

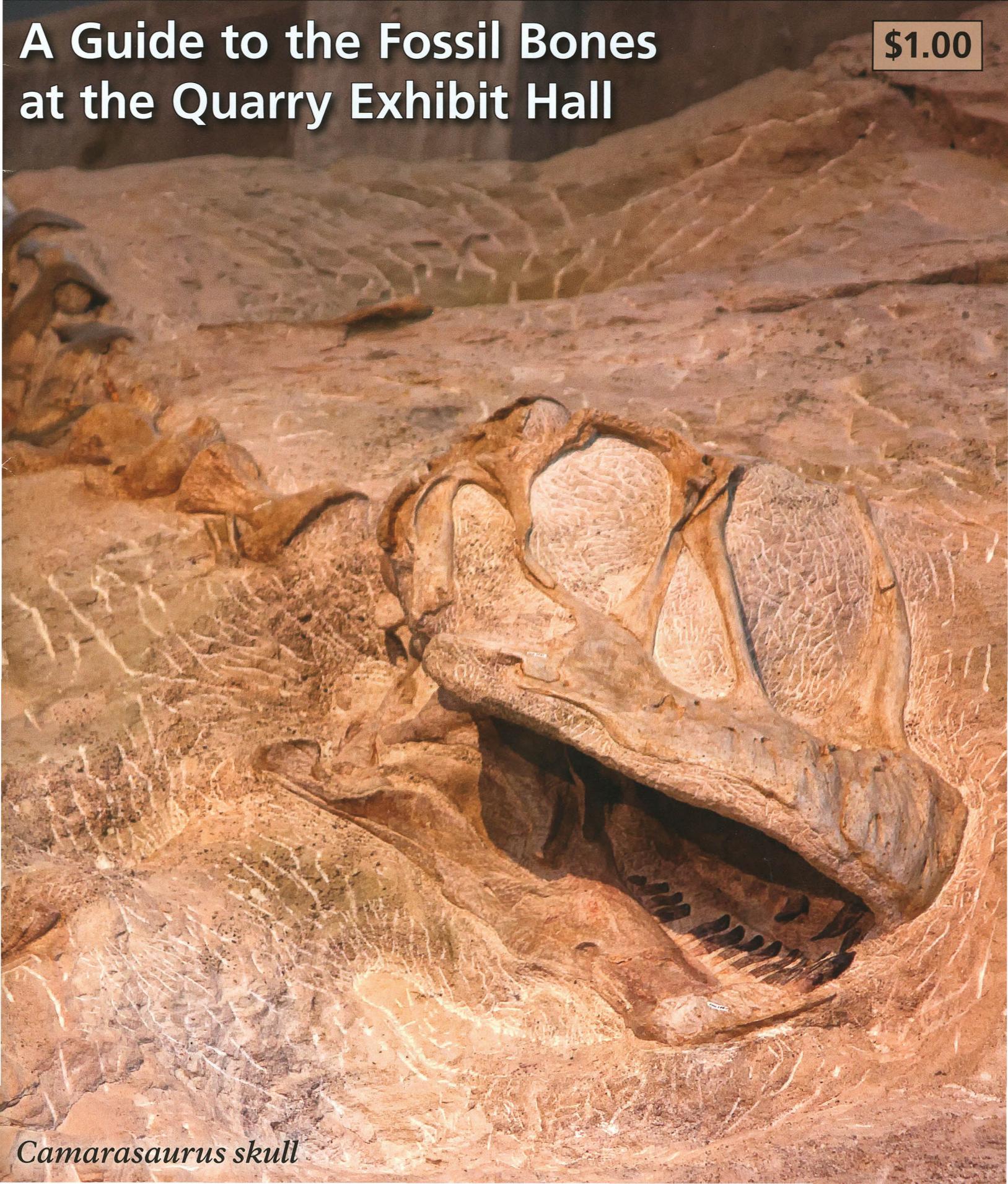
National Park Service
U.S. Department of the Interior

Dinosaur National Monument
Utah, Colorado



A Guide to the Fossil Bones at the Quarry Exhibit Hall

\$1.00



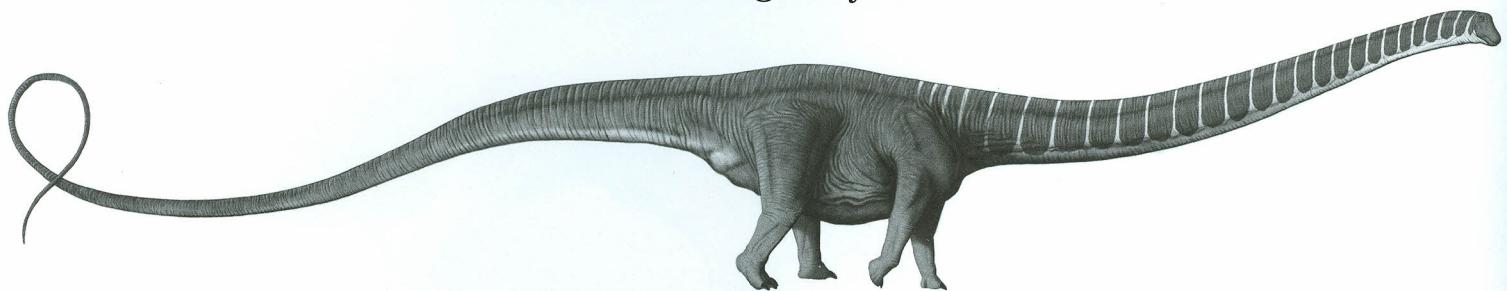
Camarasaurus skull

DINOSAURS OF THE QUARRY FACE: A Jurassic Time Capsule

The dinosaur bones now exposed on the Quarry cliff were buried in an ancient river about 149 million years ago. Over time the sediments turned to rock, protecting the bones in a stone time capsule.

Earl Douglass, a paleontologist from the Carnegie Museum in Pittsburgh, PA, opened this capsule when he discovered eight tail vertebrae of an *Apatosaurus* in 1909. This led to the eventual discovery of remains of 10 different species of dinosaurs at the Quarry. The gigantic plant-eating *sauropods* were the most common dinosaurs in the area. As in today's ecosystems, meat-eating *theropods* were less numerous and account for less than five percent of all Quarry fossils.

Artwork of dinosaurs with bones on the Quarry face are shown on the back cover.



WHERE ARE THE PALEONTOLOGISTS?

In 1991 the reliefing of bones in this quarry was completed. The emphasis of the fossil resource management program was shifted to field and laboratory investigation to try and understand the complete environment of the Morrison ecosystem of 149 million years ago.

The bone-bearing layer of the Quarry has been almost completely exposed. In exposing and reliefing bones, we recognized that we were also destroying information about the environment the dinosaurs lived in. That information helps us understand more about the details of this prehistoric environment.

Theft, vandalism and erosion are threats to fossil bones. Bones in the Quarry are well protected from those threats. Field work has located other smaller but no less significant sites. These sites include dinosaur trackways, embryos, eggs, juveniles, nearly complete specimens, a new species of theropod, and bones of smaller animals that lived with the dinosaurs. For security, these sites are not open to the public. Information from these sites will not be analyzed until laboratory work is completed, which may take years of preparation and consultation with other experts. After consultation, the results are published for professional review. During that time, the fossils must be preserved and properly stored. Some specimens are studied here, while others are loaned to scientific institutions with expertise in specific fields of study. Proper analysis, preservation and storage of the fossils takes a great deal of time and funds.

HOW TO USE THIS GUIDE:

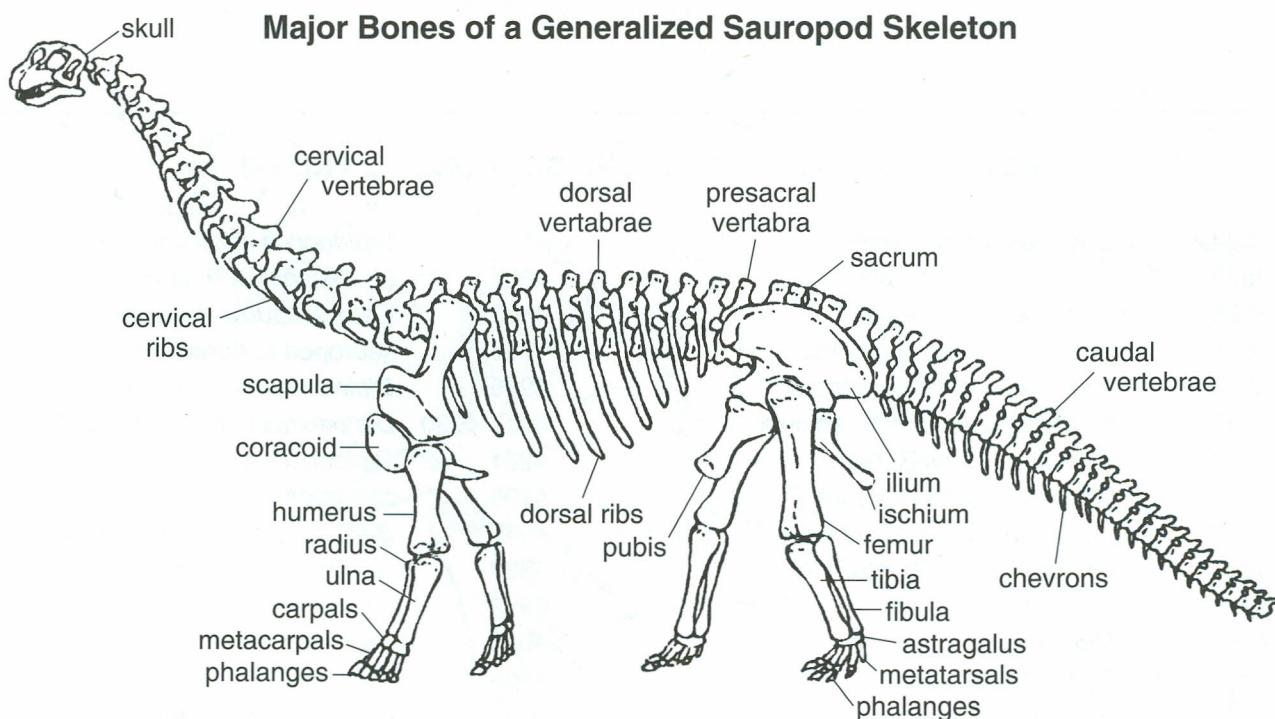
Name That Bone

Paleontologists use a grid system to record the bones' location. The location and orientation of bones in the Quarry has been very important in understanding environmental conditions. For example, the general orientation of skeletal remains is one indicator of which way the river current was flowing.

The Quarry face is divided into sections, and each bone has a catalog number. The numbers used in these illustrations are actual catalog numbers. A small locator map will help you find the approximate area on the Quarry face. The key to identification of the fossil bones is based on years of collaboration between paleontologists at Dinosaur National Monument and other museums and universities.

Both juvenile and adult bones are located on the Quarry face. Catalog numbers of juvenile specimens begin with a "J." Scientific names have been used to identify the bones. Use the illustration of the sauropod skeleton below to help identify the bones you locate.

Over 1,500 bones remain exposed on the Quarry face. Some bones have only been partly identified. Not all bones have been drawn in this guide.



SKULLS: Rare Pieces of The Puzzle

One of the outstanding features of the quarry is the large number of skulls that have been found. The skull of an animal often *disarticulates* (separates) from the skeleton after death, thus skulls are rarely found articulated with the vertebrae. Of the 14 complete skulls that were discovered on this site, two *Camarasaurus* skulls have been left on the Quarry face. The original skull of an *Allosaur* is on display in the exhibits.

DISARTICULATED BONES: A Dinosaur Puzzle

You may wonder how to solve the many puzzles this jumble of bones presents. The bones were deposited by an ancient river flowing to the east. Positions of a string of neck and back vertebrae of a *Stegosaurus* (#4713-4724), tail vertebrae of a *Camarasaurus* (#4801-4806) and lower leg, ankle and foot bones of a *Diplodocus* (#4927-4930, 4999, 4684, and 4931) provide visual clues to the direction the water flowed.

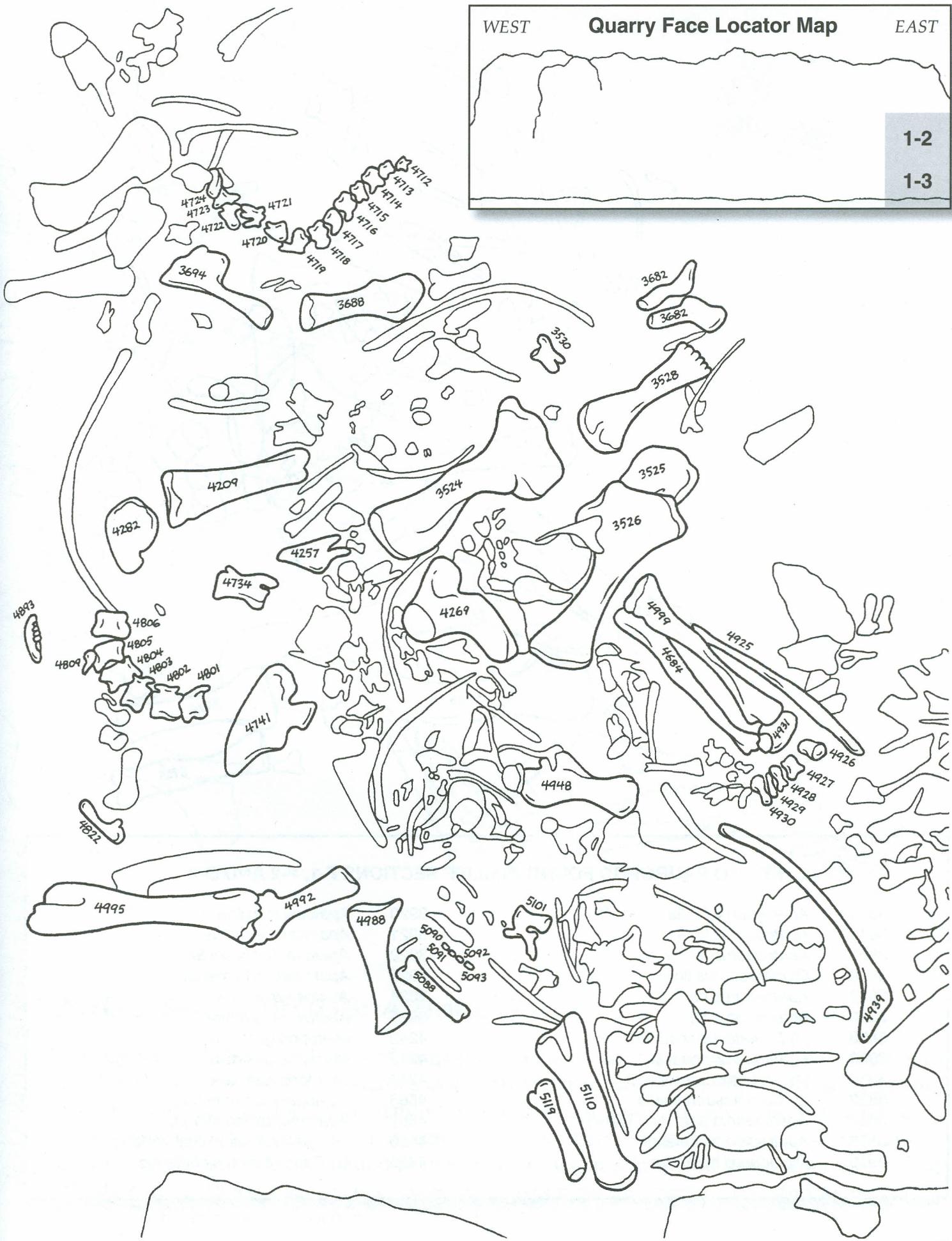
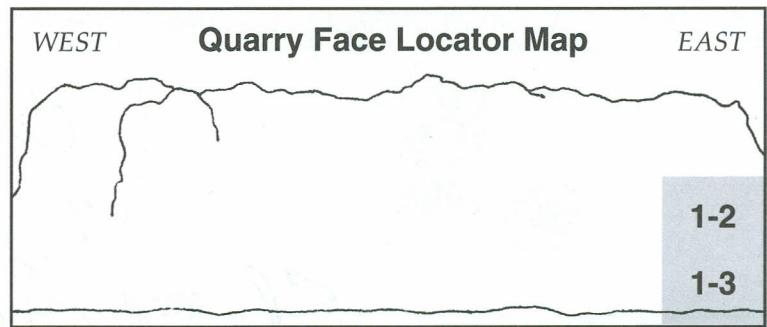
When bones are articulated (still joined together) it may be assumed the carcass did not travel far from the place of death, and did not experience great trauma from predators, scavengers or environmental conditions.

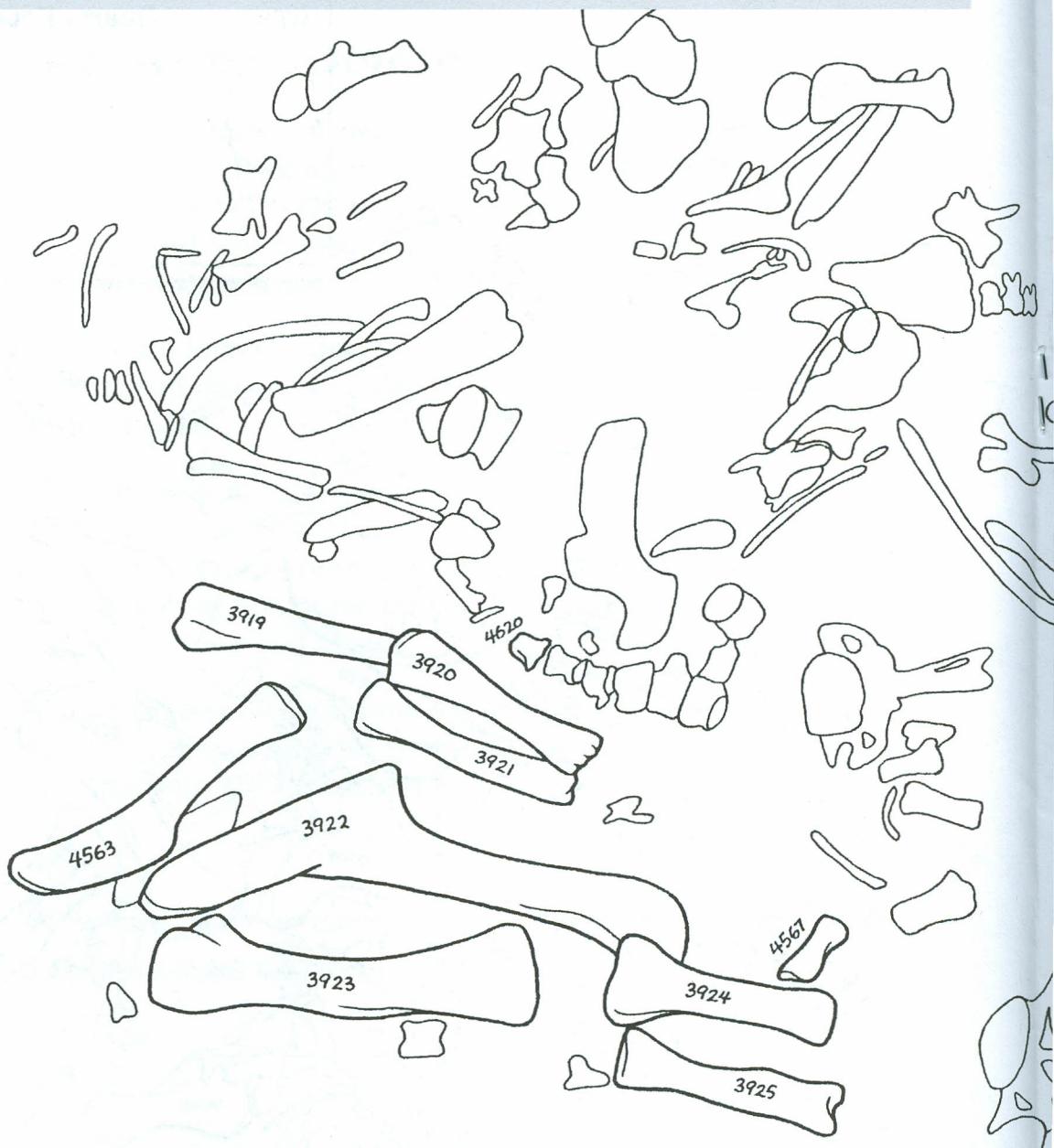
Most of the other bones in this section are disarticulated, and are from adults and juveniles of at least seven species of dinosaurs. Disarticulated bones may have traveled a greater distance and received greater trauma than articulated bones. Because of the tumbling action while traveling downstream, some bones have rounded and smooth edges making it difficult to determine their type and origin.

As you look at other sections of the cliff face, look for the position of articulated bones to detect the easterly flow of water. You can identify types of bones not listed in this guide by comparing their shape and size with the ones shown.

KEY TO BONES FOUND IN CLIFF SECTIONS 1-2 AND 1-3

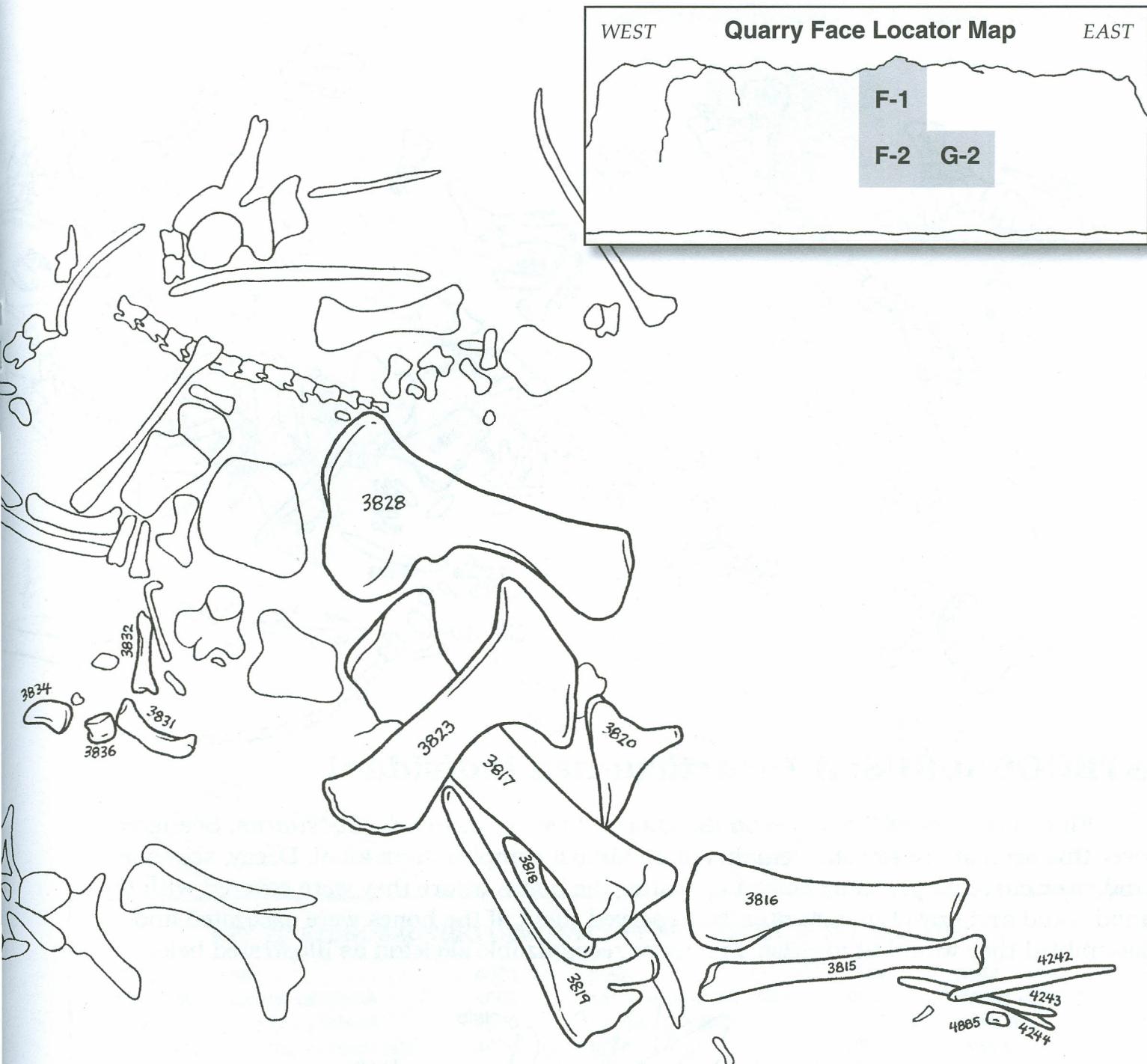
3524	<i>Camarasaurus</i> L. scapula	4809	<i>Diplodocus</i> distal chevron
3525	<i>Diplodocus</i> L. coracoid	4822	(J) <i>Allosaurus</i> R. ulna
3526	<i>Diplodocus</i> L. scapula	4893	<i>Camptosaurus</i> lower jaw
3528	(J) <i>Diplodocus</i> L. humerus	4925	sauropod L. dorsal rib
3530	<i>Diplodocus</i> caudal vertebra	4926	<i>Diplodocus</i> cervical vertebra
3682	(J) <i>Diplodocus</i> L. & R. articulated pubes	4927-4930	<i>Diplodocus</i> L. metatarsals
3688	(J) <i>Apatosaurus</i> R. humerus	4931	<i>Diplodocus</i> astragalus (ankle)
3694	(J) <i>Diplodocus</i> L. scapula	4939	sauropod dorsal rib
4209	(J) <i>Camarasaurus</i> L. tibia	4948	<i>Barosaurus</i> cervical vertebra
4257	<i>Camarasaurus</i> R. maxillary	4988	sauropod R. ulna
4269	<i>Camarasaurus</i> cervical vertebra	4992	(J) sauropod L. scapula
4282	<i>Diplodocus</i> L. coracoid	4995	sauropod femur
4684	<i>Diplodocus</i> L. fibula	4999	<i>Diplodocus</i> L. tibia
4712	<i>Stegosaurus</i> axis	5088	(J) <i>Diplodocus</i> L. femur
4713-4720	<i>Stegosaurus</i> cervical vertebrae	5090-5093	<i>Camptosaurus</i> caudal vertebrae
4721-4724	<i>Stegosaurus</i> dorsal vertebrae	5101	sauropod vertebra
4734	<i>Diplodocus</i> caudal vertebra	5110	sauropod R. humerus
4741	<i>Allosaurus</i> R. ilium	5119	(J) sauropod R. femur
4801-4806	<i>Camarasaurus</i> caudal vertebrae		





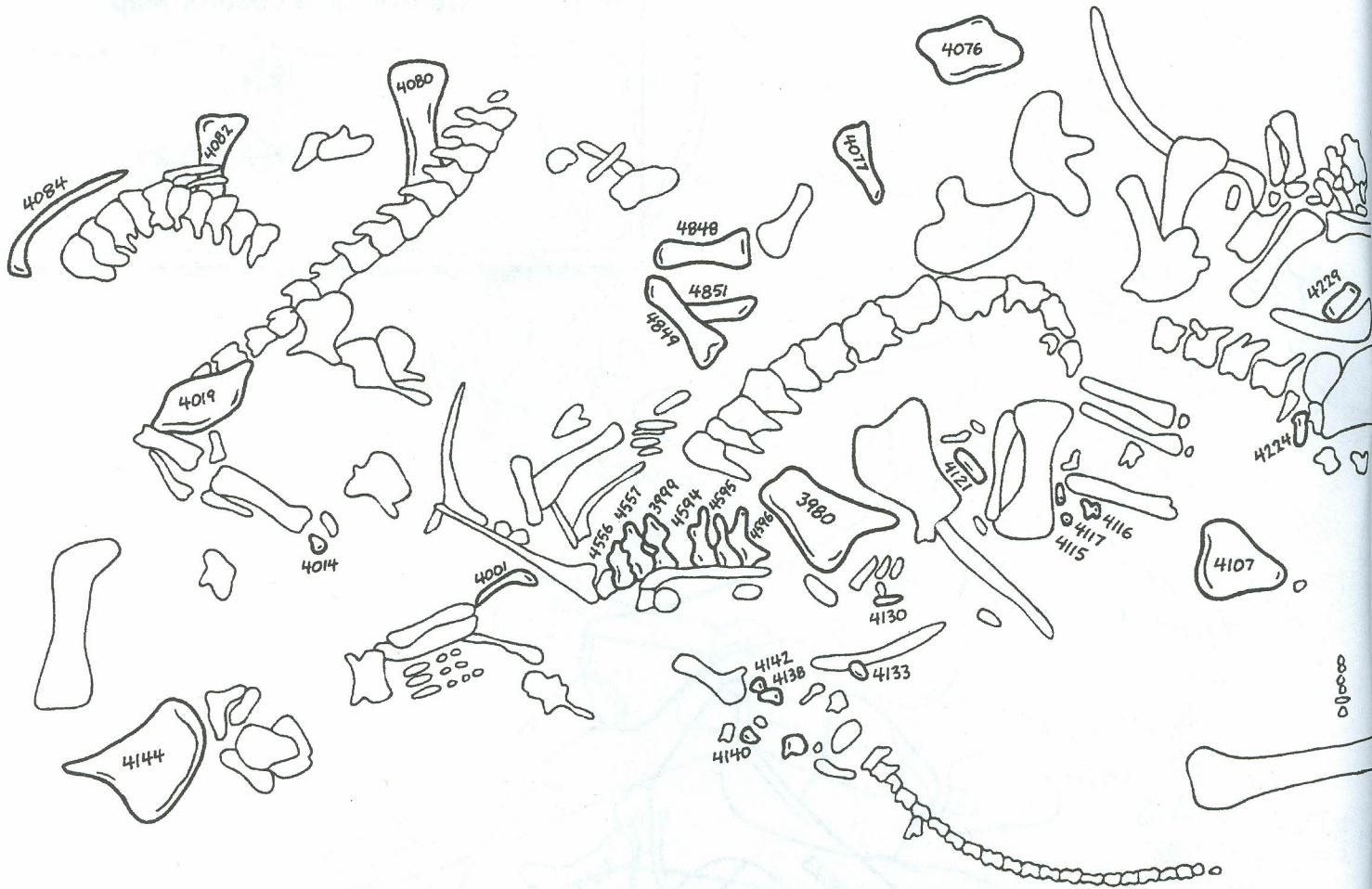
KEY TO SAUROPOD FOUND IN CLIFF SECTIONS F-1, F-2 AND G-2

3815	<i>Apatosaurus</i> fibula	3920	<i>Apatosaurus</i> ulna
3816	<i>Apatosaurus</i> tibia	3921	<i>Apatosaurus</i> radius
3817	<i>Apatosaurus</i> femur	3922	<i>Apatosaurus</i> scapula
3818	<i>Camarasaurus</i> tibia	3923	<i>Apatosaurus</i> humerus
3819	<i>Apatosaurus</i> rib	3924	<i>Apatosaurus</i> ulna
3820	<i>Apatosaurus</i> rib	3925	<i>Apatosaurus</i> radius
3823	(J) <i>Diplodocus</i> scapula	4242	sauropod gastralia
3828	<i>Apatosaurus</i> scapula	4243	sauropod gastralia
3831	(J) <i>Camptosaurus</i> femur	4244	sauropod gastralia
3832	(J) <i>Camptosaurus</i> tibia	4563	<i>Apatosaurus</i> humerus
3834	<i>Apatosaurus</i> phalange (claw)	4567	<i>Apatosaurus</i> metacarpal
3836	<i>Apatosaurus</i> phalange	4620	(J) <i>Apatosaurus</i> caudal vertebra
3919	<i>Diplodocus</i> humerus	4885	(J) <i>Camarasaurus</i> phalange



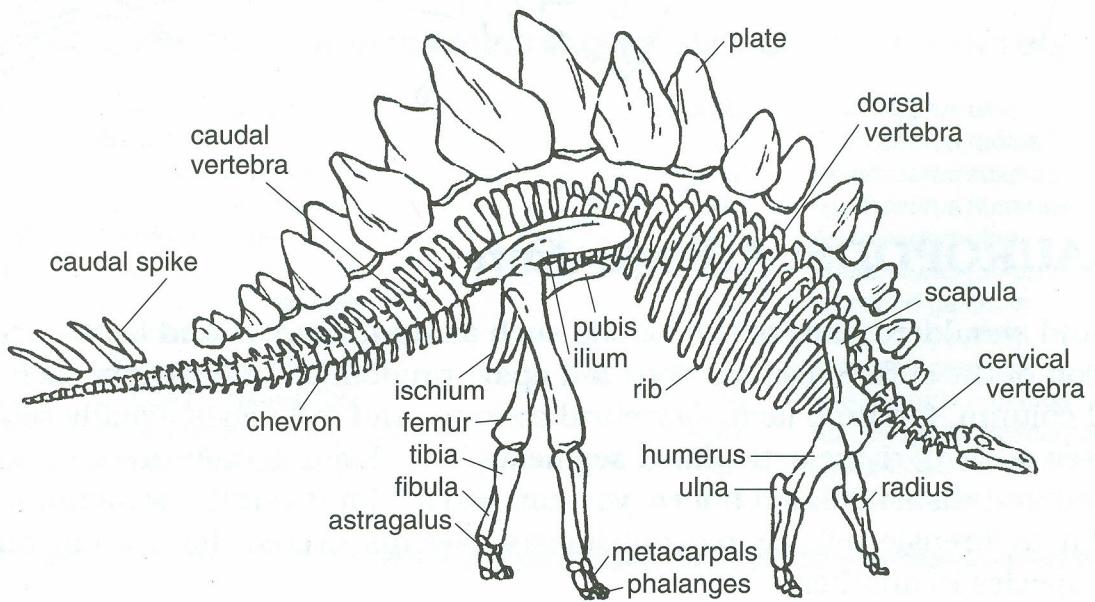
LARGE SAUROPODS: A Bone Jam

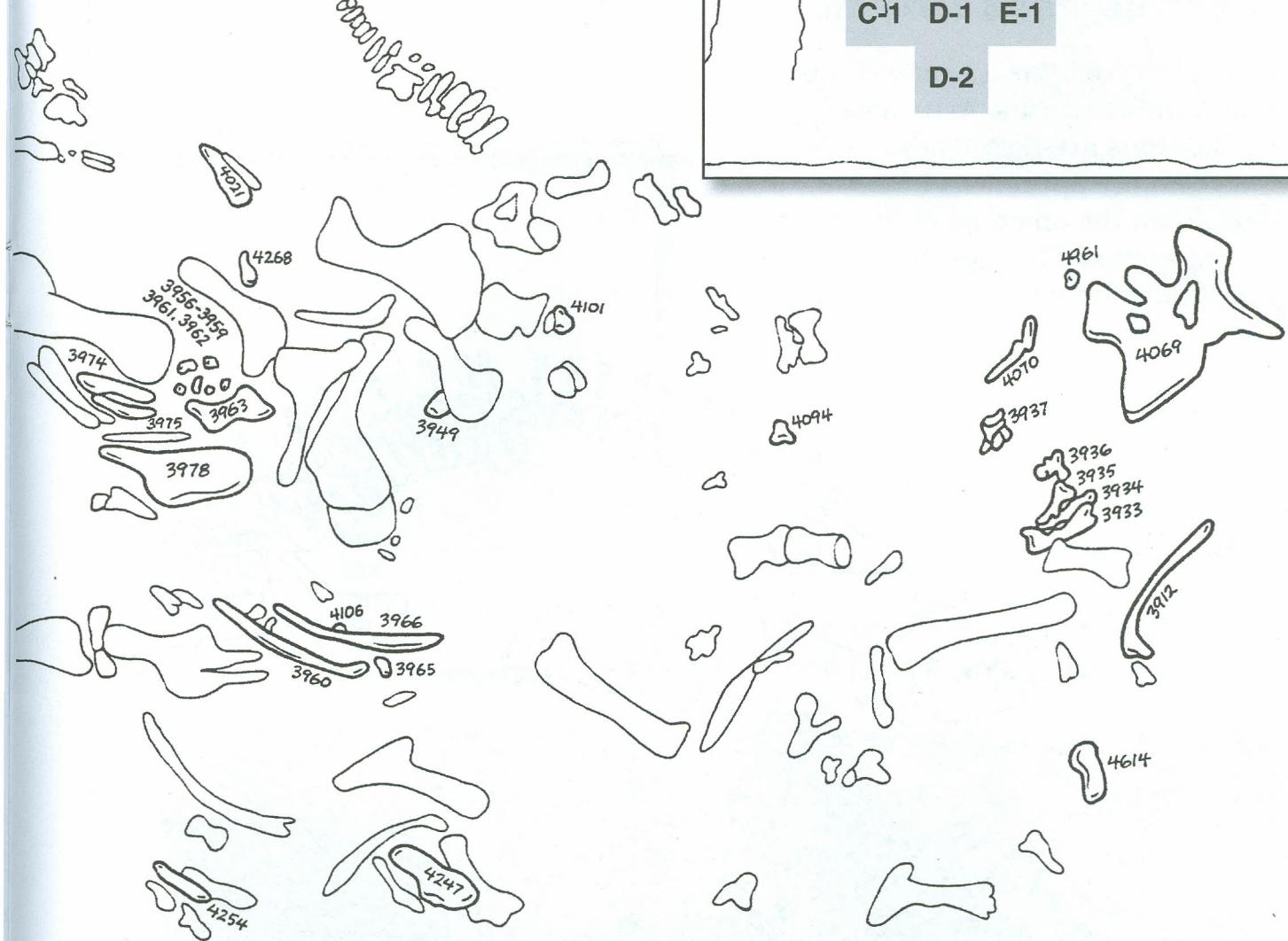
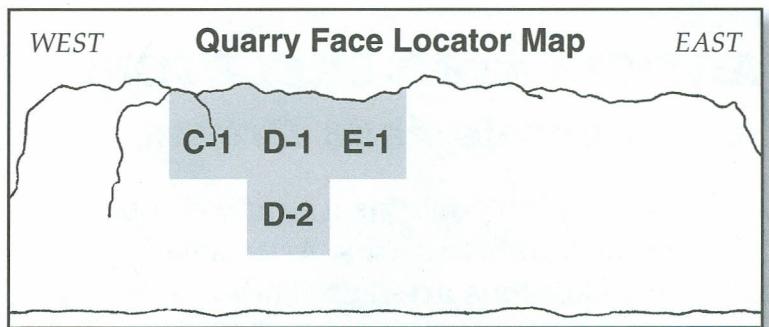
Huge leg and shoulder bones of sauropods such as *Apatosaurus* and *Diplodocus* dominate this section of the cliff. Skeletons don't fall apart randomly. Weak points such as the skull-vertebral column, forelimb (arm)-vertebral column, and tail-pelvis usually separate first. You can see some of those articulated segments here. Even though this section contains articulated and disarticulated bones, you can learn a lot if you know anatomy. Using methods similar to forensic science, paleontologists have discovered that similar bones differ from one species to another.



STEGOSAURUS: A Disarticulated Individual

Fifteen percent of the bones on the Quarry face are those of *Stegosaurus*. Scattered over this section are skeletal remains of an almost complete individual. Decay, scavengers, and river currents probably helped to scatter the bones before they were covered with the mud, sand and gravel that eventually preserved them. If the bones were excavated and assembled they would fit together in a more recognizable skeleton as illustrated below.



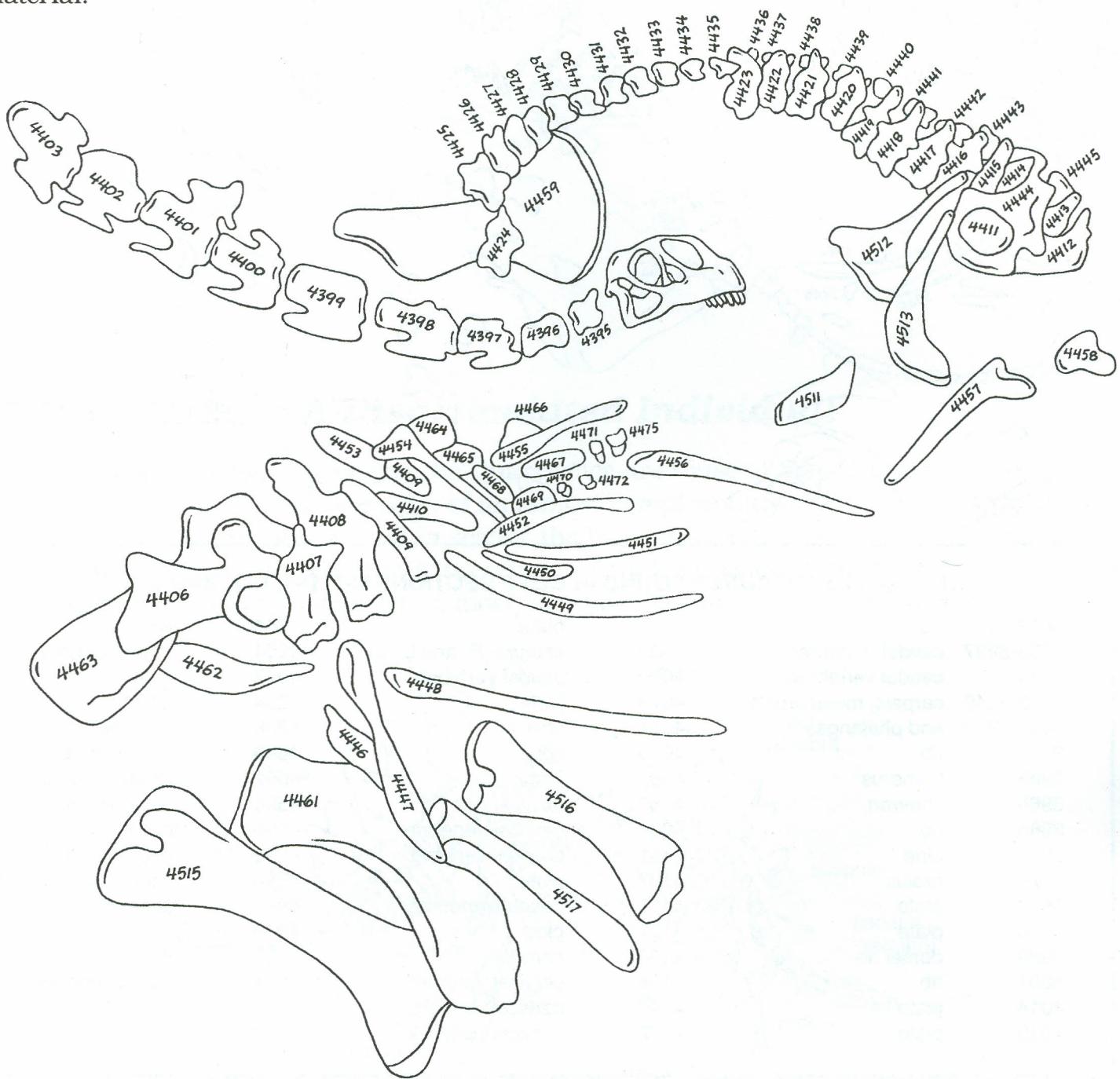
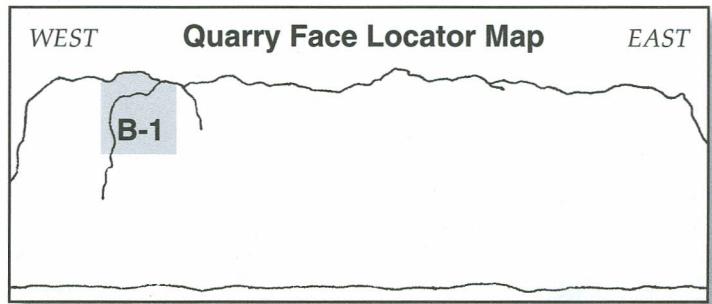


KEY TO STEGOSAURUS FOUND IN CLIFF SECTIONS C-1, D-1, D-2, AND E-1

3912	rib	4021	plate	4144	plate
3933-3937	caudal vertebrae	4069	sacrum, R. and L. ilia	4224	dorsal vertebra
3949	caudal vertebrae	4070	caudal vertebrae	4247	ischium
3956-3949	carpals, metacarpals	4076	plate	4254	radius
3961-3962	and phalanges	4077	tibia	4268	(J) humerus
3960	rib	4080	tibia	4556	dorsal vertebra
3963	humerus	4082	femur	4557	dorsal vertebra
3965	chevron	4084	rib	4594	dorsal vertebra
3966	rib	4094	cervical vertebra	4595	dorsal vertebra
3974	ulna	4101	cervical vertebra	4596	dorsal vertebra
3975	radius	4107	plate	4614	astragalus
3978	plate	4115-4117	caudal vertebrae	4848	humerus
3980	plate	4121	plate	4849	tibia
3999	dorsal rib	4130	chevron	4851	plate
4001	rib	4138	cervical vertebra	4961	caudal vertebrae
4014	plate	4140	cervical vertebra		
4019	plate	4142	cervical vertebra		

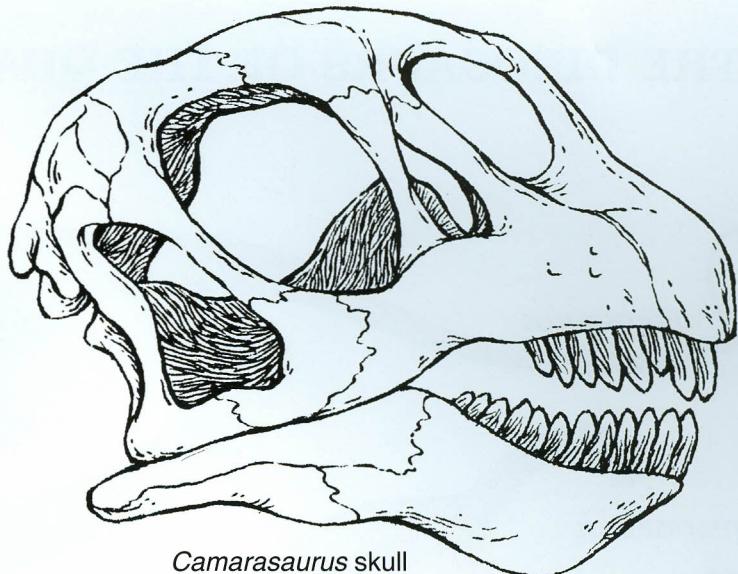
ARTICULATED SKELETON: A Paleontologist's Dream

This section contains a nearly complete skeleton of *Camarasaurus*. Articulated dinosaur skeletons are rare. They are very important reference specimens because they tell us about the anatomy of the entire skeleton, and are used by paleontologists to identify and compare with less complete material.



**KEY TO CAMARASAURUS BONES
FOUND IN CLIFF SECTION B-1**

4395	atlas
4396-4403	cervical vertebrae
4406-4410	dorsal ribs
4411-4445	caudal vertebrae
4446-4458	dorsal ribs
4459	scapula
4461	scapula
4462	coracoid
4463	humerus
4464	ulna
4465	radius
4466-4470	metacarpals
4471-4472	phalanges
4511	pubis
4512-4513	ischium
4515	femur
4516	tibia
4517	fibula



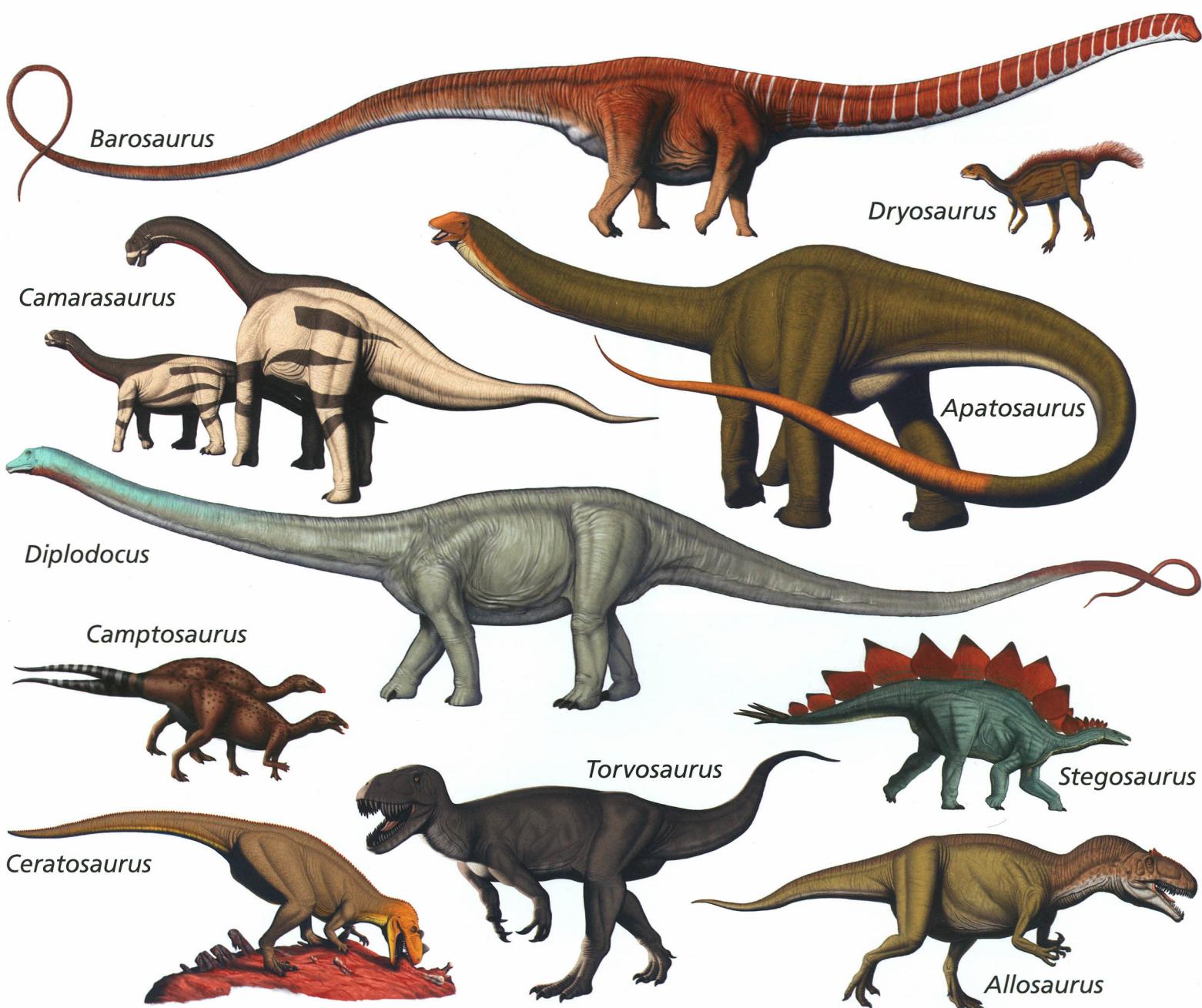
Camarasaurus skull

This skull is incomplete and tilted in a way that makes it hard to see from the quarry viewing platform.

Use the drawing above to help you identify the fossil photographed below.



THE DINOSAURS OF THE QUARRY




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NATURAL
HISTORY
Association

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Illustrations by Clint McKnight, Tess Kissinger and Bob Walters

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Quarry Bone Guide

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