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SOME AMERICAN JURASSIC AMMONITES

OF THE

GENERA QUENSTEDTICERAS, CARDIOCERAS, AND AMOEBOCERAS
FAMILY CARDIOCERATIDAE

BY

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SOME AMERICAN JURASSIC AMMONITES OF THE GENERA QUENSTEDTICERAS, CARDIOCERAS, AND AMOEOCERAS, FAMILY CARDIOCERATIDAE.

By JOHN B. REESIDE, Jr.

INTRODUCTION.

The species *cordiforme* Meek and Hayden, *distans* Whitfield, *canadense* Whiteaves, and *dubium* Hyatt (probably including *whitneyi* J. P. Smith), variously assigned to the genera *Amaltheus*, *Quenstedticeras*, *Amoeboceras*, and *Cardioceras*, and *subtumidum* Whitfield and Hovey, assigned to *Aegoceras*, include all the previously described species of Jurassic ammonites that are considered in this paper. Material accumulated in the National Museum at Washington, mainly through the efforts of field parties of the United States Geological Survey, has shown, however, the presence of a number of undescribed forms of considerable scientific interest. These new species were obtained mainly from the Sundance formation of Wyoming. One comes from the Ellis formation of Montana, one from Jurassic beds near Lillooet, British Columbia, and three from the *Cardioceras*-bearing beds near the base of the Naknek formation of Alaska.

The interpretation of the data furnished by the study of these fossils has been hindered somewhat because the exact stratigraphic location of much of the material is unknown. It was gathered with regard merely for the general stratigraphic and geographic position. However, as a knowledge of the general relationship of the forms to those of other areas is in itself of value to the stratigrapher and systematist it has seemed desirable to describe and figure the species.

In making comparisons with European forms the writer has had little authentically identified material and has relied entirely upon the published descriptions and figures. For this reason in part the European names have not been ap-

plied, even when there seemed to be no recognizable differences between the American and European species. Furthermore, the writer has accepted the names as applied by the European authors, although there is a wide variation in their conceptions of the same species, particularly as to the limits within which a given specific name should be applied. Some authors have extended such names as *cordatum* Sowerby and *excavatum* Sowerby to cover a considerable range of form, whereas others have restricted these names and applied other names to variants from the type. It seems to the writer at least a great convenience to have names for the distinguishable forms, even though intermediate forms cause doubts as to the exact systematic rank of such names.

The writer takes this opportunity to thank Mr. T. W. Stanton for advice and assistance, and Mr. C. A. Reeds, of the American Museum of Natural History, for the loan of Whitfield and Hovey's figured specimens. He wishes to express his appreciation of the work of Mr. W. O. Hazard, who photographed the specimens, and of Miss Frances Wieser, who retouched the photographs and assembled the plates.

DISTRIBUTION OF SPECIES.

The species discussed in this paper are placed under 33 specific and 2 varietal names. Of these names, 30 are new and 5 are old names, 2 of which are restricted in application.

The distribution of the species by formations is as follows:

Sundance formation of northeastern Utah:

Cardioceras hyatti Reeside.

Sundance formation of northwestern Colorado:

Cardioceras cf. *C. wyomingense* Reeside.

Sundance formation of southern Wyoming:

Quenstedticeras? hoveyi Reeside.
suspectum Reeside.

Cardioceras auroraense Reeside.
cordiforme (Meek and Hayden).
crassum Reeside.
crookense Reeside.
harsi Reeside.
hyatti Reeside.
plattense Reeside.
russelli Reeside.
schucherti Reeside.
stantoni Reeside.
stantoni var. *obesum* Reeside.
wyomingense Reeside.

Cardioceras? albanense Reeside.
incertum Reeside.
latum Reeside.
sp. undet.

Sundance formation of northeastern Wyoming and western South Dakota (Black Hills):

Quenstedticeras? hoveyi Reeside.
subtumidum (Whitfield and Hovey).
suspectum Reeside.
tumidum Reeside.

Cardioceras americanum Reeside.
bellefourchense Reeside.
canadense (Whiteaves).
cordiforme (Meek and Hayden).
crassum Reeside.
crookense Reeside.

Sundance formation, etc.—Continued.

Cardioceras americanum Reeside—Continued.
distans (Whitfield).
distans var. *depressum* Reeside.
harsi Reeside.
obtusum Reeside.
russelli Reeside.
stillwelli Reeside.
sundancense Reeside.
whitfieldi Reeside.
whiteavesi Reeside.
wyomingense Reeside.

Cardioceras? latum Reeside.

Ellis formation of Montana:

Quenstedticeras collieri Reeside.

Mariposa slate of California:

Amoeboceras dubium Hyatt.

Cardioceras-bearing beds of British Columbia:

Cardioceras canadense (Whiteaves).
lillooetense Reeside.
whiteavesi Reeside.

Cardioceras-bearing beds in the lower part of the Naknek formation of Alaska:

Cardioceras alaskense Reeside.
distans (Whitfield).
distans var. *depressum* Reeside.
martini Reeside.
spiniferum Reeside.

The following table and list show the geographic distribution of the species:

The localities which have furnished the material on which this paper is based and the species identified from each locality are listed below. The numbers are indicated in the table on page 7. The accompanying index map (fig. 1) shows the localities in the State of Wyoming from which these fossils have been obtained, the numbers corresponding to those in the following list:

4. Sundance formation, SW. $\frac{1}{4}$ sec. 13, T. 23 N., R. 79 W., Carbon County, Wyo.:
Cardioceras haresi.
Cardioceras? latum.
5. Sundance formation, Difficulty Canyon, in sec. 31, T. 24 N., R. 80 W., Carbon County, Wyo.:
Cardioceras hyatti.
stantoni.
stantoni var. *obesum*.
6. Sundance formation, east side of Freezeout Hills in T. 25 N., R. 78 W., Carbon County, Wyo.:

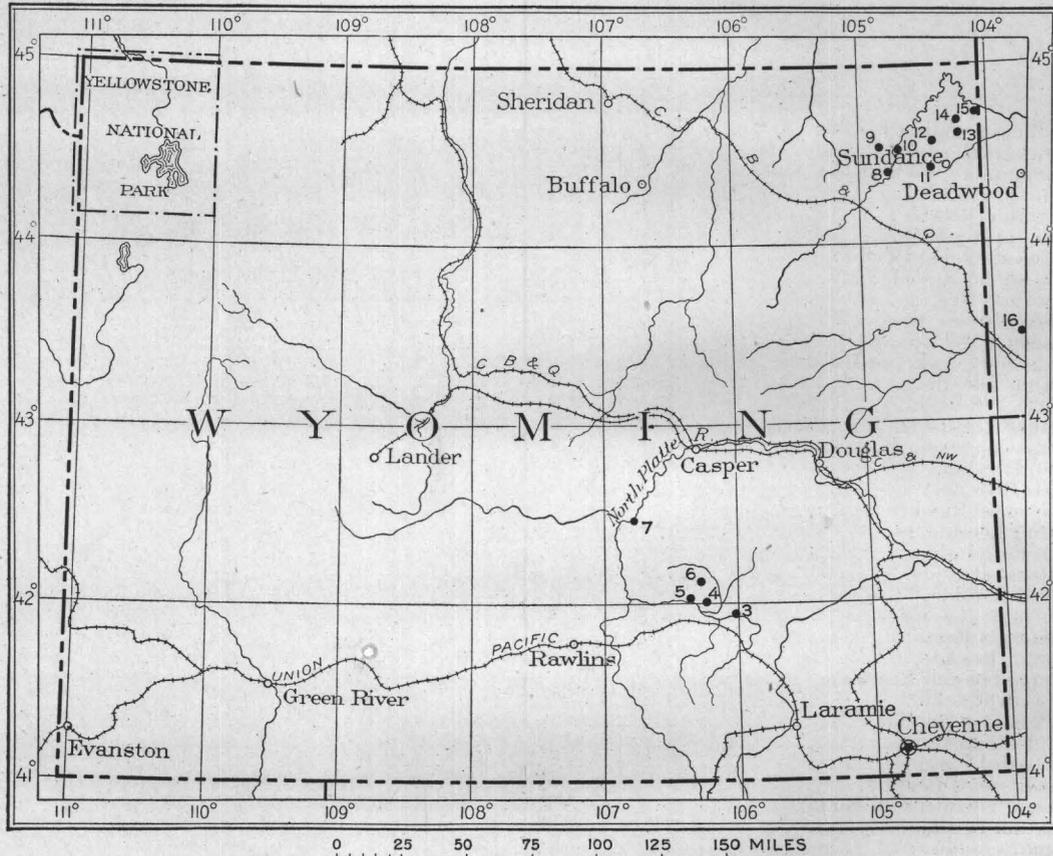


FIGURE 1.—Map of Wyoming showing localities where *Cardioceratidae* were obtained.

List of localities and fossils.

1. Sundance formation, near dinosaur quarry of Carnegie Museum at Jensen, Uinta County, Utah:
Cardioceras hyatti.
2. Sundance formation, near Yampa River, Moffat County, Colo.:
Cardioceras cf. *C. wyomingense*.
3. Sundance formation, Como Bluff, near Aurora, Wyo. (now known as Ridge, on the Union Pacific Railroad, in T. 22 N., R. 77 W., Carbon County):
Quenstedticeras? hoveyi.
suspectum.
Cardioceras wyomingense.
stantoni.
russelli.
auroraense.
Cardioceras? latum.

From belemnite zone near middle of formation:

Cardioceras cordiforme.
wyomingense.
schucherti.
crassum.
Cardioceras? incertum.
albaniense.
sp. undet.

From the nodules above the belemnite zone:

Cardioceras cordiforme.
crookense.

7. Sundance formation, near Grand Canyon of the North Platte, south of Alcova, Natrona County, Wyo.:

Quenstedticeras? hoveyi.
Cardioceras plattense.

8. Sundance formation, half a mile northeast of the Johnson horse ranch in T. 52 N., R. 65 W., Belle Fourche River, 25 miles west of Sundance, Wyo.:
Quenstedticeras? *suspectum*.
subtumidum.
Cardioceras distans.
distans var. *depressum*.
harsi.
crassum.
bellefourchense.
Cardioceras? *latum*.
9. Sundance formation, 4 miles west of Devils Tower, Crook County, Wyo.:
Cardioceras distans var. *depressum*.
cordiforme.
wyomingense.
harsi.
crookense.
obtusum.
Cardioceras? *latum*.
10. Sundance formation, 2 miles south of Belle Fourche River, near Bear Lodge Butte (Devils Tower), Crook County, Wyo.:
Cardioceras distans.
whitfieldi.
11. Sundance formation, 4 miles west of Sundance, Crook County, Wyo.:
Cardioceras distans var. *depressum*.
cordiforme?
stillwelli.
canadense.
whiteavesi.
sundancense.
americanum.
12. Sundance formation, foothills west of Bear Lodge Mountains, Crook County, Wyo.:
Quenstedticeras? *hoveyi*.
13. Sundance formation, Sundance-Aladdin stage road at south fork of Redwater Creek, Crook County, Wyo.:
Cardioceras distans var. *depressum*.
14. Sundance formation, miles southwest of Barrett (Aladdin), Crook County, Wyo.:
Cardioceras wyomingense.
15. Sundance formation, 1½ miles north of Redwater Creek, near boundary between South Dakota and Wyoming, in Wyoming:
Quenstedticeras? *hoveyi*.
Cardioceras cordiforme.
harsi.
russelli.
obtusum.
Cardioceras? *latum*.
16. Sundance formation, Red Canyon, half a mile south of Mathias Peak, in sec. 24, T. 3 S., R. 7 E., Fall River County, S. Dak.:
Quenstedticeras? *tumidum*.
17. Ellis formation, sec. 7, T. 25 N., R. 26 E., Blaine County, Mont. (Little Rocky Mountains):
Quenstedticeras collieri.
18. Ellis formation, sec. 27, T. 25 N., R. 26 E., Blaine County, Mont. (Little Rocky Mountains):
Quenstedticeras collieri.
19. Mariposa slate, Texas Ranch, Calaveras County, Cal.:
Amoeboceras dubium.
20. *Cardioceras*-bearing beds, head of Big Creek, tributary of Chilcotin River; about 90 miles northwest of Lillooet, Lillooet County, British Columbia:
Cardioceras canadense.
lillooetense.
whiteavesi.
21. *Cardioceras*-bearing beds in lower part of Naknek formation, east side of Oil Bay, Cook Inlet region, Alaska:¹
Cardioceras distans.
distans var. *depressum*.
spiniferum.
martini.
alaskense.
22. *Cardioceras*-bearing beds near creek entering Boulder Creek, Matanuska Valley, Alaska:
Cardioceras martini.

Comparative list of American and most closely related European species.

American species.	European species.
<i>Quenstedticeras collieri</i> Reeside.....	<i>Quenstedticeras lamberti</i> (Sowerby).
<i>Quenstedticeras?</i> <i>hoveyi</i> Reeside.....	<i>Quenstedticeras?</i> <i>goliath</i> (D'Orbigny).
<i>subtumidum</i> (Whitfield and Hovey).....	<i>goliath</i> (D'Orbigny) var. <i>De Loriol</i> .
<i>suspectum</i> Reeside.....	<i>goliath</i> (D'Orbigny).
<i>tumidum</i> Reeside.....	<i>Quenstedticeras carinatum</i> Eichwald.
<i>Cardioceras alaskense</i> Reeside.....	<i>Cardioceras vagum</i> Ilowaisky.
<i>americanum</i> Reeside.....	<i>excavatum</i> (Sowerby) Lahusen.
<i>auroraense</i> Reeside.....	<i>nikitinianum</i> Lahusen.
<i>bellefourchense</i> Reeside.....	(?)
<i>canadense</i> (Whiteaves).....	<i>zenaidae</i> Ilowaisky.
<i>cordiforme</i> (Meek and Hayden).....	<i>cordatum</i> (Sowerby) var. <i>b</i> <i>De Loriol</i> .
<i>crassum</i> Reeside.....	<i>popilianense</i> Boden.
<i>crookense</i> Reeside.....	(?)
<i>distans</i> (Whitfield).....	<i>cordatum</i> (Sowerby) var. <i>d</i> <i>De Loriol</i> .
	<i>rouillieri</i> (Nikitin) Lahusen.

¹ Stanton, T. W., and Martin, G. C., Mesozoic section on Cook Inlet and Alaska Peninsula: Geol. Soc. America Bull., vol. 16, pp. 394, 395, 406, 1905.

American species.	European species.
Cardioceras distans var. depressum Reeside.....	Cardioceras vertebrale (Sowerby) var. a Ilowaisky.
harsi Reeside.....	(?)
hyatti Reeside.....	cordatum (Sowerby) Lahusen, Borissjak.
lillooetense Reeside.....	cordatum (Sowerby) var. a De Loriol.
martini Reeside.....	excavatum (Sowerby) Borissjak.
obtusum Reeside.....	(?)
plattense Reeside.....	(?)
russelli Reeside.....	(?)
schucherti Reeside.....	rouillieri (Nikitin).
spiniferum Reeside.....	(?)
stantoni Reeside.....	vertebrale (Sowerby) Boden.
	quadradtoides (Nikitin).
stantoni var. obesum Reeside.....	vertebrale (Sowerby) Boden.
	quadradtoides (Nikitin).
stillwelli Reeside.....	excavatum (Sowerby) var. laevigata Boden.
sundancense Reeside.....	excavatum (Sowerby) as refigured by Healey.
whiteavesi Reeside.....	vertebrale (Sowerby) as refigured by Healey.
whitfieldi Reeside.....	tenuicostatum Nikitin.
wyomingense Reeside.....	nikitinianum Lahusen.
Cardioceras? albaniense Reeside.....	(?)
incertum Reeside.....	(?)
latum Reeside.....	(?)
sp. undet.....	(?)
Amoeboceras dubium Hyatt.....	Amoeboceras alternans (Von Buch). bauhini (Oppel).

CORRELATION.

Sundance formation of Wyoming, Utah, and Colorado.—The Sundance formation has been considered by nearly all American authors as a single paleontologic and stratigraphic unit of Lower Oxfordian age, in the sense in which that term is applied by the continental and particularly the Russian stratigraphers. The present study bears out this interpretation. The fauna of the localities listed in this paper is essentially a unit, even though the species are widely separated in geographic range. Some of the species from northeastern Wyoming show affinities with the genus *Amoeboceras* in the tendency to obsolescence of the ventral ribs and may indicate a late stage of the Sundance, but no true representatives of *Amoeboceras* are known from the formation. A single species from the Sundance of South Dakota, *Quenstedticeras? tumidum* Reeside, may indicate an older horizon than the *Cardioceras* zone, but this is still open to some doubt. The close relationship between the cardioceratids of the Sundance and those of the zone of *Cardioceras cordatum* Sowerby, of the European Jurassic, indicates their equivalence. It is true that some of the American species seem to have no close relatives in the European faunas so far as one may judge from the literature of the subject, but the remaining species are sufficient to establish the correlation. Many Euro-

pean stratigraphers refer the *cordatum* zone to the Lower Oxfordian, others to the Upper Oxfordian or to the Lower Corallian, and still others drop the terms Oxfordian and Corallian and substitute Argovian or Sequanian.

Ellis formation of Montana.—The single ammonite described from the Ellis formation of Montana would indicate a lower stratigraphic position than that of the Sundance. The number of species of invertebrates common to both formations is sufficient to preclude a great difference in age, yet many of the most characteristic forms of the one are lacking in the other, particularly the ammonites. *Quenstedticeras* of the type of *Quenstedticeras collieri* is characteristic of a zone referred by many continental stratigraphers to the latest Callovian, by others to the Lower Oxfordian or Divesian.

Mariposa slate of California.—The one species from the Mariposa slate is a true *Amoeboceras* and indicates, as long ago pointed out by Smith¹ and Hyatt,² a later age than that of the Sundance formation, a conclusion which is strengthened by the presence of *Aucella* with the ammonite. *Amoeboceras* is characteristic of a zone referred by many authors to the Upper Oxfordian, by others to the Kimmeridgian.

¹ Smith, J. P., Age of the auriferous slates of the Sierra Nevada: Geol. Soc. America Bull., vol. 5, p. 254, 1894.

² Hyatt, Alpheus, Trias and Jura in the Western States: Idem, pp. 407-413.

Cardioceras-bearing beds of British Columbia.—The three species of *Cardioceras* identified from British Columbia are in one collection accompanied by a species of *Aucella* related to *Aucella bronni* Quenstedt and by fragments of a belemnite. As the matrix of the ammonites is very different from that of the specimens of *Aucella* it is quite justifiable to assume that the conditions prevalent elsewhere obtain here and that there are two different horizons represented in the collection. The beds containing the species of *Cardioceras* are of the same age as the Sundance formation, whereas

The accompanying table presents these correlations in compact form.

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 Douvillé, Robert, Étude sur les Cardiocératidés de Dives, Villers-sur-Mer, et quelques autres gisements: Soc. géol. France, Paléontologie, vol. 19, fasc. 2, Mém. 45, 1912.

Correlation of European and North American strata.

	Europe.				Alaska.	British Columbia.	United States.
	Buckman. ^a	Haug. ^b	De Lapparent. ^c	Most continental stratigraphers.			
		Kimmeridgian.	Kimmeridgian.	Kimmeridgian.	(?)	(?)	(?)
Zone of <i>Amoeboceras</i> .	Kimmeridgian.	Lusitanian.	Sequanian.	Upper Oxfordian.	Naknek formation.	Zone of <i>Aucella</i> cf. <i>A. bronni</i> .	Mariposa slate.
Zone of <i>Cardioceras</i> .	Argovian.	Upper Oxfordian.	Upper Oxfordian.	Lower Oxfordian.	(?)	Zone of <i>Cardioceras</i> .	Sundance formation.
Zone of <i>Quenstedticeras</i> .	Divesian.	Lower Oxfordian.					Ellis formation. ^e
Zone of <i>Cosmoceras</i> .	Callovian.	Callovian.	Callovian.	Callovian.	Chinitna shale. ^d	(?)	

^a Buckman, S. S., Geol. Soc. London Quart. Jour., vol. 69, p. 160, 1913.

^b Haug, Émile, Traité de géologie, vol. 2, fasc. 2, p. 998, 1910.

^c De Lapparent, A. A. C., Traité de géologie, pt. 2, livre 1, p. 1289, 5th ed., 1905.

^d May include Middle Jurassic.

^e Relations to Sundance formation uncertain. (See p. 10.)

those containing *Aucella* are probably of the age of the Mariposa slate.

Cardioceras-bearing beds of the Naknek formation of Alaska.—The four species of *Cardioceras* and one variety from the lower part of the Naknek formation warrant the correlation of the zone containing them with the Sundance and with the *Cardioceras* zone of British Columbia. As the overlying part of the Naknek formation contains *Aucella*, it probably is equivalent at least in part to the Mariposa slate and the *Aucella* zone of British Columbia.¹

¹ Stanton, T. W., and Martin, G. C., Mesozoic section on Cook Inlet and Alaska Peninsula: Geol. Soc. America Bull., vol. 16, p. 407, 1905.

Healey, Maud, *Ammonites (Cardioceras) excavatus* Sowerby *Ammonites (Cardioceras) vertebralis* Sowerby, *Ammonites (Cardioceras) cordatus* Sowerby: Paleontologia Universalis, pls. 92-94, 1905.

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SYSTEMATIC DESCRIPTIONS.

Family CARDIOCERATIDAE H. Douvillé.

The term *Cardioceratidae* was attributed by Robert Douvillé¹ in his discussion of the group to Henri Douvillé,² who characterized the family as a "polymorphic group, the origin of which is still uncertain, and which appears in the Callovian; aperture of the shell simple, without lappets or rostrum."³ He included in the family the genera *Macrocephalites*, *Cadoceras*, *Stephanoceras* (= *Stepheoceras*), *Cardioceras*, and *Reineckia* (including *Spiticeras*).

In 1892 Hyatt⁴ applied the name to a group including *Cardioceras*, *Cadoceras*, *Quenstedticeras* (= *Quenstedticeras*), and *Neumayria* Nikitin (not Bayle) but gave no discussion.

In 1900 Hyatt⁵ grouped under the name *Cadoceratidae* the same genera which in 1892

he put into the family *Cardioceratidae* and added the genus *Amoeboceras* to include the group of *Ammonites alternans* von Buch.

In 1912 Robert Douvillé⁶ included under the term *Cardioceratidae* the genera *Macrocephalites*, *Cadoceras*, *Chamoussetia*, *Stepheoceras*, *Pachyceras*, *Quenstedticeras*, and *Cardioceras* (including *Amoeboceras* Hyatt), and characterized the group as follows:

Aperture of shell simple, without lateral lappets or rostrum. * * * Costae continuous on the ventral region; no external nor ocular tubercles; lateral tubercles may or may not be present; the keel is never really individualized (as it is, for example, in *Amaltheus* of the group *margaritatus*).

The enrollment is subject to great variation. The living chamber of individuals of large size is normally scaphitoid in the genera *Macrocephalites*, *Pachyceras*, *Cardioceras*, and in certain early species of *Quenstedticeras* (*Q. carinatum*). The suture possesses generally archaic characters; in other words, the several elements are all similar, with parallel axes perpendicular to the radius, simply decreasing in size in approaching the umbilicus. Only in *Stepheoceras* and *Pachyceras* do these different elements commence to be individualized. * * * On the contrary, the sutures of the genera *Cadoceras*, *Quenstedticeras*, and *Cardioceras* are almost identical.⁷

It seems to the writer that the keel of *Amoeboceras* Hyatt does become individualized, but otherwise the description applies very well.

The following summary gives the principal diagnostic characters of the genera which Douvillé includes in the family.

Macrocephalites von Sutner; type *M. macrocephalus* (Schlotheim): Shell large, involute; increases markedly in circumference, and the external side is broad and rounded; scaphitoid in adult. Umbilicus narrow and deep in typical forms but wide in some Asiatic species. Umbilical shoulders invariably rounded. Aperture semilunate. All whorls regularly covered with numerous sharp ribs, which divide one or more times near the umbilicus and pass straight out and across the venter. In typical forms the ribs tend to become attenuated near the umbilicus; in others they tend to be accentuated near the umbilicus. Sutural features not generic.

Cadoceras (Fischer) Nikitin; type *C. modiolare* (Luidius): Youngest whorls of shell rounded; next older whorls show elevated cross section; latest whorls enlarged in the umbilical region so that cross section is lower.

¹ Douvillé, Robert, Étude sur les Cardiocératidés de Dives, Villers-sur-Mer, et quelques autres gisements: Soc. géol. France, Paléontologie, vol. 19, fasc. 2, Mém. 45, p. 11, 1912.

² Douvillé, Henri, Notes pour le cours de paléontologie, professé à l'École des mines en 1889-90, 1890.

³ Translated from quotation by R. Douvillé.

⁴ Hyatt, Alpheus, Jura and Trias at Taylorsville, Cal.: Geol. Soc. America Bull., vol. 3, p. 410, 1892.

⁵ Von Zittel, K. A., and Eastman, C. R., Textbook of paleontology, p. 580, 1896.

⁶ Douvillé, Robert, op. cit., p. 11, 1912.

⁷ Translation.

Typical aspect of adult is globular. Cross section of whorl may narrow ventrally in some species but is never pinched or keeled. Living chamber of adult smooth. Umbilicus narrow. Umbilical shoulders of adult sharp. Ribs rather straight on younger whorls, bend forward in an arc on older whorls but show no siphonal sinus. Primary ribs usually bifurcate, though in some specimens simple primary ribs are present. No intercalated secondary ribs. Umbilical tubercles do not appear before a relatively advanced age. Sutural characters not generic.

Chamoussetia R. Douvillé; type *C. chamouseti* (D'Orbigny): Shell flattened laterally. Venter narrow; pinched above the region where the shell attains a diameter of 60 or 70 millimeters. Umbilicus narrow; umbilical shoulders overhang the line of involution at the stage where the shell has a diameter of 80 to 90 millimeters. Ribs well marked only on young and quite straight; lacking on flanks above the stage where the diameter of the shell is 30 to 40 millimeters. First and second lateral saddles of the suture equal in height.

Quenstedticeras Hyatt; type *Q. lamberti* (Sowerby): Inner whorls rounded, next whorls more or less narrowed externally but not pinched and keeled. In adults the ventral region is rounded again and in no species is sharp. Living chamber of large forms smooth. Aperture has a ventral crest in young. In young the ribs are invariably sickle-shaped and on the external region have a distinct siphonal sinus. With greater age the ribs become straighter. The umbilical ribs usually fork and there are usually intercalated secondary ribs which do not extend to the umbilicus. Costae not tuberculate. Sutural characters not generic.

Cardioceras Neumayr and Uhlig; type *C. cordatum* (Sowerby): Older whorls rounded, younger whorls sharp-ventered and in many species pinched into a keel. Adult is invariably sharp-ventered. Living chamber of adult smooth. Umbilicus wide only in youth. Umbilical shoulders of adult sharp and overhang the line of involution. Ribs well marked on young of many species at the stage where the shell has a diameter of 10 millimeters; usually sickle-shaped. Older individuals have straighter ribs, commonly tuberculate. Ribs

usually bifurcate once (some of them twice) and usually show a sharp siphonal sinus. Sutural features not generic.

Amoeboceras Hyatt; type *A. alternans* (von Buch): Like *Cardioceras* except that the ribs disappear on the venter, leaving two smooth bands bordering the keel, whose crenulations therefore appear to have no relation to the ribs. The umbilical ribs are straight and usually simple to the venter; the secondaries arise between them independently.

Stepheoceras Buckman; type *S. coronatum* (Bruguière): Shell stout or much depressed; venter broadly rounded; in no species sharp or keeled. Living chamber of adults in some species ornamented by more or less distinct ribs; in other species smooth. Umbilicus invariably wide; some species have sharp tuberculated umbilical shoulders. Young whorls in nearly all species tuberculate; ornamentation of young and adult whorls practically the same. The ribs are nearly straight and regularly bifurcated. Suture in some species has a very wide second lateral saddle, but in others it is narrow.

Pachyceras Bayle; type *P. lalandei* (D'Orbigny): Shell variable in form, either elevated or much depressed. Older whorls rounded; with age they become narrowed ventrally and in some species even sharp. Living chamber is ornamented by ribs, feeble in some species, very stout in others. Adult scaphitoid. Sculpture consists of stiff, straight, blunt ribs starting from the umbilical shoulder and passing over the venter without any trace of a sinus. Some species show tubercles at the umbilical shoulders.

In recent papers Buckman¹ assigns *Stepheoceras* (type *Ammonites humphresianus* Sowerby, not *A. coronatus* Bruguière, which is the type of *Erymnoceras*) to the family Stepheoceratidae Neumayr; the genera *Pachyceras*, *Macrocephalites*, with *Tornquistes* and *Erymnoceras*, to the family Pachyceratidae Buckman; and the genera *Cadoceras*, *Quenstedtoceras* [= *Quenstedticeras*], *Chamoussetia*, *Cardioceras*, *Amoeboceras*, with the new genera *Pseudocadoceras*, *Longaeviceras*, *Pronsiceras*, *Eboraciceras*, and *Vertumniceras*, to the family Cadoceratidae Hyatt. Buckman considers Cardioceratidae H. Douvillé as of doubtful validity through

¹ Buckman, S. S., Yorkshire type ammonites, Part XV, pp. xi, xii; Part XVI, desc. 116; Part XVII, pp. xiii, xiv, desc. 117, 118, 1918.

technical lack of publication, but inasmuch as Hyatt himself used the term *Cardioceratidae* in 1892 (see above) with the same scope as his later term *Cadoceratidae*, the former should stand even if Douvillé's usage is not accepted as establishing it. None of the species considered in this paper will fall within the new genera, which Buckman characterizes as follows:

Genus PSEUDOCADOCERAS Buckman.

Type, *Am. longaevus* Bean, syntype=*P. boreale*, Y. T. A. CXXIb.

Syn. *Cadoceras* pars, Auctt. The *Grewingki* series, S. Buckman, 1913, 162.

A cadoceratid series like young *Cadoceras*, but not developing cadicone stage, only feeble inflation; the catagenetic feature of excentrumbilication, commencing almost as soon as swelling, would prevent any cadicone development. (Suture line (D'Orbigny, 1848, CLXXIX, 9) rather simple, L1 same length as EL, L2 short and broad.)

Genus LONGAEVICERAS Buckman.

Type, *Am. longaevus* Bean, lectotype, Y. T. A. CXXIa.

A cadoceratid series like *Pseudocadoceras* but prorsiradiate, attaining only to feeble swollen stage. Develops oxycone?

R. Douvillé (1912, p. 21) reckoned *Am. galdrynus* as a *Chamoussetia*, but its lack of inflation indicates a different stock. It is an involute development either of the present genus or of a parallel series; for this one may end without developing keel. *Am. funiferus* Phillips, 1829, vi, 23, is prior name for *Am. galdrynus*.

Genus EBORACICERAS Buckman.

Type, *A. dissimilis* Brown, holotype, Y. T. A. CXVIIIa.

A cadoceratid series which develops considerable inflation but does not attain to cadicone. Versi-, subflexiradiate, ribs of low relief, primaries short, secondaries angulate on periphery but straightening out in swollen stage; obsolescence follows. L1 rather narrow stemmed, longer than EL; L2 quite short, rather broad (cf. D'Orbigny, CLXXVI, 3). *Eboracum*, York.

Genus PROSICERAS Buckman.

Type, *Am. gregarius* Leckenby, lectotype, Y. T. A. CXVIIa.

A cadoceratid series swelling in serpenticone stage, presumably not attaining inflation of *Eboraciceras* by some 10 per cent. Marked prorsiradiation. Well-developed arcuation of ribs on narrowish rounded venter. Whorls convergent. Suture line with rather short, broad lobes, L1 about as long as EL, L2 fairly developed.

Chamoussetia, which is much earlier in date, has remains of similar prorsiradiation. Apart from date it could not be involute development, for present genus gives no sign of attaining the much swollen galeatiform whorl with distinct carination.

Genus VERTUMNICERAS Buckman.

Type, *Am. vertumnus* Leckenby, holotype, Y. T. A. CXVIa.

A cadoceratid series distinguished by coarse subflexicostae which are strong on venter, where they form a herring-bone pattern rising to a slight discontinuous ridge. (Suture line with long L1 and quite short L2, *V. spatiatum*, CXVIc.)

The forms described in this paper belong largely to the genus *Cardioceras*. Two species have a rounded venter in the adult stage and are referred with doubt to *Quenstedticeras*. They differ from the normal representatives in the obscure keel that is present in the younger stages and in this respect are like *Quenstedticeras? goliath* (D'Orbigny). Three species have rounded whorls in the younger stages and a sharp venter in the adult but do not show the suture and sculpture of *Pachyceras* and are referred with doubt to *Cardioceras*. One species is a typical *Amoeboceras* and one a typical *Quenstedticeras*.

Genus QUENSTEDTICERAS Hyatt.

Quenstedticeras collieri Reeside, n. sp.

Plate I, figures 1-8.

Shell compressed; venter quite narrow but not sharp or keeled. Cross section of whorl oval, higher than wide. Umbilicus wide; umbilical shoulders evenly rounded. Living chamber and aperture unknown.

Sculpture regular. Where the diameter of the shell is less than 8 millimeters the exposed flanks of the whorl are smooth. Where the diameter is more than 8 millimeters fairly sharp ribs rise within the umbilicus, bend backward a little, then pass out over the flanks in a shallow forward curve to the venter, where they bend forward to form chevrons. Some of the ribs fork at the middle of the flank, and at about the same position a few intercalated secondary ribs rise. An entire rib has a sigmoid form.

The suture has a narrow siphonal lobe. First lateral saddle a little broader than siphonal lobe; first lateral lobe about same width as siphonal lobe but longer; remaining elements small. Suture little incised. Radius cuts first lateral lobe.

This species is based on young specimens only but is worthy of description as a member of the group of *Quenstedticeras lamberti* Sowerby. It differs from this typical species

mainly in the paucity of intercalated ribs. Its sculpture and the form of the whorl separate it from any other American species.

The species is named for Mr. A. J. Collier, of the United States Geological Survey, who collected the type.

All specimens from Ellis formation.

Localities: Type, sec. 7, T. 25 N., R. 26 E., Blaine County, Mont.; also a number of poorly preserved fragments. Sec. 27, T. 25 N., R. 26 E., Blaine County, Mont., one small specimen and a number of fragments.

Quenstedticeras? hoveyi Reeside, n. sp.

Plate I, figures 9-14; Plate II, figure 1.

1906. *Ammonites (Aegoceras) subtumidum* Whitfield and Hovey (part), Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 400, pl. 62 (not pls. 60, 61).

Shell stout, venter rounded. Earliest whorls depressed; at 16 millimeters diameter the cross section is circular and there is a shallow pinching of the venter; where the diameter is more than 16 millimeters the whorls are well rounded, a little wider than high. Type is entirely septate, but a specimen 190 millimeters in diameter referred to this species has last three-eighths of final whorl unseptate; aperture is unknown. The whorls of the specimen last mentioned are a little broader proportionately than those of the type. Umbilicus narrow, in width one-half height of outer whorl. At extreme end of the large specimen width of the umbilicus is only one-third height of outer whorl. Umbilical shoulders well rounded to a diameter of perhaps 20 millimeters, then inner slope is steep. In mature individuals umbilical shoulders overhang.

Sculpture consists of straight, short, broadly rounded umbilical ribs that fork close to the umbilicus into two or three rounded secondaries, which pass out to the venter and bend forward to make a shallow siphonal sinus. Intercalated secondaries uncommon. On the larger specimen, at a diameter of 120 millimeters, the umbilical ribs have vanished, but the ventral ribs are visible and show a faint sinus. At a diameter of 140 millimeters and more the whorl is smooth.

The suture has a wide siphonal lobe; first lateral saddle as wide as the siphonal lobe; first lateral lobe relatively narrow and a little longer than the siphonal lobe; second lateral saddle about as wide as first lateral saddle; second lateral lobe relatively small; auxiliaries small. Suture deeply incised. Radius just cuts first lateral lobe.

This species is marked by its narrow umbilicus, short umbilical ribs, and the wide superior saddle of the suture. It may include the form figured by Whitfield and Hovey in Plate LXII of their paper. The writer has had the opportunity of comparing the original specimen with his types and finds it to agree in form and suture, though the lack of the earlier whorls and the crushing of Whitfield and Hovey's specimen introduce some doubt. The species differs from *Quenstedticeras? suspectum* Reeside in its narrow umbilicus and wide superior saddle. It differs from all foreign species in the form of the umbilicus but seems to be related to *Quenstedticeras? goliath* (D'Orbigny) in the obscure angulation on the venter of the young produced by the shallow pinching. The round-ventered adult points to the genus *Quenstedticeras*, but the young stages are not normal for the genus, and the reference is therefore questioned.

This species is named for Mr. E. O. Hovey, of the American Museum of Natural History.

All specimens from Sundance formation.

Localities: Type, foothills west of Bear Lodge Mountains, Crook County, Wyo.; also, another specimen. Near Aurora (Ridge), Wyo.; large specimen figured in Plate II and one small one. Belle Fourche River, opposite mouth of Inyankara Creek, Crook County, Wyo.; one large specimen figured by Whitfield and Hovey. (This locality is probably identical with locality 8 of list on page 9, half a mile northeast of the Johnson horse ranch, Belle Fourche River, Crook County, Wyo.) Near the Grand Canyon of the North Platte, Natrona County, Wyo.; one small specimen. A locality 1½ miles north of Red-water Creek, near the south boundary between Dakota and Wyoming, in Wyoming.

**Quenstedticeras? subtumidum (Whitfield and Hovey)
Reeside.**

Plate IV, figures 1-4.

1906. *Ammonites (Aegoceras) subtumidum* Whitfield and Hovey (part), Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 400, pl. 60, figs. 3, 4. (Not pl. 60, fig. 5; pl. 61, figs. 1, 2; pl. 62.)

Whitfield and Hovey's description is as follows:

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, figures 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.

Shell moderately stout. Venter concealed in type where diameter is less than 50 millimeters; at the diameter of 50 millimeters it is quite sharp but not pinched; it becomes more rounded with increase in size and at the diameter of 70 millimeters is broadly rounded and a little wider than high. Last half-whorl preserved unseptate; aperture unknown. Umbilicus narrow, in width a little more than half the height of the outer whorl. Umbilical shoulders evenly rounded in younger whorls to a diameter of perhaps 30 millimeters; then inner slope is abrupt.

Sculpture consists of rather coarse, straight, rounded umbilical ribs which fork at about one-third the distance to the middle of the venter into two, rarely three, rounded secondaries. Intercalated secondary ribs are common. The secondaries pass outward to the venter and swing forward to form a chevron, sharp at 50 millimeters diameter but rounded at and above the diameter of 70 millimeters. The sculpture is persistent on the unseptate part of the type. There are 16 primary and 48 secondary ribs to each whorl on the type.

The suture has a moderately wide siphonal lobe; wider first lateral saddle; first lateral lobe narrower than the first lateral saddle; remaining elements small. Radius just touches the first lateral saddle.

This species is characterized by its coarse sculpture and sharp but unpinched venter, which becomes rounded with increase in size. It seems to be a normal *Quenstedticeras* in the lack of pinching and in the rounding of the venter with age, but as the innermost whorls have not been seen the reference is questioned. The writer has at hand the four specimens figured by Whitfield and Hovey. The original of Plate LX, figures 3 and 4, of their paper, should receive the name, though inappropriate, of *subtumidum*, as the originals of the remaining figures are distinct from it and from one another. The species is easily distinguished from *Quenstedticeras? hoveyi* Reeside and *Q. suspectum* Reeside by the form of the whorls. It differs from *Quenstedticeras? goliath* (D'Orbigny) De Loriol¹ only in the number of ribs to the whorl and the sharper umbilical shoulders.

The type is in the American Museum of Natural History, New York City.

Locality: Type, Sundance formation, Belle Fourche River, opposite the mouth of Inyan-kara Creek, Crook County, Wyo. This locality is apparently the same as that half a mile northeast of the Johnson horse ranch, on Belle Fourche River. (See No. 8 in list of localities, p. 9.)

Quenstedticeras? suspectum Reeside, n. sp.

Plate II, figures 2-4; Plate III; Plate IV, figures 5-7; Plate V, figures 1-2.

Shell robust, stout; venter rounded. Early whorls up to 8 millimeters diameter, broad and depressed; from 8 to 12 millimeters in diameter broadly rounded with venter faintly pinched, and subangular; above 30 millimeters whorls are very stout, rounded, wider than high. The specimen shown in Plate II, figures 2-4, is entirely septate, but another individual 260 millimeters in diameter, referred to this species (Pl. III, figs. 1, 2) shows half a whorl unseptate, very stout, and scaphitoid; aperture unknown. Umbilicus moderately wide, in width three-fifths the height of the outer whorl. Umbilical shoulders gently rounded in early whorls to the stage where the diameter is 20 or 25 millimeters, then inner slope is steep, straight, and eventually becomes very high and finally overhangs the umbilicus.

¹ De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *Am. renngeri*) du Jura bernois, I. Schweizer. paléont. Gesell. Abh., vol. 25, No. 6, p. 24, pl. 2, fig. 15, 1898.

Sculpture of early whorls regular. Where the diameter is less than 8 millimeters, the whorls are smooth. Where the diameter is greater than 8 millimeters, distinct ribs are present on the exposed area of the whorls. These high, rounded ribs rise within the umbilicus, pass outward with little curve about one-third the distance to the venter, fork, pass almost to the median line of the venter, then bend forward to form a shallow, rounded sinus. Intercalated secondary ribs are common. On the younger subangular whorls the sinus is quite angular and is really a broad chevron. Where the diameter is greater than 80 millimeters, the ribs of the specimen shown in Plate IV, figures 5-7, gradually become lower and more rounded, and are much less distinct where the diameter is 120 millimeters. Other specimens, which agree very well in every other particular with the last, have throughout the younger stages somewhat coarser and more rounded ribs. On the large specimen preserving part of the living chamber it is marked only by faint striae. There are from 22 to 30 primary ribs to the whorl.

The suture has a relatively wide siphonal lobe; first lateral saddle and first lateral lobe narrow, subequal in width; first lateral lobe a little longer than the siphonal lobe; second lateral saddle and lobe small; auxiliaries small. Suture deeply incised. The radius just cuts the first lateral lobe.

The chief characters of this species are the stout, persistently rounded whorls, the moderately wide umbilicus, and the regular sculpture, which is clearly visible to the region where the diameter is at least 120 millimeters. It is related to the form described as *Quenstedticeras? hoveyi* Reeside but differs in having lower whorls and a much wider umbilicus. It differs from all the European species, judged by published figures, in the form of the umbilicus, though it is related to *Quenstedticeras? goliath* (D'Orbigny) in the obtuse angulation of the younger whorls. As in the species *hoveyi* Reeside, the adult is like a normal *Quenstedticeras*, but the young are not.

All specimens from Sundance formation.

Localities: Type locality, near Aurora (Ridge), Wyo.; also two other specimens and a number of fragments. Locality half a mile northeast of the Johnson horse ranch, Belle Fourche River, 25 miles west of Sundance,

Wyo.; specimen 300 millimeters in diameter doubtfully referred to this species and the original of Plate III.

Quenstedticeras? tumidum Reeside, n. sp.

Plate IV, figures 8-10; Plate V, figures 3, 4.

1906. *Ammonites (Aegoceras) subtumidum* Whitfield and Hovey (part), Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 400, pl. 60, fig. 5. (Not pl. 60, figs. 3, 4; pl. 61; pl. 62.)

Shell very stout. Innermost whorls not seen. Where diameter is more than 30 millimeters, cross section of whorls is broad, evenly rounded. Type entirely separate; aperture unknown. Umbilicus broad in young but narrow in adult; its width is three-fourths the height of the outer whorl. Umbilical shoulders well rounded at the diameter of 30 millimeters but become fairly sharp and have steep inner slope at perhaps 40 millimeters.

The sculpture at the diameter of 30 millimeters consists of coarse, rounded primary ribs which begin within the umbilicus and rise into a moderately high elongated node at the middle of the flank. From each node three, rarely two, rounded secondary ribs pass out across the broad venter and bend forward to form a shallow rounded sinus. Intercalated secondaries are common. There would be 18 to 20 primary ribs and 60 to 65 secondaries on a complete whorl at the diameter of 30 millimeters. At the diameter of 50 millimeters the primary ribs show very faintly on the high umbilical wall and do not rise into a node on the flank; the secondaries are as on the younger whorls, though practically straight. At the diameter of 75 millimeters the umbilical ribs show as low, broad swellings near the umbilical shoulders and the secondaries pass as faint straight ridges across the venter. At the diameter of 100 millimeters the whorl is smooth.

The suture has a siphonal lobe; first lateral saddle and first lateral lobe of equal width. The first lateral lobe and the siphonal lobe equal in length. The second lateral saddle and other elements small. The radius barely cuts the first lateral lobe. Suture moderately incised.

The swollen form, fine ventral ribs, and nodose younger whorls mark this species. The whorls visible have the characters of a normal *Quenstedticeras*, but until the absence of pinching on the whorls where the diameter is

less than 30 millimeters is known the reference should be questioned. The form and sculpture distinguish this species from related American species. The closest foreign relative, at least in form, is *Quenstedticeras carinatum* Eichwald. If the inner whorls of this specimen are not pinched, it is the only true *Quenstedticeras* from the Sundance formation that the writer has seen and would indicate that the Ellis formation of Montana has in some places an equivalent in the lower part of the Sundance.

The type and only specimen is in the American Museum of Natural History, New York City.

Locality: Type, Sundance formation, Red Canyon, south of Mathias Peak, South Dakota (probably sec. 34, T. 3 S., R. 7 E., Fall River County).

Genus *CARDIOCERAS* Neumayr and Uhlig.

Cardioceras alaskense Reeside, n. sp.

Plate VI, figures 7-10.

Shell much compressed, venter pinched and keeled. Cross section of whorls at the diameter of 15 millimeters oval, a little higher than wide, sharp-ventered; at the diameter of 40 millimeters much compressed, flanks subparallel, venter pinched, width about four-sevenths the height; later whorls more triangular, much higher than wide. Type entirely septate. Umbilicus narrow, in width one-fourth the height of the outer whorl. Umbilical shoulders gently rounded to the diameter of 20 millimeters, then sharper; the steep inner slope increases in height and finally overhangs the umbilicus.

Ventral sculpture of whorls where the diameter is less than 10 millimeters not seen; umbilical ribs visible at the diameter of 7 or 8 millimeters. These low, rounded umbilical ribs pass first backward, then radially to the middle of flank, where they fork. The secondaries pass to the venter and curve sharply forward to cross the keel as crenulations. At the diameter of 15 millimeters there are 26 umbilical ribs to the whorl. At the diameter of about 50 millimeters the umbilical ribs are still distinct. At the diameter of 80 millimeters the umbilical ribs are practically absent, but at the middle of the flank the low, rounded secondaries rise, pass outward and then forward, making crenulations on the keel.

The youngest part of the type, at the diameter of perhaps 100 millimeters for the entire shell, is practically smooth and has a crenulated keel. There would be 60 or 70 secondaries on a complete whorl at the diameter of 80 millimeters.

The suture is much incised; the siphonal lobe is wide, the first lateral saddle narrower; the first lateral lobe is longer than the siphonal lobe and as wide as the first lateral saddle; other elements small. The radial line cuts the first lateral lobe.

This species is best recognized by its peculiar compressed form with pinched venter and narrow umbilicus. In form *Cardioceras vagum* Ilowaisky¹ is quite like this species but is a little more compressed, has fewer secondaries, and wider umbilicus.

Locality: Lower part of Naknek formation, east shore of Oil Bay, Cook Inlet region, Alaska.

Cardioceras americanum Reeside, n. sp.

Plate VI, figures 15-20.

Shell compressed, discoidal. Type has maximum diameter of 50 millimeters. Whorl shows a triangular cross section, higher than wide; venter slightly pinched, sharp; sides almost straight from umbilicus to keel. Younger whorls concealed in type, but in another specimen are seen to be first depressed, then almost circular in cross section. Venter sharp at the diameter of about 8 millimeters, and where the diameter is more than 8 millimeters the whorls are high, compressed, and sharp ventered. Living chamber and aperture unknown. Umbilicus narrow, in width about half the height of the outer whorl. Umbilical shoulders gently rounded to the diameter of about 25 millimeters, then umbilical shoulders become sharp and umbilical walls steep.

Sculpture feeble but very irregular. On the type low, broad ribs rise at the umbilical shoulders and pass to the middle of the flank, where they fork into three low, rounded secondaries. Between these bundles intercalated secondaries rise. All bend evenly forward to cross the sharp venter as crenulations, and here and there a secondary forks just before it reaches the middle of the venter. The last whorl of the type has 17 primary ribs and about 75 crenulations on the sharp venter. Other specimens show fine ventral ribs at the diameter of 10 milli-

¹ Ilowaisky, David, L'Oxfordien et le Séquanien des gouvernements de Moscou et de Riasan: Soc. imp. nat. Moscou Bull., new ser., vol. 17, p. 270, pl. 11, fig. 1, 1903.

meters, but the umbilical ribs do not begin until the diameter reaches 20 to 25 millimeters.

The suture has a very wide siphonal lobe, narrower first lateral saddle, and still narrower first lateral lobe. The second lateral saddle is about as wide as the first lateral lobe, the second lateral lobe is quite narrow, and the auxiliaries feeble. The siphonal lobe is the longest and the radius to it does not touch the other lobes.

Cardioceras americanum is best recognized by its high, triangular, flat-sided cross section, regular but low sculpture, and by the sutural proportions. It is distinguished from *Cardioceras cordiforme* (Meek and Hayden) in its more compressed form, finer and less elevated ribs, more abrupt umbilical shoulders, and long siphonal lobe of the suture; from *Cardioceras whitfieldi* Reeside by the coarser and more persistent sculpture, relatively coarse crenulations on the venter, and by the suture. It differs from *Cardioceras excavatum* (Sowerby) Lahusen¹ in the smaller number of umbilical ribs and the wider and steeper-walled umbilicus but is otherwise very close; from *Cardioceras excavatum* (Sowerby) Bukowski² by the apparently weaker sculpture, flatter-sided whorls, and steep umbilical shoulders; from *Cardioceras cordatum* (Sowerby) D'Orbigny³ in the relative length of the siphonal lobe and form of umbilical shoulder.

Locality. Type and four other specimens from Sundance formation, 4 miles west of Sundance, Wyo.

***Cardioceras auroraense* Reeside, n. sp.**

Plate X, figures 1-5.

Shell compressed, keeled. Cross section of adult whorl triangular, wider than high; earlier whorls fairly stout. Living chamber and aperture not preserved. Umbilicus narrow, in width about half the height of outer whorl of adult; in earlier whorls umbilicus apparently wider. Umbilical shoulders sharp and high on later whorls.

¹ Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasan-schen Gouvernements: Com. géol. [Petrograd] Mém., vol. 1, No. 1, p. 48, pl. 5, fig. 2, 1883.

² Bukowski, Gejza, Über die Jurabildungen von Czenstochau in Polen: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, Band 5, p. 130, pl. 26, figs. 21, 22, 1887.

³ D'Orbigny, Alcide, Paléontologie française; Terrains jurassiques, vol. 1, p. 514, pl. 193, 1850-1860.

Sculpture of whorls where the diameter is less than 80 millimeters unknown. On younger whorls it consists of high, sharp umbilical ribs which rise to a maximum at the middle of the flank, bifurcate, pass to the venter, where they are raised slightly, then bend forward to cross the keel as crenulations. Intercalated secondaries are common. On the last whorl of the type the ribs decrease in distinctness and are almost imperceptible at the end. On the fragment figured the youngest part preserved is perfectly smooth. The type has 15 primary ribs and about 45 secondaries to the whorl.

The suture shows a relatively wide siphonal lobe, wide first lateral saddle, short and narrow first lateral lobe, small second lateral saddle and second lateral lobe; auxiliaries small. The radius just touches the first lateral lobe.

This species is based on a partly crushed, weathered individual, which is about 120 millimeters in maximum diameter, and on an apparently normal mold of part of another, which shows part of three whorls. The material is poor, but the great lateral compression of the whorls, much more than the crushing would account for, together with the high, sharp sculpture and the suture, separate it from the other species at hand. *Cardioceras plattense* Reeside and *Cardioceras schucherti* Reeside are related but are both less compressed. *Cardioceras plattense* has coarse primaries which divide nearer the umbilicus; *Cardioceras schucherti* has perhaps twice as many secondary ribs for the same number of primary ribs. *Cardioceras cordatum* (Sowerby) Lahusen⁴ is related but has a somewhat different cross section and more ribs; *Cardioceras cordatum* (Sowerby) var. *a* De Loriol⁵ has more ribs; *Cardioceras nikitinianum* Lahusen⁶ is very close in form to our species. *Cardioceras cordatum* (Sowerby) as refigured by Healey⁷ is strikingly like this species except that it is much stouter.

Localities: Type, Sundance formation, Aurora (Ridge), Wyo. (Hyatt and Russell); Como Bluff, near Aurora (Ridge), Wyo. (C. Schuchert).

⁴ Lahusen, Joseph, op. cit., p. 49, pl. 5, fig. 3, 1883.

⁵ De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *Am. renggeri*) du Jura bernois, I: Schweizer. paleont. Gesell. Abh., vol. 25, No. 6, p. 16, pl. 2, figs. 1-3, 1898.

⁶ Lahusen, Joseph, op. cit., p. 49, pl. 5, fig. 8.

⁷ Healey, Maud, Paleontologia Universalis, pls. 94, 94a, 1905.

Cardioceras bellefourchense Reeside, n. sp.

Plate XI, figures 1, 2; Plate XII, figures 1, 2.

1906. *Ammonites (Amaltheus) cordiformis* Meek and Hayden (part). Whitfield and Hovey, Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 401, pls. 58, 59. (Not pls. 52-56, 60.)

Shell stout; venter angular in all stages above 10 millimeters in diameter, which are the only stages seen; not pinched where the diameter is more than 40 millimeters and not much so below that diameter. Cross section of early whorls oval, keeled, higher than wide; at the diameter of 35 millimeters well rounded, subequal in width and height; at the diameter of 50 millimeters broadly cordiform with obscure ventral shoulders; at the diameter of 70 millimeters and more rounded cordiform, width greater than height, ventral angle obtuse. Last one-eighth whorl of type unseptate, aperture unknown. Umbilicus wide in young stages, narrow in adult; width about half the height of outer whorl. Umbilical shoulders gently rounded where the diameter is less than 40 millimeters; where it is more than 40 millimeters the inner slope is flat. At the diameter of 90 millimeters the inner slope is parallel to the axes, but at the maximum diameter of the specimen, 130 millimeters, it overhangs the umbilicus.

Sculpture regular. Umbilical part of earlier whorls shows high rounded ribs. Last whorl of type has coarse, high, rounded umbilical ribs on the older half, but on the younger half these gradually decrease in height and distinctness and are practically lacking on the unseptate part. At one-third the distance from umbilicus to venter, these primary ribs divide into two, rarely three, rounded secondary ribs which first pass outward and then bend rather sharply forward to form chevrons on the sharp venter. Toward the end of the last whorl these secondary ribs also become less distinct, though still clearly visible. There are some intercalated secondaries, and a few secondaries fork on the venter. It is probable that the living chamber is smooth finally. There are 15 umbilical ribs and about 45 secondaries on the last whorl of the type, though the inner whorls show more primaries.

The suture shows a wide siphonal lobe; first lateral saddle and first lateral lobe about equal in width, both narrower than the siphonal

lobe; first lateral lobe longer than the siphonal; second lateral saddle of medium size; second lateral lobe and auxiliaries small. The radius cuts the first lateral lobe and touches the second.

Cardioceras bellefourchense is best recognized by its broad, rounded whorls with sharp venter, coarse, rounded ribs, and the proportions of the suture. It differs from *Cardioceras crassum* Reeside in the form of the whorls, especially the inner whorls, and in the relative widths of the superior saddle and amount of incision of the suture; from *Cardioceras plattense* Reeside in lacking the second bifurcation; from *Cardioceras russelli* Reeside in the coarser sculpture and different suture. The writer knows no foreign forms like this species.

Locality: Type, Sundance formation, half a mile northeast of the Johnson horse ranch, Belle Fourche River, 25 miles east of Sundance, Wyo.

Cardioceras canadense Whiteaves.

Plate XVII, figures 5-11.

1903. *Cardioceras canadense* Whiteaves, Ottawa Naturalist, vol. 17, pp. 65-67, figs. 1, 1a.

Whiteaves described this species as follows:

Shell, at least in its immature stage, compressed, shallowly and rather widely umbilicated, with a small and minutely crenulated keel. Whorls about five, increasing rather rapidly in size and rather strongly embracing, about one-half the sides of the inner ones being covered by the overlap of those that succeed them. Umbilicus occupying about one-third of the entire diameter, on each side, though its margin is rounded and very indistinctly defined; peripheral carina neither very prominent nor distinctly compressed.

Surface of each side of the outer volution marked with a few comparatively large and distant but narrow and acute primary radiating ribs, that commence at the suture and terminate about halfway across, in a small pointed tubercle. Of these ribs there are about ten in the specimen figured. Besides them there are rather more than twice as many small short secondary ribs, that are little more than narrow, transversely elongated, compressed and acute tubercles, on the outer half of each side. The primary ribs almost bifurcate from a median tubercle, and seem to occasionally alternate with an intercalated secondary rib, but the secondary ribs are not quite continuous with any of the primaries. Between the secondary ribs, also, and parallel to them there are a few fine radiating raised lines.

Sutural line unknown, as are also the exact shape and sculpture of the adult and the contour of the outer lip.

Shell compressed, venter shouldered and keeled. Cross section of whorl rudely hexagonal, wider than high. Whorls not much overlapping. Final one-eighth of last whorl of best specimen preserved unseptate. Aperture un-

known. Umbilicus wide, four-fifths the height of outer whorl in width. Umbilical shoulders gently rounded.

Sculpture very characteristic. Earlier whorls smooth on flanks where the shell is less than 15 millimeters in diameter; distinct ribs show on venter where the diameter is more than 8 millimeters. These ribs appear first as a faint, crenulated keel and extend outward from it with growth of shell. Where the diameter is more than 15 millimeters umbilical ribs are present. These ribs begin at line of involution, pass first backward, then outward in a shallow forward curve, increasing in height till they reach a point beyond the middle of the flank, where each rises into a high node and forks into two or three short secondary ribs. Some intercalated secondaries are present. Each short secondary rises into a node and divides, the branches bending forward and passing across the keel as sharp crenulations. There are 16 umbilical ribs on the last whorl of the larger specimen (Pl. XVII, fig. 5) and there would be about 90 crenulations on the complete keel.

The suture shows a very wide siphonal saddle, wide first lateral saddle, narrow first lateral lobe, relatively wide second lateral saddle, and small second lateral lobe. The radius just touches the tip of the first lateral lobe.

The nodose ribs with double forking, the fine secondaries, and the sutural characters distinguish this species. The figures published by Whiteaves are not particularly good, but the details shown and the description given tally so well with the Wyoming specimens at hand that there seems to be little doubt of their identity with the Canadian form.

Cardioceras canadense Whiteaves is most like *Cardioceras whiteavesi* Reeside but differs sharply in having forked secondaries. It differs from *Cardioceras sundancense* Reeside in the presence of high nodes, more vigorous sculpture, and narrower umbilicus. It is distinguished from *Cardioceras vertebrale* (Sowerby) var. *densiplicatum* Boden¹ by the persistence of smooth flanks on the inner whorls to a diameter of 15 millimeters, fewer umbilical ribs, much finer ventral ribs, and stouter whorls; from *Cardioceras zenaidae* Ilowaisky² only by

the slightly greater number of ventral ribs; from *Cardioceras* sp. Borissjak³ by the lack of a second bifurcation of the ribs.

Localities: Type, *Cardioceras*-bearing beds, 2½ miles northeast of Fernie, British Columbia. Sundance formation, 4 miles west of Sundance, Wyo.; also four other specimens. *Cardioceras*-bearing beds Lillooet, British Columbia, one fragment, indistinguishable from this species.

***Cardioceras cordiforme* (Meek and Hayden) Neumayr.**

Plate VII, figures 1-6; Plate VIII, figures 1-7; Plate IX, figure 1.

1859. *Ammonites cordiformis* Meek and Hayden, Acad. Nat. Sci. Philadelphia Proc. for 1858, p. 57.
 1860. *Ammonites cordiformis* Meek and Hayden, Acad. Nat. Sci. Philadelphia Proc., October, 1860, p. 418.
 1865. *Ammonites cordiformis* Meek and Hayden. Meek and Hayden, Paleontology of the upper Missouri: Smithsonian Contr. Knowledge, vol. 14, No. 172, pt. 1, pp. 122-123, pl. 5, figs. 2a-e.
 1880. *Ammonites cordiformis* Meek and Hayden (part). Whitfield, Report on the geology and resources of the Black Hills of Dakota, U. S. Geol. and Geog. Survey Rocky Mtn. region, pp. 378-380. (Not pl. 6, figs. 20-24.)
 1883. *Cardioceras cordiforme* (Meek and Hayden). Neumayr, K. Akad. Wiss. Wien Denkschr., Math.-Naturwiss. Classe, Band 47, p. 302.
 1894. *Cardioceras cordiforme* (Meek and Hayden). Smith, Geol. Soc. America Bull., vol. 5, p. 253.
 1894. *Quenstedtioceras cordiforme* (Meek and Hayden). Hyatt, Geol. Soc. America Bull., vol. 5, p. 409.
 1900. *Cardioceras cordiforme* (Meek and Hayden) (part?). Logan, Kansas Univ. Quart., Series A., vol. 9, No. 2, p. 124. (Not pl. 27, figs. 1-12?.)
 1906. *Ammonites (Amaltheus) cordiformis* Meek and Hayden (part). Whitfield and Hovey, Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 401. (Not pls. 52-59; not pl. 60, figs. 1, 2.)
 1910. *Cardioceras cordiforme* (Meek and Hayden) (part). Grabau and Shimer, North American index fossils, vol. 2, p. 185, fig. 1442, septum. (Not fig. 1442, entire ammonite.)

Meek and Hayden's original description is as follows:

Shell lenticular, adult specimens being much more convex than the young; umbilicus rather small, or from one-third to one-half the breadth of the outer whorl; dorsum carinate; volutions increasing so as to more than double their diameter every turn, each of the inner ones from one-half to three-fourths hidden within the ventral groove of the succeeding whorl. Surface ornamented by numerous small flexuous costae, which, in crossing the sides, increase by division and intercalation so as to number two or three times as many at the periphery as around the umbilicus. In approaching the dorsum they curve for-

¹ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 37, pl. 1, fig. 14, 1911.

² Ilowaisky, David, L'Oxfordien et le Séquanien des gouvernements de Moscou et de Riasan: Soc. imp. Nat. Moscou Bull., new ser., vol. 17, p. 269, pl. 10, figs. 33-36, 1903.

³ Borissjak, A., Die Fauna des Donez-Jura: Com. géol. (Petrograd) Mém., new ser., livraison 37, p. 66, pl. 1, fig. 11, 1908.

ward, and all cross the dorsal carina, to which, in young specimens, they impart a distinctly crenate outline.

Greatest diameter of a specimen divested of its outer whorls, 3.30 inches; diameter of its last turn, from umbilicus to dorsum, 1.63 inch; breadth of same, 1.46 inch.

Shell compressed, discoidal throughout development. The venter is distinctly sharp at a diameter of 7 or 8 millimeters and continues so throughout life. Where the diameter is greater than 40 millimeters the cross section is triangular, expanding laterally in the umbilical region as the size increases. One specimen preserves five-eighths of a whorl unseptate, with some constriction toward the outer end, though this may be accidental. Aperture not seen. Umbilicus wide in young (two-thirds height of whorl), narrow and deep in adult; umbilical shoulders rounded where the diameter is less than 20 to 30 millimeters, then the straight inner slope is parallel to the axis of the shell until the diameter reaches 70 to 80 millimeters; youngest whorls have overhanging umbilical walls.

The sculpture differs somewhat in coarseness in individuals of same size. Where the diameter is less than 6 millimeters the whorls are smooth and broadly rounded. At the diameter of 7 or 8 millimeters faint but distinct ventral ribs and a keel appear. These become more distinct with increase in size, and at the diameter of 25 millimeters there are 25 to 30 fairly sharp ribs to the whorl at the umbilical shoulders and 60 to 70 on the venter. Each umbilical rib passes outward straight or faintly curved, bifurcates at about the middle of the flank, and bends forward to cross the venter. There are a few intercalated secondaries and a few simple primaries. The outer whorls, preserved as internal casts, have in medium-sized individuals relatively fine rounded ribs of the same type as on the inner whorls. These ribs become fainter with age, and the largest specimens have only striae on the outer whorl. Meek's type at the diameter of 85 millimeters has 22 umbilical and 65 ventral ribs to the whorl.

The suture of this species has the siphonal lobe broader than the first lateral saddle and the first lateral lobe, the first lateral lobe broader than the first lateral saddle, and the second lateral lobe about half the width of the first lateral lobe. The siphonal lobe is shorter

than the first lateral lobe. The radius cuts the first lateral lobe and touches the second.

Meek and Hayden's original description is sufficiently general to include more than the typical *Cardioceras cordiforme*, and in this he has been followed by later workers. The type specimen, however, represents a quite distinct form and to it the writer would restrict the name. The diagnostic characters of *Cardioceras cordiforme* are the evenly curved, unshouldered flanks of the whorls; the narrow umbilicus; fine, low, shallow sigmoid ribs, persisting in some individuals to a diameter of perhaps 200 millimeters; wide siphonal lobe and narrow superior saddle of the suture.

Cardioceras cordiforme (Meek and Hayden) differs from *Cardioceras whitfieldi* Reeside in its stronger and more persistent sculpture, and its relatively lower cross section; from *Cardioceras americanum* Reeside in its stouter form, stronger sculpture, and less abrupt umbilical shoulders in the young, and in the sutural details; from *Cardioceras crookense* Reeside in its less swollen venter, more regular sculpture, and narrower first lateral lobe of the suture. It is distinguished from *Cardioceras excavatum* (Sowerby) Nikitin¹ by the lack of pinching near the keel and by its regular sculpture; from *Cardioceras cordatum* (Sowerby) var. *b.* Loriol² by its narrower umbilicus and by sutural details. *Cardioceras popilianense* Boden³ differs in suture, finer ribs, and in the height of the whorl, though very like Meek and Hayden's species in general expression.

All specimens from Sundance formation.

Localities: Type, "southwest base of Black Hills," Wyo.; also several small specimens. Locality in T. 25 N., R. 78 W., Freezeout Hills, Crook County, Wyo., 1 large specimen and 18 small ones. Locality, 1½ miles north of Redwater Creek, near the boundary between Wyoming and South Dakota in Wyoming; 14 small specimens. Locality, 4 miles west of Devils Tower, Crook County, Wyo.; 10 small specimens.

¹ Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischken an der oberen Wolga: Acad. sci. St.-Petersbourg Mém., 7th ser., vol. 28, No. 5, p. 52-54, pl. 2, fig. 13, 1881.

² De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *Am. rengerii*) du Jura bernois, I: Schweizer. paleont. Gesell. Abh., vol. 25, No. 6, p. 16, pl. 2, figs. 4-7, 1898.

³ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. paleont. Abh., N. F., Band. 10, Heft 2, p. 41, pl. 2, figs. 4, 5, 1911.

Cardioceras crassum Reeside, n. sp.

Plate XII, figures 3-4; Plate XIII, figure 1; Plate XIV, figures 1, 2.

1906. *Ammonites (Amaltheus) cordiformis* Meek and Hayden (part). Whitfield and Hovey, Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 401, pls. 52, 55, 56. (Not pls. 53, 54, 58, 59, 60.)

Shell stout; venter sharp at all stages seen but not pinched. Cross section of whorl at the diameter of 40 millimeters is wider than high; flat subparallel sides and swollen venter; width three-fourths the height. Where the diameter is greater than 75 millimeters the cross section is rounded-triangular and width and height are subequal. The type at the diameter of 150 millimeters preserves nearly one-fourth whorl unseptate; aperture unknown. Umbilicus narrow, in width half the height of the outer whorl. Umbilical shoulders at the diameter of 40 millimeters rounded; at the diameter of 55 millimeters they have short steep inner slope; at the diameter of 75 millimeters they are sharp and have high steep inner slope; in older stages they overhang.

Sculpture regular, relatively coarse throughout stages seen. From the diameter of 40 millimeters to the diameter of 75 millimeters fairly high rounded ribs rise at the umbilical shoulders, pass nearly straight to the middle of the flank, bifurcate, pass to the venter, and then bend forward to form sharp chevrons at the middle line. There are few intercalated ribs on these earlier whorls. Between the diameters of 75 and 125 millimeters the primary ribs are at first high and coarse, the point of bifurcation is closer to the umbilicus, and there are single intercalated secondary ribs between the pairs that branch from the primaries. Toward the end of the septate portion the umbilical ribs gradually decrease in height until they disappear. The secondaries continue distinct to the end of the part of the living chamber preserved, though progressively lower in height. The last septate whorl of the type has 15 umbilical ribs and 45 secondary ribs. A specimen 230 millimeters in diameter preserves nearly three-fourths of a whorl unseptate. The youngest part is practically smooth.

The sutural details of the type are difficult to see, though the proportions are clear. The siphonal lobe is broad and short, the first lateral saddle about as broad as the siphonal lobe, the first lateral lobe long, narrow, and

deeply incised, the second lateral saddle broad, and the second lateral lobe small. The radius cuts the first lateral lobe and touches the second.

Cardioceras crassum is marked by its vigorous sculpture, stout form, sharp but unpinched venter, and the sutural proportions. It is possible that large specimens of *Cardioceras hyatti* Reeside, *Cardioceras stantoni* Reeside, and *Cardioceras wyomingense* Reeside would be like this species in form, but all of these have a distinctly pinched venter at the diameter of 40 millimeters, and the suture differs. It differs from *Cardioceras russelli* Reeside in the sharper venter, more vigorous and more persistent sculpture, and the form of the younger whorls.

All specimens from Sundance formation.

Localities: Type, T. 25 N., R. 78 W., Freeze-out Hills, Carbon County, Wyo. Locality half a mile northeast of the Johnson horse ranch, Belle Fourche River, 25 miles west of Sundance, Crook County, Wyo., 2 specimens.

Cardioceras crookense Reeside, n. sp.

Plate IX, figures 2-4.

Shell compressed; venter somewhat swollen, sharp, and but little pinched; flanks well rounded. Cross section of whorl higher than wide. Type entirely septate; living chamber and aperture unknown. Umbilicus relatively narrow, width one-half the height of the outer whorl. Umbilical shoulders well rounded and inner slope short and steep.

Sculpture is characteristic in its irregularity. Rounded but distinct ribs rise within the umbilicus. A few pass to the keel as single ribs, but most pass about one-third the distance toward the keel and bifurcate. Here and there a secondary divides again immediately, forming an irregular trifold bundle. A few intercalated secondaries are present; and rarely a secondary bifurcates at the keel. Most of the ribs bend gently forward on the venter. The whole system of ribs has an irregular wavy appearance. There are 29 umbilical ribs on the last whorl of the type and about 60 at the keel.

The suture has a wide siphonal lobe; wide first lateral saddle; rather narrow triangular first lateral lobe, which is about equal in length to siphonal lobe; wide, shallow second lateral saddle; short second lateral lobe; and very small auxiliaries. The radius just cuts the first lateral lobe.

Cardioceras crookense is best marked by the rounded flanks of its whorls, the peculiar sculpture, and the suture. Among related forms it differs from *Cardioceras cordiforme* (Meek and Hayden) in its relatively swollen whorls, less regular sculpture, and the wide first lateral saddle of its suture; from *Cardioceras wyomingense* Reeside in the narrow umbilicus and irregular sculpture. It is distinguished from *Cardioceras excavatum* (Sowerby) Nikitin¹ by the lesser pinching of the venter and narrow umbilicus; from *Cardioceras excavatum* (Sowerby) Lahusen,² *Cardioceras excavatum* (Sowerby) Bukowski,³ and from *Cardioceras excavatum* (Sowerby) Borissjak⁴ by its irregular sculpture and less pinched venter; from *Cardioceras cordatum* (Sowerby) var. *c* De Loriol⁵ by its irregular sculpture. From *Cardioceras cordatum* (Sowerby) var. *d* De Loriol⁶ it is scarcely distinguishable in form and sculpture.

All specimens from Sundance formation.

Localities: Type and one other small specimen from locality 4 miles west of 'Devils Tower, Crook County, Wyo. Fragment from T. 25 N., R. 78 W., Freezeout Hills, Carbon County, Wyo.

***Cardioceras distans* (Whitfield) Neumayr.**

Plate XV, figures 18-21; Plate XVI, figures 1-6.

1880. *Ammonites cordiformis* var. *distans* Whitfield, Report on the geology and resources of the Black Hills of Dakota: U. S. Geog. and Geol. Survey Rocky Mtn. Region, pp. 380-381, pl. 6, fig. 25.

1883. *Cardioceras distans* (Whitfield) Neumayr, K. Akad. Wiss. Wien Denkschr., Math.-Naturwiss. Classe, Band 47, p. 302.

Whitfield's description is as follows:

Shell of moderate size, slightly cordiform in a transverse section of the volution, or approaching subquadrate, and distinctly keeled on the back. Volutions few in number, largely embracing, leaving a broad, open umbilicus equal to nearly one-third of the diameter of the entire shell, and in which is exposed less than one-third of the breadth of each volution. Umbilical margin of the volution ab-

ruptly rounded, sides depressed convex, somewhat flattened in the middle, slightly decreasing in convexity and thickness outward to about the outer fourth of the width, beyond which point the surface abruptly declines to the thickened, rounded, and prominent dorsal keel.

Surface marked by strong, distant, and abruptly elevated flexuous ribs or ridges, with concave interspaces; originating a little outside of the umbilical margin, they are directed, with a slight sigmoidal curvature, nearly across the volution, and are then directed abruptly forward along the dorsal slope for a distance nearly equal to one-half the width of the volution at the point of their occurrence, and form strong, wavelike ridges in crossing the dorsal carina. On the dorsal slopes there are also one and sometimes two additional ridges between the primary ones but usually of a little less strength. The primary ridges sometimes form pointed spinelike nodes at their intersection with the intermediate or secondary ones, but this is not a constant feature, even on the same shell, and only occurs when the primary ridge dies out or bifurcates, forming two secondaries on the slope, which is an exceptional feature. Lines of growth apparently coincident with the ridges or nearly so.

Shell compressed, venter obscurely shouldered and with pinched keel. Cross section of whorl about as high as wide, subquadrate. Living chamber and aperture unknown. Umbilicus moderately wide with rounded shoulders; width of umbilicus four-fifths the height of last whorl.

Sculpture consists of high, sharp umbilical ribs (18 on last whorl of type), which bifurcate at about the middle of the flanks and bend sharply forward on the venter, producing a coarsely nodose keel.

The suture of the type shows a fairly wide ventral lobe, wide first lateral saddle, relatively narrow first lateral lobe, narrow second lateral saddle, and small second lateral lobe. The radius just cuts the first lateral lobe.

The most characteristic features are the stout form, coarse sculpture, and moderately wide umbilicus.

Most of the specimens referred to this species show more ribs to the whorl than the type but otherwise agree very well. A large specimen (Pl. XVI, figs. 1-3) has very pronounced sculpture, more secondaries than the type, and rather abrupt umbilical shoulders. The suture of this specimen has a first lateral saddle but little wider than the first lateral lobe.

Cardioceras distans (Whitfield) is distinguished from *Cardioceras wyomingense* Reeside by its stouter form, coarser sculpture, and more rounded umbilical shoulders; from *Cardioceras stantoni* Reeside by its stout form and

¹ Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischkin an der oberen Wolga: Acad. sci. St.-Petersbourg Mém., 7th ser., vol. 28, No. 5, p. 52, pl. 2, fig. 13, 1881.

² Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasanschen Gouvernements: Com. géol. [Petrograd] Mém., vol. 1, No. 1, p. 48, pl. 5, fig. 2, 1883.

³ Bukowski, Gejza, Über die Jurabildungen von Czenstochau in Polen: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, Band 5, p. 130, pl. 26, figs. 21, 22, 1887.

⁴ Borissjak, A., Die Fauna des Donez-Jura: Com. géol. [Petrograd] Mém., new ser., livraison 37, p. 7, pl. 1, fig. 6, 1908.

⁵ De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *A. m. renggeri*) du Jura bernois, I: Schweizer. paleont. Gesell. Abh., vol. 25, No. 6, p. 16, pl. 2, fig. 8, 1898.

⁶ Idem, p. 17, pl. 2, fig. 9.

narrower umbilicus; from *Cardioceras auro-raense* Reeside by its more compressed form; from *Cardioceras russelli* Reeside by its coarser sculpture and pinched venter. It differs from *Cardioceras vertebrale* (Sowerby) Boden¹ in its less quadrate cross section and more vigorous sculpture; from *Cardioceras rouillieri* (Nikitin) Lahusen² in the more rounded ribs and lesser anterior inclination of the secondaries but is very close; from *Cardioceras cordatum* (Sowerby) Lahusen³ in having fewer ribs and less compressed form; from *Cardioceras rouillieri* Nikitin⁴ in having a wider umbilicus and fewer secondaries. *Cardioceras cordatum-nikitinianum* Bukowski⁵ has less vigorous sculpture. *Cardioceras cordatum* (Sowerby) var. *f* De Loriol⁶ has more quadrate whorls and finer sculpture; *Cardioceras vertebrale* (Sowerby) var. *a* Ilowaisky⁷ is hardly separable except that the whorls are stouter. *Cardioceras cordatum* (Sowerby) refigured by Maud Healy⁸ is very close to *Cardioceras distans*.

Localities: Type, Sundance formation, 2 miles south of Belle Fourche River, near Bear Lodge Butte (Devils Tower, Crook County), Black Hills, Wyo. Sundance formation, half a mile northeast of the Johnson horse ranch, Belle Fourche River; 25 miles west of Sundance Mountain, Crook County, Wyo. Several large and a number of fragmentary small specimens.

Lower part of Naknek formation, east side of Oil Bay, Cook Inlet region, Alaska. Four small complete and a number of fragmentary specimens.

¹ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 37, pl. 1, fig. 13, 1911.

² Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasan-schen Gouvernements: Com. géol. [Petrograd] Mém., vol. 1, No. 1, p. 50, pl. 5, figs. 5, 6, 1883.

³ Idem, p. 49, pl. 5, figs. 3, 4.

⁴ Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologá, und Mischkin an der oberen Wolga: Acad. sci. St.-Pétersbourg, 7th ser., vol. 28, No. 5, p. 56, pl. 2, fig. 17, 1881.

⁵ Bukowski, Gejza, Über die Jurabildungen von Czenstochau in Polen: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, Band 5, p. 129, pl. 26, fig. 20, 1887.

⁶ De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *Am. renggeri*) du Jura bernois, I: Schweizer. paleont. Gesell. Abh., vol. 25, No. 6, p. 17, pl. 2, figs. 10, 11, 1898.

⁷ Ilowaisky, David, L'Oxfordien et le Séquanien des gouvernements de Moscou et de Riasan: Soc. Imp. Nat. Moscou Bull., new ser., vol. 17, p. 268, pl. 10, fig. 31, 1903.

⁸ Healey, Maud, *Ammonites (Cardioceras) cordatus* Sowerby: Paleontologia Universalis, pls. 94, 94a, 1905.

***Cardioceras distans* (Whitfield) var. *depressum* Reeside, n. var.**

Plate XV, figures 22-24; Plate XVI, figures 7-11.

The variety here named *depressum* differs from the typical *Cardioceras distans* only in the distinct depression of the whorls. The ratio of height to width in *Cardioceras distans* is about one to one; in the variety it is four to five.

Cardioceras vertebrale (Sowerby) var. *a* Ilowaisky⁹ is scarcely separable.

Localities: Type, Sundance formation, half a mile northeast of the Johnson horse ranch, Belle Fourche River, 25 miles west of Sundance, Wyo.; also five small specimens and many fragments. Sundance formation, 4 miles west of Devils Tower, Crook County, Wyo.; three small specimens. Sundance formation, 4 miles west of Sundance, Crook County, Wyo.; one specimen. Sundance formation, Sundance-Aladdin stage road at south fork of Redwater Creek, Crook County, Wyo.; 11 small specimens. Lower part of Naknek formation, east side of Oil Bay, Cook Inlet region, Alaska; one specimen.

***Cardioceras haresi* Reeside, n. sp.**

Plate XIX, figures 4-12.

Shell stout, whorls depressed, venter keeled. Oldest whorls not seen. Cross section of whorls, where the shell is less than 15 millimeters in diameter, oval, higher than wide; where the diameter is 15 to 25 millimeters, rudely hexagonal subequal in width and height; where it is more than 25 millimeters depressed, wider than high, quadrate. Small part only of living chamber preserved in type, but another specimen (Pl. XIX, figs. 9-12) shows about half of whorl unseptate. Aperture unknown. Umbilicus wide, in width about 1½ times the height of the outer whorl. Umbilical shoulders gently rounded.

Sculpture regular. Exposed part of whorls where the diameter is less than 7 or 8 millimeters, smooth; where it is more than 8 millimeters, sharp, high umbilical ribs are present.

⁹ Ilowaisky, David, L'Oxfordien et le Séquanien des gouvernements de Moscou et de Riasan: Soc. imp. nat. Moscou Bull., new ser., vol. 17, p. 268, pl. 10, figs. 31, 32, 1903.

These ribs rise within the umbilicus, bend backward, emerge from the umbilicus, and pass outward in a shallow forward curve to the middle of the flanks. On the outer whorls each primary rib, at the middle of the flanks, is raised into a fairly high, elongated node. The primaries bifurcate, pass outward on the venter, and then bend sharply forward, decreasing in distinctness near the middle of the venter but rising in a distinct node when they reach the median line. The chevron formed is comparatively sharp, making an angle of perhaps 50°. Intercalated secondaries are uncommon on the inner whorls but are numerous on the outer whorls. The last complete whorl of the type has 22 primary ribs and about 50 secondaries. The unseptate specimen shows on the inner surface a mold of sculpture like that on the venter of the outer whorl of the type, but the venter of this specimen shows the keel almost continuous and like that of *Cardioceras obtusum* Reeside, with the secondaries quite distinct to the keel. There would be apparently 18 to 20 primary ribs and 50 to 60 secondary ribs on a complete whorl.

The suture has a broad siphonal lobe, subequal first lateral saddle and lobe, first lateral lobe a little longer than siphonal lobe, relatively wide second lateral saddle, small second lateral lobe, and small auxiliaries.

Cardioceras haresi is best recognized by the depressed, quadrate cross section of the outer whorls, which has the greatest width external, the sharp high primary ribs, and acute ventral chevrons. It is distinguished from *Cardioceras obtusum* Reeside by the sharper sculpture, quadrate cross section, and different sutural proportions; from *Cardioceras ? latum* Reeside by the presence of a keel on the younger whorls, stronger sculpture, and quadrate cross section. The writer knows no similar foreign species.

The species is named for Mr. C. J. Hares, who collected the type.

All specimens from Sundance formation.

Localities: Type, 1½ miles north of Redwater Creek in Wyoming, near the boundary between South Dakota and Wyoming. Also several small specimens and fragments of larger ones. Locality 4 miles west of Devils Tower, Wyo.; one specimen. Locality in SW. ¼ sec. 13, T. 23 N., R. 79 W., Carbon County, Wyo.; one

specimen. Locality half a mile east of the Johnson horse ranch, Belle Fourche River, 25 miles west of Sundance, Wyo.

***Cardioceras hyatti* Reeside, n. sp.**

Plate XV, figures 1-4.

Shell compressed, venter pinched, keel elevated. Cross section of whorl quadrate, higher than wide. Last half whorl of type unseptate, aperture unknown. Umbilicus relatively narrow, a little more in width than half the height of the outer whorl. Umbilical wall rounded on inner whorls, abrupt on last whorl of type.

Sculpture regular. The ribs begin at the umbilical shoulder, pass outward in a shallow curve to about the middle of the flank, bifurcate and pass to the venter, where they bend forward and cross the keel. Some intercalated secondaries are present. The ribs are rather coarse and fairly sharp but of even height from umbilicus to venter. Last whorl of type has 21 umbilical ribs and 55 secondaries. The earlier whorls appear to be smooth to the region where the shell attains a diameter of 7 or 8 millimeters.

Suture has relatively narrow dorsal lobe, wide shallow first lateral saddle, triangularly arranged first lateral lobe, wide second lateral saddle, and small second lateral lobe. Auxiliaries very small. Radius just cuts tip of first lateral lobe.

The most diagnostic characters of this species are the narrow umbilicus, compressed form, and regular, even sculpture.

Cardioceras hyatti Reeside differs from *Cardioceras stantoni* Reeside in the narrower umbilicus and coarser sculpture. It differs from *Cardioceras cordatum* (Sowerby) Lahusen¹ in the lack of prominences on the ribs, and in its stouter, more quadrate whorls but is quite similar; from *Cardioceras cordatum-quadratooides* Bukowski² in its coarser sculpture and less quadrate cross section; from *Cardioceras cordatum* (Sowerby) Borissjak³ only in its more compressed whorl; from *Cardioceras*

¹ Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasanschen Gouvernements: Com. géol. [Petrograd] Mém., vol. 1, No. 1, p. 49, pl. 5, fig. 3, 1883.

² Bukowski, Gejza, Über die Jurabildungen von Czenstochau in Polen: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, Band 5, p. 130, pl. 26, fig. 23, 1887.

³ Borissjak, A., Die Fauna des Donez-Jura: Com. géol. [Petrograd] Mém., new ser., livraison 37, p. 8, pl. 1, fig. 8, 1908.

cordatum (Sowerby) var. *b* De Loriol¹ in its stouter whorls, different suture, and abrupt umbilical shoulders.

This species is named in honor of Mr. Alpheus Hyatt.

All specimens from Sundance formation.

Locality: Type, from Difficulty Canyon, sec. 31, T. 24 N., R. 80 W., Carbon County, Wyo., one specimen. Two specimens from locality near the Carnegie Museum dinosaur quarry, Jensen, Utah.

***Cardioceras lillooetense* Reeside, n. sp.**

Plate XVII, figures 20-23.

Shell compressed, venter pinched and keeled. Cross section of whorls at first broader than high, cordiform; at the diameter of 25 millimeters, compressed, oval, with well-rounded flanks, higher than wide; at and above the diameter of 35 millimeters, subquadrate with obscure ventral shoulders and flattened flanks; higher than wide. Three-eighths of the last whorl of the type unseptate; aperture unknown. Umbilicus moderately wide, in width nearly equal to the height of the outer whorl of type; umbilical shoulders gently rounded to the diameter of 25 millimeters; then the shoulders become sharper and the inner slope becomes oblique.

Sculpture regular. Low, fairly sharp ribs rise within the umbilicus, bend backward, emerge, and pass nearly straight outward, rising to a faint node at the middle of the flank. Then each primary bifurcates, one or two intercalated ribs rise between the bundles, and all bend forward and cross the keel as crenulations on it. Many of the secondaries fork at the base of the keel. The last whorl of the type has 20 primary ribs and about 80 crenulations on the keel. On a fragment of a larger specimen of this species than the type the umbilical ribs end abruptly at the middle of the flank and are only faintly connected with the three secondaries which rise abruptly on the venter but are much fainter at the base of the keel.

The suture is deeply incised. Siphonal lobe and first lateral saddle about equal in width; first lateral lobe narrower than first lateral saddle and a trifle longer than the siphonal lobe; second lateral saddle wide and

shallow; second lateral lobe and auxiliaries small. The radial line just cuts the first lateral lobe.

Cardioceras lillooetense is marked by its compressed form, obscurely shouldered venter, straight primary ribs, and fine secondaries. The large specimen mentioned above approaches in several respects the genus *Amoeboceras*, but the secondary ribs are distinct to the keel though faint and the umbilical ribs are rarely simple to the keel. It is distinguished from *Cardioceras americanum* Reeside by its more distinct sculpture and swollen venter; from *Cardioceras hyatti* Reeside by its more rounded ribs, more numerous secondaries and straighter primaries; from *Cardioceras sundancense* Reeside by its more compressed form and more distinct sculpture. It differs from *Cardioceras cordatum* (Sowerby) var. *a* De Loriol² in the greater number of umbilical costae but is otherwise very close; from *Cardioceras cordatum* (Sowerby) Boden,³ as figured, in the relative independence of the primaries and secondaries.

Locality: *Cardioceras*-bearing beds at head of Big Creek, tributary to Chilcotin River, Lillooet, British Columbia; one entire and four broken specimens.

***Cardioceras martini* Reeside, n. sp.**

Plate IX, figures 5-8.

Shell compressed, venter pinched and keeled. Cross section of whorl oval; flanks flattened, higher than wide. Last three-eighths of whorl unseptate; aperture unknown. Umbilicus narrow, in width a little more than half the height of the outer whorl. Umbilical shoulders rounded to the stage where the shell attains a diameter of 35 millimeters, and where the diameter is more than 35 millimeters the inner slope is short and steep.

Sculpture somewhat irregular. Numerous low but sharp ribs rise within the umbilicus and run almost straight outward to the middle of the flank. Many of the ribs fork at this point; others continue simple to the keel and show an intercalated secondary that rises at the line of forking between each pair of primaries. Some of the secondaries fork on the venter. The secondaries all bend for-

¹ De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *Am. rennggeri*) du Jura bernois, I: Schweizer. paleont. Gesell. Abh., vol. 25, No. 6, p. 16, pl. 2, figs. 6, 7, 1898.

² De Loriol, Perceval, op. cit., p. 15, pl. 2, figs. 1-3.

³ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 35, pl. 1, figs. 6-8, 1911.

ward to cross the keel, which is evenly but finely serrate. The type has 33 primary ribs and 80 secondary ribs on the last whorl.

The suture has a moderately wide siphonal lobe; wide first lateral saddle; first lateral lobe relatively narrow and equal in length to the siphonal lobe; second lateral saddle nearly as wide as first lateral lobe; other lobes small.

This species is marked by its compressed form, pinched venter, fine, sharp ribs, and the proportions of the suture. It differs from *Cardioceras crookense* Reeside in the finer, sharper ribs and greater pinching of the venter; from *Cardioceras cordiforme* (Meek and Hayden) in its finer, straighter, and less elevated umbilical ribs and in sutural detail, though in general aspect very close to this species. It is distinguished from *Cardioceras cordatum* (Sowerby) var. *c* de Loriol¹ in the pinching of the venter and the finer ribs; from *Cardioceras cordatum* (Sowerby) var. *d* De Loriol² in the more compressed form and finer ribs; from *Cardioceras excavatum* (Sowerby) Lahusen³ in that the ribs are sharp and distinct; from *Cardioceras excavatum* (Sowerby) Bukowski⁴ it is scarcely separable.

The species is named for Mr. G. C. Martin, of the United States Geological Survey, who collected the type.

Localities: Type, *Cardioceras*-bearing beds along creek entering Boulder Creek from north, Matanuska Valley, Alaska; also four other specimens. Lower part of Naknek formation, east side of Oil Bay, Cook Inlet region, Alaska; four specimens.

***Cardioceras obtusum* Reeside, n. sp.**

Plate XX, figures 1-6.

Shell swollen, depressed, venter obtusely keeled. Oldest whorls not seen. Cross section of whorl oval, longer than wide, where the diameter is less than 12 millimeters; where it is 20 to 25 millimeters, almost circular; where it is 25 millimeters, oval, wider than high. Living

¹ De Loriol, Perceval, Étude sur les mollusques et brachiopodes de l'Oxfordien (zone à *Am. renngeri*) du Jura bernois, I: Schweizer. paleont. Gesell. Abh., vol. 25, No. 6, p. 16, pl. 2, fig. 8, 1898.

² Idem, p. 17, pl. 2, fig. 9.

³ Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasanschen Gouvernements: Com. géol. [Petrograd] Mém., vol. 1, No. 1, p. 48, pl. 5, fig. 2, 1883.

⁴ Bukowski, Gejza, Über die Jurabildungen von Czenstochau in Polen: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, Band 5, p. 130, pl. 26, figs. 21, 22, 1887.

chamber and aperture unknown. Umbilicus wide, about 1½ times the height of outer whorl. Umbilical shoulders gently rounded.

Sculpture regular. Where the diameter is 8 millimeters, the exposed part of the whorls is smooth; where the diameter is greater distinct, rounded umbilical ribs are present. These ribs become more elevated as the shell increases in size but are invariably rounded. They begin within the umbilicus, pass outward with a shallow forward curve to about the middle of the flank, where they reach the maximum height, then bifurcate into low, flattened secondaries. The secondaries bend forward to meet the keel, which, however, is quite smooth and even and practically lacks nodes. A few intercalated secondaries occur. There would be 25 umbilical ribs and about 60 secondaries on the complete last whorl of the type. The keel is obscure where the diameter is less than 20 millimeters.

The suture shows a wide, short siphonal lobe; first lateral saddle and first lateral lobe subequal in width and the first lateral lobe is a trifle longer than the siphonal lobe; second lateral saddle and second lateral lobe small; auxiliaries very small. The radius cuts the tip of the first lateral lobe.

Cardioceras obtusum is best recognized by its depressed oval whorls; rounded primary and close, flattened secondary ribs; smooth rounded keel; and the suture. It differs from *Cardioceras haresi* Reeside in the greater distinctness of the ventral ribs, oval cross section, and in the wider superior saddle of the suture; from *Cardioceras? latum* Reeside in the sharp venter and lesser depression of the younger whorls. No foreign forms are known to the writer which are quite like this species.

All specimens from Sundance formation.

Localities: Type, locality in Wyoming 1½ miles north of Redwater Creek, near the boundary between South Dakota and Wyoming; also one other specimen. Locality 4 miles west of Devils Tower, Crook County, Wyo.; five small specimens.

***Cardioceras plattense* Reeside, n. sp.**

Plate IX, figures 9-12.

Shell fairly stout; venter swollen, obtusely shouldered, and keeled; early whorls very stout, distinctly keeled. Cross section of last whorl about as wide as high, broadly cordiform; inner whorl depressed oval. Umbilical part of

living chamber preserved for half whorl; aperture unknown. Umbilicus moderately wide, in width three-fifths the height of the outer whorl in type. Umbilical shoulders gently rounded to the place where the shell attains a diameter of 25 to 30 millimeters, then rounded with steep inner wall.

Sculpture consists of low, rounded umbilical ribs on the exposed part of the inner whorls where the diameter of the shell is greater than about 20 millimeters, though better preservation might show them to have begun earlier. At this diameter distinct ventral nodes and a crenulated keel are present. The umbilical ribs continue low and rounded on the whole of the type, though on the unseptate part they become less distinct. These umbilical ribs pass about one-fourth the distance toward the keel and divide into two (rarely three) secondaries. Intercalated secondaries rise between the bundles. The secondaries pass outward to a point three-fourths of the way from umbilicus to keel, are raised into low, elongated nodes, bifurcate and bend forward a little to cross the sharpened venter as crenulations. There would probably be 15 primary ribs on the last whorl of the type and 70 to 80 crenulations on the keel.

The suture shows a long, narrow siphonal lobe, wide first lateral saddle, relatively short first lateral lobe, small second lateral saddle and lobe, and a few small auxiliaries.

This species is marked by its stout form, distinct regular sculpture, twice-forked ribs and low ventral nodes, and by the sutural proportions. It differs from *Cardioceras sundancense* Reeside in its coarser and more persistent sculpture, stouter form, and in the relative length of the siphonal lobe of the suture; from *Cardioceras wyomingense* Reeside in its narrower umbilicus, stouter form, second bifurcation of the ribs, and sutural detail; from *Cardioceras russelli* Reeside in its stouter form, second bifurcation of the ribs, and in the relative lengths of the lobes of the suture; from *Cardioceras auroraense* Reeside in its stouter form, second bifurcation of the ribs, and in sutural proportions. From related foreign species it is sharply distinguished by the second bifurcation.

Locality: Type specimen is from Sundance formation, "near the Grand Canyon of the North Platte," near Alcova, Natrona County, Wyo.

Cardioceras russelli Reeside, n. sp.

Plate XIII, figures 2, 3; Plate XIV, figures 3-5.

Shell moderately compressed, discoidal; venter sharp throughout life. Cross section of whorls invariably cordiform, higher than wide in youth; width and height subequal in later stages. Only fragment of living chamber of type known (not shown in figures); aperture unknown. Umbilicus narrow; width equals two-fifths height of last whorl. Umbilical shoulders gently rounded to the region where the diameter of the shell is about 40 millimeters; then the umbilical wall becomes steep and at a diameter of about 70 millimeters begins to overhang.

Sculpture of youngest whorls unknown. From a diameter of 50 millimeters to a diameter of 90 millimeters fairly high rounded ribs begin at the umbilical shoulder, pass about one-third the distance toward the keel, and split into two or three secondaries. A few intercalated secondaries are present. The secondaries continue outward, curving gently forward, to the sharp venter. On the last whorl of the type the ribs gradually become indistinct, and above a diameter of 90 millimeters the whorl is practically smooth. Umbilical ribs number about 20 to the whorl and secondaries about 50.

The suture shows a short siphonal lobe and long first lateral lobe. The siphonal lobe, first lateral saddle, first lateral lobe, and second lateral saddle are about equal in width. The second lateral lobe is small; the auxiliaries feeble. The radius cuts the first lateral lobe and barely cuts the second.

Cardioceras russelli is best marked by its stout form, relatively strong regular sculpture, and the sutural proportions. It differs from *Cardioceras wyomingense* Reeside in the more triangular cross section of the whorl, the much narrower umbilicus, and in the relative length of the lobes of the suture; from *Cardioceras sundancense* Reeside in its vigorous and more persistent sculpture, blunter unshouldered venter, and in sutural details; from *Cardioceras cordiforme* Meek and Hayden in the blunter venter, more elevated ribs, and in sutural detail. The writer knows no close European species.

The species is named for Mr. I. C. Russell, who with Alpheus Hyatt collected part of the material on which this paper is based.

All specimens from Sundance formation.

Localities: Type, in Wyoming 1½ miles north of Redwater Creek, near the boundary between South Dakota and Wyoming. Come Bluff, near Aurora (Ridge), Wyo.; one specimen.

Cardioceras schucherti Reeside, n. sp.

Plate XI, figures 3-5.

Shell stout, venter sharp and pinched. Oldest whorls unknown. Cross section cordiform, about as wide as high, in all stages to a diameter of 30 millimeters. Living chamber and aperture unknown. Umbilicus narrow in type, in width a little over half the height of the outer whorl. Umbilical shoulders rounded on innermost whorl preserved, abrupt on outer.

Sculpture of type a bit obscured by weathering but yet distinct. Inner whorl shows fairly high umbilical ribs. Outer whorl has umbilical ribs that are first stout and high but become low and rounded. At about middle of flank each rib is raised and divides into four secondaries; between some of the bundles an intercalated secondary rises. The youngest part of the last whorl of the type had apparently no secondaries. The secondaries bend gently forward and cross the keel as crenulations. There would be about 15 umbilical ribs and 80 secondaries on a complete whorl of the type.

The suture shows a short, broad siphonal lobe; broad first lateral saddle; long, narrow first lateral lobe; and wide second lateral saddle. Apparently there are few small auxiliaries. The radius cuts the first lateral lobe.

Cardioceras schucherti is distinguished by the combination of stout whorls with cordiform section, subdivision of each primary into four secondaries, and a suture that has a short, broad siphonal lobe and a long, narrow first lateral lobe. It differs from *Cardioceras platense* Reeside in suture and in lacking a second forking of the ribs; from *Cardioceras wyomingense* Reeside in its narrow umbilicus, stout form, and in the suture; from *Cardioceras auroraense* Reeside in its stouter form, more numerous secondaries, and sutural details; from *Cardioceras cordiforme* (Meek and Hayden) in fine secondaries and in sutural detail. It is

distinguished from *Cardioceras rouillieri* Nikitin¹ by its less pinched venter and less persistent sculpture, though apparently very close; from *Cardioceras nikitinianum* Lahusen² by finer secondaries and stouter form.

This species is named for the collector of the type, Prof. Charles Schuchert.

Locality: Type specimen from Sundance formation, in T. 25 N., R. 78 W., Freezeout Hills, Carbon County, Wyo.

Cardioceras spiniferum Reeside, n. sp.

Plate XVIII, figure 4; Plate XIX, figures 1-3.

Shell compressed; venter much pinched, sharp. Earlier whorls unknown. Cross section of whorls sharp, cordiform. Last half whorl unseptate; aperture unknown. Umbilicus narrow, in width about half the height of the outer whorl. Umbilical shoulders sharp and inner slope steep on the part of type preserved.

Sculpture of inner whorl marked. Distant, sharp umbilical ribs rise within the umbilicus, pass about halfway to the keel, rise into a high, sharp node, and then divide into two or three secondaries. Between each of these groups two or three intercalated secondaries are present. All bend forward on the venter to the base of the keel and subdivide into fine striae-like ribs on the keel. The unseptate part shows low, rounded, distant swellings near the middle of the flank, which have coarse striae on and between them.

Entire suture not seen. Siphonal lobe apparently long and narrow, first lateral saddle narrow, first lateral lobe longer than the siphonal lobe and wide, second lateral saddle and lobe relatively short and narrow. Suture deeply incised.

The compressed form, pinched venter, and high nodes at point of division of the primary ribs mark this species. It is closely related to *Cardioceras canadense* Whiteaves but so far as may be judged differs in the pinching of the venter, the position of the second forking, and the proportions of the suture. However, as the specimens of *Cardioceras canadense* available for comparison are all small, the

¹ Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischkin an der oberen Wolga: Acad. sci. St.-Petersbourg Mém., 7th ser., vol. 23, No. 5, p. 56, pl. 2, fig. 17, 1881.

² Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasanschen Gouvernements: Com. géol. [Petrograd] Mém., vol. 1, No. 1, p. 50, pl. 5, fig. 7, 1883.

differences may not hold. The coarsely striated keel and high nodes separate *Cardioceras spiniferum* from *Cardioceras distans* with which it is associated. The writer knows no close European species.

Locality: Type, lower part of Naknek formation, east side of Oil Bay, Cook Inlet region, Alaska.

***Cardioceras stantoni* Reeside, n. sp.**

Plate XV, figures 5-8.

1906. *Ammonites (Amaltheus) cordiformis* Meek and Hayden (part). Whitfield and Hovey, Am. Mus. Nat. Hist. Bull., vol. 22, art. 23, p. 401, pl. 60, figs. 1, 2; pl. 53.

Shell much compressed, discoidal; keel sharp and high. Cross section of whorl rudely hexagonal, higher than wide. Last half whorl of type unseptate, aperture unknown. Umbilicus wide, a little greater in width than the height of the outer whorl. Umbilical shoulders gently rounded.

Sculpture consists of high, sharp ribs, which bend backward slightly on the umbilical wall, then pass outward, curving a little forward, to the middle of the flank, increasing in elevation. Then each rib forks, the branches passing outward to the venter where they are elevated and bend forward to form crenulations on the keel. Some intercalated secondaries are present. The last whorl of the type has 24 umbilical ribs and 55 ventral ribs.

The suture shows a relatively narrow siphonal lobe, wide superior saddle, relatively narrow triangular first lateral lobe, small second lateral lobe, and feeble auxiliaries.

The compressed form, wide umbilicus with rounded shoulders, and sharp sculpture best mark this species.

Cardioceras stantoni Reeside differs from *Cardioceras wyomingense* Reeside in its coarser and more elevated ribs and rounded umbilical shoulders; from *Cardioceras hyatti* Reeside in its wider umbilicus. It is separable from *Cardioceras vertebrale* Sowerby var. *densiplicata* Boden¹ by its greater compression and less nodose sculpture; from *Cardioceras quadratoides* Nikitin² by its coarser, apparently

sharper sculpture and less numerous secondaries; from *Cardioceras vertebrale* (Sowerby) var. *alta* Boden³ by its relatively finer sculpture.

This species is named for Mr. T. W. Stanton, who collected the type.

All specimens from Sundance formation.

Localities: Type, Difficulty Canyon, sec. 31, T. 24 N., R. 80 W., Carbon County, Wyo.; also five other specimens. Aurora (Ridge), Wyo.; Alpheus Hyatt and I. C. Russell, collectors; one specimen. Como Bluff, near Aurora, Wyo.; Charles Schuchert, collector; one specimen.

***Cardioceras stantoni* var. *obesum* Reeside, n. var.**

Plate XV, figures 9-11.

This variety differs from the typical form only in its stouter whorls.

Locality: Sundance formation, Difficulty Canyon, sec. 31, T. 24 N., R. 80 W., Carbon County, Wyo.

***Cardioceras stillwelli* Reeside, n. sp.**

Plate VI, figures 11-14.

Shell compressed, venter pinched slightly and keeled, flanks rounded. Cross section of whorl gently rounded, higher than wide. Living chamber and aperture unknown. Umbilicus narrow, about half the height of outer whorl in width; umbilical shoulders gently rounded.

Sculpture feeble. Exposed part of early whorls smooth. Last whorl of type entirely septate and has 10 broad, low umbilical ribs, which are obscure at the beginning of the last whorl but become quite distinct. The interspaces are smooth or show fine striae. The umbilical ribs reach the middle of the flank and split into four or five fine, low, crowded secondaries, between which other fine intercalated secondaries rise, so that the venter shows about 12 secondaries to each primary rib. Many of the secondaries divide before reaching the keel so that it shows very fine crenulations.

The suture shows a very broad siphonal lobe, first lateral saddle wider than the first lateral lobe, which is relatively narrow, small second

¹ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 37, pl. 1, fig. 14, 1911.

² Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischkin an der oberen Wolga: Acad. Sci. St.-Petersbourg Mém., 7th. ser., vol. 28, No. 5, p. 58, pl. 2, fig. 20, 1883.

³ Boden, Karl, op. cit., p. 38, pl. 1, fig. 15.

lateral saddle and lobe, and feebly developed auxiliaries. The radius just cuts the tip of the first lateral lobe.

This species is based on a single broken specimen but is quite distinct in its peculiar sculpture, rounded umbilical shoulders and flanks, and sutural characters.

Cardioceras stillwelli differs from *Cardioceras whitfieldi* Reeside, its nearest American relative, by its rounded flanks, fine sculpture, and in sutural detail. It differs from *Cardioceras schellwieni* Boden¹ in the rounded umbilical shoulders, less defined umbilical ribs, and particularly in the absence of nodes on the venter; from *Cardioceras excavatum* (Sowerby) var. *laevigata* Boden² in the feeble sculpture, rounded umbilical shoulders, and narrower umbilicus.

The species is named for Mr. L. W. Stillwell, who collected the type.

Locality: Type, Sundance formation, 4 miles west of Sundance, Crook County, Wyo.; one specimen.

***Cardioceras sundancense* Reeside, n. sp.**

Plate XVII, figures 12-19; Plate XVIII, figures 1-3.

Shell compressed, discoidal. Where the diameter is 10 to 16 millimeters the shell is much compressed, keeled, and has quadrate cross section of whorls; where the diameter is 25 to 35 millimeters the whorl is stout, subequal in width and height, and has ventral shoulders. At 35 millimeters in diameter the venter is distinctly pinched near the keel. At 50 millimeters in diameter the whorl is cordiform, and the ventral shoulders are still discernible. Where the shell is more than 60 to 70 millimeters in diameter the whorl is cordiform, and width and height are subequal; sides evenly curved to the keel, which is sharp and crenate. A specimen preserving the early whorls where the diameter is less than 10 millimeters shows them to be first much depressed, then almost circular in cross section.

The type preserves three-eighths of the last whorl unseptate and scaphitoid. Aperture unknown.

Umbilicus in the younger whorls moderately wide. Umbilical shoulders gently rounded to

the line of involution but become higher with age; from a diameter of 20 millimeters to a diameter of 40 millimeters the umbilical wall is parallel to the axis of the shell; where the shell is more than 40 millimeters in diameter the umbilical wall overhangs the line of involution. In the plane passing through the last septum of the type the width of the umbilicus is one-third the height of the outer whorl.

Sculpture of younger whorls of type seen only on umbilical shoulders to a diameter of 75 millimeters and consists of low, rounded primary ribs, about 20 to the whorl. The first half of the last septate whorl of type shows on the flanks nine broad, low, rounded, evenly spaced ribs, or rather swellings, which decrease in distinctness toward the living chamber. These primary ribs seem to divide into two or three very low secondary ribs, and between each group one or two intercalated secondary ribs rise. The secondary ribs pass to the venter, are raised into blunt, elongated nodes, and bifurcate again, the resulting tertiary ribs passing forward and across the keel as crenulations. The younger half of the last septate whorl and the living chamber are smooth except for fine sigmoid striae and crenulations on the keel. On young individuals of this species the keel and the ribs seem to arise at a diameter of about 10 millimeters and to show above this diameter about the same characters. Low but distinct umbilical ribs within the umbilicus bend backward slightly, then emerge and pass almost radially to the middle of the flank, where they are elevated a trifle and bifurcate. Many intercalated ribs rise at the middle line of the flanks. All the secondaries pass to the venter, are raised into blunt nodes, and many then divide. All bend forward and cross the keel. On a specimen 40 millimeters in diameter there are 20 primary ribs to the whorl and about 100 crenulations on the keel.

The suture is marked by a short, broad siphonal lobe; first lateral saddle broader than the first lateral lobe; first lateral lobe long and relatively narrow; second lateral lobe and saddle small; auxiliaries feebly developed. The radius cuts both the first and second lateral lobes.

Cardioceras sundancense Reeside is characterized by the regular but rather weak sculpture of the younger whorls, in particular by the

¹ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 36, pl. 2, fig. 3, 1911.

² Idem, p. 40, pl. 2, fig. 2.

second bifurcation and the fine ribs on the venter, by the form of the adult whorl, and by the short siphonal lobe of the suture. It differs from *Cardioceras canadense* Whiteaves by its less elevated ribs and by its different sutural proportions; from *Cardioceras whiteavesi* Reeside by its finer ventral ribs and different sutural proportions. It is distinguished from *Cardioceras schellwieni* Boden¹ by the more numerous primary and secondary ribs and by sutural details; from *Cardioceras kokeni* Boden² by the presence of relatively large primary ribs; from *Cardioceras cordatum* (Sowerby) Boden³ by the fine, even ventral ribs; from *Cardioceras excavatum* (Sowerby) Boden⁴ by the fine ventral ribs and crenulated keel. *Cardioceras dieneri* Neumann-Borissjak⁵ seems to agree in form with some very small individuals of our species. *Cardioceras excavatum* (Sowerby) as refigured by Healey⁶ is practically indistinguishable.

Locality: Type and five smaller specimens from Sundance formation, 4 miles west of Sundance, Crook County, Wyo.

Cardioceras whiteavesi Reeside, n. sp.

Plate XVII, figures 1-4.

Shell moderately compressed, venter shouldered and keeled. Cross section of whorl rudely hexagonal, wider than high. Final five-eighths of last whorl unseptate; aperture unknown. Umbilicus wide, about equal in width to the height of the outer whorl. Umbilical shoulders rounded but have a steep inner slope.

Sculpture relatively coarse. Keel appears at diameter of about 8 or 9 millimeters. Earlier whorls smooth on exposed flanks to diameter of 15 millimeters, then umbilical ribs appear, which soon become high and sharp and rise into a sharp node within the middle line of the

flank. Each of the primary ribs then divides into two low secondaries, which then rise into high nodes on the venter and continue from these obliquely forward to the keel, upon which they produce coarse crenulations. Some intercalated secondaries are present, and some of these divide on the venter. The ribs are clearly visible to the keel. The last whorl of the type has 15 umbilical ribs, and there would be about 56 crenulations on the keel.

The suture has a relatively long, wide siphonal lobe; wide first lateral saddle; short, narrower first lateral lobe, small second lateral saddle and lobe, and very feebly developed auxiliaries.

Cardioceras whiteavesi Reeside is best characterized by its coarse nodose sculpture and the very long, wide siphonal lobe of the suture. It is closest to *Cardioceras canadense* Whiteaves but is sharply differentiated by its coarse ventral ribs, coarsely crenulated keel, and long siphonal lobe. It differs from *Cardioceras vertebrale* (Sowerby) var. *duplicata* Boden⁷ in having fewer umbilical ribs and more pronounced nodes; from *Cardioceras vertebrale* (Sowerby) Nikitin⁸ in the more inward position of the primary nodes, the finer secondaries, due to greater forking and more numerous intercalation of secondaries; from *Cardioceras zenaidae* Ilowaisky⁹ in its coarser ventral ribs. *Cardioceras vertebrale* (Sowerby), refigured by Healey,¹⁰ is stouter but is very like *Cardioceras whiteavesi* in general expression.

This species is named for Mr. J. F. Whiteaves, Canadian paleontologist.

Localities: Type, Sundance formation, 4 miles west of Sundance, Wyo.; one specimen. *Cardioceras*-bearing beds, Lillooet, British Columbia; one fragment indistinguishable from this species.

¹ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 36, pl. 2, fig. 3, 1911.

² Idem, pl. 1, figs. 9, 10.

³ Idem, p. 35, pl. 1, figs. 6, 7.

⁴ Idem, p. 38, pl. 2, fig. 1.

⁵ Borissjak, A., Die Fauna des Donez-Jura: Com. géol. [Petrograd] Mém., new ser., livraison 37, p. 9, pl. 1, fig. 10, 1908.

⁶ Healey, Maud, *Ammonites (Cardioceras) excavatus* Sowerby: Paleontologia Universalis, pls. 92, 92a, 92b, 1905.

⁷ Boden, Karl, p. 37, pl. 1, fig. 14.

⁸ Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischkin an der oberen Wolga: Acad. sci. St.-Petersbourg Mem., 7th ser., vol. 28, No. 5, p. 57, pl. 2, fig. 18, 1881.

⁹ Ilowaisky, David, L'Oxfordien et le Séquanien des gouvernements de Moscou et de Riasan: Soc. Imp. nat. Moscou Bull., new ser., vol. 17, p. 269, pl. 10, figs. 33-36, 1903.

¹⁰ Healey, Maud, *Ammonites (Cardioceras) vertebrale* Sowerby: Paleontologia Universalis, pls. 93, 93a, 93b, 1905.

Cardioceras whitfieldi Reeside, n. sp.

Plate VI, figures 1-6.

1880. *Ammonites cordiformis* Meek and Hayden (part). Whitfield, Report on the geology and resources of the Black Hills of Dakota, U. S. Geog. and Geol. Survey Rocky Mtn. Region, pp. 378-380, pl. 6, figs. 20-24.
1910. *Cardioceras cordiforme* (Meek and Hayden) (part). Grabau and Shimer, North American index fossils, vol. 2, p. 185, fig. 1442, entire ammonite. (Not fig. 1442, suture.)

Shell compressed, discoidal, venter somewhat pinched and sharply keeled. Flanks of whorls in younger stages nearly plane and subparallel; in later stages nearly plane from umbilical shoulder to keel. Cross section of type sharply triangular, much higher than wide. Living chamber and aperture unknown. Umbilicus narrow, about two-fifths height of outer whorl in width. Umbilical shoulders to a diameter of 30 millimeters for the shell rounded without abrupt inner slope. Where the diameter is more than 30 millimeters the inner slope is abrupt and the shoulder quite sharp; it begins to overhang slightly at a diameter of about 65 millimeters.

Sculpture feeble. Early whorls at a diameter of perhaps 10 millimeters show distinct ribs on the flanks. These ribs are visible to a diameter of about 45 millimeters and number 25 to the whorl. The final third of the last whorl of the type preserved shows only striae on the umbilical shoulders and inner part of the flank. At one-third the distance out from the umbilicus the primary ribs divide into two or three secondaries, which pass radially for another third, bend forward to the base of the keel, and there bifurcate. The keel is crenulated by these fine, crowded tertiary ribs. All the secondary ribs are irregular and indistinct on the final third of the last whorl of the type.

The suture has a wide, short siphonal lobe; first lateral saddle and first lateral lobe subequal; second lateral saddle and second lateral lobe small; auxiliaries feebly developed. The radius just touches the tips of the first and second lateral lobes.

Cardioceras whitfieldi Reeside is marked by its triangular cross section, narrow, deep umbilicus, suppressed sculpture, and its suture. It is quite distinct from *Cardioceras cordiforme* Meek and Hayden to which species Whitfield

referred the type specimen. It differs from *Cardioceras americanum* Reeside in its steeper walled, narrow umbilicus and finer sculpture on flanks and keel; from *Cardioceras stillwelli* Reeside in its more vigorous sculpture, steeper walled umbilicus, and the less oval cross section of the whorls. It may be distinguished from *Cardioceras tenuicostatum* Nikitin¹ by the greater compression at same diameter, less pinching of the venter, and more finely crenulated keel; from *Cardioceras excavatum* (Sowerby) var. *laevigatum* Boden² by the nonpersistence of the primary ribs; from *Cardioceras popilianense* Boden³ only by its narrower umbilicus, less pinched venter, and suture; from *Cardioceras tenuicostatum* (Nikitin) Borissjak⁴ by the finely crenulated keel and more swollen venter.

Locality: Type, Sundance formation, tops of highest hills, 2 miles south of Belle Fourche River, near Bear Lodge Butte (Devils Tower), Wyo.

Cardioceras wyomingense Reeside, n. sp.

Plate XV, figures 12-17.

Shell much compressed, venter pinched, keel elevated. Flanks of whorls flattened; venter a little swollen, producing an obscure shoulder. Cross section of whorl higher than wide. Living chamber and aperture unknown. Umbilicus about equal in width to height of outer whorl. Umbilical wall rather abrupt.

Sculpture very regular. Distinct sharp ribs start within the umbilicus, pass straight or slightly curved to the middle of the flank, bifurcate there and pass to the venter, then bend forward and cross the keel as low crenulations. A few intercalated secondaries are present, and some of the secondaries bifurcate again near the keel. There are about 25 umbilical ribs and about 60 secondaries to the whorl at a diameter of 45 millimeters.

The inner whorls of the type are not well preserved. On another specimen referred to this species (Pl. XV, fig. 17) the exposed parts of the flanks are smooth to a diameter of more

¹ Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischkin an der oberen Wolga: Acad. sci. St.-Petersbourg Mém., 7th ser., vol. 28, No. 5, p. 57, pl. 2, fig. 19, 1881.

² Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 40, pl. 2, fig. 2, 1911.

³ Idem, p. 41, pl. 2, figs. 4, 5.

⁴ Borissjak, A., Die Fauna des Donez-Jura: Com. géol. [Petrograd] Mem., new ser., livraison 37, p. 10, pl. 1, fig. 12, 1908.

than 6 millimeters for the shell. No keel is visible on the cross section until a diameter of 9 millimeters is reached, where the ribs on the flanks are also plain. These earlier whorls are almost round in cross section. At the diameter of about 13 millimeters the cross section of the whorl is higher than wide and the umbilical wall is narrow but distinct. A large septate fragment referred to this species (Pl. XV, fig. 14) shows the same sort of sculpture, rather high umbilical ribs but more intercalated secondaries than occur on the type.

The suture of the septate fragment (Pl. XV, fig. 14) shows a long, relatively narrow siphonal lobe; wide superior saddle; narrow first lateral lobe, shorter than the siphonal lobe; small second lateral saddle and second lateral lobe; and poorly developed auxiliaries. The radius just cuts the first lateral lobe.

The material on which this species is founded is fragmentary, but the great compression of the shell, the flat flanks, the width of the umbilicus, and the sculpture form a group of characters deserving of a distinctive name.

Cardioceras wyomingense Reeside is distinguished from *Cardioceras stantoni* Reeside by its sharper umbilical shoulders, finer ribs, obscure ventral swelling, and less elevated keel; from *Cardioceras cordiforme* (Meek and Hayden) by its wider umbilicus, coarser sculpture, and by its wide superior saddle and narrow first lateral lobe. It differs from *Cardioceras popilianense* Boden¹ in its coarser and more regular ribs and wider umbilicus; from *Cardioceras rouilleri* Nikitin² in its wider umbilicus, more numerous primary and coarser secondary ribs, and less pinched venter; from *Cardioceras nikitinianum* Lahusen³ in its wider umbilicus and more numerous ribs; from *Cardioceras cordatum* (Sowerby) Lahusen⁴ in the lower cross section of the whorl, more obtuse and nonnodose ribs; from *Cardioceras cordatum* (Sowerby) Ilowaisky⁵ in wider umbilicus and coarser ribs;

from *Cardioceras cordatum* (Sowerby) Borissjak⁶ in wider umbilicus and more compressed form. *Cardioceras excavatum* (Sowerby) var. *a* Borissjak⁷ is scarcely separable, according to the figure.

All specimens from Sundance formation.

Localities: Type, Aurora (Ridge), Wyo.; also several other fragments. Locality 3 miles southwest of Barrett (Aladdin), Crook County, Wyo.; one small and fragment of large specimen. Locality 4 miles west of Devils Tower, Crook County, Wyo.; two small specimens. Locality in T. 25 N., R. 78 W., Freezeout Hills, Carbon County, Wyo.; five fragments of large specimens. Locality 4 miles west of Sundance, Wyo.; one small specimen. Locality near Yampa River (?), Colo.; fragments.

***Cardioceras? albanitense* Reeside, n. sp.**

Plate XXIII, figures 1-3; Plate XXIV, figures 1, 2.

A single large specimen, practically complete, has a robust form and the venter narrowly rounded. Cross section of outer whorls about as wide as high, cordiforme. Whorls not known below 80 millimeters. Living chamber occupies three-fourths of last whorl, scaphitoid; outer part of aperture missing. Umbilicus narrow, steep-walled, in width about one-half the height of the whorl on inner turns. Umbilical shoulder fairly sharp and overhanging.

Sculpture regular. At the diameter of 120 millimeters broad, rounded umbilical ribs (16 to the whorl) split at about one-fourth the distance toward the venter into three or four low, rounded secondaries. Intercalated ribs rise between these bundles. The secondaries bend forward on the venter to form an obtuse sinus. There would be 60 siphonal ribs on a complete whorl at the diameter of 120 to 150 millimeters. The older part of the living chamber shows the siphonal ribs very faintly; the remainder of the living chamber has only broad, low, obscure swellings on the flanks.

The last suture has a moderately wide, short siphonal lobe; first lateral saddle of about same width; first lateral lobe relatively narrow and longer than the siphonal lobe; other elements small. Suture not deeply incised. Radial line cuts both the first and second lateral lobes.

¹ Boden, Karl, Die Fauna des unteren Oxford von Popilany in Litau: Geol. u. palaeont. Abh., N. F., Band 10, Heft 2, p. 41, pl. 2, figs. 4, 5, 1911.

² Nikitin, S. N., Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Mischkin an der oberen Wolga: Acad. sci. St.-Petersbourg Mém., 7th ser., vol. 28, No. 5, p. 56, pl. 2, fig. 17, 1881.

³ Lahusen, Joseph, Die Fauna der jurassischen Bildungen des Rjasanischen Gouvernements: Com. géol. [Pétrograd] Mém., vol. 1, No. 1, p. 5, pl. 5, figs. 7-9, 1883.

⁴ Idem, p. 49, pl. 5, fig. 3.

⁵ Ilowaisky, David, L'Oxfordien et le Séquanien des gouvernements de Moscou et de Riasan: Soc. imp. nat. Moscou Bull., new ser., vol. 17, p. 266, pl. 10, figs. 28-30, 1903.

⁶ Borissjak, A., Die Fauna des Donez-Jura: Com. géol. [Pétrograd] Mém., new ser., livraison 37, p. 8, pl. 1, fig. 8, 1908.

⁷ Idem, p. 8, pl. 1, fig. 7.

This specimen is very close to *Cardioceras? incertum* Reeside in the narrow venter, in suture, and in the type of sculpture. It differs in its proportionately wider whorls, larger size, and more persistent and finer sculpture. The inner whorls are not preserved, and it is not possible to say whether they were rounded or had a ventral angle. Despite the uncertainty attached to this specimen it should be recognized in future collections and it deserves a distinct name. The writer knows no closely related foreign species.

Locality: Type, Sundance formation, in T. 25 N., R. 78 W., Freezeout Hills, Carbon County, Wyo.

Cardioceras? incertum Reeside, n. sp.

Plate XX, figures 17-20; Plate XXI; Plate XXII, figures 1, 2.

Shell stout, venter round in youth but narrow and almost sharp in adult. Whorls unknown where the shell is less than 25 millimeters in diameter; from a diameter of 25 millimeters to a diameter of 55 millimeters cross section of whorl broadly rounded and height about three-fourths the width; where the shell is more than 55 millimeters in diameter whorl narrowed ventrally and cross section cordiform, subequal in width and height. The type is 130 millimeters in diameter and preserves nearly half the last whorl unseptate, scaphitoid; aperture unknown. Umbilicus moderately wide, in width about three-fourths the height of the outer whorl in the plane of the last septum. Umbilical shoulders rounded and inner slope short and steep until the shell attains a diameter of 90 millimeters.

Sculpture of moderate strength. Rather low, rounded umbilical ribs pass one-third the distance from the umbilicus to the venter, split into two or three low, rounded secondaries, which pass almost to the median line of the venter and then bend forward to form shallow chevrons. The ventral sculpture was not seen where the diameter is less than 80 millimeters and chevrons may be lacking. Some intercalated secondaries are present. Toward the end of the septate part of the type the umbilical ribs become faint and on the living chamber are

imperceptible. The secondaries are plainly visible on the early part of the living chamber but grow fainter and finally disappear. There are 17 umbilical ribs and 50 secondaries on the last septate whorl of the type.

The suture shows a short, wide siphonal lobe; first lateral saddle equal in width to the siphonal lobe; long, narrow first lateral lobe; second lateral saddle equal in width to first lateral lobe; small second lateral lobe; and auxiliaries. The radius cuts the first lateral lobe. Suture deeply incised.

Cardioceras? incertum is marked by the rounded venter of the older whorls and the narrowed venter of the younger ones, the low sculpture, and the suture. The generic reference of this species is open to question. The sculpture and suture might occur with *Cardioceras* or *Quenstedticeras*. Some species of *Quenstedticeras* have sharp-ventered young, but the adults are all round-ventered. *Cardioceras* acquires a keel or a sharpened venter at an early stage and keeps it throughout life. As the adult of this form is as sharp-ventered as some undoubted species of *Cardioceras*, it is tentatively referred to that genus, though certainly it is not a typical *Cardioceras*. The adult suggests *Cardioceras bellefourchense* Reeside, though it is not so stout nor so strongly sculptured, and *Cardioceras crassum* Reeside, but it is less strongly sculptured. The younger whorls differ from *Quenstedticeras? subtumidum* (Whitfield and Hovey) in form and suture.

Besides the type specimen there are five other large specimens from the type locality which preserve the outer whorls only. These specimens all show a rounded venter in the older part, which narrows markedly in the younger part. All show a persistence of the ventral ribs on the living chamber and essentially the same suture. There is some variation in the width of the whorls, and the stoutest specimen is shown in figure 1, Plate XXI. It has seemed inadvisable to ascribe these specimens to different species until material with the younger whorls preserved is available.

Locality: Type specimen from Sundance formation, T. 25 N., R. 78 W., Freezeout Hills, Carbon County, Wyo. Also the outer whorls of five large, poorly preserved specimens.

Cardioceras? latum Reeside, n. sp.

Plate XX, figures 7-16.

Shell stout, whorls depressed; venter rounded except in large individuals. Cross section of whorls where the diameter is less than 15 millimeters not seen in type, but in other specimens is practically circular; where the diameter is more than 15 millimeters cross section is oval, much wider than high. In a part of a whorl (Pl. XX, figs. 13-16) belonging to a shell that had a diameter of 80 to 90 millimeters the venter is broadly angular, but otherwise the form is the same as that of the younger whorls. Last half whorl of type is unseptate, as is also large fragment. Aperture unknown. Umbilicus wide, in width $1\frac{1}{2}$ times height of outer whorl. Umbilical shoulders gently rounded through all stages seen.

Sculpture regular. Whorls smooth to diameter of 8 or 9 millimeters, when distinct umbilical ribs begin. On the type these are at first rounded, then sharp; they rise within the umbilicus, pass outward with a shallow, forward curve to the middle of the flank, and there reach the maximum height. Each primary then forks into two, rarely three, low, rounded secondaries, which pass nearly to the middle line of the venter and bend forward to make a shallow, rounded chevron. On some specimens the ribs are faint at the median line of the venter, but there is never an elevated keel. The large fragment mentioned above has a mold on the inner side that shows the characteristic round venter and shallow, rounded chevrons of the type, but on the exterior it has only obscure traces of the secondaries on the older end and none on the younger end. The primaries, however, are well marked.

The suture of the type has a broad siphonal lobe; equally broad first lateral saddle; relatively narrow first lateral lobe of same length as siphonal lobe; short, wide second lateral saddle; small second lateral lobe; and auxiliaries. The radius just touches the first lateral lobe.

This species is characterized by its depressed whorls that have a flattened, unkeeled venter; rounded, shallow ventral chevrons; and the acquisition of an obtusely angled venter at maturity. The writer is in doubt as to its generic reference. The form, sculpture, and suture place it with the *Cardioceratidae* beyond question. The suture differs from that of

Stepheoceras, *Pachyceras*, and *Chamoussetia*, and the sculpture differs from that of *Macrocephalites* and *Cadoceras*. None of these genera, moreover, are known from the horizon of true *Cardioceras* with which this species is associated. It would seem to belong to either *Quenstedticeras* or *Cardioceras*. The main distinction between these genera is that the adult of *Quenstedticeras* is round-ventered, whereas the adult of *Cardioceras* is sharp-ventered. As this species has at first a round venter and later an angular venter, it is referred to *Cardioceras*, with the reservation that it is certainly not a typical representative of the genus. The writer knows no species close enough to deserve comparison.

All specimens from Sundance formation.

Localities: Type, half a mile northeast of the Johnson horse ranch, Belle Fourche River, 25 miles west of Sundance, Crook County, Wyo.; also another crushed specimen. SW. $\frac{1}{4}$ sec. 13, T. 23 N., R. 79 W., Carbon County, Wyo.; one small and part of a large specimen. Locality 4 miles west of Devils Tower, Crook County, Wyo.; two specimens. Locality $1\frac{1}{2}$ miles north of Redwater Creek, near the boundary between South Dakota and Wyoming, in Wyoming; 1 small specimen. Como Bluff, near Aurora (Ridge), Wyo.; 1 small specimen.

Cardioceras? sp. undet.

Plate XXIV, figures 3, 4.

Single specimen, poorly preserved. Shell compressed, venter pinched where the diameter is more than 30 millimeters. Cross section higher than wide. Living chamber partly preserved (three-eighths of last whorl) but crushed; scaphitoid. Umbilicus narrow, in width one-fourth height of outer whorl. Umbilical shoulders sharp and steep, overhanging inner slope on last whorl.

Whorls entirely smooth, so far as can be observed; where the diameter is more than 50 or 60 millimeters. Sculpture unknown where the diameter is less than 50 millimeters.

Suture crowded, little incised. Siphonal lobe, short, narrow; first and second lateral saddles wide, subequal; first lateral lobe about as wide as siphonal lobe and a little longer; second lateral lobe relatively narrow, short; other elements small.

The specimen described above is too poor for definite reference, but the general form is that

of *Cardioceras*. It might be a larger specimen of forms like *Cardioceras hyatti* Reeside and *Cardioceras americanum* Reeside, though the proportions of the suture make this doubtful. The compressed form, pinched venter, and the nearly equal size of the first and second lateral saddles are very suggestive of *Chamoussetia* R. Douvillé¹ and it would be within reason to refer the specimen to that genus, though the American specimen is associated with *Cardioceras*.

Locality: One specimen from Sundance formation, T. 25 N., R. 78 W., Freezeout Hills, Carbon County, Wyo.

Genus AMOEBOCERAS Hyatt.

***Amoeboceras dubium* (Hyatt) Reeside.**

Plate XXIV, figures 5-8.

1894. *Cardioceras dubium* Hyatt, Geol. Soc. America Bull., vol. 5, p. 420.

1894. ?*Cardioceras whitneyi* Smith, Geol. Soc. America Bull., vol. 5, p. 253.

Hyatt's description is as follows:

The young are imperfect, but it can be readily seen that the earliest stages were smooth for a long period, as in some species of the genus *Cardioceras*, and that they differ entirely from the heavily tuberculated young of the genus *Amaltheus*.

¹ Douvillé, Robert, Soc. géol. France, Paléontologie, vol. 19, fasc. 2, Mém. 45, pp. 19-23, 1912

The costae arise abruptly and do not appear to differ materially, so far as seen on the sides, from those of later stages. This is also more consistent with the characteristics of *Cardioceras* than with those of *Amaltheus*.

The costae on the sides and genicular ridges are numerous, linear and single. There are no lateral tubercles, but occasionally the costae disappear on the sides just before reaching the geniculae. The geniculae are very prominent and tuberculated.

The whorls are compressed, with sides flattened. The venter is very narrow. The inclusion varies from about one-third the diameter of the inner to considerably less, and there may be two species, one including more involute and the other the less involute forms, but both have what would be called open umbilici. The keel is prominent and deeply crenulated. It is separated from the geniculae by narrow channels, which are not crossed by bifurcations of the costae, as in more generalized species of this genus. The serrations of the keel appear to be separated by the channels from the costae.

The sutures were present, and, although much distorted, it was ascertained that they had large first lateral saddles and lobes, with smaller second lateral saddles and small second lateral lobes. There are auxiliary saddles on the umbilical shoulder, and the abdominal lobe is shorter than the first lateral lobes. These sutures are decidedly cardioceran.

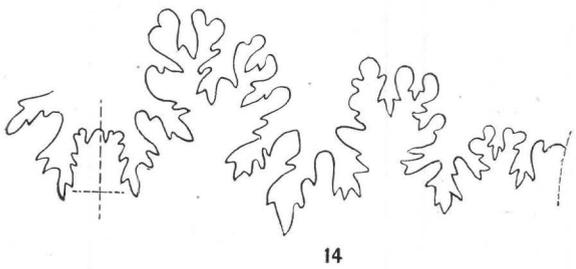
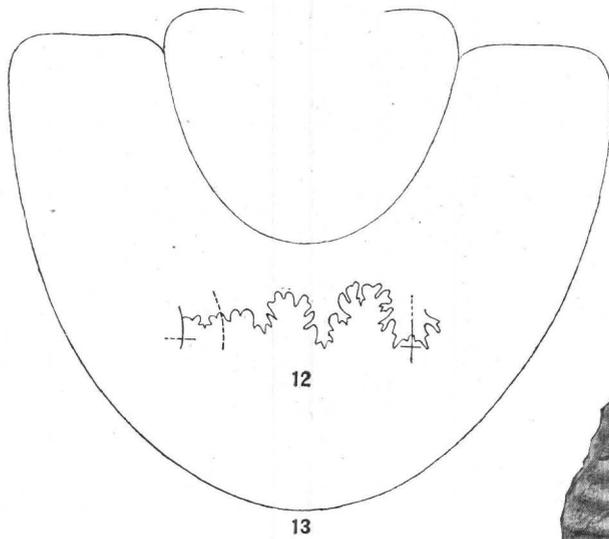
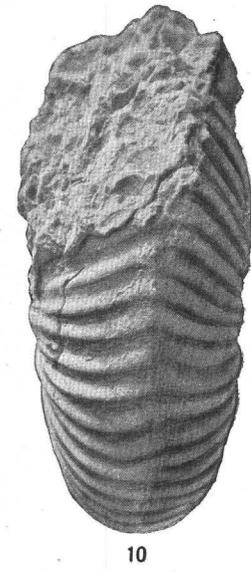
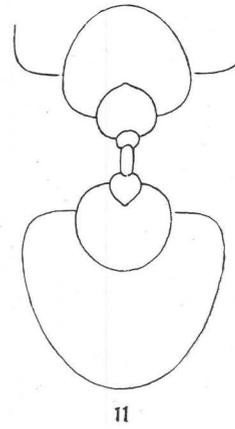
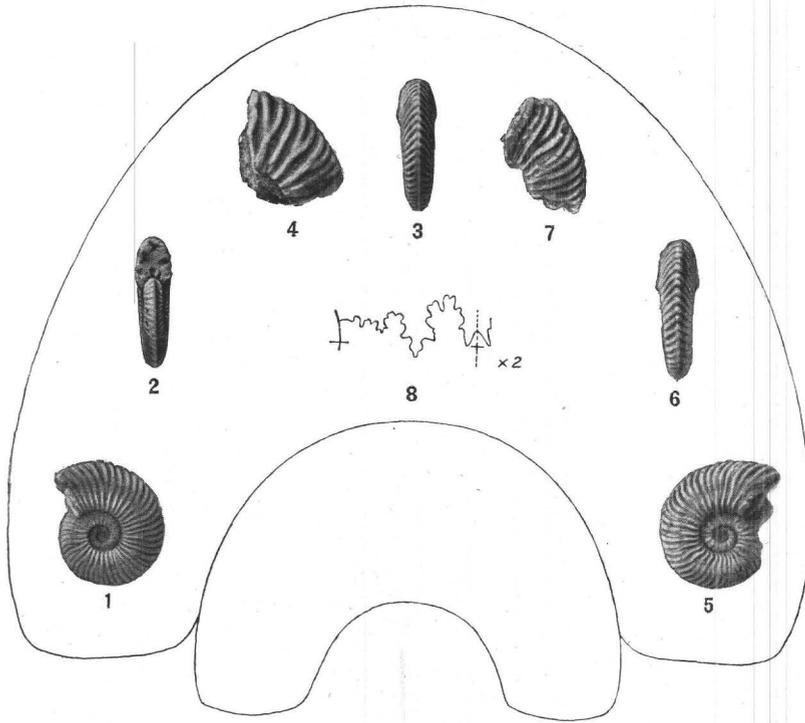
This species is marked by the straight, simple ribs and the smooth channels on the venter and is apparently a true *Amoeboceras*. *Cardioceras whitneyi* Smith from the same locality may be the same species.

Locality: Type, Mariposa slate, Texas ranch, Calaveras County, Calif.

PLATES.

PLATE I.

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FIGURES 1-4. <i>Quenstedticeras collieri</i> Reeside, n. sp., from Ellis formation in sec. 7, T. 25 N., R. 26 E., Little Rocky Mountains, Mont.....	14
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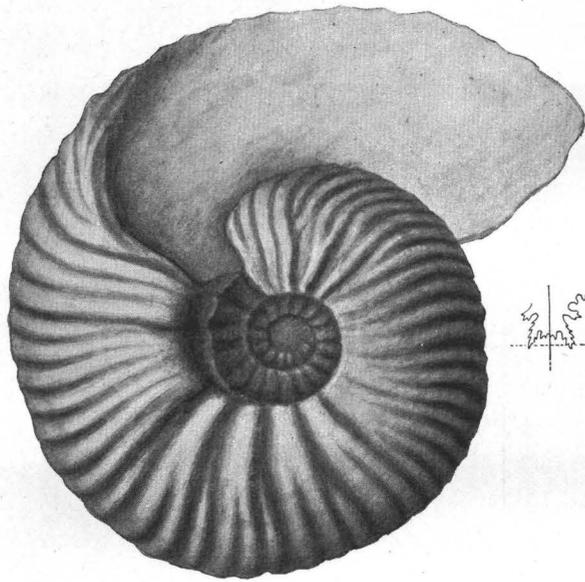
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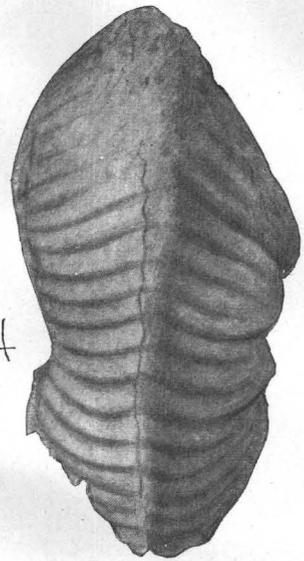
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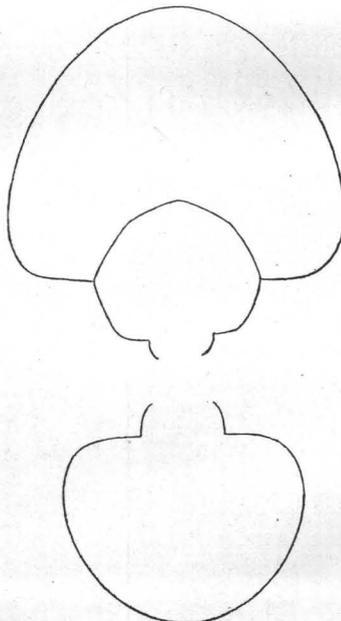
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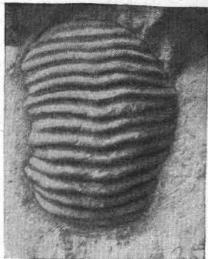
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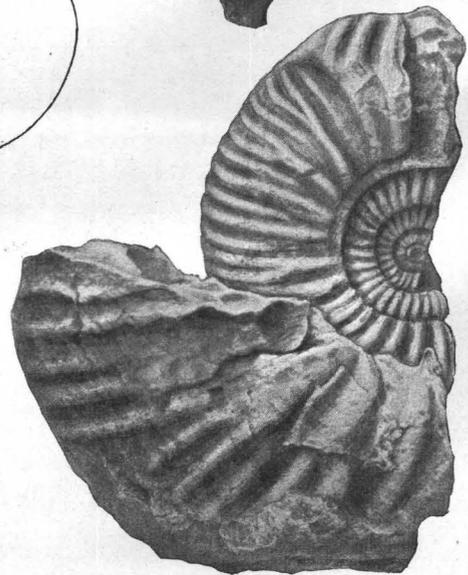
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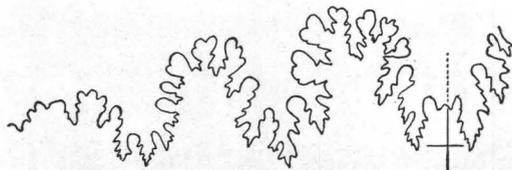
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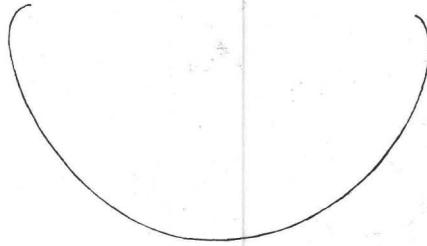
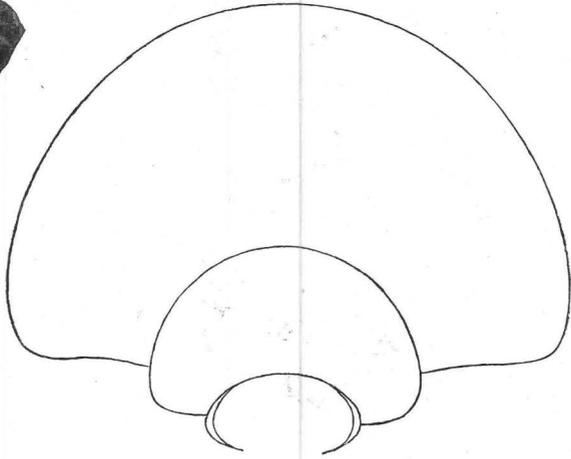
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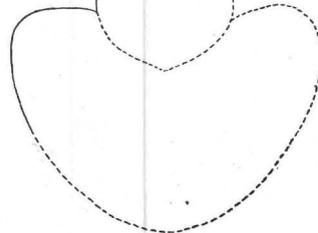
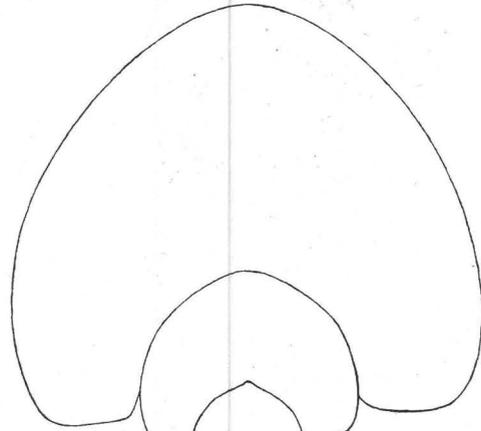
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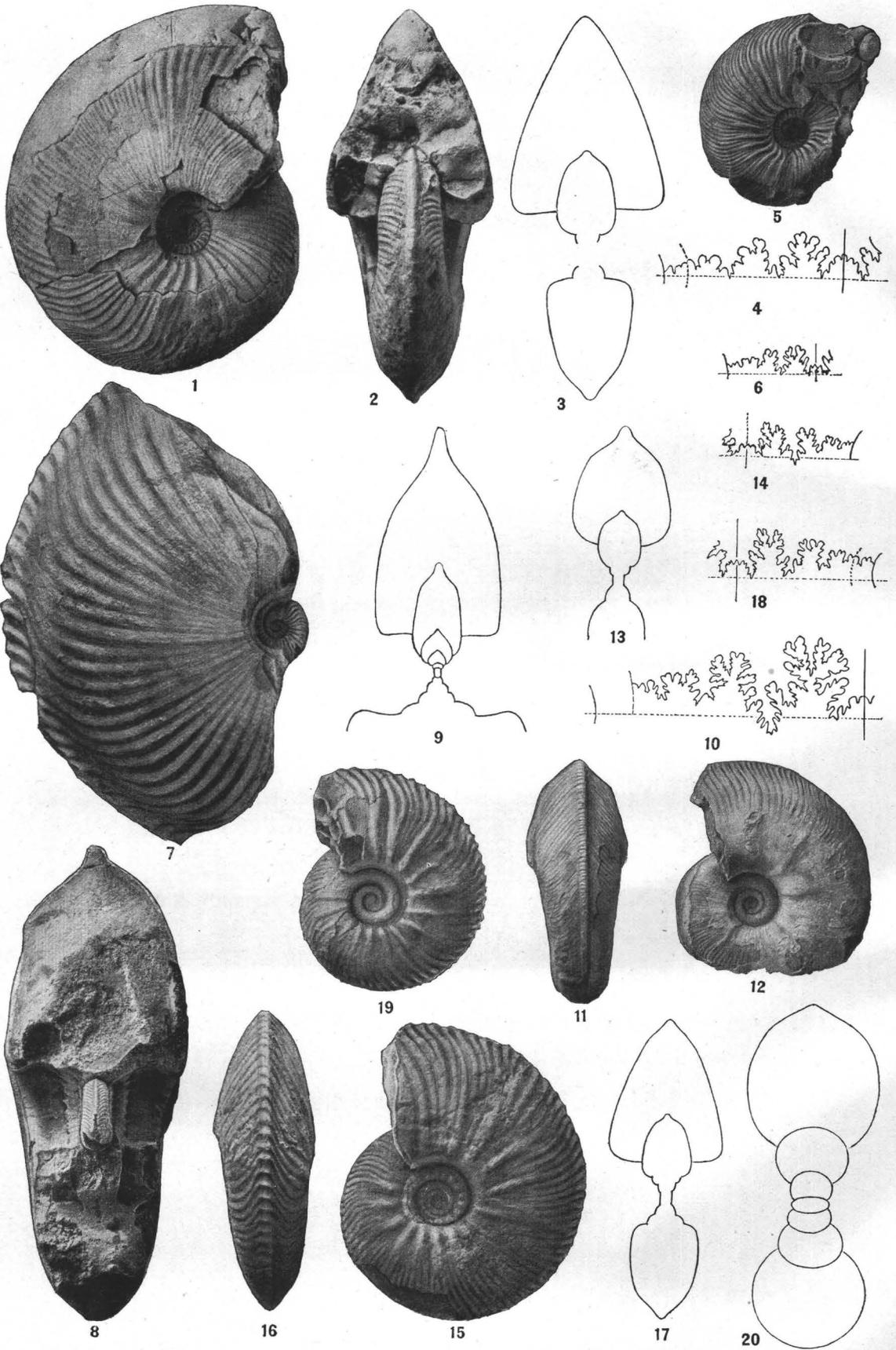


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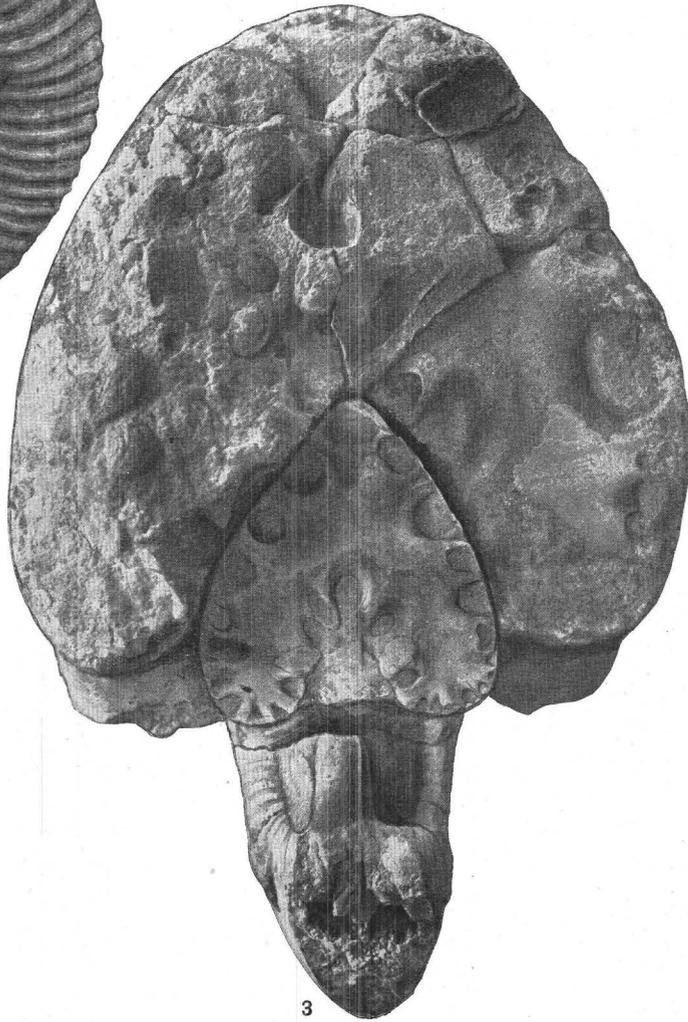
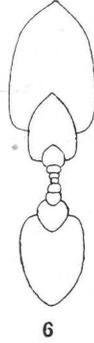
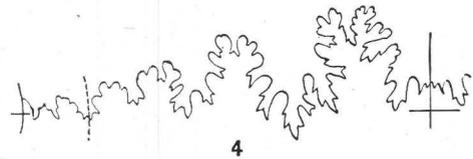
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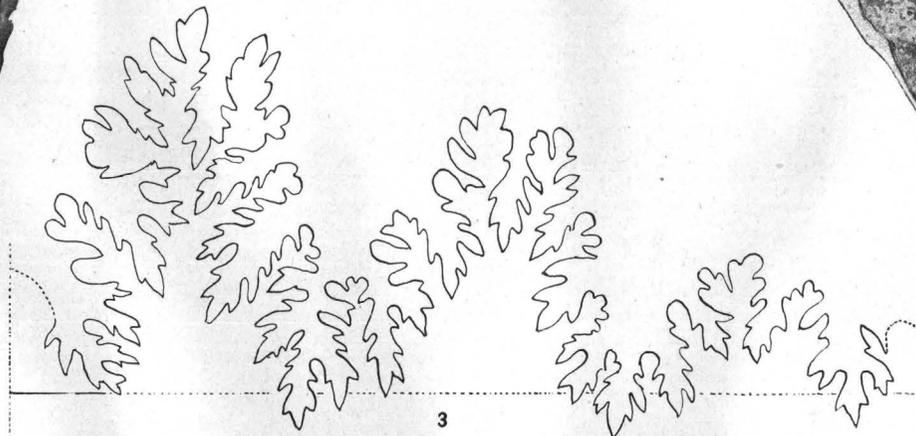
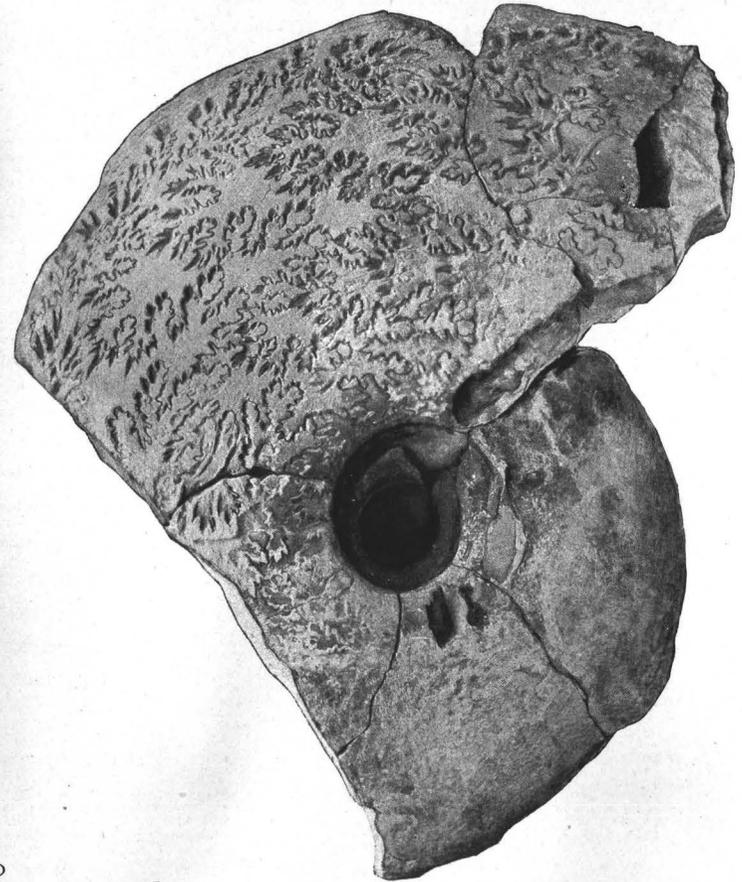
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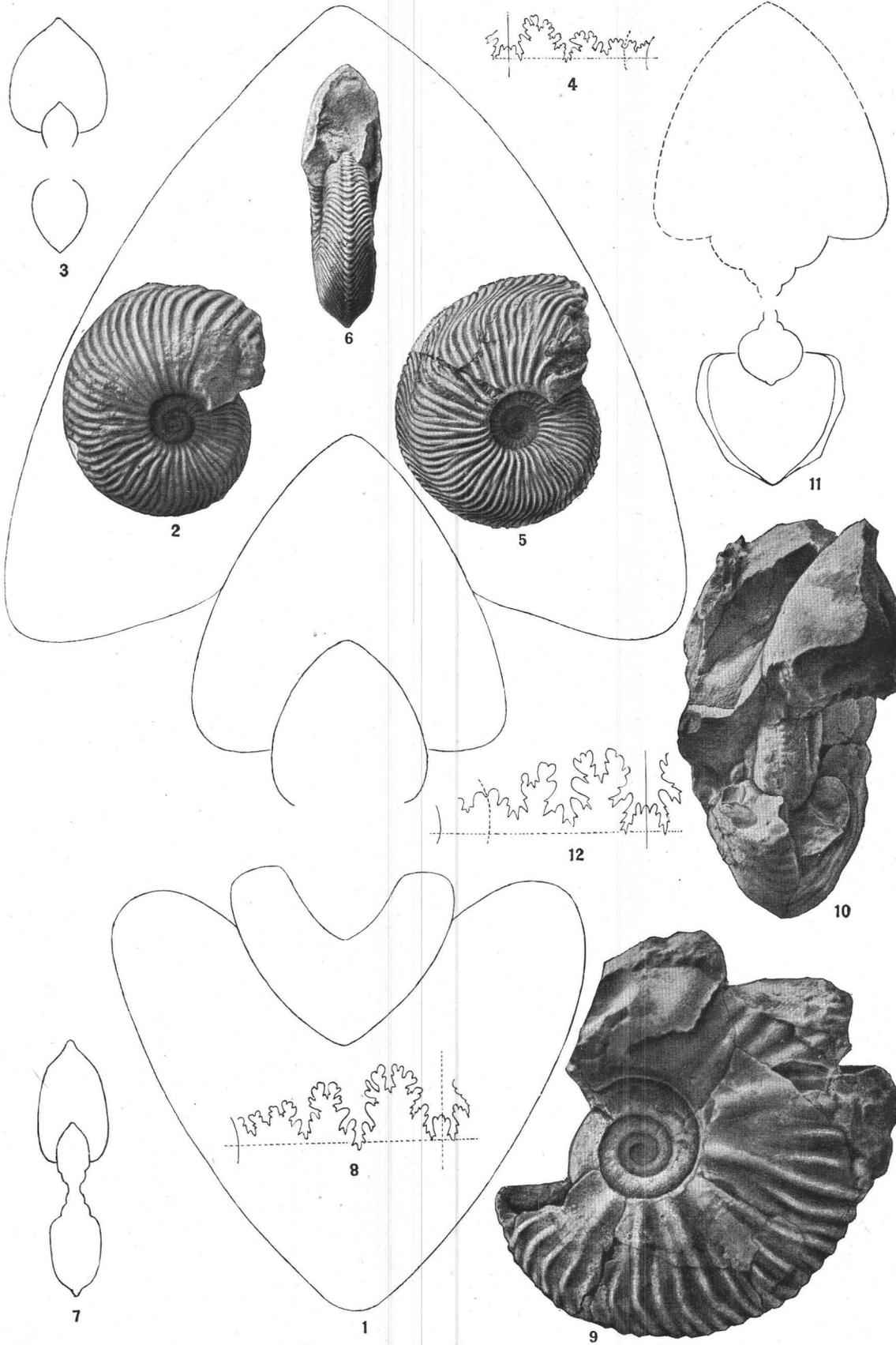
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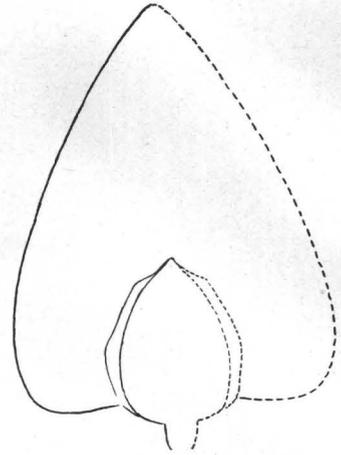
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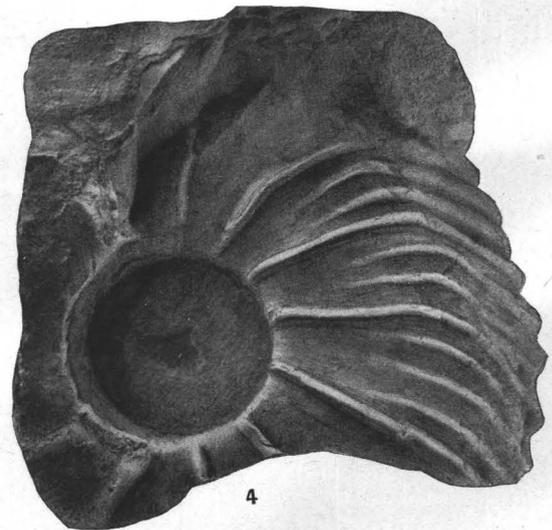
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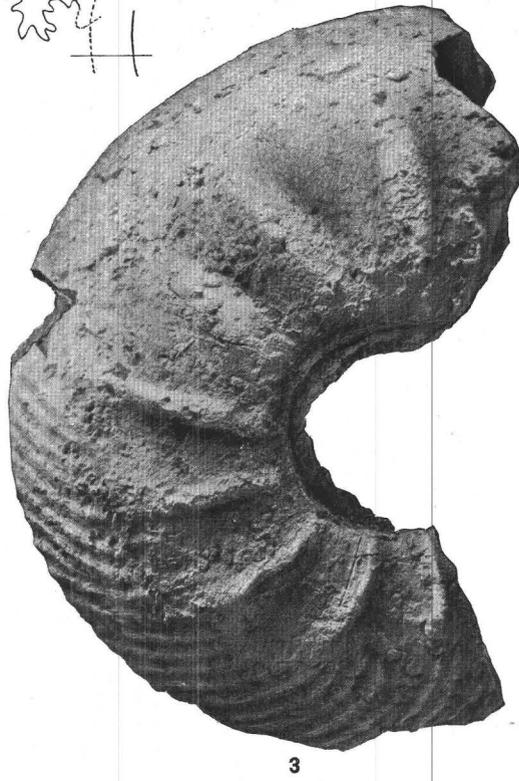
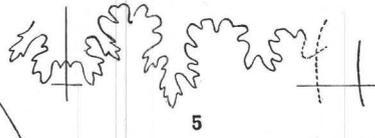
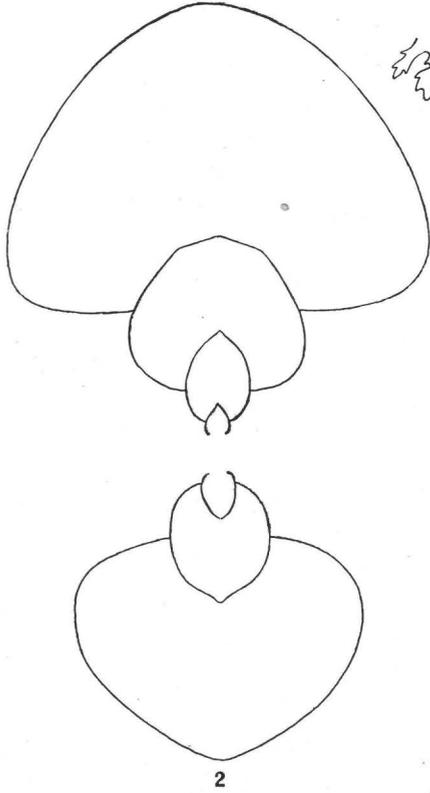
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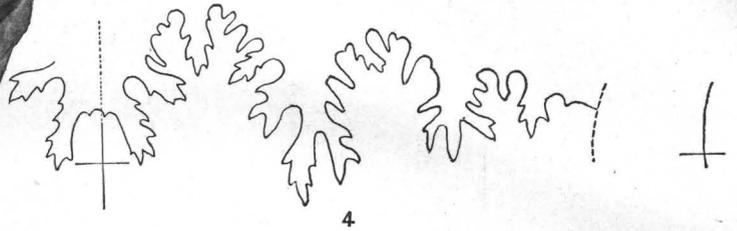
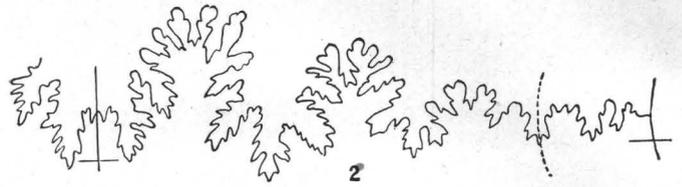
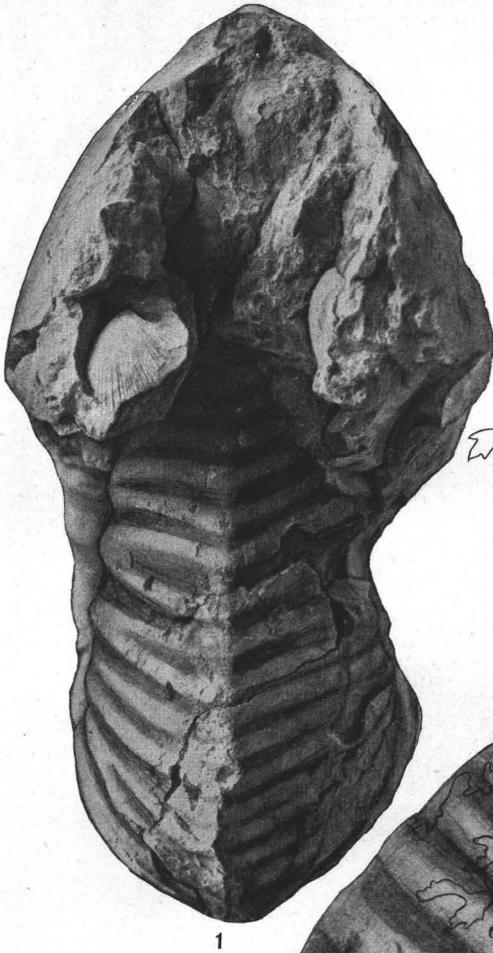
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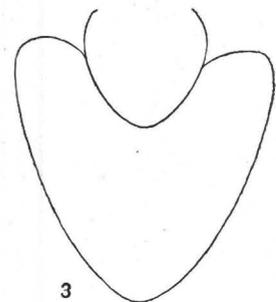
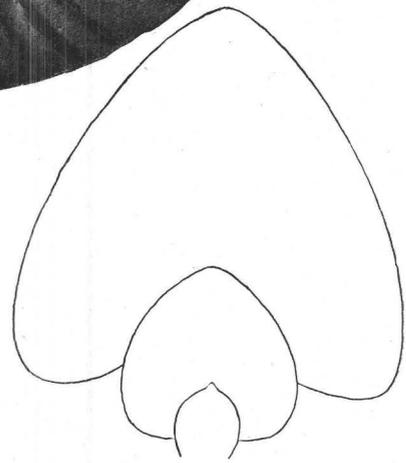
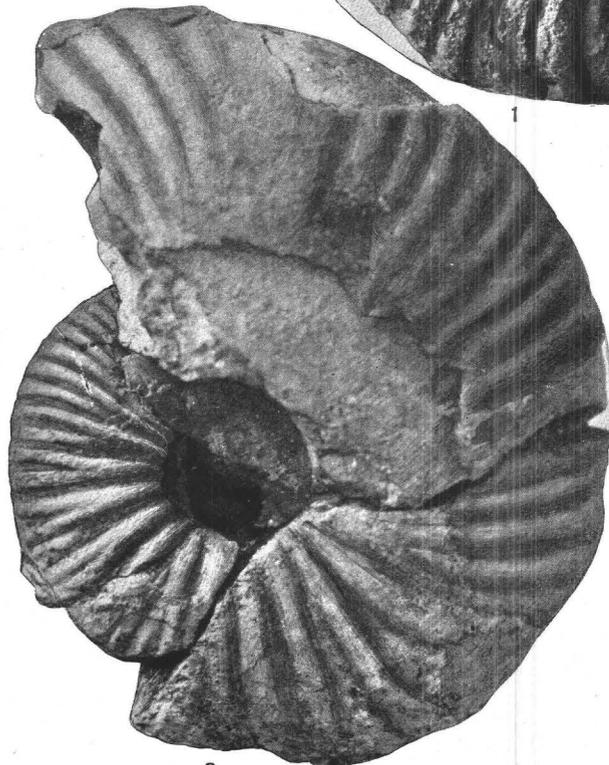
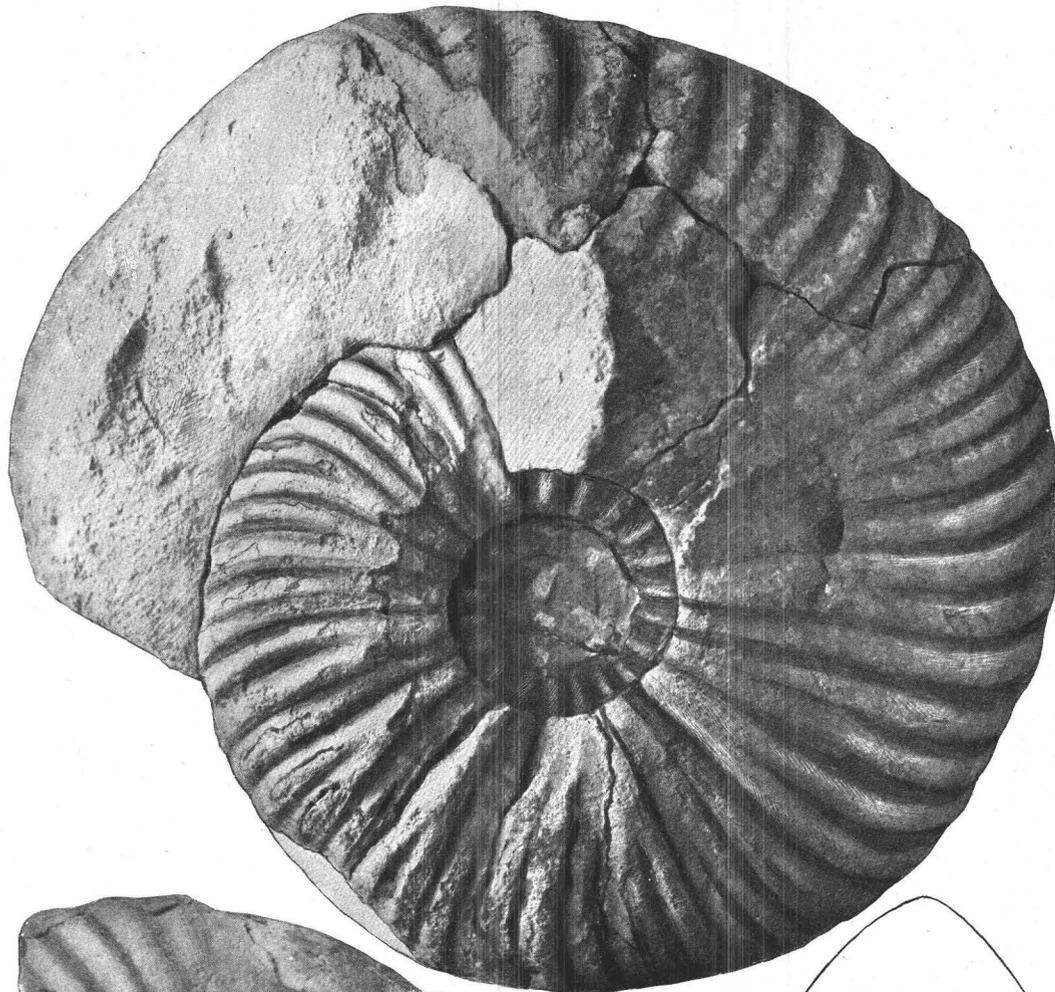
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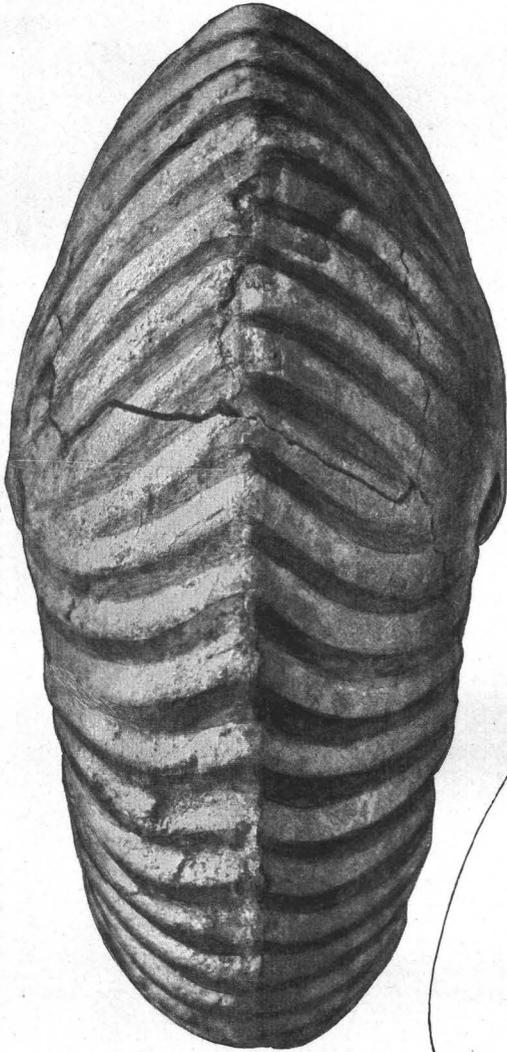
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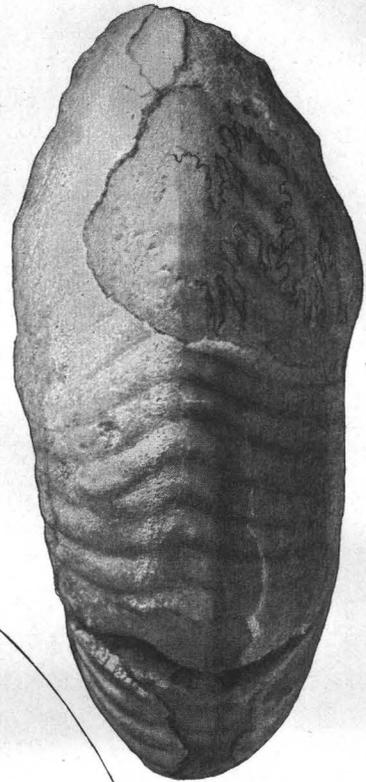
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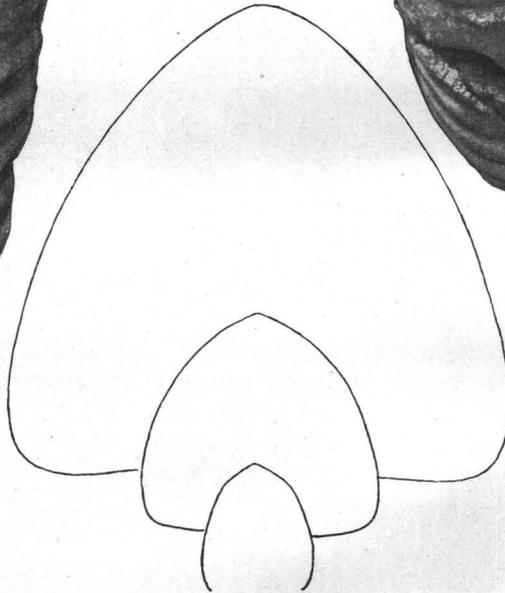
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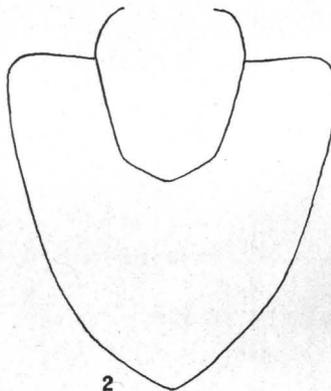
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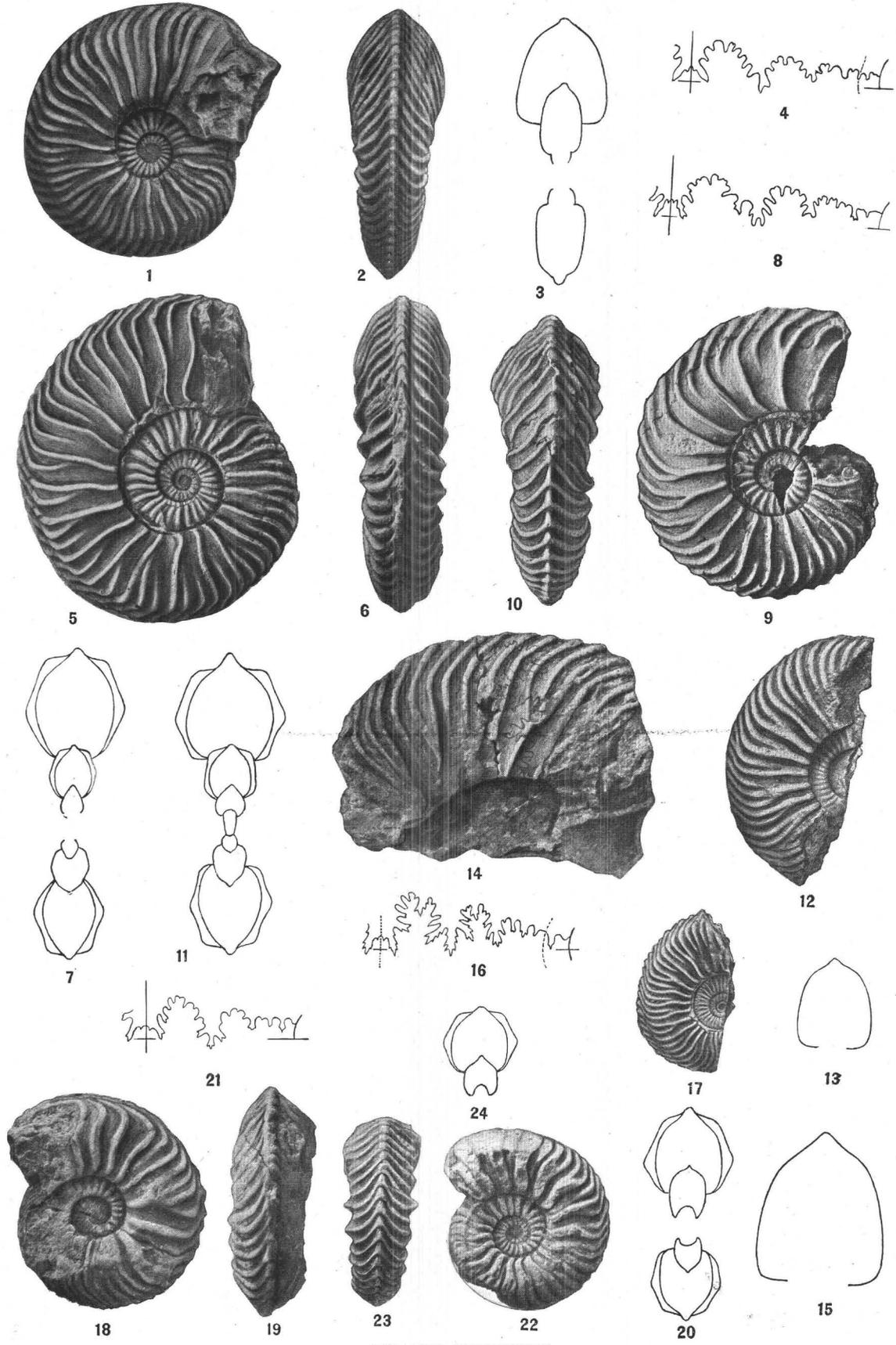
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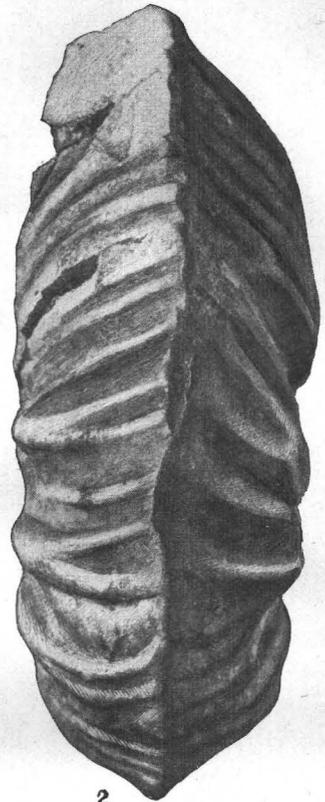
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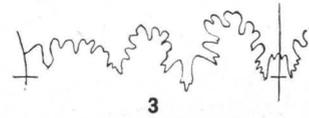
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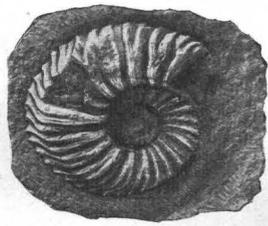
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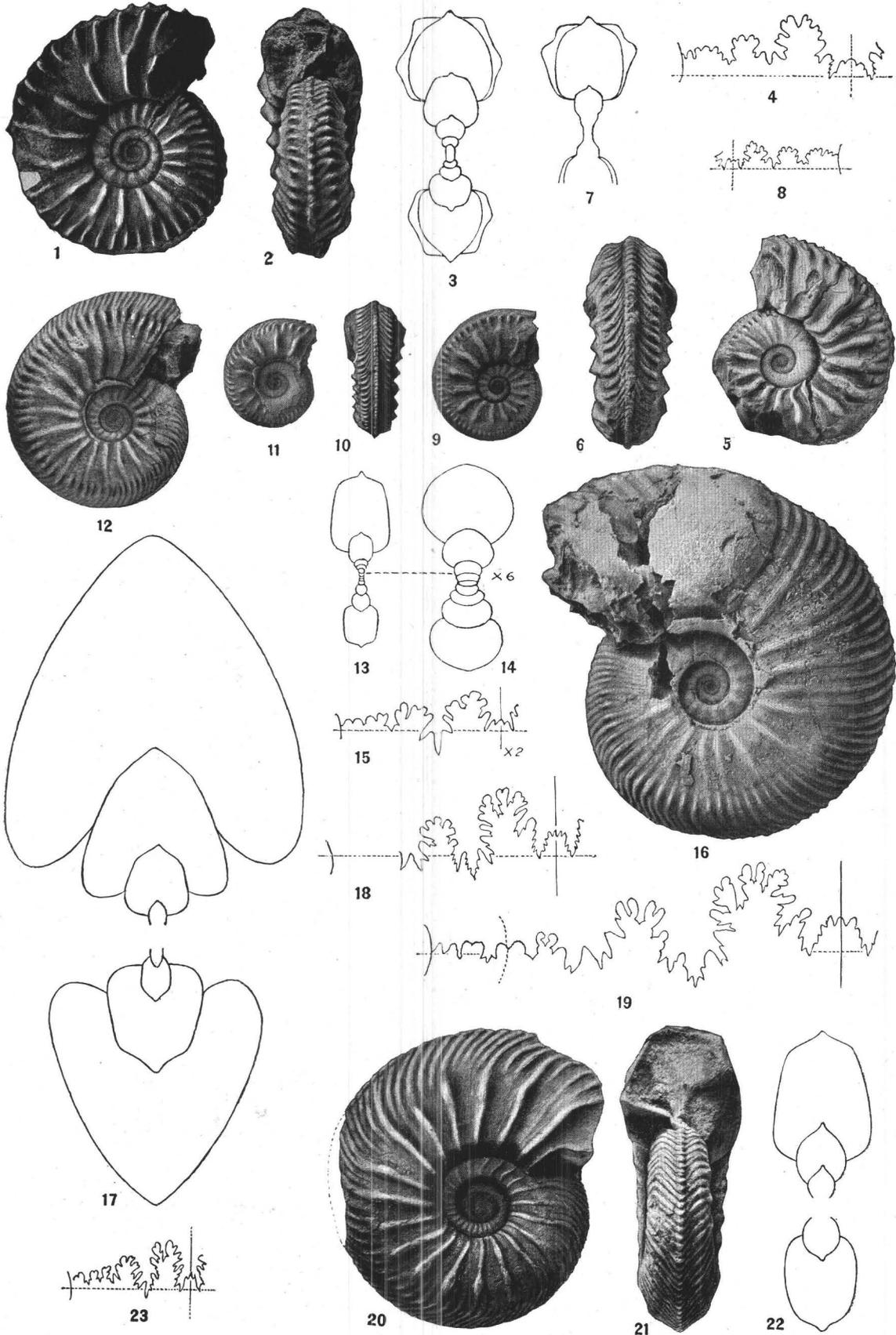
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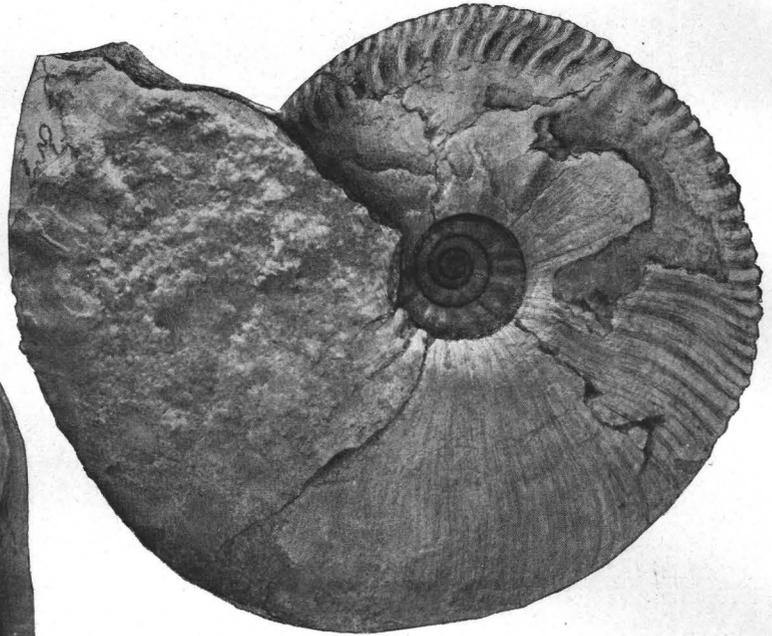
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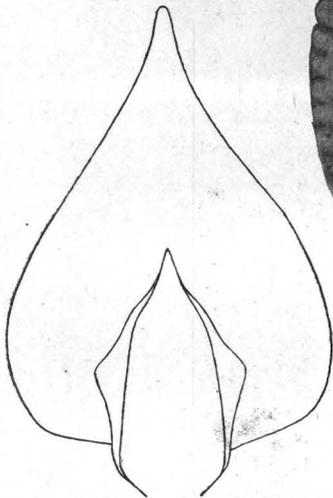
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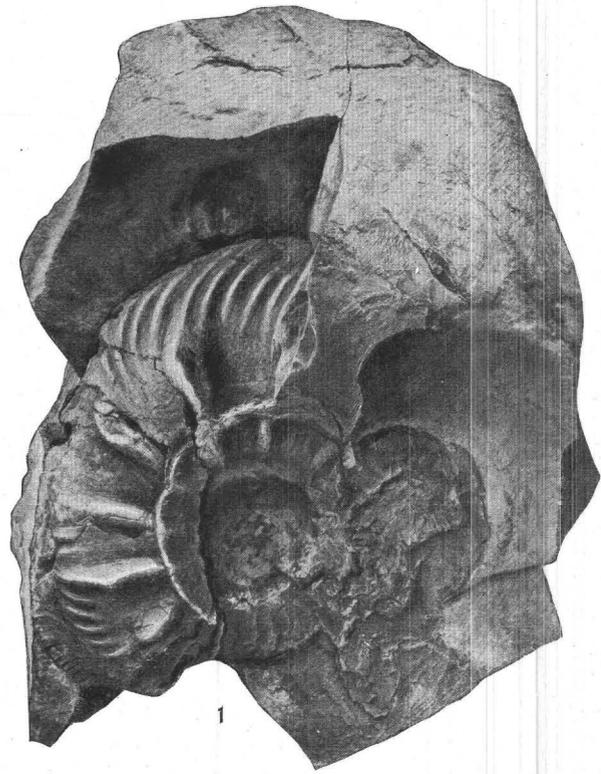
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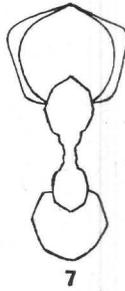
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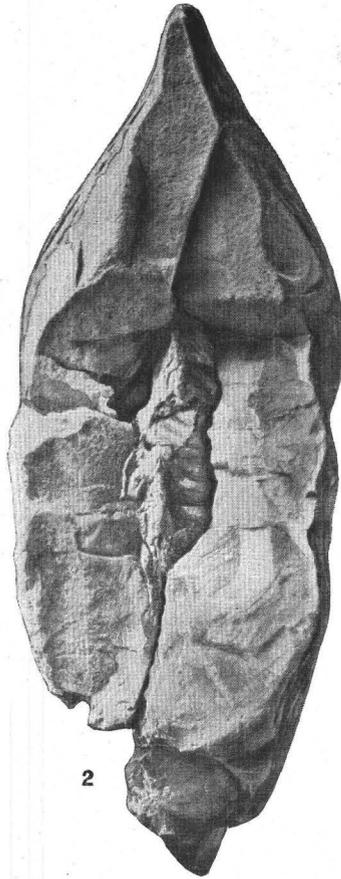
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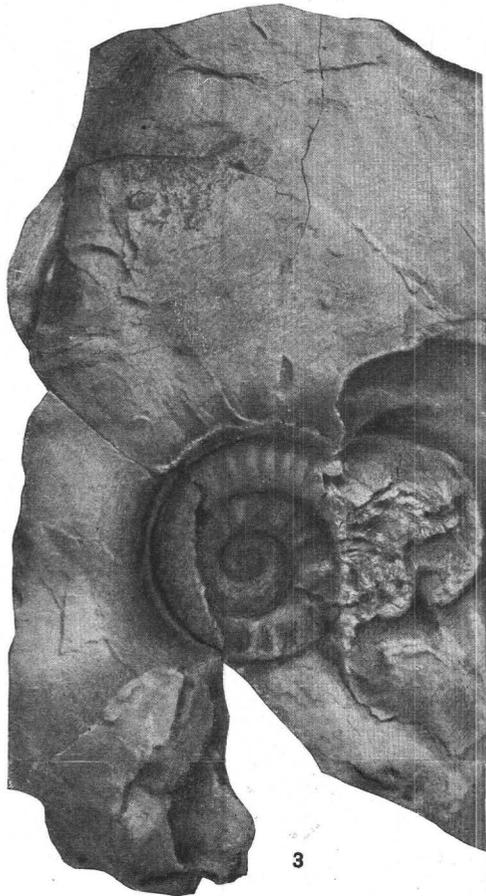
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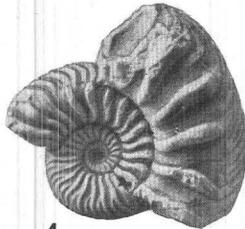
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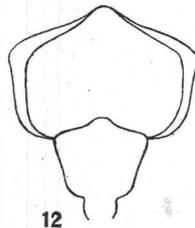
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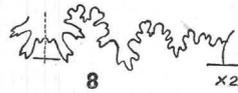
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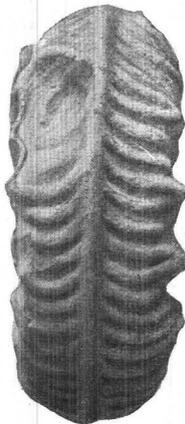


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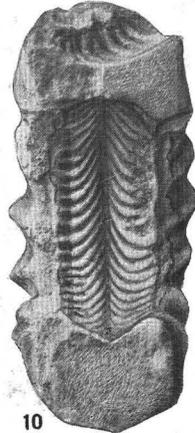
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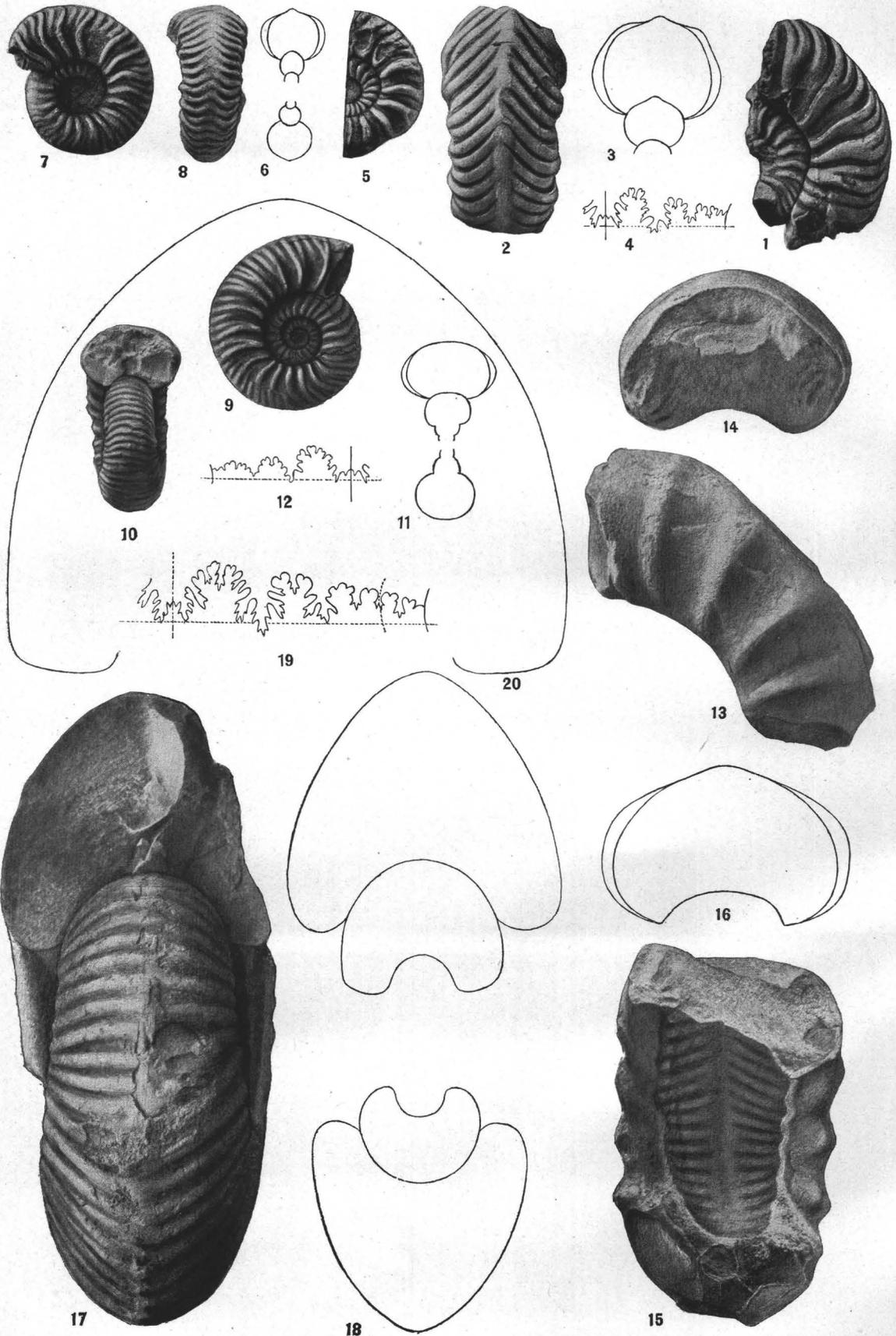


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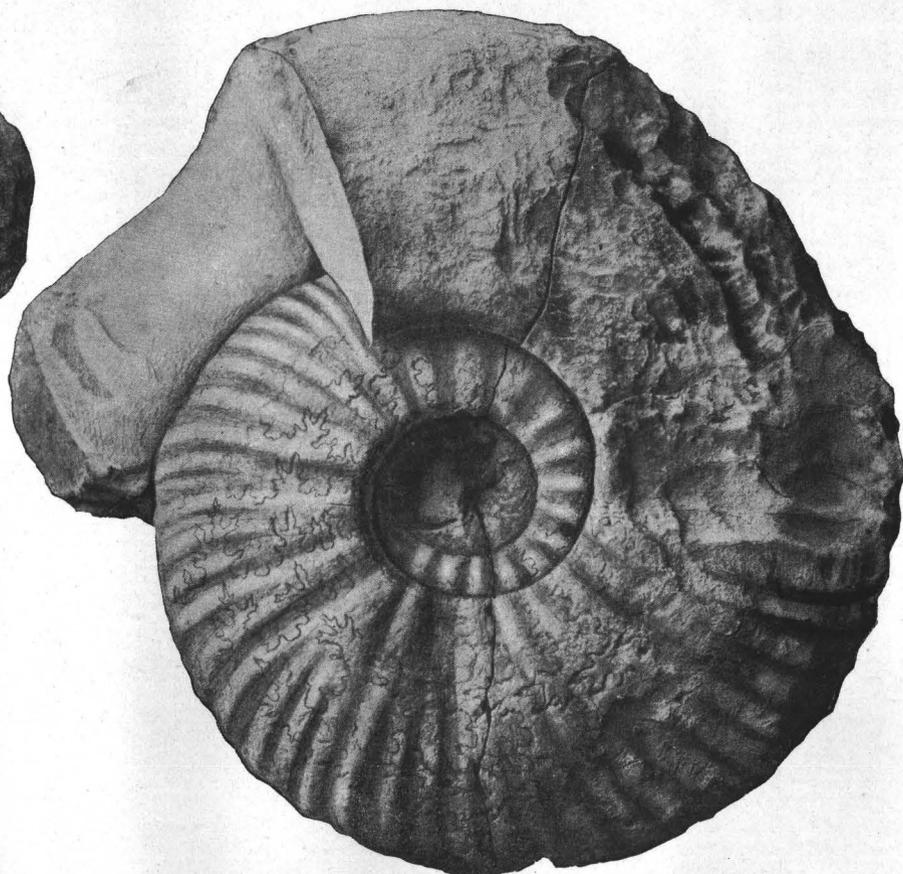
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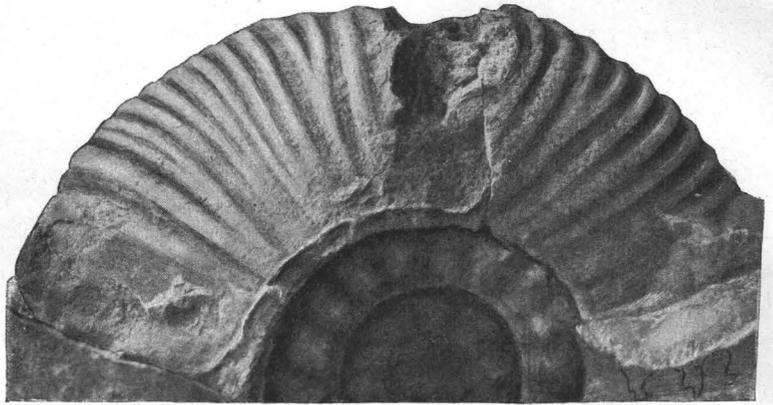


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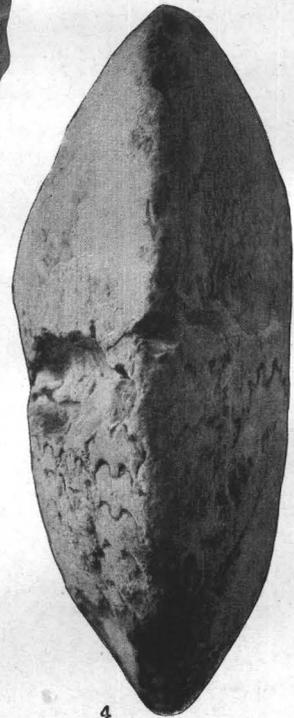
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