Morphologic Approach to Fossil Studies in the Biology Laboratory

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Fossils, once viewed as curiosities, can become objects of potential value in the science curriculum. The authors utilize them to provide a new dimension in the biology laboratory.

Study of fossil shells in the biology laboratory introduces students to a new dimension in biological investigation. Important relationships between paleontological and biological studies are highlighted through directed observation of ancient forms of life (Fig. 1). This geologic time perspective, introduced early in contacts with life studies, gives a depth of understanding for subsequent work in biology (Lokke, 1963; Lokke, 1965). Original morphologic investigation forms the basis for open-end experiments and problem-solving experiences enjoyed by students with little or no geological background. Fossils may be purchased from supply houses if rock exposures of the local area do not permit access to study material.

Potential instructional value is illustrated here with morphologic features in a group of fossil clams belonging to the genus named *Exogyra*. These forms are separated from other members of the Family Ostreidae (Superfamily Ostracea) by a spirally curved beak. The genus was first described in 1820 by Say with *Exogyra costata* as the genotype. Taxonomic refinements have been made by Stephenson (1914), Boese (1919), Stephenson (1941), Young (1963), and Lerman (1965). Two inequal valves characterize the genus. The lower (left) valve is large, hemispherical, thick, and composed of many layers of calcite. The upper (right) valve is smaller, usually thin, and operculiform or cap-shaped. Presence or absence of costae and their location in relation to the beak and umbonal ridge are utilized in taxonomic differentiation. Other important shell features are shape, length, height, convexity, hinge, ligament grooves, growth lamellae, and growth lines. Specimens of this genus occur in rocks assigned to the Cretaceous System throughout the Gulf and Atlantic Coastal Plain.

Our specimens, belonging to *Exogyra ponderosa* Roemer, were collected from three localities in Fannin, Hunt, and Delta counties, in Northeast Texas. Enclosing strata belong to the Taylor Group in the Gulf Series of the Cretaceous System. Lower valves vary from 4.5 cm to 12.0 cm in width and 8.5 cm to 14.0 cm in length (Fig. 2). Confirmation of an apparent variation in shell size between the three localities requires additional collections and statistical treatment of the data. Surface ornamentation consists of growth lines and costae. Costae are restricted to the umbo region in this species. Well-developed costae extend over the entire shell in specimens from rocks of a younger geologic age. These costate forms, *Exogyra cancellata* Stephenson, have been traced 2500 miles across the Gulf and Atlantic Coastal Plains by Stephenson (1933). Utilizing biometric techniques and procedures, Lerman (1965) has recorded morphologic variation in *E. ponderosa*, *E. costata*, and *E. cancellata*. This work suggests many possibilities for student investigation in statistical treatment of morphologic data from fossil species.

Fig. 1. Students closely observe morphologic features in specimens of *Exogyra ponderosa* Roemer collected from Cretaceous rocks in East Texas. Comparisons with similar features in Recent pelecypod shells gives perspective for studies of living forms.

Details of internal shell features and growth layers are also of interest. Ligament grooves, measured in specimens from the three localities, average 7.2, 7.1, and 6.2 cm in length and 1.6, 1.0, and 1.3 cm in width. Muscle scars are circular and vary in diameter from 1.2 cm to 4.6 cm in these specimens. The muscle scar appears to migrate away from the beak area with maturity. An approximation of body cavity size is found in the weight of water required to fill the lower valve. Conversion of weight in grams to volume in cubic centimeters provides an exercise in measurement. The amount of clay required to fill the cavity is an extremely effective and permanent demonstration of available volume. Comparison with recent pelecypod specimens helps to determine the proportion of shell cavity filled with soft parts. Processes of shell secretion and variations in composition provide interesting studies for the more advanced student.

Careful morphologic work supplies a background for paleoecological interpretation. Review of faunal associations may reveal features of possible environmental significance. Oyster shells belonging to the genus *Ostrea* encrust many *Exogyra* shells. *Cliona* sp. sponge borings leave an almost completely shredded shell in some specimens. Based upon a salinity tolerance of 16.5% to 30% observed in living *Cliona* sponges, DeVries (1964) suggests that inferences for Upper Cretaceous salinities may be made on the presence or absence of sponge borings in *Exogyra* shells.

Morphologic features may also be examined for clams of an earlier or later geologic age. Newell (1942) presents results of morphologic studies of the Superfamily Mytilacea, fossil clams found throughout the United States in Pennsylvanian and Permian rocks. A similar report is available for the Late Paleozoic representatives of the Superfamily Pectinacea (Newell, 1937). Investigations of corals, bryozoans, brachiopods, gastropods, and other fossil groups are equally fascinating. Biology and paleontology texts aid in relating shell structure to soft part anatomy (Morton, 1960). Additional information, for most of the fossil groups, is found in the *Treatise of Paleontology* (Moore, Editor, 1951-1966).

A morphologic approach to fossil studies effectively demonstrates the relationship of shell morphology to soft part anatomy. Fossils are no longer viewed as curiosities, but become objects of high potential value in the biology curriculum. These morphologic investigations provide a time perspective in biological studies and present fascinating adventures into the geologic history of life.

References

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Date Collected: 3/13/64 Locality—Taylor Group at Ben Franklin, Texas
Name of Specimen: *Exogyra ponderosa* Roemer

	Ligament		Muscle		Overall		
Number	L	W	L	W	L	W	Other Data
I-1	9.0	1.3	4.6	3.0	Broken	11.0	Borings on outer shell surface.
I-2	7.0	1.6	3.0	3.3	Broken	Broken	Marine encrustations on shell.
I-3	6.6	?	2.2	?	11.0	8.5	Float specimen.
I-4	7.4	Broken	3.4	3.2	?	10.5	Lower valve broken.
I-5	5.4	1.2	Broken	Broken	?	8.5	Borings on inside shell surface.
I-6	7.8	1.4	Broken	Broken	12.0	?	Shell shredded by Cliona boring.
I-7	8.6	2.0	3.4	3.2	14.0	12.0	Lower valve highly concave.
Max.	9.0	2.0	4.6	3.3	14.0	12.0	
Min.	5.4	1.2	2.2	3.0	11.0	8.5	

Summary Sheet for Exogyra ponderosa Roemer

		Ligament			Muscle			Overall Size			
		Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Other Data
Ben Franklin, Texas	L	9.0	5.4	7.2	4.6	2.2	3.4	14.0	11.0	12.0	Shells very large. Lower valves highly concave.
	W	2.0	1.2	1.6	3.3	3.0	3.1	12.0	8.5	10.2	
Wolfe City, Texas	L	10.2	4.0	7.1	1.2	2.6	1.9	13.0	9.0	11.0	Shells small. High ridge on lower valve.
	W	1.5	0.6	1.0	3.0	1.5	2.2	10.7	7.5	9.1	
North Sulfur River at Highway 24	L	8.8	3.7	6.2	3.3	1.7	2.5	13.7	8.5	11.1	Body cavity volume less than specimens from other areas.
	W	1.9	0.7	1.3	3.2	2.2	2.7	11.5	4.5	8.0	

Fig. 2. Data chart for a single locality and summary chart for three localities in East Texas illustrate one form of systematic data accumulation for observations of morphologic features in fossil specimens. Different forms of arrangement and presentation may be utilized to fulfill specific curriculum objectives, and additional data may be recorded by students at higher grade levels. Measurements are recorded in centimeters.

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Giant Vacuum Cleaner

A giant vacuum cleaner, pushed by a small, gasoline powered tractor, is on the mud flats of Seabrook Harbor in New Hampshire. The new machine, called a "mussel crusher," marks another experimental stage in the war to remove great beds of saltwater mussels which are encroaching upon and destroying the clam flats of the area.

The machine sucks up clusters of mussels through a manually controlled flexible pipe, pulls them through a grinder which chews them into bits the size of a thumbnail, and blows the product back onto the flats where tides and shorebirds soon do away with all edible parts. With clams at a premium and clam digging a sport of steadily increasing popularity, the mussel crusher could be a real boon to the economy of coastal residents.