The foraminifera of the Heath formation of Northwestern Peru, South America

The Foraminifera of the Heath Formation of Northwestern Peru, South America.[1])

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With 2 plates (II, III).

In Quebrada Heath in the Zorritos region of northwestern Peru there is a series of black bituminous shales which weather to a dirty chocolate color. These shales were called the Heath formation and first described by JOSEF GRZYBOWSKI in 1899[2]). They were considered by him as Lower Miocene in age. In 1922 E. M. SPIEKER[3]) showed that the Lower Zorritos beds of the Zorritos formation were Lower Miocene, and that the Heath beds were probably Upper Oligocene in age. BOSWORTH, the same year, in "The Geology of the Tertiary and Quaternary Periods in the Northwest Part of Peru" included them in his Zorritos formation which subsequent study has shown to run from the Middle Oligocene into the Lower Miocene. In 1928 OLSSON and IDDIGS[4]) considered the Heath as Upper Oligocene, and again in 1931 OLSSON[5]) considers it as Upper Oligocene.

As the Heath Formation is reported to be rich in smaller Foraminifera, I collected in 1927 a series of samples from the type locality, but have been much disappointed in the small number present. In all I have found 13 different species of Foraminifera and these are not overabundant. There is however the possibility that at some other locality there may be many more micro-fossils. OLSSON showed that the larger fossils of the Heath formation are endemic. The Fora-

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[1]) Work carried out under a Grant-in-Aid, National Research Council.

[2]) Die Tertiärablagerungen des nördlichen Peru und ihre Molluskenfauna. Neues Jahrb., Beil. Bd. 12, pp. 610—664, pls. 15—20, 1899.

[3]) The Paleontology of the Zorritos Formation of the North Peruvian Oil Fields. The Johns Hopkins University Studies in Geology **3**, 1922.

[4]) Geology of Northwest Peru. Bull. Am. Ass. Petr. Geologist, vol. 12, no. 1, pp. 1—39, 1928.

[5]) Contributions to the Tertiary Paleontology of Northern Peru: Pt. 4, The Peruvian Oligocene. Bull. Am. Paleo., vol. 17, no. 63, 1931.

minifera also appear to be new to science. The 13 species of Foraminifera represent 9 genera, no genus including more than 2 species. Most of the fossils are well preserved, but many of them have been slightly broken, making identification more or less difficult. Due to the lack of closely related forms it is difficult if not impossible to give any definite ecological relations and such has not been attempted.

In the following descriptions I have used the classification advocated by CUSHMAN in 1925 except where otherwise noted.

Genus Haplophragmoides Cushman 1910.

Haplophragmoides heathensis W. BERRY *n. sp.*

Plate II, figs. 11, 12, 13.

Test small, free, more or less involute, planospiral, chambers low, broad, usually 6 in the last formed coil, somewhat inflate, peripheral line of test slightly depressed at the sutures, wall composed of fine even sand grains, much cement, exterior fairly smooth, aperture a depressed slit.

Diameter 0.26 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This small species may be related to *H. hetha* from the same locality. The nearest described form seems to be *H. columbiensis* CUSHMAN, but this form is nearer to *H. hetha* and will be considered under that species. This small form is rare but can be easily identified by the small and over-inflate chamber just under the aperture.

Haplophragmoides hetha W. BERRY *n. sp.*

Plate III, figs. 10, 11, 12.

Test small, free, more or less involute, planospiral, chambers low, broad, usually 5 in last-formed coil, somewhat inflate; peripheral line of the test in side view depressed at sutures; wall composed of rather fine even sand grains, much cement, fairly smooth exterior; aperture a depressed slit at the base of the apertural face of the last chamber.

Diameter 0.23 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This small species is apparently related to *H. columbiensis* CUSHMAN, but is much smaller and has a smaller number of chambers.

Both *H. hetha* and *H. heathensis* have the umbilicus slightly covered but can easily be distinguished by the difference in the first chamber of the last-formed coil.

Genus Textularia Defrance, 1824.

Textularia heathensis W. BERRY *n. sp.*

Plate III, figs. 8, 9.

Test compressed, increasing rapidly in width, initial end rounded, apertural end truncated; chambers usually indistinct, sutures only slightly depressed; walls arenaceous, of fine angular sand grains with much fine cement, surface smoothly finished; aperture in a depression high on the inner face of the last chamber near its point of attachment.

Length 0.42 mm., width 0.27 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This species does not seem to be closely related to any of the described forms. It is easily recognized by the distinctive aperture.

Genus Bolivina d'Orbigny, 1839.

Bolivina qubrada W. BERRY *n. sp.*

Plate III, fig. 5.

Test elongate, periphery rounded, sutures, especially the earlier ones, distinctly limbate, very slightly oblique, becoming more so towards apertural end. Chambers numerous, distinct, six or seven making up last half of the test, earlier ones very short, later ones much higher. Wall thin, rather finely perforate, surface smooth, aperture elongate, narrow.

Length usually less than 0.50 mm., width about 0.19 mm., thickness about 0.14 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

This *Bolivina* is very characteristic in the development of the earlier chambers. In them the partitions or septae are very close together and nearly at right angles to the axis of the test. The younger part of the test has the commoner type of chambers which are about twice as wide as high and not about four times as wide as high as is the case with the earlier ones. I have not been able to find any described form that this species may be closely related to.

Genus Bulimina d'Orbigny, 1826.

Bulimina bicona W. BERRY *n. sp.*
Plate III, figs. 13, 14.

Test nearly fusiform, apical end abruptly rounded, apertural end with a rounded point, bases of chambers appearing above the apex, the last one extending from the apertural end to about half-way back on the test; chambers slightly inflate; sutures depressed; aperture a comma shaped slit, often broken.

Length 0.33 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This peculiar *Bulimina* is extremely rare in the formation. Complete specimens are almost never found. It is easily recognized however, by its distinctive shape, being in fact almost biconical in shape.

Bulimina heathensis W. BERRY *n. sp.*
Plate III, figs. 6, 7.

Test elongate, nearly uniform diameter for most of its length, about two and one quarter times as long as wide; chambers indistinct; sutures depressed; wall smooth, polished; aperture elongate, irregular.

Length 0.53 mm., diameter 0.24 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This unusual species is fairly common among the foraminifera of the Heath formation. It has the appearence of being broken and if it were not for the number of them I would think such to be the case. However it seems to be a good species and can only be referred to the genus *Bulimina.* I know of no species to which it bears a close resemblence. It can easily be recognized by its irregular make-up.

Genus Cristellaria Lamarck, 1812.

(Robulus in Cushman's new classification.)

Cristellaria dix W. BERRY *n. sp.*
Pl. III, figs. 3, 4.

Test biconvex, closely coiled, usually 10 or 11 chambers in the last whorl; sutures limbate; surface unornamented; no keel present Apertural face usually broken.

Diameter 0.55 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This apparently new species seems to be somewhat closely related to *C. peruviana* W. BERRY described from the Eocene of about the same region. The new species has a larger number of chambers in the last whorl and is nearly twice as large. *C. dix* is the smaller of the *Cristellaria* found in the Heath and can often be easily recognized by the absence of the apertural face.

Cristellaria heathensis W. BERRY *n. sp.*

Pl. III, figs. 1, 2.

Test broadly biconvex, closely coiled, usually 11 chambers in the last whorl, sutures marked by slightly raised ribs uniting at the umbilicus which is slightly raised. Remaining surface plain, periphery surrounded by a broad rounded keel, usually about twice as thick as high; apertural face flattened or convex with a slight rim about the margin.

Diameter 0.57 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This species does not seem closely related to any of the described forms. The broad rounded keel is very characteristic and there is no evidence that it is either a worn off sharp keel or that it has been broken.

Genus Sphaeroidina d'Orbigny, 1826.

Sphaeroidina (?) *peruviana* W. BERRY *n. sp.*

Pl. II, fig. 4.

Test fairly large, only 3 last formed chambers visible and making up the entire test. Chambers somewhat inflate, sutures somewhat depressed, walls coarsely perforate.

Diameter 0.33 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This rather indefinite fossil has been referred to the genus *Sphaeroidina*. It does not entirely fit the description of that genus as none of the earlier chambers are exposed, but rather than set up a new genus I have placed it in this existing genus. There is a slight resemblence to *Globigerina bulloides* var. *triloba* BRADY, but here again only the last chambers show. It can easily be recognized by the embracing character of the three chambers that are visible.

Genus Discorbis Lamark, 1804.

Discorbis heathensis W. BERRY *n. sp.*
Pl. II, figs. 1, 2, 3.

Test circular in outline, periphery rounded, chambers usually 7 in the last formed coil; sutures straight, distinct, slightly limbate on the dorsal side and ending in blunt projections of clear material at the inner edge of the chambers; both sides slightly umbilicate; aperture a narrow slit; wall smooth, slightly polished, punctate.

Diameter average about 0.69 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

This regularly formed *Discorbis* does not fit the typical description of the genus. It appears however to be closely related to *D. rugosa* (D'ORBIGNY), but has a fewer number of chambers in the last formed coil. *D. heathensis* is also much smaller than *D. rugosa.* This new species can easily be recognized by the peculiar character of the inner ends of the limbate portions of the sutures.

Genus Truncatulina d'Orbigny, 1826.

(Cibicides of Cushman's classification 1928.)

Truncatulina heathensis W. BERRY *n. sp.*
Pl. II, figs. 8, 9, 10.

Test convex, periphery rounded, chambers numerous, usually 9 in the last formed whorl, increasing rapidly in size; sutures distinct, limbate on both dorsal and ventral sides, fused into a raised umbonal mass at the center on both sides; wall finely perforate, aperture a slit at the base of apertural face and extending along the chamber margin on the dorsal side.

Diameter 0.47 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

T. heathensis is closely related to *T. hetha* from the same locality. It is easily distinguished from *T. hetha* in being larger and in having a smaller number of chambers in the last whorl. *T. heathensis* can be easily recognized by the very heavy limbate ridge which crosses the fourth chamber of the last whorl from the umbo to the periphery.

Truncatulina hetha W. BERRY *n. sp.*

Pl. II, figs. 5, 6, 7.

Test convex, periphery rounded, chambers numerous, usually 10 in the last whorl, they increase rapidly in size; sutures distinct, limbate on the ventral side, fused at the center into a raised umbonal mass; sutures depressed on the dorsal side, umbonal region filled with clear shell material; wall perforate; aperture a well defined slit at the base of the apertural face, with a slight lip.

Diameter 0.40 mm.

Occurrence: Heath formation, northwestern Peru in Quebrada Heath.

Type in collection of Willard Berry.

T. hetha can easily be recognized by the heavy limbate ridge that runs from the center to the periphery over the suture between the second and third chamber of the last whorl on the ventral side. It is closely related to *T. heathensis.*

Genus Anomalina d'Orbigny, 1826.

Anomalina heathensis W. BERRY *n. sp.*

Pl. II, figs. 14, 15, 16.

Test small, chambers usually 7in the last formed whorl, slightly inflate, sutures slightly depressed, sligthly curved backward, those on the ventral side slightly limbate, umbilical region on ventral side raised; wall smooth, slightly punctate; aperture a simple slit at the middle of the base of the last formed chamber.

Diameter 0.28 mm.

Type in collection of Willard Berry.

A. heathensis is the smallest *Anomalina* found in the region and the only one found in the Heath formation. It does not bear a close relationship to any described forms and can best be recognized by the raised umbilical region, and its rather small size.

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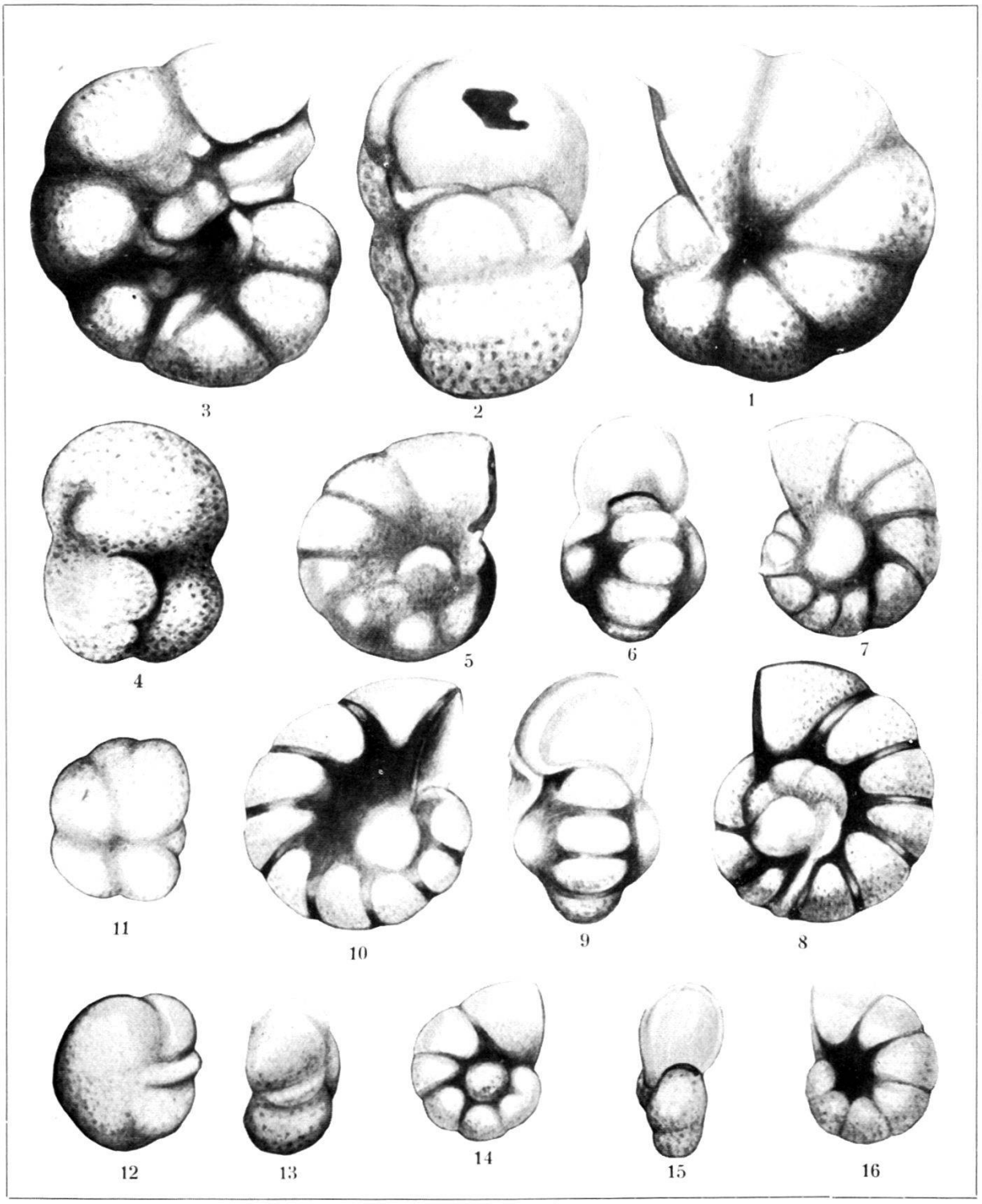

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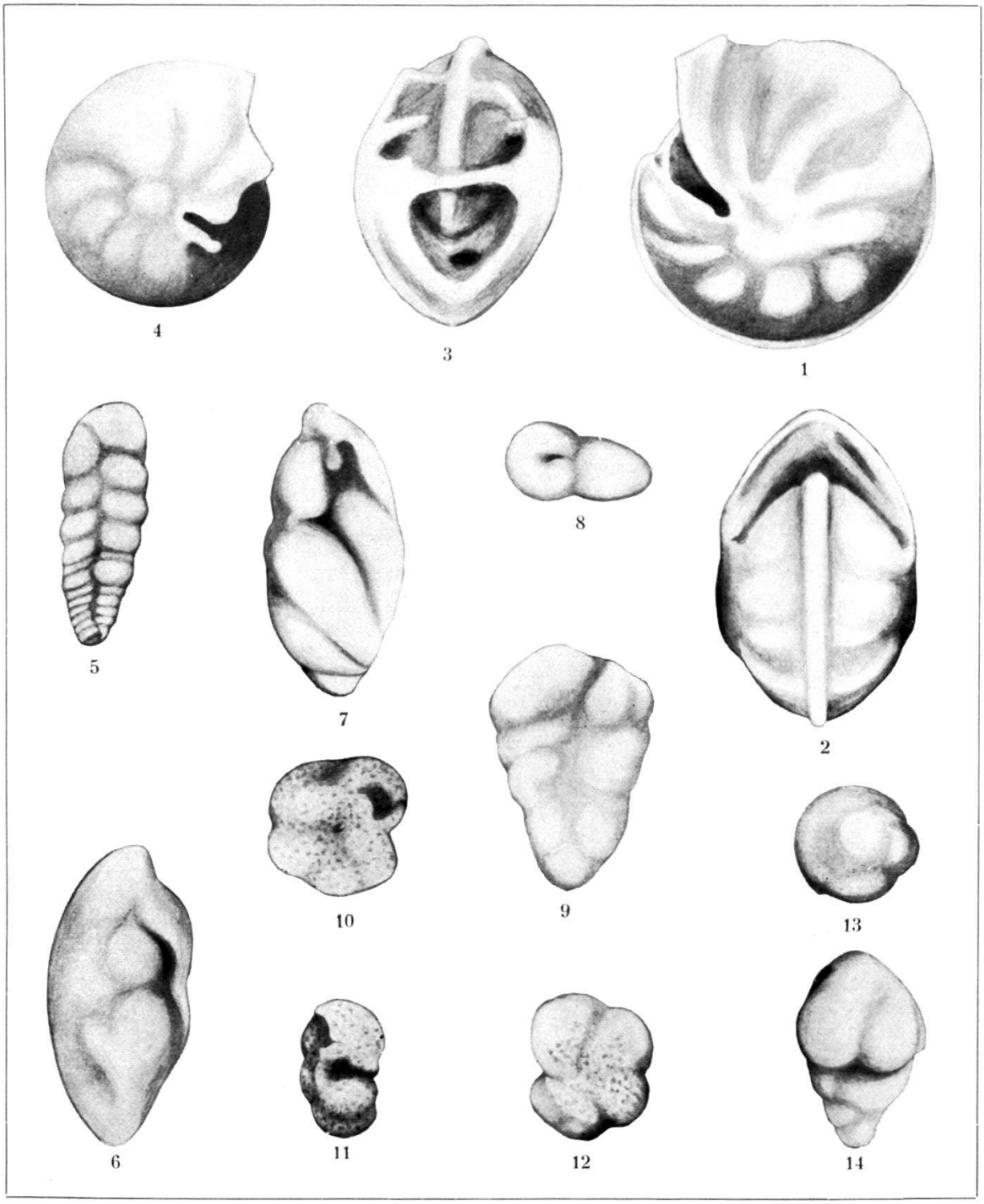
Figures 1—3 *Discorbis heathensis* n. sp.
,, 4 *Sphaeroidina (?) peruviana* n. sp.
,, 5—7 *Truncatulina hetha* n. sp.
,, 8—10 *T. heathensis* n. sp.
,, 11—13 *Haplophragmoides heathensis* n. sp.
,, 14—16 *Anomalina heathensis* n. sp.

All figures enlarged about 29 times.
Drawings by D. W. Curtiss of Columbus, Ohio.



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Figures 1, 2 *Critellaria heathensis* n. sp.
,, 3, 4 *C. dix* n. sp.
,, 5 *Bolivina qubrada* n. sp.
,, 6, 7 *Bulimina heathensis* n. sp.
,, 8, 9 *Textularia heathensis* n. sp.
,, 10—12 *Haplophragmoides hetha* n. sp.
,, 13, 14 *Bulimina bicona* n. sp.

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