] later assigned the horizon of *M. pontieri* to the top of the Cenomanian.

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[50] Hyatt, Alpheus, U. S. Geol. Survey, Mon. 44, p. 116.

[51] Shumard, B. F., Descriptions of new Cretaceous fossils from Texas: Acad. Sci. St. Louis Trans., vol. 1, pp. 591–592, 1859.

[52] Leriche, Maurice, Sur la présence du genre *Metoicoceras* Hyatt dans la Craie du Nord de la France et sur une espèce nouvelle de ce genre (*Metoicoceras ponticri*): Soc. Géol. Nord (France) Annales, vol. 34, pp. 121–124, pl. 2, text figs. 1–3, 1905.

[53] De Grossouvre, Albert, Le Crétacé de la Loire- Inférieure et de la Vendée: Soc. sci. nat. Ouest France Bull., ser. 3, vol. 2, pp. 11–25, pls. 1–2, text figs. 1–2, 1912.

[54] D'Orbigny, Alcid, Paléontologie française, ser. 1, Terrain crétacé, vol. 1, p. 325, pl. 97, figs. 1–2, 1840; Prodrome de paléontologie, vol. 2, p. 146, 1850.

[55] Spath, L. F., On new ammonites from the English chalk: Geol. Mag., vol. 63, p. 80, 1926.

Böse [56] reported *Metoicoceras* as *M.* aff. *whitei* Hyatt and *M.* sp. nov. from beds in Coahuila, Mexico, which he assigned with some doubt to the upper Cenomanian. He also, as Grossouvre had done, assigned *Ammonites geslinianus*, particularly as figured by Petrascheck (*Pulchellia geslinianа*), to *Metoicoceras.*

Reagan [57] described *Metoicoceras wyomingense* from the "Colorado series of the Salt Creek region (Big Horn), Wyoming." It is said to have a broad umbilicus with indefinite shoulders; flattened venter bordered by low, elongated nodes; obscure ribs; no nodes on outer part of flank. The sutures are very ornate for *Metoicoceras* and have two or at most three lateral lobes instead of four or five. The writers doubt that this species belongs to the genus in question, though it is hazardous to make any final judgment on figures only.

Moreman [58] described *Metoicoceras irwini* and figured also *M. whitei* Hyatt, *M. swallowi* (=*M. whitei* variety), and *M. gibbosum* Hyatt, all from the Eagle Ford shale of north Texas.

Metoicoceras may be considered to include ammonites with more or less compressed shells. Umbilicus small, with or without umbilical nodes; ribs near umbilicus may be nearly obsolete if there are no umbilical nodes, or strong, rounded if there are. Ribs somewhat flexed to nearly straight, usually forking on the flank; intercalated secondary ribs common. Outer part of flank usually bears distinct ribs and a row of nodes which forms the inner margin of a ventro-lateral facet. Venter bordered by two rows of elongated nodes and in the earlier stages concave or flattened. In late stages the nodes decrease in prominence, the venter becomes rounded, and the ribs pass across as coarse rounded folds. Living chamber usually scaphitoid in large individuals. Suture relatively simple, ceratitic, consisting of three principal lobes, two principal saddles, all more or less clearly bifid, and a few small auxiliaries.

It may be of interest to characterize briefly the recorded species of *Metoicoceras.*

gibbosum. Whorl relatively stout; umbilicus small, one-eighth the diameter; umbilical nodes weak or lacking; ribs weak on inner part of flank, strong and rather coarse on outer part, ending in moderately strong nodes; ventro-lateral facet well defined, marginal nodes relatively high; suture with saddles indented by numerous small marginal lobes.

swallowi. Whorl not much compressed; umbilical nodes strong, subconical; umbilicus relatively wide, one-fourth the diameter; ribs

[56] Böse, Emil, On a new ammonite fauna of the lower Turonian of Mexico: Texas Univ. Bull. 1856, p. 203, pl. 12, figs. 1–4, 7, 1920.

[57] Reagan, A. B., Cretacic Mollusca of Pacific Slope: Pan-American Geologist, vol. 41, p. 181, pl. 19, figs. 1–2, 1924.

[58] Moreman, W. L., Journ. Paleontology, vol. 1, pp. 92–96, pl. 13, figs. 3, 4; pl. 14, fig. 4; pl. 15, figs. 1, 3, 1927.

strong, ending in strong nodes; ventro-lateral facet well defined; marginal nodes blunt and heavy, becoming later high and sharp; suture with very simple saddles.

whitei. Whorl somewhat compressed; umbilicus small, one-tenth the diameter; umbilical nodes weak, elongated radially; ribs only moderately strong, ending in moderately strong nodes; ventro-lateral facet fairly well defined; marginal nodes only moderately high; suture with saddles indented by numerous small marginal lobes.

"*whitei*" (Kanab, Utah). Whorl somewhat compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking at all stages; ribs very weak or inner part of flank, becoming stronger towards the periphery and ending in weak nodes; ventro-lateral facet poorly defined; marginal nodes only moderately high; suture with saddles indented by numerous small marginal lobes.

kanabense. (Known only by very small shells.) Whorl much compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking; ribs weak on umbilical part of flank but visible, becoming stronger towards the periphery and ending in weak nodes; ventro-lateral facet poorly defined; marginal nodes moderately high; suture with saddles indented by numerous small marginal lobes.

irwini. Whorl much compressed; umbilicus small, one-eighth the diameter; umbilical nodes lacking at all stages; ribs lacking on inner part of flank and weak on outer part, ending in obscure nodes; ventro-lateral facet not defined; marginal nodes relatively low; suture with saddles indented by numerous small marginal lobes.

acceleratum. (Known only by very small shells.) Whorl not much compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking; ribs weak on inner part of flank, becoming stronger on outer part and ending in fairly strong nodes; ventro-lateral facet well defined; marginal nodes apparently blunt, connected by ribs which are not depressed; suture with saddles indented by numerous marginal lobes.

pontieri. Whorls compressed; umbilicus small, one-tenth the diameter; umbilical nodes lacking; ribs very weak near umbilicus, stronger on outer part of flank, ending in very weak nodes; ventro-lateral facet obscure; marginal nodes low; suture seems to have saddles with small marginal lobes.

dumasi. Whorls not much compressed; umbilicus small, one-eighth the diameter; umbilical nodes lacking; ribs weak on inner part of flank, stronger on outer part, ending in weak nodes; ventro-lateral facet fairly well defined; marginal tubercles low but distinct; suture with saddles divided by small marginal lobes.

petraschecki. Whorl not much compressed; umbilicus moderately wide, one-sixth the diameter; umbilical nodes fairly strong, few in number; ribs fairly strong, ending in moderately strong nodes;

ventrolateral facet well defined; marginal nodes not shown nor described in original publication; suture not shown.

gourdoni. Whorl not much compressed; umbilicus fairly wide, one-fifth the diameter; umbilical nodes strong, few in number; ribs moderately strong, ending in moderately strong nodes; ventrolateral facet well defined; marginal nodes strong; suture apparently with saddles indented by small marginal lobes.

bureaui. Whorl much compressed; umbilicus small, one-eighth the diameter; umbilical nodes lacking; ribs weak on inner part of flank, stronger on outer part, but terminal nodes obscure; ventrolateral facet obscure; marginal nodes low; suture not shown.

geslinianum. Whorl very much compressed; umbilicus relatively wide, one-fourth the diameter; umbilical nodes weak; ribs fairly strong, but no terminal nodes and no ventrolateral facet; marginal nodes low; suture not shown.

pervinquierei. Width of whorls not shown; umbilicus fairly wide, one-fifth the diameter; umbilical nodes few but stout, prominent; ribs moderately strong, ending in weak nodes; ventrolateral facet obscure; marginal nodes fairly strong; suture with saddles indented by numerous small marginal lobes.

METOICOCERAS WHITEI Hyatt

Plate 3, Figure 8; Plate 4, Figures 1–7

1903. *Metoicoceras whitei* (part) Hyatt, U. S. Geol. Survey Mon. 44 p. 122, pl. 14, figs. 1–9, 15 (not pl. 13, figs. 3–5; pl. 14, fig. 10).

1930. *Metoecoceras* aff. *whitei* Hyatt, Böse, Texas Univ. Bull. 1856, p. 203, pl. 12, figs. 4, 7.

1927. *Metoicoceras whitei* Hyatt, Moreman, Journ. Paleontology, vol. 1, p. 92, pl. 13, figs. 3–4.

1928. *Metoicoceras whitei* Hyatt, Adkins, Texas Univ. Bull. 2838, p. 249.

It is the writers' belief that in the species *whitei* as originally defined two forms were included, one represented by the specimens from Kanab Valley, Utah, figured by Hyatt, and those from Utah previously called *Buchiceras swallowi*[59]; the other, the typical *whitei*, by the material figured by Hyatt, apparently from Texas. The doubt as to the latter is introduced by the fact that Hyatt, in the description of his figure, assigns the type specimen to Texas and on page 127 of his paper assigns it to Utah.[60] Inasmuch as C. A. White's *Buchiceras swallowi* was referred to the species and the name was intended to honor Doctor White, it seems possible that Hyatt's type may have come from Utah. However, at the present time one can only accept the plate description as correct, all the more

[59] White, C. A., Report upon the invertebrate fossils collected in portions of Nevada, Utah, Colorado, New Mexico, and Arizona: U. S. Geog. Surveys W. 100th Mer. Rept., vol. 4, pt. 1, p. 202, pl. 20, fig. 1, 1876; Stanton, T. W., The Colorado formation and its invertebrate fauna: U. S. Geol. Survey Bull. 106, p. 168, pl. 37, fig. 1; pl. 38, figs. 1–3, 1893.

[60] A discrepancy present in the original manuscript and not introduced in the editing of this nosthumous publication.

as Texan specimens in full agreement with it are abundant. Brief characterizations of the two forms included under *whitei* are given above.

Eight more or less fragmentary molds of the exterior of a species of *Metoicoceras* are here referred to *M. whitei* Hyatt, s. s. The sutures are entirely unknown and the form must be in part inferred because of accidental compression during fossilization. Nevertheless the ornamentation is sufficiently in agreement to warrant the assignment. The ventrolateral facet is not well shown on some of the specimens, but this feature is probably a result of the manner of preservation.

Metoicoceras whitei (in the broad sense) is known at various localities in the Mowry shale of central and eastern Wyoming, the Greenhorn limestone of the Great Plains region and Black Hills, the Mosby sandstone member of the Warm Creek shale of Wyoming, the basal part of the Colorado group of Utah and New Mexico, usually in all these formations in association with *Inoceramus labiatus* Schlotheim and unquestionably of lower Turonian age.

Plesiotypes.—Cat. Nos. 73776, 73777, U.S.N.M.

METOICOCERAS species

Plate 2, Figure 1

A single mold of the exterior of the shell of a small *Metoicoceras* differs from accompanying *M. whitei* in its feeble sculpture and in the development of elongated riblike prominences near the middle of the flank of the outer whorl. This feature does not accord with any described species of *Metoicoceras*, but the writers do not venture to assign a name to the form without more adequate material.

Cat. No. 73778, U.S.N.M.

EXPLANATION OF PLATES

Except for plate 2, Figure 1, and plate 4, Figures 3, 4, and 7, all specimens shown are from the Aspen shale, 80 feet below the top, in the NW.¼ of sec. 32, T. 21 N., R. 115 W., Lincoln County, Wyo. The excepted specimens are from the Aspen shale, 350 feet below the top, in sec. 17, T. 16 N., R. 117 W., Uinta County, Wyo. All figures are natural size except where enlargement is indicated.

PLATE 1

Page

FIGURE 1. *Periplomya? aspenana* Reeside and Weymouth, new species, the holotype, a natural cast of the exterior, U.S.N.M. Cat. No. 73765-- 7

FIGURES 2, 3. *Anomia* species, two plaster casts from natural molds of the exterior. U.S.N.M. Cat. No. 73764---------- 7

FIGURE 4. *Tellina?* species, view (× 2) of a natural mold of the interior retaining part of the shell. U.S.N.M. Cat. No. 73770---------- 10

FIGURE 5. *Pteria* (*Oxytoma*) species, view (× 5) of a wax squeeze from a natural mold of the exterior. U.S.N.M. Cat. No. 73763---------- 6

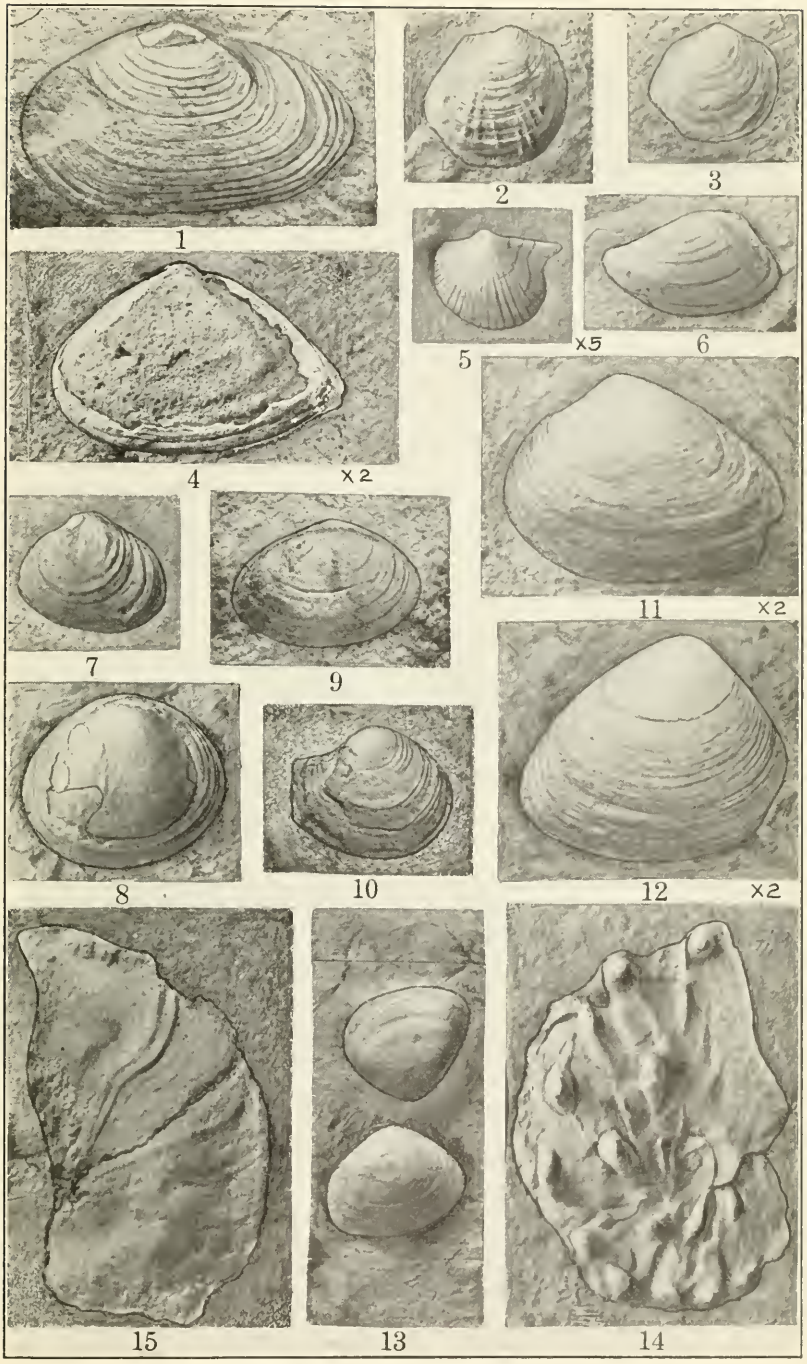
FIGURE 6. *Tancredia? lincolniana* Reeside and Weymouth, new species, plaster cast from the holotype, a natural mold of the exterior. U.S.N.M. Cat. No. 73767---------- 8

PLATE 2

PLATE 3

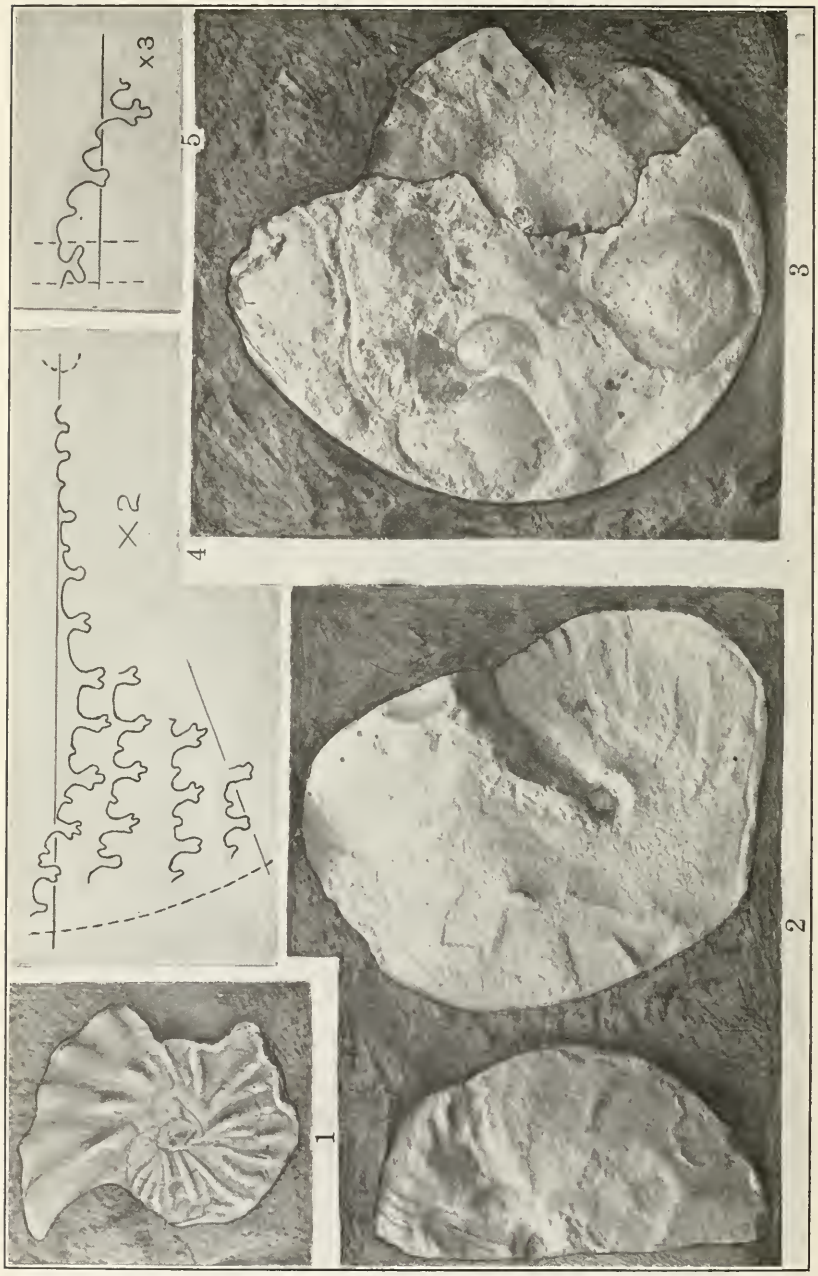
PLATE 4

U. S. GOVERNMENT PRINTING OFFICE: 1931



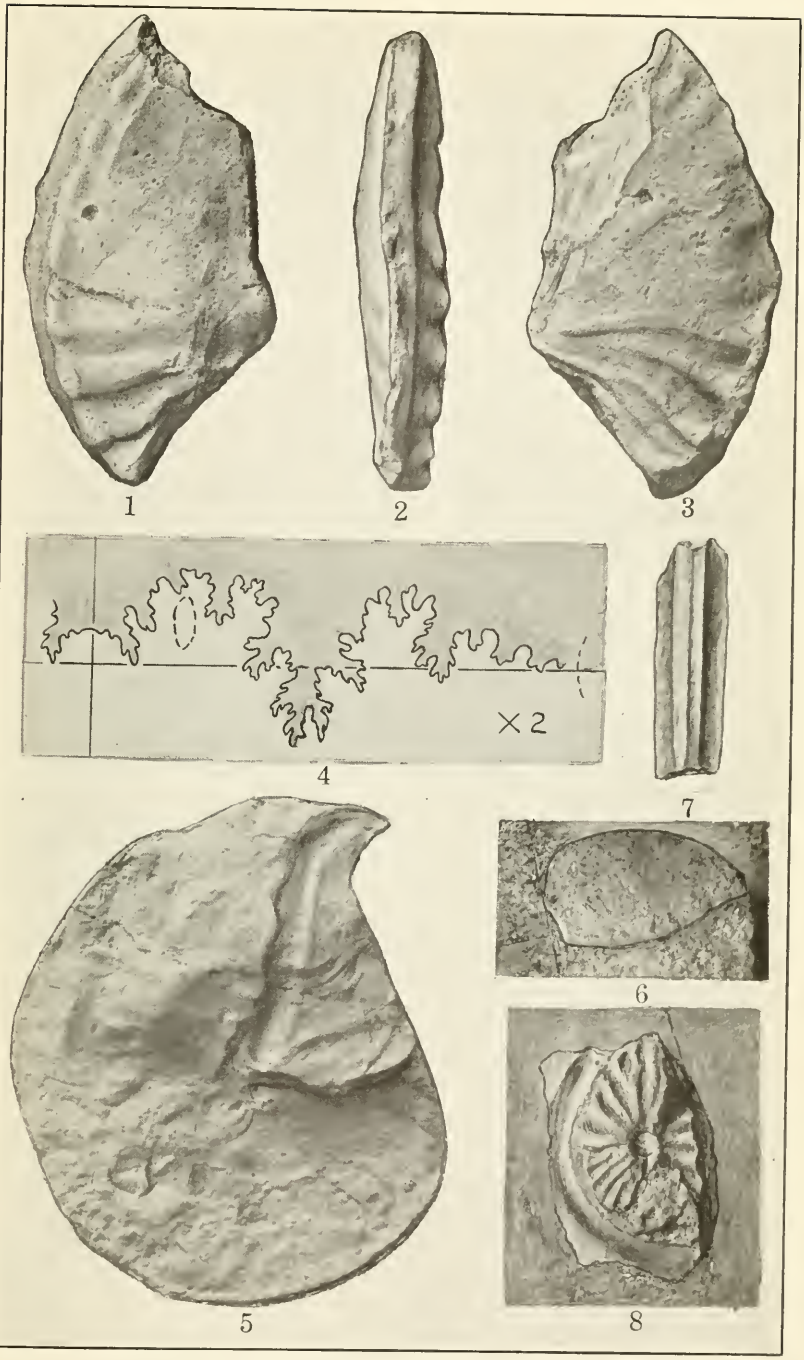
MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGES 23 AND 24



MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGE 24.



MOLLUSKS FROM THE ASPEN SHALE

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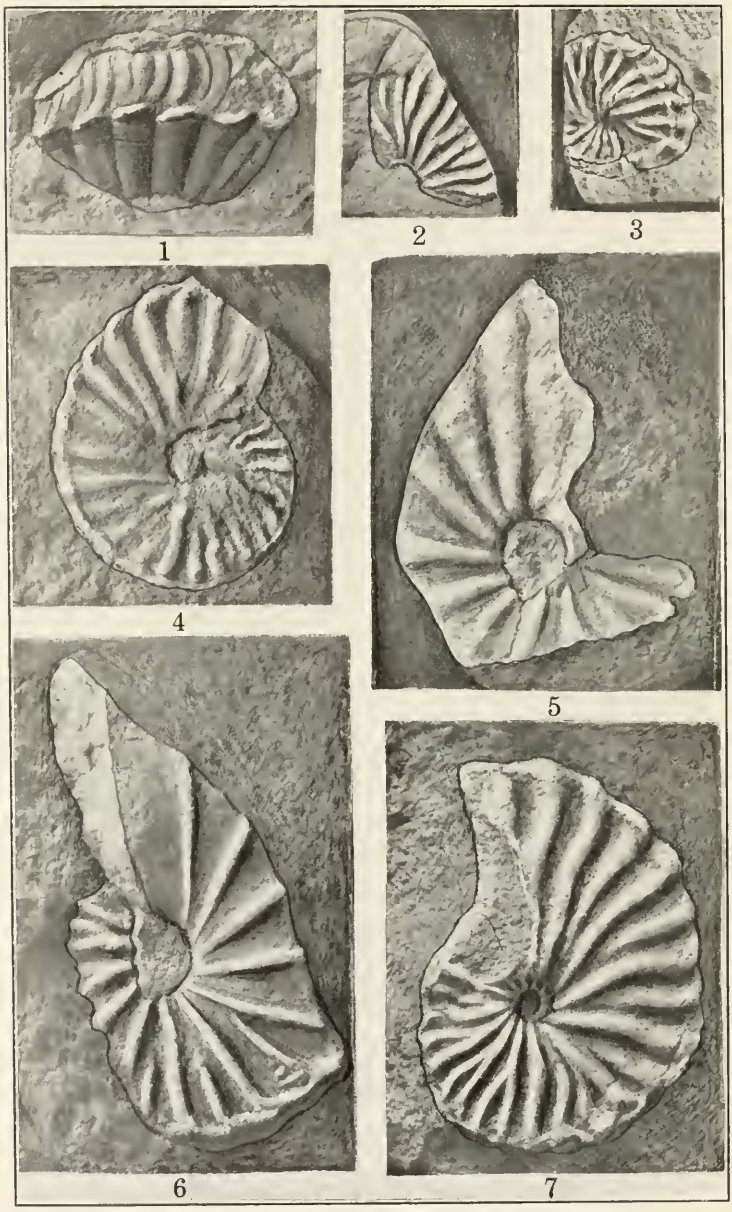

MOLLUSKS FROM THE ASPEN SHALE

FOR EXPLANATION OF PLATE SEE PAGE 24.