

SMITHSONIAN MISCELLANEOUS COLLECTIONS
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BELLEROPHONT GASTROPODS

(WITH 2 PLATES)

BY

J. BROOKES KNIGHT

Research Associate in Paleontology, U. S. National Museum



(PUBLICATION 3865)

CITY OF WASHINGTON
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(WITH TWO PLATES)

As far as I can learn, only two species and two genera of bellerophonts have been described from Cambrian rocks, and the placement of one of those as a bellerophont is problematical. *Owenella antiqua* (Whitfield) is an undoubted bellerophont assignable to the Sinuitidae. It occurs in beds of the Upper Cambrian, Trempealeauan stage in the upper Mississippi Valley, in Texas, and in the Great Basin. Following Whitfield's faulty original description (Whitfield, 1878, p. 52) it has been described twice, once by Ulrich and Scofield (1897, pp. 847, 1080) and again by Knight (1941, p. 223). The second species that I am regarding very tentatively as a bellerophont is *Coreospira rugosa* Saito, 1936. It was described from the *Bonnia* zone, the uppermost zone of the Upper *Redlichia* shales of Korea, by Saito (1936, p. 360) and was discussed by Knight (1941, p. 86). Although the Upper *Redlichia* shales are assigned to the upper part of the Lower Cambrian, the *Bonnia* zone is referred questionably to the Lower Cambrian and may be lowest Middle Cambrian (Saito, 1936, p. 347). A second species of *Coreospira* will be described in this paper, a species collected from the lower Middle Cambrian Ptarmigan formation near Field, British Columbia.

Coreospira has the symmetrically coiled shell of a bellerophont but lacks a feature that characterizes all other bellerophonts previously described, an emargination, sinus, or slit, in the supposedly anterior lip. In respect to this, and some other features, *Coreospira* seems allied to *Helcionella* Grabau and Shimer, 1909. It may be that *Coreospira* is transitional between *Helcionella* and the more typical, but still primitive, bellerophonts of the Upper Cambrian, a matter that I intend to discuss again in another paper. For the present I propose to consider it as the oldest known and most primitive bellerophont genus.

In addition to the new species of *Coreospira*, I shall describe four new species of Upper Cambrian bellerophonts, all of which require

new genera for their reception. Some of the species described are represented only by steinkerns or fillings. Unless the fillings are of such a nature as to show evidence of the form or outline of the apertural lips, it is, in my opinion, generally useless to erect species or genera on them. So important is the form of the lip that a species erected without knowledge of it, or a genus based on such a species, usually is unclassifiable. Even from the utilitarian viewpoint such a species has little value as a stratigraphic guide, for generally it can only be recognized where the beds in which it occurs are identified first on other grounds. This, of course, is stratigraphic paleontology in reverse. The form of the outer lip can be determined (1) when the shell is perfectly preserved, very rare in Paleozoic beds, (2) when the outline of the apertural margins is preserved in the matrix, also relatively rare, and (3) when the growth lines on the outer surface of the shell are preserved in one way or another, for the growth lines are a record of the shell margins of earlier growth stages. If none of the foregoing conditions is fulfilled, there may be still other evidence that is useful if used with caution. Occasionally a filling is found which shows the imprint of rather faint undulations in the inner surface of the shell, undulations that record an irregularity of growth at some period in the life history of the individual. Since such an irregularity of growth affects the growing margin of the shell all at once, the undulation in the inner shell surface caused by it will usually give a satisfactory clue to the form of significant parts of the apertural margins. For example, if the reader will examine the figures of *Sinuella minuta* on plate 2 of this paper he will see that figures 2a-b show a specimen with the shell and its growth lines preserved although the apertural margins themselves are not preserved. These show clearly the form of the sinus in the anterior lip. Figure 2d shows a specimen that is a filling with the shell removed so that the growth lines are not preserved. However this filling shows an undulation recording an irregularity of growth, and this undulation also shows the outlines of the sinus in the outer lip. It is by employing such criteria that the form of the lip was determined for some of the species here described that otherwise would not have warranted description.

Acknowledgments and remarks.—I am deeply indebted to several colleagues, more familiar with the stratigraphy of the Cambrian than I am, for the placement of these species in the Cambrian time-stratigraphic sequence. For this, thanks are due to Virgil E. Barnes, Preston E. Cloud, Jr., G. Arthur Cooper, Norman M. Denson, and Christina Lochman.

I offer no apologies for the unconventional illumination of the specimens photographed. It was necessary to direct the light so as to show objectively certain obscure but significant features on the specimens that would have been lost entirely if conventional lighting from the upper left had been employed.

Stratigraphic position.—In view of its possible importance for bellerophont phylogeny, as well as for stratigraphic application, the present known occurrence of the two old and four new genera of Cambrian bellerophonts is recapitulated in terms of the American Cambrian succession (Howell, et al, 1944, chart No. 1). Admittedly, the Cambrian succession is not well understood and is subject to revision as our understanding of it grows; nevertheless its main features appear to be well enough understood for our present purpose.

Coreospira Saito is now known from two widely separated regions, Korea and the Rocky Mountains of British Columbia. In both regions it occurs at the same, or approximately the same, level; just above (or below?) the boundary of the Lower and Middle Cambrian. Next in order appears *Cycloholcus*, new, related to *Coreospira*, near the base of the Upper Cambrian Dresbachian stage. Following these two very primitive and somewhat questionable bellerophonts, the first of the undoubted bellerophonts, *Sinuella*, new, appears in Upper Cambrian beds of upper Dresbachian or lower Franconian stage. Seemingly somewhat higher in the section, middle Franconian, appears *Anconochilus*, new. *Cloudia*, new, occurs in the lower Trempealeuan (or upper Franconian?) and thus is contemporaneous with, or possibly precedes, *Owenella* Ulrich and Scofield which characterizes the lowest zone of the Trempealeau stage and may range higher.

Suborder BELLEROPHONTACEA Ulrich and Scofield, 1897

Family COREOSPIRIDAE Knight, new family

Genus COREOSPIRA Saito, 1936

Genotype, by original designation: *Coreospira rugosa* Saito, 1936.

Diagnosis.—Small, bellerophontiform gastropods with a flat or gently arched outer (dorsal) whorl-face extending laterally as a roundly subangular ridge overhanging the sides. The sides are nearly flat and the umbilici open. There is no emargination (sinus or slit) in the anterior lip and the margins of the lateral lips are approximately tangent to the coil. The ornamentation consists of growth lines and of transverse undulations strong enough to impress themselves on the inner surface of the shell.

Remarks.—Saito, in describing the genus originally, regarded it as coiled “slightly sinistrally (?)” and therefore as not bilaterally symmetrical or bellerophontiform. However, he seems to have been far from certain on this very fundamental point. On studying his description and figures I concluded that the shells he was describing were probably bellerophontiform and redescribed his species tentatively as such in 1941 (p. 86). The new species described below appears to confirm my conclusions in this respect.

COREOSPIRA WALCOTTI Knight, new species

PLATE I, FIGURES 2a-d

Description.—Small bellerophontiform gastropods seemingly of two or three whorls coiled symmetrically in a plane with widely open umbilici; outer whorl surface (here regarded as dorsal) flatly arched, bounded by rounded angulations on each side, the angulations being the widest part of the shell; sides gently concave sloping gently inward to the sharp umbilical shoulders; aperture flaring behind under the coil so that the growth lines are oblique to the radius and tangent to the coil; anterior lip without an emargination, the growth lines passing directly across the dorsal whorl-face; ornamentation fine growth lines and broad transverse undulations on the sides of the shell, the latter seemingly more strongly developed inside the shell than outside, for the internal filling shows them much more strongly than does the shell surface.

Measurements (approximate).—Holotype, U.S.N.M. No. 111960, length 6 mm., width 2 mm.; figured paratype, U.S.N.M. No. 111961, length 11 mm., width 3 mm.

Hypodigm.—10 specimens, 8 of them other than the holotype and figured paratype, under U.S.N.M. No. 111962.

Remarks.—The specimens are preserved in a dark granular limestone and some of them appear to be distorted by pressure. Some patches of shell are preserved. Only one specimen shows the left side and although it is imperfect there is nothing about it to indicate asymmetry.

Comparisons.—This species differs from *C. rugosa* Saito most conspicuously in that its dorsal surface is gently rounded instead of flat.

Occurrence.—Top of the Ptarmigan formation, lower Middle Cambrian at Walcott's locality 58k on Mount Stephen, 3 miles east of Field, British Columbia. These beds were originally placed in the Lower Cambrian Mount Whyte formation (Walcott, 1928, p. 317) but are now assigned as given above.

Genus *CYCLOHOLCUS* Knight, new genus

Genotype: *Cycloholcus nummus* Knight, new species.

Diagnosis.—Disklike, bellerophontiform gastropods with prominent rounded keels bordering the outer (dorsal) whorl-face and the umbilici, with a rounded groove between. The lateral margins of the aperture are oblique to the radius and tangent to the coil. There seems to be no emargination in the outer lip. The transverse section of a whorl is roughly dumbbell-like. It differs from *Coreospira* Saito largely in its coinlike shape and in the relatively prominent keel about the umbilici. It seems to lack transverse undulations of such strength as to be impressed on the inner surface, for, unlike *Coreospira*, fillings are nearly smooth. The genotype is the only known species.

CYCLOHOLCUS NUMMUS Knight, new species

PLATE I, FIGURES 3a-d

Description.—Seemingly of about $3\frac{1}{2}$ whorls; the keels surrounding the umbilici protruding slightly more than those bordering the outer whorl-face; the outer whorl-face narrow and rounded; ornamentation coarse, fasciculated growth lines that show on the inner surface of the shell only sporadically and faintly.

Measurements.—Holotype, U.S.N.M. No. 111957, length 10.4 mm., width 2.8 mm.; figured paratype, U.S.N.M. No. 111958, length 11.0 mm.

Hypodigm.—7 specimens, 5 of them, other than the holotype and figured paratype, under U.S.N.M. No. 111959.

Remarks.—The holotype and figured paratype are free fillings accompanied by the matrix from which they were broken. The other paratypes are still in the dark-gray granular limestone matrix. The block from which the figured paratype was broken retains the shell for the most part, but a few fragments clung to the filling, exposing small areas of the impression of the ornamentation in the matrix.

Occurrence.—From limestone interbedded with the Nolichucky shales (Dresbachian stage, lower Upper Cambrian) at some point in eastern Tennessee now uncertain; probably from a point on Cub Creek, 1.5 miles southeast of Morristown, Tenn.

Family CYRTOLITIDAE Ulrich and Scofield, 1897

Genus *CLOUDIA* Knight, new genus

Genotype: *Cloudia buttsi* Knight, new species.

Diagnosis.—Bellerophontiform gastropods of moderately large size,

with deep, open umbilici surrounded by subangular shoulders, and with roundly subangular dorsum. The whorls are in contact but without involution. The anterior lip has a shallow, gently rounded sinus. In many respects the genus reminds one of *Cyrtolites* Conrad, 1838, but its whorls are not so quadrate in section and there is no dorsal notch-keel; neither does it show the strong transverse undulations that help characterize *Cyrtolites*.

CLOUDIA BUTTSI Knight, new species

PLATE 2, FIGURES 1a-e

Description.—Seemingly of four or more whorls when mature, the whorls nearly twice as wide as high, with wide, steep, very gently arched umbilical slopes; the dorsal surface arched with nearly flat slopes and rounded crest; ornamentation unknown except on the inner part of the umbilical slopes where it consists of fine growth lines; the sinus in the anterior lip shallow and gently arched.

Measurements.—Holotype, U.S.N.M. No. 112054, length 32 mm., width 22 mm.; figured paratype, U.S.N.M. No. 112056, length 21.4 mm., width 15 mm.

Hypodigm.—24 specimens, as given below.

Remarks.—All the specimens are fillings preserved in rough, dolomitic¹ chert. Only one preserves some silicified shell surface in the middle part of the umbilicus. Several show the form of the outer lip faintly but unmistakably recorded as imprints of slight irregularities of growth. If it had not been for the record of the highly important form of the outer lip I should not have ventured to describe and name either the species or genus.

This very interesting species was discovered independently by Dr. Charles Butts, of the United States Geological Survey and by a party headed by Dr. Preston E. Cloud, Jr., of the same organization. Both Dr. Butts and Dr. Cloud called it independently to my attention and both regard it as a useful index fossil for the Copper Ridge dolomite of the southern Appalachians.

Occurrence.—All specimens are from the lower part of the middle third of the Copper Ridge dolomite just above a zone of digital, *Gymnosolen*-like stromatolites. This position seems to be assignable to the Trempealeauan stage of the Upper Cambrian but may be upper Franconian. The collections were made at the following localities in Alabama: The holotype (U.S.N.M. No. 112054) and a paratype

¹ See Cloud, Barnes, and Bridge, 1945, p. 135.

(U.S.N.M. No. 112055) from a point about midlength of the Alabama-Georgia State line, NW $\frac{1}{4}$, NW $\frac{1}{4}$, fractional sec. 19, T. 11 S., R. 12 E., U.S. G. S. Special Map, Rock Run and vicinity; a figured paratype (U.S.N.M. No. 112056) and 3 unfigured paratypes (U.S.N.M. No. 112057) from a point at the midlength of the south side NW $\frac{1}{4}$, NE $\frac{1}{4}$, sec. 5, T. 12 S., R. 10 E., Cherokee County, Ala. (rock in place); a figured paratype (U.S.N.M. No. 112058) and 4 unfigured paratypes (U.S.N.M. No. 112059) from a point just south of center of SW $\frac{1}{4}$, NE $\frac{1}{4}$, SW $\frac{1}{4}$, sec. 12, T. 12 S., R. 9 E., Cherokee County, Ala.; 4 unfigured paratypes (U.S.N.M. No. 112062) from a point near center of E $\frac{1}{2}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$, SW $\frac{1}{4}$, sec. 22, T. 12 S., R. 9 E., Cherokee County, Ala.; 4 unfigured paratypes (U.S.N.M. No. 112061) from a point about 200 feet south-southwest of a point in the SW $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$, SE $\frac{1}{4}$, sec. 15, T. 12 S., R. 9 E.; 6 unfigured paratypes (U.S.N.M. No. 112060) from a point about 2 miles northwest of center of Anniston, Anniston Quadrangle, Calhoun County, Ala.

Family SINUITIDAE Dall, in Zittel-Eastman, 1913

Genus ANCONOCHILUS Knight, new genus

Genotype: *Anconochilus barnesi* Knight, new species.

Diagnosis.—Rather large, involute, and probably narrowly phaneromphalous gastropods with a deep, broad, rounded sinus in the anterior lip; posterior lip of the aperture seemingly flaring backward under the coil; whorl section rounded dorsally with the sides of the dorsal slope somewhat flattened; surface characters of the shell entirely unknown.

Remarks.—When preserved in the form of fillings, *Anconochilus* is remarkably similar to *Simuites* Koken, 1896. Indeed it was only after considerable study of the specimens, of the genotype species, all of them fillings, that I felt that I could differentiate it from *Simuites*. The basis for the differentiation resides in the form of the lateral and probably the posterior lips as indicated on several of the specimens by the impressions of the irregularities of growth. These indicate that the margins of the lateral lips did not have the pronounced forward convexity that characterizes *Simuites* and led to the name "*bilobatus*" for its genotype species. On the contrary, the margins of the lateral lips in *Anconochilus* sweep toward the sides and downward from the apex of the sinus to the circumumbilical shoulders with only a very gentle convexity. Furthermore they appear to have passed tangentially under the whorl in such a way that there must have been

some backward flaring. If this is the case, as it seems to be, the umbilicus most probably was open although narrow. To clarify these distinctions the student can compare profitably the illustration showing the side view of the holotype of *Sinuities cancellatus* (Hall) in Knight, 1941 (pl. 6, fig. 3a) and those of the holotype of the present species.

ANCONOCHILUS BARNESI Knight, new species

PLATE I, FIGURES 1A-C

Description.—Since the surface characters of this species are entirely unknown, the diagnosis given above for the genus, supplemented by the following measurements, will serve also as the description of the species.

Measurements (approximate).—Holotype, U.S.N.M. No. 112045, length 28 mm., width 24 mm.; figured paratype, U.S.N.M. No. 112046a, length 32.5 mm., width 27.5 mm.; figured paratype, U.S.N.M. No. 112046b, length 26 mm., width 22 mm.

Hypodigm.—The holotype, 2 figured paratypes, and 8 unfigured paratypes (U.S.N.M. No. 112047).

Occurrence.—Pedernales dolomite member of the Wilberns formation at a level about 50 feet above a stromatolitic bioherm that probably is assignable to the Point Peak shale member of the Wilberns. This suggests that the occurrence is at about the middle of the Franconian stage of the Upper Cambrian. The locality (Univ. Texas 86-T-2-14G) is 2.5 miles airline southeast of Willow City, Gillespie County, Tex., 2,400 feet southeast of the intersection of the Willow City-Sandy Post Office road and the old Fredricksburg-Burnet road; 1,000 feet east of Willow Creek at a point 1,500 feet south of Willow City-Sandy Post Office road, and 200 feet south of Cretaceous overlap.

Genus SINUELLA Knight, new genus

Genotype: *Sinuella minuta* Knight, new species.

Diagnosis.—Small, widely phaneromphalous, only slightly involute bellerophontiform gastropods with a gently concave dorsum bordered by low, rounded shoulders. The anterior lip has a moderately deep, rounded sinus.

Comparisons.—*Sinuella* reminds one of *Bucanella* Meek, 1871, in its broad, rather flat whorls, open umbilici and in the shape of the sinus in the anterior lip. It differs markedly from *Bucanella* in that its dorsum is slightly concave and faintly bilobate while that of *Bucanella* is strongly convex and trilobate. In fact, the faintly depressed dorsum is unique among bellerophonts.

SINUELLA MINUTA Knight, new species

PLATE 2, FIGURES 2a-g

Description.—With the characters given above for the genus. The ornamentation consists of growth lines occasionally expressing themselves on the dorsum as widely spaced, sharp transverse lirae. There must have been something like 5 or 6 whorls.

Measurements (approximate).—Holotype, U.S.N.M. No. 112049, length 1.27 mm., width .80 mm.; figured paratype, U.S.N.M. No. 112050b, length 1.52 mm., width .92 mm.; figured paratype, U.S.N.M. No. 112052, length 3.8 mm.

Hypodigm.—About 30 specimens as listed below.

Remarks.—The minute specimens of this species are mostly imbedded in a gray, granular, glauconitic limestone. The holotype retains the shell. It is broken in two parts, one part free and the other imbedded in matrix. All the other specimens are fillings, either partly exposed in matrix or broken free from it. The shell commonly adheres to the outer matrix rather than to the filling. A few of the fillings are in part glauconitic.

Occurrence.—The specimens were all collected by the late Dr. C. D. Walcott in 1885, and the precise level of their occurrence in the Upper Cambrian is now undeterminable from the records. Dr. Preston E. Cloud, Jr., with others, has recently restudied in detail the early Paleozoic stratigraphy of the localities from which the specimens came and on the basis of associated fossils and lithology he advises me that these specimens could not have come from beds higher than the Point Peak shale member of the Wilberns formation nor lower than the Cap Mountain limestone member of the Riley formation. He is further of the opinion that they most probably come from either the upper part of the Cap Mountain limestone member or from limestone interbeds in the Lion Mountain sandstone member of the Riley formation, or from the Morgan Creek limestone member of the Wilberns. Thus they are of late Dresbachian or early Franconian age. Other than the Coreospiridae, this is the earliest bellerophont now known.

The specimens are represented in three collections from two localities in the Central Mineral Region of Texas. The holotype (U.S.N.M. No. 112049), 2 figured paratypes (U.S.N.M. No. 112050a and U.S.N.M. No. 112050b), and 12 unfigured paratypes (U.S.N.M. No. 112051) in one collection, and 6 unfigured paratypes in another (U.S.N.M. No. 112048) are from Potatotop Hill, 7 miles

northwest of Burnet, Tex. One figured paratype (U.S.N.M. No. 112052) and 7 unfigured paratypes (U.S.N.M. No. 112053) are from Packsaddle Mountain, 11 miles southeast of Llano, Tex.

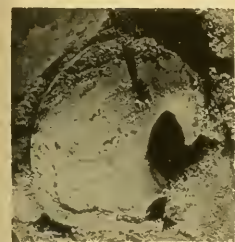
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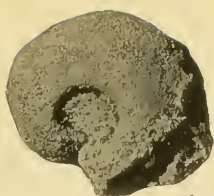
EXPLANATION OF PLATES

PLATE I

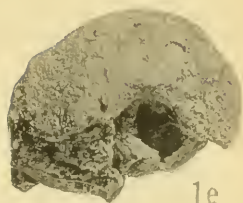
- 1a-e. *Anconochilus barnesi* Knight, new species. All figures $\times 1$. 1a-b, the holotype (U.S.N.M. No. 112045), oblique and side views respectively. Note on 1a the irregularities of growth outlining the margin of the outer lip at former stages of growth. 1c, a paratype (U.S.N.M. No. 112046b), side view. 1d-e, a paratype (U.S.N.M. No. 112046a), front and side views respectively. Irregularities of growth outline the anterior sinus in figure 1d. What appears to be the lateral margin of the lip in figure 1e is actually a line of breakage intersecting the course of the true margin at a high angle.
- 2a-d. *Coreospira walcotti* Knight, new species. All figures $\times 4$. 2a-b, the holotype (U.S.N.M. No. 111960), side and oblique views respectively. The specimen is a filling except for the small patch of adhering shell in the lower central part. 2c-d, a paratype (U.S.N.M. No. 111961), side and front views respectively. The specimen is largely a filling except for patches of shell adhering in the umbilical region and on the



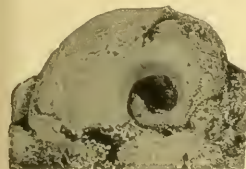
1a



1c



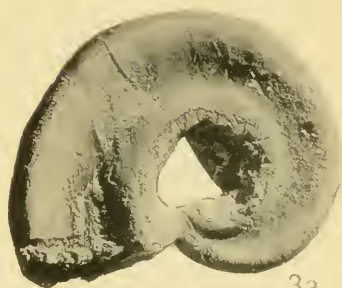
1e



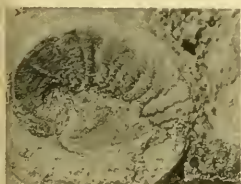
1b



1d



3a



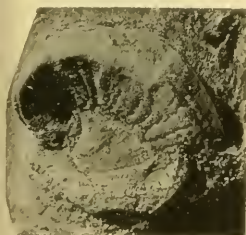
2a



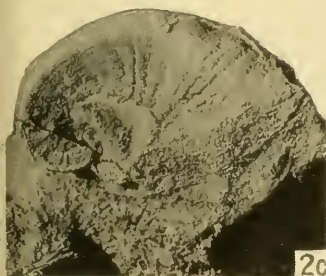
3b



3c



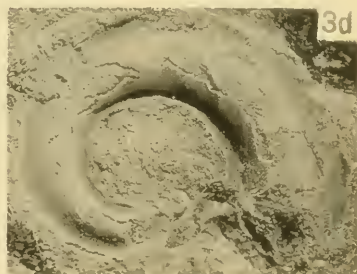
2b



2c



2d



3d

CAMBRIAN BELLEROPHONT GASTROPODS

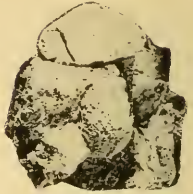
(See explanation of plates.)



1a



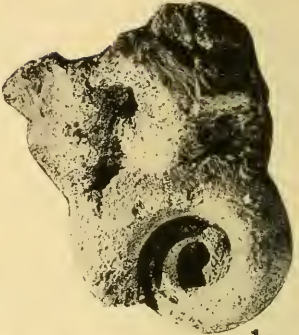
1c



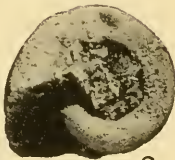
1b



1d



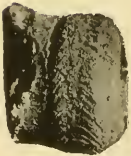
1e



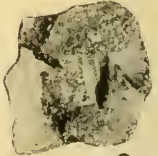
2c



2d



2a



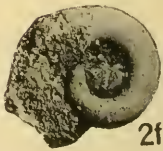
2e



2b



2g



2f

CAMBRIAN BELLEROPHONT GASTROPODS
(See explanation of plates.)

outer whorl-face. The growth lines and irregularities of growth on the latter show clearly that there is no anterior sinus.

- 3a-d. *Cycloholcus nummus* Knight, new species. All figures $\times 4$. 3a-b, the holotype (U.S.N.M. No. 111957), side and marginal views respectively. Note the irregularities of growth tangent to the umbilicus and passing obliquely backward across the sides of the whorl. These indicate positions of former lateral apertural margins. The specimen is a filling, without shell and with the umbilical coil broken through. 3c-d, a paratype (U.S.N.M. No. 111958), side view of filling and corresponding inner shell surface adhering to the matrix respectively. There are small patches of shell adhering to the filling and, in the corresponding areas of the counterpart, impressions in the matrix of some of the external surface may be seen. These not only give information as to the ornamentation but, together with the irregularities of growth, confirm the course of the lateral apertural margins inferred on the holotype from irregularities of growth alone.

PLATE 2

- 1a-e. *Cludia buttsi* Knight, new species. All figures $\times 1$. 1a, a paratype (U.S.N.M. No. 112058), front view. Note the irregularities of growth near the lower (adapertural) end outlining a former apertural margin and thus showing the shallow, rounded sinus in the anterior lip. 1b, a paratype (U.S.N.M. No. 112056), with the whorl in the upper part sectioned transversely. 1c-e, the holotype (U.S.N.M. No. 112054), three views to show the form. All specimens are fillings.
- 2a-g. *Sinuella minuta* Knight, new species. All figures $\times 15$. 2a-b, the holotype (U.S.N.M. No. 112049), two slightly oblique dorsal views showing form and growth lines. This specimen retains the shell. 2c-d, a paratype (U.S.N.M. No. 112050b), side and dorsal views respectively. This specimen is a filling and an irregularity of growth shown on figure 2d confirms the form of the anterior lip shown by the growth lines on the holotype. 2e, the holotype, view from below. The specimen is broken across and shows sections of the whorls and the degree of involution. 2f, side view of a paratype (U.S.N.M. No. 112050a). 2g, side view of a paratype (U.S.N.M. No. 112052). This is the largest specimen in the collection and, like many specimens, is poorly preserved as a partial glauconitic filling.