



(Extract from '*Geology of Utah's Parks and Monuments* 2000 Utah Geological Association Publication 28 D.A. *Sprinkel, T.C. Chidsey, Jr., and P.B. Anderson, editors*')

### **DINOSAUR NATIONAL MONUMENT**

Dinosaur National Monument was established by presidential proclamation on October 4, 1915. The site was originally established to protect the famous dinosaur quarry discovered in the Upper Jurassic Morrison Formation by Carnegie Museum paleontologist Earl Douglass. The monument was enlarged in 1938 to include the spectacular canyons cut by the Green and Yampa Rivers. For more information on the geology and a stratigraphic section of Dinosaur National Monument, see Gregson and Chure, (this volume), Untermann and Untermann (1954, 1969), Hansen and others (1983), and Hansen (1996).

The oldest sedimentary unit known from Dinosaur National Monument is the Precambrian Uinta Mountain Group. Hansen (1996) reported on fossilized algal globules *Chuarina* sp. from the Uinta Mountain Group near Manila, Utah, about 70 miles north of the monument.

The Upper Cambrian Lodore Formation consists of variegated, glauconitic shales, and sandstones that contain marine invertebrates and trace fossils. Brachiopods, gastropods, and trilobites have been identified from the Lodore Formation in Dinosaur National Monument (Herr, 1979; Herr and others, 1982; Hansen, 1996).

Corals, brachiopods, gastropods, and echinoderms are preserved, but rare, in the Lower Mississippian Madison Limestone (Hansen and others, 1983). Upper Mississippian brachiopods, fish, and coal beds are present in the Doughnut Formation (Hansen and others, 1983). The Lower Pennsylvanian Round Valley Limestone contains bryozoans, brachiopods, mollusks, and echinoderms (Hansen and others, 1983). Sponge spicules, corals, brachiopods, echinoid spines, crinoids, foraminifera, and conodonts are common in the marine facies of the Middle Pennsylvanian Morgan Formation (Driese, 1982).

The Permian Park City Formation (equivalent to the Phosphoria Formation farther north) consists of limestone, sandstone, and some chert layers. Marine invertebrates including brachiopods, bivalves, cephalopods, gastropods, and other invertebrates have been found in this unit (Hansen and others, 1983).

Peabody (1948) studied some unusual reptile tracks in the Lower Triassic Moenkopi Formation in the vicinity of Dinosaur National Monument. These include some swimming traces now in the collections of the Utah Field House Museum of Natural History in Vernal, Utah. *Scoyenia* traces have been reported from the Moenkopi at Dinosaur National Monument (Lockley and others, 1990).

In the 1960's an important vertebrate tracksite was discovered just northeast of Dinosaur National Monument. Today over two dozen tracksites have been identified within the monument. Numerous tracksites have been discovered in the Upper Triassic Popo Agie and Chinle Formations. Fossil tracks are diverse and include those identified from dinosaurs, mammal-like reptiles, phytosaurs, aetosaurs, lepidosaurs, trilophosaurs, and tanystropheids (Lockley and others, 1990, 1992a, 1992b, 1992c; Hunt and others, 1993a). Among these is a swimming trackway of *Gzvyneidichnium* that shows webbing between the toes. In addition, there are examples of both walking and swimming types of these tracks. Horseshoe crab-like tracks are documented from the Chinle Formation at Dinosaur National Monument. There is also some petrified wood in the Chinle Formation in the monument.

Tridactyl theropod tracks and a rich *Otozoum* tracksite are known from the Lower Jurassic Glen Canyon Sandstone, which is equivalent to the Navajo Sandstone farther south and the Nugget Sandstone farther west and north (Lockley and others, 1992a; Santucci and others, 1998). The Middle Jurassic Carmel Formation is a shallow marine deposit that locally contains gypsiferous beds. Bivalves, gastropods, echinoderms, and a few rare tridactyl vertebrate tracks have been reported from the Carmel Formation in nearby areas adjacent to Dinosaur National Monument.

Chure (1993) reported on three plesiosaur specimens that may have been collected from the Redwater Member of the Stump Formation (Middle to Upper Jurassic) near the western boundary of Dinosaur National Monument. Belemnites, ammonites, gastropods, and bivalves occur in the Middle Jurassic Curtis Member of the Stump Formation in the Dinosaur National Monument area.

The Upper Jurassic Morrison Formation is widely recognized as one of the most prolific dinosaur-bearing units in the world. In addition to the dinosaurs, the Morrison Formation has produced important collections of Jurassic mammals and other vertebrates (Chure and Engelmann, 1989). The Morrison Formation at Dinosaur National Monument contains four members including, from oldest to youngest, the Windy Hill, Tidwell, Salt Wash, and Brushy Basin Members (Turner and Peterson, 1999).

Utah's first theropod dinosaur (also recognized as the second dinosaur discovered in Utah) was found in 1870 near what is today Dinosaur National Monument (Marsh, 1871; Bilbey and Hall, 1999). Earl Douglass made his famous discovery of the dinosaur bonebed in 1909. Under Douglass' direction the Carnegie Museum worked the site until 1922. During 1923, the U.S. National Museum collected a specimen of *Diplodocus*, which was mounted for display in that museum. In 1924, the University of Utah collected a skeleton of *Androdemus* (now *Allosaurus*) from the quarry. Holland (1912, 1915, 1916b, and 1924) and Gilmore (1924, 1925a, 1925b, 1926, 1932, 1936a, and 1936b) published extensively on the dinosaur discoveries from Dinosaur National Monument.

Theodore White was hired as the monument's first paleontologist in 1953. White focused his attention on the preparation of the *in situ* bone-bearing layer and talking with the public about the world of dinosaurs. He hired and trained two maintenance men, Tobe Wilkins and Jim Adams, to relief the bones on the Carnegie Quarry cliff face. White published both scientific and popular articles about the fossils at Dinosaur National Monument (White, 1958, 1964, 1967). White liked to call himself the "Chief Ramrod of the Hammers and Chisels" until his retirement in 1973 (Ann Elder, written communication, 1999). Russ King, Dan Chure, Ann Elder, and Scott Madsen have recently worked as staff paleontologists at Dinosaur National Monument (Chure, 1987, 1992; Chure and McIntosh, 1990). Elder (1999) provides an historical overview of the Carnegie Quarry at Dinosaur National Monument..

Between 1989 and 1992, George Engelmann conducted a comprehensive paleontological survey of the Morrison Formation at Dinosaur National Monument (Engelmann, 1992). More than 270 fossil sites were recorded during the survey. Most of the sites were dinosaur bone localities, but sites containing plant remains, invertebrates, and small vertebrates were also reported.

A number of new dinosaurs have been collected in recent years from Dinosaur National Monument. In 1990, the first large carnivorous theropod dinosaur was collected from the Salt Wash Member of the Morrison Formation (Chure and Madsen, 1993; Chure and others, 1993). Chure (1994) reported on the oldest troodontid dinosaur which was recovered from the monument. A partial skeleton of a hatchling dinosaur, identified as *Camptosaurus*, was discovered at the monument in 1991 (Chure and others, 1992). This is the only hatchling of *Camptosaurus* sp. known from the fossil record.

Chure and others (1989) reported on non-mammalian vertebrates collected from the Brushy Basin Member of the Morrison in Dinosaur National Monument. Evans and Chure (1999) reported on lizards from the Morrison Formation that were collected in the monument. The remains of the turtle *Glyptops* sp. and the crocodile *Hoplosuchus kayi* (Gilmore, 1926) and *Goniopholis* sp. have been collected from the monument. Several tiny frog skeletons and many isolated frog bones have been collected from a Brushy Basin microvertebrate locality in the park. Some of the frog remains have recently been described and represent a new pipoid anuran named *Rhadinosteus* (Henrici, 1992, 1993, 1998).

Engelmann and others (1989) reported on microvertebrates, including mammals, that have been collected from quarries in Dinosaur National Monument. The quarries are in the Brushy Basin Member of the Morrison and have yielded hundreds of isolated teeth and a few partial jaws. The skull of a new multituberculate *Glirodon grandis* was also found at the monument (Engelmann and Callison, 1999). Other mammals identified include a triconodont, a symmetrodont, at least two species of dryolestids, and a paurodontid.

Yen and Reeside (1950) described freshwater mollusks from the Morrison Formation. Sohn and Peck (1963) identified the ostracod *Theriosynoecum wyomingense* as a guide fossil for the Salt Wash Member of the Morrison Formation.

Ash (1993b, 1994) reported on an unusual leaf *Czechanowskia* sp. from the Brushy Basin Member of the Morrison Formation in the monument. This plant is considered by some as an indicator of humid paleoclimates. The discovery of this plant in deposits of an alkaline-saline lake farther south brings this interpretation into question (Turner and Fishman, 1991). A ginkgo leaf locality occurs in the middle of the Brushy Basin Member of the Morrison Formation. Tidwell (1990) reported on a plant locality in Orchid Draw in the western part of Dinosaur National Monument. A palynological (fossil pollen) assessment of the Morrison Formation, including several sites within the monument, was conducted by Litwin and others (1998).

Recent evidence shows that dermestid beetle larvae (Coleoptera: Dermestidae) borings are preserved in dinosaur bones collected from the Carnegie Quarry (Hastiotis, and others, 1999). These trace fossils suggest subaerial exposure of the dinosaur carcasses prior to burial and represent the earliest evidence of dermestids in the paleontological record.

Recent work in the Lower Cretaceous Cedar Mountain Formation has produced some spectacular fossil specimens. One site in particular, a river-deposited bonebed, has yielded a nearly complete articulated sauropod skull, elements of a second disarticulated sauropod skull, numerous sauropod post-cranial elements, and a few isolated theropod bones. Though only a preliminary analysis of these fossils has been completed, the cranial material appears to be some of the most complete Cretaceous sauropod specimens found in North America (Ann Elder, written communication, 1999).

The Dakota Formation of Late Early or Early Late Cretaceous age consists of shoreface and terrestrial strata deposited along the western margin of the western interior seaway. Petrified wood and fragmentary invertebrate remains have been found in this formation. Fish scales and bones are locally abundant in the Mowry Shale of Late Cretaceous age. Bivalves, ammonites, and shark teeth are also known from the Mowry Shale in the Dinosaur National Monument area. The Upper Cretaceous Frontier Formation contains bivalves, gastropods, ammonites, petrified wood, and some thin coal beds. The Mancos Shale is not well exposed in the monument, but locally this unit is very fossiliferous and preserves a high diversity of marine invertebrates. Ammonites are reported from the Mancos at Ashley Creek and Brush Creek near the monument (Kennedy and Cobban, 1991).

Sharpe (1991) reported on the Quaternary and Holocene flora in Dinosaur National Monument collected to assess vegetation changes.

To purchase the Book - *Geology of Utah's Parks and Monuments 2000*  
*Utah Geological Association Publication 28 D.A. Sprinkel, T.C. Chidsey,*  
*Jr., and P.B. Anderson, editors*

Go to <http://www.utahgeology.org/2000guidebook.htm>