A NEW EARLY CRETACEOUS ARTICULATE BRACHIOPOD FROM THE NORTHWEST TERRITORIES, CANADA, AND ITS PALEOBIOGEOGRAPHIC SIGNIFICANCE

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ABSTRACT—A new terebratellid brachiopod species, Modestella jeletzkyi n. sp., is described from the Early Cretaceous of Prince Patrick Island, Northwest Territories, Canada. The occurrence extends the paleobiogeographic range of Modestella from northwest Europe into the northern high-latitudes of the North American continent. This new record of Modestella suggests brachiopod dispersal between northwest Europe and North America via the East Greenland Seaway, probably during the Albian. The occurrences of two other Cretaceous terebratellid genera, Advenina and Psilothyris, are updated. They are both homeomorphic with Modestella. Advenina, from the Tethyan and Jura regions of Europe, is now recorded from the Early Cretaceous of Sardinia. The occurrence of Psilothyris in North America and Europe is best explained by dispersal through the opening central Atlantic Ocean, indicating the continuation of Hispanic Corridor-type faunal links established during the Jurassic.

INTRODUCTION

CRETACEOUS STRATA outcrop over a large part of Canada. However, only a few brachiopod species have been recorded from the Cretaceous marine sedimentary rocks of Canada. These have been described from the Canadian Interior (Saskatchewan, Warren, 1937) and the western coastal islands (Vancouver Island and Queen Charlotte Islands, Whiteaves, 1876–1903; Burwash, 1913). There are over one hundred localities in the Canadian Arctic Islands, Yukon, and the Cordilleran region from which Mesozoic brachiopods (articulate and inarticulate) have been reported (Geological Survey of Canada fossil reports, personal observation). These warrant further investigation to determine their taxonomic and paleobiogeographic affinities. The Cretaceous Western Interior Seaway appears to have been inhospitable for articulate brachiopods in Canada and the United States of America. The inarticulate Lingula dominates records from Saskatchewan and Alberta. This genus could presumably tolerate more environmental stress than articulate brachiopods. Modestella jeletzkyi n. sp., described below, was collected from the Christopher Formation of Prince Patrick Island, Canadian Arctic (Figures 1, 2).

Owen (1970, 1981) commented on the resemblance of Cretaceous brachiopods described from Canada to European forms: Hesperorhyncha superba Warren to Orbirhyncha, Terebratella harveyi Whiteaves to species of Genmcardula, and Kingena occidentalis Whiteaves to Kingena s.s. The internal structures of these Canadian forms have yet to be investigated.

Modestella jeletzkyi n. sp. is significant for its affinities with elements of brachiopod faunas described from Europe. It represents the first Cretaceous brachiopod taxon to be described from Canada in over 50 years. It is also the first Canadian Cretaceous brachiopod to have transverse serial sections of its internal structures published.

Methods.—The small, rounded and generally smooth-shelled terebratellids commonly display homeomorphy among their external morphologies. Investigation of internal structures is therefore necessary. Ideally, ontogenetic studies of internal structures should be undertaken on a series of specimens to understand loop development. Unfortunately, this is not always possible. The internal structures of one specimen of Modestella jeletzkyi n. sp. (Figures 3, 4) have been investigated by making acetate peels of serially ground surfaces. Sections were made transverse to maximum length, starting at the pedicle umbo (method described by Sandy, 1989a). The results were drawn using a Nikon SMZ-10 binocular microscope and drawing tube. In some peels crystallization of calcite crystals within the brachiopod’s internal cavity made it difficult to differentiate original shell-structures from inorganic crystalline structures. However, most of the original internal structures of biological origin could be identified easily by varying the power and angle of the light-source transmitted through the acetate peel.

Terminology.—The following morphological terms are defined for clarification.

Dorsal/ventral and brachial/pedicel: for descriptions of the external morphology “brachial valve” and “pedicel valve” have been used instead of “dorsal valve” and “ventral valve” so as not to imply life position. Outline: describes the shape of the specimen when viewed from above the brachial valve. Profile: describes the shape of the valves when viewed laterally looking towards the lateral commissure. Length (L): maximum length of the specimen parallel to the plane of bilateral symmetry. Ideally measured from the tip of the pedicle valve’s umbo to the anterior commissure. Width (W): maximum width measured perpendicular to maximum length. Thickness (T): maximum thickness measured perpendicular to maximum length. All dimensions are in mm.

SYSTEMATIC PALEONTOLOGY
Phylum BRACHIOPODA Duméril, 1806
Class ARTICULATA Huxley, 1869
Order TEREBRATULIDA Waagen, 1883
Suborder TEREBRATELLIDINA
Muir-Wood, 1955
Superfamily ZEILOERIACEA Allan, 1940
Family ZEILOERIIDAE Allan, 1940
Genus MODESTELLA Owen, in Casey, 1961

Type species.—Modestella modesta Owen, in Casey, 1961, p. 573.

MODESTELLA JELETZKYI n. sp.
Figures 3–6

Holotype.—GSC 95441.
Paratypes.—GSC 95442–95447.
Material.—Seven complete specimens and several others in a small block of dark-gray (N 3, Rock Color Chart, Geological Society of America, reprinted 1984) grainstone. Specimens are presently housed at the Geological Survey of Canada type collections in Ottawa.

Locality and horizon.—Specimens were collected by B. Beau-
Figure 1—Location of Prince Patrick Island, Canadian Arctic. Inset square on left shown enlarged on right. Triangle represents GSC locality C-133992, Prince Patrick Island. Abbreviations: BI = Banks Island; DI = Devon Island; EI = Ellesmere Island; GNLD = Greenland; HB = Hudson Bay; VI = Victoria Island.

champs in 1987 from the Christopher Formation on Prince Patrick Island, District of Franklin, Northwest Territories, Lat. 76°08'00"N, Long. 120°03'09"W (Figures 1, 2). They are recorded under Field Number 87-HBB-88-88A and GSC locality C-133992. The specimens have been suggested as Albian in age (unpublished Geological Survey of Canada Fossil Report Km-5-1988-JAJ). However, this stage is not proven on the basis of the associated fauna (unpublished Geological Survey of Canada Fossil Report Km-5-1988-JAJ).

Eymology.—For the late J. A. Jeletzky.

Diagnosis.—Rounded, subpentagonal outline; maximum width at or just anterior of mid-length; anterior commissure weakly sulcate; weak dental lamellae; broad concave septulum; short median septum.

Description.—Outline rounded, subpentagonal, to subtriangular to elongate-oval; length greater than width and thickness (Figure 5, Table 1); width greater than thickness (Figure 6, Table 1); profile biconvex, brachial valve may be flatter; lateral commissure generally straight, weakly deflected toward pedicle valve in some large specimens.

Pedicleumbo suberect (commonly damaged); foramen large, rounded, mesothyrid to permesothyrid(?); beak ridges rounded, bordering concave interarea; deltoidal plates not observed; two weak carinae on brachial valve, at approximate length of 4 mm, border weakly developed sulcus, which is up to 3 mm wide on largest specimens; two correspondingly weak carinae on pedicle valve define weak uniplication; no distinct fold in pedicle valve; shell endopunctuation well-marked; numerous growth lines on both valves.

Dental lamellae weakly developed, traced to section 1.0 mm (Figure 4); septulum broad, concave (sections 1.4–1.9 mm); median septum appears short, traced 2.0 mm in brachial valve.

Figure 2—Cretaceous stratigraphy of the Queen Elizabeth Islands. The Queen Elizabeth Islands extend from Prince Patrick Island in the west to Ellesmere Island in the east (Figure 1). Stratigraphic relationships are shown from west (left) to east (right). Vertical lines indicate rocks absent or not identified. MBF = Mould Bay Formation. Based on Balkwill et al. (1983, fig. 5).

Figure 3—Modestella jeletzkyi n. sp. from the Christopher Formation (Albian), Prince Patrick Island, District of Franklin, Northwest Territories, Canada. 1–4, holotype, GSC 95441, (×2); 5–8, paratype, GSC 95442 (×2), specimen since sectioned, plaster cast deposited in the collections of the Geological Survey of Canada.
Figure 4—Transverse serial sections through a specimen of *Modestella jeletzkyi* n. sp., GSC No. 95442; sections transverse to maximum length and drawn with brachial valve lowermost; magnifications of sections: 0.0–1.0 × 4; 1.2, 1.4 × 5; 1.6 × 5.5; 1.8–6.2 × 10; enlargements of 1.6–2.0 × 25; dimensions of sectioned specimen, L 11.0, W 10.1+, T 4.9.
(to section 3.0 mm); crural bases with rounded outline in transverse section (sections 1.9–2.4 mm) before characteristic crescent-shape of descending lamellae develops (sections 2.5–2.7 mm etc.); transverse band flat (section 3.8 mm); recurvature of loop seen in sections 5.8–6.2 mm.

Remarks.—Modestella jeletzkyi n. sp. differs from Modestella modesta Owen by its generally rounder outline and sulcate anterior commissure. Modestella festiva Owen is larger than Modestella jeletzkyi n. sp. Both Modestella festiva and Modestella faba (J. de C. Sowerby) have more elongate outlines than Modestella jeletzkyi n. sp. Transverse serial sections of a specimen of Modestella faba from the Lower Albion of Folkestone, Kent, England taken by Owen (1965, fig. 12) are closely comparable to those of Modestella jeletzkyi n. sp. (Figure 4). In Modestella jeletzkyi n. sp. the dental lamellae are not as strongly developed and the median septum not as long as in the sectioned specimen of Modestella faba (Owen, 1965). However, the broad septalum supported by the median septum and the development of the crural bases are similar. These comments are also applicable when comparing transverse serial sections of Modestella jeletzkyi n. sp. (Figure 4) to other representatives of Modestella (Owen, 1963; Popiel-Barczyk, 1972). The close morphological similarities between Modestella modesta Owen and Modestella jeletzkyi n. sp. suggest that they are closely related.

In Advenina the crural bases originate at the lateral edges of a septulum floored by subhorizontal hinge-plates. In Modestella the crural bases originate from the ventral edges of a V-shaped septalum. In Rugitela the crural bases originate dorsally. In conjunction with the median ridge this gives Rugitela a W-shaped septalum. It must be noted that a median ridge-like structure appeared to be present in the septalum of Modestella jeletzkyi n. sp. However, this was believed to be calcite of inorganic origin that had crystallized on the surface of the septalum post-mortem and therefore not an original feature of the brachiopod. It is extremely important to distinguish between calcite of organic (i.e., shell) and inorganic (i.e., precipitate) origin when interpreting acetate peels, especially where the presence or absence of small morphological features (e.g., a median ridge in the septalum) is given taxonomic significance.

Psilothyris has a median ridge developed anteriorly in its septalum whereas Modestella does not, having instead a broad concave septalum. The sulcate anterior commissure of Modestella jeletzkyi n. sp. distinguishes it from homeomorphic species of Psilothyris.

Modestella jeletzkyi n. sp. can be distinguished from other sulcate terebratulids, Rugitela hippocus (Roemer) and Rugitela roemeri Owen, for example, by differences in outline, profile and the development of the sulcus. Rugitela hippocus has a more globose profile and more strongly developed sulcus than Modestella jeletzkyi n. sp., while Rugitela roemeri has a more elongate outline and broader sulcus. It is possible that from external examination specimens of Modestella jeletzkyi n. sp. could be considered juveniles of Rugitela hippocus. However, Modestella jeletzkyi n. sp. lacks sharp beak ridges and has a large pedicle foramen as opposed to the small foramen of Rugitela hippocus.

The median septum of Modestella jeletzkyi n. sp. does not appear to be as long as in other species of the genus. Based on external examination, the median septum of the holotype could only be traced for approximately one-quarter of the brachial valve's length, although this does not prove that the median septum is short. However, the serial sections of Modestella jeletzkyi n. sp. (Figure 4) lend support to a short median septum (i.e., less than half the brachial valve's length).

Associated fauna.—Bivalves and serpulid and spirorbid worm tubes are associated with the brachiopods. The associated fauna does not allow a definite stage assignment. However, the worm tubes appear to be closely related to forms described from the

![Figure 5](image1.png)  
**Figure 5**—Plot of length versus thickness and width for specimens of *Modestella jeletzkyi* n. sp. Simple regression line shown. Correlation coefficient for length versus thickness = 0.734 for length versus width = 0.895. Dimensions in mm.

![Figure 6](image2.png)  
**Figure 6**—Plot of width versus thickness for specimens of *Modestella jeletzkyi* n. sp. Simple regression line shown. Correlation coefficient for width versus thickness = 0.691. Dimensions in mm.

### Table I

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† indicates damage in that orientation.

PALEOBIOGEOGRAPHIC AND STRATIGRAPHIC SIGNIFICANCE

The record of *Modestella jeletzkiyi* n. sp. is significant in establishing the genus as a Boreal faunal component in the North American Continent. Marine transgressions towards the end of the Early Cretaceous may have assisted the establishment of *Modestella* in the Arctic regions. *Modestella* has previously been recorded from England (Owen, 1961, 1963, 1988; Owen et al., 1968), northern Germany, northern France, and Poland (Owen, 1988; Popiel-Barczyk, 1972) (Figure 7). These records indicate that *Modestella* had a Boreal distribution. The known range of the genus is Lower Albian to Cenomanian (Owen, 1988).

*Modestella jeletzkiyi* n. sp. is the most northerly record of the genus and certainly supports the Boreal affinities of this genus. The East Greenland Seaway between Greenland and the Scandinavian Peninsula (Jeletzkiy, 1984) appears to be the most direct route linking the known occurrences of *Modestella* in Europe and Canada. Tucholke and McCoy (1986) have inferred southward-flowing currents in this Seaway region during the early Aptian. Other Early Cretaceous brachiopod distributions in Europe suggest a South to North dispersal from the low latitudes of the Tethyan region to higher latitudes for some species (Ager and Walley, 1977; Middlemiss, 1973, 1979; Owen, 1973), while others suggest North to South dispersal (Middlemiss, 1979). At the present time it is not possible to say whether *Modestella* dispersed in a northerly or southerly direction. A lower latitude link across the opening Atlantic Ocean via the Western Interior Seaway of North America appears unlikely for *Modestella*. articulate brachiopods are rare in the Western Interior Seaway. *Modestella* is recorded only from Europe and Prince Patrick Island. It is not yet known from the Cordilleran region of North America. The record of *Modestella* from Prince Patrick Island is not proof of an Albian age, but lends support to an Albian (or Cenomanian) age determination for collections from GSC locality C-133992.

The terebratulids *Advenina* and *Psiolothyris* are homeomorphic with *Modestella* in their external morphology. The paleobiogeographic distributions of *Modestella*, *Advenina*, and *Psiolothyris* are shown on Figure 7. The genus *Advenina* was proposed for brachiopods described from the Berriasian and Valanginian of France and Switzerland and the Valanginian to Aptian of the Crimea, Northern Caucasus, Georgia, and Kopet Daga (Sandy, 1986a). Species referred to the genus were of Tethyan and Jurassic biogeographical affinities. *Advenina oweni* was originally recorded from the Berriasian and Valanginian of Provence (Sandy, 1986a). Additional specimens of this species have since been identified from St. Antonio, extreme southwest of Sardinia (F. A. Middlemiss, personal commun.). They were collected from approximately the Valanginian–Hauterivian boundary. The terebratulid genus *Psiolothyris* is very similar to *Advenina* in its external and internal morphology. These two Early Cretaceous genera appear to be very closely related and may share common ancestry. *Psiolothyris* has been recorded from northwest and southern Europe and North America (Arizona and Baja California, Mexico) (see references in Sandy, 1986b). The link between the European and American occurrences of *Psiolothyris* was via the opening central Atlantic Ocean connecting the western Tethys and eastern Pacific Oceans. This indicates the continuation of European and American links established via the Hispanic Corridor (Smith, 1983) during the Jurassic. This faunal link appears to have been established between European and North American brachiopods by the Middle Jurassic (e.g., *Flabellothyris*, Ager and Walley, 1977) and continued through the Late Jurassic and into the Early Cretaceous (Sandy, 1989b). A central Atlantic Ocean link appears the most credible for un-
derstanding the distribution of *Psilothyris* rather than an easterly Transpacific connection.

**ACKNOWLEDGMENTS**

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**REFERENCES**


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