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A new Early Carboniferous nautilid from the Caney Formation of Oklahoma, Central North America

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Introduction

The Caney Formation, named and defined by Taff (1901), comprises a relatively thin (approximately 115 m thick in the type section) marine sedimentary unit consisting mostly of shale with limestone concretions. The formation is divided into the Ahloso, Delaware Creek, Sand Branch, and Rhoda Creek Members in ascending order (Elias, 1956; Elias and Branson, 1959, and others). We describe below a new trigonoceratid nautilid species, *Epistroboceras caneyense*, recovered from limestone concretions in the dark gray shale of the Sand Branch Member at the type section for this member. The material examined was collected at an outcrop in the stream bed of Sandy Branch Creek, approximately 1.6 km downstream from the junction of this stream and Highway 48 south of the town of Wapanucka, Johnston Co., Oklahoma. The locality is identical to loc. 2082 (Girty, 1909) and loc. M-15 (Mapes, 1979). Ammonoids, including *Cravenoceras richardsonianum* and *Eumorphoceras bisulcatum*, from this locality indicate a middle Chesterian (late Early Carboniferous) age in Gordon's (1964) biostratigraphic scheme.

Systematic paleontology

Family Trigonoceratidae Hyatt, 1884
Genus ***Epistroboceras*** Turner, 1954

Type species.—*Epistroboceras stubblefieldi* Turner (1954, p. 308, 309, pl. 22, figs. 1–8; text-fig. 1c) from the Isle of Man.

Other included species.—*Epistroboceras anglicum* (Hyatt, 1893, p. 410, 411) from Yorkshire, *E. caneyense* sp. nov. (this report), *E. gracile* Shimansky (1967, p. 154, 155, pl. 19, figs. 5a, b, v, 6) from the southern Urals, *E. phillipsianum* (Orbigny, 1847, pl. 93, figs. 1, 2, only; see Koninck, 1878, p. 130) from Belgium, *E.* ? *pinum* Shimansky (1996, p. 27, pl. 2, figs. 4a, b, v) from Novaya Zemlya, *E. rusanovi* Shimansky (1993, p. 21, 22, pl. 3, figs. 8a, b, v, 9a, b) from Novaya Zemlya, *E.* ? *sulcifer* (Léveillé, 1835, p. 38, pl. 2, figs. 1, 2) from Belgium, *E. texanum* (Miller and Youngquist, 1948, p. 654, 655, pl. 94, fig. 6, text-fig. 1) from Texas and Nevada (Youngquist, 1949, pl. 57, figs. 10–12), *E.* sp. from the Fayetteville Formation, Arkansas (Gordon, 1964, p. 147, pl. 11, figs. 2, 3, text-fig. 21B), *E.* sp. from the Pitkin Formation, Arkansas (Gordon, 1964, p. 147).

Range.—Middle Visean to late Serpukhovian (Early Carboniferous).

Diagnosis.—Coiled genus of trigonoceratids having evolute and compressed shell with concave venter, carinate ventrolateral angles, and converging but obtusely angulated flanks; juvenile shell like *Stroboceras*, but lateral grooves developed in juvenile stages become obsolescent with maturity; adoral growth lines are not accentuated as in *Stroboceras*; flanks commonly ornamented by longitudinal lirae; sutures with shallow ventral and broadly rounded lateral lobes; siphuncle subventral.

Discussion.—*Epistroboceras* was considered to be a subgenus of *Stroboceras* (Hyatt, 1884) by Gordon (1964) based on similarity of the juvenile shell morphologies. The *Stroboceras*-like indented shells in the early growth stages are also recognized in *Aphelaeceras* (Hyatt, 1884) and *Echigoceras* (Niko, 2002).

Although there is a possibility that the genus *Aphelaeceras* with a tightly coiled shell is assignable as a subgenus of *Stroboceras*, *Echigoceras* cannot be so assigned because it differs in having a cyrtoconic shell. This suggests that the early juvenile shell morphology should be considered a suprageneric characteristic rather than a subgeneric one in the sense of Gordon (1964). In addition, loss of the outer whorl contact, which is the diagnostic feature of *Stroboceras*, has not been recorded in *Epistroboceras*. For these reasons, we consider *Epistroboceras* to be a distinct genus.

Turner (1954) assigned *Nautilus bisulcatus* Koninck (1878; non M'Coy, 1844; see Miller and Garner, 1953, p. 136) and *N. sulcatus* Sowerby, 1826 to *Epistroboceras*. Subsequently Histon (1999) transferred *Stroboceras crassum* Foord, 1900 to *Epistroboceras*. Shimansky (1967) added a new species, *Epistroboceras chancharense*, from the southern Urals. However, the well developed lateral grooves in the adoral whorls of these species suggest that they are better referred to *Stroboceras* rather than *Epistroboceras*. *Epistroboceras kathleenae* Ramsbottom and Moore (1961) from Ireland does not belong to the genus *Epistroboceras*. Its almost circular whorl shape and six spirals (= longitudinal ridges) on the flanks suggest a possible relationship between *E. kathleenae* and *Discitoceras* (Hyatt, 1884). *Aphelaeceras* has the most closely similar shell morphology with *Epistroboceras*, but it has non-angulated flanks in the adoral whorls. In terms of this criterion, *Epistroboceras ventrosiphonatum* Lai and Wang in Wang (1983) from the Middle Carboniferous of Xinjiang, Northwest China may be referable to *Aphelaeceras*.

Epistroboceras caneyense sp. nov.

Figure 1

Diagnosis.—Species of *Epistroboceras* with a width/height ratio of approximately 0.77 on adoral whorl; relatively deep lateral (ocular) sinus in peristome; siphuncular position near midway between center of whorl and ventral margin, with a siphuncular position ratio (see the description for its definition) of approximately 0.22.

Description.—The single coiled phragmocone available for study has an evolute shell consisting of approximately 1 3/4 volutions with 28 mm in maximum observable diameter and 9 mm in maximum observable whorl width; umbilicus perforate; short diameter of umbilical perforation 4.5 mm. Juvenile whorl facing umbilical perforation is *Stroboceras*-like with cone-shaped embryonic shell; sections of juvenile whorl are subcircular with concave venter as ventral groove (vg), and concave ventrolateral shoulders as ventrolateral grooves (v-lg) and roughly rounded flanks and dorsum; bilaterally symmetrical 2 lateral grooves (lg 1, 2) developed on flanks, latter of which is very narrow and shallow; vg and v-lg in juvenile whorl are overlapped by succeeding whorl as impressed area. Juvenile whorl surface is ornamented by four longitudinal ridges with bilateral symmetry, and accentuated growth lines; ventral ridges (vr) at boundary between vg and v-lg, ventrolateral (v-lr) at boundary between v-lg and lg 1, lateral (lr) on flanks at boundary between lg 1 and lg 2, and dorsolateral (d-lr) at boundary between lg 2 and umbilical wall. Adoral whorl rapidly inflates and its sections shift to compressed suboctagonal profiles; width/height ratio of whorl approximately 0.77; vg relatively wide for genus forming ventral platform bordered by carinated ventrolateral angles (= vr) approximately 120 degrees, having 0.23 in ratios of vg width per whorl width; flanks converging, form bilaterally symmetrical obtuse angle of approximately 160 degrees, at approximately 1/3 length of flank from venter; v-lg, lg 1 and lg 2 become obsolescent and flattened as shell grows; umbilical angle becomes distinct with approximately 120 degrees; umbilical walls indicate nearly linear profiles; 1 dorsal (contact) groove is added. Except for vr, surface ridges become subdued as shell grows; weak lirae partly recognized on flanks; growth lines indicate a lobate peristome shape, with deep V-shaped ventral (hyponomic) sinus, rounded ventrolateral saddle, relatively deep U-shaped lateral (ocular) sinus, and nearly linear dorsal rim. Adoral sutures with shallow but broad lateral lobe; sutures on ventral side cannot be observed where shell walls are not exfoliated. Septa moderately concave for genus, forming short camerae; there are 6 to 7 camerae in corresponding whorl height. Siphuncular position subventral, near midway between center of whorl and ventral margin; ratio of distance of central axis of septal foramen from ventral whorl surface per corresponding whorl height in dorsoventral section (siphuncular position ratio) is approximately 0.22.

Material examined.—A single partly preserved shell is the holotype that is reposited in the Ohio University Zoological Collection (OUZC) at Ohio University at Athens, Ohio with a registration number of OUZC 5100.

Etymology.—The specific name is derived from the Caney Formation from which the type specimen was recovered.

Discussion.—*Epistroboceras caneyense* sp. nov. can be distinguished from the most similar species *E. texanum* by having a higher width/height ratio on the

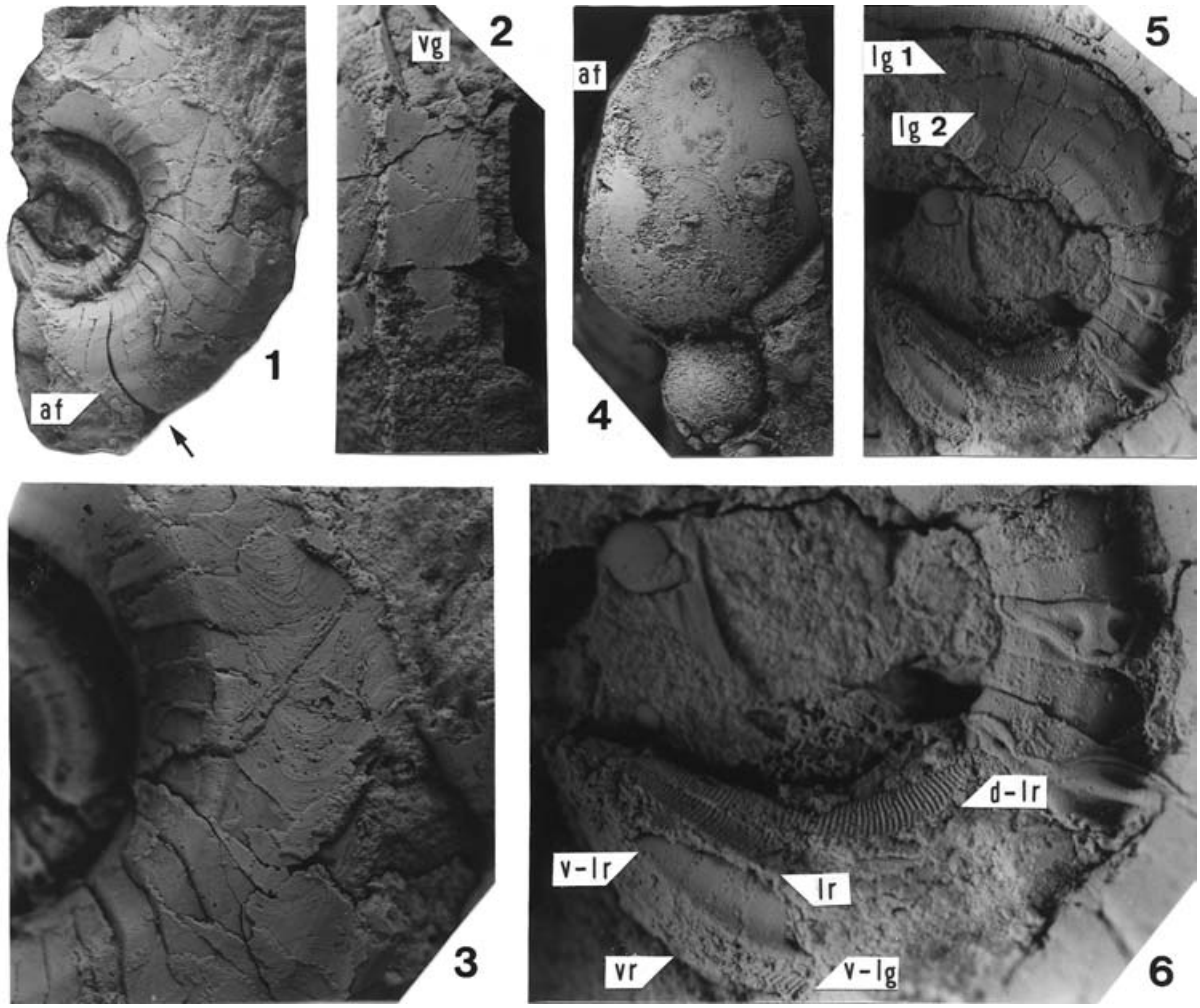

Figure 1. *Epistroboceras caneyense* sp. nov., holotype OUZC 5100. **1.** Lateral view, arrow indicates position of cross-sectional view of Figure 1.4, ×2. **2.** Partial enlargement of ventral view, to show growth lines indicating ventral (hyponomic) sinus in peristome, ×5. **3.** Partial enlargement of lateral view, to show growth lines indicating lateral (ocular) sinus in peristome, ×5. **4.** Cross-sectional view, ×5. **5.** Partial enlargement of lateral view, to show *Stroboceras*-like juvenile shell, ×5. **6.** Details of apical part, ×10. Abbreviations: vg = ventral groove; v-lg = ventrolateral groove; lg 1, 2 = lateral grooves; vr = ventral ridge; v-lr = ventrolateral ridge; lr = lateral ridge; d-lr = dorsolateral ridge; af = angle on flank.

adoral shell (approximately 0.77 versus approximately 0.5 in *E. texanum*), the less eccentric siphuncular position (siphuncular position ratios approximately 0.22 versus 0.18–0.20 in *E. texanum*), and the lack of distinct longitudinal lirae in the lateral groove of the juvenile shell. *Epistroboceras stubblefieldi* also has a lower width/height ratio on the adoral shell, ranging from 0.62 to 0.65, than the present new species, which has a ratio of approximately 0.77.

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