

ONE HUNDRED YEARS OF *TYRANNOSAURUS REX*: THE SKELETONS

1

Neal L. Larson

In 1905, Henry Fairfield Osborn, of the American Museum of Natural History, published the name *Tyrannosaurus rex* for a large theropod discovered by Barnum Brown within the Upper Maastrichtian Hell Creek Formation of Montana. Later, *Dynamosaurus imperiosus* Osborn 1905 and 2 cervical vertebrae described as *Manospondylus gigas* (Cope 1892) were included in the species (Osborn 1916). The most complete *T. rex* skeleton, AMNH 5027, was also excavated by Barnum Brown from the Hell Creek Formation of Montana in 1908. Because there were so few specimens, most people believed that *T. rex* was rare.

A dinosaur renaissance beginning in the 1960s inspired many paleontologists to seek out new and more complete specimens. Since 1965, 42 skeletons (5% to 80% complete by bone count) of *T. rex* have been excavated from the Western Interior of North America. To date, *T. rex* has been found in the uppermost Cretaceous terrestrial rocks from central Alberta to southern New Mexico, and from north-central South Dakota to central Utah. These skeletons, along with innumerable numbers of bones and teeth, have been discovered, excavated, displayed, and written about in numerous scientific and popular books and publications.

The discovery of the *Tyrannosaurus* specimen known as Sue and its subsequent publicity (Glut 2000; Fiffer 2000; Larson and Donnan 2002) reignited this renaissance. The rumors of Sue's value lured dozens of amateur paleontologists and untrained fortune hunters into the field. Although most knew nothing about collecting or caring for fossils once they were discovered, people were looking for dinosaurs in areas that no one had ever searched. Within the last 15 years, most exposures of the Hell Creek and Lance Formations have been explored, resulting in many new specimens of *Tyrannosaurus* and other dinosaurs being discovered. These new *Tyrannosaurus* specimens have yielded more information about *T. rex* than was once thought possible, as evidenced by this volume. Much has now been learned about the respiratory, digestive, and reproductive systems, feeding habits, range, sex, lifestyles, injuries, and diseases of the tyrant-lizard king. These new specimens have provided data on arm and jaw strength, speed, and growth rate, and findings have bolstered the finding of a close relationship of bird and theropods. Because of these new discoveries, the once-rare *T. rex* is now one of the most abundant large theropods in many museum collections. An annotated catalog of these specimens is presented below.

Introduction

Figure 1.1. Site map for *Tyrannosaurus rex* discoveries. See text and Table 1.1 for number identification.

Tyrannosaurus *rex* Specimens

Brief descriptions follow each of the more complete *Tyrannosaurus rex* specimens recovered to date. Each listed specimen has a minimum of 10 associated skeletal bones from several parts of the body or a fairly complete skull. The list excludes specimens consisting of only a braincase and/or a few skull bones, or only foot bones, or only caudal bones, as well as the countless specimens of *T. rex* teeth and isolated bones. Although there may be some omissions, the total number of skeletons is particularly impressive when considering that most of these specimens have been found in the last 15 years. Considering the wide geographic range of the specimens, and assuming there is only one North American species, the paleogeographic range of *T. rex* was immense—possibly larger than that of most other large theropods (Fig. 1.1).

Although some authors have considered *Nanotyrannus lancensis* (Bakker et al. 1988) synonymous with *T. rex* (Carr 1999; Carr and Williamson 2004; Holtz 2004; Glut 1997, 2000, 2003, 2006), others (Bakker et al. 1988; Currie 2003; Larson this volume) do not agree. Tooth count, bone shape, and foramen placement and size, along with many other skeletal differences, seem to clearly separate the 2 genera. Because there is so much evidence separating *Nanotyrannus* from *T. rex*, I have excluded *Nanotyrannus* from the following list of *T. rex* specimens. *Aublysodon molnari* Paul, 1988 (= *Stygivenator molnari* Olshevsky, Ford, and Yamamoto, 1995), was excluded for similar reasons.

The following *Tyrannosaurus rex* skeletons have been assigned a percentage of completeness on the basis of the number of bones found with each skeleton. The total number of bones in a skeleton of *T. rex* is approximately 300 (Appendix). All identifiable bones, whether complete or incomplete, are counted as bones in the totals. For many skeletons, some bones were fragmented or eroded, and others were fragmented before burial. In most instances, if the incomplete bones can be positively identified, they are treated as complete bones for the purpose of calculating the percentage of completeness for each skeleton. Every effort was made to avoid inflating the count (for instance, rib heads were counted but rib shafts were not, unless they could be proved to be from separate ribs already counted). The completeness of a skeleton was then derived by dividing the number of bones found with each specimen by the total number of bones in a skeleton.

I attempted to locate and list all *Tyrannosaurus* specimens collected from the upper Maastrichtian terrestrial rocks of North America. All specimens are listed, whether they are in private hands or public institutions. Any errors or omissions are solely my responsibility. All known institutions, repositories, and private collectors that may have *Tyrannosaurus rex* skeletal elements in their collections were contacted for data, and most were cooperative. The following specimens are listed chronologically and alphabetically by their catalog number and/or their nickname or moniker. The year of excavation is given rather than the year of discovery because some of them were not excavated until many decades after they were initially found (Table 1.1).

Table 1.1. Summary of *Tyrannosaurus Rex* Skeletons by Year of Excavation (as of August 2006)

Location	Year Excavated	Specimen No./ Name	Discoverer, Year	State/ Province	No. of Elements	% of Skeleton	Skull/ Parts	Sex*	Current Location
1	1900	BMNH R7994	Brown, 1900	WY	40	13	Y	--	Natural History Museum, London, England
2	1902–1905	CM 9380	Brown, 1902	MT	34	11	Y	F	Carnegie Museum of Natural History, Pittsburgh, PA
3	1902	CM 1400	Peterson, 1902	WY	29	10	Y	?	Carnegie Museum of Natural History, Pittsburgh, PA
4	1908	AMNH 5027	Brown, 1908	MT	143	48	Y	M?	American Museum of Natural History, NY, NY
5	1967	MOR 008	MacMannis, 1967	MT	46	15	Y	F?	Museum of the Rockies, Bozeman, MT
6	1967–1969	LACM 23844	Garbani, 1966	MT	74	25	Y	M	Natural History Museum of LA County, LA, CA
7	1967	LACM 23845	Garbani, 1969	MT	37	12	Y	?	Natural History Museum of LA County, LA, CA
8	1981	SDSM 12047	Floden, 1980	SD	82	27	Y	M?	Museum of Geology, South Dakota School of Mines and Technology, Rapid City, SD
9	1981	RTMP 81.12.1	Sternberg, 1946	AB	49	16	Y	M	Royal Tyrrell Museum of Palaentology, Drumheller, AB
10	1981	RTMP 81.6.1 Black Beauty	Baker, 1980	AB	85	28	Y	F	Royal Tyrrell Museum of Palaentology, Drumheller, AB
11	1981	MOR 009 Hager rex	Hager, 1981	MT	58	19	N	?	Museum of the Rockies, Bozeman, MT
12	1983, 2003	NMMNH PR1081	Staton and LaPoint, 1982	NM	10	3	Y	?	New Mexico Museum of Natural History and Science, Albuquerque, NM
13	1990	MOR 555 Wankel <i>T. rex</i>	Wankel, 1988	MT	146	49	Y	M	Museum of the Rockies, Bozeman, MT
14	1990	FMNH PR2081 Sue	Hendrickson, 1990	SD	219	73	Y	f	Field Museum, Chicago, IL

Table 1.1 continued

Location	Year Excavated	Specimen No./ Name	Discoverer, Year	State/ Province	No. of Elements	% of Skeleton	Skull/ Parts	Sex*	Current Location
15	1992, 1993, 2003	BHI 3033 Stan	Sacrison, 1987	SD	190	63	Y	M	Black Hills Institute of Geological Research, Hill City, SD
16	1992	Samson	Zimmerscheid, 1987	SD	121	40	Y	F	Private, Carnegie Museum of Natural History, Pittsburgh, PA
17	1992	DMNH 2827	Fickle, 1992	CO	10	3	N	?	Denver Museum of Nature & Science, Denver, CO
18	1993	Bowman	Pearson, 1992	ND	45+	15+	N	?	Pioneer Trails Regional Museum, Bowman, ND
19	1993–1996, 2006	BHI 4100 Duffy	Sacrison, 1993	SD	79	26%	Y	?	Black Hills Institute of Geological Research, Hill City, SD
20	1993	UWGM 181	Pallen, 1993	MT	20	7	Y	?	Geological Museum, University of Wisconsin, Madison, WI
21	1994–2001	RSM 2523.8 Scotty	Gebhardt, 1991	SK	120+	40+	Y	F	<i>T. rex</i> Discovery Centre, Eastend, SK
22	1994–1995	BHI 6219007	Garstka, 1994	ND	12	2	Y	?	Various, incl. Black Hills Inst. Geol. Res., Hill City, SD
23	1995	BHI 6239 Steven	Sacrison, 1995	SD	15	5	N	F?	Black Hills Inst. Geol. Res., Hill City, SD
24	1995	LDP 977-2 Pete	Patchus, 1995	WY	35+	12+	N	?	Univ. New Orleans, New Orleans, LA
25	1995–1996	Barnum	Theisen, 1995	WY	47	16	N	?	Private
26	1996–1998	BHI 4182 Fox	Fox, 1994	SD	29	10	Y	F?	Black Hills Inst. Geol. Res., Hill City, SD
27	1997–2004	MOR 980 Pecks Rex	Tremblay, 1997	MT	120+	40+	Y	M	Ft. Peck Paleo. Station, Ft. Peck, MT
28	1997	Tinker	Eatman, 1997	SD	73	24	Y	?	Private
29	1998–1999	Ollie	Pfister, 1998	MT	124	41	Y	?	Great Plains Paleo., Madison, WI
30	1998	Rex B	Alley, 1998	SD	24	8	Y	M	Black Hills Inst. Geol. Res., Hill City, SD
31	1999	Rex-C	Alley, 1999	SD	18	6	Y	F	Private, SD

Table 1.1 continued

Location	Year Excavated	Specimen No./ Name	Discoverer, Year	State/ Province	No. of Elements	% of Skeleton	Skull/ Parts	Sex*	Current Location
32	2000	BHI 6248 E. D. Cope	Derlinger, 1999	SD	30	10	Y	?	Black Hills Inst. Geol. Res., Hill City, SD
33	2000	Monty	Landowner, 1999	WY	53	18	Y	?	Babiarz Inst. Paleon. Studies, Mesa, AZ
34	2000–2003	MOR 1125 B-rex	Harmon, 2000	MT	111	37	Y	F	Museum of the Rockies, Bozeman, MT
35	2000–2001	MOR 1126 C-rex	Horner, 2000	MT	26	9	Y	?	Museum of the Rockies, Bozeman, MT
36	2001	UCRC PV1	Zerbst, before 1950	WY	60+	20+	N	?	University of Chicago, Chicago, IL
37	2001	UMNH 110000	Difley and Saharatian, 2001	UT	26	9	Y	?	Utah Museum of Natural History, Salt Lake City, UT
38	2001–2002	TCM 2001.90.1 Bucky	Derflinger, 1998	SD	101	34	N	F	The Children's Museum, Indianapolis, IN
39	2001	MOR 1128 G-rex	Wilson, 2001	MT	23	7	N	F	Museum of the Rockies, Bozeman, MT
40	2001	MOR 1152 F-rex	Stewart, 2001	MT	25?	8?	N	?	Museum of the Rockies, Bozeman, MT
41	2001–2002	Otto	Pfister, 2001	MT	32	11	N	?	Great Plains Paleontology, Madison, WI
42	2002–2003	MOR/USNM N-rex	Myrhvold, 2001	MT	40	13	Y	?	National Museum of Natural History, Washington, DC
43	2002–2004	BHI 6230 Wyrex	Wells and Wyrick, 2002	MT	114	38	Y	M	Black Hills Institute of Geological Research, Hill City, SD
44	2003–2005	LACM 7509/10167 Thomas	Curry, 2003	MT	110+	37+	Y	?	Natural History Museum of Los Angeles County, LA, CA
45	2004–2005	Wayne	Olson, 2004	ND	24	8	N	?	Private, Fargo, ND
	2005	Ivan	Olson, 2005	SD	116	39	N	?	Private, Fargo, ND

Note—See text and Figure 1.1.

* Sex: M, gracile morph; F, robust morph. See P. Larson (this volume).

The years 1900 through 1909 marked the dawn of our understanding of *Tyrannosaurus rex*. This decade includes the initial discovery and description of *Tyrannosaurus rex* Osborn 1905. Four incomplete skeletons of *T. rex* were unearthed during this time, and each one would contribute tremendously to the knowledge of this magnificent dinosaur (Osborn 1905, 1906, 1912, 1916). Nearly 60 years would pass before any other skeletons were collected, and it would be nearly 80 more years before ideas of how they lived, acted, and walked would change.

BMNH R7994

(Originally AMNH 5866)

(*Holotype of *Dynamosaurus imperiosus* Osborn 1905*)

DISCOVERED: The year 1900, Barnum Brown, a professional collector employed by AMNH.

LOCATION: Seven Mile Creek, Weston County, WY (Fig. 1.1, site 1).

FORMATION: Lance Formation.

EXCAVATED: American Museum expedition under Barnum Brown, 1900.

REPOSITORY: Natural History Museum, London, England, UK.

ACQUISITION: Purchased from the American Museum of Natural History, 1960.

DESCRIBED: Osborn (1905, 1906); Newman (1970); Carpenter (1990); Glut (1997).

SKELETAL REMAINS: The skull consists of both palatines and both dentaries. The postcranial skeleton has all 10 cervical vertebrae, plus 9 left and 4 right cervical ribs. The first 5 dorsal and the 5 sacral vertebrae are also present, along with the right ilium, the left ischium, and the right femur.

COMPLETENESS: Forty bones, or 13% of a skeleton by bone count.

ON DISPLAY? Yes, according to Phillip Manning (personal communication 2005); some parts, the dentary, and maybe another bone or two, are displayed at the Natural History Museum, London, England, UK.

COMMENTS: This *Tyrannosaurus rex* specimen had the first articulated neck with cervical ribs. It was discovered with numerous scutes of what is now known to be from an *Ankylosaurus* (Carpenter 2004). The species was synonymized with *Tyrannosaurus rex* by Osborn (1906) in his second contribution on *Tyrannosaurus*.

CM 9380

(Originally AMNH 973)

(*Holotype of *Tyrannosaurus rex* Osborn 1905*)

DISCOVERED: The year 1902, Barnum Brown, a professional collector employed by AMNH.

LOCATION: From Quarry No. 1, near Jordan, Garfield County, MT (Osborn 1905) (Fig. 1.1, site 2).

FORMATION: Hell Creek Formation, 220 feet above the Bearpaw Shale.



Figure 1.2. *CMNH 9380, skeleton on display.*
Photo by Peter Larson.

EXCAVATED: American Museum expedition, under Barnum Brown, 1902–1905.

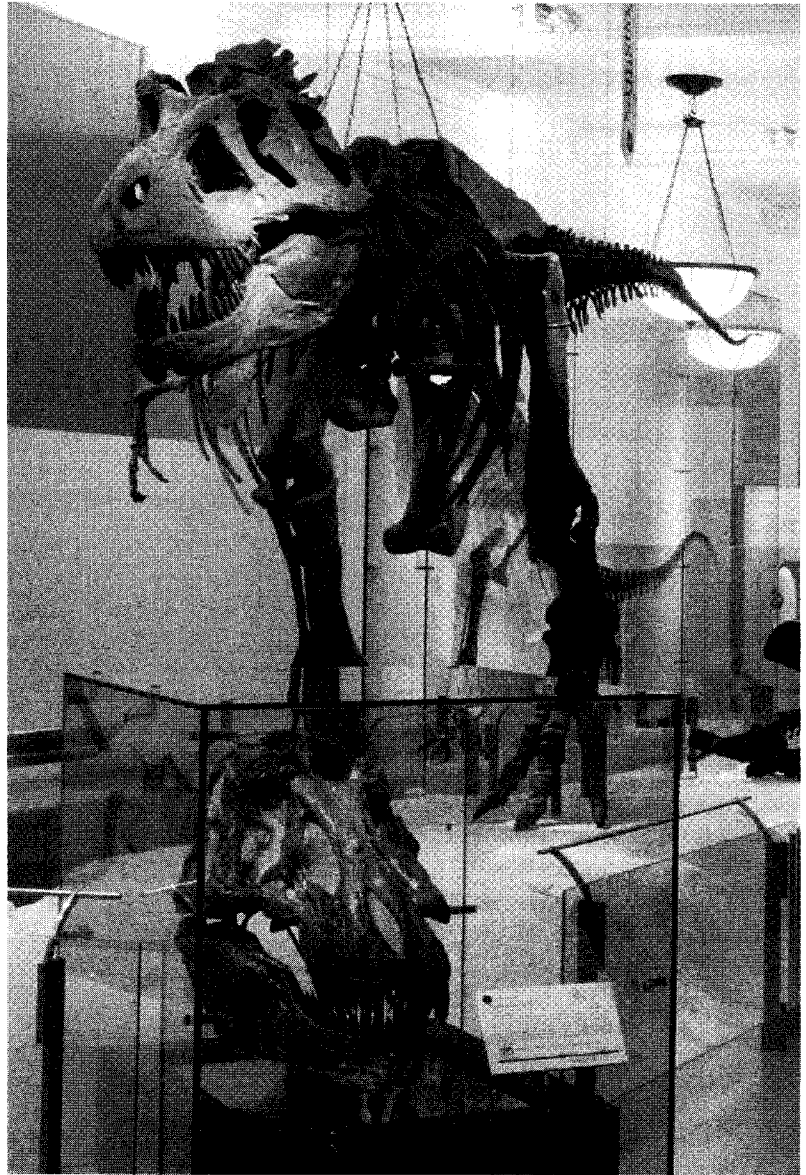
REPOSITORY: Carnegie Museum of Natural History, Pittsburg, PA.

ACQUISITION: Purchased from the American Museum of Natural History, 1941.

DESCRIBED: Osborn (1905, 1906, 1912, 1916); Carpenter (1990); Glut (1997).

SKELETAL REMAINS: The partial skeleton consists of the right maxilla, both lacrimals, left squamosal and ectopterygoid, both dentaries, and the left surangular. It also has 1 cervical, 7 dorsals, and 5 sacral vertebrae; 3 gastralia; right scapula and left humerus; both ilia, pubes, and ischia; the left femur and part of the right tibia; and 3 metatarsals (McIntosh 1981).

Figure 1.3. AMNH 5027, skeleton on display. Photo courtesy AMNH library.



COMPLETENESS: Thirty-four bones, or 11% of a skeleton by bone count.
ON DISPLAY? Was on display at the Carnegie Museum of Natural History, Pittsburg, PA, since the early 1940s. In 2005, the skeleton was dismantled, but it is scheduled to be freshly restored, remounted, and back on display sometime late 2007.

COMMENTS: The American Museum of Natural History sold the skeleton soon after the beginning of World War II. It has often been stated that it was necessary to ensure that a *Tyrannosaurus rex* would survive in the event of a bombing. Because the skeletal pose had not been redone since it went on display in the 1940s, the Carnegie Museum of Natural History is now in the process of conserving and remounting the original skeleton.

CM 1400

DISCOVERED: The year 1902, Olaf Peterson, a professional collector employed by Carnegie Museum.

LOCATION: Snyder Creek, Niobrara County, WY (Fig. 1.1, site 3).

FORMATION: Lance Formation.

EXCAVATED: Olaf Peterson and Carnegie Museum expedition, 1902.

REPOSITORY: Carnegie Museum of Natural History, Pittsburg, PA.

DESCRIBED: Partially described by McIntosh (1981).

SKELETAL REMAINS: McIntosh (1981) noted that CM 1400 contains the left maxilla, premaxilla, and pterygoid, the nasals, and the braincase. The postcranial skeleton consists of 2 cervical ribs, 1 dorsal vertebrae, 1 dorsal rib, 3 chevrons, the left ischium, and both pubes (incomplete).

COMPLETENESS: Twenty-nine bones, or 10% of a skeleton by bone count.
ON DISPLAY? No.

COMMENTS: Because the Carnegie was in possession of this large theropod specimen, it encouraged Osborn (1905) to publish on *Tyrannosaurus rex* earlier than he originally intended (<http://paleo.amnh.org/projects/t-rex/index.html>).

AMNH 5027

DISCOVERED: The year 1908, Barnum Brown, a professional collector employed by AMNH.

LOCATION: Near Dry Creek, McCone County, MT (Fig. 1.1, site 4).

FORMATION: Hell Creek Formation, 220 feet above the Bearpaw Shale.

EXCAVATED: American Museum field crew under Barnum Brown, 1908.

REPOSITORY: American Museum of Natural History, New York.

DESCRIBED: Osborn (1912, 1916).

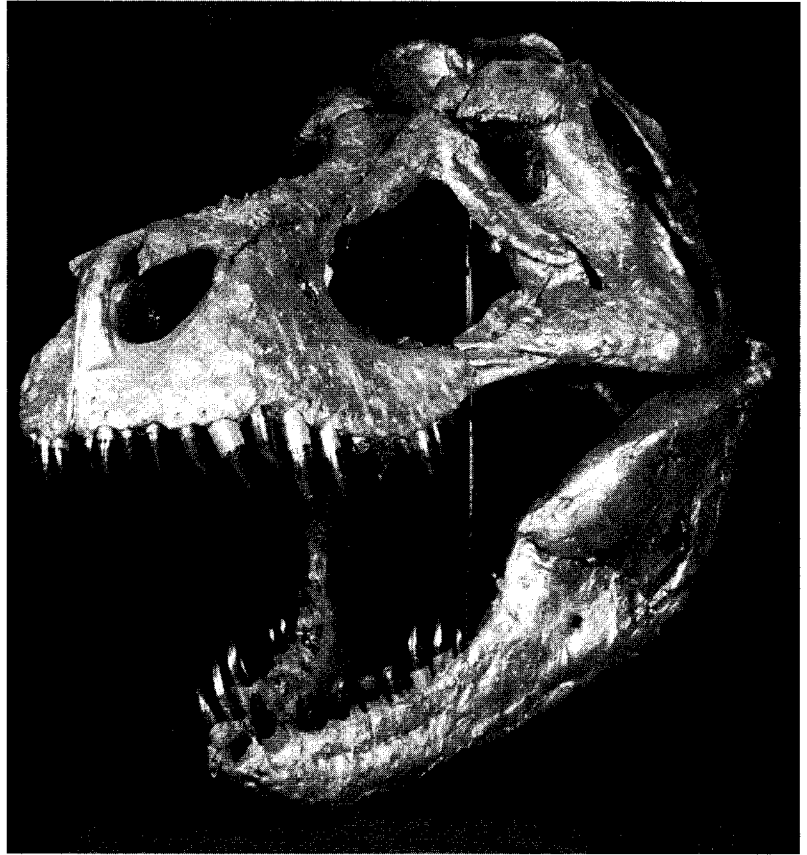
SKELETAL REMAINS: The specimen boasts the first complete skull, all of the cervical, dorsal, and sacral vertebrae, plus 18 caudal vertebrae and 7 chevrons; 9 cervical ribs from the right side; 20 dorsal ribs; both ilia, ischia, and pubes.

COMPLETENESS: A total of 143 bones, or 48%, of a skeleton by bone count.

ON DISPLAY? Yes, at the American Museum of Natural History, New York.

COMMENTS: This specimen of *Tyrannosaurus rex* was the classic one, the best *T. rex* skeleton on view anywhere until Sue and Stan were prepared in 2000 and 1995, respectively. The skull and much of the skeleton were articulated, but the skeleton lacked legs, feet, forelimbs, and the distal end of the tail. With 143 bones, this was the most complete *T. rex* skeleton until 1990 with the excavation of MOR 555 (146 bones) and a *T. rex* named Sue (219 bones). In 1996, the skeleton, which had been mounted in an upright position, was remounted into a more natural pose. There are casts of the skull and of the skeleton in museum collections throughout the world.

Figure 1.4. MOR 008, cast of skull. Photo by Ed Gerken.



1910–1959

Wars, rumors of wars, and the Great Depression kept many paleontologists out of the field and in the lab from the 1910s through the 1950s. Although there was only some dinosaur collecting from Upper Cretaceous formations undertaken during this period in the United States, there was substantial collecting in Canada. Some paleontologists, such as the Sternberg family and Barnum Brown, did extensive collecting in Alberta, helping to build the collections and displays in the major museums of Canada, Europe, and the United States. It was also during this time that Roy Chapman Andrews discovered an entirely new Late Cretaceous dinosaur fauna in Mongolia, which would later include the Asian tyrannosaurid, *Tarbosaurus*.

1960–1979

Beginning in the mid 1960s, new dinosaur finds once again began to lure more people into the field, and many amateurs would make important discoveries. New discoveries in Montana would begin to establish the Museum of the Rockies and Los Angeles County Museum as major repositories for dinosaurs. For the first time, non-East Coast museums would possess original specimens of the tyrant-lizard king.

Discoveries of *Deinonychus* and the resultant revolutionary concepts about dinosaurs by John Ostrom (Yale University) would help to change the way we looked at dinosaurs. Many modern researchers would use Ostrom's

brilliant research as a springboard to present *Tyrannosaurus* and other dinosaurs as active, warm-blooded, birdlike animals instead of cold-blooded, lizardlike creatures (e.g., Bakker 1986; Paul this volume).

MOR 008

DISCOVERED: In 1967, by Dr. William MacMannis, an archeologist from Montana State University (Larson and Donnan 2002).

LOCATION: Garfield County, MT (Fig. 1.1, site 5).

FORMATION: Hell Creek Formation.

EXCAVATED: A team from the Museum of the Rockies, 1967.

REPOSITORY: Museum of the Rockies, Bozeman, MT.

DESCRIBED: Partial description in Molnar (1991).

SKELETAL REMAINS: The skull is missing only the left premaxilla, the right palatine, the right epipterygoid, and the vomer. The lower jaw is missing the splenials, the coronoids, the right dentary, and the left prearticular. An atlas is also present.

COMPLETENESS: Forty-six bones, or 15% of a skeleton by bone count.

ON DISPLAY? A cast of the skull is on display at the Black Hills Museum of Natural History, Hill City, SD.

COMMENTS: The specimen consists of only an articulated skull and the atlas of a very large (Sue size), robust adult. It was on display at the Museum of the Rockies until 1990, when it was moved to the collections. Portions of this skull were molded and cast to supplement the missing portions of MOR 555 (a gracile *Tyrannosaurus rex*).

LACM 23844

DISCOVERED: The year 1966, Harley Garbani, plumber and amateur paleontologist (Dingus 2004).

LOCATION: L. D. Engdahl Ranch, Garfield County, MT (Glut 2002) (Fig. 1.1, site 6).

FORMATION: Hell Creek Formation.

EXCAVATED: J. R. McDonald and LACM field crew, 1967–1969 (Glut 2002).

REPOSITORY: Natural History Museum of Los Angeles County, Los Angeles, CA.

DESCRIBED: Partial description of the skull in Molnar (1991); see also Molnar (this volume).

SKELETAL REMAINS: The skull consists of the right premaxilla, maxilla, postorbital, squamosal, and pterygoid; both jugals, both lacrimals, the left quadrate and quadratojugal; nasals; frontals and the occipital; both surangulars, dentaries, articulars, and angulars; the left splenial; and prearticular. The postcranial skeleton consists of 2 cervical, 7 dorsal, and 4 caudal vertebrae; 5 ribs; 10 chevrons; the right scapula, femur, and astragalus; and both ischia, left tibia, 4 metatarsals, and 10 phalanges. Many of the bones are incomplete (Glut 2002).

COMPLETENESS: Seventy-four bones, or 25% of a skeleton by bone count.



Figure 1.5. LACM 23844, skull. Photo by Dick Meier, courtesy Natural History Museum of Los Angeles County.

ON DISPLAY? Yes, at the Natural History Museum of Los Angeles County, Los Angeles, CA.

COMMENTS: The skull and partial skeleton were disarticulated and provided the first detail for many of the bones (Molnar 1991). The specimen was excavated over the span of several field seasons. The rancher assisted by bulldozing the overburden away (Dingus 2004). There are several casts of this skull on display throughout the world.

LACM 23845

(Holotype of *Albertosaurus megragracilis* Paul 1988 and of *Dinotyrannus megragracilis* Olshevsky et al. 1995)

DISCOVERED: The year 1969, Harley Garbani, plumber and amateur paleontologist (Dingus 2004).

LOCATION: L. D. Engdahl Ranch, Garfield County, MT (Glut 2002) (Fig. 1.1, site 7).

FORMATION: Hell Creek Formation.

EXCAVATED: Harley Garbani and the LACM field crew, 1967 (Dingus 2004).

REPOSITORY: Natural History Museum of Los Angeles County, Los Angeles, CA.

DESCRIBED: Molnar (1980); Paul (1988); Olshevsky et al. (1995); Larson and Donnan (2002); Carr and Williamson (2004).

SKELETAL REMAINS: The skull consists of the right maxilla, right lacrimal, frontals, nasals, parietals, both dentaries, right coronoid, and right surangular. The postcranial skeleton has the right scapula, coracoid, and ulna; both ischia; the right femur, tibia, and astragalus; a nearly complete right foot (missing metatarsals I and IV and the phalanges from the first toe); and there are also 2 phalanges from the left foot (R. Farrar, personal communication 2005).

COMPLETENESS: Thirty-seven bones, or 12% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: This specimen is a juvenile *Tyrannosaurus rex* (P. Larson, personal communication 2005; Carr and Williamson 2004). It was discovered about 2 feet above LACM 23844, in scrap piles that were created while bulldozing the overburden away from the lower *T. rex*. Because of bulldozing, much of the skeleton was fragmentary (Dingus 2004).

The 1980s

Several new and important skeletons were found during this decade. The first *Tyrannosaurus* skeletons from South Dakota, New Mexico, and Alberta increased the known range of *T. rex* by hundreds of miles in all directions. (*Manospondylus gigas* Cope, 1892, was collected from South Dakota, but that specimen consisted of only 2 cervical vertebrae.) Toward the end of this decade, one of the Alberta *T. rex* skeletons would become the first original *T. rex* skeletons to tour the world.

SDSM 12047

(Mud Butte *T. rex*)

DISCOVERED: The year 1980, Jennings Floden, rancher and amateur fossil collector (Larson and Donnan 2002).

LOCATION: Jennings Floden Ranch, near Zeona, Butte County, SD (Fig. 1.1, site 8).

FORMATION: Hell Creek Formation.

EXCAVATED: Phil Bjork, Jennings Floden, and neighbors 1981; Floden and neighbors 1983.

REPOSITORY: Museum of Geology, South Dakota School of Mines and Technology, Rapid City.

DESCRIBED: Partial description by Bjork (1982); Carpenter (1990).

SKELETAL REMAINS: Nearly complete skull, missing only the premaxillae. The lower jaw has both dentaries, the right angular, and the right coronoid. The postcranial skeleton includes parts of 3 ribs and



Figure 1.6. SDSM 12047, skull on display as Museum of Geology. Photo by Peter Larson.

has a complete section of tail from the 15th to the 34th caudal (including chevrons).

COMPLETENESS: Eighty-one bones, or 27% of a skeleton by bone count.
ON DISPLAY? Yes, the skull is on display in the Museum of Geology, Rapid City, SD.

COMMENTS: After the initial digging in 1981, the South Dakota School of Mines had found the skull, some vertebrae, and some ribs. Floden believed that more of the skeleton was still in the ground and recruited neighbors to reopen the dig. They uncovered the skull within a few days. Two years later, they discovered articulated tail vertebrae and the second lower jaw (Smith-Hill 1983). Associated with the skeleton were elements from a gar (*Lepisosteus*), 2 turtles (including a baenid), 2 crocodiles (*Branchychampsa* and *Leidyosuchus*), *Champsosaurus*, and the teeth from the theropod *Nanotyrannus* (Bjork 1982). The skull and skeleton are currently being prepared, and a description of the specimen is also planned.

RTMP.81.12.1
(Huxley T. rex)

DISCOVERED: The year 1946, Charles M. Sternberg, a professional paleontologist.

LOCATION: Near the town of Huxley, along the Red Deer River, Alberta (Fig. 1.1, site 9).

FORMATION: Scollard Formation.

EXCAVATED: Phil Currie with the Provincial Museum of Alberta, Edmonton, in 1981.

REPOSITORY: Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta.

ACQUISITION: Transferred from the Provincial Museum of Alberta in Edmonton.

DESCRIBED: Partial description by Currie (1993).

SKELETAL REMAINS: From the skull, only a right postorbital exists. The postcranial skeleton consists of 8 anterior caudals, 5 anterior chevrons, part of the sacrum, 7 anterior dorsal vertebrae, 1 rib, both ilia, left ischium, left pubis, both femora, both tibiae, both fibulae, right astragalus and calcaneum, the 2 right tarsals, 1 metatarsal, and 7 pedal phalanges from the right foot (A. Neuman, written communication February 1994).

COMPLETENESS: Forty-nine bones, or 16% of a skeleton by bone count.

ON DISPLAY? Yes, at the Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta.

COMMENTS: Sternberg found the specimen halfway down a steep cut-bank on the Red Deer River in Alberta. He believed that the specimen was mostly gone, so he did not attempt to excavate it. Currie, while investigating some of Sternberg's earlier finds, determined that it would be worth excavating to see whether there was more of the skeleton (Currie 1993). At 52° north latitude, this is the northernmost *Tyrannosaurus rex*.

Figure 1.7. *Huxley-rex*, RTMP 81.6.1, mixture of real bones and cast, with original pelvis in foreground. Photo by Peter Larson.





Figure 1.8. *Black Beauty*
RTMP 81.6.1, cast skull.
Photo by Ed Gerken.

RTMP 81.6.1
(*Black Beauty*; *Cowley T. rex*)

DISCOVERED: The year 1980, Jeff Baker, a high school student (Currie 1993).

LOCATION: Near the confluence of the Crowsnest and Willow Rivers (Crowsnest Pass) in southwestern Alberta (Fig. 1.1, site 10).

FORMATION: Willow Creek Formation.

EXCAVATED: Phil Currie with the Provincial Museum of Alberta, Edmonton, in 1981.

REPOSITORY: Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta.

ACQUISITION: Transferred from the Provincial Museum of Alberta in Edmonton.

DESCRIBED: Partial description by Carpenter (1990) and Currie (1993).

SKELETAL REMAINS: According to Currie (1993), the specimen consists of a nearly complete skull but only partial lower jaws (it has both dentaries, the left splenial, and the right angular). It also has 5 cervical and 7 dorsal vertebrae; 2 cervical and 8 dorsal ribs; a right humerus; a manus phalange; both femora; both tibiae; the left fibula,

calcaneum, and astragalus; 4 metatarsals; and 5 pes phalanges (A. Neuman, written communication February 1994).

COMPLETENESS: Eighty-five bones, or 28% of a skeleton by bone count.
ON DISPLAY? Yes, the skull is on display at the Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta. The skeleton has been part of an international traveling exhibit.

COMMENTS: Black Beauty got its name from its beautifully colored black bones. It was discovered when Jeff Baker took a break from fishing and went walking in the hills. This would be the first *T. rex* to receive a nickname, but it would not be the last. It has an articulated skull showing minor distortion. It became the first *Tyrannosaurus rex* skeleton to go on tour, spending considerable time traveling across Canada and Japan. This specimen is the westernmost *Tyrannosaurus rex*, found at 114° west longitude.

MOR 009

(*Hager rex*)

DISCOVERED: The year 1981, Mick Hager, former director of the Museum of the Rockies (Larson and Donnan 2002).

LOCATION: Garfield County, MT (Fig. 1.1, site 11).

FORMATION: Hell Creek Formation.

EXCAVATED: Museum of the Rockies field crew, 1981.

REPOSITORY: Museum of the Rockies, Bozeman, MT.

SKELETAL REMAINS: The skeleton consists of the right dentary, parts of 4 ribs, 22 caudal vertebrae, and 7 chevrons; the right ilia, both ischia, and both pubes; both femora (left incomplete), tibiae (incomplete), the right fibula and astragalus; and 4 metatarsals and 7 pes phalanges (P. Larson, personal communication 2005).

COMPLETENESS: Fifty-eight bones, or 19% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: There is a good possibility that more of the specimen remains uncollected (Mick Hager to P. Larson, personal communication 2005).

NMMNH P-1013-1

DISCOVERED: The year 1982, D. Staton and J. LaPoint, amateurs.

LOCATION: The east side of Elephant Butte Reservoir, near Truth or Consequences, NM (Fig. 1.1, site 12).

FORMATION: Hall Lake Member of the McRae Formation.

EXCAVATED: Gillette and staff from the New Mexico Museum of Natural History 1983; Tom Williamson, September 2003.

REPOSITORY: New Mexico Museum of Natural History, Albuquerque, NM.

DESCRIBED: Partial description by Gillette et al. (1986); Carr and Williamson (2000); Carr and Williamson (2004); and Williamson and Carr (2005).

SKELETAL REMAINS: The specimen consists of a left dentary, an incomplete palatine (originally identified as an articular), a right prearticular, some incomplete teeth, and a nearly complete chevron (Gillette et al. 1986); a right squamosal and postorbital; an articular, splenial, and at least 2 chevrons; and some tooth fragments (Tom Williamson, personal communication 2005).

COMPLETENESS: Ten bones, or 3% of a skeleton by bone count.

ON DISPLAY? Yes, the lower jaw is on display at the New Mexico Museum of Natural History, Albuquerque, NM.

COMMENTS: This *Tyrannosaurus rex* extended the known range in the northern Great Plains south 1300 km nearly to the Mexican border. The specimen was found in an area that is normally submerged beneath the Elephant Butte Reservoir. It was discovered while D. Staton and J. LaPoint were taking a break from a sailboat outing (Gillette et al. 1986). The low level of the reservoir in 2003 gave Williamson the opportunity to return to the site and collect more bones some 20 years after its initial excavation. This specimen is the southernmost *T. rex* at 33° north latitude.

The 1990s

The 1990s became the decade for the most incredible *Tyrannosaurus rex* discoveries, with nearly twice as many specimens found and excavated than in all of the years before. With the 3 most complete *T. rex* skeletons excavated in the first 2 years, who could have expected that there would be so many more specimens found? And who could have anticipated all of the publicity and controversies that some of these dinosaurs would generate (e.g., Davies 1997; Donnan and Counter 2000; Glut 2000, 2002; Fiffer 2000; Larson and Donnan 2002)?

MOR 555

(*Wankel rex*; *Devil rex*)

DISCOVERED: The year 1988, Cathy Wankel, novice.

LOCATION: From the south side of Fort Peck Lake, McCone County, MT (Fig. 1.1, site 13).

FORMATION: Hell Creek Formation.

EXCAVATED: Pat Leiggi and Museum of the Rockies field crew, 1990.

REPOSITORY: Museum of the Rockies, Bozeman, MT.

DESCRIBED: Partial description by Horner and Lessem (1993); forelimb described by Carpenter and Smith (2001).

SKELETAL REMAINS: The skull consists of a complete braincase, right dentary, left maxilla, nasals, vomer, both squamosals, both postorbitals, both quadrates and quadratojugals, both jugals, both lacrimals, both pterygoids, and both epipterygoids. The skeleton consists of both scapulae and coracoids, the left arm and most of the left hand (missing only 3 bones), complete legs and left foot (minus 1 phalange), plus the right II, III, and V metatarsals. Also collected were a complete pelvic girdle (including the sacrum), nearly all of the dorsal and cervical ver-

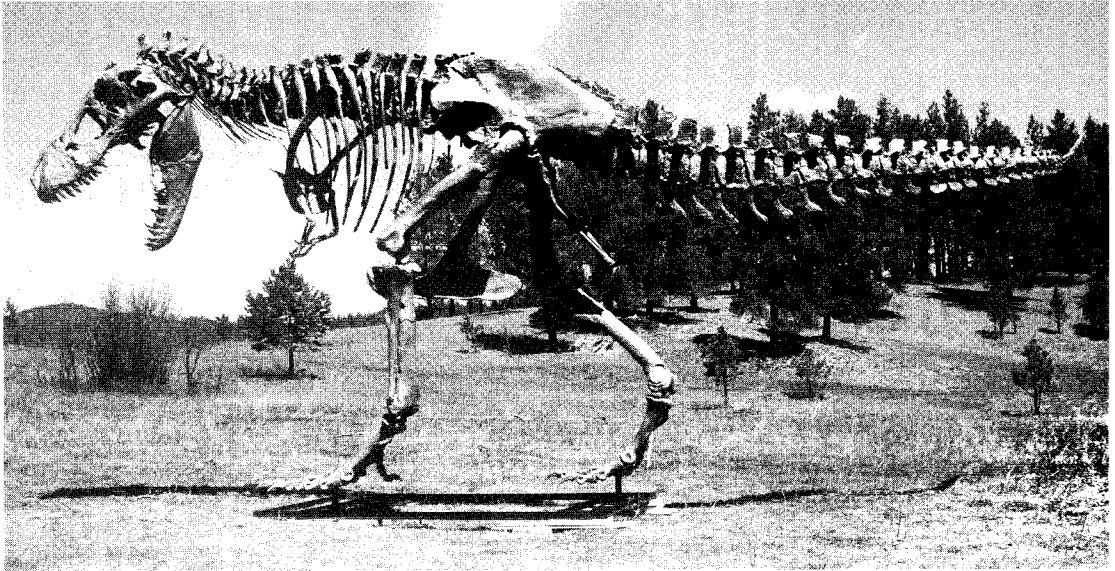


Figure 1.9. MOR 555, cast of skeleton. Photo by Ed Gerken.

tebrae (missing only the atlas), the first 14 caudal vertebrae plus 1 additional, 6 chevrons, 4 dorsal ribs, and 5 cervical ribs.

COMPLETENESS: Fourteen bones, or 49% of a skeleton by bone count.

ON DISPLAY? Yes, a portion of the skeleton went on display in 2005 at the Museum of the Rockies, Bozeman, MT.

COMMENTS: This dinosaur was discovered while Cathy Wankel was hiking on a butte in the Hell Creek Formation on the south side of Fort Peck Lake while the rest of her family was fishing (Horner and Lessem 1993). Some resin casts of this skeleton may be seen at the Dallas Museum of Natural History, Houston Museum of Nature and Science, University of California Museum of Paleontology, Museum of the Rockies, and Black Hills Museum of Natural History, among many others. A bronze casting of this dinosaur may also be viewed outside the Museum of the Rockies, Bozeman, MT.

FMNH PR2081

(*Sue*, formerly BHI 2033)

DISCOVERED: The year 1990, Susan Hendrickson, amateur archeologist and paleontologist.

LOCATION: Maurice Williams Ranch, north of the town of Faith, Ziebach County, SD (Fig. 1.1, site 14).

FORMATION: Hell Creek Formation, about 15 feet above the contact with the Fox Hills Formation (P. Larson, personal communication 2006).

EXCAVATED: Black Hills Institute field crew from August 14 to September 1, 1990.

REPOSITORY: Field Museum of Natural History, Chicago, IL.

ACQUISITION: Sotheby's Auction, 1997.

DESCRIBED: A full description of the skull and skeleton was published by Brochu (2003); it was also partially described by Larson (1994, 2000);

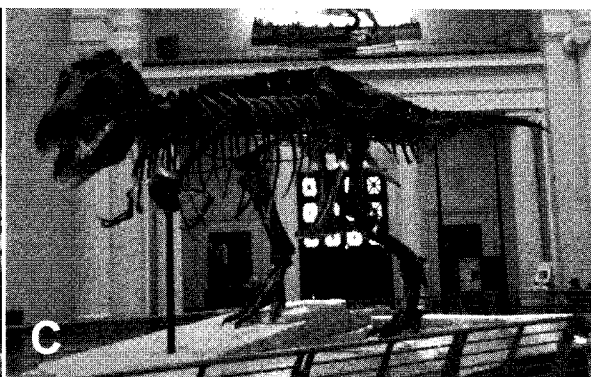


Figure 1.10. *Sue* FMNH PR2081, during excavation (A); skull during preparation with Terry Wentz (B); on display at the Field Museum (C). Photos: (A, C) Peter Larson; (B) Ed Gerken.

Donnan and Counter (2000); Carpenter and Smith (2001); Larson and Donnan (2002); and Larson and Rigby (2005).

WEB SITE: <http://www.fieldmuseum.org/sue/> and http://www.bhigr.com/pages/info/info_sue.htm.

SKELETAL REMAINS: A complete skull, 61 vertebrae (9 cervical, 11 dorsal, 5 sacral, 36 caudal), 25 chevrons, 13 cervical ribs, both proatlases, 19 dorsal ribs. It also has both scapulae and coracoids, the furcula, the right arm and most of the right hand, a complete pelvic girdle, both legs, both calcanea and astragali, a tarsal, a nearly complete right foot (missing 2 bones), and a single pes phalange from the left foot (Brochu 2003).

COMPLETENESS: A total of 219 bones, or 73% of a skeleton by bone count.

ON DISPLAY? Yes, in 2000, Sue went on display at the Field Museum of Natural History, Chicago, IL.

COMMENTS: The dinosaur was named in honor of its discoverer, Sue Hendrickson. The skeleton was found along with the remains of 3 other theropods (a partial tibia and fibula from a *Tyrannosaurus rex* subadult, a frontal from a juvenile *T. rex*, and a lacrimal from *Nanotyrannus*), several skeletal elements of *Thescelosaurus*, stomach contents of *Edmontosaurus*, a turtle skull and scutes, crocodile teeth and parts, fish teeth and vertebrae, a varanid, abundant plants, and mollusks.

No other dinosaur has provoked so much attention as a dinosaur named Sue. Several groups, including Black Hills Institute and the

U.S. federal government, laid claim to the bones (see Davies 1997; Donnan and Counter 2000; Larson and Donnan 2002; Fiffer 2000). The Field Museum of Natural History in Chicago, aided by Walt Disney World, Ronald McDonald House, and other sources, acquired Sue from Sotheby's Auction in 1997. The rights to the Sue trademarked name were given to the Field Museum by BHI in 1999. On May 17, 2000, the Field Museum unveiled the prepared and mounted skeleton of Sue to the public. The Field Museum also developed 2 traveling exhibits around casts of the Sue skeleton.

BHI 2033 (Sue) and several other specimens were used by Stephan Pickering in an unpublished manuscript (Glut 1997) to establish a second species of *Tyrannosaurus*. Although there may be reasons to erect a second *Tyrannosaurus* species from the Late Maastrichtian of North American (Larson and Donnan 2002; Bakker, personal communication; Paul 1988; Larson this volume), both Sue and Stan compare favorably with the type of *T. rex*. As a side note, Pickering came to the BHI to study some of the specimens used to justify the new species.

BHI 3033

(Stan)

DISCOVERED: The year 1987, Stan Sacrison, amateur paleontologist.

LOCATION: The Niemi Ranch, near Buffalo, Harding County, SD (Fig. 1.1, site 15).

FORMATION: Hell Creek Formation, 16 m beneath the K-T boundary (K. Johnson, written communication 2000).

EXCAVATED: Black Hills Institute field crew from April 14 to May 7, 1992; a few more skeletal elements were collected in 1993 and 2003.

REPOSITORY: Black Hills Institute of Geological Research, Hill City, SD.

DESCRIBED: Partially described in Donnan and Counter (1999); Larson (2000); Larson and Donnan (2002); Hurum and Sabath (2003); P. L. Larson (this volume); Larsson (this volume); Stevens et al. (this volume).

WEB SITE: http://www.bhigr.com/pages/info/info_stan.htm.

SKELETAL REMAINS: The skeletal elements collected with Stan include: a nearly complete skull (missing the right articular and the left coronoid); 59 vertebrae (9 cervical, 14 dorsal, 5 sacral, 31 caudal); 24 chevrons; 14 cervical ribs (including the proatlas); 12 dorsal ribs; a nearly complete pelvic girdle (the distal ends of both ischia and pubes were weathered away); left femora; both tibiae; the left fibula; both calcanea and astragali; 3 left metatarsals; and 11 pes phalanges.

COMPLETENESS: A total of 190 bones, or 63% of a skeleton by bone count.

ON DISPLAY? Yes, since 1996 at the Black Hills Institute of Geological Research, Hill City, SD.

COMMENTS: Stan was the first of many *Tyrannosaurus rex* skeletons found in Harding County, SD. It was named in honor of Stan Sacrison, its discoverer. Soon after Stan found this dinosaur, he became discouraged because he was told that this skeleton was just another

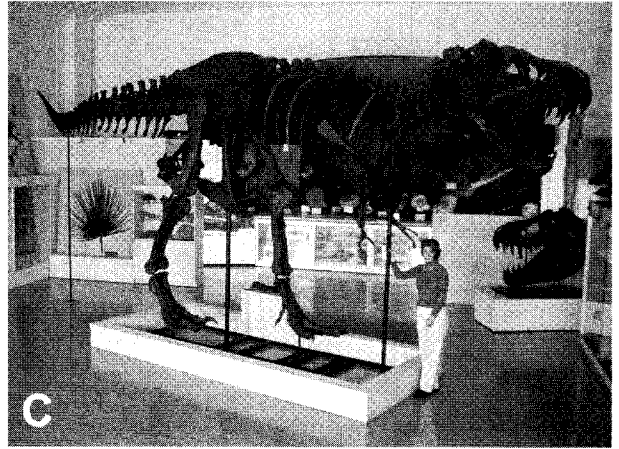
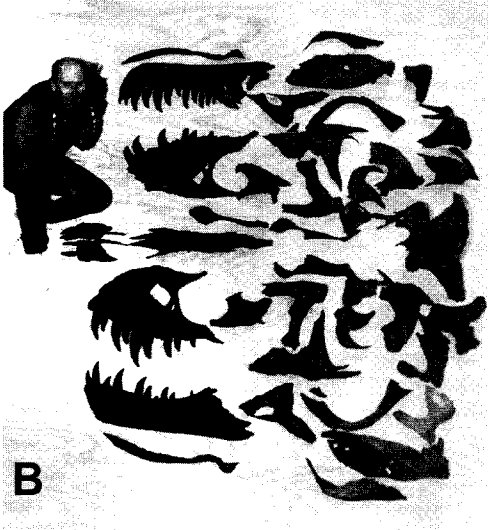
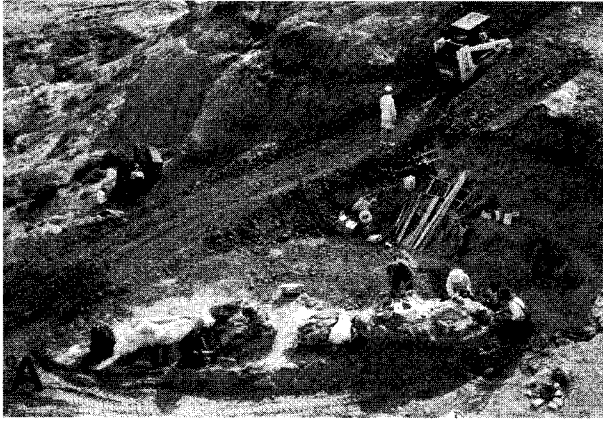


Figure 1.11. *Stan* BHI 3033, during excavation (A); disarticulated skull with Terry Wentz (B); on display at Black Hills Institute, with Brenda Larson (C). Photos: (A, B) Ed Gerken; (C) Larry Shaffer.

articulated *Triceratops*. The bones lay in the ground until 1992, when BHI became aware of the skeleton and began excavation. Stan was found with 2 non-*T. rex* bones: an *Edmontosaurus* vertebrae and an acid-etched *Triceratops* tibia with both ends missing, bitten (Larson and Donnan 2002), and innumerable well-preserved leaves (Johnson 1996).

Preparation of this skeleton was completed in May 1995, and Stan went on tour in Japan until June 1996 as part of the *T. rex* World Tour. Because Stan's skull was disarticulated and so well preserved, it provided much new information on the osteology and mechanics of tyrannosaurid skulls (Donnan and Counter 1999; Larson 2000; Larson and Donnan 2002; Hurum and Sabath 2003; P. Larson this volume; Larsson this volume).

More than 35 cast Stan skeletons and 50 Stan skulls are on display in public and private institutions worldwide, including: the Smithsonian Institute, Washington, DC; Oxford University, Oxford, England, UK; North American Museum of Ancient Life, Lehi, UT; Kenosha Public Museum, Kenosha, WI; and National Science Museum, Tokyo.

Samson

(*Z-rex*, Mr. Z, Mr. Zed)

DISCOVERED: The year 1987, Mike Zimmershied, landowner's son, amateur.

LOCATION: Donald Zimmershied Ranch, near the Jump-off, Harding County, SD (Fig. 1.1, site 16)

FORMATION: Hell Creek Formation.

EXCAVATED: Fred Nuss, Alan Deitrich, Steve and Stan Sacrison, 1992.

REPOSITORY: Private, Graham Lacey.

ACQUISITION: Purchased in 2004 from Fred Nuss and Alan Deitrich for an undisclosed amount.

DESCRIBED: Partially described in Glut (2002); Larson and Donnan (2002).

WEB SITE: <http://www.carnegiemnh.org/ditw/paleolab/samson/index.htm>.

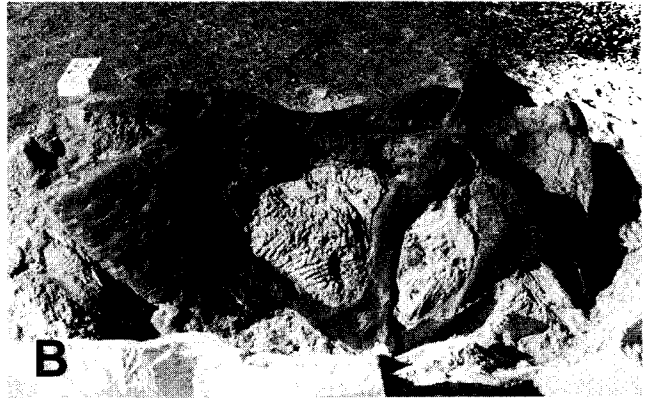
SKELETAL REMAINS: According to Dale Russell (personal communication 1997), the skeleton has a nearly complete skull, 9 cervical and 7 dorsal vertebrae, 2 cervical and 10 dorsal ribs, 17 caudals, at least 4 chevrons, both femora, left fibula, abundant tibia pieces, 3 metatarsals, and 10 pes phalanges.

COMPLETENESS: A total of 121 bones, or 40% of a skeleton by bone count.

ON DISPLAY? Yes, currently at the Carnegie Museum Paleo Lab while undergoing preparation.

COMMENTS: The landowners knew that this was a of a *Tyrannosaurus rex* skeleton as early as 1987. In 1992, professional collectors Fred Nuss and Alan Deitrich, from Kansas, contracted with the landowner and proceeded to excavate the skeleton. They named it "Z-rex" for the first letter of the landowner's last name. The skeleton and skull were

Figure 1.12. *Samson* (*Z-rex*); anterior view of skull block (A); side view of skull (B). Photos courtesy Dale Russell.



then transported to Kansas for storage. It was repeatedly offered for sale over the next dozen years. Z-rex became the first *T. rex* offered for sale over the Internet and was offered for sale in the Wall Street Journal on April 23, 1999 (Glut 2002).

The specimen was acquired by international businessman, Graham Lacey, who changed its name from Z-rex to Samson and transported to the Carnegie Museum in Pittsburgh, where it is currently undergoing preparation. Samson's preparation can be observed in the Carnegie Museum Paleo Lab. More information on Samson can be obtained from Glut (2002, p. 578).

DMNH 2827

DISCOVERED: The year 1992, Charlie Fickle and his dog, both amateurs.

LOCATION: A housing development, Littleton, CO (Fig. 1.1, site 17).

FORMATION: Lower part of the Denver Formation.

EXCAVATED: Collected by the Denver Museum of Nature & Science under the direction of Kenneth Carpenter, 1992.

REPOSITORY: Denver Museum of Nature & Science, Denver, CO.

DESCRIBED: Carpenter and Young (2002).

SKELETAL REMAINS: Carpenter and Young (2002) reported that the partial skeleton consisted of a left femur, ilium, scapula, and coracoid; right tibia, fibula, and astragalus; a distal caudal vertebrae, ribs, and 3 teeth.

COMPLETENESS: Twelve bones, or 4% of a skeleton by bone count.

ON DISPLAY? Yes, some of this specimen can be seen at the Denver Museum of Nature & Science.

COMMENTS: This *Tyrannosaurus rex* has the distinction of being the only dinosaur discovered by a dog (K. Johnson, personal communication 2005). It is also the only *T. rex* found to date in Colorado (although teeth were previously known) and the only *T. rex* with a street address (K. Carpenter, personal communication 2005). DMNH 2827 was scattered before burial and was also damaged by earth-moving equipment before discovery (Carpenter and Young 2002).

Bowman

DISCOVERED: November 1992, Dean Pearson, amateur.

LOCATION: Near Rhame, Bowman County, ND (Fig. 1.1, site 18).

FORMATION: Hell Creek Formation, 32 m below the K-T boundary (Dean Pearson, notes with specimen).

EXCAVATED: Pioneer Trails Regional Museum, volunteers, 1992–1994.

REPOSITORY: Pioneer Trails Regional Museum, Bowman, ND.

SKELETAL REMAINS: According to Dean Pearson (notes with specimen), there were 45 bones of the skeleton collected. They consisted of ribs, vertebrae, both pubes, the distal end of the scapula, and gastralia (Don Wilkening, personal communication 2005).

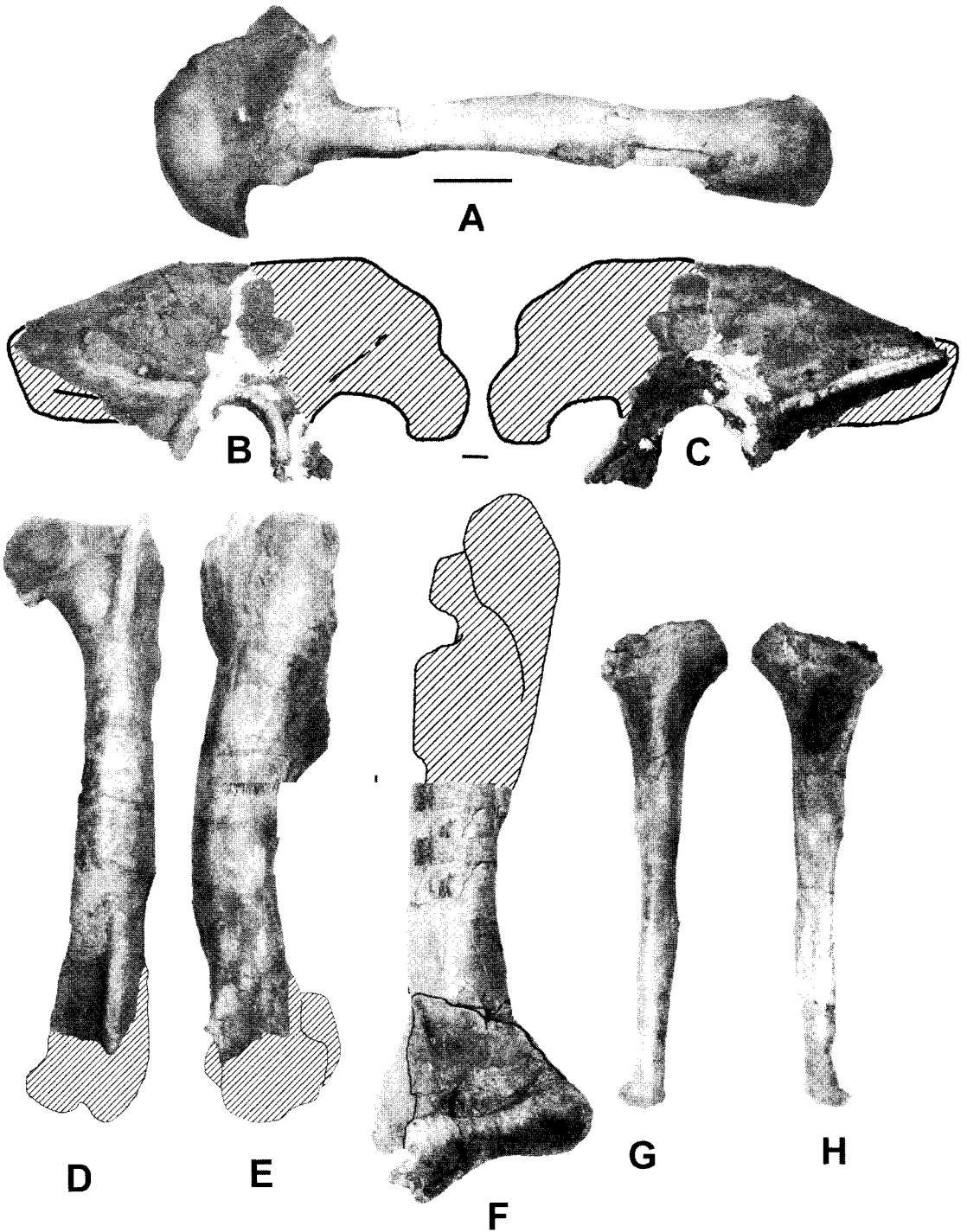


Figure 1.13. DMNH 2827, left scapula and coracoid (A); left ilium in medial (B) and lateral (C) views; left femur in anterior (D) and lateral (E) views; right tibia and astragalus in anterior view (F); right fibula in lateral (G) and medial (H) views.

COMPLETENESS: Less than 45 bones (because some are gastralia), or less than 15% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: The museum has never given the specimen a collection or an acquisition number. The bones are still in plaster jackets, and they are also encased in a hard concretion that makes preparation difficult. Because of that, it is not known when the specimen will be prepared (Don Wilkening, personal communication 2005).

BHI 4100

(Duffy)

DISCOVERED: The year 1993, Stan Sacrison, amateur paleontologist.

LOCATION: John, Betty, and David Niemi Ranch, near Buffalo, Harding County, SD, about a quarter mile from the Stan excavation site (Fig. 1, site 19).

FORMATION: Hell Creek Formation, estimated to be about 16 m beneath the K-T boundary (Johnson 1996).

EXCAVATED: Black Hills Institute field crew, summers of 1993, 1994, 1996, and 2006.

Figure 1.14. *Duffy, BHI 4100, during excavation.*
Photo by Ed Gerken.



REPOSITORY: Black Hills Institute of Geological Research, Hill City, SD.
DESCRIBED: Partially described by Counter (1996), Larson and Donnan (2002).

SKELTAL REMAINS: Most of the skull and a portion of the skeleton was recovered. The skull consists of: both maxillas, right premaxilla, nasals, both lacrimals, left postorbital, both quadrates, both jugals, left squamosal, both quadratojugals, left pterygoid, both palatines, left ectopterygoid, right epipterygoid, both dentaries, right surangular, right prearticular, the right splenial, right coronoid, a partial braincase, and 49 loose, rooted teeth. The skeleton has both scapulae and coracoids, 1 astragalus; the right ischium; 8 caudals; 13 dorsals and cervical vertebrae; 9 dorsal ribs; and 6 chevrons. About 50 loose teeth were found along with the specimen.

COMPLETENESS: Seventy-six bones, or 25% of a skeleton by bone count.

ON DISPLAY? Yes, some portions are on display at the Black Hills Institute of Geological Research, Hill City, SD, and a bronze cast of the left side of the skull is on the outside of their building. The skull bones are prepared, but most of the skeleton remains unprepared.

COMMENTS: Duffy was named for attorney Pat Duffy, who was the defense attorney for BHI in the Sue case (see Larson and Donnan 2004). The skull and partial skeleton of Duffy were disarticulated and scattered over a large area. This prompted Black Hills Institute to use a Bobcat to assist with the discovery of the bones. This ground-penetrating Bobcat was used to scrape thin layers of the quarry floor away during multiple passes, which led to the discovery of much of the specimen. The final dimensions of the quarry were approximately 55 feet by 70 feet. The Black Hills Institute originally excavated during 1993–1996, then returned in 2006 and removed the hills around the specimen. Within 3 days, they had excavated 3 additional skull bones and several other unidentifiable bones.

UWGM 181

DISCOVERED: Mike Pallett, University of Wisconsin geology student, 1993.

LOCATION: Near Ekalaka, Carter County, MT (Fig. 1.1, site 20).

FORMATION: Hell Creek Formation.

EXCAVATED: University of Wisconsin Field Crew, 1993.

REPOSITORY: University of Wisconsin, Geology Museum, Madison, WI.

SKELTAL REMAINS: A partial, fragmentary skull with 3 associated vertebrae. According to Richard Slaughter, director of the UW Museum of Geology, the following skull elements are represented: left dentary, right dentary, right surangular, splenial, right maxilla, left postorbital, right postorbital, right frontal (with attached prefrontal, parietal, and laterosphenoid), right jugal, right quadratojugal, right quadrate, and, tentatively, partial pterygoid, squamosal, and prearticular (not sided).

COMPLETENESS: Twenty bones, or 7% of a skeleton by bone count.

ON DISPLAY? No.

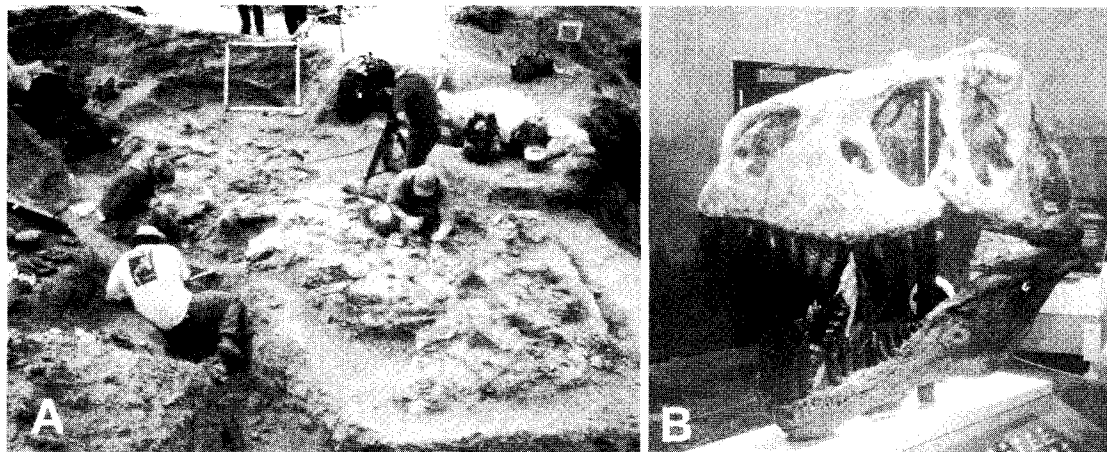


Figure 1.15. *Scotty*, RSM 2523.8., during excavation (A); skull on display at the RSM Fossil Research Station (B). Photos courtesy Royal Saskatchewan Museum.

COMMENTS: “This specimen is really broken up, with close to 100 small pieces that have not been identified to element yet” (R. Slaughter, written communication 2005).

RSM 2523.8
(*Scotty*)

DISCOVERED: The year 1991, Robert Gebhart, schoolteacher.

LOCATION: Near Eastend, southern Saskatchewan (Fig. 1.1, site 21).

FORMATION: Frenchman Formation.

EXCAVATED: Royal Saskatchewan Museum field crew 1994 through 2001.

REPOSITORY: Royal Saskatchewan Museum.

SKELETAL REMAINS: The skull is nearly complete. It is missing both palatines, the epipterygoids, the splenials, the coronoids, the left angular, and about a third of the teeth. Most of the skull bones are incomplete. The postcranial skeleton is less known because most of it is still unprepared. There are more than 40 cervical, dorsal, and caudal (but no sacral) vertebrae, 16 dorsal ribs (at least), 1 scapula, 1 manus phalange, and the right femur, tibia, and fibula, along with both ilia, ischia, and pubes. There is also at least 1 metatarsal and several pes phalanges (Phil Currie, personal communication 2005).

COMPLETENESS: About 120 + bones to date, or at least 40% of a skeleton by bone count.

ON DISPLAY? Yes, the skull is on display and several portions of the skeleton can be seen undergoing preparation at the *T. rex* Discovery Centre in Eastend, Saskatchewan.

COMMENTS: This skeleton was discovered by Robert Gebhart as he accompanied Tim Tokaryk and John Storer on a field trip for the Royal Saskatchewan Museum. The specimen was nicknamed *Scotty* after a bottle of spirits consumed in the field by the discoverers.

Preparation is underway at the *T. rex* Discovery Centre in Eastend, Saskatchewan (owned and operated by the Royal Saskatchewan

Museum). The skull and skeleton were disarticulated and spread out over a large area (Glut 2003). Scotty is a large adult *Tyrannosaurus rex* skeleton with a femur length of 1290 mm (P. Currie, personal communication 2005). There are still years of work ahead to finish preparation because of the hard encasing rock, so eventually more of the skeleton may be discovered.

BHI 6219

(007, Double-O-Seven)

DISCOVERED: The year 1994, Bill Garstka, professional collector.

LOCATION: Near Marmouth, Slope County, ND (Fig. 1.1, site 22).

FORMATION: Hell Creek Formation.

EXCAVATED: Collected by Warfield Fossils field crew (led by Rick Hebdon and Bill Garstka) in 1994 and 1995.

REPOSITORY: The skull bones were sold to a private collector in New York, the foot bones to another collector, and the remaining portions were eventually purchased by Black Hills Institute in 2005.

ACQUISITION: Through purchase.

SKELETAL REMAINS: The skull consists of both maxillae, both premaxillae, and parts of the dentary. The skeleton consisted of 1 vertebrae, 1 dorsal rib, 1 metatarsal, 1 pes phalange, the distal end of left humerus, and parts of a tibia and fibula (Rick Hebdon, personal communication 2005).

COMPLETENESS: Twelve bones, or 3% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: According to Rick Hebdon (personal communication 2005), most of the skeleton was found weathered out in an arroyo; the remaining portions were under a hard sandstone ledge. The field crew jackhammered on the sandstone ledge for 6 weeks in 1994 and came back in 1995 and dynamited the ledge. Not much of the skeleton was found, but the humerus and a large fragment of tooth indicate that it is probably a robust morphotype.

BHI 6249

(Steven)

DISCOVERED: The year 1995, Steve Sacrison, an amateur paleontologist.

LOCATION: John, Betty, and David Niemi Ranch, near Buffalo, Harding County, SD, about a quarter mile south of the Duffy excavation site (Fig. 1.1, site 23).

FORMATION: Hell Creek Formation, estimated to be 6 to 10 m beneath the K-T boundary (P. Larson, personal communication 2005).

EXCAVATED: Black Hills Institute field crew summer of 1995.

REPOSITORY: Black Hills Institute of Geological Research, Hill City, SD.

DESCRIBED: Partially described by Larson and Donnan (2002).

ACQUISITION: Collected by Black Hills Institute field crew.

SKELETAL REMAINS: Skeletal elements collected with Steven are a nearly

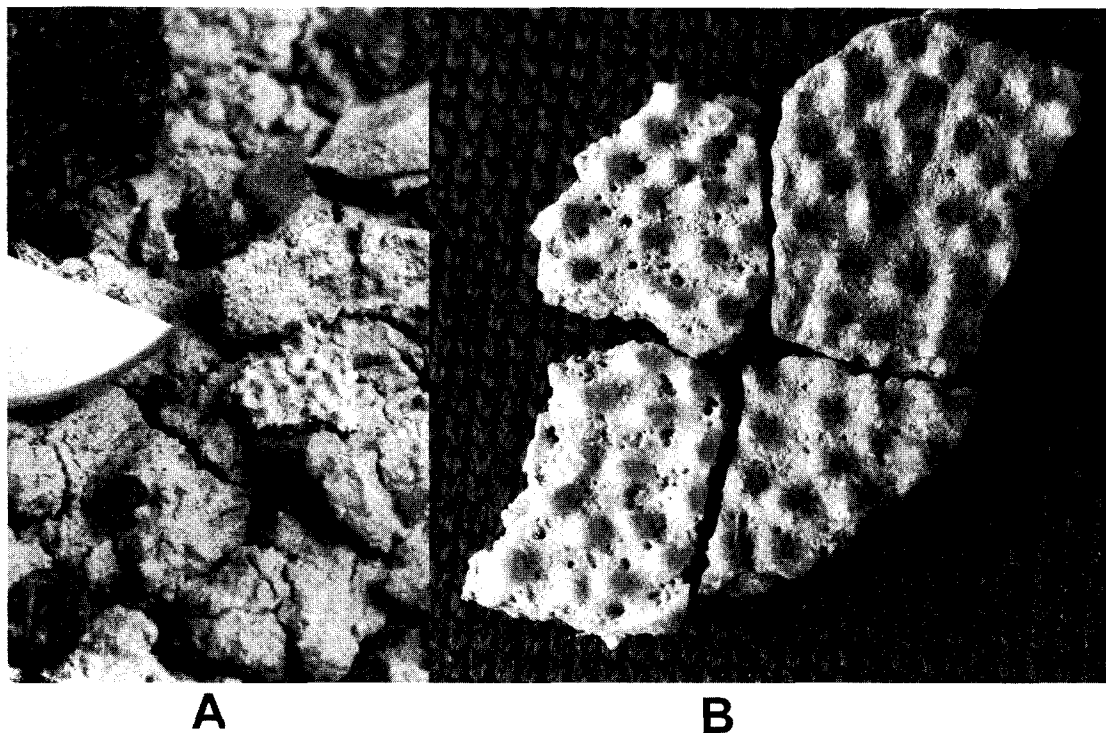


Figure 1.16 *Theropod* eggshell (A) found with Steven, BHI 6249; close-up (B). Photos: (A) Ed Gerken.

complete right femur, 6 dorsal vertebrae (mostly incomplete), 5 dorsal ribs, 1 phalange, and 2 incomplete skull bones.

COMPLETENESS: Fifteen bones, or 5% of a skeleton by bone count.
ON DISPLAY? No.

COMMENTS: Steven was named for Steve Sacrison, Stan Sacrison's twin brother, who found the specimen. The skeleton was scattered and most of its bones were incomplete. Some of them also appeared to have been bitten and chewed. This led P. Larson (1997) to first speculate cannibalism in *Tyrannosaurus* because they were the only animals large enough to have been able to bite through the large bones. Theropod eggshell was also discovered, but it will never be known whether the eggshell washed in or whether it came from this dinosaur.

LDP#977-2
(Pete)

DISCOVERED: The year 1995, Rob Patchus, a graduate student from University of New Orleans.

LOCATION: Swanson Ranch, Niobrara County, WY (Fig. 1.1, site 24).

FORMATION: Lance Formation, about 800 feet below the K-T contact.

EXCAVATED: Lance Dinosaur Project field crew in the summer of 1995.

REPOSITORY: Stored at the University of New Orleans, New Orleans, LA.

DESCRIBED: Derstler and Myers (2005, this volume).

SKELETAL REMAINS: According to Derstler and Myers (2005), the skeleton contains 2 short strings of articulated cervical and dorsal verte-

brae along with some ribs and gastralia that are heavily weathered. There are also parts or fragments of the hind limbs, pelvis, ribs, and vertebrae weathered downslope from the specimen.

COMPLETENESS: Estimated to be between 10% to 15% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: Pete was named in honor of Rob's grandfather, Pete Patchus, and for Pete Larson. Pete is undergoing preparation at UNO but is not yet on public display. Hurricane Katrina (August 2005) interrupted the work by putting the specimen off limits for more than 9 months. As a result, neither the records nor the specimen could be worked on, investigated, or inventoried (Derstler, personal communication 2005).

Barnum

DISCOVERED: The year 1995, Bruce Hamilton and Leon Theisen, professional collectors.

LOCATION: Near the headwaters of Seven Mile Creek, north of the Cheyenne River, Niobrara County, WY (Fig. 1.1, site 25).

FORMATION: Lance Formation.

EXCAVATED: Collected by Japh Boyce and R. J. B. Rockshop field crew in 1995 and 1996.

REPOSITORY: Status unknown.

WEB SITE: http://www.factmonster.com/spot/dino_bargaintrex.html.

ACQUISITION: Undisclosed investors purchased Barnum at a Bonhams and Butterfields auction in May 2004.

SKELETAL REMAINS: The skull consists of incomplete bones, including both maxillae, left jugal, left ectopterygoid, right squamosal, left dentary, surangular, and articular. The skeleton also has mostly incomplete bones consisting of 1 cervical, 4 dorsal, and 3 caudal vertebrae; 9 dorsal ribs, some gastralia; 6 metatarsals, 3 pes phalanges; left ilium, left ischium, both pubes (right incomplete), both femora (right incomplete), left tibia, fibula, astragalus, and calcaneum; partial left scapula, left humerus, and manus claw.

COMPLETENESS: Forty-seven bones, or 16% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: According to Japh Boyce (personal communication 2005), he named the skeleton in honor of Barnum Brown, who had discovered the first *Tyrannosaurus rex* bones (described as *Dynamosaurus imperiosus* Osborn 1905) not far from this site. Boyce originally claimed that this specimen was the rest of the holotype skeleton (BMNH R7994, formerly AMNH 5866; see above), but according to Carpenter (personal communication 2006), if that were true, there would be 3 femurs for the type instead of 2.

According to Japh Boyce, he sold the specimen to a group of investors known as Tyrex in 2000. Soon after this, Tyrex brought a case against Boyce, claiming lack of clear title. After Boyce demonstrated a clear title, the specimen was auctioned off for \$90,000 by



Figure 1.17. Fox, BHI 4182, left dentary at the excavation, with Casey Smith. Photo by Ed Gerken.

Bonhams and Butterfields, an auction house, in May 2004 to unknown investors (Japh Boyce, personal communication 2005).

BHI 4182
(Fox; Foxy Lady; County rex)

- DISCOVERED:** The year 1994, Lloyd Fox, rancher.
- LOCATION:** Land belonging to Harding County, located within the pasture of Lloyd, Eunice, and Russell Fox, near Redig, Short Pine Hills, Harding County, SD (Fig. 1.1, site 26)
- FORMATION:** Hell Creek Formation.
- EXCAVATED:** Black Hills Institute field crew, summers of 1996, 1997, and 1998.
- DESCRIBED:** Partially described by Larson and Donnan (2002).
- REPOSITORY:** Black Hills Institute of Geological Research, Hill City, SD.
- SKELETAL REMAINS:** The skull consists of the left postorbital, right quadratojugal, right ectopterygoid, both dentaries, both surangulars, both articulars, both prearticulars, both angulars, both splenials, both coronoids, and 43 loose, rooted teeth. The postcranial skeleton was found with 2 cervical, 1 dorsal, and 3 caudal vertebrae, 5 dorsal ribs, and 2 cervical ribs.
- COMPLETENESS:** To date, 29 bones, or 10% of a skeleton by bone count.
- ON DISPLAY?** Yes, the left dentary is on display at the Black Hills Museum of Natural History, Hill City, SD.
- COMMENTS:** Lloyd Fox discovered a *Tyrannosaurus rex*, later named Fox, in honor of Lloyd, in 1994 on a parcel of Harding County land. Black Hills Institute of Geological Research received permission from the

county commissioners to begin excavation in 1996. The specimen was widely scattered; more probably remains buried at the site. Portions of the skull and skeleton indicate that it is a robust morphotype.

MOR 980
(Peck's Rex)

DISCOVERED: The year 1997, Lou Tremblay, biology teacher.

LOCATION: McCone County, MT (Fig. 1.1, site 27).

FORMATION: Hell Creek Formation.

EXCAVATED: Collected from 1997 through 2004 by several different groups, including different parties led by J. Keith Rigby, Nate Murphy, and Kraig Derstler (see Derstler and Myers this volume).

REPOSITORY: Museum of the Rockies, Bozeman, MT, on loan to the Fort Peck Paleontology Field Station at Fort Peck, Montana.

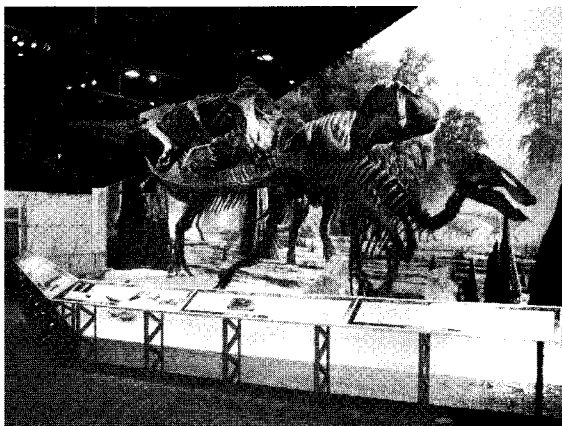
DESCRIBED: Furcula by Larson and Rigby (2005); Lipkin and Carpenter this volume.

SKELETAL REMAINS: The skull consists of a braincase, both maxillae and premaxillae, incomplete nasals (most of the right), right postorbital, right jugal, both lacrimals, both quadrates, both quadratojugals, both dentaries, left splenial, left prearticular, right surangular, and the right articular. The forelimbs include the furcula, both scapulas, 1 coracoid, both humeri, metacarpal III, and 3 manus phalanges. Its hind limbs and pelvis include a complete right leg with calcaneum, astragalus, and 1 metatarsal; a complete left ilium, partial right ilium, both pubes, both ischia, and the sacral vertebrae. The skeleton also has some dorsal and cervical vertebrae, a string of 9 or 10 anterior caudal vertebrae (most with chevrons), many dorsal ribs, some cervical ribs, and quite a few gastralia (N. Murphy, personal communication 2005).

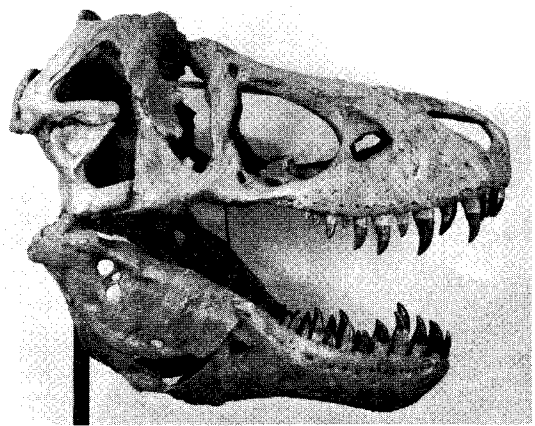
COMPLETENESS: There has not yet been a complete skeletal inventory. It is estimated to be about 120 bones, or 40% complete by bone count.

ON DISPLAY? Cast of the skeleton is on display at Fort Peck Interpretive Center, Fort Peck.

Figure 1.18. *Peck's Rex*, MOR 980, cast of skeleton at the Fort Peck Interpretive Center (A); cast of skull (B). Photos courtesy Nate Murphy.



A



B

COMMENTS: Peck's Rex was another *Tyrannosaurus rex* involved in controversy. The property was originally private, but the federal government foreclosed the land because of an unpaid loan. A California teacher discovered the *T. rex* while exploring for fossils as an Earth Watch volunteer, under the supervision of J. Keith Rigby, who began the excavation. After the Earth Watch group closed the quarry, later that year, the original landowners returned and tried to excavate the dinosaur themselves. The government seized the specimen, and eventually the specimen was put under the care of the Museum of the Rockies (<http://www.nd.edu/~ndmag/au2003/rigbyrex.html>).

The specimen received its nickname after nearby Fort Peck Lake. The excavation of this specimen was unusual because several different groups participated. J. Keith Rigby of Notre Dame University, along with Earth Watch volunteers, the original landowners, Nate Murphy from the Judith River Dinosaur Institute, and Kraig Derstler from the University of New Orleans were all involved with the recovery of the skeleton. For further discussion, see Derstler and Myers (this volume).

Tinker

DISCOVERED: The year 1997, Mark Eatman, professional collector.

LOCATION: Harding County Land, SD (Fig. 1.1, site 28).

FORMATION: Hell Creek Formation.

EXCAVATED: Mark Eatman in 1997, and Mike Farrell in 1998 (Glut 2002).

REPOSITORY: None, as of yet.

DESCRIBED: Partially described in Glut (2002).

SKELETAL REMAINS: According to Barry James (personal communication 2005), the specimen has most of a skull (although some bones are only pieces and fragments) consisting of the both premaxillae, left maxillae, both quadratojugals, right palatine, left jugal, quadrate, squamosal, pterygoid, a parietal, and part of 1 nasal. The lowers consist of left dentary, both articulares, both coronoids, right surangular, the left prearticular, angular, and splenial. The skeleton is made up of 20 partial caudal vertebrae and 12 chevrons; 5 dorsal and 2 cervical ribs and numerous rib fragments; both pubes, both ilia (incomplete), and the left ischia; parts of both scapula, the right coracoid, both humeri (left complete); and a manus and a pes claw.

COMPLETENESS: Seventy-three bones, or 24% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: Because of the status of the land, its ownership has been tied up in litigation for several years. Bakker (personal communication 2002) has viewed this specimen, and is certain that it is a juvenile *T. rex*. He is also convinced that this specimen offers important information on growth rates for *T. rex* and will finally settle the differences between juvenile *Tyrannosaurus* and *Nanotyrannus*.

According to B. James (personal communication 2005), the

specimen was found with a right maxilla and jugal from a larger individual, along with a dentary from another theropod. He believes that there are perhaps 3 different individual *T. rex* specimens from the site. The specimen was heavily weathered and broken. The initial collecting was done without glue or plaster, so many of the bones were fragmented. In addition to *T. rex* bones, there were also a number of *Edmontosaurus* skeletal elements, plants, molluscs, and crocodile teeth found with the specimen (Glut 2002).

Ollie (Rex A)

DISCOVERED: October 1998 by Craig Pfister, a professional collector.

LOCATION: Southeast of Ekalaka Carter County, MT (Fig. 1.1, site 29).

FORMATION: Hell Creek Formation.

EXCAVATED: Craig Pfister, 1998 and 1999.

REPOSITORY: Currently housed at Great Plains Paleontology, Madison, Wisconsin.

SKELTAL REMAINS: The skull consists of the left maxilla, both premaxillae, both postorbitals, both quadrates, left jugal, both pterygoids, and a partial braincase. The skeleton consists of both femora, both tibia, both fibula, both astragali and calcanea, 2 metatarsals, several phalanges, 1 ischia, the left pubis, right ilium, right scapula, both humeri, right radius, right ulna, several cervical vertebrae, multiple dorsal and caudal vertebrae, many cervical and dorsal ribs, and several chevrons (Craig Pfister written communication 2005).

COMPLETENESS: A total of 124 bones, or 41% of a skeleton to date (Craig Pfister, written communication 2005).

ON DISPLAY? No.

COMMENTS: The site measures 20 m by 17 m . Many of the bones show evidence of scavenging (Craig Pfister, written communication 2005).

Rex B (*Triceratops-Alley T. rex*)

DISCOVERED: The year 1998 by Bill Alley, rancher and amateur collector.

LOCATION: Northeast of Isabel, Corson County, SD (Fig. 1.1, site 30).

FORMATION: Hell Creek Formation.

EXCAVATED: Bill Alley, 1998 through 2000.

REPOSITORY: Currently housed at Black Hills Institute of Geological Research, Hill City, SD, for cleaning, restoration, and casting.

SKELTAL REMAINS: The skull consists of the left maxilla, left premaxilla, left quadrate, left quadratojugal, both lacrimals, nasals, left ectopterygoid, and a braincase with disarticulated, nonfused frontals. The skeleton consists of only the right scapula, right coracoid, and 1 rib. There are also numerous fragmented bones with this specimen, and several other unprepared skull bones whose identification cannot yet be made.



Figure 1.19. *Rex C*, maxilla and premaxilla (A), pes phalanges (B).

COMPLETENESS: Twenty-four bones, or 8% of a skeleton to date.

ON DISPLAY? No.

COMMENTS: This specimen is of the gracile form nearly as large as Stan.

The bones were scattered, with preservation ranging from good to poor. This is one of the most eastern *T. rex* specimens, at 101.5° west longitude.

Rex C

DISCOVERED: The year 1999 by Bill Alley, rancher and amateur collector.

LOCATION: Northeast of Isabel, Corson County, SD (Fig. 1.1, site 31).

FORMATION: Hell Creek Formation.

EXCAVATED: Bill Alley, 1999.

REPOSITORY: None.

SKELETAL REMAINS: The skull consists of the right maxilla, right premaxilla, right surangular, right articular and the right splenial. The skeleton consists of the right (?) tibia and astragalus (calcaneum?), both fibula, 3 pes phalanges, right ischia, 1 cervical vertebrae, 1 dorsal vertebrae, 2 caudal vertebrae, 1 chevron, and several boxes of unidentified parts.

COMPLETENESS: Eighteen bones, or 6% of a skeleton to date.

ON DISPLAY? No.

COMMENTS: The maxilla and pes phalanges of this *Tyrannosaurus rex* are quite large, similar in size to Sue. Bone preservation is excellent.

One of the pes phalanges has some severe pathologies, perhaps from a healed break. This is another easternmost *T. rex* specimen, at 101.5° west longitude.

2000–2005

The excavations of *Tyrannosaurus rex* continued into the 21st century. Although some of these discoveries were made in the 1990s, there were quite a number of *T. rex* skeletons found since 2000. There have been several television specials about some of these discoveries, such as Discovery Channel's *Valley of the T. rex*, which highlight many of the new discoveries made by the Museum of the Rockies near Hell Creek, south of Fort Peck Lake, MT.



BHI 6248
(*E. D. Cope*)

DISCOVERED: The year 1999, Bucky Derflinger, rancher, amateur fossil collector.

LOCATION: Wade Derflinger Ranch, near Usta, Perkins County, SD (Fig. 1.1, site 32).

FORMATION: Lower portion of the Hell Creek Formation.

EXCAVATED: Black Hills Institute field crew summer of 2000.

REPOSITORY: Currently stored at Black Hills Institute of Geological Research, Hill City, SD.

DESCRIBED: Partial description by Larson and Donnan (2002).

SKELETAL REMAINS: To date, *E. D. Cope* consists of a maxilla, dentary, ectopterygoid, angular, other undetermined skull bones, some vertebrae, ribs, and concretion-encased bones. Other than the left maxilla, the preparation of the specimen has not yet begun.

COMPLETENESS: About 10% of skeleton by bone count.

ON DISPLAY? The left maxilla is on display at the Black Hills Museum of Natural History, Hill City, SD.

COMMENTS: During the excavation, a number of centra were discovered piled on the surface. It appeared that some time ago, someone had intentionally piled these bones up. Larson and Donnan (2002) speculated that this could possibly be the site from which Edward Drinker Cope had collected 2 vertebrae from a partial *Tyrannosaurus rex* he described as *Manospondylus gigas*. Unfortunately, this

Figure 1.20. *E. D. Cope*,
BHI 6248, excavation site.
Photo by Dan Counter.

question remains unsolved. Chemical analysis might answer the question.

This specimen was scattered over a large area like Duffy, Steven, and Fox. And like Steven, it appears that it was also cannibalized (Larson and Donnan 2002). Most of the skeletal elements are encased in sideritic and phosphatic concretions, making it difficult to prepare and recognize the bone elements. More of the skeleton could be buried at the site.

Monty

DISCOVERED: The year 1999, anonymous landowner.

LOCATION: Northern Niobrara County, WY (Fig. 1.1, site 33).

FORMATION: Lance Formation.

EXCAVATED: Collected by Craig Sundell, Fred Nuss, and crew in 2000.

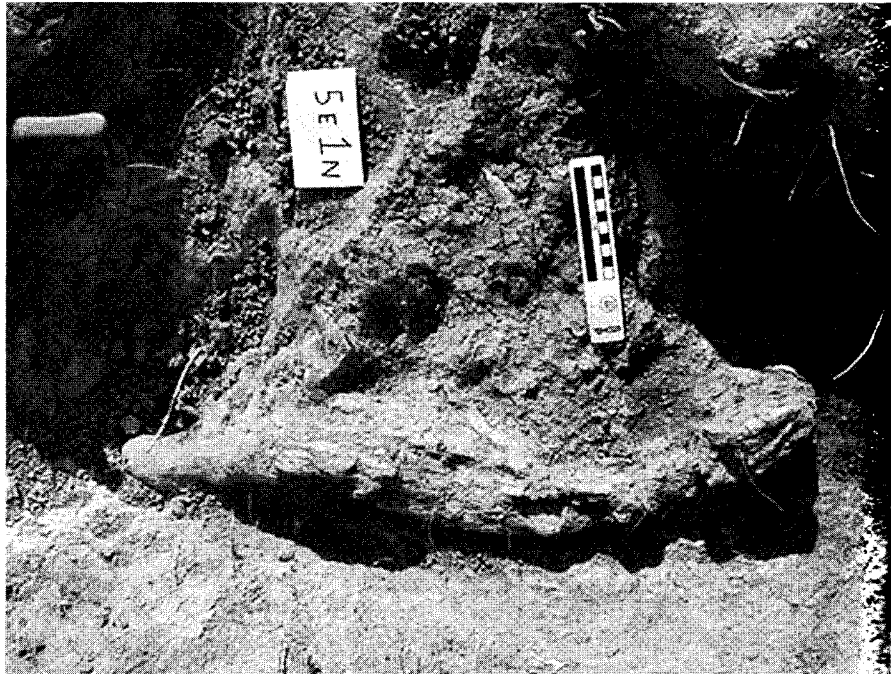
REPOSITORY: Babiartz Institute of Paleontological Studies (BIOPSI), Mesa, AZ.

SKELTAL REMAINS: Babiartz (personal communication 2005) reports that the skull consists of a braincase; nasals; the right maxilla, lacrimal, postorbital, quadratojugal, and the squamosal; both quadrates, both pterygoids; the left premaxilla, jugal, and surangular. The skeleton consists of 4 cervicals, 2 dorsals, 3 caudals, 12 dorsal ribs, 4 gastralia, 1 pubis, a partial ilium, 1 pes phalange, an ulna(?), and several bones still in jackets.

COMPLETENESS: Fifty-three bones, or 18% (to date) of a skeleton by bone count.

ON DISPLAY? Yes, parts at Arizona State University.

Figure 1.21. *Monty*, right maxilla during excavation. Photo by Craig Sundell.





COMMENTS: The specimen was named after the landowner's first name, Monty. It has a fairly good braincase from which an endocast is being produced.

MOR 1125
(*Bob; B-rex*)

DISCOVERED: The year 2000 by Bob Harmon, a professional preparator for the Museum of the Rockies.

LOCATION: Near the Fort Peck Lake, Charles M. Russell National Wildlife Refuge, Garfield County, MT (Fig. 1.1, site 34).

FORMATION: Lower half of the Hell Creek Formation.

EXCAVATED: Bob Harmon, Nels Peterson, and a Museum of the Rockies field crew, 2001–2003.

REPOSITORY: Museum of the Rockies, Bozeman, MT.

DESCRIBED: Description of dinosaur skin tissue from the femur in Schwei-

Figure 1.22. *B-rex*, MOR 1125, cast of skull on display at the Museum of the Rockies. Photo by Peter Larson.

tzer et al. (2004) and in the medullary bone from the same femur by Schweitzer et al. (2005). See also Schweitzer et al. (this volume).

SKELETAL REMAINS: The skeleton has a fairly complete yet disarticulated skull that is missing both premaxilla and a dentary, plus a few other skull bones. There are 3 cervical, 4 dorsal, 5 sacral, and 12 caudal vertebrae, along with 7 chevrons, 4 cervical, 13 dorsal ribs, left scapula and coracoid, the furcula, left ulna, both femora, tibiae, and fibulae, right calcaneum and astragalus, and 11 pes phalanges (P. Larson, personal communication 2005).

COMPLETENESS: A total of 111 bones, or 37% of a skeleton by bone count.

ON DISPLAY? Yes, the furcula, ulna, a portion of the femur (showing the structure within the bone) and a cast of the skull are on display at the Museum of the Rockies, Montana State University, Bozeman, MT.

COMMENTS: This specimen has made headlines with the discovery of medullary bone in the right femur indicating that it was an egg-producing female (see Schweitzer et al. 2005, this volume), proving that you can sex a rex, or at least some of them. It has also been referred to as Bob, after the discoverer, Bob Harmon, before it was determined to be female. It is of the robust morphotype.

MOR 1126

(C-rex)

DISCOVERED: The year 2000, Celeste Horner.

LOCATION: South of the Fort Peck Lake, Garfield County, MT (Fig. 1.1, site 35).

FORMATION: Lower half of the Hell Creek Formation.

EXCAVATED: Bob Harmon, Joe Coolie, and a Museum of the Rockies field crew, 2000–2001.

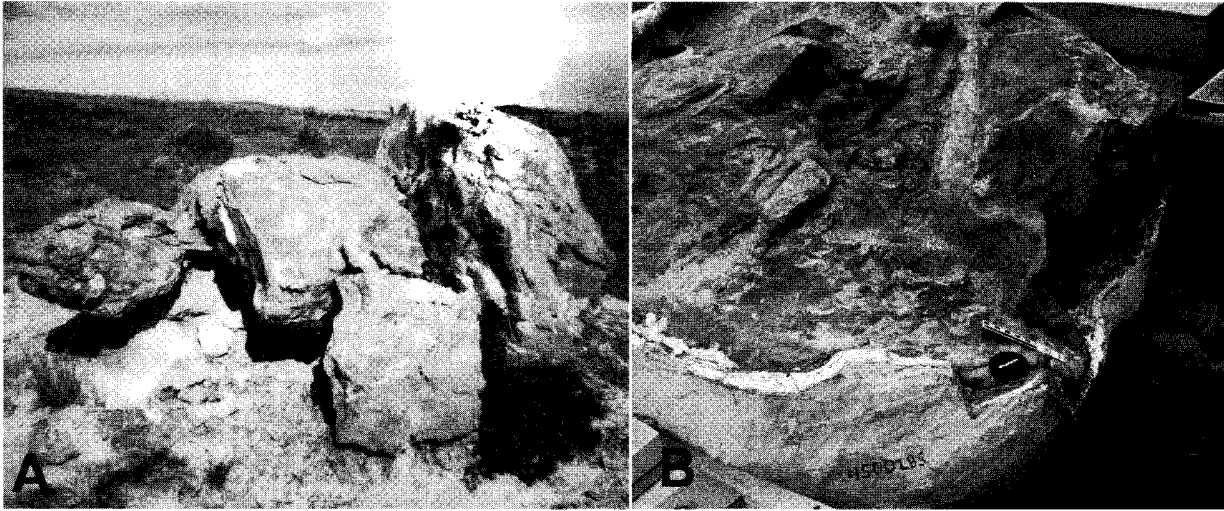
REPOSITORY: Museum of the Rockies, Bozeman, MT.

SKELETAL REMAINS: The skeleton consists of a left prearticular and surangular, 20 dorsal ribs of varying completeness, 3 partial dorsal vertebrae, and a chevron (P. Larson, personal communication 2005).

COMPLETENESS: Twenty-six bones, or 9% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: C-rex was named in honor of Celeste Horner, after the first letter in her name. Beginning in 2001, the Museum of the Rockies began naming (or referring to) each of their different *Tyrannosaurus rex* specimens after the first letter of the first name of its discoverer. Although most of these *T. rex* specimens are made up of only a bone or two, some (such as B-rex, C-rex, and G-rex) are much more complete.



UCRC PV1

DISCOVERED: The year 1950 (or earlier), Zerbst family (Arlene Zerbst, personal communication 2005), but not identified as a *Tyrannosaurus rex* skeleton until 1997 by Craig Derstler (P. Larson, personal communication 2005).

LOCATION: A few kilometers south of the Zerbst ranch house on Schneider Creek, a branch of the Cheyenne River, Niobrara County, WY (Fig. 1.1, site 36).

FORMATION: Lance Formation.

EXCAVATED: Collected by a field crew led by Paul Sereno, University of Chicago, students, and Project Exploration 2001.

REPOSITORY: University of Chicago Research Collection, University of Chicago, Chicago, IL.

DESCRIBED: Furcula and pectoral girdle by Lipkin and Sereno (2004).

SKELETAL REMAINS: Paul Sereno (written communication) relates that “the skeleton preserves a complete, articulated and in-the-round torso including both pectoral girdles and forelimbs (including the furcula), gastral basket, ribcage, and the cervical-dorsal column. Only fragments of the hind-limbs, folded under the torso, remain. A body outline can be seen in cross-section, with the inside of the torso filled with finer-grained siltstone than the outside (medium-to-course sandstone).”

COMPLETENESS: Estimated 60 bones, or 20% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: Originally published as UCPC V1. The body portion of an articulated *Tyrannosaurus rex* skeleton was known for many years before anyone identified that it was anything more than just another duckbill skeleton. It lay on a parcel of BLM land within the pasture of Leonard Zerbst, and often became the stop for geological field trips to view a dinosaur in the rough.

Figure 1.23. UCRC PV1, as found in large, weathered blocks (A); left arm, hand scapula, coracoid, and furcula undergoing preparation (B). Photos: (A) Wendy Taylor; (B) Paul Sereno.

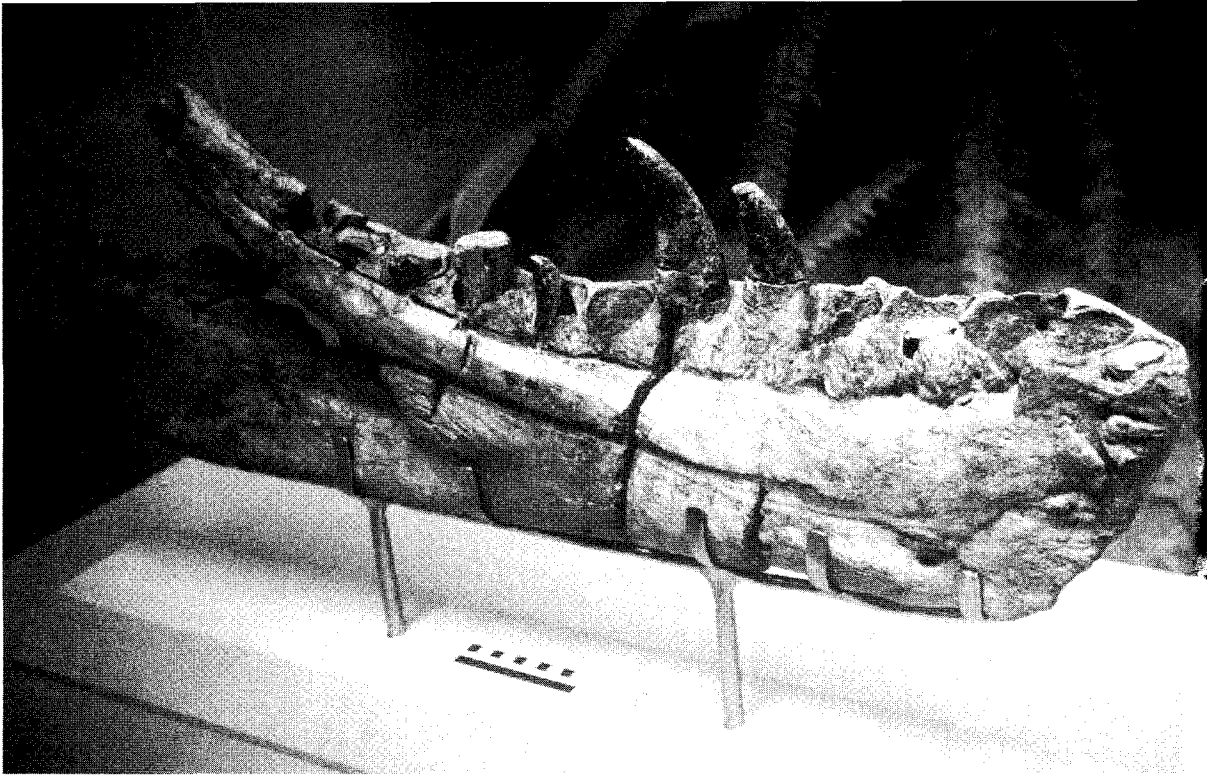


Figure 1.24. *UMNH 110000, left dentary on display at the New Mexico Museum of Natural History.*

According to Paul Sereno (written communication), “the specimen lay on its side in a large, extremely hard, sideritic, sandstone concretion. The earliest photo (in a 1952 rancher’s gazette) shows a complete concretion set atop a footing of softer siltstone. The specimen was thought to be a duckbill as *Edmontosaurus* is common in the area. Since that time, the concretion broke into about 5 pieces, the largest containing the intact torso.

“There is no evidence that the skull was ever present, as traces should have been found in the flat terrain surrounding the concretion. A 20cm-diameter tree trunk and eroded hadrosaur bones are preserved lodged against the torso; the individual appears to have fallen suddenly into a channel. With partial preparation, it was possible to identify the specimen as *Tyrannosaurus rex*, an individual approximately 66% the size of ‘Sue,’ FMNH PR2081.”

UMNH 110000

DISCOVERED: The year 2001 by Rose Difley (student) and Quintin Saharation (technician) from the University of Utah (Sampson and Loewen 2005).

LOCATION: Near Price, Carbon County, UT, in the Manti La-Sal National Forest (Fig. 1.1, site 37).

FORMATION: North Horn Formation.

EXCAVATED: Collected by the Utah Museum of Natural History field crew, 2001.

REPOSITORY: Utah Museum of Natural History, Salt Lake City, UT.

DESCRIBED: Sampson and Loewen (2005).

SKELETAL REMAINS: The skull is very incomplete, consisting of a right postorbital and squamosal. The skeleton consists of 2 cervical 3 sacral and a series of 6 midcaudal vertebrae, along with 6 chevrons and a rib. Pelvic girdle elements include: the left pubis and ischium and the distal blade of the right ilium. There is a partial leg consisting of the left tibia, fibula, and the astragalus (Sampson and Loewen 2005).

COMPLETENESS: Twenty-six bones, or about 9% of a skeleton, by bone count.

ON DISPLAY? Yes, at the Utah Museum of Natural History, Salt Lake City, UT.

COMMENTS: This discovery extended the known geographic range of *Tyrannosaurus rex* westward into central Utah. This indicates that *T. rex* spanned “habitats from wet lowland coastal plain environments to cooler alluvial plain settings and semi-arid, upland intermontane basins” (Sampson and Loewen 2005). Because *Alamosaurus* has been found in the same formation, Sampson and Loewen (2005) suggested that perhaps *T. rex* may have exploited this potential food source.

TCM 2001.90.1

(*Bucky*; formerly BHI 4960)

DISCOVERED: The year 1998, Bucky Derflinger, rancher, amateur fossil collector.

LOCATION: Wade Derflinger Ranch, original Usta town site, Perkins County, SD (Fig. 1.1, site 38).

FORMATION: Hell Creek Formation, not far above the contact of the Fox Hills Formation.

EXCAVATED: Black Hills Institute field crew, summer of 2001 and 2002.

REPOSITORY: The Children’s Museum, Indianapolis, IN.

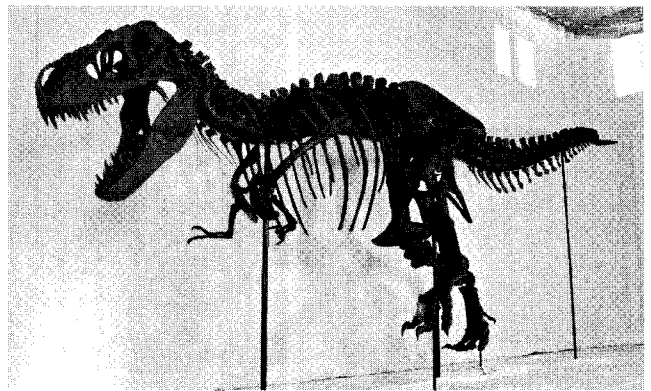
DESCRIBED: Furcula by Larson and Rigby (2005) and Lipkin and Carpenter (this volume); partial description of excavation and elements by Glut (2006).

ACQUISITION: Purchased from the Black Hills Institute of Geological Research, 2001.

Figure 1.25. *Bucky*, TCM 2001.90.1, portion of the large *Bucky* excavation (A); skeleton as mounted (B).



A



B

SKELETAL REMAINS: There were no skull elements or major leg bones found with the skeleton. The skeleton consists of 8 cervical, 9 dorsal, 5 sacral, and 15 caudal vertebrae; 14 chevrons; 11 cervical ribs; 16 dorsal ribs; 24 gastralia; a complete yet pathological furcula; both scapulas, right coracoid, left ulna, 2 manus phalanges; both ilia, 1 ischia, 4 metatarsals, and 9 pes phalanges.

COMPLETENESS: A total of 101 bones, or 34% of a skeleton by bone count.

ON DISPLAY? Yes, the original Bucky skeleton is mounted, along with a cast of Stan, as if attacking a *Triceratops* skeleton (Kelsey).

COMMENTS: Bucky Derflinger discovered a pes phalange from this *Tyrannosaurus rex* while he was breaking in a young horse on his father's ranch about 8 miles east of the original Sue dig site. This could be considered the first discovery of a *T. rex* by a horse. The specimen was named Bucky in honor of its discoverer, but as fate would have it, this is a robust morphotype and therefore most likely female.

The carcass originally lay on the ground, decomposing, and became disarticulated. Soon after, it was transported by water and deposited in a low, shallow valley. The size of the excavation is enormous, about 150 feet by 30 feet, and with 12 to 30 feet of overburden. The skeleton was discovered along with numerous bones from an *Edmontosaurus* (with bite marks in the sacrum), several *Triceratops* bones, turtle elements, a diverse Late Cretaceous fauna of fish, reptiles, mammals, dinosaurs, and plants.

MOR 1128

(G-rex)

DISCOVERED: The year 2001, Greg Wilson, then a student at University of California, Berkeley.

LOCATION: Near the Fort Peck Lake, Garfield County, MT (Fig. 1.1, site 39).

FORMATION: Hell Creek Formation.

EXCAVATED: Nels Peterson and the Museum of the Rockies field crew, 2001.

REPOSITORY: Museum of the Rockies, Bozeman, MT.

SKELETAL REMAINS: The skeleton consists of an incomplete dentary, 7 robust ribs, 4 dorsal and 1 caudal vertebrae, 3 chevrons, a partial scapula, both ischia, both pubes, the left femur, and left tibia (P. Larson, personal communication 2005).

COMPLETENESS: Twenty-three bones, or 8% of a skeleton by bone count.

ON DISPLAY? A single tooth from the specimen is all that is currently on display (Bob Harmon, personal communication 2005).

MOR 1152

(F-rex)

DISCOVERED: The year 2001 by Frank Stewart.

LOCATION: Near the Fort Peck Lake, Garfield County, MT (Fig. 1.1, site 40).

FORMATION: Lower half of the Hell Creek Formation.
EXCAVATED: Museum of the Rockies field crew, 2001.
REPOSITORY: Museum of the Rockies, Bozeman, MT.
SKELETAL REMAINS: The skeleton consists of a leg, pelvis, posterior ribs, some posterior dorsal vertebrae (all heavily weathered), a metatarsal, 7 caudal vertebrae, and 4 chevrons.
COMPLETENESS: A total of 25(?) bones, or 8(?)% of a skeleton by bone count.
ON DISPLAY? No.
COMMENTS: The legs, pelvis, and ribs are heavily weathered and fragmented.

Otto

DISCOVERED: The year 2001 by Craig Pfister, a professional collector.
LOCATION: Near Ekalaka, Carter County, MT (Fig. 1.1, site 41).
FORMATION: Hell Creek Formation.
EXCAVATED: The years 2001 and 2002 by Craig Pfister.
REPOSITORY: Currently housed at Great Plains Paleontology, Madison, WI.
SKELETAL REMAINS: According to Craig Pfister, the skeleton consists of both femora, both tibia, 2 metatarsals, 1 fibula, multiple cervical and dorsal ribs, and multiple caudal vertebrae.
COMPLETENESS: Thirty-two bones, or 10% of a skeleton by bone count.
ON DISPLAY? No.
COMMENTS: The site was a point bar deposit and measured 40 m by 32 m and 15 m deep (Craig Pfister, written communication 2005).

MOR/USNM

(N-rex)

DISCOVERED: The year 2001, Nathan Myhrvold, computer businessman, enthusiastic amateur, Hell Creek Project underwriter.
LOCATION: South of Fort Peck Lake, Charles M. Russell National Wildlife Refuge, Garfield County, MT (Fig. 1.1, site 42).
FORMATION: Hell Creek Formation.
EXCAVATED: Michael Brett-Surman and a Smithsonian Institution field crew, 2002, 2003.
REPOSITORY: According to Michael Brett-Surman (personal communication 2005), the specimen is currently still held by the Museum of the Rockies, but it is in the process of being transferred to the National Museum of Natural History, Smithsonian Institution, Washington, DC.
SKELETAL REMAINS: The skeleton consists of an incomplete dentary, an angular, 1 cervical vertebrae, 2 cervical ribs, 2 dorsal spines, 2 dorsal ribs, 3 caudal vertebrae, 3 chevrons, an ilium (weathered), ischium, pubis, right leg, and articulated foot (nearly complete).
COMPLETENESS: About 40 bones, or 13% of a skeleton by bone count.

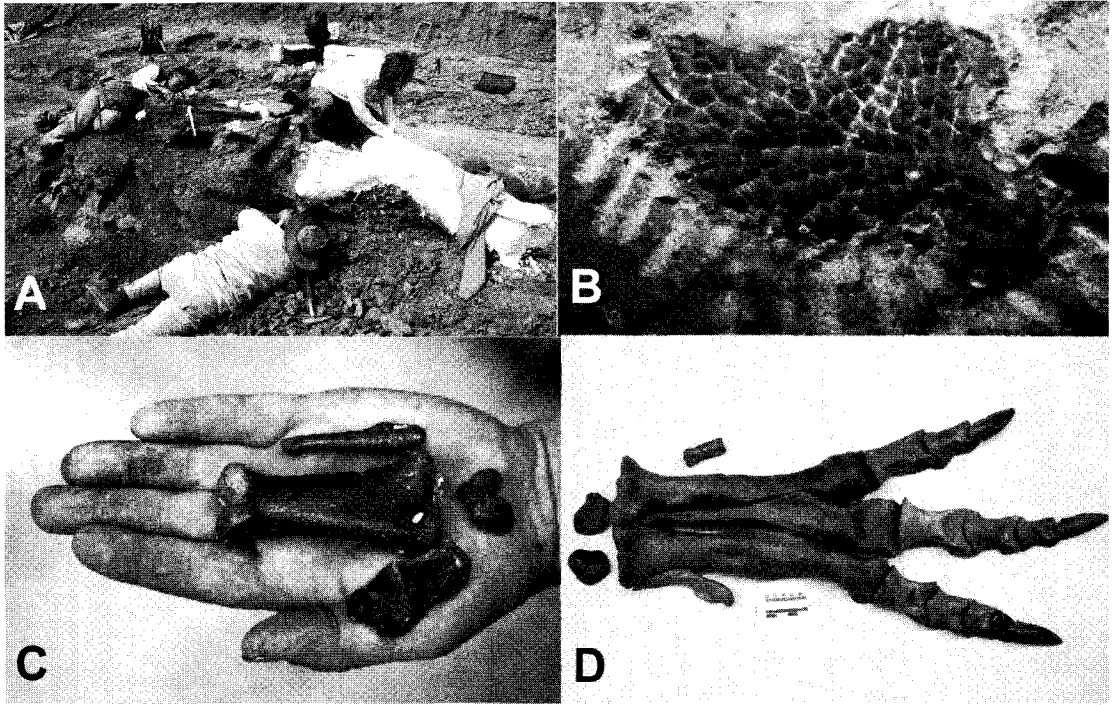


Figure 1.26. *Wyrex*, BHI 6230, excavation (A); skin impression (B); left carpals and metacarpals (C); right pes (D).

ON DISPLAY? No.

COMMENTS: This skeleton was named for first initial of the discoverer's name. Nathan Myhrvold was working as a volunteer with the Museum of the Rockies in 2001 when he found the skeleton. The Smithsonian Institute, which has only a cast of Stan on display, has been trying to obtain an original skeleton and is working on acquiring this specimen from the Museum of the Rockies; thus, at this time, it has no catalog number.

BHI 6230
(*Wyrex*)

DISCOVERED: The year 2002, Dan Wells, policeman and amateur collector, and Don Wyrick, landowner, rancher, and amateur collector.

LOCATION: Don and Allison Wyrick Ranch, north of Baker, Fallon County, MT (Fig. 1.1, site 43).

FORMATION: Hell Creek Formation.

EXCAVATED: Dan Wells 2002 and 2003, Black Hills Institute field crew 2004.

REPOSITORY: Currently housed at the Houston Museum of Nature and Science, Houston, TX.

DESCRIBED: Partial description by Larson and Donnan (2004).

SKELETAL REMAINS: The skull consists of a partial braincase, the right squamosal, postorbital, jugal, surangular, articular, prearticular, and angular. The postcranial skeleton consists of 2 nearly complete legs and feet (lacking to date only the left tibia, astragalus, calcaneum, 1 left tarsal, both metatarsal I, and 5 pes phalanges from the right foot). There are 22 vertebrae (5 dorsal, 1 cervical, and 11 caudal), 20 ribs (5 cervical and 15 dorsal), both ischia, right pubis, and right

ilium. It also has a left scapula, coracoid, humerus, ulna, carpals, and all 3 metacarpals. Seventeen gastralia have been found with the skeleton to date.

COMPLETENESS: A total of 114 bones (to date), or 38% of a skeleton by bone count.

ON DISPLAY? No, but preparation of the skeleton may be viewed at the Black Hills Institute of Geological Research, in Hill City, SD.

COMMENTS: Intrigued by the find, Wells took a bone to the Black Hills Institute for identification. He returned to the site the next summer and began to excavate in earnest. Don Wyrick realized the importance of the find when legs, foot bones, and vertebrae started appearing. He called a halt to the digging, contacted the Black Hills Institute, and arranged to have them finish the excavation. The name “Wyrex” is a combination of the first 2 letters of Don’s last name and “rex.”

In May 2004, Black Hills Institute began the first live online *Tyrannosaurus rex* excavation. With daily reports, photos, and video segments of the days digging, this dinosaur excavation extended far beyond the quarry and into schools, homes, and businesses for the next 3 weeks. Thousands of people a day went to the Web site to see what new bones or discoveries had been made.

To date, 22 turtles (*Plesiobaena antiqua*) have been unearthed at this site, from complete to disarticulated and fragmentary shells. Wyrex was buried on the edge of an ancient pond or lake, and these turtles had perhaps been feeding on the carcass. It is unknown at this point what caused the death of either the *T. rex* or the turtles.

Some of the exciting discoveries with Wyrex are carpals along with 3 metacarpals from the left hand (see Lipkin and Carpenter this volume), and 2 nearly complete feet. During preparation, several patches of skin (Fig. 1.26B) were found with the skeleton. Most of the skin patches (more than a dozen) were found on the bottom side of the articulated tail. The discovery of skin with Wyrex is a first for *T. rex*. Plans are currently underway for further excavation at the site in hope of finding more of the skeleton. The preparation of the skeleton may be viewed by the public at Black Hills Institute of Geological Research in Hill City, SD. Ownership of the specimen is currently being transferred the Houston Museum of Nature and Science, where it is scheduled to be on display by 2009.

LACM 7509/150167

(*Thomas*)

DISCOVERED: The year 2003, Bob Curry, schoolteacher and amateur fossil collector.

LOCATION: BLM land near Ekalaka, Carter County, MT (Fig. 1.1, site 44).

FORMATION: Hell Creek Formation.

EXCAVATED: An international crew from the Natural History Museum of Los Angeles County, 2003–2005.

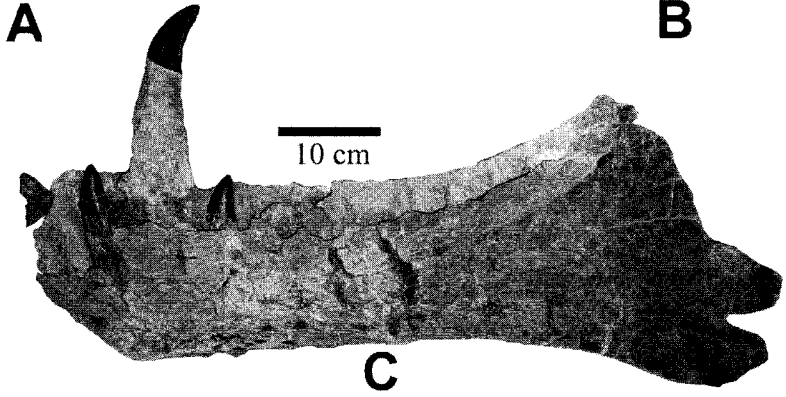
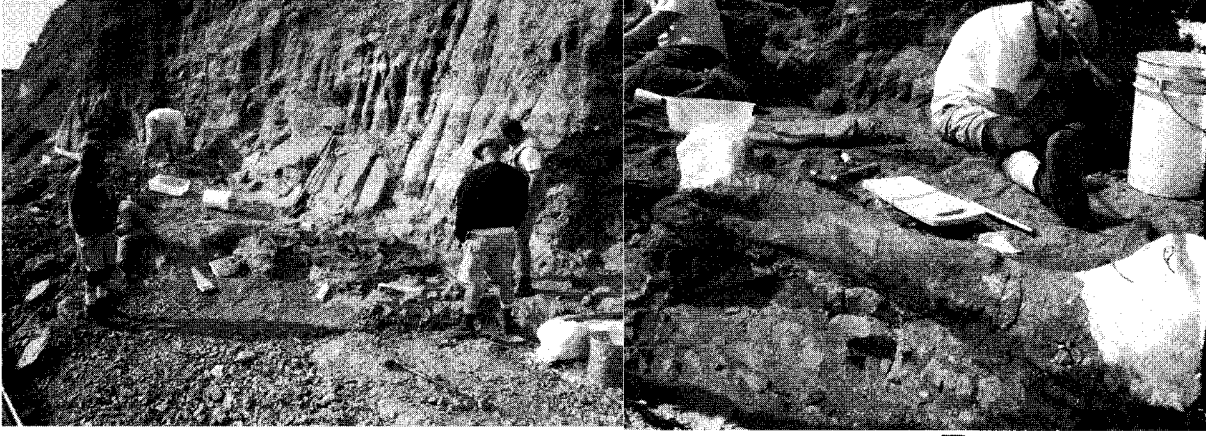


Figure 1.27. *Thomas*, LACM 7509:150167, during excavation (A); right femur during excavation (B); right dentary (C). Photos: (A) Doug Goodreau; (B) Ursula Goelich; (C) Gary Takeuchi. All photos courtesy Natural History Museum of Los Angeles County.

REPOSITORY: The Natural History Museum of Los Angeles County, Los Angeles, CA.

SKELETAL REMAINS: From Luis Chiappe (written communication 2005):

“The skull consists of a complete braincase, postorbital, both jugals, squamosal, quadratojugal, quadrate, lacrimal, both frontals, both maxillae, ectopterygoid, both dentaries, and at least one set of articulated postdentary bones (there are other skull bones but in jackets but they cannot be identified at this time). There are also 30–35 loose teeth and a few more in situ. The skeleton consists of complete legs and feet (missing I metatarsal and some phalanges, a few dorsals, the sacrum, about 20 caudals, along with many ribs and gastralia. The pelvis includes both ilia and ischia. Both scapula and coracoids are preserved although no forelimb elements are known at the moment.”

COMPLETENESS: A total of more than 110 bones (to date), or more than 37% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: The dinosaur was named *Thomas* by the discoverer, Bob Curry, in honor of his brother. Frankie Jackson of Montana State University informed Luis Chiappe (director of the Dinosaur Institute at the LACM) of the discovery. The excavation took 3 seasons, during which they collected about 130 blocks, some containing several elements. Much of the specimen remains unprepared, so the number of recognized elements is likely to increase (Luis Chiappe, written communication 2005).



Figure 1.28. *Ivan*, during excavation showing scapula-coracoid, ribs, and other bones. Photo courtesy Gary Olson.

Wayne

DISCOVERED: The year 2004, Gary Olson, professional collector.

LOCATION: South of Rhame, southwest Bowman County, SD (Fig. 1.1, site 45).

FORMATION: Hell Creek Formation.

EXCAVATED: Gary Olson and Alan Komrosky, 2004–2005.

REPOSITORY: None; currently in possession of the collector, Fargo, ND.

SKELETAL REMAINS: This incomplete specimen consists of 19 caudal and 1 dorsal vertebrae, 2 chevrons, several rib (and/or gastralia) segments, plus some other unidentified parts (Gary Olson, personal communication).

COMPLETENESS: Twenty-four bones, or 8% of a skeleton by bone count.

ON DISPLAY? No.

COMMENTS: A disarticulated, weathered skeleton.

Ivan

DISCOVERED: The year 2005, Gary Olson, professional collector.

LOCATION: North of Buffalo, northwest Harding County, SD (Fig. 1.1, site 46).

FORMATION: Hell Creek Formation.

EXCAVATED: Gary Olson and Alan Komrosky, 2005.

REPOSITORY: None; currently in possession of the collector, Fargo, ND.

SKELETAL REMAINS: Gary Olson (personal communication 2005) relates that the skeleton consists of a nearly complete pelvis, with paired ilia (top half eroded), paired ischia, and paired pubes articulated to the sacrum. Ivan has one leg, consisting of a femur, tibia, fibula, and astragalus. The feet contain 2 metatarsals and 6 pes phalanges. The body has a fused scapula coracoid, an estimated 15 cervical and dorsal vertebrae, and approximately 25 cervical and dorsal ribs (this rib count may also include some gastralia), approximately 25 caudal vertebrae, and an estimated 30 chevrons.

COMPLETENESS: A total of 116 bones, or 39% of a skeleton by bone count (Gary Olson inventory).

ON DISPLAY? No.

COMMENTS: Gary Olson was hunting for fossils when he happened upon several bones of a large theropod weathering out of the hillside. Exposed were the femur, tibia, metatarsals, pes phalanges, and large number of rib and bone scraps. He planned to dub it Ivan the Terrible, but unfortunately, the specimen was not found with a skull, so he called it just Ivan. Olson explained that he dug all around the skeleton, but it appears that if Ivan was originally buried with its skull, it weathered out long ago. The preservation is excellent.

Additional Important Specimens

The holotype of *Manospondylus gigus* Cope, 1892, consisted of 2 large theropod cervical vertebrae (only 1 vertebra is known to exist today). It was later discussed and redefined as *Tyrannosaurus rex* by Osborn in 1916. In 1905, Barnum Brown collected another, very partial, *Tyrannosaurus rex* specimen from Hell Creek, MT. According to Osborn (1906), the specimen (AMNH 5881) consisted of the left femur, both tibiae, left fibula, and 4 metatarsals. Brown in 1908 collected a braincase of a *T. rex* in MT (AMNH 5029 = CM 9379); it also has a splenial, articular, and a prearticular. The American Museum has another individual *T. rex* braincase (AMNH 5117), collected by Sternberg and figured by Osborn (1912).

The Museum of Paleontology, University of California, Berkeley, has several different *Tyrannosaurus rex* specimens, one a maxilla (UCMP 118742), the other a maxilla with dentaries (UCMP 131583), both from Montana. The Science Museum of Minnesota has the anterior portion of a braincase from South Dakota (MMS 51-2004) (Molnar 1991). The Museum of the Rockies collected a portion of a braincase in MOR 1131 (also referred to as J-rex). There is also a large partial theropod specimen from the Tornillo Formation of West Texas that was described as *T. rex* (Lawson 1976), but Carpenter (1990) thought that it was morphologically too different to include it in the species (although Carr and Williamson 2004 believe it is).

Williamson and Carr (2005) reported on an additional, yet fragmentary, *Tyrannosaurus rex* specimen (with dentary) from the Naashoibito Member of the Kirtland Formation in New Mexico.

There are reports of 2 additional *T. rex* skeletons discovered during the summer of 2005 from the Hell Creek Formation in Harding County. Although I have seen a few bones from these specimens, it is still premature to provide any details on their completeness or significance.

There are numerous less complete *Tyrannosaurus rex* specimens (10 bones or fewer) in various collections across North America and Europe (e.g., Natural History Museum, London, England, UK) that have not been included in this summary. It certainly appears probable that more *T. rex* discoveries will be made in the near future. With so many new specimens to study, there is still the potential to learn much more about the most famous of all the dinosaurs, *T. rex*.

Specimen	No. of Bones	Percentage of Skeleton
Sue FMNH PR2081	219	73%
Stan BHI 3033	190	63%
MOR 555	146	49%
AMNH 5027	143	48%
Ollie*	124	41%
Scotty RSM 2523.8*	120+	40%+
Samson (Z-rex)*	121	40%
Pecks rex MOR 980*	120	40%
Ivan*	116	39%
Wyrex BHI 6230	114	38%
MOR 1125	111	37%
Thomas LACM 7509/10167*	110+	37%+
Bucky TCM 2001.90.1	101	34%
Black Beauty RTMP.81.6.1	85	28%
SDSM 12047	82	27%
Duffy BHI 4100	79	26%
LACM 23844	74	25%
Tinker, SD, collected by Eatman and Ferrel*	73	24%
UCRC V1*	60	20%
MOR 009	58	19%

Table 1.2. *Twenty Most Complete Tyrannosaurus Rex Skeletons*

Note.—See text for details.

* The bone count was provided by others, or the number is estimated because the preparation is not yet complete. For some specimens, the actual bone count may go up (with further preparation) or down (if gastralia were identified as ribs).

From all of the information that could be learned from contacting people personally, visiting museums, reading publications, and researching on the Internet, it appears that there are currently 46 known *Tyrannosaurus rex* specimens with 10 bones or more (Table 1.1). As can be seen from Figure 1.1 and Table 1.1, most *Tyrannosaurus rex* skeletons were collected just south of Fort Peck Lake, near the type of Hell Creek Formation, with a second large conglomeration near the border of Montana, North Dakota, and South Dakota. The exposures of the Hell Creek Formation are extensive and well exposed in these regions, which most likely is the reason for the discovery of so many specimens from these areas. Although fewer specimens are known from other regions, there is every reason to believe that additional specimens will be found. In summary, then, the range of *T. rex* is therefore known to include nearly the entire Western Interior.

There is always much discussion as to which is the most complete *Tyrannosaurus rex* skeleton, or where each skeleton lies according to the amount of completeness. For that reason, the 20 most complete *T. rex* skeletons are summarized in Table 1.2.

Thanks to Peter Larson and Robert Farrar for providing me with quite a bit of this information and also for the much-needed editorial help during the drafting of this chapter. Thanks to Kenneth Carpenter and Peter Larson for

Acknowledgments

their patience, editing, and the organization of this publication. Thanks to the Black Hills Museum of Natural History for organizing the 100 Years of *Tyrannosaurus rex* Symposium in June 2005. Thanks to John Babiarez, Japh Boyce, Kenneth Carpenter, Luis Chiappe, Phil Currie, Kraig Derstler, Bob Harmon, Rick Hebdon, Barry James, Christine Lipkin, Nate Murphy, Gary Olson, Scott Sampson, Richard Slaughter, Craig Sundell, Tom Williamson, and the Black Hills Institute for providing me with much-needed information on the specimens. Larry Shaffer helped by cleaning up and organizing the many photos of *T. rex*. Thanks to all of the different photographers, who are credited in the figure captions. And finally, a big, special thank you to each and every one of the landowners (including the U.S. and Canadian governments), who allowed access to the discoverers and the collectors of these wonderful and fascinating creatures.

References Cited

- Bakker, R. T. 1986. *The Dinosaur Heresies: New Theories Unlocking the Mystery of the Dinosaurs and Their Extinction*. Zebra Books, New York.
- Bakker, R. T., Williams, M., and Currie, P. 1988. *Nanotyrannus*, a new genus of pygmy tyrannosaur, from the latest Cretaceous of Montana. *Hunteria* 1(5):26.
- Bjork, P. R. 1982. On the occurrence of *Tyrannosaurus rex* from northwestern South Dakota (abstract). *Proceedings of the South Dakota Academy of Science* 61:161–162.
- Brochu, C. A. 2003. Osteology of *Tyrannosaurus rex*: insights from a nearly complete skeleton and high-resolution computed tomographic analysis of the skull. *Journal of Vertebrate Paleontology* 22, Memoir 7, Supplement to 4.
- Carpenter, K. 1990. Variation in *Tyrannosaurus rex*. P. 141–145 in Carpenter, K., and Currie, P. J. (eds.). *Dinosaur Systematics: Approaches and Perspectives*. Cambridge University Press, Cambridge.
- . 2004. Redescription of *Ankylosaurus magniventris* Brown 1909 (Ankylosauridae) from the Upper Cretaceous of the Western Interior of North America. *Canadian Journal of Earth Science* 41: 961–986.
- Carpenter, K., and Smith, M. 2001. Forelimb osteology and biomechanics of *Tyrannosaurus rex*. P. 90–116 in Tanke, D. H., and Carpenter, K. (eds.). *Mesozoic Vertebrate Life*. Indiana University Press, Bloomington.
- Carpenter, K., and Young, D. B. 2002. Late Cretaceous dinosaurs from the Denver Basin. *Colorado, Rocky Mountain Geology* 37(2): 237–254.
- Carr, T. D. 1999. Craniofacial ontogeny in Tyrannosauridae (Dinosauria, Coelurosauria). *Journal of Vertebrate Paleontology* 19(3): 497–520.
- Carr, T. D., and Williamson, T. E. 2000. A review of Tyrannosauridae (Dinosauria: Coelurosauria) from New Mexico. P. 113–145 in Lucas, S. G., and Heckert, A. B. (eds). *Dinosaurs of New Mexico. New Mexico Museum of Natural History and Science Bulletin* 17.
- Carr, T. D., and Williamson, T. E. 2004. Diversity of Late Maastrichtian Tyrannosauridae (Dinosauria: Theropoda) from western North America. *Zoological Journal of the Linnean Society* 142: 479–523.
- Cope, E. D. 1892. Fourth note on the dinosauria of the Laramie. *American Naturalist* 26: 756–758.
- Counter, D. 1996. *T-rex: The Real World* (video). Off Line Video, Butte, MT.
- Currie, P. J. 1993. Black Beauty. *Dino Frontline* 4: 22–36.

- . 2003. Cranial anatomy of tyrannosaurid dinosaurs from the Late Cretaceous of Alberta, Canada. *Acta Palaeontologica Polonica* 48(2): 191–226.
- Davies, M. J. 1997. The curse of *T. rex*. Nova (video). WGBH Boston Video, South Burlington, VT.
- Derstler, K., and Myers, J. 2005. Preliminary account of the tyrannosaurid “Pete” from the Lance Formation of Wyoming. P. 20 in *100 Years of Tyrannosaurus rex: A Symposium, Abstracts*. Black Hills Museum of Natural History, Hill City, SD.
- Dingus, L. 2004. *Hell Creek, Montana: America’s Key to the Prehistoric Past*. St. Martin’s Press, New York.
- Donnan, K., and Counter, D. 1999. *The Rex-Files: STAN* (video). Counter Productions & Black Hills Institute of Geological Research, Hill City, SD.
- . 2000. *The Rex-Files: SUE* (video). Counter Productions & Black Hills Institute of Geological Research, Hill City, SD.
- Erickson, G. M., Lappin, A. K., and Larson, P. L. 2005. Androgynous *rex*—the utility of chevrons for determining the sex of crocodylian and non-avian dinosaurs. *Zoology* 108: 277–286.
- Fiffer, S. 2000. *Tyrannosaurus Sue*. W. H. Freeman, New York.
- Gillette, D. D., Wolberg, D. L., and Hunt, A. P. 1986. *Tyrannosaurus rex* from the McRae Formation (Lancian, Upper Cretaceous), Elephant Butte Reservoir, Sierra County, New Mexico. P. 235–238 in Clemons, R. E., King, W. E., Mack, G. H., and Zidek, J. (eds.). *New Mexico Geological Society Guidebook, 37th Field Conference, Truth or Consequences Region*. New Mexico Geological Society, Socorro, NM.
- Glut, D. F. 1997. *Dinosaurs: The Encyclopedia*. McFarland, Jefferson, NC.
- . 2000. *Dinosaurs: The Encyclopedia, Supplement 1*. McFarland, Jefferson, NC.
- . 2002. *Dinosaurs: The Encyclopedia, Supplement 2*. McFarland, Jefferson, NC.
- . 2003. *Dinosaurs: The Encyclopedia, Supplement 3*. McFarland, Jefferson, NC.
- . 2006. *Dinosaurs: The Encyclopedia, Supplement 4*. McFarland, Jefferson, NC.
- Holtz, T. R., Jr. 2004. Tyrannosauroida. P. 111–136 in Weishampel, D. B., Dodson, P., and Osmólska, H. *The Dinosauria*. 2nd ed. University of California Press, Berkeley.
- Horner, J. R., and Lessem, D. 1993. *The Complete T. rex*. Simon & Schuster, New York.
- Hurum, J. H., and Sabath, K. 2003. Giant theropod dinosaurs from Asia and North America: skulls of *Tarbosaurus bataar* and *Tyrannosaurus rex* compared. *Acta Palaeontologica Polonica* 48(2): 161–190.
- Johnson, K. R. 1996. Description of seven common fossil leaf species from the Hell Creek Formation (Upper Cretaceous: Upper Maastrichtian), North Dakota, South Dakota, and Montana. *Denver Museum of Natural History Proceedings, Series 3*(12).
- Larson, P. L. 1994. *Tyrannosaurus sex*. P. 139–155 in Rosenberg, G., and Wolberg, D. (eds.). *Dino Fest Proceedings*. Paleontological Society Special Publication 7.
- . 1997. The king’s new clothes: a fresh look at *Tyrannosaurus rex*. P. 65–71 in Wolberg, D. L., Stump, E., and Rosenberg, G. D. *Dinofest International Proceedings*. Academy of Natural Sciences, Philadelphia.
- . 2000. Cranial morphology, mechanics, kinesis, and variation in *Tyrannosaurus rex*. In *The Rex Files: Scientific Papers and Popular Articles and Miscellaneous Information on Tyrannosaurus rex*. Black Hills Institute of Geological Research, Hill City, SD.
- Larson, P. L., and Donnan, K. 2002. *Rex Appeal, the Amazing Story of Sue, the*

- Dinosaur that Changed Science, the Law and My Life*. Invisible Cities Press, Montpelier, VT.
- . 2004. *Bones Rock*. Invisible Cities Press, Montpelier, VT.
- Larson, P. L., and Rigby, K. 2005. Furcula of *Tyrannosaurus rex*. P. 247–255 in K. Carpenter (ed.). *The Carnivorous Dinosaurs*. Indiana University Press, Bloomington.
- Lawson, D. 1976. *Tyrannosaurus* and *Torosaurus*, Maestrichtian dinosaurs from Trans-Pecos, Texas. *Journal of Paleontology* 50: 158–164.
- Lipkin, C., and Sereno, P. C. 2004. The furcula of *Tyrannosaurus rex*. *Journal of Vertebrate Paleontology* 24(Suppl. to 3): 83A–84A.
- Maleev, E. A. 1974. Gigantic carnosaurs of the family Tyrannosauridae. *Results of the Soviet-Mongolian Paleontological Expedition* 1: 132–191.
- McIntosh, J. S. 1981. Annotated catalogue of the dinosaurs (Reptilia, Archosauria) in the collections of Carnegie Museum of Natural History. *Carnegie Museum of Natural History Bulletin* 18: 1–67.
- Molnar, R. E. 1991. The cranial morphology of *Tyrannosaurus rex*. *Palaeontographica* 217: 137–176.
- Newman, B. H. 1970. Stance and gait in the flesh-eating *Tyrannosaurus*. *Biological Journal of the Linnean Society* 2:119–123.
- Olshevsky, G., Ford, T. L., and Yamamoto, S. 1995. The origin and evolution of the tyrannosaurids, part 1. *Kyoryugaku Saizensen [Dino Frontline]* 9: 92–199.
- Osborn, H. F. 1905. *Tyrannosaurus* and other Cretaceous carnivorous dinosaurs. *Bulletin of the American Museum of Natural History* 21: 259–265.
- . 1906. *Tyrannosaurus*, Upper Cretaceous carnivorous dinosaur (second communication). *Bulletin of the American Museum of Natural History* 22: 281–296.
- . 1912. Crania of *Tyrannosaurus* and *Allosaurus* (*Tyrannosaurus* contribution No. 3). *Memoirs of the American Museum of Natural History* 1: 1–30.
- . 1916. Skeletal adaptations of *Ornitholestes*, *Struthiomimus*, *Tyrannosaurus*. *Bulletin of the American Museum of Natural History* 33: 733–771.
- Paul, G. S. 1988. *Predatory Dinosaurs of the World: A Complete Illustrated Guide*. Simon and Schuster, New York.
- Russell, D. A. 1970. Tyrannosaurs from the Late Cretaceous of Canada. *National Museum of Natural Sciences, Publications in Paleontology* 1: 1–34.
- Sampson, S. D., and Loewen, M. A. 2005. *Tyrannosaurus rex* from the Upper Cretaceous (Maestrichtian) North Horn Formation of Utah: biogeographic and paleoecological implications. *Journal of Vertebrate Paleontology* 25(2): 469–472.
- Schweitzer, M. H., Wittmeyer, J. L., and Horner, J. R. 2004. A novel dinosaurian tissue exhibiting unusual preservation. *Journal of Vertebrate Paleontology* 24(Suppl. to 3): 111A.
- . 2005. One pretty amazing *Tyrannosaurus rex*: a presentation celebrating 100 years of *Tyrannosaurus rex*. P. 36 in *100 Years of Tyrannosaurus rex: A Symposium, Abstracts*. Black Hills Museum of Natural History, Hill City, SD.
- Smith-Hill, P. 1983. Haystack Butte surrenders terrible lizard: South Dakota ranchers dig dinosaurs. *American West* (March/April): 23–29.
- Williamson, T. E., and Carr, T. D. 2005. Latest Cretaceous tyrannosaurs from the San Juan Basin, New Mexico. P. 38 in *100 Years of Tyrannosaurus rex: A Symposium, Abstracts*. Black Hills Museum of Natural History, Hill City, SD.

The number of bones in an adult *Tyrannosaurus rex* skeleton is estimated at 300. Of these, 55 are skull bones, which include 41 cranial and 14 mandible elements. The cranial elements consist of paired premaxillae, maxillae, nasals (fused), lacrimals, jugals, postorbitals, squamosals, quadrates, quadratojugals, palatines, pterygoids, ectopterygoids, epipterygoids, the unpaired vomer, and the braincase. The braincase consists of the unpaired basioccipital, supraoccipital, basisphenoid, and parasphenoid, along with the paired parietals (fused), exoccipital-opisthotics, prootics, laterosphenoids, and frontals. The lower jaws consist of paired dentaries, coronoids (also referred to as “supradentaries” by some other authors), splenials, angulars, surangulars, prearticulars, and articulars. Hyoids remain undescribed in tyrannosaurids, although there were probably at least 2 in *Tyrannosaurus rex*. Teeth are not counted because they are shed.

The axial skeleton (minus the skull) contains 114 bones. It consists of 10 cervical vertebrae, 2 proatlas, 18 cervical ribs, 13 dorsal vertebrae, 22 dorsal ribs (the 12th and 13th dorsal vertebrae do not have ribs), 5 sacral vertebrae, 44 caudal vertebrae (estimated, the actual caudal count for *Tyrannosaurus rex* is yet unknown), and 40 to 42 chevrons (estimated). Osborn (1916) estimated that *T. rex* had 56 caudals, Maleev (1974) estimated 40 and 45 in the Asian tyrannosaurid, *Tarbosaurus*, Holtz (2004) believed that tyrannosaurs had from 35 and 44 caudals, and Paul (1988) estimated that there are 39 caudals in *T. rex*. The most complete tail, FMNH PR2081 (Sue), has 36 caudal vertebrae and was restored with 47 caudal vertebrae (Brochu 2003). The number of *T. rex* chevrons is also unknown because this number ultimately relies on the caudal count. Chevrons probably begin with the second caudal vertebrae, and they may or may not have extended to the last caudal vertebra. The placement of the first chevron varies in living crocodylians and nonavian dinosaurs, and the chevron count varies as well (Erickson et al. 2005). I consider gastralia as dermal elements and have not included them in this bone count. FMNH PR2081 has a fairly complete set of gastralia of 13 pairs (Brochu 2003). Both TCM 2001.90.1 (Bucky) and MOR 980 (Peck's Rex) also have fairly complete gastralia baskets. Some *T. rex* gastralia are as large as dorsal ribs and are often confused or misidentified as dorsal ribs.

The appendicular skeleton contains 89 bones. The forelimbs have 31 bones consisting of the furcula, 4 shoulder girdle (paired scapulae and paired coracoids), 6 forelimb (paired humeri, paired ulnae, and paired radii), 4 wrist (2 paired carpals), 16 manus bones (6 metacarpals and 10 manus phalanges—i.e., 5 in each hand). On the basis of MOR 980 (Peck's Rex) and BHI 6230 (WYREX), *Tyrannosaurus rex* had 3 metacarpals in each hand, as in *Daspletosaurus* (Russell 1970), yet only 2 functional fingers on each hand (see Lipkin and Carpenter this volume). The hind limbs consist of 58 bones, which include the following: 6 pelvic (paired ilia, pubes, and ischia), 6 leg (paired femora, tibiae, fibulae), 8 ankle (paired calcanea, astragali, and 2-paired tarsals), and 35 bones in the feet (5 pairs of metatarsals and 14 pairs of pes phalanges). The fifth metatarsal was apparently nonfunctional and had no phalanges.