GASTROLITHS or GIZZARD STONES

Many animals swallow small rocks that stay in their stomachs. These rocks (called gizzard stones or gastroliths) tumble around in their stomachs, helping to grind up tough food fibers (like leaves, twigs, pine needle, etc.). When gastroliths are found with (or inside) dinosaur fossils, they are typically very smooth and polished from years of tumbling around in a dinosaur's digestive tract.

Some of the animals that use gizzard stones are:

- some birds (like emus) who eat tough, fibrous food - they need the stones because they have no teeth.

- some dinosaurs, including
  - Claosaurus
  - Psittacosaurus
  - Massospondylus 
  - Sellosaurus
  - Omeisaurus

  - Apatosaurus 
  - Barosaurus
  - Dicraeosaurus
  - Seismosaurus

Geologists usually require several pieces of evidence before they will accept that a rock was used by a dinosaur to aid its digestion. First, the stone must be unlike the rock found in its geological vicinity. Secondly, it should be rounded and polished, because inside a dinosaur's gizzard any genuine gastrolith would have been acted upon by other stones and fibrous materials in a process similar to the action of a rock tumbler. Lastly, the stone must be found with the bones of the dinosaur which ingested it. It is this last criterion that causes trouble in identification, as smooth stones found without context can (possibly erroneously in some cases) be dismissed as having been polished by water or wind.

Gastroliths can be distinguished from stream- or beach-rounded rocks by several criteria: gastroliths are highly polished on the higher surfaces, with little or no polish in depressions or crevices, often strongly resembling the surface of worn animal teeth.

Stream- or beach-worn rocks, particularly in a high-impact environment, show less polishing on higher surfaces, often with many small pits or cracks on these higher surfaces. Finally, highly polished gastroliths often show long microscopic hairline scratches, presumably caused by contact with a sharp corner of a freshly swallowed stone. Since most gastroliths were scattered when the animal died and many entered a stream or beach environment, some gastroliths show a mixture of these wear features. Others were undoubtedly swallowed by other dinosaurs and highly polished gastroliths may have been swallowed repeatedly.

The Early Cretaceous Cedar Mountain Formation of Central Utah is full of highly polished red and black cherts, which may partly represent gastroliths. Interestingly, the cherts may themselves contain fossils of ancient animals, such as corals. These stones do not appear to be associated with stream deposits and are rarely more than fist-sized, which is consistent with the idea that they are gastroliths. **Gastroliths have sometimes been called 'Morrison stones' because they are often found in the Morrison Formation, which is a Jurassic formation roughly 150 million years old.** Some gastroliths are made of petrified wood.

Paleontologists are researching new methods of identifying gastroliths that have been found disassociated from animal remains, because of the important information they can provide. If the validity of such gastroliths can be verified, it may be possible to trace gastrolithic rocks back to their original sources. This may provide important information on how dinosaurs migrated. Because the number of suspected gastroliths is large, they could provide significant new insights into the lives and behavior of dinosaurs.

Gastroliths (stomach stones) are known from many extant and extinct vertebrate clades and are potentially useful for paleobiological interpretations. However, the connection between bones and gastroliths in the fossil record is not always evident. Therefore, there are processes, which could lead to the loss of gastroliths from the body but also to the coincidental association of gravel with vertebrate remains.

The separation modes for bones and gastroliths comprise active behaviors in the living animal (regurgitation and defecation) as well as several post-mortem processes, including the transport of bones and/or stones by other animals (scavengers) and water transport as well as the selective destruction of stones or bones (mainly the latter).

Examples of fossil gastrolith-bearing taxa include tangasaurids, crocodilians, sauropodomorph as well as non-avian theropod dinosaurs, and birds. The occurrence pattern of gastroliths within the fossil record shows that associated gastroliths are especially abundant in stagnant aquatic environments.

A simple classification system for the authenticity of gastroliths has been introduced. The scale ranges from 1 (cluster of stones in the abdominal area of the skeleton) to 6 (surface finds of isolated, rounded and occasionally polished stones without associated bones).

The analysis of fossil stomach contents is difficult in general. Complications include the identification of small amounts of partly digested food, the discrimination between food and unintentionally swallowed particles, the possibility that the food contents are the result of a non-typical feeding situation or that the stomach contents were subject to fossil or recent contamination (Richter, 1988). These problems do not only apply to food items but also to other stomach contents including gastroliths (stomach stones). Gastroliths are known from many extinct vertebrate clades (Whittle and Everhart, 2000). Unfortunately, the identification of isolated gastroliths is very difficult and often impossible.