

Article XXIII. — REMARKS ON AND DESCRIPTIONS OF
JURASSIC FOSSILS OF THE BLACK HILLS.

By R. P. WHITFIELD and E. O. HOVEY.

PLATES XLII—LXII.

The fossils described in this article are all from American Jurassic rocks, a geological horizon but little known in this country, and one that has received but little attention until within a comparatively short time. About 1855 Prof. Jules Marcou mentioned the occurrence of Jurassic rocks along the line of the Rocky Mountains, through the central portion of the United States. Previous writers had mentioned doubtfully the occurrence of Jurassic fossils at various places. In 1864 Messrs. Meek and Hayden published the first undoubted forms of this age in their 'Palæontology of the Upper Missouri,' in the Smithsonian Contributions, and later Mr. Meek figured several species of Jurassic age in Volume II of the Fortieth Parallel Survey. Still later, in Newton and Jenney's report on the 'Resources of the Black Hills of Dakota,' a still larger number of Jurassic forms are given. Up to this time very few collections of Jurassic forms were known. Field parties occasionally brought in from their explorations a few specimens that were referable to this group of rocks, and the American Museum of Natural History had received from such sources some twenty-five or thirty specimens, embracing perhaps a dozen species, illustrating this formation in its extensive collections.

In the spring of 1891, the Museum sent Dr. E. O. Hovey into the Black Hills of Dakota especially to collect from this group, this being thought to be the most favorable locality known; and the fossils figured and described in this paper are the direct results of that expedition.

Pentacrinus astericus M. & H.

PLATE XLII, FIGS. 1-3.

Among the Crinoidal remains brought with the Black Hills fossils are several specimens of *Pentacrinus asteriscus* Meek & Hayden that show rather more of this organism than any hitherto obtained. On Plate XLII there are given three figures, by photography, of some of these specimens. Figure 1 of the plate is of natural size, and shows a fragment of column, badly weathered and worn, retaining at

the top some of the calyx plates and bases of three of the arms, and along the sides of the stem are shown parts of the fimbria usually present on the columns of this genus of Crinoids; while the rock in which it is preserved is largely composed of the broken up remains of this species.

Figure 2 of the same plate, enlarged to two diameters, shows another specimen which preserves the column with the fimbria and one side of the calyx and bases of three of the arms to the first bifurcating plate, or to the third radial, of each of three arms to this point. The subradials, alternating with the first radials, are minute, but appear as bulbous protuberances at the top of the column between the first radials. The column is small and pentangular in the upper part, with the fimbriations at irregular distances, but near the head the sides of the column show punctations at the junction of each disc, as if for attachment of fimbria.

Figure 3 is also enlarged to two diameters, and was photographed sideways, thinking to bring into better relief the lower plates of the body. The base of the calyx is gone, but the cuneiform plates of three rays are seen and parts of the arms of these rays, but beyond the arm plates all the parts are so obscured and indistinct that but little can be said about them. The arms appear to have been rounded on the back, and show no particular sculpturing. The fimbria of the column are also round and are composed of rather short joints. The column discs as found on the surface of the rocks are very variable, some showing a simple pentagon, while others are sharply stellate with deeply reëntering angles, and with all grades of form between. Meek's figure given on Plate III of *Palæont. of the Upper Missouri* gives a very fair general expression of their appearance, although the stems, seen imbedded in the rock, are mostly plainly pentagonal with flat sides. The woodcut on p. 67 of the same work also shows well the general features of most of the specimens observed.

Mr. Meek seems to have had doubts as to whether this species from the Black Hills was really distinct from *P. scalaris* of Goldfuss. We have in our collection fine specimens of *P. briarius* and *P. subangularis* with stem attached. We have also stems and stem discs of *P. bavaricus* Winkler; *P. cingulatus* Munster; *P. scalaris*, and *P. pentagonalis* Goldfuss, but it would be very difficult or impossible to confound this American species with any of these without too great a stretch of probability.

Meek's specimens are said to have come from Red Buttes and North Platte River, southwest base of the Black Hills. The specimens

in the Museum collection are from near Elkhorn, S. D., and from Red-water Creek, near Sundance, Black Hills Jurassic formation.

***Ophiocten* (?) *bellefourchensis* n. sp.**

PLATE XLII, FIG. 4.

Several specimens of an Ophiurian occur in the collection of Jurassic fossils from the Black Hills. They are imbedded in a sandy limestone and are extremely imperfect and unmanageable, and are referred with much doubt to any established genus.

The body is discoid, that of the largest individual being thirteen mm. in diameter. It seems to be composed of minute plates, apparently squamose in structure and arrangement, although from the fact that all are imbedded disc down, the arrangement is impossible to determine satisfactorily. The arms at their insertion on the underside of the disc on each side are bordered by a single large lateral plate (lateral shield of authors), and at the base of the arm the usual forked or Y-shaped plate, composed of two or possibly three elements, is seen, and between the posterior arms, or opposite the anterior arm, occurs a rather large oval madreporite. The arms on the ventral surface are composed of a central narrow groove, when not worn, with marginal plates which are spine bearing. These lateral plates appear to be composed of several elements, the number and form not being determinable. The arms have been proportionally long, rather robust in their median portion, but more slender near the disc and at their origin. The anterior arm, or that opposite the madreporite, in the larger individual, has been fully four centimeters long, measuring from the central opening.

Locality.—These specimens are all from a sandy limestone occurring in Belle Fourche Valley, Wyo. Collected by Dr. E. O. Hovey.

The species is an attractive form, but all four of the specimens are so weather-worn that it is difficult to obtain from them enough positive features to characterize the species. There is but slight chance of its generic characters being identical with those of *Ophiocten*; we therefore propose for it the provisional name ***Ophioaster***.

***Cidaris bellefourchensis* n. sp.**

PLATE XLII, FIG. 5.

There are two distinct forms of Cidaroid spines associated in the same locality with the *Ophiocten* and *Pentacrinus* stems, but which are probably only those of a single species of Echinoderm. One of

these is figured on Plate XLII, Fig. 5, and is probably a primary spine. The shaft is cylindrical and longitudinally ridged and when entire was about 5 cm. in length. The head of the spine below the collar rapidly tapers to the articulation, which is perforated, and the collar has apparently been crenulated. The shaft is contracted above the head and then gradually swells to about one third of its present length, which would be one fourth of its original length, above which point it gently tapers throughout its length. The shaft is marked by about fifteen raised granulated ridges on which the granules or tubercles are closely arranged. The second specimen is much smaller, but presents similar features, only reduced in strength corresponding to its dimensions. A third spine occurs in the collection, but it is small and very finely but deeply striated longitudinally, and most likely belonged to a distinct Echinoderm.

Locality.—In sandy limestone, Belle Fourche Valley, Black Hills, Wyo. Collected by E. O. Hovey.

Pinna jurassica n. sp.

PLATE XLIV and PLATE XLV, Fig. 1.

Shell of medium size, elongate triangular, very gradually and regularly widening throughout its length, the dorsal and basal margins being quite straight. The largest specimen of the species is a trifle over five inches in length by one and three fourths inches at the outer end in its flattened condition. The species belongs to the group of true *Pinnae*, those having a median sulcus, and not to the *Atrina* group. In this particular species the median sulcus is quite a prominent feature, and by it each valve is sharply divided into two sections. This median sulcus would appear, from the specimens, which are largely in the shape of internal casts, to have been closed at the beak end, and for some distance beyond (quite variable in different individuals), then to have been open to the posterior end, as if the shell had been absolutely divided into four parts instead of into only two valves. So strongly is this the case that the fracturing of the limestone is very distinctly shown between the two sections of the valve through the median sulcus.

Cardinal division of the shell distinctly marked by from seven to nine longitudinal ridges which become rather faint on the larger part of the shell, and on the lower side by three or four ridges, situated below the sulcus, also by concentric furrows indicating the outline of the valve, which are prolonged at the cardinal margin and broadly rounded backwards below.

There is no species of *Pinna* that can be readily confounded with this one, as the strongly marked median sulcus will easily distinguish it. The species seemed to have been exceedingly abundant, as the particular layer of limestone in which it occurs is quite well filled

with the shells, as may be seen in the group figured on Plate XLIV.

Locality. — Red Cañon, S. D., Black Hills. E. O. Hovey, collector. In October, 1897, Dr. Wortman, at that time of the Museum, brought specimens of this species from Freezeout, Albany Co., Wyo.

***Modiola jurassica* n. sp.**

PLATE XLV, FIGS. 3 and 4.

Shell above medium size for the genus, very transverse, but decidedly modioloid in character. Beaks small, enrolled, and situated back a little distance from the anterior end, slightly angular on the umbo, the angulation continuing backwards forming a prominent ridge along the umbonal region for nearly one third of the length of the shell, where it becomes rounded and lost in the general prominence of the valve. A distinct oblique sulcus crosses the valves from the beaks to the basal margin just in front of the umbonal prominence. Hinge line straight, highest behind; from which point the posterior end is obliquely rounded and prolonged below the middle. Basal margin broadly emarginate just behind the middle by the mesial sulcus which crosses the valves. Anterior end full and prominent. Surface marked only by concentric lines of growth.

Somewhat resembles *Modiola (Volsella) formosa* M. & H., figured and described in Palæont. Up. Missouri, pages 86 and 87, figures A and B, but differs in the length of the hinge line, in the greater length and prominence of the anterior end, and in being destitute of surface striæ.

Locality. — Lookout Peak, Spearfish, Black Hills, S. D. Collected by E. O. Hovey.

***Modiolarca jurassica* n. sp.**

PLATE XLV, FIG. 2.

Shell very small, measuring 13 mm. in extreme length, very ventricose, modioliform, much higher behind than in front. Beaks situated almost anterior, proportionally large, inflated, but distinctly sulcated by an oblique sulcus which crosses the valve to the basal margin which it decidedly modifies. Surface marked by concentric undulations only, which are strongest behind the very prominent umbonal ridge.

Locality. — Belle Fourche Valley, 1½ miles northeast of Devil's Tower, Black Hills, in white limestone of the Jurassic formation. Collected by E. O. Hovey.

***Septifera sturgisensis* n. sp.**

Shell small, decidedly mytiliform, very acute and a little more than twice as long as the greatest width. Beak sharp, byssal side straight or only slightly concave for nearly its entire length. Hinge line quite short, less than the width of the shell below; base sharply rounded; posterior margin broadly curved

giving to the form of the valve a greater width at the lower fourth than above. Buccal area below the beak swollen on the anterior side. Surface of the shell sharply ridged along the center from the beak to quite near the base. Surface concentrically marked with strong undulating lines of growth. Only right valves are known.

On breaking the rock under the beak the internal plate or septum was seen to extend about one twelfth of an inch from the beak on a specimen 23 mm. long from beak to base.

This shell quite closely resembles *Mytilus whitei* Whitfield, described in Newton and Jenney's Report of the Resources of the Black Hills of Dakota, p. 360, plate v, figs. 9-12, but the hinge line is so much shorter, and the shell so greatly narrowed above, that it can hardly be mistaken.

Locality.—Found $2\frac{1}{2}$ miles northwest of Sturgis, S. D., and at Red-water Creek, Sundance. Collected by E. O. Hovey.

***Astarte dacotensis* n. sp.**

PLATE XLV, FIG. 5-7, and PLATE XLVI.

Shell small, circular, ventricose, nearly equilateral. Beak only slightly prominent, not protruding, directed slightly forward. Lunule distinct and well marked; escutcheon also quite distinct but narrow. Surface of the shell marked by strong, rather deep, simple concentric furrows and ridges parallel to the outer border of the shell, those near the beak being more closely arranged and gradually becoming more distant toward the border. On a full grown shell measuring 2 cm. in height from beak to base the ridges count eight in the space of 1 cm. near the middle of the height. Other and finer concentric lines are seen marking the surface when examined under a magnifier.

On internal casts the adductor muscular scars are seen to be rather large and prominent, situated considerably above the middle of the valve. The outline of the shells of the species varies but little in different individuals, and the ventricosity of the valves is rather uniform.

Localities.—Specimens have been found at Spring Creek, Pennington Co., S. D., at Red Cañon, and several other localities. The species also occurs, but without locality mark, among Jurassic fossils in the Cope collection, and specimens were also brought in from Freezeout, Albany Co., Wyo., by Dr. Wortman's party. The fine block figured on Plate XLVI is from Red Cañon, S. D., and was collected by E. O. Hovey.

***Trigonia sturgisensis* n. sp.**

PLATE XLVII and PLATE XLVIII, FIGS. 1-3 and 7.

There are two distinct forms of *Trigonia* in the Black Hills material, both of which seem to be undescribed. One of these, the one placed

under the above heading, occurs at three different localities, and each in a different matrix, which gives them a somewhat different appearance one from the other. Still I am inclined to consider them as belonging to the one species.

The one form, that from $2\frac{1}{2}$ miles northwest of Sturgis, S. D., as represented on Plate XLVII and on Plate XLVIII, Fig. 7, consists entirely of internal casts, and is preserved in a soft sandy rock, much weathered and consequently shows but faintly any of the actual surface markings. They are generally of a decidedly ovate outline, largest anteriorly, measuring about 6 x 4.5 cm. and rather more than moderately convex, while on some of them there remains a fairly well defined umbonal ridge, extending from the beaks backward to the posterior angle, with moderately well defined concentric markings on most of them. Besides this, there are a number of strong, moderately distant, short plicæ crossing the disc of the valve from the position of the umbonal angle, obliquely backwards, across a rather faintly marked sulcus, just below the umbonal ridge and uniting with the concentric undulations where meeting them, forming thereby a system of acute V-shaped angles, which thus mark the body of the valves. These V-shaped figures have extended up to, and onto the beaks, each one becoming shorter than the one below. The posterior slope, above the umbonal ridge, seems to have been marked only by concentric undulations.

The second form, that from the second locality, which is Belle Fourche Valley, 2 miles northeast of Mato Teepee, or Devil's Tower, Wyo., is much smaller than the above, seldom exceeding that of Fig. 3, of Plate XLVIII. They are similar in form and surface markings, and on them the V-shaped sculpturing is quite strongly shown on the umbo, as well as near the posterior basal angle, and along the basal margin of the valves the concentric undulations are distinct. On the specimen shown in Fig. 3, just mentioned, there are some faint indications of fine radiating striæ traversing the cardinal slope. But these are quite problematical.

Those from the third locality, which is Belle Fourche Valley, 3 miles north of Hulet, Wyo., and 75 feet above the base of the Jurassic, or about 50 feet above the bed in which the second form occurs, are also in an entirely different kind of deposit. Still in size and all specific features, these two are alike, scarcely differing from the Sturgis specimen except in size and strength of surface markings.

Considering these circumstances and that the three localities differ but little in the elevation of the strata in which they occur above the

base of the Jurassic bed in the Black Hills it is considered unwise to separate the three forms specifically.

All the examples were collected by E. O. Hovey.

***Trigonia poststriata* n. sp.**

PLATE XLVIII, FIGS. 4-6.

Shell much below medium size for the genus, depressed convex, decidedly angular along the umbonal ridge, almost sharply so, posterior cardinal slope slightly concave, while the disc of the valves is gently and evenly convex from beak to the basal border, and from the umbonal ridge to the anterior end of the shell. General form of the outline of the shell quadrate, with the anterior end rounded. Hinge line about one half the length of the shell, posterior end obliquely truncate, longest at the postero-basal angle, where the sharply angular posterior ridge strikes the basal and posterior margins. Basal line gently and evenly curved. Beaks small, pointed, situated rather behind the anterior third of the shell's length.

Besides the fine striæ of the postero-cardinal slope, the anterior end of the valves is marked by what might be called pseudo-concentric lines, lines that are not concentric but which are connected and coincident with the concentric undulations of the surface, but which are deflected from the concentric lines and pass off downward and outward to the anterior margin, instead of to the cardinal margin. These lines are somewhat coarser than the true concentric undulations, and extend over about the anterior third of the valves.

The surface sculpturing of this shell is peculiar and will serve to distinguish it from all other known species of the genus.

Locality.—In sandy shales of Jurassic age, in the Belle Fourche Valley, 4 miles southwest of Hulet, Wyo. Collected by E. O. Hovey.

***Tancredia transversa* n. sp.**

PLATE XLIX, FIGS. 1 and 2.

Shell of medium size or larger, very transverse, narrowly elliptical. Beak subcentral, or a very little anterior to the center, apparently pointed backwards from the deeper excavation just posterior to its position, but really directed toward the anterior end. Shell smooth except for faint concentric lines parallel to the margin of the shell. Shell substance quite thick and usually crystalline when preserved in a limestone matrix.

Resembles *Tancredia inornata* Meek—*Astarte inornata* M. & H., Pal. Up. Missouri, p. 94, pl. iii, fig. 12. See also, Pal. Black Hills, Whitf., pl. vi, figs. 9-13, of which the specimen represented by fig. 11 is probably not correctly identified, and should very possibly be referred to the present form, which is much more transverse and narrower than *T. inornata*, with the beaks less prominent and more nearly central.

Locality. — Occurs in a limestone matrix with *Comptonectes bellistriata* M. & H. and *Ostrea strigillecula*, $2\frac{1}{2}$ miles southwest from Sturgis, S. D.

Quenstedtia planulata n. sp.

PLATE XLVIII, FIG. 11.

Shell depressed convex, transversely ovate, tellinaform. Beaks small appressed, projecting but little above the line of the hinge and situated slightly in front of the middle of the length of the shell. From the beak the anterior cardinal margin of the shell is broadly rounded to the anterior end, thence more narrowly rounded to the base, which is gently curved and arched to the posterior umbonal angle, above which the posterior margin is rather narrow and obliquely receding to the posterior hinge line. The posterior hinge line gently declines and is straight from the beaks to the end of the shell, and the edge of the shell is abruptly inflected, forming a narrow escutcheon for the entire length of the hinge behind the beak. The umbonal angle from the beak to the posterior basal angle is at first sharply defined, becoming less distinct toward the end of the shell. Body of the shell marked by distinct irregular concentric lines of growth, and the posterior cardinal slope is gently concave.

There is no American shell below the Tertiary that can well be confounded with this one. It is decidedly *Psammobia*-like in its general aspect. The figured specimen is in a light-colored Jurassic sandstone from north of Crow Peak, S. D. A second one, more poorly preserved, is from Belle Fourche Valley, 4 miles southwest of Hulet, Wyo. Collected by E. O. Hovey.

Pleuromya ? concentrica n. sp.

PLATE XLVIII, FIGS. 8 and 9.

Shell of medium size, oval or ovate in outline, moderately convex. Beaks rather large, somewhat prominent, situated rather more than a third of the length from the anterior end. Anterior end pointed or sharply rounded, longest below the middle; posterior end more broadly rounded, longest above the middle. Basal margin strongly arched. Surface of valves marked by strong concentric undulations, parallel to the margin of the shell, of which about five will occupy the space of half an inch on the center of the valve below the middle of its height. The shell, much of which is preserved on the best specimen, has been very thin and the surface apparently smooth, except for the concentric undulations.

The second specimen, which is entirely an internal cast and somewhat vertically compressed, shows strong anterior muscular scars, but all other internal features are very obscure.

Localities. — The first mentioned specimen is labelled Red Cañon, southern Black Hills. The last one is labelled "Opposite mouth of

Inyan Kara Creek, Wyo. Loomis Coll." ; the other stands credited to E. O. Hovey.

Pholadomya obscura n. sp.

PLATE XLVIII, FIG. 10.

Shell below the usual size for this genus, very transversely elongate, being fully twice as long antero-posteriorly as the height from base to hinge line, exclusive of the projecting beaks. Beaks large, protuberant, extending much above the general line of the hinge, situated near the anterior end, which is slightly truncate and receding below; basal line strongly curved, protuberant in the middle of the length, posterior end truncate, narrow, receding above to the extremity of the hinge line. Surface strongly grooved concentrically, or undulate. On the opposite side from that shown in the figure, the postero-cardinal portion of the shell shows a few (three or four) slightly defined, radiating ridges, which are not visible on the side figured, but which are distinct enough to characterize the specimen as a poor representative of the genus *Pholadomya*.

Locality. — In light colored sandy rock of the Jurassic, at Redwater Creek Valley, north of Crow Peak, S. D., 25 feet above the red beds accounted as Triassic. Collected by E. O. Hovey.

Teredo ? sp.

PLATE XLIX, FIG. 3.

Among the material brought in from the Jurassic formation of the Black Hills are some specimens containing burrowings of a mollusk, but none of them appear to contain remains of the shells which excavated them. They resemble burrows of *Teredo* more nearly than those of any other genus of burrowers such as *Saxicava*, *Pholas*, or *Lithodomus*, as they are more tortuous in their direction than would be the case in any of those, and the form of the terminal bulb shows more similarity to those of *Teredo* than of any other. They are in limestone, and some show remains of molluscan shells among their fillings, but these are mostly fragments of oysters. Many of the burrows are filled with muddy sediments only. The rock in which they occur may have been a loose mass, but the surface shown by the photograph is a fresh fracture, while the opposite side may have been part of an oyster bed, judging from the occurrence of shells of that kind on it. There is nothing about them that would indicate the kind of animal which made them or to suggest an appropriate name for their designation.

Locality. — They are from the Divide between North and South Forks of Redwater Creek, one half mile east of Sundance, at the top of the Belemnite shale, Wyo. Collected by E. O. Hovey.

Neritoma (?) (*Oncochilus*) *occidentalis* n. sp.

PLATE L, FIGS. 1-6.

Shell neritaform, smooth except for rugose concentric lines of growth which sometimes appear almost like distinct varices. Spire consisting of from two to about three volutions, of which the last one forms almost the entire bulk. Aperture large, very transverse, the margin thick and continuous from the base of the columella to its junction with the body of the preceding volution, axis imperforate, the columellar lip forming a broad flattened plate like that of *Nerita*, the margin of which is smooth or undulated (?) like that of *Velates*.

Surface of the shell quite commonly marked by revolving color bands, generally in black and white, but which do not appear to be at all uniform in width or position. Sometimes the last volution is all white, others may be mostly black with white encircling streaks.

The shell is very like *Nerita peleronta* in its general form and in the obliquity of the aperture, but some of them are much more conical, and the spire somewhat pointed. The margin of the inner lip is rather obscure, but on the largest one figured, the margin would appear to be undulated on the edge.

Locality.—In a white limestone of Jurassic age, on the east side of Sundance River, between the forks of the Redwater, Wyo. Collected by E. O. Hovey.

***Belemnites obtusus* n. sp.**

PLATE L, FIG. 9.

Among the many specimens of *Belemnites densus* M. & H. in the collection from the Black Hills Jurassic, there occurs a single one which differs so materially in form from *B. densus* that it has been deemed safer to consider it as a distinct species than to refer it to that one.

The specimen differs from those of *B. densus* in being thickened below instead of slender and pointed; the greatest diameter is one and one fourth inches from the lower end, and the extremity is bluntly rounded instead of pointed. It is again slightly contracted above. In all other respects it resembles *B. densus* Meek & Hayden.

The specimen does not appear to be the result of accident, or to be dependent on abnormal growth or thickening. When broken open it appears entirely normal except that the phragmocone does not show the usual septate character as do those of *B. densus*. See Plate L, Figs. 7 and 8.

Locality.—North side of Redwater Valley, north of Beulah, Wyo. Collected by E. O. Hovey.

***Ammonites (Egoceras) subtumidum* n. sp.**

PLATE LX, FIGS. 3-5; PLATE LXI, FIGS. 1 and 2.

Shell attaining more than medium size, and extremely variable in different individuals, and at different stages of growth. Section decidedly cordiform when not compressed, the volutions imbedded about one third of their diameter, giving a moderately large umbilicus which in the larger (older) specimens has vertical sides. At the period represented by the individual figured on Plate LX, Figs. 3 and 4 (two views of the same individual), the shell is generally very strongly annulated, or marked by very strong transverse and deeply marked ridges crossing the volution, beginning at the edge of the umbilicus as a single protuberant transverse node or ridge, dividing midway of the side into two or three sharply elevated ridges, having a strongly forward curvature in crossing the dorsum, with an additional intercalated ridge added to fill up the space after crossing the outer half of the shell.

Another specimen, no larger than this, increases in lateral expansion nearly twice as rapidly as the one figured. The transverse ridges are much more numerous, counting nine or ten in the space occupied by eight on the figured one, and fully four at the edge of the umbilicus in the space of three on the figured one. The greater lateral expansion also gives to the shell a much more rapidly expanding form. Now if we consider the specimen figured on Plate LXI, it will be seen that at the margin of the umbilicus, these transverse ridges form strong distant nodes, differing much from those of the first mentioned specimen and in crossing the dorsum they are fewer in number but much stronger, still retaining the forward curvature in the dorsum. In this specimen it will be seen that nearly the outer half of the volution represents the chamber of habitation and that no septa are present, while the surface of the specimen is almost smooth, only faint undulations being preserved and only seen when the light is directed across them. Besides this the section of the volution is proportionally contracted in a dorso-ventral direction, and the shell has lost the nodes along the border of the umbilicus. Some of these differences may be due partly to a dwarfing of growth, but only to a very slight extent. On another specimen of about the size of the figure given on Plate LXI, which is septate throughout, the nodes on the margin of the umbilicus are retained to a much later growth and the section of the volution is strongly cordiform. The height of the section from the umbilicus is 8 cm. and the transverse diameter uncompressed equals 10 cm.

The sutures in this species are extremely complicated as well as very variable. In some specimens they are distant, with considerable

space between them. In others they are crowded together and interlocked to so great an extent that it is next to impossible to trace their parts. The divisions or extremities of the saddles are usually rounded or lobate, while the parts of the lobes are sharp and pointed, with many ramifications. A photographic figure of the back of one of the closely compacted sutured specimens is given, natural size, on Plate LX, Fig. 5. And on a fragment of what appears to be a portion of a large individual of probably the same species, lately received from Baja Banda, Lower California, on which the sutures, measuring from the lower extremity of one suture to the same point of the next one forward or behind on the line of the dorsum, measure 83 mm. or about $3\frac{1}{4}$ inches, there is hardly a space an eighth of an inch wide that is not intersected by the interlocking of the ramifications of the adjoining sutures anywhere seen on the side of the specimen.

Localities.—The specimens from the Black Hills referred to this species are from Red Cañon, Southern Black Hills, a half mile south of Mathias Peak, collected by E. O. Hovey; and from the Belle Fourche, opposite the mouth of Inyan Kara Creek, Wyo., presented by F. B. Loomis. The fragment of the large specimen mentioned as from Baja Banda, Lower California, was presented by C. R. Orcutt of San Diego, Cal., and may possibly represent a different species.

NOTES ON CHANGES OBSERVED IN *Ammonites (Amaltheus) cordiformis*
M. AND H. DURING LATER STAGES OF GROWTH.

In an article published in this Bulletin (Vol. XXII, Article VII, pp. 131–134) some remarks were made about the changes which had been noticed to take place among *Ammonites* in their passage through the different stages of development towards the adult or final stages of growth. It was there stated that in the case of *Am. cordiformis* M. & H. from the region of the Black Hills of South Dakota many such changes had been observed.

In the earlier stages of this species all are of similar character, but in those of more advanced ages many changes occur. And the plates representing that species preserved in the Museum collections are here arranged to show some of the peculiar features undergone by that form in its progress to old age. The figures given on Plates LII and LIII show the usual form of the species as known to Messrs. Meek and Hayden, from the Black Hills region, while on Plate LIV, and on Plate LIII, the right hand figure, shows one of the extreme forms produced in the species in what may be adult age of certain

individuals. The remaining plates portray what may be the normal form of the species, where the body of the shell is expanded laterally so as to present a broad ventricose form instead of the thin flattened shell shown on Plate LIV. This specimen is broken so as to show that the next inner volution is as strongly corrugated as that shown on Plate LII.

EXPLANATION OF PLATE XLII.

PENTACRINUS ASTERICUS *M. and H.* Page 389.

Fig. 1. A weathered specimen retaining parts of three of the arms, badly worn, and a portion of the stem and fimbria. Natural size.

Fig. 2. Part of a stem with fimbria attached, and also one side of a calyx up to the bases of the free arms, on three of the rays. Figure enlarged to 2 x.

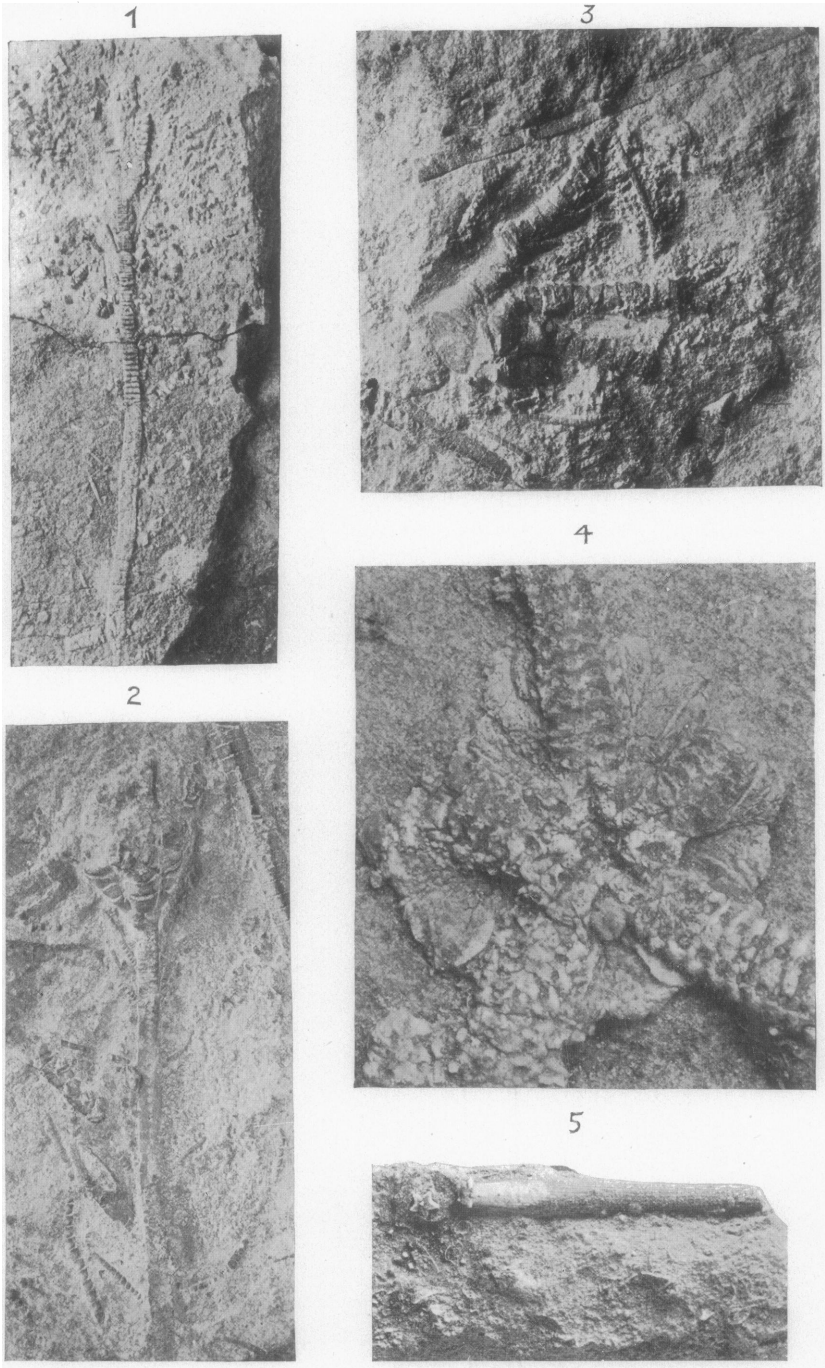
Fig. 3. A calyx retaining parts of four of the free arms, enlarged to 2 diameters. The base of the calyx is broken away up to the third radials, all five of which are retained in the stone. The specimen was photographed sideways supposing this would bring out the plates, but the entire process failed.

OPHIOCTEN (?) BELLEFOURCHENSIS n. sp. Page 391.

Fig. 4. Central portion of the best example of the species as it lies upon the rock, enlarged to 4 diameters. The specimen is badly weathered and the parts are too indistinct for delineation.

CIDARIS BELLEFOURCHENSIS n. sp. Page 391.

Fig. 5. View of a portion of the spine described. The figure does not show the head or collar of the spine or the surface features, owing principally to the direction in which the light is directed upon it.



BLACK HILLS JURASSIC FOSSILS.

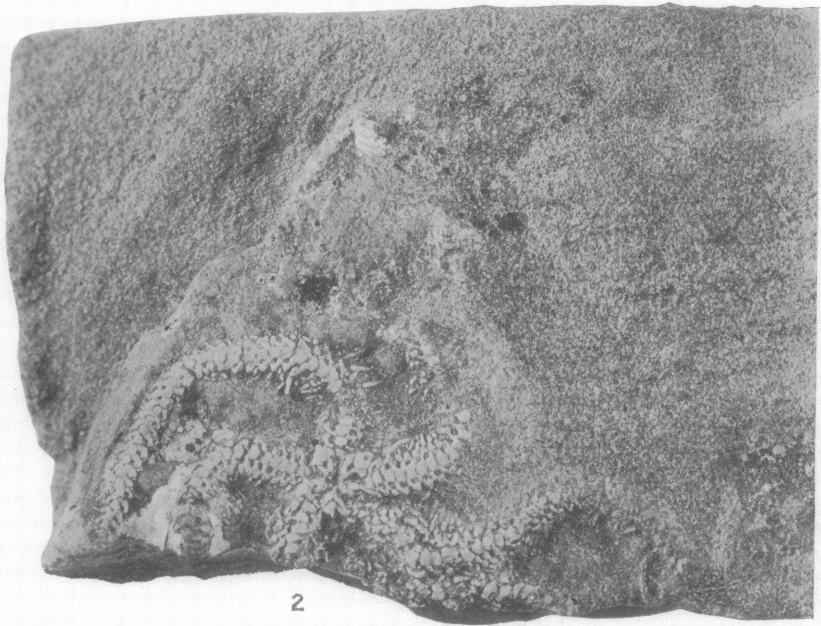
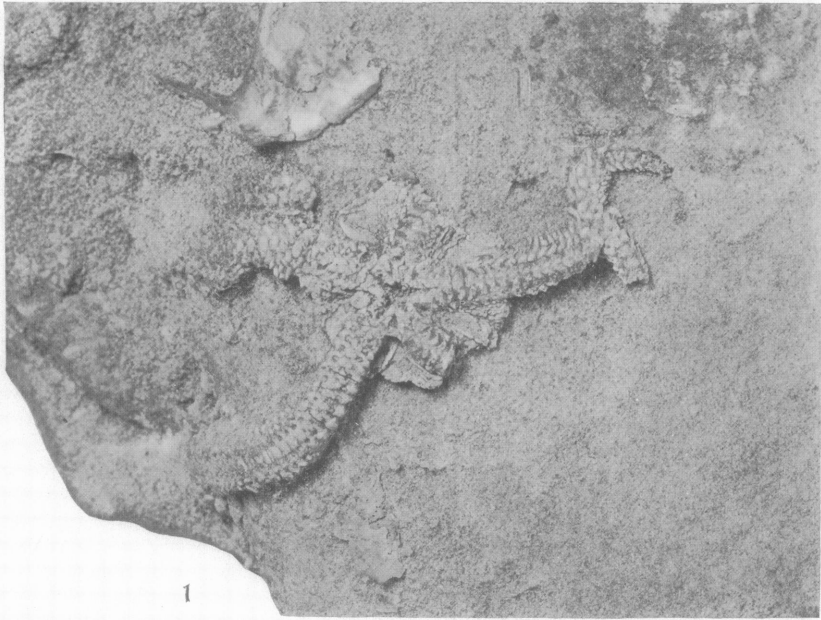
EXPLANATION OF PLATE XLIII.

OPHIOCTEN BELLEFOURCHENSIS n. sp. Page 391

Fig. 1. View (enlarged to 2 diameters) of the specimen shown on Plate XLII.

Fig. 4. This figure shows the features of the species much better than that on the foregoing plate. The disc is shown and the arms partially.

Fig. 2. View (enlarged to 2 diameters) of a second individual from the same locality, but weathered as badly as the other. The parts of the arms are much better shown and some of the mouth plates can be distinguished, but their outlines are not definable even by the use of a magnifier.

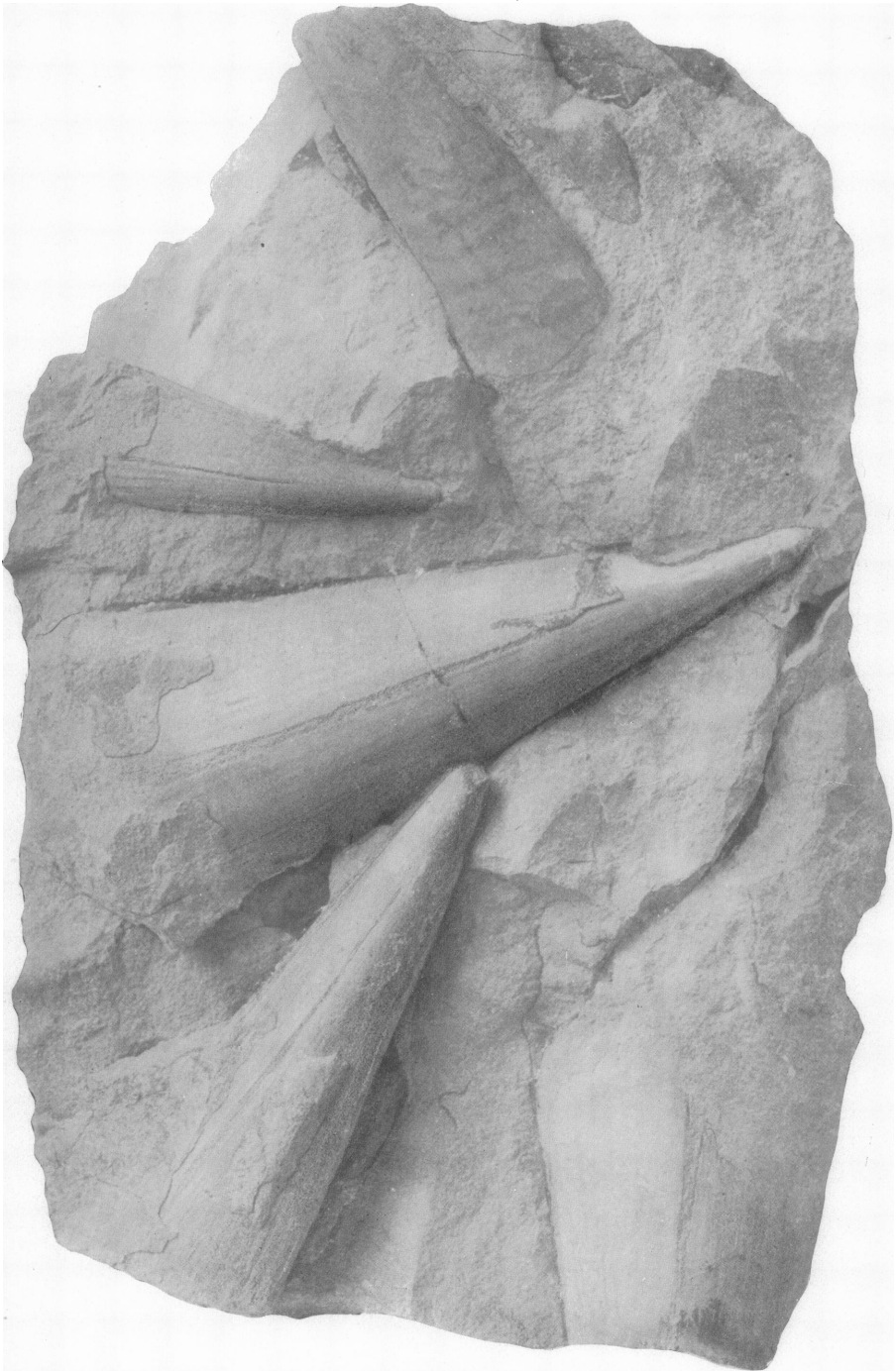


BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE XLIV.

PINNA JURASSICA n. sp. Page 392.

View of a portion of a limestone nodule in which are preserved many specimens of this species. In fact, the rock is pretty well filled with the shells, which usually exfoliate on breaking the rock, the shell adhering to the stone. The division along the side of the shell is well shown on some of them, and the longitudinal radiations of the valves are also shown, but the concentric undulations are mostly lost.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE XLV.

PINNA JURASSICA n. sp. Page 392.

Fig. 1. View, natural size, of a specimen from which the shell has separated leaving only the natural cast on which the median sulcus of the valve is very plain, and also the radii; but the concentric lines are only faintly seen.

MODIOLARCA JURASSICA n. sp. Page 393.

Fig. 2. View, twice enlarged, of the left valve described.

MODIOLA JURASSICA n. sp. Page 393.

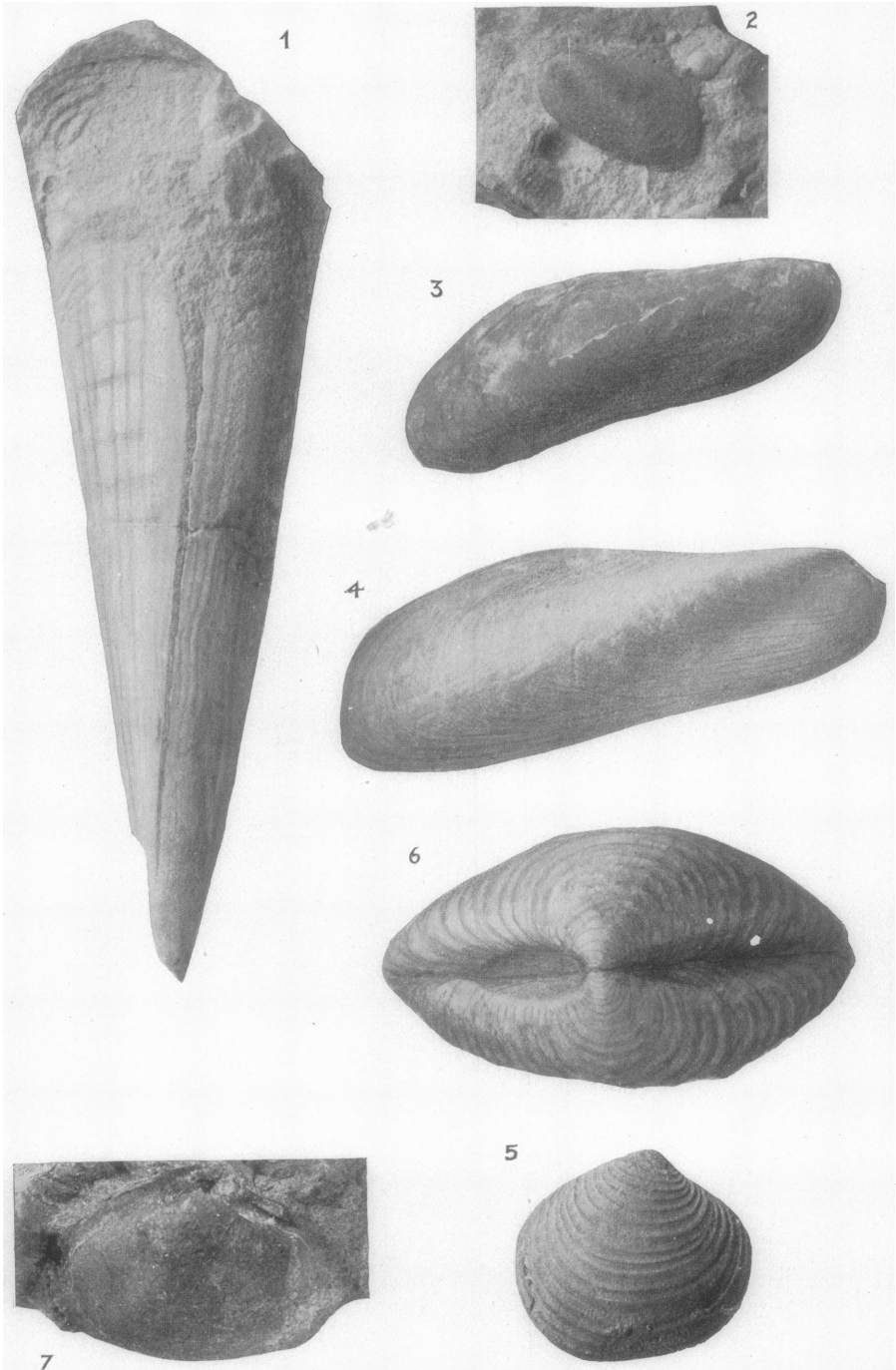
Figs. 3 and 4. Views of two right valves, of different sizes. The general form of the shell is well shown, and the concentric lines are shown on Fig. 4. There are no radiating striæ existing as is seen on *M. (Volsella) formosa* M. and H.

ASTARTE DACOTENSIS n. sp. Page 394.

Fig. 5. Side view of a small specimen, 2 x, showing general form of the undulations. The specimen is not as circular as the general run of the species, and is from a different locality, and from Prof. E. D. Cope's collection. Locality unknown.

Fig. 6. Cardinal view, greatly enlarged, of the above specimen to show the lunule and escutcheon.

Fig. 7. View of an internal cast, enlarged. The figure was intended to show the muscular scars and hinge teeth.

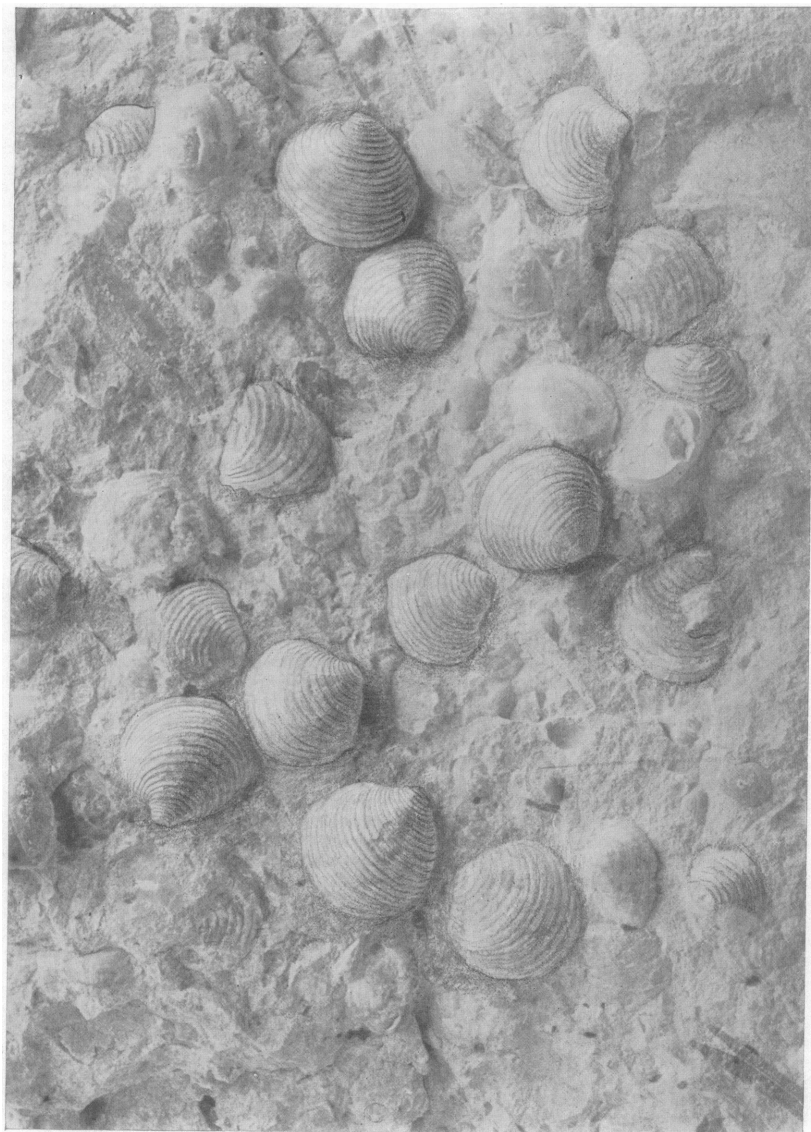


BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE XLVI.

ASTARTE DACOTENSIS n. sp. Page 394.

The figure shows part of a block of limestone containing many individuals of the species, natural size. The opposite side of the block bears the specimen of *Ammonites cordiformis* figured on Plate LIV.

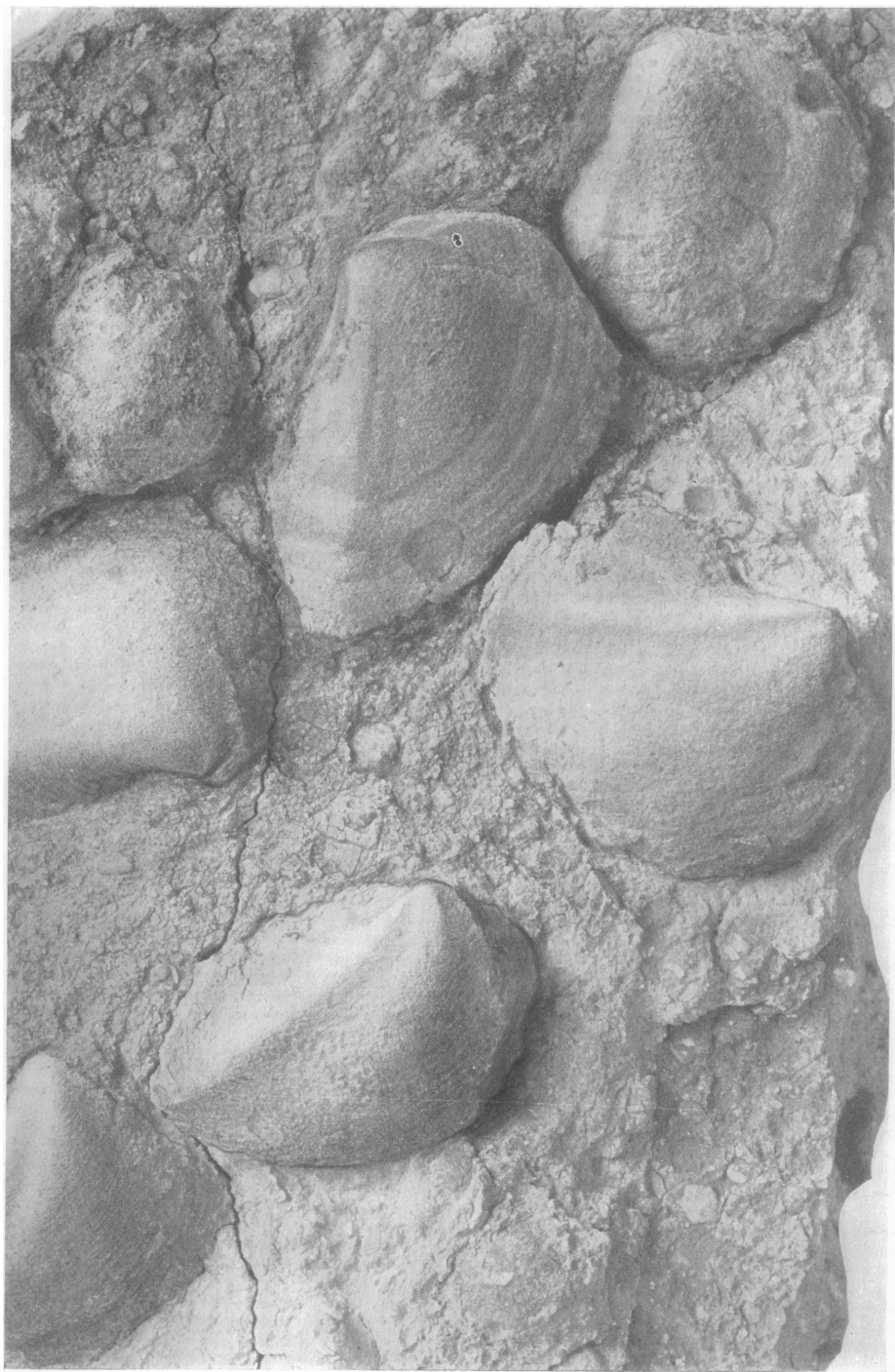


BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE XLVII.

TRIGONIA STURGISSENSIS n. sp. Page 394.

Block containing several weathered internal casts of this species. The block is of a friable sandstone and the casts do not retain any of the surface markings except faint indications of the concentric undulations of growth. Five right valves and one left are distinctly shown. Natural size.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE XLVIII.

TRIGONIA STURGISSENSIS n. sp. Page 394.

Figs. 1 and 2. Views, natural size, of a right and a left valve of a form of this species from Belle Fourche Valley, 3 miles northeast of Mato Teepee, Wyo.

Fig. 3. View of a right valve of the same, from Belle Fourche Valley, 3 miles north of Hulet, Wyo., 75 feet above base of the Jurassic.

Fig. 7. View of a right side of a cast from near Sturgis, S. D., which shows the oblique plicæ of the umbonal ridge extending to near the beak. A specimen from a limestone band near Sturgis shows this system of marking extending onto the beak.

TRIGONIA POSTSTRIATA n. sp. Page 396.

Figs. 4-6. Views of three right valves of different sizes, all showing the same features. The photographer turned them upright to show the striations of the cardinal slope.

PLEUROMYA (?) *CONCENTRICA* n. sp. Page 397.

Fig. 8. View of the right side of a specimen retaining both valves with but little compression, and preserving the general form of the shell.

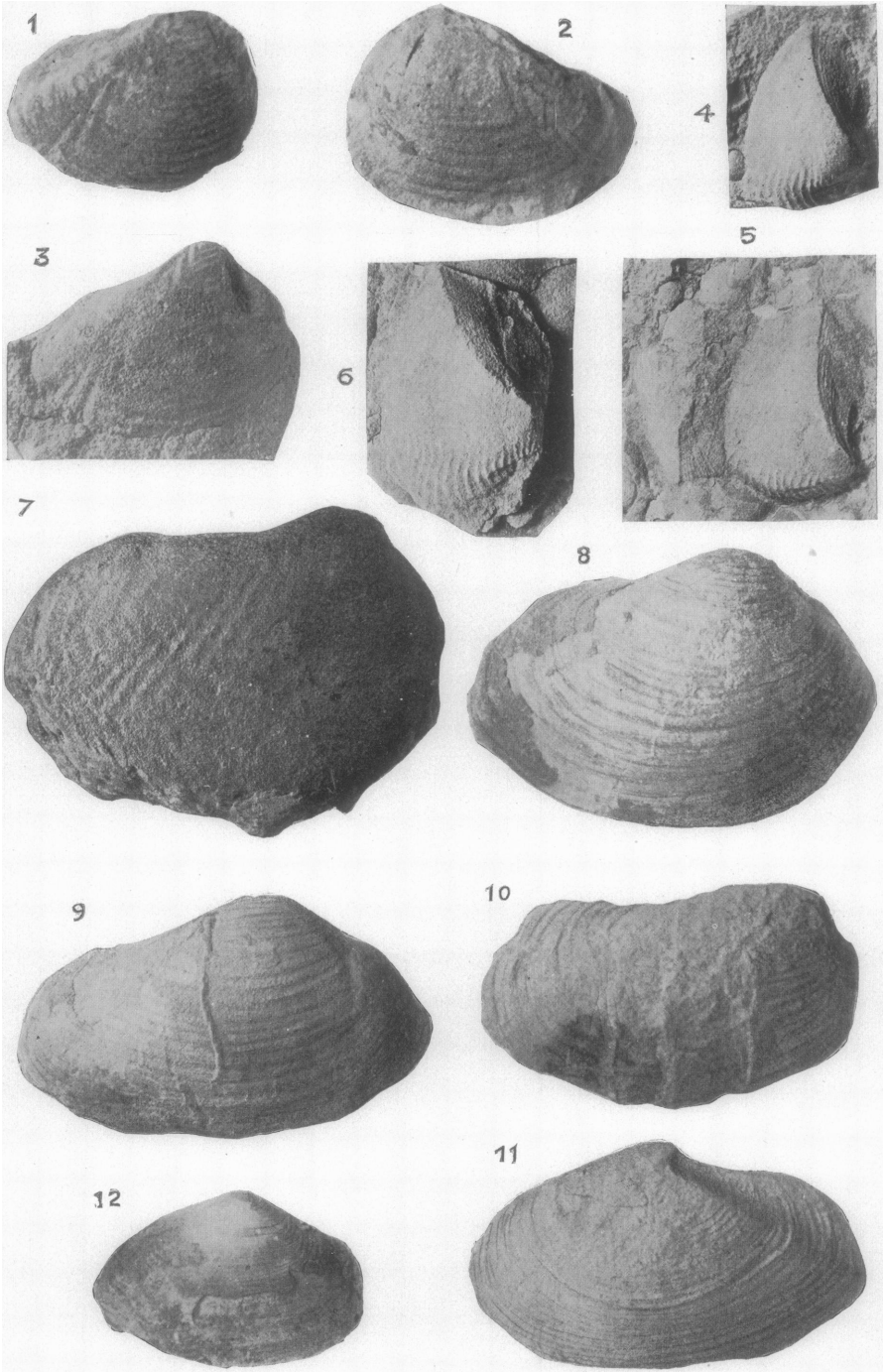
Fig. 9. View of the right side of an internal cast, which shows considerable vertical compression, narrowing the shell somewhat.

PHOLADOMYA *OBSCURA* n. sp. Page 398.

Fig. 10. View of the right side of the specimen described.

QUENSTEDTIA PLANULATA n. sp. Page 397.

Fig. 11. View of the best valve known, natural size



BLACK HILLS JURASSIC FOSSILS.

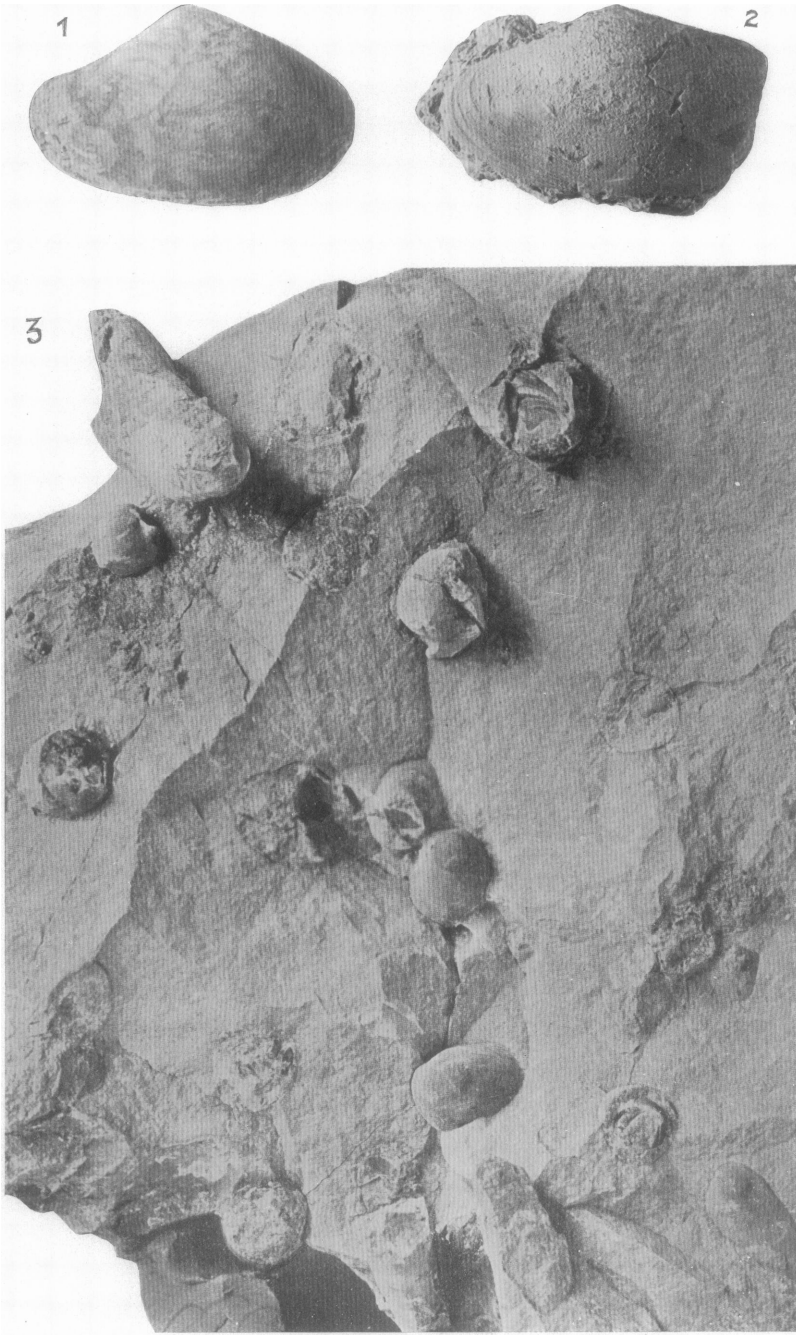
EXPLANATION OF PLATE XLIX.

TANCREdia TRANSVERSA n. sp. Page 396.

Figs. 1 and 2. Views of two different valves of this species. The one represented by Fig. 1 is less transverse than any other of several referred to it. That represented by Fig. 2 has one third the valve broken off, so that it is apparently very much shortened and does not properly represent the true form

TEREDO (?) sp. Page 398.

Fig. 3. Represents a part of a block of limestone that contains the filling of burrows of a form of *Teredo*-like shell, the exact nature of which has not been determined.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE L.

NERITOMA (?) (ONCOCHILUS) OCCIDENTALIS n. sp. Page 399.

Figs. 1-3. Views of specimens of varying sizes, all of which preserve color distinct enough to be retained in the photographs. They are all black.

Fig. 4. Represents the aperture of the specimen given in Fig. 3, which is broken through just in front of the white color which crosses the shell near the middle, and in breaking revealed the inner lip, which extends over more than half the broken area, the border of which is a straight line.

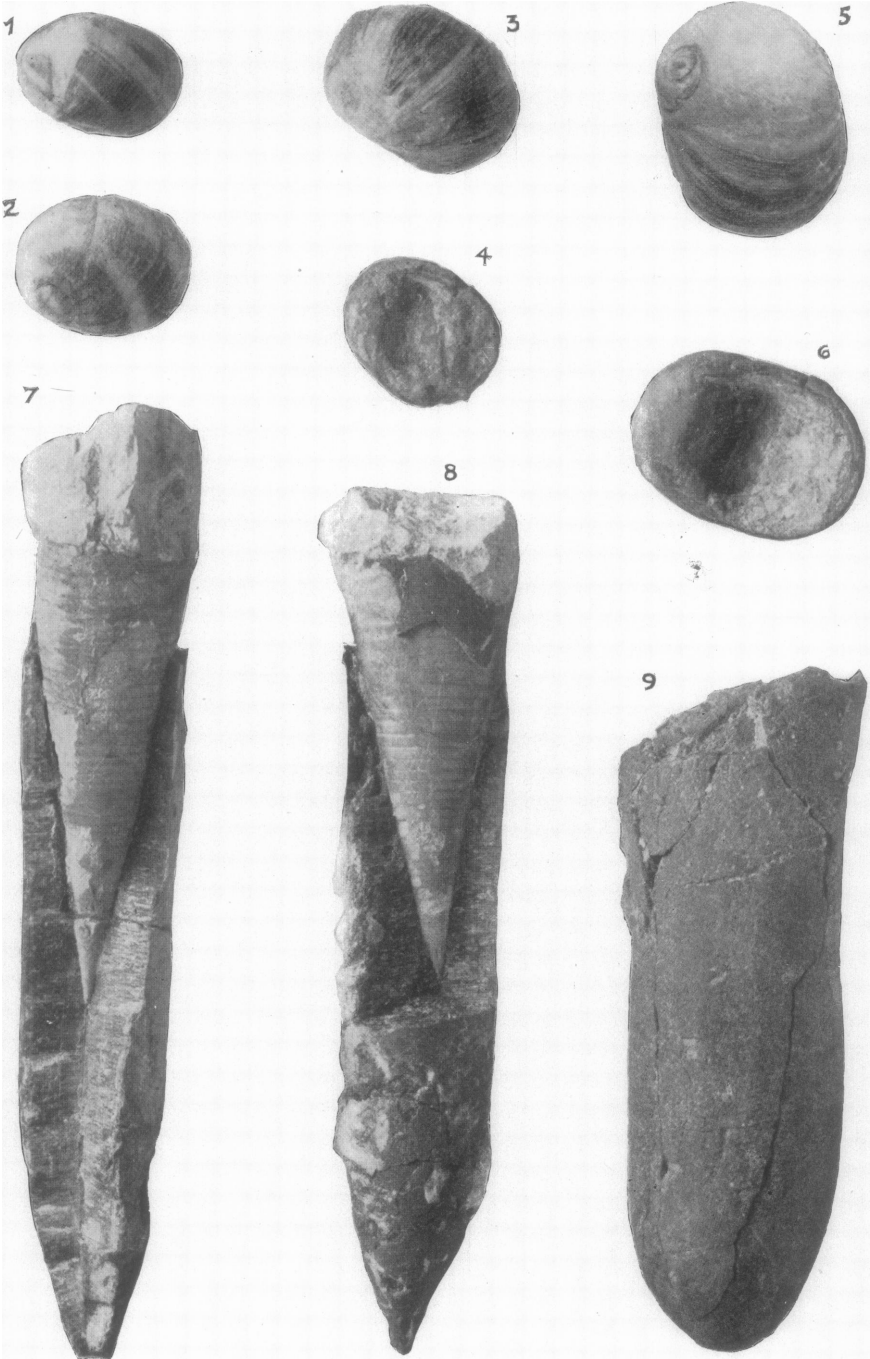
Figs. 5 and 6. Opposite sides of a large individual, all white. The inner lip is shown, but is not distinct in the figure. Its margin appears to be notched.

BELEMNITES DENSUS *M. and H.* Page 399.

Figs. 7 and 8. Represent two individuals which have been broken and manipulated to show the phragmocone filling the cavity of the specimens, and showing the septa.

BELEMNITES OBTUSUS n. sp. Page 399.

Fig. 9. View, natural size, of the specimen described. The specimen is split longitudinally and reveals the growth and form of the alveolus and its filling. It does not indicate any abnormality or diseased condition that would lead one to suppose its form depended on accident. The filling of the cavity is not septate in the usual manner as are those on the plate by its side, but rather suggests that the septa, if shown at all, were very oblique.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LI.

BELEMNITES DENSUS *Meek*. Page 399.

Part of slab containing many young shells. Natural size.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LII.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

Figs. 1 and 2 of this Plate are given to show the prevailing features of this species during middle life, when the shells present the usual form and characters described and referred to it by Meek and Hayden. The specimen is above the prevailing size as known to them, but still below the average of those usually found in the Black Hills localities.

This specimen is from Freezeout, Albany Co., central Wyo., and was brought in by Dr. Wortman in 1897



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LIII.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

The figure represents a portion of a large slab, 14 x 20 inches, and quite irregular in shape, on which there are preserved parts of twelve fairly good specimens of the species, besides fragments of others. The right-hand specimen in the figure, although normal in form as far as it is preserved, shows the succeeding volution to have had the form of that figured on Plate LIV, which has a thickness near the umbilicus of less than two inches (= 50 mm.), while the diameter across the shell in the widest part is five and three eighths inches (= 137 mm.). This specimen is the same as that given on Plate LIV, and will also represent the form for which the term *A. cordiformis plana* is there used. The slab from which the Plate is taken is from Red Cañon, S. D. Collected by E. O. Hovey. †



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LIV.

AMMONITES (AMALTHEUS) CORDIFORMIS PLANA. Page 401.

The figure represents a form of this species which is entirely destitute of the usual markings on the side, and of the crenulations or dentations of the keel shown in the usual form of the species. This feature is quite common to this shell in the Black Hills when of this size. But the volution within this one is as strongly marked and ribbed as either of those represented on Plate LIII, or on Plate LII, Figs. 1 and 2, at the same size. On the inside of the outer portion of the present figured specimen these ribs and markings can be readily observed. The specimen is from Red Cañon, S. D. Collected by E. O. Hovey

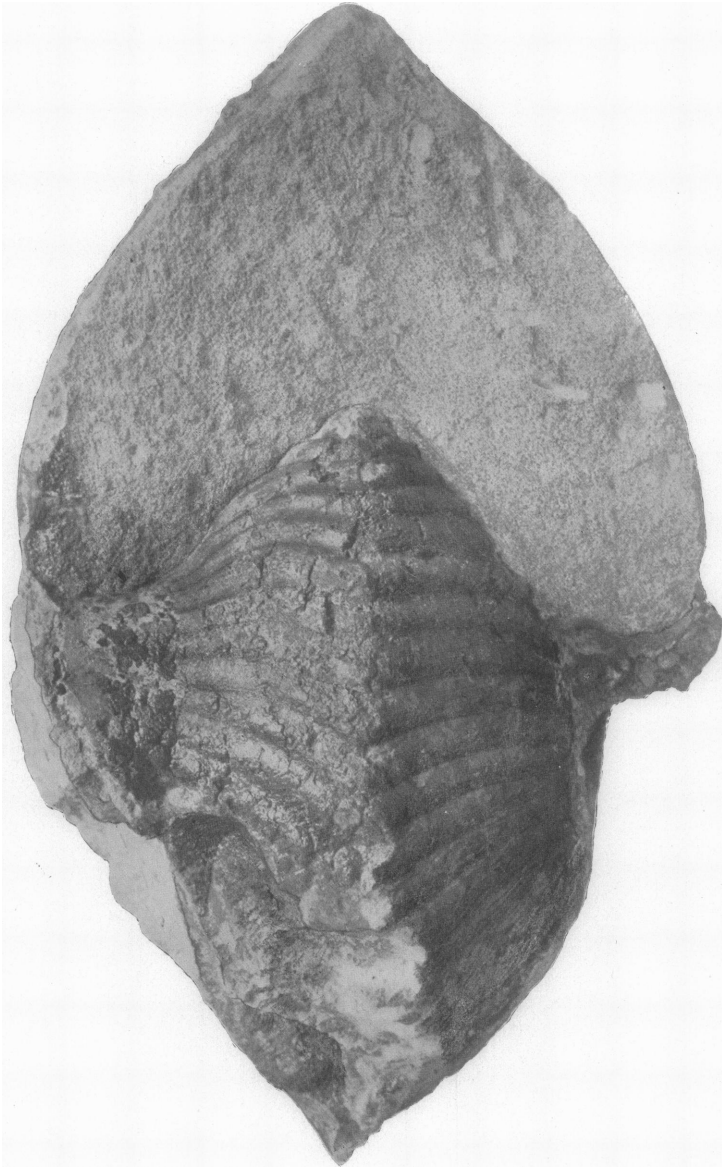


BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LV.

AMMONITES (*AMALTHEUS*) *CORDIFORMIS* *M. and H.* Page 401.

The figure on this plate represents the inner portion of the specimen figured on Plate LVI, with the outer portion from the break upward removed, and the lower portion placed in profile See description of that Plate.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LVI.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

The figure on this Plate represents, nearly natural size, the same specimen shown on Plate LV, only the outer portion above the fracture (absent there) is in place here. In this condition the specimen measures seven and three fourths inches in height, and it is fully four inches through from side to side.

This last volution shows none of the usual plications common to the inner whorls, but the surface is smooth except for the growth lines. Plate LVII shows the opposite side of the last whorl, where the substance representing the shell itself is preserved, showing the growth lines and the strong undulations into which the notches of the keel are developed in old age.



EXPLANATION OF PLATE LVII.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

The reverse side of the top of the specimen figured on Plate LVI, showing the upper part only, where the substance replacing the shell is preserved and retains the surface markings of the shell.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LVIII.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

The figure represents the side view of a large imperfect shell of this species showing the undulating corrugations continued on the shell to a much greater age than they are on that shown on Plates LV and LVI. If the chamber of habitation had been preserved on this individual, it would have had a greater diameter than the other, this being all within the septate portion. Red Cañon, S. D. Collected by E. O. Hovey.

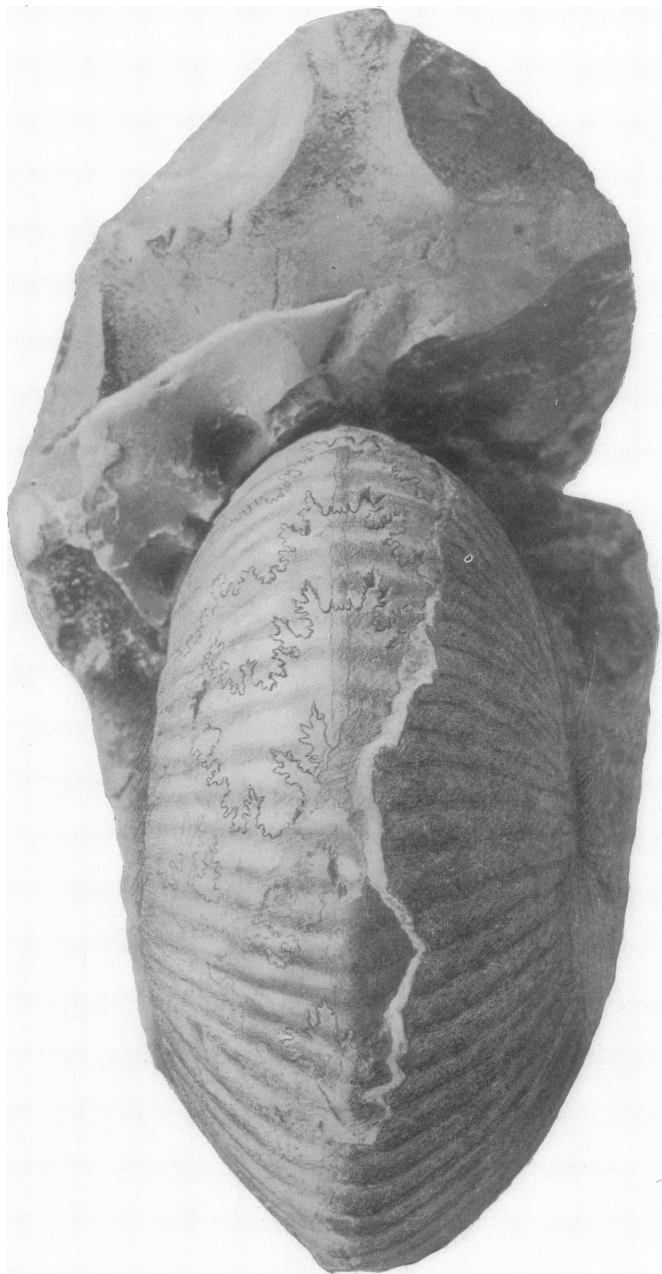


BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LIX.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

Profile view (half an inch less than natural size) of the specimen shown on Plate LVIII, to show the undulations of the surface, and to present to some degree the suture lines of the septa. It is nearly free from distortion by compression and shows but slightly the deflection forward of the undulations in approaching the keel.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LX.

AMMONITES (AMALTHEUS) CORDIFORMIS *M. and H.* Page 401.

Fig. 1. A small specimen of this species where the corrugations are more numerous than usual.

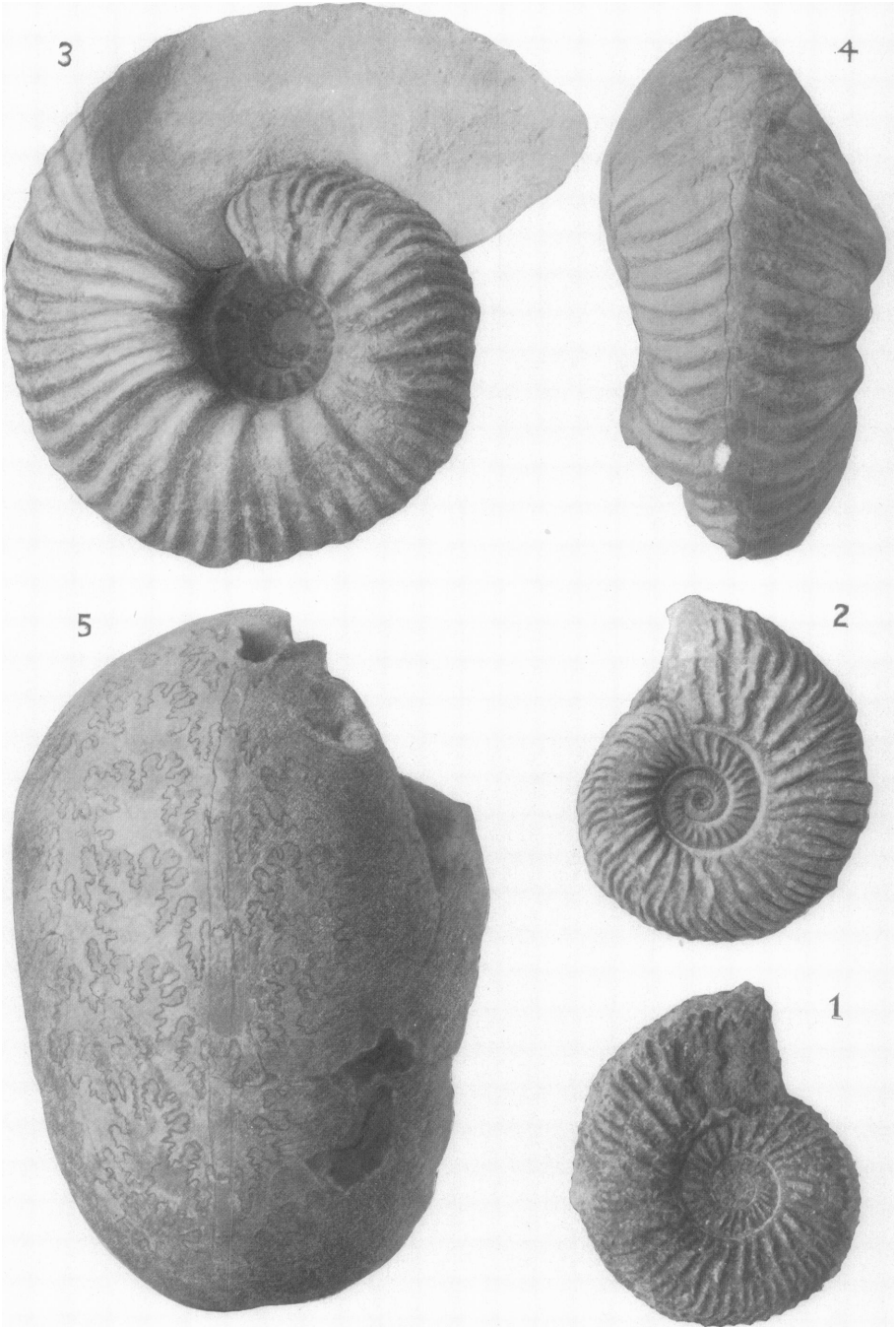
Fig. 2. View of a slightly larger shell, with the corrugations more nearly of the normal size. Compare these figures with those of Plate LII.

AMMONITES (ÆGOCERAS) SUBTUMIDUM n. sp. Page 400.

Fig. 3. Side view of a small specimen showing the usual features of half-grown individuals with the corrugations grouped into fascicles near the back of the shell.

Fig. 4. View of the back of the volution showing the forward flexure of the corrugations in crossing the dorsum. This specimen is from Inyan Kara Creek, Wyo. Collected by F. B. Loomis, 1897.

Fig. 5. View, natural size, of the back of an imperfect specimen which has entirely lost the undulations of the surface. On this same individual, the inner volution is as strongly corrugated, only somewhat more closely and finer, as are those of Figs. 3 and 4. This figure also shows very distinctly the outline of the septa, and along the median line the course of the siphuncle with the median saddles crossing it. Red Cañon, south of Mathias Peak, S. D. Collected by E. O. Hovey.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LXI.

AMMONITES (*ÆGOCERAS*) SUBTUMIDUM n. sp. Page 400.

The figures on this Plate are lateral and profile views, natural size, of what appears to be an abnormally developed specimen of the above-named species. The inner volution has the plications crossing the shell developed into rounded nodes on the margin of the umbilicus. On the middle of the tube they become grouped into fascicles of twos and threes, but in an endeavor to represent them across the dorsum they are somewhat wrongly portrayed. Beyond this the outer chamber, in this case, is abnormally narrowed towards the outer end, so as to cause a contraction of the width. It is barely possible that this feature is not abnormal, and that the shell may be the representative of a new species.



BLACK HILLS JURASSIC FOSSILS.

EXPLANATION OF PLATE LXII.

AMMONITES (*ÆGOCERAS*) *SUBTUMIDUM* n. sp. Page 400.

The figure represents the largest individual of the species yet obtained from the Black Hills. The specimen is entirely septate, consequently the real size is not known; it may have been much larger. As it is entirely denuded of shell it shows more or less of the septa, but owing to the direction in which the light reaches it in the photograph the great depth of the umbilicus is entirely lost, which is exactly one inch where the outer coil joins the next within.

The specimen is from the Belle Fourche, opposite the mouth of Inyan Kara Creek, Wyo. Collected by F. B. Loomis, 1902.



