

BIOSTRATIGRAPHIC POTENTIAL OF THE CRYPTODONT BIVALVE  
*BUCHIOLA RETROSTRIATA*  
FROM UPPER DEVONIAN SHALE, SOUTHWESTERN VIRGINIA

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ABSTRACT

*Buchiola retrostriata* (von Buch), a former inhabitant of muddy deep-sea substrata, can be used to identify lower Upper Devonian shale (about middle Finger Lakes to basal Cohocton) in Virginia. This distinctive and fairly abundant cryptodont clam has potential as a zonal guide fossil for rocks characterized by what has been traditionally termed the "Naples fauna" in the Appalachian Basin.

At a time when Devonian shales in the Appalachian Basin are being explored as possible new sources of natural gas, and are being sampled and mapped with increasing frequency, it is clearly advantageous to the field geologist to be able to distinguish these shales from lithologically similar units at different stratigraphic levels and to recognize stratigraphic position of shales within the Devonian. Based on our experiences in southwestern Virginia, *Buchiola retrostriata* can be used as both a guide to the lower Upper Devonian in the region and as a means of distinguishing the Brallier Formation from younger shaly units occurring in discontinuous outcrops.

In the summer of 1980, the authors were instructors at Virginia Polytechnic Institute's geology field school in southwestern Virginia. One of the projects assigned to our students involved mapping rock units in a structurally complex area north of Nebo in northeastern Smyth County (Fig. 1). In the mapping area, Cambro-Ordovician dolomite and limestone override a thick sequence of shale along the Saltville Thrust Fault. After an initial examination of individual rock units, a question arose as to the identity and age of the shale unit in the foot-wall block. The unit is composed of sparsely fossiliferous, greenish-gray shale, with

dark gray shale and grayish-green sandstone interbeds. Sandstone layers contain macerated, carbonized plant fragments. Rare invertebrate animal remains are localized on a few bedding planes within the shale. The entire unit is folded, broken, and geometrically distorted due to flowage beneath the sole of the fault.

The shale unit occurs in a part of Virginia that has not been mapped in detail. Although similar in general appearance to the Upper Devonian Brallier Formation, we initially thought that the shale could be a "Chemung" (Greenland Gap Group) equivalent based on abundance of green shale, or part of the Lower Mississippian Price Formation based on presence of sandstone containing plant fragments and the dark gray shale beds. We identified the shale unit as Brallier by collecting specimens of *B. retrostriata*, a cryptodont bivalve limited to rocks of Late Devonian age (Cox *et al.*, 1969, p. N244; Shimer and

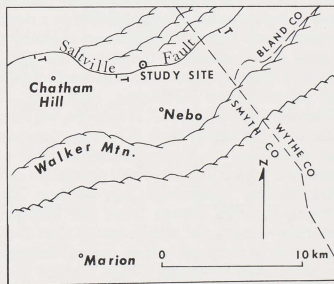


Figure 1. Location map showing study site where we first recognized the biostratigraphic value of *Buchiola retrostriata*.

Shrock, 1944, p. 373) and previously described as occurring only in the Millboro Shale and Brallier Formation in Virginia (Butts, 1940, pp. 310, 319), from outcrops along Smyth County Road 622.

Subclass CRYPTODONTA Neumayr, 1884  
Order PRAECARDIOIDA Newell, 1965  
Family PRAECARDIIDAE Hornes, 1884  
Genus BUCHIOLA Barrande, 1881

### BUCHIOLA RETROSTRIATA

(von Buch, 1832)

Fig. 2

*Diagnosis:* Shell small, thin, approximately equi-valve with prosogyrate beaks; valves hemiovoid, slightly inflated and elongate; cardinal area broad and straight with a few taxodont-like denticulations in some specimens located below weakly developed beaks; twelve to fourteen wide, flat plications with elevated edges radiating from the beaks, each plication crossed by curved, ventrally concave corrugations; in mature areas of shell, groove between plications divided by a low, narrow radial ridge.

*Discussion:* The Brallier Formation was deposited on the outer parts of a submarine fan located seaward of the extensive Catskill delta system (see Avary and Dennison, 1980; McIver, 1970). Shale layers in the Brallier are interpreted as hemipelagic deposits that accumulated between pulses of turbidity current sedimentation (represented by sandstone interbeds).

Two general modes of life seem possible for *B. retrostriata*. Occurrence in association with a sparse fossil assemblage containing pelagic cephalopods and within a deep-water shale deposit suggests an epipelagic mode of life, perhaps floating in the upper part of the water column attached to algae or other debris (Goldring, 1978, Fig. 38; Thayer, 1974, Fig. 18A). However, we favor the interpretation that *B. retrostriata* was an epifaunal or semi-infaunal benthic organism, which lived in small groups on or in the muddy submarine fan surface. Evidence for this comes from the following morpho-functional attributes: 1) thin shells (serving to diminish whole animal density); 2) small size (creating a high surface area/volume ratio); and 3) broad shell plications (enhancing high surface area/volume ratio). These characteristics of the shell could have promoted buoyancy in soft sediment and probably allowed successful occupa-

tion of muddy, deep-water substrata (see Stanley, 1970, p. 83).

*Biostratigraphic potential:* *Buchiola retrostriata* is one of the more abundant and easily identified components of the so-called "Naples fauna" in the Appalachian Basin (Butts, 1940, p. 316; Prosser and Swartz, 1913, p. 413; Clarke and Swartz, 1913, p. 614). The Naples fauna in Virginia also contains comparatively rare *Proboloceras lutheri* Clarke, an ammonoid whose stratigraphic occurrence defines a range zone in the upper half of the Finger Lakes Stage of the Senecan Series (Fig. 3). Other components are small bivalves (*Honeoyea* sp., *Ontaria* spp., *Paracardium doris* Hall), small cephalopods (*Bactrites* spp.), and a possible pteropod (*Styliolina fissurella* Hall). Large brachiopods are conspicuously absent. Lists and illustrations of Naples taxa can be found in Butts (1940, 1941).

This unique assemblage ranges from about the upper half of the Millboro Shale

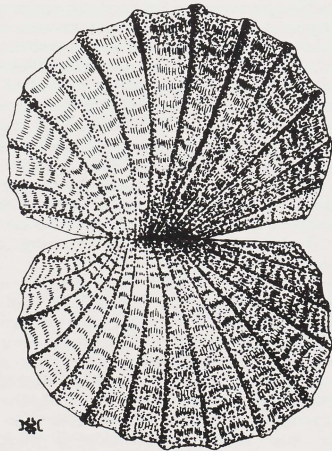


Figure 2. Restoration of *Buchiola retrostriata* showing valves conjoined. External view, approximately  $\times 12$ . (Sketch by Harris.)

(middle Finger Lakes) through the Brallier (upper Finger Lakes to basal Cohocton) defining an assemblage zone in Virginia, which is equivalent to the "Naples horizon" and "Brallier Shale" as defined on paleontologic grounds by Butts (1940, p. 308-320).

In the absence of a diverse and abundant fauna, *B. retrostriata* is a characteristic fossil of the upper Millboro and the Brallier. It occurs in greater numbers than *P. lutheri*

(we collected 26 external and internal molds of *B. retrostriata* and only one of *P. lutheri* in several hours of searching), and its size (3 to 10 mm in largest dimension for molds collected) and distinctive surface ornamentation make it easy to identify even when incomplete molds are found. *Buchiola retrostriata* is minute and distinctive enough to be identified in chips or cores collected from the subsurface, and has obvious potential as a zonal guide fossil (see Krumbein and Sloss, 1963, p. 357).

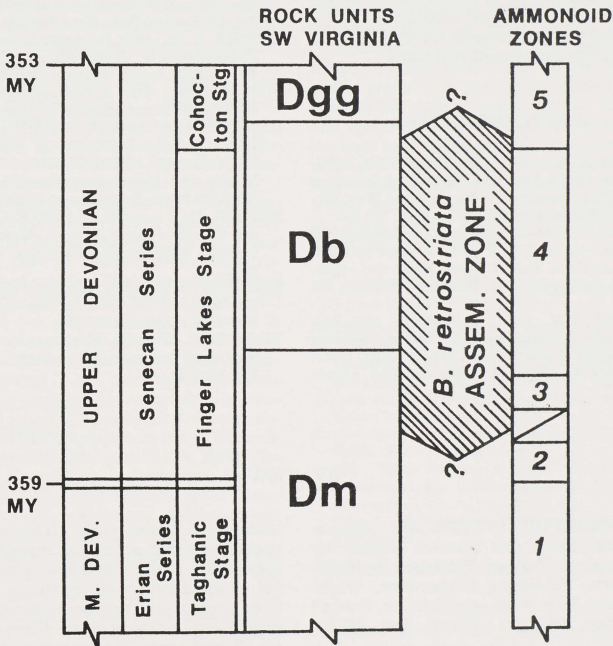


Figure 3. Divisions of the Upper Devonian and position of the *Buchiola retrostriata* assemblage zone. Rock units: Dm, Millboro Shale; Db, Brallier Formation; Dgg, Greenland Gap Group equivalents. Ammonoid zones: 1, *Pharciceras amplexum*; 2, *Ponticeras perlatum*; 3, *Manticoceras simulator*; 4, *Probeloceras lutheri*; 5, *Manticoceras rhynchostoma*. (Divisions and absolute ages based on Avary and Dennison, 1980, Fig. 3; ammonoid zones from Norris, 1979, Fig. 6).



We recommend that the rocks characterized by the Naples fauna in Virginia be regarded as the *B. retrostriata* assemblage zone (Fig. 3), with *B. retrostriata* serving as a zonal guide fossil because of its fairly short range, numerical abundance compared to other co-occurring taxa, and its distinctive appearance. *Buchiola retrostriata* could become a useful tool for field geologists in recognizing lower Upper Devonian shale occurring in isolated outcrops, and possibly could be used in subsurface exploration because only fragments of external molds are required for identification of the species.

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#### REVIEW

**METAMORPHIC PETROLOGY:** Mineralogical, Field, and Tectonic Aspects, by Francis J. Turner. Published by Hemisphere Publishing Corporation, Washington, New York, and London, Second Edition, 1981, xvii + 524 pp., illus., \$28.50

In this second edition, the approach, purpose, and scope of the work remains essentially the same as in the first edition, emphasizing Eskola's facies concept and synthesis of metamorphic facies. Through this most sensible approach, the mineralogical data and field aspects of metamorphic petrology are most readily perceived and

understood by the reader. It has long been recognized that a gradual transition from seimentary rocks to rocks with mineralogical compositions and structures resulting from processes of transformations (or, *metamorphism*) exists in many diverse regions on all continents. It is recognized that the proper study of geological processes is accomplished in the field in the examination of specific exposures. Thus, Professor Turner has made extensive use of case histories to explicate his treatment and descriptions of metamorphic processes. The text is forthright, well organized, and quite readable. This new edition is highly recommended.

—H.C.S.