indistinct. There are four spiracles and an anus. Spiracles are apertures to the internal respiratory system. Hair-like tentacles made of skeletal ossicles, brachioles, used an assortment of cover plates to move food to the mouth. Six species of blastoids have been described from the Falls area (Table 1).

The "head" is actually the body of the crinoid. Better known as the calyx, it holds the vital organs. Arms attach to the top of the calyx. The calyx and arms, together, are the crown (see figure 2). The feather-like arms of crinoids are composed of skeletal plates. Each arm contains rows of smaller, tentacle-like pinnules. Shallow marine crinoids today are often described as "feather stars" (see figure 7).

Food is captured by tube feet and transported down the ambulacral groove on the side of the arm to the mouth. Crinoid arms are in multiples of five. crinus, found in the Jeffersonville Limestone, had 80.

While the blastoid's anal opening was next to the mouth, most crinoids had theirs elevated. Crinoids were more efficient at feeding than blastoids. Nineteen species of crinoids are known from the Falls area in the Jeffersonville and North Vernon = Sellersburg Limestone (see Table 1). Most are in the Beechwood Member, called the Beechwood Limestone. It has the most diverse echinoderms in the local Devonian rocks.

Both crinoid calices and blastoid thecae are rare at the Falls. Less than 20 of each have been documented by interpretive staff since 1993. If you locate one in the park, please take a photo and tell the interpretive staff. Remember, never remove them from the Falls of the Ohio area. All fossils, loose and imbedded, must not be removed from the property according to federal and state regulations. We want to show them to others as they tell an important story in the ancient history of the Falls of the Ohio.

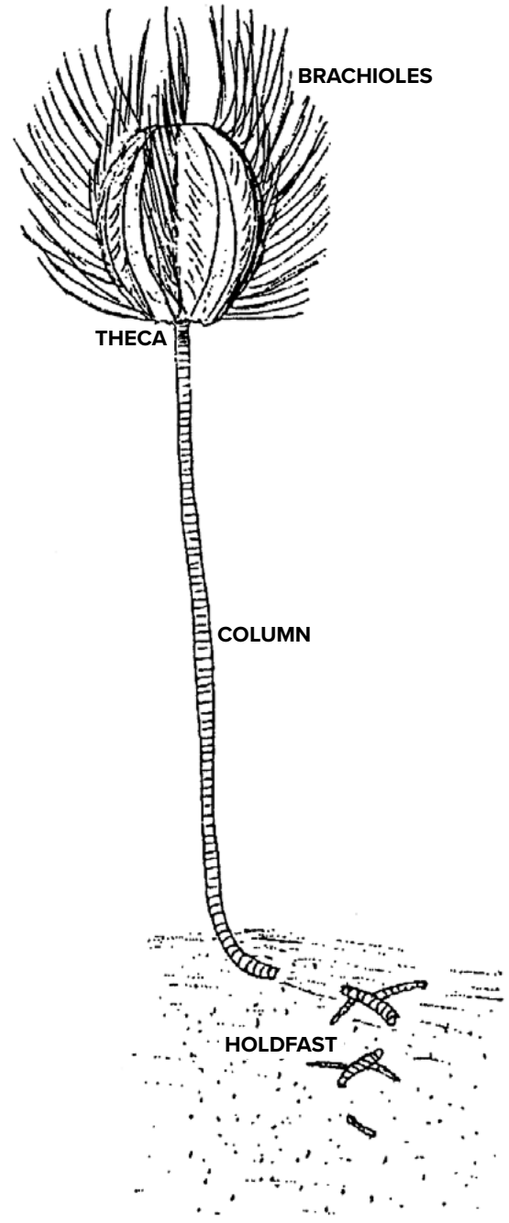

Figure 6. Blastoid reconstructed living Eleacrinus verneuili

Crinoids & Blastoids from the Falls of the Ohio (Jeffersonville and Beechwood Limestones)

Blastoids

Eleacrinus greeni (Miller & Gurley)
Eleacrinus venustus (Miller & Gurley)
Eleacrinus verneuili (Roemer)
Eleutherocrinus cassedayi Shumard & Yandell
Heteroschisma pyramidatus (Shumard)

Crinoids

Ancyrocrinus spinosus Hall
Comanthocrinus priscus Springer
Dolatocrinus exstans Springer
Dolatocrinus grandis Miller & Gurley
Dolatocrinus insuetus Rowley
Dolatocrinus lacus Lyon
Dolatocrinus major Wachsmuth & Springer
Dolatocrinus marshi Lyon
Dolatocrinus multibrachiatus Rowley
Dolatocrinus pyramidatus Springer
Dolatocrinus rotundus Springer
Dolatocrinus spinosus Miller & Gurley
Dolatocrinus vetustus Miller & Gurley
Gennaeocrinus kentuckiensis Shumard
Hadrocrinus discus Lyon
Himerocrinus plenissimus (Lyon)
Megistocrinus knappi Lyon & Casseday
Megistocrinus spinulosus Lyon
"Poteriocrinus" cylindricus Lyon
"Poteriocrinus" simplex Lyon

Figure 7. Stalkless living crinoid in an aquarium.

Crinoids & Blastoids

AT THE FALLS OF THE OHIO

Fig. 1. Crinoid (top) and blastoid (bottom).

Crinoids and blastoids (figure 1) are two kinds of fossils you may see on the fossil beds at the Falls of the Ohio. These fossils belong to the phylum Echinodermata. Starfish, sand dollars, and sea urchins are echinoderms that are commonly observed along the seashore today.

DNR Indiana Department of Natural Resources

Memories made naturally. INDIANA STATE PARKS

FALLS OF THE OHIO

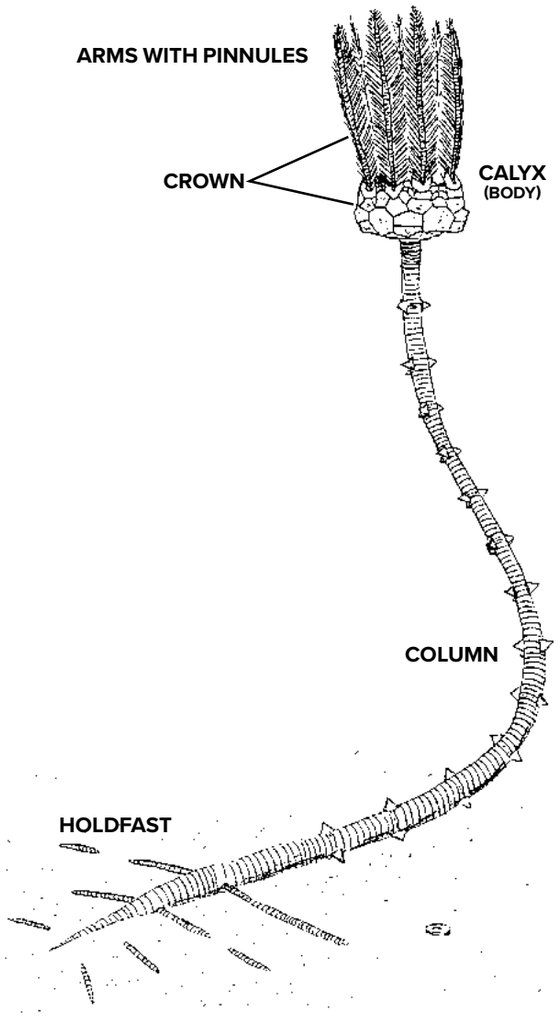

Figure 2. Reconstructed Dolatocrinus crinoid

Echinoderm means "spiny skin." If you have touched a starfish or sand dollar, you may be familiar with their scratchy texture. They lack an outer skin like us. Crinoids are still living today. Stalked species occur in water 500 feet (150 meters) or deeper. Stalkless species live in shallow water (figure 7). One important characteristic of living (and most fossil) echinoderms is their pentameral symmetry. That means their body is organized in multiples of five. We have bilateral symmetry (a left and a right side).

Fossils of these animals might be mistaken for plants, since both had a long, narrow "stem." Superficially, the column may be compared to a stalk, and the "head" (which is actually the body) is often compared to a flower. These animals did not carry out photosynthesis. They ate microscopic plankton. Crinoids and blastoids had a gut, muscles, nerves, a reproductive system, and other features of animals. Oxygen is distributed to tissue through a water vascular system. Their "blood" is seawater.

As adults, most of these Devonian echinoderms could not move; however, their relatives –starfish, echinoids and sea cucumbers–could. If a storm buried a starfish, it could wiggle out and crawl away. Immobile crinoids and blastoids might be buried, and if lucky (for us) became preserved as a fossil. But most of the time they would rot on the sea floor.

Comparing Crinoids and Blastoids

Crinoids are widespread in the ocean. Blastoids became extinct at the end of the Permian Period, some 200 million years ago. More than 650 species of crinoids inhabit the world's oceans today. Considering how little we know about the deep ocean, that number is grossly under-represented.

Class Crinoidea and Class Blastoidea share some common characteristics but have important differences. The most significant relate to their body, which is often described as the "head." (See figures 2 and 6). Echinoderm skeletal material consist of calcified plates or ossicles.

Crinoid plates are held together with muscle and ligaments. Upon death, the tissue decays within several weeks. Calcified parts disarticulate into small fragments by wave action and scavengers.

Blastoids had fused plates that were more likely to remain intact after death. They may have been shattered by hitting rocks, or crushed upon burial or by scavengers. Refer to the illustrations (figures 2 and 6) to identify important characteristics.

Figure 3. Crinoids on the upper fossil beds

Crinoids and blastoids have a stem, called a column. It consisted of hundreds or thousands of disk-like columnals. The central axial canal or lumen contained a fluid-filled sac and nerve that extended the length of the column.

These are very common fossils and can be found abundantly on the upper fossil beds with small column sections (figure 3). Like any growing organism, the column started small (in diameter and length) and increased in size as the animal matured. Crinoid stalks rarely grew more than one inch or 2.5 cm in diameter. The thickest portion was at the base, closest to the sea floor sediment. The weight added stability as the length of the column grew. Crinoid columnals are usually finely ridged, allowing adjacent columnals to interlock. Not all are round disks. Dolatocrinus has "flanges" positioned at 120-degree angles and Himerocrinus columnals resemble cogwheels.

A circular cross-section is most common. Star, four- or five-leaf clover-shaped lumens are not unusual. Two and five holes may be observed. The columnal with five lumens is usually square, not round. Columns must be buried within a matter of weeks after the animal's death, or the individual columnals would fall away and become mixed with the surrounding sediment on the sea floor.

Figure 4. Multi-cirri crinoid holdfast

Crinoids used a variety of methods to anchor them in place. The bottom of the stalk ends in a holdfast (see figure 2). The most widespread way of "staying put" was with cirri (think "roots"). Cirri radiated from the column into the soft sediment (figure 4), much like the trees on the edge of the Ohio River. Blastoids used this technique exclusively as far as the fossil record shows us (see figure 6).

One Devonian crinoid genus, Ancyrocrinus, used a unique grappling hook (fig. 5). It could have swiveled or hooked against organisms or debris to keep it from being swept away by swift ocean currents in a storm.

A third type of holdfast was a button-like disk that was cemented to a hard surface. These simple holdfasts may be found attached to a variety of fossils.

Crinoids and blastoids have distinct body structures. Blastoid "heads" resemble a flower bud. Called the theca, it contains the vital organs. Five-petal or zipper-shaped ambulacral grooves moved food. There are five openings at the top of a blastoid. The mouth is at the apex and is usually

Figure 5. Ancyrocrinus holdfast